Government
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SESSIONAL PAPERS

VOLUME 19

SECOND SESSION OF THE TWELFTH PARLIAMENT

OF THE

DOMINION OF CANADA

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4. Supplementary Estimates of sums required for the service of the Dominion for the year ending on the 31st March, 1913. Presented by Hon. Mr. White, 10th March, 1913.
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5. Supplementary Estimates of sums required for the service of the Dominion for the year ending on 31st March, 1914. Presented by Hon. Mr. White, 20th May, 1913.
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7. Report on dividends remaining unpaid, unclaimed balances and unpaid drafts and bills of exchange in Chartered Banks of the Dominion of Canada, for five years and upwards prior to 31st December, 1911. Presented by Hon. Mr. White, 26th November, 1912.
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10. Report of the Department of Trade and Commerce for the fiscal year ended 31st March, 1912. (Part I.—Canadian Trade). Presented by Hon. Mr. Foster, 30th January, 1913. *Printed for distribution and sessional papers.*

10a. Report of the Department of Trade and Commerce, for the year ended 31st March, 1912. (Part II.—Canadian Trade with (1) France, (2) Germany, (3) United Kingdom, and (4) United States). Presented by Hon. Mr. Foster, 12th December, 1912. *Printed for distribution and sessional papers*

10b. Report of the Department of Trade and Commerce for the fiscal year ended 31st March, 1912. (Part III.—Canadian Trade with Foreign Countries, except France, Germany, the United Kingdom and United States). Presented by Hon. Mr. Foster, 15th January, 1913.. .. ..*Printed for distribution and sessional papers.*

10c. Report of the Department of Trade and Commerce, for the fiscal year ended 31st March, 1912. (Part IV.—Miscellaneous Information). Presented by Hon. Mr. Reid, 17th February, 1913.. ... .*Printed for distribution and sessional papers.*

10d. Report of the Board of Grain Commisioners for Canada. Presented by Hon. Mr. Foster, 3rd February, 1913.. .. ..*Printed for distribution and sessional papers.*

10e. Report of the Department of Trade and Commerce for the fiscal year ended 31st March 1912. (Part VI.—Subsidized Steamship Services). Presented, 1913. *Printed for distribution and sessional papers.*

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12. Reports, Returns and Statistics of the Inland Revenues for the Dominion of Canada for the year ended 31st March, 1912. (Part I.—Excise). Presented by Hon. Mr. Nantel, 25th November, 1912.. .. .. ..*Printed for distribution and sessional papers*

13. Report of the Department of Inland Revenue for year ended 31st March, 1912. (Part II.—Inspection of Weights and Measures, Gas and Electricity). Presented by Hon. Mr. Nantel, 25th November, 1912.. .. ..*Printed for distribution and sessional papers.*

14. Report of the Department of Inland Revenue for year ended 31st March, 1912. (Part III.—Adulteration of Food). Presented by Hon. Mr. Nantel, 25th November, 1912. *Printed for distribution and sessional papers.*

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26a. Summary Report of the Mines Branch, Department of Mines, for the calendar year 1911.. .. ..*Printed for distribution and sessional papers.*

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27. Report of the Department of Indian Affairs for the year ended 31st March, 1912. Presented by Hon. Mr. Roche, 29th November, 1912.
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28. Report of the Royal Northwest Mounted Police, 1912. Presented by Hon. Mr. Borden, 14th January, 1913... .. ..*Printed for distribution and sessional papers*

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29. Report of the Secretary of State of Canada for the year ended 31st March, 1912. Presented by Hon. Mr. Coderre, 3rd December, 1912.
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29b. Report of the work of the Archives Branch of the Department of the Secretary of State, for the year 1912. Presented by Hon. Mr. Coderre, 2nd June, 1913.
Printed for distribution and sessional papers.

30. The Civil Service List of Canada, 1912. Presented by Hon. Mr. Coderre, 3rd December 1912.. .. ..*Printed for distribution and sessional papers.*

31. Fourth Annual Report of the Civil Service Commission of Canada for the period from 1st September, 1911, to 31st August, 1912. Presented by Hon. Mr. Coderre, 24th January, 1913.. .. ..*Printed for distribution and sessional papers.*

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32. Annual Report of the Department of Public Printing and Stationery, for the fiscal year ended 31st March, 1912. Presented by Hon. Mr. Borden, 24th April, 1913.
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complaints against them, the names of the persons who brought these complaints; also a copy of all correspondence relating thereto, and of the reports of inquiries in the cases where such have been held. Presented 14th January, 1913.—*Mr. Demers.* *Not printed.*

61s. Return to an Order of the House of the 4th December, 1912, for a copy of all correspondence, complaints, petitions, memoranda, notes of evidence, reports of investigations and other documents in the possession of the Department of Inland Revenue regarding the dismissal of J. Fabien Bugeaud, Bonaventure, Quebec, assistant inspector of weights and measures in the Quebec district, and the appointment of his successor or successors, with the names, residence, salaries and duties; also of all documents relating to A. B. Caldwell, New Carlisle, Quebec, joint assistant inspector with J. Fabien Bugeand, and the duties assigned to him, together with a copy of all recommendations for said new appointment. Presented 14th January, 1913.—*Mr. Marcil (Bonaventure)*.. .. ..*Not printed.*

61t. Return to an Address to His Royal Highness the Governor General of the 4th December, 1912, for a copy of all correspondence, Orders in Council and all other papers or documents in any way relating to the dismissal of Duncan McArthur, from the Annuities Branch, while the said branch was attached to the Department of Trade and Commerce. Presented 15th January, 1913.—*Mr. Murphy*.. .. ..*Not printed.*

61u. Return to an Order of the House of the 26th February, 1912, for a copy of all documents, letters, requests, reports, recommendations and evidence taken under investigation by Dr. Shentliff, relating to the dismissal of Charles O. Jones, postmaster of Bedford, County of Missisquoi. Presented 15th January, 1913.—*Mr. Kay.* *Not printed.*

61v. Return to an Order of the House of the 1st April, 1912, for a copy of all letters, telegrams, complaints or other papers or documents in the possession of the Government or any department thereof, relating to the dismissal of Archibald Barss, postmaster, New Harbour, West, Guysborough County, N.S. Presented 15th January, 1913.—*Mr. Sinclair*.. .. ..*Not printed.*

61w. Return to an Order of the House of the 10th December, 1912, for a copy of all correspondence, documents, recommendation and other reports respecting the dismissal of Dr. A. Allaire as surgeon of the penitentiary of St. Vincent de Paul, and also respecting the payments of his gratuities, superannuation or retiring allowance. Presented 15th January, 1913.—*Mr. Wilson (Laval)*.. .. ..*Not printed*

61x. Return to an Order of the House of the 10th December, 1912, for a copy of all correspondence, documents, recommendations and reports respecting the dismissal of Oscar Beauchamp as warden of the penitentiary of St. Vincent de Paul, and also respecting the payments of his gratuities, superannuation or retiring allowance. Presented 15th January, 1913.—*Mr. Wilson (Laval)*.. .. ..*Not printed.*

61y. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of John McDonald, freight handler and checker Intercolonial railway at Sydney Mines Nova Scotia, in the riding of North Cape Breton and Victoria, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to same, and a detailed statement of the expenses of such investigation. Presented 16th January, 1913.—*Mr. Mackenzie*.. .. ..*Not printed.*

61z. Return to an Order of the House of the 9th December, 1912, for a copy of all letters, correspondence, documents and reports relating to the dismissal of Allan Kinney, of Linwood, Antigonish County, Nova Scotia, a sectionman on the Intercolonial rail-

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61 (7o). Return to an Order of the House of the 29th January, 1913, for a copy of all letters, telegrams, reports and other documents relative to the dismissal of Edward C. Humphreys, of Trenton, N.S., as an officer of the Inland Revenue Department and to the appointment of his successor. Presented 20th February, 1913.—*Mr. Macdonald.* *Not printed.*

61 (7p). Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of H. J. Fixott, port physician at Arichat, Richmond County, N.S. Presented 21st February, 1913.—*Mr. Kyte*.. .. ..*Not printed.*

61 (7q). Return to an Order of the House of the 10th December, 1912, for a copy of all correspondence, letters, telegrams and other documents relating to the dismissal of D. Morin as postmaster of St. Pie de Bagot, County of Bagot. Presented 21st February, 1913.—*Mr. Marcil (Bagot)*.. .. ..*Not printed.*

61 (7r). Return to an Order of the House of the 10th December, 1912, for a copy of all correspondence, investigations and papers generally concerning the dismissal of Ernest Paquin, postmaster of St. Cecile de Levrard, County of Nicolet. Presented 21st February, 1913.—*Mr. Lemieux*.. .. ..*Not printed.*

61 (7s). Return to an Address to His Royal Highness the Governor General of the 17th February, 1913, for a copy of all complaints and charges made against John R. McDonald, Indian agent at Heatherton, Antigonish County, of the recommendations to council and of the order in council made thereon, and of all letters, correspondence, and documents connected in any way with his dismissal. Presented 25th February, 1913.—*Mr. Chisholm (Antigonish)*... .. ..*Not printed.*

61 (7t). Return to an Order of the House of the 15th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of Joseph Day, customs officer at Little Bras D'Or, C.B., in the riding of North Cape Breton and Victoria, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to same, and a detailed statement of the expenses of such investigation. Presented 25th February, 1913.—*Mr. McKenzie*.. .. ..*Not printed.*

61 (7u). Return to an Address to His Royal Highness the Governor General of the 29th January, 1913, for a copy of all complaints against Duncan McLeod, appraiser of customs at Sherbrooke, Province of Quebec, of all information obtained as to his conduct through seizures of goods by special officers of customs and by investigation; of all reports of investigation; of the order in council dismissing said Duncan McLeod; and of all correspondence between him and the Department of Customs. Presented 25th February, 1913.—*Mr. McCrae*.. .. ..*Not printed.*

61 (7v). Return to an Order of the House of the 17th February, 1913, for a copy of all papers, letters, telegrams, evidence, &c., given at the investigation or investigations and of reports of such investigations, relating to the dismissal of Edouard D. Chiasson, sub-collector of customs at Lamèque, Gloucester County, and the appointment of his successor. Presented 25th February, 1913.—*Mr. Turgeon*.. ..*Not printed.*

61 (7w). Return to an Order of the House of the 15th January, 1913, for a copy of all papers, letters, telegrams, evidence and other documents regarding the dismissal of George F. Briggs, customs officer at McAdam Junction, York County, N.B. Presented 25th February, 1913.—*Mr. Carvell*.. .. ..*Not printed.*

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61 (9s). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Edward Landry, lightkeeper, Petite de Grat, Richmond County, N.S., and of all evidence taken and report of investigation held by H. P. Duchemin, in regard to the same; also a detailed statement of the expenses of such investigation. Presented 18th March, 1913.—*Mr. Kyte*.. .. ..*Not printed.*

61 (9t). Return to an Order of the House of the 27th January, 1913, for a copy of all documents, petitions, letters, correspondence, inquiries and reports concerning the dismissal of Evariste Talbot, employed in the general freight office of the Intercolonial. Presented 18th March, 1913.—*Mr. Lapointe (Kamouraska)*......*Not printed*

61 (9u). Return to an Order of the House of the 29th January, 1913, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Department of Railways or any department of the government, relating to the dismissal of Philip H. Ryan, an employee of the Intercolonial railway at Mulgrave, N.S., and if there was an investigation, the names of all witnesses examined, a copy of the evidence, and a detailed statement of the expenses of such investigation. Presented 18th March, 1913.—*Mr. Sinclair*..*Not printed*

61 (9v). Return to an Order of the House of the 3rd February, 1913, for a return showing how many postmasters and other post office employees were removed from office respectively, from the 1st of July, 1896, to the 1st of October, 1911, and the number in each province; and from the 10th of October, 1911, up to date, with the number in each province; also the number of post offices in operation in each province on the 1st July, 1896. Presented 26th March, 1913.—*Mr. Rainville*..............*Not printed.*

61 (9w). Return to an Address to His Royal Highness the Governor General of the 3rd February, 1913, for a copy of all orders in council, and of all letters, telegrams, complaints, petitions and of all other documents of any kind, in the possession of the government, or of any department or official thereof, in any way relating to or concerning the dismissal of Dr. Clarence T. Campbell, post office inspector at London, Ontario. Presented 26th March, 1913.—*Mr. Ross*..........................*Not printed.*

61 (9x). Return to an Order of the House of the 9th December, 1912, for a return showing the number of postmasters that have been dismissed in the County of Missisquoi since 1st October, 1911, the names of the postmasters who have been appointed to succeed them, the cause of the dismissals and a copy of all complaints and correspondence with respect to the same, and of all reports of investigations where such have been held. Presented 26th March, 1913.—*Mr. Kay*...............................*Not printed.*

61 (9y). Return to an Order of the House of the 27th January, 1913, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Post Office Department, regarding any change in any post office or postmastership in Bonaventure County, between 5th December, 1912, up to date. Presented 26th March, 1913.—*Mr. Marcil (Bonaventure)*......*Not printed.*

61 (9z). Return to an Address to His Royal Highness the Governor General of the 9th December, 1912, for a copy of all papers, documents, correspondence, orders in council, &c., relative to the dismissal of S. A. Johnson, late postmaster at Petite Rivière, Lunenburg County, N.S. Presented 26th March, 1913.—*Mr. MacLean (Halifax).*
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61 (12*i*). Return to an Order of the House of the 19th March, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of John C. Bourinot, chief customs officer at Port Hawkesbury, Inverness County, Nova Scotia, and of the evidence taken and report of investigation held by Mr. H. P. Duchemin, in regard to the same; also a detailed statement of the expenses of such investigation. Presented 21st April, 1913.—*Mr. Chisholm (Inverness).* *Not printed.*

61 (12*j*). Return to an Order of the House of the 31st March, 1913, for a copy of all charges, evidence, correspondence, letters and telegrams in the Department of Railways and Canals since the 21st day of September, 1911, relating to the dismissal of Alexander E. Morrison, Point Tupper, N.S., from the service of the Intercolonial railway, and of all recommendations for the appointment of his successor. Presented 21st April, 1913.—*Mr. Kyte* .. ..*Not printed*

61 (12*k*). Return to an Order of the House of the 3rd February, 1913, for a copy of all letters, telegrams, reports and other papers and documents received from the officers of the Canadian Brotherhood of Railway Employees, by the Department of Labour, or of the Department of Railways and Canals, between the 1st day of January, 1912, and the 25th day of January, 1913, relating to investigations and dismissals of employees for political partizanship, and of the replies thereto. Presented 22nd April, 1913.—*Mr. Sinclair*..*Not printed.*

61 (12*l*). Return to an Order of the House of the 31st March, 1913, for a copy of all complaints and charges against James Falconer, of Newcastle, County of Northumberland, New Brunswick, as correspondent of the *Labour Gazette* at Newcastle, and of all letters, telegrams and other correspondence relating in any way to his dismissal and the appointment of a successor. Presented 22nd April, 1913.—*Mr. Loggie..Not printed.*

61 (12*m*). Return to an Order of the House of the 19th March, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of John B. Chisholm, lightkeeper at Port Hastings, Inverness County, Nova Scotia, and the evidence taken and report of investigation held by Mr. H. P. Duchemin, in regard to the same; also a detailed statement of the expenses of such investigation. Presented 24th April, 1913.—*Mr. Chisholm (Inverness)*..........*Not printed*

61 (12*n*). Return to an Order of the House of the 7th April, 1913, for a copy of all correspondence, telegrams, charges and other documents, relating to the dismissal of Epiphane Nadeau, immigration agent at St. Leonard, Victoria County, N.B. Presented 25th April, 1913.—*Mr. Michaud*.. .. ..*Not printed.*

61 (12*o*). Return to an Order of the House of the 31st March, 1913, for a copy of all charges, correspondence, letters, telegrams, and other documents relative to the dismissal of D. J. Morrison, boatman in the customs service at Big Bras D'or, North Cape Breton and Victoria, N.S., and of the evidence taken and of reports of the investigation held by H. P. Duchemin, in regard to the same, with a detailed statement of expenses of such investigation. Presented 25th April, 1913.—*Mr. McKenzie.* *Not printed*

61 (12*p*). Return to an Order of the House of the 31st March, 1913, for a copy of all charges, correspondence, letters, telegrams, and other documents relative to the dismissal of Rod McLeod, boatman in the customs service at Big Bras D'or, North Cape Breton and Victoria, N.S., and of the evidence taken and of reports of the investigation held by H. P. Duchemin, in regard to the same, with a detailed statement of expenses of such investigation. Presented 25th April, 1913.—*Mr. McKenzie.* *Not printed.*

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61 (14*c*). Return to an Order of the House of the 28th April, 1913, for a copy of all charges, correspondence, telegrams, and other documents relative to the dismissal of John P. McKinnon, section foreman on the Intercolonial railway at Shubenacadie, in the riding of North Cape Breton and Victoria, N.S. Presented 20th May, 1913.—*Mr. McKenzie*...*Not printed.*

61 (14*d*). Return to an Order of the House of the 15th January, 1913, for a copy of all papers, letters, telegrams, evidence and other documents regarding the dismissal of Mary A. Bohan, as postmistress at Bath, Carleton County, N.B. Presented 21st May, 1913.—*Mr. Carrell*...*Not printed.*

61 (14*e*). Return to an Order of the House of the 15th January, 1913, for a copy of all papers, letters, telegrams, evidence and other documents regarding the dismissal of Edward Lafferty, postmaster at Benton, Carleton County, N.B. Presented 21st May, 1913.—*Mr. Carrell*...*Not printed.*

61 (14*f*). Return to an Order of the House of the 15th January, 1913, for a copy of all papers, letters, telegrams, evidence and other documents regarding the dismissal of Dennis McGaffigan, postmaster at Florenceville, Carleton County, N.B. Presented 21st May, 1913.—*Mr. Carrell*...*Not printed.*

61 (14*g*). Return to an Order of the House of the 27th January, 1913, for a copy of all correspondence and documents bearing upon any change made or asked for in the employees of the Department of Marine and Fisheries in the County of Bonaventure between 5th December, 1912, up to date. Presented 27th May, 1913.—*Mr. Marcil (Bonaventure)*.. .. ..*Not printed.*

61 (14*h*). Return to an Order of the House of the 15th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of J. A. McKenzie, postmaster at Ashfield, Inverness County, N.S. Presented 2nd June, 1913.—*Mr. Chisholm (Inverness)*.. .. ..*Not printed.*

61 (14*i*). Return to an Order of the House of the 29th January, 1913, for a copy of all letters, petitions, telegrams, complaints, reports and other papers and documents in the possession of the Post Office Department, or any department of the government, relating to the dismissal of James Bowles, postmaster at Alder River, N.S., and if there was an investigation, the names of all the witnesses examined, a copy of the evidence, and a detailed statement of the expense of such investigation. Presented 2nd June, 1913.—*Mr. Sinclair*...*Not printed.*

61 (14*j*). Return to an Order of the House of the 21st April, 1913, for a copy of all correspondence, complaints, reports, recommendations, petitions, certificates and other documents relating to the dismissal of Mr. Edmund Lacroix, as postmaster of the Parish of St. Joseph du Lac, County of Two Mountains, and the appointment of Rodrique Larocque, of the same place as postmaster. Presented 2nd June, 1913.—*Mr. Ethier*...*Not printed.*

61 (14*k*). Return to an Order of the House of the 23th May, 1913, for a copy of all papers, letters, documents, reports and inquiry, relating to the lighthouse keeper of the Parish of Repentigny, County of L'Assomption. Presented 3rd June, 1913.—Mr. *Seguin*...*Not printed.*

61 (14*l*). Return to an Order of the House of the 16th April, 1913, for a copy of all papers, documents, evidence, reports, &c., relating to the dismissal of B. C. Kanock, late shipping master at Lunenburg, N.S. Presented 4th June, 1913.—*Mr. McLean (Halifax)*. *Not printed*

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superintendent of the Intercolonial at Lévis, in reference to Alfred Laugnay, an employee of the Intercolonial at St. Charles, County of Bellechasse. Presented 27th February, 1913.—*Mr. Lapointe (Kamouraska)*............................*Not printed.*

83e. Return to an Order of the House of the 19th February, 1913, for a copy of all telegrams, letters, petitions, reports of engineers, plans, surveys, and other documents in the possession of the Department of Railways and Canals, and having been received since 1st January, 1912, relating to the construction of a branch line of the Intercolonial Railway into Guysborough County. Presented 18th March, 1913.—*Mr. Sinclair*..*Not printed.*

83f. Return to an Order of the House of the 24th February, 1913, for a copy of all petitions, resolutions, letters, telegrams and correspondence, relating to free or reduced transportation of hay over the Intercolonial Railway for the farmers of Antigonish County, Nova Scotia, and also of the evidence taken and report made as to the shortage of hay in that and other of the eastern counties of Nova Scotia. Presented 18th March, 1913.—*Mr. Chisholm (Antigonish)*..........................*Not printed.*

83g. Return to an Order of the House of the 29th January, 1913, for a copy of all letters telegrams, tenders, acceptances of tenders, cancellation of tenders and other papers and documents in the possession of the Department of Railways and Canals, or any department of the government, bearing date after 1st July, 1912, relating to the supply of ice for the use of the Intercolonial Railway at Mulgrave, N.S. Presented 18th March, 1913.—*Mr. Sinclair*..........................*Not printed.*

83h. Return to an Order of the House of the 12th February, 1913, for a copy of all letters correspondence, petitions and other documents, on file in the Department of Railways and Canals, or in the office of the Intercolonial Railway at Moncton, relating or in any way appertaining to the new public wharf at Sackville, N.B., and the necessity of establishing in the interest of the traffic of the Intercolonial Railway, and of the shipping and trade facilities of Sackville, and of the commerce of communities adjacent thereto, rail connections between the said wharf and the main line of the said railways at Sackville station; also of all letters and other communications received by the chairman or vice-chairman of the Government Railways Managing Board, or by any official of the said railway, relating in any manner to the said subject, received by them or any of them during the years 1911, 1912 and 1913. Presented 19th March, 1913.—*Mr. Emmerson*..........................*Not printed*

83i. Return to Order of the House of the 19th March, 1913, for a return showing who the tenderers were, and the amount of each tender for the supply of castings for the Intercolonial Railway during the present year. Presented 28th March, 1913.—*Mr. Macdonald*..........................*Not printed.*

83j. Return to an Order of the House of the 19th March, 1913, for a return showing how many kegs of nails were purchased in 1912 for the Intercolonial Railway; the prices paid therefor in each case; whether tenders were invited in the case of each purchase and, if so, who the respective tenderers were and the prices submitted; to whom were the contracts awarded in each case. Presented 28th March, 1913.—*Mr. Murphy.* *Not printed.*

83k. Return to an Order of the House of the 19th March, 1913, for a return showing the amounts received by the Intercolonial Railway for freight and passengers respectively for each of the twelve months of the calendar years 1910, 1911 and 1912, at the following stations:—Montreal, Halifax, St. John, Sydney, Truro, Moncton, New Glasgow

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since he entered upon his duties.—Also return to an Order of the House of the 2nd April, 1913, for a copy of all accounts for personal expenses paid by the government to Mr. St. Amour, Superintendent of the Soulanges Canal, since the date of his appointment. Presented 29th April, 1913.—*Mr. Boyer*......................*Not printed.*

109. Return to an Order of the House of the 10th December, 1912, for a copy of all correspondence, letters, telegrams, petitions and other documents received since the 1st day of January, 1912, asking that the line of railway known as the Vale Road, should be taken over by the Intercolonial Railway. Presented 30th January, 1913.—*Mr. Macdonald*...............................*Not printed.*

110. Return to an Order of the House of the 27th January, 1913 for a copy of all correspondence in connection with the issuing of letters patent to the Quebec Railway, Light, Heat and Power Company, Limited, and also said letters patent. Presented 30th January, 1913.—*Mr. Lemieux*..*Not printed.*

111. Return to an Order of the House of the 9th December, 1912, for a copy of all papers, documents, correspondence, &c., between the Department of Trade and Commerce and Mr. Donnelly, late Canadian Trade Commissioner in Mexico, relating to the closing of the office of such trade commissioner in Mexico. Presented 3rd February, 1913.—*Mr. Maclean (Halifax)*...*Not printed.*

112. Return called for by Section 88 of Chapter 62, Revised Statutes of Canada, requiring that the Minister of the Interior shall lay before parliament, each year, a return of liquor brought from any place out of Canada into the territories by special permission in writing of the Commissioner of the Northwest Territories. Presented by Hon. Mr. Roche, 3rd February, 1913...*Not printed.*

113. Return to an Order of the House of the 22nd January, 1913, for a copy of all letters, telegrams and other papers and documents, relating to the resignation of Lt.-Col. W. F. Moore, 20th Regiment, Halton Rifles, and also of the resignation and the reply thereto. Presented 6th February, 1913.—*Mr. Macdonald*...............*Not printed.*

114. Return to an Order of the House of the 20th January, 1913, for a copy of all letters, papers, telegrams and other documents in connection with the strike of firemen and other men employed on the D.G.S. *Earl Grey*, in the year 1912 and 1913. Presented 11th February, 1913.—*Mr. Macdonald*...................................*Not printed.*

115. Return to an Order of the House of the 27th March, 1912, for a copy of all papers, letters and telegrams relating to the applications for, or the granting of, a lease of False Cove Flats, Vancouver, B.C. Presented 11th February, 1913. *Mr. Macdonald.* *Not printed.*

116. Return to an Order of the House of the 27th January, 1913, for a copy of all correspondence and other papers in connection with a proposed guarantee of bonds to the Quebec and Saguenay railway. Presented 11th February, 1913.—*Mr. Lemieux*....*Not printed.*

116a. Return to an Order of the House of the 9th April, 1913, for a copy of all documents, including petitions, memorials, letters and telegrams, addressed to the government, or any of its members, urging it to take over and incorporate into the Canadien government railway system, the Quebec and Oriental Railway and the Atlantic, Quebec and Western Railway, with a copy of all the answers thereto. Presented 20th May, 1913. —*Mr. Marcil (Bonaventure)*...*Not printed.*

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131. Return to an Order of the House of the 4th December, 1912, for a copy of all papers, documents, telegrams, reports, letters, and instructions regarding smelt and salmon fishing in the Restigouche river and the Baie des Chaleurs since October, 1911, up to date, together with copy of instructions issued to officials of the Department of Marine and Fisheries in that connection. Presented 18th February, 1913.—*Mr. Marcil (Bonaventure)*..........*Not printed.*

132. Return to an Order of the House of the 29th January, 1913, for a copy of all correspondence and papers concerning the increase of salary of Mr. Sevigny, employed at the immigration office at Montreal. Presented 18th February, 1913.—*Mr. Carvell.* *Not printed.*

133. Return to an Order of the House of the 5th February, 1913, for a return showing whether any order for goods has been given by the Department of Public Works since 1st October, 1911, at Montreal, Quebec, St. John and Halifax; tenders asked for in each case; orders for goods given without tenders; names of firms, and amounts in each case. Presented 19th February, 1913.—*Mr. Macdonald*..........*Not printed.*

134. Return to an Order of the House of the 10th December, 1912, for a copy of all correspondence and other papers, in the Department of Public Works, concerning the awarding of a contract for a Welsh coal supply to the various Dominion public buildings in Montreal. Presented 19th February, 1913.—*Mr. Lemieux*....*Not printed.*

135. Return to an Order of the House of the 5th December, 1912, for a return showing how many dredging contracts were let by the Department of Public Works during the year 1911-12, the name of each tenderer and the amount of each tender. Presented 19th February, 1913.—*Mr. Lemieux*..........*Not printed.*

135*a*. Return to an Order of the House of the 4th December, 1912, for a return showing the quantity by cubic yards of dredging made in the harbour of Bathurst by the dredge *Restigouche* during the months of May, June, July, August, September, October, and November of the year 1911, and during the same months in the year 1912. Presented 19th February, 1913.—*Mr. Turgeon*..........*Not printed.*

135*b*. Return to an Order of the House of the 10th December, 1912, for a copy of all correspondence, documents, recommendations and reports respecting the dredging Des Prairies river, the work done, depth, length and width of channel dredged, the list of men employed to perform that work, their salaries, and the amount of money spent on that work since the 1st of October, 1911, up to the 21st November, 1912. Presented 12th May, 1913.—*Mr. Wilson (Laval)*..........*Not printed*

135*c*. Return to an Order of the House of the 3rd March, 1913, for a copy of all documents, letters, reports of engineers and a detailed statement of expenditure in connection with dredging at Ste. Anne de Restigouche and Cross Point, Bonaventure County. Presented 4th June, 1913.—*Mr. Marcil (Bonaventure)*..........*Not printed.*

135*d*. Return to an Order of the House of the 19th March, 1913 for a return showing the amount of dredging done by the government dredges for private parties or firms in Prince Edward Island, during the season of 1912; the names of the parties or firms for whom this dredging was done; the number of yards of material dredged for each party or firm; the class of material dredged, and the price per yard the government charged for this dredging; who measured the material dredged, and whether it was scow measurement that was made; who recommended the said dredging to be done; if the resident engineer or any engineer was consulted in regard to the measuring, and if the resident engineer or any engineer had control over the matter at all. Presented 6th June, 1913.—*Mr. Hughes (Kings, P.E.I.)*..........*Not printed.*

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187*f*. Return to an Order of the House of the 31st March, 1913, for a copy of all papers, telegrams, applications, and other documents in connection with the S.W. 2-19-20, west 2nd M. Homestead, patented 3rd June, 1892; the S. ½ of N.E. 20-20-21, west 2nd M. patented 11th October, 1904, N.W.H.B., as assignee of Edward Boucher; the S.E. ¼ of 22-20-21, west 2nd M., N.W.H.B., patented 22nd September, 1900, as assignee of Louis McGillies; the S.E. ¼ of 28-20-21, west 2nd M., N.W.H.B., patented 26th August, 1901, as assignee of J. Bte. Fagant, jr., and the E. ½ of S.E. ¼ of 32-20-21, west 2nd M., N.W.H.B., patented 11th September, 1901, as assignee of Jos. Alexander; and of all papers in connection with any claims of G. W. Brown or others in connection with these lands. Presented 3rd June, 1913.—*Mr. Bradbury*....................*Not printed.*

187*g*. Return to an Order of the House of the 31st March, 1913, for a copy of all papers, telegrams, applications and other documents regarding the S.W. ¼, 28-20-21, west 2nd M., N.W.H.B., patented 1st March, 1909, as assignee of Norbert Bellehumeur; and the W. ½ of S.E. ¼, 32, 20, 21, west 2nd M., N.W.H.B., patented 1st March, 1909, as assignee of Norbert Bellehumeur; and of all papers in connection with any claims by Norman McKenzie or others against the Government in connection with these lands. Presented 4th June, 1913.—*Mr. Bradbury*..................................*Not printed.*

188. Return to an Order of the House of the 10th March, 1913, for a copy of all correspondence or communication of any kind between the Department of Insurance at Ottawa and the Department of Insurance at Toronto since June, 1907, touching the transfer of the Canadian Guardian Life Insurance Company from the jurisdiction of the Insurance Department at Ottawa to that of the jurisdiction of the Insurance Department at Toronto; of all correspondence, if any, between the Insurance Department at Ottawa and the *Saturday Night*, newspaper of Toronto, touching the affairs of the Canadian Guardian Life Insurance Company or the International Insurance Company, Limited; and of all correspondence and other communications between the Department of Insurance at Ottawa and the Government of the province of Alberta in reference to the affairs of the Canadian Guardian Life Insurance Company or the International Insurance Company, Limited. Presented 31st March, 1913.—*Mr. German.*
Not printed.

189. Copy of an Order in Council, &c., respecting a contribution of $30,000 to assist in alleviating the distress of the sufferers by the disastrous cyclone which swept over the City of Regina and its vicinity. Presented by Hon. Mr. White, 31st March, 1913.
Not printed.

190. Copy of correspondence respecting the Treaty of Commerce and Navigation between the United Kingdom and Japan. Presented by Hon. Mr. Borden, 1st April, 1913.
Printed for sessional papers only.

190*a*. From Imperial Consulate General of Japan for the Dominion of Canada. The undersigned, His Imperial Majesty's Consul General at Ottawa, duly authorized by His Government, has the honour to declare that the Imperial Japanese Government are fully prepared to maintain with equal effectiveness the limitation and control which they have since 1908 exercised in the regulation of emigration from Japan to Canada. 11th April, 1913. Presented by Hon. Mr. Borden, 11th April, 1913........*Not printed.*

191. Copy of the order in council in connection with the appointment of a Commission to inquire into the claims of the province of British Columbia for exceptional treatment. Presented by Hon. Mr. Borden, 1st April, 1913.......*Printed for sessional papers only.*

191*a*. Memorandum *re* British Columbia's claims for special consideration. Presented by Hon. Mr. Borden, 1st April, 1913.....................*Printed for sessional papers only.*

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son of damage or disease contracted while in the service; also of all such claims paid, the amounts in each case, and the persons to whom paid. Presented 25th April, 1913.—*Mr. Carvell*............................. ....*Not printed*

203. Return to an Order of the House of the 11th December, 1912, for a copy of all papers, documents, pay-rolls, accounts, receipts, and correspondence in connection with all expenditures of money made in 1912 upon the Petite Rivière breakwater, Lunenburg County, Nova Scotia. Presented 29th April, 1913.—*Mr. Maclean (Halifax).* *Not printed.*

203a. Return to an Address to His Royal Highness the Governor General of the 9th December, 1912, for a copy of all advertisements tenders, contracts, orders in council, letters, correspondence, &c., relating to the construction of a wharf or breakwater at Seaforth, Halifax County, N.S. Presented 29th April, 1913.—*Mr. Maclean (Halifax).* *Not printed.*

203b. Return to an Order of the House of the 20th March, 1912, for a copy of all documents, letters, correspondence, petitions, reports, &c., addressed to the Department of Public Works since the 21st September last on the subject of a wharf now under construction at St. Croix, in the County of Lotbinière, province of Quebec. Presented 29th April, 1913.—*Mr. Fortier*.......................... ....*Not printed.*

203c. Return to an Order of the House of the 19th March, 1913, for a return showing whether the repairs to Red Point wharf, Lot 48, Prince Edward Island, have been completed; if the work was done by tender or by day labour; if by tender, with whom the contract was made; if by day labour, the number of superintendents, inspectors, or overseers employed, their names, the number of days each did work, and the wages per day paid to each; the number of men employed, their names, the number of days each did work and the wages per day paid to each; who supplied the materials; the amount of each kind or class used, and the price paid for each kind or class; the total amount paid for materials, wages and cost of the work. Presented 2nd May, 1913.—*Mr. Hughes (Kings, P.E.I.)*..*Not printed.*

203d. Return to an Order of the House of the 31st March, 1913, for a copy of all documents, papers, correspondence, representations, &c., relating to the purchase of land at Digby, Nova Scotia, for the purpose of a site for a public wharf. Presented 2nd May, 1913.—*Mr. Maclean (Halifax)*..*Not printed.*

203e. Return to an Order of the House of the 19th March, 1913, for a return showing whether the repairs to Southport wharf, Lot 48, Prince Edward Island, have been completed; if the work was done by tender or by day labour; if by tender, with whom the contract was made; if by day labour, the number of superintendents, inspectors, or overseers employed, their names, the number of days each did work, and wages per day paid to each; the number of men employed, their names, the number of days each did work and the wages per day paid to each; who supplied the materials; the amount of each kind or class used and the price paid for each kind or class; the total amount paid for materials, wages and cost of the work. Presented 2nd May, 1913.—*Mr. Hughes (Kings, P.E.I.)*..*Not printed.*

203f. Return to an Order of the House of the 11th December, 1912, for a copy of all accounts, correspondence, telegrams, complaints and other documents in possession of the Department of Public Works, in relation to the expenditure of moneys on harbour improvements at Grand Etang, during the year 1911-12. Presented 13th May, 1913.—*Mr. Chisholm (Inverness)*.. .. ..*Not printed.*

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DEPARTMENT OF THE INTERIOR

REPORT

OF THE

CHIEF ASTRONOMER

FOR THE

YEAR ENDING MARCH 31

1911

PRINTED BY ORDER OF PARLIAMENT

OTTAWA
PRINTED FOR J. de L. TACHÉ, PRINTER TO THE KING'S MOST
EXCELLENT MAJESTY
1915

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REPORT OF THE CHIEF ASTRONOMER AND INTERNATIONAL BOUNDARY COMMISSIONER.

DEPARTMENT OF THE INTERIOR,
DOMINION ASTRONOMICAL OBSERVATORY,
OTTAWA, CANADA, May 1, 1911.

W. W. CORY, Esq., C.M.G.,
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, 1911.

The correspondence in the twelve months was:—

Letters received	2,190
Letters sent	3,365
Accounts examined	864

A statement of the work of the photographic division appears as Appendix No. 5.

The library contains 3,839 bound books and some 410 bound pamphlets. These are entered in a card catalogue under author and title. A further classification by subject was contemplated, but has been postponed, as, especially in the case of volumes of transactions of societies, collected works, etc., it calls for a great number of entries and cross references, on account of the diversity of the subjects treated. For lack of time, the librarian, who has other duties to perform, has been unable to make this classification. Sixty scientific periodicals are procured by subscription, and the number of observatories, societies, etc. (principally astronomical and meteorological), from which regular publications are received, is over 90. The bookbinder who has been employed here for some years numbering bound volumes for the library and preparing periodicals, unbound reports, etc., for binding at the Printing Bureau, has been provided with machinery and appliances, so that the binding may be done in the building. Since the bindery has been fully equipped (in February last) some 300 volumes have been bound; there are still 500 volumes or more awaiting binding.

The mechanicians have been kept busy with repairs and minor alterations to field and observatory instruments. No construction of special importance has been undertaken.

Fourteen meetings of the Ottawa Centre of the Royal Astronomical Society of Canada have been held, beginning in October. These meetings are fortnightly, alternately afternoon meetings in the Observatory and evening meetings usually held in a hall in the city. The number stated includes the annual meeting in December and a very enjoyable reception at the Observatory, for members of the society and their friends, on March 23rd.

The Saturday 'open evenings,' when the public is invited to visit the Observatory to look through the equatorial telescope, continue to be appreciated. There are also many day-time visitors, who, though they have not the opportunity of viewing the sky, are interested in examining the instruments and equipment.

The Observatory grounds have been terraced and sodded, with the exception of the northeastern corner, and the necessary roads laid out and prepared. Electric lights have been placed on the grounds and along the pathway leading to the electric railway. The residence of the Chief Astronomer was completed and was occupied by him at the end of July.

The foundation of the small building to house an instrument to carry the micrometer and stellar camera was laid last summer, but the superstructure was not proceeded with. The piers for the meridian marks have been erected, and the foundations laid of the buildings which are to cover them. Wooden sheds have been built over the piers to protect them from the weather, pending completion of the permanent structures. These piers are built for underground reference marks.

Mr. J. S. Plaskett attended the meeting of the Astronomical and Astrophysical Society of America, at Harvard, and that of the International Union for Co-operation in Solar Research at Mt. Wilson, Cal., last summer. At the former Mr. Plaskett was placed on three committees; those on the Solar Rotation, Radial Velocities, and the Classification of Spectra. At the meeting of the Solar Research Union, a share of the work of determining the solar rotation was allotted to this Observatory, associated with the observatories at Pulkowa, Edinburgh, Cambridge (England), Allegheny and Mt. Wilson. The invitation which Mr. Plaskett was authorized to convey to the Astronomical and Astrophysical Society to hold their annual meeting here next August has been accepted.

The apparatus for the solar work consists of a coelostat telescope, of 80 feet focus, and a Littrow grating spectrograph of 23 feet focus. Three different gratings have been thoroughly tested and the most suitable is now permanently mounted and is in regular use. A device consisting of two reflecting prisms has been applied, for bringing the opposite limbs of the sun on the slit together. One of the problems in regard to the solar rotation is whether the rotational velocity varies for different lines of the spectrum. An investigation of the errors which may thus arise has been undertaken. Experimenting has been done on the kind of plate that should be used, the development, etc., for the regions of the spectrum which are to be investigated, λ 5500 to λ 5700 and λ 4220 to λ 4280. The work of obtaining and measuring plates for the solar rotation is under way.

Four orbits of spectroscopic binary stars have been completed, η Camelopardalis, ν Orionis, 93 Leonis and ϵ Ursae Minoris. Work on three or four others is nearing completion, and a good deal of preliminary observing and measuring has been done on several other binaries. The weather for observing has been unusually bad during the past year; the average number of spectra obtained monthly has been 65, as against 76 last year. Part of this decrease may be accounted for by the fact that fainter stars have been observed upon, requiring larger exposure time. The aperture of the telescope is relatively small, compared with the instruments used in many of the observatories engaged in this branch of astronomical work. A larger telescope is much to be desired.

The telescope has also been used in measuriug the position angles and distances of visual double stars, and in observing occultations of stars by the moon.

Photographs were taken of Halley's Comet, when it was near the earth, with the Brashear Doublet and also with a large Zeiss Tessar wide-angle lens. The weather at this time was, however, extremely unfavourable.

The underground lenses and long focus collimating lenses for the meridian marks, with the necessary mountings, have been ordered.

Improvements have been made in the mounting of the microscopes of the transit-circle and in the illuminating apparatus. The ventilation of the room has been improved by using ventilating fans, but it is still found that the temperature within does not follow that of the air without in a satisfactory manner, and further improvements in ventilation are contemplated.

The system of controlled clocks and dials has worked satisfactorily. Two hundred and ninety-two dials are now in operation.

The Bosch photographic seismograph has been in constant operation throughout the year. To one of the pendulums, magnetic damping has been applied by means of a powerful horseshoe magnet, the other pendulum retaining the air damping. The magnetic damping reduces the effect of the microseisms, and allows the phases of the greater disturbances to be more surely identified. Earthquake bulletins are issued regularly, and are sent to other earthquake stations in exchange for their bulletins. Twenty-four bulletins have been issued during the year, giving records of 89 earthquakes, and have been distributed to 55 stations. No earthquakes occurring in Canada have been recorded.

To assist in distinguishing earthquakes not of seismic origin, a Fuess electric recording Anemograph has been installed. It records the direction, velocity and pressure of the wind in ink on paper moved by clock-work.

The longitude of the transit house at Winnipeg, on Fort Osborne barrack ground, which is intended to serve as a base for longitude determinations in the prairie provinces, was determined early last summer by telegraphic exchange of time with Ottawa, using one of the copper wires of the Canadian Pacific Railway Company's telegraph. The low resistance and self-inductance of this wire made it possible to dispense altogether with repeaters, thereby obviating the uncertainty which prevails in using them as to the speed of response of the relays to current passing in the two directions, and materially increasing the accuracy of the exchanges. The time of transmission was six one-hundredths of a second, indicating a velocity of nearly 22,000 miles per second, and was remarkably constant from night to night, throughout the series of exchanges.

The longitudes of eight other stations were determined, namely, Walsh, Coutts, and Pincher in Alberta; North Portal and Mortlach, Saskatchewan; Emerson, Manitoba; and Sault Ste. Marie and Windsor, in Ontario. The last two were determined by exchange of signals with Ottawa, the others by exchanges with Winnipeg. The latitudes of all the stations, including Winnipeg, were also determined.

The work of the Magnetic Survey comprised the determination of declination, inclination, horizontal intensity, and the diurnal variation of declination at forty-eight points along the Canadian Pacific Railway between Chapleau and Moosejaw, and at forty-four points in southern and southwestern Ontario. The average distance between points was twenty-five miles. Two observers were employed on this work.

The negotiations referred to in my last annual report in regard to the questions at issue in Passamaquoddy bay, culminated in a treaty which was signed at Washington on May 21st, and ratified on June 6th, 1910.

By this treaty the boundary line through the southern part of the bay is defined by seven bearings and distances, beginning at the point between Treat island and Friar Head referred to in Article I. of the Treaty of 1908, and terminating in the middle of Grand Manan channel.

The boundary line as thus defined passes to the east of Pope's Folly island, and through the dredged channel to the west of the Middle Grounds.

The commissioners have not yet undertaken the marking of this line, nor of any part of the line defined by the first article of the Treaty of 1908.

The operations under the second article of the same treaty were continued by Mr. A. J. Brabazon, D.L.S., on behalf of Canada, and Mr. J. E. McGrath for the United States. They comprised the placing of reference monuments on each side of the river St. Croix, from the terminal point of last season's operations near St. Stephen, to near the outlet of the lower lake, at Vanceboro, and the making of a triangulation to determine the positions of these monuments.

The work on the third section of the boundary line was carried on by a joint survey party under Mr. Geo. C. Rainboth, D.L.S., on behalf of Canada, and Mr. Jas. B. Baylor, of the United States Coast and Geodetic Survey, for the United States. The work consisted in the survey of the boundary line along the St. John river from last season's terminal point, near Edmundston, N.B., up the river to the mouth of St. Francis river, and up the latter river, the line being defined by reference to monuments placed on each side of the rivers. These monuments are connected by triangulation. The survey operations were terminated near the boundary line of Temiscouata county, Quebec.

It is with very great regret that I record here the death of Mr. Rainboth. He was taken ill in camp just at the time that he was ready to bring the season's work to a close. His desire to see personally to the arrangements necessary in this connection led him to delay placing himself under medical care until it was too late. He was finally brought by canoe to Edmundston, and then placed on the train with the hope of getting him safely home in Ottawa. He died on the train at Rivière-du-Loup. He was one of the best known surveyors in the Ottawa valley, where he had practised his profession from his youth. He had also made many surveys for the Department of the Interior in the Northwest. Since 1905, he was in charge of the fieldwork of the resurvey of the 'Ashburton Line,' that is, the boundary line from the St. Lawrence river to the source of the St. Croix.

The resurvey of the 49th parallel (section 6 of the Treaty of 1908) was carried on by a Canadian party under Mr. J. J. McArthur, D.L.S., for a distance of about 150 miles from a point a short distance west of North Portal, eastward along the southern boundary of the Provinces of Saskatchewan and Manitoba. An American party at the same time was engaged on the resurvey of the same line farther west.

Mr. Geo. White-Fraser, D.T.S., continued the work of defining the boundary line through the straits of Georgia and Fuca, by means of reference monuments on the shores. This work is done under the eighth article of the Treaty of 1908.

Two surveying parties were employed on the survey of the boundary of the Alaska Coast Strip (Treaty of 1903); one under Mr. N. J. Ogilvie, D.L.S., in the Lynn Canal region, the other under Mr. F. H. Mackie, D.L.S., at the head of Portland canal.

The survey of the 141st meridian under the provisions of the Treaty of 1906 was continued by two large parties, one Canadian, one American, each divided into a number of sub-parties. The chiefs of the Canadian parties were Messrs. J. D. Craig, F. Lambart and A. G. Stewart, Dominion land surveyors.

The vista cutting and the placing of the final monuments were completed between White river and Yukon, also north of the latter about half-way to Porcupine river. On the latter section, the triangulation and topographical work were completed.

The survey of the line is therefore completed between the last mentioned point and the Natazhat range, south of White river. The projection of the meridian was carried to a point about ten miles north of Porcupine river.

Mr. D. H. Nelles, D.L.S., completed the precise levelling to a point on the 141st meridian. This line of levels is now complete from the summit of White Pass, along the White Pass Railway and the Dawson Road to Dawson, and thence west to the meridian. An American surveyor has completed the connection with tide-water by carrying a line of precise levels from Skagway, along the railway, to the summit.

On the Geodetic survey, two observers were employed, one in the province of Ontario, one in Quebec, measuring the angles of the primary triangles. Three reconnaissance parties, to select points for the extension of the triangulation, worked respectively in the western part of Ontario, to the south and east of Georgian bay, and on the British Columbia coast. A station-building party worked north and northwest of Toronto, erecting the towers for the triangulation, where these were required. Three parties were employed on the precise levelling. One of these parties worked in Ontario and one in Nova Scotia. The third, beginning at a bench-mark of the U.S. Coast and Geodetic Survey at Stephen, Minn., carried a line of levels north to Emerson, Man., and thence west along the railways, paralleling the international boundary.

Herewith are submitted, as appendices, reports by Dr. O. Klotz and Messrs. Plaskett, Stewart, and Macara, upon the work under their charge respectively; also a statement of the work done in the photographer's office.

I have the honour to be, sir,

Your obedient servant,

W. F. KING,
Chief Astronomer.

APPENDIX 1.

REPORT OF THE CHIEF ASTRONOMER, 1911.

SEISMOLOGY, TERRESTRIAL MAGNETISM AND GRAVITY

BY

OTTO KLOTZ, LL.D., F.R.A.S.

CONTENTS

ILLUSTRATIONS.

APPENDIX 1.

SEISMOLOGY, TERRESTRIAL MAGNETISM AND GRAVITY, BY OTTO KLOTZ, LL.D., F.R.A.S.

OTTAWA, ONT., April 1st, 1911.

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, during the fiscal year April 1, 1910, to March 31, 1911, 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 of 1906; a Callendar electric thermograph; a Shaw-Dines micro-barograph; a Fuess electric anemograph; besides wet and dry bulb thermometers. The new instrument acquired during the year is the anemograph.

The above instruments, outside of the seismographs, serve as auxiliary instruments for the interpretation of the seismograms, which show at times disturbances and movements that are not readily attributable to earthquakes. In this respect they have served their purpose well, as illustrated by the accompanying reproductions showing an intercomparison of micro-barogram, thermogram, anemogram and seismogram. (Figs. 5, 6 and 7.)

Beginning with the micro-barograph, which records rapid change of atmospheric pressure, but not the absolute pressure shown by a barometer, we find that almost simultaneous with the sudden increase of pressure, cold air pouring down from the higher regions, the thermograph shows a marked corresponding decrease of temperature. Again, this rapid increase of atmospheric pressure manifests itself by the pressure plate of the anemograph, and lastly the resulting steep gradients of the isobars induce strong winds, setting up oscillations of the observatory and ground, producing motion more or less irregular of the seismograph pier, as shown on the seismogram.

Owing to the proximity of our machine shop to the seismograph room, it has not been considered safe to draw conclusions as to the movement of the horizontal pendulum zero due to the diurnal heating of the earth by the sun, whereby the ground heaves or bulges following the course of the sun. It is expected that in the near future other quarters will be provided for the machine shop, and that the necessary delicate observations of earth movements due to heat may be made. As an example of the sensitiveness of the seismograph or horizontal pendulum, may be mentioned an incident of last August, when a party of the Sons of England, in convention here, visited the Observatory. Their presence in the room above the seismograph room, which is in the basement, was duly recorded by the seismograph, in fact the time of their coming and going to and from the room was clearly shown. The 'impression' they left behind amounted to .097 seconds of arc, that is, they had compressed the earth equivalent to a gradient of one inch in thirty-three miles, or one in two million. Weighty Englishmen!

A brief description of the anemograph No. 1792, Fuess, Steglitz-Berlin, may be given. The accompanying illustrations will assist in understanding the working of the instrument. It records, by means of six pens, the direction, velocity and pressure of the wind, four pens being required for direction and one each for velocity and pressure.

Velocity.—Referring to Figs. 1, 2, 3, 4, *C* represents four copper hemispherical cups, each $20\frac{1}{2}$ cm. in diameter and 80 cm. between centres of opposite cups. The cup-cross is secured to a steel rod by a nut, and has a ball-bearing. The cups move very freely, being set rotating with the slightest movement of the air. The steel rod *R* terminating in a point, rests in a small steel cup, and has a worm near its lower extremity which gears into the wheel *G*, having 144 teeth, so that 144 revolutions of the cups *C* are equivalent to one revolution of the wheel *G*. The electric record that is made of the velocity is the record of each revolution of the wheel *G*, and which is effected by an electric contact at *T*, closing the circuit momentarily thereby actuating through an electro-magnet the ratchet wheel *I* in the recording device, to be described later, and moving the paper forward a half-millimetre, which is recorded by the pen *O*, which also furnishes the time scale.

Direction.—The part of the apparatus *WPV* moves freely, being ball-bearing under the cap where the chain is seen. *V* is a copper vane, 58 cm. long, 30 cm. wide at the back and 18 cm. in front. The two plates forming the vane are 9 cm. apart in front and $29\frac{1}{2}$ cm. at the back. *W* is simply a counter-weight. The motion or direction of *WPV* is communicated through the brass rod *E* to the two gear wheels *D*, the axis of the left-hand one terminating in a quadrantally-divided cylinder, upon which electric contact is made by a split copper brush, so that the latter may rest either wholly on one quadrant or on two adjoining ones. The quadrants represent respectively the directions N., E., S., W. When the brush rests only on one quadrant, one of the cardinal points will be recorded as the direction of the wind; if it rests on two then the direction of the wind will be shown as being either N.E., N.W., S.E., or S.W. In short, the apparatus records eight different wind directions, N., N.E., E., S.E., S., S.W., W., N.W. With reference to the electric recording it may be mentioned here that the circuit for direction is in circuit with that for velocity, so that direction is only recorded when the circuit is closed at the gear wheel *G*, hence the records for direction and velocity are simultaneous; while the one pen *O* records that gear wheel *G* has made another revolution, one or two of the direction pens *F* records the direction of the wind at that moment.

Pressure.—*P* represents the pressure plate and, of course, being attached to the vane frame, always faces the wind. It is $25\frac{1}{2}$ cm. in diameter, and is attached to the system of levers terminating in the spring *S*, which presses against a plate. The motion in and out of the plate *P* is communicated to the rod *B*, which in turn moves the arm *A* (Fig. 2) making, successively, twelve electric contacts *H*, representing twelve different pressures from 0 to 7.52 pounds to the square foot. How these different pressures are recorded will be described under a description of the recording device.

In Fig. 2, *N* shows the connection for 20 wires. The mechanism of the anemometer is tightly closed in. The 20 wires are gathered into a lead-covered cable, not shown, which, in passing out of the lower part, is covered with a nut having packing so as to prevent moisture or snow from entering the lower case or compartment. The cable leads along the stone cornice of the Observatory and into the building to the recording apparatus.

The steel skeleton, made of 2-inch pipes (Fig. 3), supporting the anemometer, is 6 m. in height, and the cup-cross 2 m. above this, and 20 m. (66 ft.) above the ground. The skeleton is anchored in a heavy cement bed specially built in the corner of the Observatory roof.

In Fig. 4 is seen the connection of the wires of the cable to the lightning arrester *L*, to which also are connected the wires of the recorder and the wires *K* for the current of six volts supplied by a storage battery of three cells. The eight-day clock gives the time scale by means of the rod *U* carrying the pen *O*. This rod, with rack, rests on a pinion of the clock-work, and moves uniformly to the right about halfway across the paper. At each hour the minute hand at XII slightly raises the rod, when the weight within the damping cylinder *Z* draws it over to the left-hand edge of the paper. When the minute hand, tipped with a platinum point, disengages the rod *U* it also makes electric contact whereby the ratchet wheel *I* is moved one tooth, and the paper descends $\frac{1}{2}$ mm. The hour line drawn across the paper consists, therefore, of a series of steps each of $\frac{1}{2}$ mm., there being as many steps as the velocity gear wheel *G*, already described, has made revolutions during the hour, plus one step for each hour. Instead of counting the number of steps in an hour, a glass scale is provided, graduated to a hundred half-millimetres, with an extra half-millimetre at zero for the hour contact, which is not counted in with the velocity breaks or steps.

The direction of the wind is recorded by the four pens *F*, being in the order from the left—north, east, south and west. They are connected to the armatures of four electro-magnets seen to the left, so that when the circuit is closed one or two of the pens makes a jog in the respective line.

The recording of the pressure is done by an ingenious device. It has already been stated that the pressure arm *A* makes twelve different contacts, there being, therefore, twelve different circuits or currents therefor, represented by the twelve coils *Y* above and below the iron plate *X*, which acts as an armature. This iron plate, carrying a vertical rod, rests on a pivot, and is free to move thereon, *i.e.*, to be attracted to any corresponding pair of coils, so that the vertical rod describes, in going the rounds of all the contacts, a cone. This motion of the rod is communicated to the axis of a pinion which gears in the rack on the carriage *M* on which is supported the pen *J* for registering the pressure. The pressure is recorded for twelve definite pressures, the pen moving 3 mm. (6 half-mm.) for each pressure from zero pressure. The pressure record is thus represented by a to-and-fro movement of the carriage *M*, and this motion is recorded by the pen *J*. By comparing the length of the lines made by *J* with the table of constants, which I especially determined for this instrument, we obtain the pressure in pounds per square foot of the wind at any particular time.

Constants.—For velocity, we have the diameter of the cup-cross between centres of 80 cm. Hence pathway of one revolution is 251.33 cm. As the gear wheel *G* has 144 teeth, one revolution of the wheel is equivalent to 362 m. Taking for an approximation that the cup velocity is one-third that of the wind, we obtain the indicated velocity of the wind as 1.086 km. for one revolution of the gear wheel *G*, that is for each electric contact.

Professor Marvin's direct experiments for the relationship between cup and wind velocities with an anemometer whose cups were 4 inches in diameter and arms 13.44 inches, centre to centre of cups, gave the empirical formula:

$$^{*}\log V = .509 + .9012 \log v$$

in which V is the true velocity of the wind, and v the velocity of the cups, the indicated velocity being $3v$. Although the dimensions of the Fuess cup-cross are considerably larger than those of the Marvin anemometer, yet the above formula is fairly applicable to the former, as deduced from comparison of indicated velocities with recorded pressures, the latter having been directly measured, as about to be explained.

Before the anemometer was mounted outside, tests were made on the pressure plate P. A slat was placed centrally over the plate; from it led two horizontal strings which passed over small brass pulleys, and then weights were successively attached to the connected strings. Beginning with zero and increasing by one pound up to twelve pounds, readings were taken of the position of the arm A, as it passed over the various contacts from 0 to 12. Each of the twelve small brass plates on which electric contact is made was subdivided by estimation to tenths when taking the readings of the arm A for the different weights. From a number of careful readings the following mean values were obtained:—

Actual measurements with weights over pulleys, pressing pressure plate.		Interpolated Values.	
Pounds	Readings on Arm.	Readings on Arm.	Pounds.
0	1·62	1·62	0
1	3·20	2·50	·56
2	4·66	3·50	1·21
3	5·95	4·50	1·89
4	7·17	5·50	2·65
5	8·03	6·50	3·45
6	8·74	7·50	4·38
7	9·32	8·50	5·66
8	9·91	9·50	7·30
9	10·42	10·50	9·14
10	10·98	11·50	11·12
11	11·45	12·50	13·68
12	11·88		

It was intended to have the adjustment of the spring S so that the centre of the first small brass plate, which would be equivalent to 1.50 in the above method of reading, should indicate zero pressure, but after adjustment it was found that zero pressure read 1.62, a matter of no consequence. It must be remembered that the pressure plate is $25\frac{1}{2}$ cm. in diameter, giving a surface of 79.16 square inches. Hence, if the wind were blowing against a square foot, in order to produce the same arm reading, which is the record we get on our anemogram, the pounds pressure represented would be $\frac{79.16}{144} = .55$, that shown by the actual pressure plate of $25\frac{1}{2}$ cm. diameter.

* Circular D, Instrument Room, Washington, 1893.

Applying the constant .55 to the last column of the preceding table, we obtain the pressure per square foot when the contact is centrally over the twelve small brass plates, and equivalent to the arm readings of 1.50 (1.62), 2.50 ...... to 12.50. On the anemogram, or pen record, it would be equivalent to scale readings 0 to 66 half-millimetres, there being, as already stated, a movement of the pen of 3 millimetres or 6 divisions of the half-millimetre scale for each successive electric contact.

Interpolating for the pressures thus obtained the indicated velocities, and from the latter the true velocities from the tables given in Marvin's paper, Circular D, referred to above, these latter are reproduced in Moore's 'Descriptive Meteorology,' 1910, as tables XXVII and XXVI respectively, we obtain the following table in which there is an interpolation for the mean between two successive contacts, or for every 3 half-millimetres:—

PRESSURE TABLE.

Glass Scale Reading	Pressure per sq. ft.	Indicated Velocity	True Velocity	Glass Scale Reading	Pressure per sq. ft.	Indicated Velocity	True Velocity
½ mm.	Pounds.	Miles.	Miles.	½ mm.	Pounds.	Miles.	Miles.
0	0	0	0	36	2·41	28·5	24·6
3	·15	6	6	39	2·76	30·7	26·3
6	·31	9	8·7	42	3·11	32·8	27·9
9	·49	11·7	11·0	45	3·56	35·3	29·8
12	·67	14·0	12·9	48	4·01	37·8	31·7
15	·85	16·0	14·6	51	4·52	40·3	33·6
18	1·04	17·9	16·1	54	5·03	42·8	35·4
21	1·25	19·9	17·7	57	5·57	45·3	37·3
24	1·46	21·7	19·2	60	6·12	47·8	39·1
27	1·68	23·4	20·5	63	6·82	50·7	41·3
30	1·90	25·0	21·8	66	7·52	53·5	43·4
33	2·15	26·7	23·2	..	....	....	....

Having constructed this table, a comparison became possible between the deduced true velocity from the formula for log *V*, based upon the actual revolution of the cups, and the deduced true velocity from the actual pressure recorded by the pressure plate. This comparison is not very simple or easy, especially for the higher velocities and pressures, as for these we seldom find them here continuous for any length of time, say an hour or hours. For such, it is necessary to take measurements for shorter intervals, for one or several revolutions of the velocity gear wheel *G*, as recorded on the time scale, and compare this with the offset on the pressure record opposite to it. For instance, on Oct. 1 there was a pretty high wind for some hours, fluctuating, however. Between 2 and 3 p.m. the maximum was reached, when, during an interval of about 4 minutes, the measurements for velocity gave an indicated velocity of 39 miles, while the measurement for pressure, 4.01 pounds to the square foot, gave an indicated velocity of 38 miles, a fair inter-agreement. Again, on that same day, the pressure for several hours kept pretty constant at .67 pounds, indicating by the above table a velocity of 14 miles, while the average velocity for that time was 16.5 miles, an agreement not so accordant as the preceding one. Reducing those indicated velocities to true velocities would not change the comparison of the two independently determined quantities.

The instrument has worked satisfactorily except on one or two occasions when glare ice (the freezing of rain in mild winter weather) prevented the free action of the pressure plate. A change has been effected in the bearing of the anemometer rod, which rested in a steel cup. This latter serves now only as a guide, the weight being borne at a shoulder at the upper part of the rod on a ball-bearing.

It may be observed here that the standardizing of the large anemometers of the Imperial Meteorological Observatory at Potsdam, Germany, is done by means of a small anemometer which has been standardized at the Deutsche Seewarte, Hamburg, in the usual manner by mounting it on the extremity of a long arm which can be revolved at any given speed. The revolutions of both arm and anemometer are electrically recorded. The small anemometer is then set up in the proximity of the large one to be standardized, and from the records of both the constants of the latter are determined.

Earthquakes.

During the fiscal year there were recorded here 89 earthquakes of various degrees of intensity, as shown on the subjoined record. The most destructive, as far as human lives are concerned, were the earthquake at Cartago, in Costa Rica, on May 5, 1910, and the one of January 3-4, 1911, in Turkestan, Asiatic Russia, where many lives were lost. The distance to the epicentre of the former was 4,000 km. (2,500 miles), and to the latter, 9,800 km. (6,100 miles). It may be opportune here to refer to the method of the determination of the distance to an epicentre of a well-recorded quake, and a severe quake may be well recorded even if situate on the opposite side of the earth, but in such case the seat of disturbance must not be shallow, as was the case in the Massina destructive quake, but it must be deep-seated, say extending beyond 50 km. beneath the surface of the earth, so that it may obtain a thorough grip, so to speak, to give the earth a world-shaking.

The routine of a seismogram here is as follows:—Every morning at 10 a.m. a fresh photographic sheet is put upon the cylinder, the exposed one taken to the photographic room, developed and brought to my room, where it is examined. If an earthquake is recorded the diagram is analyzed into its constituent parts or phases. It is always gratifying if, during the quake, microseisms are absent. These are small pulsations of about 5 seconds period and are due to steep barometric gradients over the ocean, producing winds and consequent waves beating on the shores, setting up vibrations of the land, particularly if the surf pounds on and against rocky shores. On sand dunes it is less effective. We first look for the beginning of the quake, or first preliminary tremors, as is the technical term. As our seismograph (there are two) is a horizontal pendulum, and consequently records horizontal displacements of the motion of the ground, it is obvious that the more distant the quake the less effective will be the horizontal component of the longitudinal or compressional wave first arriving from the epicentre, the horizontal component disappearing completely at the antipodal point to the earthquake, where only the vertical component would be in evidence for that kind of wave, which is the one travelling with the greatest speed.

We minutely follow our zero line, which, in the absence of a disturbance, is a straight line, broken electrically by a short two-second interval every minute by our standard mean-time clock, and note the first deviation of the zero line, at times barely visible, although the motion is theoretically magnified 120 times. We measure along the respective minute, represented by 15 mm., the time of arrival of the first preliminary tremors, designated by P, and record it to the individual second. Generally the first indication of the arrival of a wave is followed within a second or so by a well-marked impulse or offset to the zero line.

We are next concerned with the finding of the second preliminary tremors S, produced by waves having transverse oscillations, like those of light,—distortional waves. The horizontal components of these, for distant quakes, are generally better marked or recorded than those of the preceding or longitudinal waves, waves like those of sound. Having thus identified the arrival of these *S* waves, we have the data for determining the distance to the epicentre. However, we look for corroborative evidence, and continue our analysis of the seismogram. As explained in former reports, seismologists recognize in the energy of earthquakes three distinct forms of waves—the longitudinal wave, producing compression and dilatation; the transverse wave, producing distortion; and the surface wave. The first two travel through the earth, from the epicentre to any point on the surface, along the 'brachistochronic' line or curve, being the shortest time-line between the points, and is concave to the straight line joining the points, the curvature being dependent upon the constants of the material within the earth along its path, while the last travels along the surface.

As might be surmised, the velocity of the first two, as they dip into the earth to various depths with changing constants within certain limits, is variable, while for the surface waves the velocity is fairly constant, as established from our own records here of various quakes, and of the same quake using the records of widely separate stations.

Wiechert and Zöppritz compiled, a few years ago, the data of severe quakes whose geographical co-ordinates were well known, as well as the local time of occurrence. From these time-curves, improperly called by some, hodographs, were constructed the abscissae representing distance and the ordinates, time. From these, then, having $S-P$ from a seismogram, or the difference in arrival of the second and first preliminary tremors, the corresponding distance to produce the difference in time is found. Professor Zeissig has interpolated the distances to 10 km. intervals and published a table for $S-P$ to 12m. 56s. corresponding to a distance of 13,000 km. Although there is some room for improvement in the table, as the compilers well recognize, yet when the distances are not too great, say 7,000 km., the deduced distances for $S-P$ are in pretty good accord, say within about 50 km., with the actual distances obtained later from accounts of the earthquake in situ.

Having now obtained the distance, Δ, we look for corroboration. From our time-curve we have the time of propagation of either the first or second preliminary for that distance, *i. e.*, we find the time of local occurrence of the quake. Knowing the rate of propagation of the surface waves, which is approximately 200 km. per minute, we have immediately the time when they should make their appearance on the seismogram, and this we compare with what we actually find to corroborate our $S-P$ distance. Again, it is found that the longitudinal waves record themselves after having been once or even twice reflected. That is to say, such waves, striking midway between the epicentre and the respective recording station, are reflected, pursuing a similar course to their preceding one, and emerge at the station in a time equal to twice the time of propagation for half the distance Δ corresponding to $S-P$. The horizontal component of this reflected wave, if there has not been too much absorption owing to the longer course or path, often manifests itself more sharply owing to the smaller angle of emergence, calling the latter the angle made by the impulse with the surface of the earth, the horizontal component being a function of the cosine of this angle. Thus the comparison of the computed time of arrival of this reflected wave, $P R_1$, with the actually recorded time is another means of checking our original deduced Δ from $S-P$. We may proceed similarly for $P R_2$ for a wave twice reflected, that is, for a wave that divides the distance into three equal paths. This wave is, however, less often clearly definable. We may in some cases be able to identify reflected *S* waves. By the time the *S* waves arrive there begins a medley of interferences that are not really distinguishable. By the time the surface, or long waves L, arrive, the field is generally pretty clear, the P and S waves having spent themselves. Unfortunately, the earthquake waves and pulsations do not accommodate themselves for ease of reading and interpretation of the seismogram. Probably in the less number of cases is the break-down or cataclysm one single effort, but a series of shocks sending out their waves, producing thereby a rather complicated record that taxes one's skill to the utmost in deciphering it.

The most important record is, of course, the accuracy of the time of arrival of the first waves. From the nature of our instrument, having photographic registration, and therefore free from the friction inherent to mechanical registration, so much in vogue on account of cheapness, we have been able to detect movements of the earth so slight that mechanical registration would not respond to them.

We have now shown how the distance, Δ, of an earthquake is found from a single seismogram. For earthquakes that occur in inhabited regions we can subsequently compare our deduced distance with the actual one. This gives a measure, on the one hand, of the accuracy of our reading of the seismogram, and on the other, of the accuracy of the above time-curves.

With world-shaking quakes we obtain sometimes a record of long waves that have travelled along the longer part of the great circle passing through the epicentre and station. In such case the maximum amplitudes of the waves by the shorter and longer paths give us a measure of the absorption. By absorption, we understand the absorption of energy per unit distance, per kilometre. Assuming that the periods of the two sets of waves are the same, for our amplitude depends on the magnification of the instrument, and the magnification in turn on the period of the wave and on the damping co-efficient, we may write the general expression for absorption in the form

$$E_\Delta = E_o e^{-k\Delta}$$

in which E_o = original energy.

E_Δ = energy at distance Δ from epicentre.

e = base of Naperian logarithms.

and k = co-efficient of absorption.

Hence the ratio of the energy at distance Δ to that at $40000-\Delta$, would be as $e^{-k\Delta}$ to $e^{-k(40000-\Delta)}$ or as 1 to $e^{-k(40000-2\Delta)}$.

The manifestation of the energy we have expressed in our seismogram by the maximum amplitude. The energy at different distances varies as the square of the amplitudes, hence we have

$$\left(\frac{a_{40000-2\Delta}}{a_\Delta}\right)^2 = e^{-k(40000-2\Delta)}$$

and, therefore,

$$k = \frac{2\cdot30}{40000-2\Delta}\, 2 \log \left(\frac{a_\Delta}{a_{40000-\Delta}}\right)$$

where 2.30 is the reciprocal of log e.

The distance, 40000—2Δ, is represented by the time interval between the M_K, M waves, that is, the times of arrival over the distances 40000—Δ, and over Δ. If we multiply this time interval by the rate of propagation or velocity, which we assume to be uniform, we obtain the desired distance. We may take the average velocity of surface waves to be 200 km. per minute. Hence, if we express $M_R - M$ in minutes, our formula becomes

$$k = \frac{\cdot 023}{M_R - M} \log \left(\frac{a}{a_R}\right).$$

In general, the former expression for k is preferable, as we eliminate $M_R - M$, also the assumed velocity of the L waves to which M belongs.

It is found that for a_R its value does not vary appreciably within a fairly wide range of the time M_R, and furthermore, that its actual measure on the seismogram is small, very small, and difficult to express with much accuracy, the error of reading being large compared with the quantity to measure. However, admitting these uncertainties, yet it is found by different investigators, and from the records of different earthquakes, that the co-efficient of absorption appears to lie between .00015 and .00035.

Taking the seismogram here of the recent severe earthquake, January 3-4, 1911, in Turkestan, where we had a record of the M and M_R waves, the value of k is found to be .00032.

Having dealt with the interpretation of the seismogram, as far as Δ and k are concerned, we shall turn to the location of an earthquake, *i.e.*, of its epicentre. In my previous report it was shown how such location may be effected graphically by means of the stereographic projection; our data being the values of Δ for three stations, not too close together, and the geographical co-ordinates of the latter. This method has proved very satisfactory, and, for accuracy, quite in keeping with the accuracy of Δ. It goes without saying that careful plotting or drawing is essential for obtaining satisfactory results.

Instead of computing for every world-shaking earthquake the necessary values of d and r, required in our stereographic projection, the following tables* were computed, so that by simple inspection or interpolation for any distance Δ up to 13,000 km. the corresponding values of d and r are obtained. It will be remembered that d represents the distance from the Pole along the respective meridian line to the centre of the circle or arc, radius r, on which the epicentre lies. The values of d and r are computed from

$$d = \frac{\cos \varphi}{\sin \varphi + \cos \Delta}, \quad r = \frac{\sin \Delta}{\sin \varphi + \cos \Delta}.$$

We may give an example of the application of the above tables for locating an epicentre, taking the Turkestan earthquake already referred to. As stations, we take Strassburg, Pulkowa and Ottawa, using their published time records of P and S for obtaining Δ, Zeissig's tables. We thus have the following data:—

Strassburg $\varphi = 48°35'$, $\lambda = 7°40'E$, $\Delta = 5300$ km. $= 47°42'$
Pulkowa $\varphi = 59°46'$, $\lambda = 30°20'E$, $\Delta = 3690$ km. $= 33°13'$
Ottawa $\varphi = 45°24'$, $\lambda = 75°43'W$, $\Delta = 9800$ km. $= 88°12'$

Interpolating from our above table we get for

Strassburg $d = 4.65$, $r = 5.20$
Pulkowa $d = 2.95$, $r = 3.16$
Ottawa $d = 9.45$, $r = 13.45$

in terms of radius = 10 cm.

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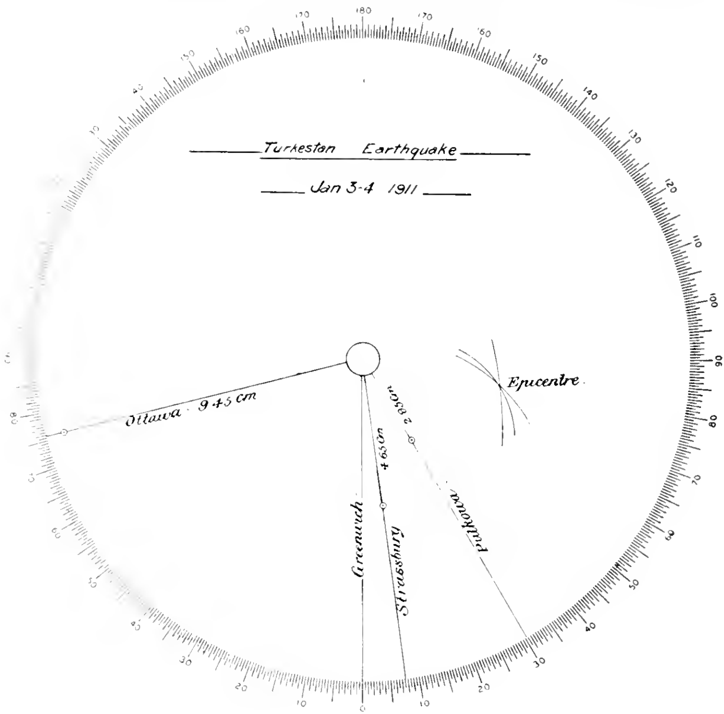
* These tables will appear in the Publications of the Dominion Observatory as Vol I, No. 1.

In the accompanying figure we have the primitive circle on which the projection is made of 10 cm. radius. We proceed to draw the meridian lines for each station, being simply the longitude from Greenwich, or zero meridian. d is laid off from the Pole along the respective meridian, and gives the centre of the circle of which r is the radius. Laying off the three d's and describing the three arcs we find them to intersect, if not at a mathematical point, yet very close to each other.



Theoretically if the earthquake emanated from a point, and our Δ's were absolutely correct, then the intersection with careful drawing would practically represent a point for the epicentre. As a matter of fact, however, the earthquake or break-down is not a point, but more properly a plane, so that we can scarcely expect our intersections to have a common point, but instead to form a minute triangle, of which we take the centre of gravity as the most probable point of the greatest intensity of the seismic disturbance.

From the distance of the Pole to this point in our construction we obtain the latitude of the epicentre, for this distance is equal to tan $(45° - \frac{1}{2}\varphi_0)$, where φ_0 is the latitude of the epicentre. The longitude is read directly on our circle, simply by drawing the meridian line from the Pole through the point or epicentre. In our diagram, the distance from the Pole is 4.28 cm., representing the tangent of 23°10′, hence $\varphi_0 = 43°40'$, and the longitude we find to be 78° 20′*E*. The epicentre of this quake has thus been found to be in

$$\varphi = 43°\,40', \quad \lambda = 78°\,20'E.$$

Prince Galitzin found, by his method, the geographical co-ordinates to be $\varphi = 43°14'$, $\lambda = 78°\,24'$, a very close agreement.

The epicentre has thus been found in a simple and expeditious manner, and with an accuracy quite in keeping with our data.

With a larger scale, say of 20 cm. for radius of our circle, we can attain somewhat greater accuracy. However, I find that with careful plotting that the 10 cm. radius serves the purpose quite well. To force the accuracy of our result within a few kilometres when our data lack such, is like cracking walnuts with a sledge-hammer. With the present conditions, I think we are doing pretty well if we feel fairly sure of our half degree in the location of our epicentre. As the absolute time at some, perhaps many, stations is not very accurately known, thereby affecting the time record, it will be noted that in the above method the absolute time does not enter, but only the time difference $S-P$, in short, the method is independent of the time correction. However, for other reasons, it is highly desirable that all stations have their time accurate within a second.

From our stereographic projection we may also deduce the azimuth of the epicentre. The azimuth is the angle at the station between the meridian and the tangent to the great circle passing through the station and epicentre. For describing this circle we have three points, the station, its nadir, and the epicentre. The station is projected on the meridian line at the distance of tan $(45° - \frac{1}{2}\varphi)$, and the nadir at, and in the opposite direction, of cot $(45° - \frac{1}{2}\varphi)$. We have thus three points cut by the circle. The three points form a triangle in the circle, and the angle at the epicentre, from simple geometrical relations, is equal to $180° - A$, where A is the required azimuth.

In the figure, the points for tan and cot $(45° - \frac{1}{2}\varphi)$ for the three stations, and the connecting lines to the epicentre, are not drawn, to avoid confusion.

In the original drawing we find graphically for Ottawa $A = 18°$, and solving trigonometrically the spherical triangle, Pole—station—epicentre, we obtain $A = 18°\,27'$. Similarly, for Strassburg we find graphically $A = 111°\,30'$, computed, $A = 112°05'$; and for Pulkowa graphically $A = 97°45'$, computed, $A = 97°\,28'$. Prince Galitzin obtains the mean, from the maximum amplitudes at the beginning of the first preliminary tremors, $A = 97°57'$.

The above azimuths are reckoned from north through east.

In some other methods the azimuth enters into the determination of the epicentre, which is not the case in the method described. It will now be shown briefly how the stereographic projection adapts itself also for plotting with azimuth and distance. We have given Δ and A. On the meridian line of any station we have three known points, their distances from the Pole being respectively

$$\frac{\cos\varphi}{\sin\varphi + \cos\Delta}, \ \tan\,(45° - \tfrac{1}{2}\varphi), \text{ and } \cot\,(45° - \tfrac{1}{2}\varphi),$$

as already explained; furthermore, the angle A at the station, which gives the tangent to the circle through the station and its nadir. Hence the circle can be described having given a chord (station to its nadir) and tangent.

Finally we draw an arc with radius $r = \frac{\sin \Delta}{\sin \varphi + \cos \Delta}$ at the distance d from the centre.

Where this arc cuts the above circle is the epicentre, whose geographical co-ordinates are then determined, as already described.

The stereographic projection for the location of the epicentre of a world-shaking earthquake has already been adopted by quite a number of stations on account of its simplicity.

Microseisms.

These pulsations that are world wide, and are recorded by modern instruments at every earthquake station, have been dealt with somewhat fully in former reports. Although their complete analysis has not yet been effected by any one, yet their cause, with the additional data as obtained here, is, as was deduced from previous years' records, due to the presence of a barometric 'Low' with steep gradients on the ocean near the coast, thereby setting up winds, followed by waves beating on the rocky shores of Eastern Canada and the New England States. If these shores were sandy beaches or lined with sand dunes throughout, the effect of the waves or surf would be materially lessened in producing these microseisms. The period of these pulsations does not vary very much, lying generally between 4 and 6 seconds. The steeper the gradients of the 'Low' the greater will be the amplitudes of the oscillations shown on the seismogram, while the period generally increases somewhat, but not by any means in the proportion of the amplitudes. Whether the periods synchronize exactly with the surf has not yet been established. The writer has on several occasions, during stormy weather on a trip across the Atlantic, counted the period of the waves as manifested by the pitching and dipping of the steamer, and found the period to be 8, 9, or 10 to the minute, *i. e.*, 6 to 7½ seconds.

At the meeting of the International Seismological Association at Zermatt, in September, 1909, a special committee on microseisms was constituted, of which the writer is a member, to have an instrument designed, constructed and mounted at the sea-shore for counting the waves, that is, of determining their period, so that the relationship between the latter and microseisms may be studied. The instrument is now in course of construction by the Cambridge Scientific Instrument Company, so that results may be looked forward to during the present year. One thing has been definitely established here, and that is, that microseisms have their origin on the ocean. One cannot but marvel that at a station hundreds of miles from the nearest sea-shore, as Ottawa is, the earth should be set in vibration, and such vibration be recorded, in consequence of an agitated sea.

In the accompanying Fig. 8, the prevalence of microseisms during the year 1910 is graphically shown. The daily record has been grouped by five days. The mean of the maximum amplitudes for every five days has been taken, or six groups for each month, and plotted as ordinate. A smooth curve was then drawn between the points so plotted.

It will be observed that the microseisms become very marked in October and continue so with some variation till the end of March, corresponding to more or less boisterous weather on the North Atlantic. February shows the most sustained large amplitude of microseisms. July and August are almost quiescent, which, too, agrees with the long barometric gradients in the gulf of St. Lawrence and adjoining Atlantic.

The effective beating of the surf, due to steep gradients, is undoubtedly affected by the direction of the wind, *i. e.*, blowing on-shore or off-shore. This differentiation of direction has not yet been carried out in the analysis of microseisms.

Microseisms, especially if of much amplitude, are a very disturbing element in reading the first phase of an earthquake record, more particularly of a distant one, for which the horizontal component is always weak, and at best sometimes difficult to read.

For the identification of the various phases and as an aid for the reading of seismograms, the following table, being re-arranged from the one of Dr. V. Conrad*, of time intervals between phases, as indicated at the head of each column, is given.

PHASE TABLE.

Distance	$S-P$	PR_1-P	PR_2-P	PR_3-P	SR_1-S	SR_2-S	SR_3-S	$eL-P$
km.	s.	s.	s.	s.	s.	s.	s.	min.
1000	108	..	..	..	..	..	..	1·9
1100	118	..	..	..	..	..	..	2·1
1200	128	..	..	..	..	..	..	2·3
1300	137	..	..	..	..	..	..	2·5
1400	147	..	..	..	..	..	..	2·7
1500	157	..	..	..	..	..	..	2·9
1600	166	..	..	..	..	..	..	3·1
1700	175	..	..	..	..	..	..	3·4
1800	185	..	..	..	..	..	..	3·6
1900	194	..	..	..	..	..	..	3·8
2000	203	15	18	19	28	34	36	4·0
2100	211	17	21	22	32	39	42	4·3
2200	220	19	24	25	35	44	48	4·5
2300	228	21	27	28	39	48	54	4·8
2400	237	23	30	31	42	53	60	5·0
2500	245	25	33	34	46	58	66	5·3
2600	253	28	36	37	51	65	73	5·5
2700	260	31	40	41	56	71	81	5·8
2800	268	34	43	44	61	78	88	6·0
2900	275	37	47	48	66	84	96	6·3
3000	283	40	50	51	71	91	103	6·5
3100	290	43	55	56	77	99	111	6·8
3200	297	46	59	61	83	107	119	7·1
3300	303	49	64	66	89	114	128	7·3
3400	310	52	68	71	95	122	136	7·6
3500	317	55	73	76	101	130	144	7·9
3600	323	58	77	81	107	138	153	8·2
3700	329	62	82	86	113	146	161	8·4
3800	335	65	86	92	119	153	170	8·7
3900	341	69	91	97	125	161	178	9·0
4000	347	72	95	102	131	169	187	9·3
4100	353	76	100	107	137	178	197	9·6
4200	359	80	105	113	144	187	207	9·9
4300	364	84	109	118	150	196	216	10·2
4400	370	88	114	124	157	205	226	10·5
4500	376	92	119	129	163	214	236	10·8
4600	381	95	124	135	170	223	247	11·1
4700	386	98	129	141	177	233	258	11·4
4800	391	102	133	146	183	242	269	11·7
4900	396	105	138	152	190	252	280	12·0
5000	401	108	143	158	197	261	291	12·3

* "Seismische Registrierungen in Wien." K. Akad. d. Wissen. Neue Folge No. 39.

PHASE TABLE (*Continued*).

Distance	$S-P$	PR_1-P	PR_2-P	PR_3-P	SR_1-S	SR_2-S	SR_3-S	$eL-P$
km.	s.	s.	s.	s.	s.	s.	s.	min.
5100	407	112	149	164	203	270	302	12·6
5200	412	116	155	171	209	280	313	12·9
5300	418	119	160	177	214	289	324	13·3
5400	423	123	166	184	220	299	335	13·6
5500	429	127	172	190	226	308	346	13·9
5600	434	130	177	197	232	317	356	14·2
5700	440	134	183	204	237	326	366	14·5
5800	445	137	188	210	243	334	376	14·8
5900	451	141	194	217	248	343	386	15·1
6000	456	144	199	221	254	352	396	15·5
6100	461	147	204	230	259	360	407	15·8
6200	467	150	209	236	263	368	417	16·1
6300	472	153	215	242	268	377	428	16·5
6400	478	156	220	248	272	385	438	16·8
6500	483	159	225	254	277	393	449	17·1
6600	488	162	230	260	281	401	459	17·4
6700	493	165	235	266	285	408	468	17·7
6800	499	167	240	271	290	416	478	18·0
6900	504	170	245	277	294	423	487	18·3
7000	509	173	250	283	298	431	497	18·6
7100	514	175	254	289	301	439	507	18·9
7200	519	177	258	294	305	447	517	19·3
7300	524	179	262	300	308	455	527	19·6
7400	529	181	266	305	312	463	537	20·0
7500	534	183	270	311	315	471	547	20·3
7600	539	186	274	317	318	478	556	20·6
7700	545	188	279	323,	321	484	565	20·9
7800	550	191	283	328	323	491	573	21·3
7900	556	193	288	334	326	497	582	21·6
8000	561	196	292	340	329	504	591	21·9
8100	566	198	296	346	332	511	600	22·2
8200	571	199	300	351	334	518	610	22·5
8300	575	201	303	357	337	525	619	22·9
8400	580	202	307	362	339	532	629	23·2
8500	585	204	311	368	342	539	638	23·5
8600	590	206	315	373	344	545	647	23·8
8700	595	208	319	379	347	551	656	24·1
8800	600	209	323	381	349	557	664	24·5
8900	606	211	327	390	352	563	673	24·8
9000	611	213	331	395	354	569	682	25·1
9100	616	215	335	400	356	575	691	25·4
9200	621	217	338	405	358	581	699	25·8
9300	625	220	342	411	361	587	708	26·1
9400	630	222	345	416	363	593	716	26·5
9500	635	224	349	421	365	599	725	26·8
9600	640	225	353	426	367	605	733	27·1
9700	644	226	357	431	368	611	742	27·4
9800	649	227	362	435	370	617	750	27·8
9900	653	228	366	440	371	623	759	28·1
10000	658	229	370	445	373	629	767	28·4
10100	662	230	373	451	376	635	776	28·7
10200	667	230	376	456	379	640	784	29·1
10300	671	231	380	462	381	646	793	29·4
10400	676	231	383	467	381	651	801	29·8
10500	680	232	386	473	387	657	810	30·1
10600	684	234	390	478	389	662	819	30·4
10700	688	235	394	483	391	668	827	30·8
10800	693	237	397	488	393	673	836	31·1

PHASE TABLE (*Concluded*).

Distance	$S-P$	PR_1-P	PR_2-P	PR_3-P	SR_1-S	SR_2-S	SR_3-S	$eL-P$
km.	s.	s.	s.	s.	s.	s.	s.	min.
10900	697	238	401	493	395	679	844	31·5
11000	701	240	405	498	397	684	853	31·8
11100	705	241	409	503	400	689	859	32·1
11200	709	242	412	507	403	695	865	32·5
11300	713	243	416	512	405	700	872	32·8
11400	717	244	419	516	408	706	878	33·2
11500	721	245	423	521	411	711	884	33·5
11600	725	247	426	526	414	716	894	33·8
11700	729	249	429	530	417	722	904	34·2
11800	733	252	432	535	421	727	915	34·5
11900	737	254	435	539	424	733	925	34·9
12000	741	256	438	544	427	738	935	35·2
12100	745	257	442	549	430	744	944	35·5
12200	748	259	445	555	434	750	952	35·9
12300	752	260	449	560	437	755	961	36·2
12400	755	262	452	566	441	761	969	36·6
12500	759	263	456	571	444	767	978	36·9
12600	762	265	459	576	448	773	986	37·3
12700	766	267	462	581	452	778	994	37·6
12800	769	269	466	585	455	784	1001	38·0
12900	773	271	469	590	459	789	1009	38·3
13000	776	273	472	595	463	795	1017	38·7

The following table gives the times of transmission along the respective paths of the longitudinal (P), and transverse (S) waves (first and second preliminary tremors) from the earthquake centre to points on the surface of the earth, distant the respective number of kilometres (every 100 km.), measured on the surface, from the epicentre. The original table or curve by Zöppritz gives the values for every 500 km. The intermediate values have been interpolated.

TRANSMISSION TIMES OF P AND S WAVES.

Distance	P	S	Distance.	P	S	Distance.	P	S
km.	s.	s.	km.	s.	s.	km.	s.	s.
100	14	25	1700	222	398	3300	384	688
200	28	50	1800	234	418	3400	393	703
300	41	74	1900	245	439	3500	402	719
400	55	99	2000	257	460	3600	410	733
500	69	124	2100	268	479	3700	418	747
600	82	148	2200	278	498	3800	426	761
700	96	172	2300	289	517	3900	434	775
800	109	196	2400	299	536	4000	442	789
900	123	220	2500	310	555	4100	449	802
1000	136	244	2600	320	572	4200	456	815
1100	149	266	2700	329	589	4300	464	828
1200	161	289	2800	339	607	4400	471	841
1300	174	311	2900	348	624	4500	478	854
1400	186	334	3000	358	641	4600	485	866
1500	199	356	3100	367	657	4700	492	878
1600	211	377	3200	376	672	4800	498	889

Transmission Times of *P* and *S* Waves.—*Concluded.*

Distance.	*P*	*S*	Distance.	*P*	*S*	Distance.	*P*	*S*
km.	s.	s.	km.	s.	s.	km.	s.	s.
4900	505	901	7700	671	1216	10400	815	1491
5000	512	913	7800	677	1227	10500	820	1500
5100	518	925	7900	682	1238	10600	825	1509
5200	524	936	8000	688	1249	10700	830	1518
5300	530	948	8100	694	1259	10800	834	1527
5400	536	959	8200	699	1270	10900	839	1536
5500	542	971	8300	705	1280	11000	844	1545
5600	548	982	8400	710	1291	11100	849	1554
5700	554	994	8500	716	1301	11200	853	1562
5800	560	1005	8600	721	1312	11300	858	1571
5900	566	1017	8700	727	1322	11400	862	1579
6000	572	1028	8800	732	1333	11500	867	1588
6100	578	1039	8900	738	1343	11600	871	1596
6200	584	1050	9000	743	1354	11700	875	1604
6300	589	1062	9100	748	1364	11800	880	1613
6400	595	1073	9200	753	1374	11900	881	1621
6500	601	1084	9300	759	1384	12000	888	1629
6600	607	1095	9400	764	1394	12100	892	1637
6700	613	1106	9500	769	1404	12200	896	1645
6800	619	1118	9600	774	1414	12300	901	1652
6900	625	1129	9700	779	1424	12400	905	1660
7000	631	1140	9800	785	1433	12500	909	1668
7100	637	1151	9900	790	1443	12600	913	1675
7200	643	1162	10000	795	1453	12700	917	1683
7300	648	1172	10100	800	1462	12800	921	1690
7400	654	1183	10200	805	1472	12900	925	1698
7500	660	1194	10300	810	1481	13000	929	1705
7600	666	1205						

This table is useful for finding the time of occurrence of the quake at the epicentre, and thereby one is enabled to check the times of arrival of the *P* and *S* waves at different stations. When making comparisons of the different records for a given quake one is almost sure to find discordances in the times given for the phases, particularly for the first, or *P* phase.

It happens, not infrequently, that for a distant quake the *P* waves fail to record at all, the horizontal component of the impulse being so small, and that, instead, the *S* waves are read for *P* waves. In such a case the above table helps to show up such erroneous readings.

Frequently, in dealing with the determination of the epicentre of an earthquake, we have before us a collection of records far from harmonious; on the contrary, the records are conflicting, and, like a case before a judge, the evidence of each witness has to be carefully weighed, circumstantial evidence must be taken into account, so that the verdict may harmonize, as well as possible, with the nature of the evidence submitted.

A great drawback in the location of earthquakes in uninhabited parts, or in the ocean, is the very unsymmetrical distribution of earthquake stations, reliable ones, around the earth.

The determination of an epicentre is generally in the nature of a triangulation, graphically or mathematically, for which purpose it is obvious that our triangles should be 'well-conditioned' for reliable results.

When we are obliged to use the data of stations that are close together, we do not have the conditions necessary for getting satisfactory results. For such stations, an inaccuracy of some seconds in the reading of a seismogram, when combined with those of nearby stations, may give widely different geographical co-ordinates for the epicentre.

Although Japan has many earthquake stations for studying the seismic condition of the country, it is to be regretted that Japan does not publish weekly or monthly bulletins, as so many other stations do, of the earthquakes recorded elsewhere. It would be so helpful in their location.

The following table, computed for radius 6,367 km., gives the chord and middle ordinate for successive values of the arc from 1,000 to 20,000 km., or 9° to 180°.

Arc.		Chord.	Middle Ordinate.	Arc.		Chord.	Middle Ordinate
1000 km.	Angular.			1000 km.	Angular.		
		km.	km.			km.	km.
1	9° 00′	999	20	11	99° 00′	9683	2232
1·5	13° 30′	1497	44	11·5	103° 30′	10000	2425
2	18° 00′	1992	78	12	108° 00′	10302	2625
2·5	22° 30′	2484	122	12·5	112° 30′	10588	2830
3	27° 00′	2973	176	13	117° 00′	10858	3040
3·5	31° 30′	3456	239	13·5	121° 30′	11110	3256
4	36° 00′	3935	312	14	126° 00′	11346	3477
4·5	40° 30′	4407	394	14·5	130° 30′	11564	3702
5	45° 00′	4873	485	15	135° 00′	11765	3930
5·5	49° 30′	5331	585	15·5	139° 30′	11947	4163
6	54° 00′	5781	694	16	144° 00′	12111	4400
6·5	58° 30′	6222	812	16·5	148° 30′	12256	4639
7	63° 00′	6654	938	17	153° 00′	12382	4881
7·5	67° 30′	7074	1073	17·5	157° 30′	12489	5125
8	72° 00′	7485	1216	18	162° 00′	12577	5371
8·5	76° 30′	7884	1367	18·5	166° 30′	12646	5619
9	81° 00′	8270	1525	19	171° 00′	12695	5867
9·5	85° 30′	8644	1692	19·5	175° 30′	12724	6117
10	90° 00′	9004	1865	20	180° 00′	12734	6367
10·5	94° 30′	9351	2045				

Record of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada. Latitude 45° 23′ 38″, Longitude 75° 42′ 57″ or 5h 02m 51s.8 W. Greenwich. Time: Mean Greenwich, midnight to midnight. Instruments: Two Bosch photographic horizontal pendulums. Nomenclature: Göttinger.

No.	Date	Char.	Phase	Time	Period	Amplitude A_E	Amplitude A_N	Remarks
	1910.			h. m. s.	s.	μ	μ	
1	Apl. 3	I	eL	19-35-5	14	.....	.....	
			F	19-57	.....	.....	.....	
2	Apl. 11	I	eL	8-17	.....	.....	.....	Earthquake reported from California.
3	Apl. 12	II_u	eP?	0-35-20	.....	.....	.....	
			e	0-40-50	.....	.....	.....	
			iPR_2	0-41-31	.....	.....	.....	Epicentre 11,000 km.
			iS	0-46-44	4	.....	.....	
			M	0-46-50	.....	12	18	
			PS_E	0-48-07	.....	.....	.....	
			eL?	0-50-15	.....	.....	.....	
			eL_N	1-03-36	14	.....	.....	
			eL_E	1-06-20	.....	.....	.....	
			L_E	1-10	20	.....	.....	
			F	2-0	.....	.....	.....	
4	Apl. 13	I	e	6-50-48	.....	.....	.....	
			eL	7-02	14	.....	.....	
			F	7-38	.....	.....	.....	
5	Apl. 27	I	eS_E?	1-38-49	.....	2	.....	N component very weak.
			eL	1-47	17	.....	.....	
			F	2-10	.....	.....	.....	
6	May 1	I_u	e	19-01	.....	.....	.....	
			eL_E	19-32 to 19-37	24	3	.....	
			L_E	19-43 to 19-51	17	3	.....	
			F	20-25	.....	.....	.....	

RECORD of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada, etc.—*Continued.*

No.	Date.	Char.	Phase.	Time.	Period	Amplitude.		REMARKS.
						A_E	A_N	
	1910.			h. m. s.	s.	μ	μ	
7	May 5	*I*	P_N?	0-34-50	3	......	......	Distance, 4000 km. Earthquake reported Cartago, Costa Rica.
			PR_1?	0·36-07	....	......	......	
			S_E	0-40-35	4	......	......	
			L_E	0-45·5	....	......	......	
			L	46 to 50	20	......	......	
			M_E	0-49	....	4	......	
			M_N	0-51	....	......	2	
			F	1-20	....	......	......	
8	May 11	*I*	P_N	7-31-39	2	......	......	
			PR_1	7-32-23	2·3	......	......	Distance, 3000 km. (San Domingo)?
			S_E	7-36·5	....	......	......	
			L_E	7-40	20	1	......	
			F	8-03	....	......	......	
9	May 12	*I*	P_N	9-11-03	2·5	......	......	Distance, 2500 km.
			S_E	9-15-06	....	......	......	No *L* recognizable.
			e_E	9-18-40	....	......	......	
			e_{EN}	9-20-06	....	......	......	
			e_{EN}	9-20-08	....	......	......	
			M_E	9-28	....	5	......	
			F	9-45	....	......	......	
10	May 13	*II*	*P*	8-07-20	....	......	......	
			S	8-14-36	....	......	......	Distance, 5600 km.
			L	8-21-16	8	......	......	
			L	8-25	14	......	......	
			M	8-32	....	12	7	
			L	8-43	12	......	......	
			L	8-53	11	......	......	

RECORD of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada, etc.—*Continued.*

No.	Date.	Char.	Phase.	Time.	Period	Amplitude. A_E	Amplitude. A_N	REMARKS.
	1910.			h. m. s.	s.	μ	μ	
	May 13	*II*	*F*	10-27	......	......	......	
11	May 15	*I*	P_N?	16-04-20	3	......	......	Sheet changed between 15-50 and 15-54
			eL_E?	16-07	8	......	......	
			F	16-20	......	......	......	
12	May 20	*I*	*P*	12-12-18	......	......	......	
			S	12-17-10	......	......	......	
			L	12-20-20	16	......	......	Distance, 3200 km.
			L	12-22	36	......	......	
			L	12-24	20	......	......	
			M	12-26·5	15	10	......	
			L	12-32	......	......	......	
			F	12-55	......	......	......	
13	May 22	I_u	*P*	6-36-28	......	......	......	Distance, 9600 km.
			PR_1	6-39-33	......	......	......	
			S	6-47-13	......	......	......	No distinct maximum.
			L	6-57	......	......	......	
			L_E	7-07	36	......	......	
			L_E	7-15	19	......	......	
			L_{NE}	7-22	16	......	......	
			F	8-00	......	......	......	
14	May 31	*II*	*P*	5-02-22	......	......	......	
			M	5-02-38	......	25	9	Distance, 4000 km.
			PR_1	5-03-51	......	......	......	
			S	5-08-00	......	......	......	
			SR_1	5-08-30	......	......	......	
			L	5-15-20	......	......	......	
			L	5-21	16	......	......	

RECORD of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada, etc.—*Continued.*

No.	Date.	Char.	Phase.	Time.	Period	Amplitude.		Remarks.
						A_E	A_N	
	1910.			h. m. s.	s.	μ	μ	
	May 31	*II*	*F*	6-20	......	......	......	
15	June 1	I_u	*e?*	6-16-07	......	......	......	
			e?	6-21-37	......	......	......	
			eL	6-33·5	......	......	......	No record on N-S component.
			Nil	6-35 to 6-55	......	......	......	
			L	6-55·5	26	......	......	No maximum.
			L	6-59 to 7-05	20	......	......	
			L	7-08 to 7-16	16·5	......	......	
			L	7-52 to 7-55	20	......	......	
			F	8-15	......	......	......	
16	June 14	*I*	*P*	19-46-00	......	......	......	
			S	19-51-46	......	......	......	Distance, 4000 km.
			eL?	19-54	......	......	......	
			L	19-55-40	20	......	.....	
			F	20-26	......	......	......	
17	June 16	*II*	*eP(?)*	6-50-00	......	......	......	Strong microseisms prevail.
			i	6-51-00	5	8	......	
			S	7-00-50	......	......	......	
			L	7-07-40	20	......	......	Distance, 8600 km.
			M	7-08·5	20	17	......	
			L	7-28	42	......	......	
			L	7-34 to 7-37	20	15	......	
			L	7-48 to 7-52	16	......	......	
			L	8-42 to 8-44	20	......	......	
			L	8-51 to 8-53	16	......	......	
			F	9-25	......	......	......	

RECORD of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada, etc.—*Continued.*

No.	Date.	Char.	Phase.	Time.	Period	Amplitude. A_E	Amplitude. A_N	REMARKS.
	1910.			h. m. s.	s.	μ	μ	
18	June 25	I	e	19–42	7	......	......	Small microseisms obscure first preliminary tremors.
			L_N	19–57·0	23	......	......	
			F	20–55	......	......	......	
19	June 29	I	eP?	8–29–34	......	......	......	
			S?	8–36–52	......	......	......	Distance, 5800 km.
			L	8–47–13	20	......	......	
			M	8–53–40	......	......	6	The amplitudes by E-W component are about ⅔ of others.
			L	8–55	14·5	......	......	
			F	10–20	......	......	......	
			Lr	11–13	......	......	......	
			Mr	11–47	18	......	6	
			Lr	11–51	17	......	5	
			Lr	12–05	16	......	5	
			Lr	13–02	16	......	1	
			Fr	13–42	......	......	......	
20	July 2	I	e	17–25	......	......	......	
			L	17–29	9	......	......	
			M_N	17–30–10	7	4	3	
			F	17–50	......	......	......	
21	July 3	I	e	9–25–36	......	......	......	
			i	9–27–28	......	......	......	
			M_E	9–28–23	5	8	......	
			M_N	9–28–30	12	......	6·5	
			F	10–00	......	......	......	
22	July 4	I	e	4–51	......	......	......	
			i	5–08	......	......	......	
			L?	5–09	9	½	2	

RECORD of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada, etc.—*Continued.*

No.	Date.	Char.	Phase.	Time.	Period	Amplitude. A_E	Amplitude. A_N	REMARKS.
	1910.			h. m. s.	s.	μ	μ	
	July 4	*I*	*F*	6–03	......	......	......	
23	July 7	*II*	*P*	4–51–30	......	......	......	
			S?	4–56–15	6	......	......	Distance, 3000 km.
			L	4–58–31	16	......	......	
			M	4–59–20	......	112	100	
			F	6–02	......	......	......	
24	July 7	*I*	*e*	8–35–16	6	......	......	No maximum
			i	8–39–22	6	......	......	
			eL	9–34	30	......	......	
			L	9–43	20	......	......	
			F	10–20	......	......	......	
25	July 17	*I*	*e*	8–14	......	......	......	
			F	8–22	......	......	......	
26	July 17	*I*	*P*	10–07–12	4	......	......	Distance, 4000 km.
			S	10–13–00	7	......	......	
			M	10–20–16	9	8	13	
			F	10–57	......	......	......	
27	July 20	*I*	*iP?*	3–47–19	......	......	......	
			i	3–56–08	7	3	5	
			i	3–56–52	6	6	......	
			L_N	4–01	20	......	......	
			F	4–25	......	......	......	
28	July 22	*I*	*L*	3–01	......	......	......	*L* very weak and not continuous.
			F	3–54	......	......	......	
29	July 29	*I*	*e*	10–48	......	......	......	Light of *N* component too weak for distinct record.
			L	10–59–14	19	......	......	
			L	11–33 to 11–41	22	......	......	

Record of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada, etc.—*Continued.*

No.	Date.	Char.	Phase.	Time.	Period	Amplitude.		Remarks.
						A_E	A_N	
	1810.			h. m. s.	s.	μ	μ	
	July 29	*I*	*F*	12-35	......	......	......	
30	Aug. 5	*II*	*iP*	1-38-30	......	......	......	
			iS	1-44-11	......	......	......	
			L_N	1-48	11	......	......	
			L_E	1-49·4	12	......	......	Distance, 3900 km.
			M_N	1-51·7	14	......	100	
			M_E	1-54	......	25	......	
			F	3-25	......	......	......	
			L_{EN}	4-08	22	......	......	
31	Aug. 11	*I*	*P(?)*	16-36-20	......	......	......	
			iS	16-41-31	......	......	......	Distance about 3400 km.
			L	16-42-10	12	......	......	
			M	16-47	12	12	10	
			F	17-48	......	......	......	
32	Aug. 21	*I*	P_N	5-56-22	......	......	......	*M* not well defined in *L*.
			P_E	5-56-36	......	......	......	Distance, 3600 km.
			iS_N	6-01-56	6	......	......	
			iS_E	6-01-51	6	......	......	
			SR_1	6-03-00	5	6	......	
			SR_2	6-03-53	5	4	......	
			L	6-05	12	......	......	
			F	7-18	......	......	......	
33	Sep. 1	*I*	*eL*	1-37	......	......	......	
			L	1-50	20	......	......	
			F	2-12	......	......	......	
34	Sep. 6	*I*	*iP*	20-14-37	......	......	......	
			iS	20-24-08	......	......	......	

RECORD of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada, etc.—*Continued.*

No.	Date.	Char.	Phase.	Time.	Period	Amplitude. A_E	Amplitude. A_N	REMARKS.
	1910.			h. m. s.	s.	μ	μ	
	Sep. 6	*I*	*L*	20–41	12	......	......	Distance, 8250 km.
			M	20–46	20–23	2	4	
			L	20–46 to 50	20–23	......	......	
			F	21–35	....	......	......	
35	Sep. 7	*I*	*iP*	7–31–49	....	......	......	
			iS	7–38–44	5	......	......	
			PS	7–41–40	....	......	......	
			eL	7–45·5	....	......	......	
			L	8–14 to 32	20	......	......	Distance, 5300 km.
			M	8–20	20	4	6	
			F	9–32	....	......	......	
36	Sep. 7	*I*	*eL*	10–47	8	......	......	
			M	11–00	8	2	4	Possibly belongs to preceding quake.
			F	12–08	....	......	......	
37	Sep. 9	*II*	*iP*	1–23–42	5	......	......	
			iS	1–32–00	8	......	......	
			L	1–42	40	......	......	Distance, 6750 km.
			M	1–50	23	12	......	
			F	3–37	....	......	......	
38	Sep. 9	*I*	*e*	9–33	....	......	......	
			L_E	10–07	20	......	......	
			F	10–35	....	......	......	
39	Sep. 16	*I*	*e*	19–25–36	....	......	......	
			M	19–29	5–7	6	4	
			F	19–44	....	......	......	
40	Sep. 22	*I*	*P?*	12–50–51	4	......	......	
			S?	12–53–51	7	......	......	

RECORD of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada, etc.—*Continued.*

No.	Date.	Char.	Phase.	Time.	Period	Amplitude.		REMARKS.
						A_E	A_N	
	1910			h. m. s.	s.	μ	μ	
	Sep. 22	*I*	eL_N	12–58	10	......	......	
			eL_E	13–02	10	......	......	
			F	13–27	......	......	......	
41	Sep. 24	*II*	*iP*	3–39–20	3	......	......	
			iS	3–44–52	5	......	......	
			L	3–50·5	32	......	......	Distance, 3750 km.
			M_N	3–58	24	......	13	
			F	5–05	......	......	......	
42	Sep. 24	*I*	*iP*	4–20–47	3–4	......	......	Shock during preceding disturbance.
			eE	4–23	10	......	......	
			M_N	4–23·7	6	......	12	
			M_E	4–24·7	5	25	......	
43	Sep. 24	*I*	*eP?*	18–47–17	5	......	......	
			S?	18–53–00	5	......	......	
			eL	19–02	16	......	......	
			M	19–02·5	16	2	2	
			F	19–46	......	......	......	
44	Oct. 4	*I*	iP_N	23–10–52	......	......	......	
			iS	23–19–34	5–6	15	15	Distance, 7200 km.
			eL	23–31·4	24	......	......	No distinct maximum.
			F	24–18	......	......	......	
45	Oct. 16	*I*	*e*	2–31	......	......	......	Microseisms obliterate phases.
			F	2–45	......	......	......	
46	Oct. 18	*I*	*e*	3–30	......	......	......	Microseisms obliterate phases.
			L	3–42	17	......	......	
			F	4–05	......	......	......	

RECORD of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada, etc.—*Continued.*

No.	Date.	Char.	Phase.	Time.	Period	Amplitude. A_E	Amplitude. A_N	REMARKS.
	1910			h. m. s.	s.	μ	μ	
47	Nov. 6	II	P?	20–43–52	......	......	......	N-S component not working.
			L	20–50	......	......	......	
			M	20–50·7	......	50	......	
			F	22–00	......	......	......	
48	Nov. 9	II	P_E	6–28–22	......	......	......	No distinct maximum.
			S_E	6–34–00	......	......	......	
			L_N	6–36–20	10	......	......	Record conspicuous for the continuous and well-marked long waves.
			L	6–56	24	......	......	
			L	7–02 to 8–38	20–17	......	......	
			F	9–05	......	......	......	Distance, 3850 km.
49	Nov. 10	I	e	12–57	......	......	......	
			L_E	13–21	24	......	......	Strong micro-seisms.
			L_E	13–31	16	......	......	No phases recognizable.
			L_N	13–34	15	......	......	
			F	14–15	......	......	......	
50	Nov. 12	I	e	18–27	......	......	......	
			F	18–50	......	......	......	
51	Nov. 14	I	e	8–27	......	......	......	
			L_E	8–33	22	......	......	
			L_N	8–35	24	......	......	
			L_E	8–41	15	......	......	
			M_N	8–47	14	......	6	
			F	9–21	......	......	......	
52	Nov. 15	I	e_N	0–30·3	......	......	......	
			F	0–51	......	......	......	
53	Nov. 15	I	e_N	14–32	......	......	......	
			L_N	14–41	13	......	......	

RECORD of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada, etc.—*Continued.*

No.	Date.	Char.	Phase.	Time.	Period	Amplitude. A_E	Amplitude. A_N	REMARKS.
	1910			h. m. s.	s.	μ	μ	
	Nov. 15	*I*	M_N	14-50	......	......	6	
			L_N	15-20	20	......	......	
			F	15-47	......	......	......	
54	Nov. 26	*II*	*P?*	5-07-16	......	......	......	Microseisms mask *P* and *S*.
			S?	5-11-20	......	......	......	
			eL	5-18	20	......	......	
			L	5-26	20	......	......	
			M_N	5-42·5	20	......	8	Period of *L* decreases.
			M_E	5-48	20	8	......	
			L	5-42 to 6-18	24-16	......	......	
			F	7-55	......	......	......	
55	Nov. 29	*I*	eL_N	3-18	20	......	......	*E* component very feeble.
			L_N	3-29 to 3-43	20-16	......	......	
			F	3-56	......	......	......	
56	Dec. 4	*I*	e_N?	11-43·5	......	......	......	
			e	11-51	......	......	......	
			e	12-12	......	......	......	
			L	12-16 to 12-30	20-16	......	......	*L* decrease in period
			F	13-07	......	......	......	
57	Dec. 10	*I*	*e*	9+	......	......	......	Unfortunately a poor photographic sheet makes the diagram only readable in patches.
			L_{NE}	10-35 to 10-44	16·5	......	......	
			F	13	......	......	......	
58	Dec. 13	*II*	P_E	11-56-10	......	......	......	
			S_E	12-05-46	......	......	......	Distance, 8300 km.
			L_N	12-21·5	28	......	......	Strong microseisms prevailed.
			L_N	12-29	24	......	......	
			L_E	12-31 to 12-33	20	......	......	

RECORD of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada, etc.—*Continued.*

No.	Date.	Char.	Phase.	Time.	Period	Amplitude. A_E	Amplitude. A_N	REMARKS.
	1910.			h. m. s.	s.	μ	μ	
	Dec. 13	*II*	M_N	12-31·5	20	......	21	
			M	12-39	18-16	15	17	
			L_N	12-40 to 12-45	16	......	......	
			F	14-48	....	......	......	
59	Dec. 14	*I*	P_E	21-04-18	3	......	......	Microseisms prevailed.
			i_E	21-09-32	....	......	......	Phases difficult to read.
			S_E?	21-10-35	5	......	4	Long waves almost wholly wanting.
			i_N	21-11-20	....	4	......	No maximum.
			i_E	21-11-25	....	......	......	
			L_E	21-17·3	....	......	......	
			i_N	21-19-19	....	......	......	
			i_N	21-23-23	....	......	......	
			L_N	21-25	12	......	......	
			F	22-00	....	......	......	
60	Dec. 16	*I*	*P*	15-05-20	....	......	......	No record 15-21 to 15-38. Changing sheet, etc.
			M?	16-00	24	......	12	
			L	16-09 to 16-13	18	5	10	
			L	16-26 to 16-28	16	......	......	
			F	18-00	....	......	......	
61	Dec. 21	*I*	P_N	10-31-00	....	......	......	
			PR_1	10-32-24	....	......	......	Distance, 4300 km. Microseisms prevailed.
			S_N	10-37-00	....	......	......	
			L_N	10-46·9	20	......	......	
			L	10-48 to 10-53	15-11	......	......	
			F	11-25	....	......	......	
62	Dec. 23	*I*	*P*?	0-50-32	....	......	......	Microseisms prevailed.

Record of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada, etc.—*Continued.*

No.	Date.	Char.	Phase.	Time.	Period	Amplitude. A_E	Amplitude. A_N	Remarks.
	1910.			h. m. s.	s.	μ	μ	
	Dec. 23	I	P?	0-58-38	......	......	......	P difficult to read. S not recognized.
			L	1-05	25	......	......	
			L	1-11 to 1-14	16-15	......	......	
			M_N	1-11·5	15	......	6	
			M_E	1-12·2	16	6	......	
			F	2-20	......	......	......	
63	Dec. 28	I	P?	17-46-14	2	......	......	
			S?	17-49-06	......	......	......	
			F?	18-30	......	......	......	
64	Dec. 29	I	eL_N	14-18·3	16	......	......	
			L_N	14-23	20	......	......	
			F	14-55	......	......	......	
65	Dec. 30	I	P?	1-07-49	......	......	......	E-W Component weaker.
			S?	1-15-34	......	......	......	
			eL?	1-18·2	......	......	......	
			L	1-26	10	......	......	
			F	2-00	......	......	......	
66	Dec. 30	I	P	3-26-42	2	......	......	
			S	3-31-28	......	......	......	E-W Component weaker.
			L	3-43	18	......	......	
			F	4-13	......	......	......	
67	1911 Jan. 1	I	e_N	10-41-36	......	......	......	
			L_N	11-09·7	20	......	......	Preceded by extremely strong microseisms.
			L_N	11-25	13	......	......	
			F	11-55	......	......	......	
68	Jan. 2	I⁻	e_E	11-07	......	......	......	
			e_N	11-09·7	......	......	......	

RECORD of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada, etc.—*Continued.*

No.	Date.	Char.	Phase.	Time.	Period	Amplitude.		REMARKS.
						A_E	A_N	
	1911			h. m. s.	s.	μ	μ	
	Jan. 2	I	L_N	11-36 to 11-39	29	......	......	
			L	11-41	20	......	......	
			F	12-00	......	......	......	
69	Jan. 2	I	e	23-19	......	......	......	
			L	23-48 to 23-53	20	......	......	
			L	23-55	18	......	......	
			L	24-00	16	......	......	
			F	24-55	......	......	......	
70	Jan. 3	I	e_N	8-12·5	......	......	......	
			L_N	8-18·5	20	......	......	*E* comp. shows only traces.
			F	8-43	......	......	......	
71	Jan. 3-4	II	P_N	23-38-36	3	......	......	
			P_E	23-38-43	3	......	......	
			PR_1	23-42-20	......	......	......	
			S_N	23-49-16	8	......	......	Distance, 9800 km.
			S_E	23-49-40	8	......	......	
			L_N	23-55-40	......	......	......	Turkestan quake.
			L_E	23-56	......	......	......	
			L	23-57	36-40	50	135	
			M	0-16	20	170	......	
			M	0-18	20	......	335	
			L	0-36 to 1-06	15	......	......	
			F	2-50	......	......	......	
72	Jan. 7	I	e	2-33-12	......	......	......	
			S?	2-44-18	......	......	......	Partly masked by wind effect.
			L	3-03	16	......	......	
			L	3-20	20	......	......	

RECORD of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada, etc.—*Continued.*

No.	Date.	Char.	Phase.	Time.	Period	Amplitude. A_E	Amplitude. A_N	REMARKS.
	1911			h. m. s.	s.	μ	μ	
	Jan. 7	*I*	*L*	3–28	19	......	......	
			F	4–10	......	......	......	
73	Jan. 9	*I*	*e*	4–46	......	......	......	Waves appear to continue for some hours, but difficult to differentiate from wind effect as shown by anemogram.
74	Jan. 10	*I*	*e*	11–00–32	......	......	......	
			F	11–10	......	......	......	
75	Jan. 10	*I*	*e*	12–31	......	......	......	
			F	12–57	......	......	......	
76	Feb. 5	*II*	*P*	4–30–42	4	......	......	
			PR_1	4–32–40	......	......	......	
			S	4–36–02	6	......	......	Distance, 3560 km.
			L	4–38–34	19	......	......	
			M	4–40–20	19	67	60	
			L_N	4–44	20	......	......	
			F	6–07	......	......	......	
77	Feb. 7	*I*	*P*	2–27–18	......	......	......	
			S	2–32–36	......	......	......	
			L	2–35–08	8–12	......	......	
			M_N	2–36·9	12	......	6	
			M_E	2–38·7	6	8	......	
78	Feb. 16	*I*	*e*	20–24–57	......	......	......	
			F	20–31	......	......	......	
79	Feb. 17	*I*	*e*	2–50–50	......	......	......	
			M	2–51–20	5·5	8	4	
			F	3–06	......	......	......	

RECORD of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada, etc.—*Continued.*

No.	Date.	Char.	Phase.	Time.	Period	Amplitude. A_E	Amplitude. A_N	REMARKS.
	1911			h. m s.	s.	μ	μ	
80	Feb. 17	I	e	14-40-25	......	......	......	
			M	14-40-46	5·5	8	4	
			F	15-07	......	......	......	
81	Feb. 18	I	e	2-05	......	......	......	
			i	2-12	......	......	......	
			L	2-13	10	......	......	
			F	2-57	......	......	......	
82	Feb. 18	II	e_N	19-04-30	......	......	......	
			e_E	19-04-34	......	......	......	
			iP_N	19-04-45	......	......	......	No distinct *S*.
			iP_E	19-04-43	......	......	......	
			L_E	19-23	16	......	......	Press report quake in Monastir.
			L_N	19-24·5	20	......	......	
			M_N	19-35	20	......	60	Distant 7350 km.
			M_E	19-36	14	30	......	
			L_E	19-41 to 19-43	14	......	......	
			L_N	19-45 to 19-50	14	......	......	
			F	20-54	......	......	......	
83	Feb. 19	I	e	2-31·6	20	......	......	
			F	2-42	......	......	......	
84	Feb. 26	I	e	13-00-20	10	......	......	
			L	13-07·5	30	......	......	
			F	13-25	......	......	......	
85	Mar. 11	I	eL	4-14	......	......	......	*N-S* component has now magnetic damping.
			L	4-17	20	......	......	*E-W* component retains air damping.
			L	4-22	19	......	......	

RECORD of the Earthquake Station, Dominion Astronomical Observatory, Ottawa, Canada, etc.—*Concluded.*

No.	Date.	Char.	Phase.	Time.	Period	Amplitude. A_E	Amplitude. A_N	REMARKS.
	1911			h. m. s.	s.	μ	μ	
	Mar. 11	*I*	*L*	4-34	16	......	......	*E-W* considerably masked by microseisms.
			F	5-00	......	......	......	
86	Mar. 13	*I*	*P*	7-40-31	......	......	......	
			eL	7-41-16	10	......	......	
			F	7-56	......	......	......	
87	Mar. 15	*I*	*e*	2-26-4	......	......	......	
			F	2-44	......	......	......	
88	Mar. 19	*I*	*P*	4-31-07	......	......	......	Epicentre 4040 km., magnetic damping shows no microseisms, being very small. Air damping shows them and thereby almost masks quake.
			S	4-36-56	......	......	......	
			L	4-44-00	20	......	......	
			L	4-47	14	......	......	
			F	5-01	......	......	......	
89	Mar. 21	*I*	*eL*	3-20	14	......	......	

TERRESTRIAL MAGNETISM.

The magnetic survey of Canada has been continued during the past year. Two observers were in the field. Mr. C. A. French occupied 48 stations along the line of the Canadian Pacific railway between Chapleau and Moosejaw, a distance of 1,200 miles, giving an average distance between the stations of about 25 miles.

Mr. J. W. Menzies occupied 44 stations distributed over western Ontario between Napanee and Windsor, with intervals approximately of 25 miles also.

At all the stations observations were taken for declination, dip and intensity, besides the necessary ones for azimuth and latitude. Mr. French used the magnetic outfit of preceding years, and described in previous reports, being a Tesdorpf magnetometer, Kew dip circle, and Watt transit. Mr. Menzies had a Cooke magnetometer, Kew dip circle, and Watt transit. As usual, both observers made comparison observations at the Agincourt Magnetic Observatory, before and after the season's work, to standardize the field instruments.

At all the stations along the Canadian Pacific railway the eastern and western magnetic elongations were observed, and the mean taken for the magnetic meridian or declination. Observations were taken at other times, also, for the purpose of eventually preparing a diurnal variation table for those northern parts or regions.

The observations in Ontario for declination did not include those of elongation, but invariably were duplicated; the general order of observations being: Azimuth, declination, dip, oscillations, deflections, deflections, oscillations, dip and declination. To the declination observations was then applied the correction or diurnal variation obtained from data tabulated from the continuous records of the Agincourt Magnetic Observatory.

A number of the stations occupied during the past season had been occupied by the Carnegie Institution in 1906, so that by the comparison of the observations in 1906 and 1910 we obtain a value for the secular variation for the interval, and also the value for the average annual change in declination. The true nature of the secular variation is still unknown, as well as of the law of its slow change. We can interpolate with a fair degree of accuracy, but extrapolation is very uncertain, especially if the time is anything but a very few years in advance. For example, the Toronto Magnetic Observatory (now at Agincourt, some 13 miles away, to avoid influence of trolly lines) has the longest reliable magnetic record in America, so that the empirical formula deduced from the long period would be expected to give a pretty accurate value for extrapolation. The formula for Toronto, given in Appendix No. 9, Report for 1879 of the United States Coast and Geodetic Survey, deduced from 40 years' observations (1840–1880), is:

$D = +3^\circ.60 + 2^\circ.82 \sin (1.4m - 44^\circ.7) + 0^\circ.09 \sin (9.3m + 136^\circ) + 0^\circ.08 \sin (19m + 247^\circ)$, where $m = t - 1850$, t being the year for which the declination is sought.

Taking $t = 1910$, hence $m = 60$, we obtain

$D = 5^\circ\ 17'$, whereas the actually observed declination was $6^\circ\ 02'$ (January, 1910). Although the stations are not quite identical, yet the difference of three-quarters of a degree shows the unreliability of extrapolating for years in advance.

We may cite an interesting case of secular variation in connection with Haussmann's magnetic survey of Württemberg, in 1900. Kornthal, near Stuttgart, was his base station, and comparison observations were made with the magnetic observatory at Potsdam. From the subseqnent observations in 1902, the annual change for Kornthal was found to be 4′.5. Based on this, values for declination—or direction of the compass needle—were published some years in advance. In 1905, Bavaria undertook a magnetic survey of its state, and amongst the stations was Ulm, a border city between the above two states. The declination observed here was found to show a greater annual change than had been found only a few years before. The continuous records of Potsdam confirmed this. Thus Potsdam showed an annual decrease in declination, up to 1903, of from 4′.2 to 4′.0, and from 1904 to 1910 it increased to 7′.4, which, for Kornthal, would be 7′.5, *i.e.*, 3′.0 more than was determined in 1900-1902, and which was supposed to hold for some years, but which was subsequently found to be materially unreliable to be thus applied.

Although the same annual change holds for a fairly large area, say a hundred miles square, yet individual places in such an area show deviations from the normal.

As in the past few years, a magnetic map accompanies this report, showing the direction of the magnetic meridian at the stations occupied during the year. It is found that these magnetic maps find favour with the public, more so than do those showing irregular curved lines of equal declination, *i.e.*, isogonic lines. Although these lines are based on magnetic observations at particular places, yet the continuous line is more or less hypothetical, and its meaning is not so readily understood by the public as a definite direction at a station of the magnetic meridian, together with its declination or variation of the compass as it is called by the ordinary man.

Mr. C. A. French reports on his work during the season as follows:—

The instruments used on the Magnetic Survey during the season of 1910 included a Tesdorpf fibre declinometer and magnetometer, No. 1977, for measuring declination and horizontal intensity; Dover dip circle, No. 145, for inclination; Troughton and Simms 6-inch theodolite for time, latitude and azimuth, and a half-seconds mean-time chronometer, Bond 511, for determining the time of oscillations.

With few exceptions, latitude was obtained from meridian altitudes of the sun, circle right and left. The azimuth of the reference point, and time were obtained from the altitude of the sun, and, whenever possible, two observations were taken, one about 9 a.m., and one about 3 p.m., at each station. In every case, the magnetic declination was obtained by taking the mean of the eastern elongation, which usually occurs between 7 and 8 a.m., and the western elongation between 1 and 2 p.m.

It frequently happened that the number of days of morning elongations differed from the number of days of afternoon elongations, in which case the mean of the mornings was taken as one observation and the mean of the afternoons as one. In addition to the elongations, there were taken a number of observations for declination which were not used to obtain a mean value, owing to the fact that no corrections for diurnal variation were available for this region. It is hoped, however, that from these results, combined with those of the preceding and next year, a table of diurnal variations will be compiled, which will be of service in reducing observations in succeeding years. A summary of the corrections obtained from observations during the season are given below. In table A are given the actual observations for declination, and the time of each; the mean declination obtained from the mean of the elongations; and the difference between the mean declination and the individual observations. These differences reduced to the even hour and half-hour, are given in table B.

TABLE A.

Station.	Date.	L. M. Time.	Observed Declination.	Mean of E & W Elongations.	Correction for Diurnal Variation
	1910	h. m.	° ′	° ′	′
Chapleau......	May 7...	7−14	4−07·7W	4− 16·4W	− 8·7
		8−55	13·1		− 3·3
		10−05	17·5		+ 1·1
		10−40	20·3		+ 3·9
		11−37	23·0		+ 6·6
		1−11	24·0		+ 7·6
		3−04	22·2		+ 5·8
		3−51	20·9		+ 4·5
		5−01	18·9		+ 2·5
	May 9...	7−34	10·2		− 6·2
		8−55	10·3		− 6·1
		9−34	12·1		− 4·3
		9−51	13·9		− 2·5
		10−24	14·6		− 1·8
		10−58	17·7		+ 1·3
		11−46	21·0		+ 4·6
		1−06	21·5		+ 5·1
		2−36	23·7		+ 7·3

TABLE A—*Continued.*

Station.	Date.	L. M. Time.	Observed Declination.	Mean of E & W Elongations.	Correction for Diurnal Variation
	1910	h. m.	° ′	° ′	′
Wayland......	May 10..	10—07	5—09·0W	5—08·8W	+ 0·2
		12—55	14·8		+ 6·0
		3—27	13·6		+ 4·8
		5—05	10·6		+ 1·8
	May 11..	8—07	2·7		− 6·1
		9—34	4·3		− 4·5
		10—26	8·6		− 0·2
		12—50	15·0		+ 6·2
Missinaibi.....	May 14..	12—52	5—58·8W	5—48·8W	+10·0
		4—17	51·5		+ 2·7
		6—19	48·6		− 0·2
	May 16..	7—29	42·0		− 6·8
		8—49	48·0		− 0·8
		10—03	54·7		+ 5·9
		10—28	54·7		+ 5·9
		11—25	53·7		+ 4·9
		12—49	52·5		+ 3·7
		2—08	53·0		+ 4·2
		3—42	53·0		+ 4·2
Grasett.......	May 19..	7—22	3—39·8W	3—46·1W	− 6·3
		9—05	42·8		− 3·3
		12—52	53·6		+ 7·5
		4—20	47·0		+ 0·9
		5—43	42·2		− 3·9
	May 20..	7—27	39·8		− 6·3
		9—02	39·2		− 6·9
		9—56	44·3		− 1·8
		10—28	48·4		+ 2·3
		1—02	51·0		+ 4·9
		2—51	54·1		+ 8·0
		3—36	50·5		+ 4·4
		5—27	46·0		− 0·1
White River...	May 23..	7—34	3—05·2W	3—11·9W	− 6·7
		8—40	9·2		− 2·7
		9—40	14·3		+ 2·4
		10—29	16·6		+ 4·7
		11—28	18·8		+ 6·9
		1—09	21·5		+ 9·6
		3—26	17·6		+ 5·7
	May 25..	7—54	3·0		− 8·9
		9—46	9·3		− 2·6
		10—26	13·4		+ 1·5
		12—45	17·6		+ 5·7
Montizambert.	May 27..	7—35	2—15·7W	2—22·3W	− 6·6
		9—08	19·1		− 3·2
		10—30	24·4		+ 2·1
		1—02	28·6		+ 6·3
		3—27	28·6		+ 6·3
		4—11	23·6		+ 1·3
	May 28..	7—42	16·4		− 5·9
Heron Bay....	May 30..	7—34	2—25·4W	2—33·4W	− 8·0
		9—05	28·5		− 4·9
		10—04	28·1		− 5·3
		11—30	37·2		+ 3·8
		1—00	40·2		+ 6·8
		3—34	36·5		+ 3·1

TABLE A—*Continued.*

Station.	Date.	L. M. Time.	Observed Declination.	Mean of E & W Elongations.	Correction for Diurnal Variation
	1910	h. m.	° ′	° ′	′
Heron Bay....	May 31.	7–37	2–27·8	2–33.4*W*	– 5·6
		8–45	24·6		– 8·8
		9–44	31·6		– 1·8
		10–24	30·1		– 3·3
		1–07	40·2		+ 6·8
Middleton.....	June 4...	7–20	17–58·7*E*	17–48·9*E*	– 9·8
		9–18	51·4		– 2·5
		10–28	47·0		+ 1·9
		12–59	39·1		+ 9·8
		3–00	41·4		+ 7·5
		5–55	47·7		+ 1·2
Schreiber.....	June 7...	7–21	0–25·2*W*	0–31·7*W*	– 6·5
		9–09	24·1		– 7·6
		10–02	28·1		– 3·6
		10–32	31·6		– 0·1
		11–19	35·6		+ 3·9
		1–29	37·7		+ 6·0
		3–18	38·1		+ 6·4
		4–48	35·1		+ 3·4
Gravel........	June 10..	7–47	0–30·8*E*	0–25·1*E*	– 5·7
		9–15	30·3		– 5·2
		10–21	26·2		– 1·1
		1–37	19·3		+ 5·8
		3–31	20·5		+ 4·6
Nipigon.......	June 11..	8–02	1–14·6*E*	1–07·0*E*	– 7·6
		1–12	00·9		+ 6·1
	June 13..	7–32	13·6		– 6·6
		9–28	8·3		– 1·3
		10–18	4·1		+ 2·9
		1–09	0–58·8		+ 8·2
		11–20	1–00·3		+ 6·7
		3–03	1·8		+ 5·2
Dorion........	June 14..	7–24	1–44·9*E*	1–39·5*E*	– 5·4
		9–20	41·0		– 1·5
		10–31	37·8		+ 1·7
		1–14	33·6		+ 5·9
		4–01	34·1		+ 5·4
Mackenzie....	June 15..	7–40	2–54·9*E*	2–49·3*E*	– 5·6
		9–02	54·9		– 5·6
		10–34	49·5		– 0·2
		1–40	43·6		+ 5·7
		4–09	47·4		+ 1·9
Fort William..	June 17.	7–48	3–21·3*E*	3–16·5*E*	– 4·8
		10–33	12·3		+ 4·2
		1–15	11·5		+ 5·0
		3–53	15·1		+ 1·4
	June 18..	8–08	24·0		– 7·5
		1–08	9·4		+ 7·1
Kaministikwia	June 22..	8–04	0–33·2*E*	0–25·3*E*	– 7·9
		10–32	26·6		– 1·3
		1–42	17·4		+ 7·9
		4–01	25·3		0·0
Savanne.......	June 27..	7–41	4–35·7*E*	4–28·1*E*	– 7·6
		9–26	33·2		– 5·1
		10–32	29·0		– 0·9
		1–34	21·6		+ 6·5

TABLE A—*Continued.*

Station.	Date.	L. M. Time.	Observed Declination.	Mean of E & W Elongations.	Correction for Diurnal Variation
	1910	h. m.	° ′	° ′	′
Savanne......		4—04	4—23·5	4—28.1*E*	+ 4·6
		4—43	24·1		+ 4·0
	June 28..	7—48	35·7		− 7·6
		10—31	28·5		− 0·4
		11—40	23·3		+ 4·8
		1—11	19·3		+ 8·8
Niblock.......	June 30..	7—43	4—62·0*E*	4—54·5*E*	− 7·5
		9—33	59·6		− 5·1
		10—34	55·9		− 1·4
		1—36	47·2		+ 7·3
		4—33	51·9		+ 2·6
	July 1....	7—23	62·0		− 7·5
		10—34	53·0		+ 1·5
		12—58	46·8		+ 7·7
Martin........	July 2....	7—33	5—05·3*E*	4—58·1*E*	− 7·2
		9—33	2·8		− 4·7
		10—32	4—57·9		+ 0·2
		11—46	55·1		+ 3·0
		1—36	53·1		+ 5·0
		4—34	54·9		+ 3·2
	July 4 ..	7—52	5—05·1		− 7·0
		9—26	2·2		− 4·1
		9—56	0·6		− 2·5
		10—36	4—58·9		− 0·8
		10—56	55·1		+ 3·0
		1—21	49·4		+ 8·7
Ignace........	July 6....	7—29	6—15·2*E*	6—10·5*E*	− 4·7
		9—25	9·2		+ 1·3
		10—24	5·9		+ 4·6
		1—19	1·0		+ 9·5
		3—49	5·6		+ 4·9
		4—49	8·8		+ 1·7
	July 7...	7—34	19·5		− 9·0
		10—32	8·2		+ 2·3
		1—22	4·2		+ 6·3
	July 8....	7—17	19·2		− 8·7
		9—29	13·1		− 2·6
		10—30	11·0		− 0·5
		1—24	4·0		+ 6·5
		3—34	6·7		+ 3·8
Taché.........	July 11...	7—41	6—63·7*E*	6—57·4*E*	− 6·3
		9—38	65·6		− 8·2
		10—37	57·5		− 0·1
		1—41	50·7		+ 6·7
		4—38	54·2		+ 3·2
	July 12...	7—31	65·0		− 7·6
		7—51	64·4		− 7·0
		8—01	63·8		− 6·4
		8—21	64·2		− 6·8
		9—36	62·4		− 5·0
		10—34	58·8		− 1·4
		1—51	49·9		+ 7·5
Wabigoon.....	July 13..	1—50	7—33·2*E*	7—39·0*E*	+ 5·8
		4—46	37·2		+ 1·8
	July 14...	8—00	46·7		− 7·7
		10—00	43·6		− 4·6

TABLE A—*Continued.*

Station.	Date.	L. M. Time.	Observed Declination.	Mean of E & W Elongations.	Correction for Diurnal Variation
	1910	h. m.	° ′	° ′	′
Wabigoon		10−35	7−41·0	7−39.0*E*	− 2·0
		1−30	29·2		+ 9·8
Dryden.......	July 16...	8−09	8−24·8*E*	8−14·1*E*	−10·7
		10−32	14·7		− 0·6
		1−41	2·9		+11·2
		4−42	9·6		+ 4·5
	July 17...	7−24	23·9		− 9·8
		1−24	4·8		+ 9·3
Eagle.........	July 18...	2−27	6−27·7*E*	6−34·7*E*	+ 7·0
		4−29	31·4		+ 3·3
	July 19...	7−18	42·2		− 7·5
		9−31	38·3		− 3·6
		10−34	34·0		+ 0·7
		11−52	27·5		+ 7·2
		2−00	28·0		+ 6·7
		7−38	44·4		− 9·7
	July 20...	4−59	30·4		+ 4·3
Vermilion.....	July 21...	7−37	7−51·3*E*	7−42·8*E*	− 8·5
		9−00	49·3		− 6·5
		9−39	46·0		− 3·2
		10−33	42·2		+ 0·6
		1−47	34·2		+ 8·6
		4−55	39·3		+ 3·5
Hawk Lake...	July 23...	7−42	7−38·8*E*	7−28·4*E*	−10·4
		10−31	30·2		− 1·8
		2−04	19·3		+ 9·1
		4−56	23·5		+ 4·9
	July 24...	7−42	35·7		− 7·3
		10−26	30·8		− 2·4
		12−05	25·8		+ 2·6
		1−54	19·7		+ 8·7
Kenora........	July 26...	10−37	9−60·2*E*	10−00·4*E*	+ 0·2
		1−49	51·8		+ 8·6
		4−48	54·3		+ 6·1
	July 27...	7−39	67·8		− 7·4
		10—31	62·5		− 2·1
		1−57	54·2		+ 6·2
Kalmar.......	July 28...	10−35	9−31·4*E*	9−31·7*E*	+ 0·3
		2−05	25·4		+ 6·3
		4−41	25·8		+ 5·9
		6−27	26·8		+ 4·9
	July 29...	7−02	37·9		− 6·2
Rennie........	July 29...	2−03	10−13·4*E*	10−19·7*E*	+ 6·3
		4−38	16·2		+ 3·5
	July 30...	7−53	26·1		− 6·4
		10−26	20·5		− 0·8
		1−46	13·5		+ 6·2
		4−28	16·3		+ 3·4
	July 31...	7−56	25·9		− 6·2
Whitemouth...	Aug. 1...	1−39	10−49·4*E*	10−57·0*E*	+ 7·6
		4−58	54·6		+ 2·4
	Aug. 2...	7−42	66·1		− 9·1
		10−04	54·7		+ 2·3
		10−53	52·5		+ 4·5
		1−45	46·3		+10·7
		4−18	51·2		+ 5·8

TABLE A—*Continued.*

Station.	Date.	L. M. Time.	Observed Declination.	Mean of E & W Elongations.	Correction for Diurnal Variation
	1910	h. m.	° ′	° ′	′
Whitemouth..		7–40	10–59·9 (omit)	10–57·0E	
Norquay......	Aug. 4...	1–49	11–13·0E	11–23·0E	+10·0
		4–33	19·6		+ 3·4
	Aug. 5...	7–54	32·1		− 9·1
		10–40	23·6		− 0·6
		1–56	14·8		+ 8·2
		4–29	20·6		+ 2·4
Winnipeg......	Aug. 8...	10–33	13–58·1E	13–56·7E	− 1·4
		1–42	47·9		+ 8·8
	Aug. 9...	7–34	63·6		− 6·9
		10–32	59·9		− 3·2
		1–34	51·7		+ 5·0
Marquette....	Aug. 11..	1–30	13–09·6E	13–17·7E	+ 8·1
		4–40	12·4		+ 5·3
	Aug. 12..	7–22	25·3		− 7·6
		10–36	18·5		− 0·8
		1–33	10·6		+ 7·1
Portage-la-Prairie......	Aug. 15..	10–42	9–24·4E	9–26·9E	+ 2·5
		1–32	20·9		+ 6·0
	Aug. 16..	7–50	34·8		− 7·9
		10–32	25·2		+ 1·7
		1–37	16·9		+10·0
McGregor.....	Aug. 17..	10–35	13–08·7E	13–09·8E	+ 1·1
		1–55	1·1		+ 8·7
		4–37	4·0		+ 5·8
	Aug. 18..	7–50	18·5		− 8·7
Carberry......	Aug. 19..	7–43	15–51·6E	15–44·0E	− 7·6
		1–38	36·3		+ 7·7
		4–28	40·0		+ 4·0
	Aug. 20..	8–06	52·1		− 8·1
		10–33	40·8		+ 3·2
		1–35	36·1		+ 7·9
Brandon......	Aug. 23..	7–36	15–12·0E	15–03·9E	− 8·1
		10–33	15–03·9		0·0
		1–34	14–53·5		+10·4
		4–49	14–58·0		+ 5·9
	Aug. 24..	7–59	15–13·9		−10·0
		10–33	15–02·9		+ 1·0
		1–39	14–56·4		+ 7·5
	Aug. 25..	7–34	15–10·9		− 7·0
		1–31	14–56·5		+ 7·4
Griswold......	Aug. 26..	7–41	16–11·3E	16–04·6E	− 6·7
		10–33	4·7		− 0·1
		1–44	15–57·8		+ 6·8
		4–24	61·4		+ 3·2
Virden........	Aug. 27..	7–57	16–49·9E	16–43·1E	− 6·8
		10–32	45·0		− 1·9
		1–37	36·6		+ 6·5
	Aug. 28..	7–37	49·4		− 6·3
Kirkella.......	Aug. 30..	1–25	16–08·0E	16–13·9E	+ 5·9
		4–35	15·4		− 1·5
	Aug. 31..	8–00	19·5		− 5·6
		10–30	9·1		+ 4·8
		1–23	8·6		+ 5·3

TABLE A—*Concluded.*

Station.	Date.	L. M. Time.	Observed Declination.	Mean of E & W Elongations.	Correction for Diurnal Variation
	1910	h. m.	° ′	° ′	′
Wapella.......	Sep. 1...	7—38	17—58·7E	17—50·6E	— 8·1
		10—28	47·7		+ 2·9
		1—48	44·2		+ 6·4
		7—36	57·7		— 7·1
		10—28	48·6		+ 2·0
		1—21	42·0		+ 8·6
Broadview....	Sep. 3....	7—33	17—20·9E	17—13·3E	— 7·6
		10—29	11·9		+ 1·4
		1—25	6·4		+ 6·9
		4—20	12·8		+ 0·5
	Sep. 5....	7—45	19·5		— 6·2
		10—30	13·2		+ 0·1
		1—35	6·5		+ 6·8
		3—40	11·5		+ 1·8
Wolseley......	Sep. 9....	1—35	18—10·2E	18—18·1E	+ 7·9
		4—22	14·0		+ 4·1
	Sep. 10..	8—07	27·0		— 8·9
		9—37	19·7		— 1·6
		10—32	14·0		+ 4·1
		1—32	8·1		+10·0
Indian Head...	Sep. 12...	1—56	19—28·4E	19—32·7E	+ 4·3
		4—33	32·0		+ 0·7
	Sep. 13...	8—01	38·5		— 5·8
		9—26	35·3		— 2·6
		10—31	31·8		+ 0·9
		1—31	25·1		+ 7·6
Balgonie......	Sep. 14...	1—43	18—50·9E	18—57·6E	+ 6·7
		4—18	54·0		+ 3·6
		8—03	63·9		— 6·3
		10—29	54·1		+ 3·5
		1—20	51·5		+ 6·1
Regina........	Sep. 16...	10—31	19—23·0E	19—26·8E	+ 3·8
		1—35	20·3		+ 6·5
		4—40	27·8		— 1·0
	Sep. 17...	7—52	33·0		— 6·2
		10—32	24·0		+ 2·8
		1—32	21·0		+ 5·8
Pense.........	Sep. 19...	7—45	19—52·5E	19—45·5E	— 7·0
		10—31	43·3		+ 2·2
		1—58	38·5		+ 7·0
		4—42	43·4		+ 2·1
Moosejaw.....	Sep. 20..	10—30	19—48·1E	19—52·9E	+ 4·8
		1—18	50·5		+ 2·4
		4—12	48·9		+ 4·0
	Sep. 21...	7—41	54·6		— 1·7
		10—24	50·0		+ 2·9
		1—23	51·7		+ 1·2
	Sep. 22...	7—30	56·6		— 3·7
		10—28	52·2		+ 0·7
		1—37	50·4		+ 2·5
		4—23	50·1		+ 2·8
	Sep. 23...	7—22	58·8		— 5·9
		10—29	50·5		+ 2·4
		1—32	47·5		+ 5·4

TABLE B.

Hours in Local Mean Time.

Month	7-00	7-30	8-00	8-30	9-00	9-30	10-00	10-30	11-00	11-30	12-00	12-30	1-00	1-30	2-00	2-30	3-00	3-30	4-00	4-30	5-00	5-30	6-00	6-30	7-00
May....		− 8·7			− 3·3		1·1	3·0		6·5			7·6	7·6			5·8		4·5		2·5				
		− 6·2			− 6·1	− 4·3	− 2·0	1·2	1·3	3·5	4·6		5·1			7·3									
							0·3						6·0					4·8			1·8				
			− 6·1			− 4·5		− 0·2					6·2												
													10·0						2·7					− 0·2	
		6·8			− 0·8					1·9		3·7			4·2				4·2						
		− 6·3			− 3·3								7·5						0·9			− 3·9			
		− 6·3			− 6·9		− 1·8	2·3					4·9				8·0	4·4				− 0·1			
		− 6·7		− 2·7						6·9			9·6					5·7							
			− 8·9			− 3·6	− 1·6	1·5					5·7												
		− 6·6			− 3·2			2·1					6·3					6·3	4·3						
		− 5·9																							
		− 8·0			− 4·9		− 5·3			3·8			6·8					3·1							
		− 5·6		− 8·8		− 1·8		− 3·3					6·8												
June....		6·5			− 7·6		− 3·6	0·1	2·0	1·3				6·0				6·1			3·4				
		− 5·7	− 5·7		− 5·0	4·6	− 0·6							5·8				4·6							
			− 7·6										6·1												
		− 6·6				− 1·3	1·4	3·6	5·3	6·0			8·2				5·2								
		− 5·4				− 1·1	0·0	1·7					5·9						5·1						
			− 5·6		− 5·6			0·2						5·7					1·9						
			4·8					4·2					5·0	5·0					1·4						
			− 7·5										7·1												
			7·9					1·3						7·9					0·0						
		− 7·6	− 7·6			− 5·1		− 0·9						6·5					4·6	4·0					
			− 7·6					0·4		4·4	5·0		8·8												
			− 7·5			− 5·1		− 1·4						7·3						2·6					
			− 7·5					1·5					7·7												
July....		− 7·2				− 4·7		0·2		2·4	3·6			5·0						3·2					
			− 7·0			− 4·1	− 2·5	1·0	3·0					8·7											
														9·5					4·9		1·7				
		− 9·0						2·3						6·3											
		− 8·7				− 2·6		− 0·5						6·5				3·8							
			− 6·3					0·1						6·7						3·2					
		7·6	− 6·7	− 6·8		− 5·0		1·4							7·5										
			− 7·7				− 4·6	− 2·4						9·8	5·8						1·8				
		− 8·5				− 3·6		0·3			7·2				6·7	7·0				3·3					
		− 9·7																			4·3				
		− 8·5			6·5	− 4·3		0·6						8·6	8·6						3·5				
			10·4					1·8							9·1						4·9				
		− 7·3						1·9			2·6				8·7										

TABLE B.—*Concluded.*

HOURS IN LOCAL MEAN TIME.

Month	7·00	7·30	8·00	8·30	9·00	9·30	10·00	10·30	11·00	11·30	12·00	12·30	1·00	1·30	2·00	2·30	3·00	3·30	4·00	4·30	5·00	5·30	6·00	6·30	7·00
July								0·7						8·6	8·6						6·1				
		- 7·1						- 2·1							6·2										
	- 6·2							0·8							6·3					5·9				4·9	
			- 6·2												7·6					3·4					
Aug.			- 6·4					- 0·6						6·2	6·3					3·5	2·6				
		- 9·1					2·3	3·4						10·7	10·7				6·0	5·6					
			- 9·1					- 1·0						10·0	8·2					2·4					
								- 1·4						8·8	8·8					3·4					
		- 6·9						- 3·2						5·0											
														8·1						5·3					
		- 7·6						- 1·0						7·1											
								3·0						6·0											
			- 7·9					1·7						10·0											
			- 8·7					1·4							8·7					5·8					
		- 7·6	- 7·6											7·7						4·0					
			- 8·1					3·2																	
		- 8·1						0·0						10·4							5·9				
			-10·0					1·0						7·5											
		- 7·0												7·4											
		- 6·7	- 6·4					- 0·1						5·3						3·2					
														6·8											
		- 6·3	- 5·6					- 1·9						5·9											
														6·5											
Sep.		- 8·1						2·9						6·4											
		- 7·1						2·0						8·6											
		- 7·6						1·4						6·9					0·5						
		- 6·2	- 6·2					0·1						6·8				1·8							
		- 7·9																		4·1					
			- 8·9			- 2·0		4·1						10·0											
															4·3					0·7					
			- 5·8			- 2·6		0·9						7·6											
			- 6·3					3·5						6·1											
														6·7					3·6						
								3·8						6·5						- 1·0					
			- 6·2					2·8						5·8											
		- 7·0	- 7·0					2·2							7·0					2·1					
		- 5·9						2·4						5·4											
Mean	- 6·2	- 7·2	- 7·3	- 6·1	- 4·8	- 3·6	- 1·3	+0·6	2·9	4·7	4·6	3·7	6·9	7·3	7·5	7·2	6·3	4·5	3·0	3·4	3·5	- 2·0	....	2·3	....
No. of Obs.	1	39	33	3	11	17	13	56	4	9	5	1	19	45	18	2	3	9	14	19	11	2		2	

The mean value for each hour and half-hour is given at the foot of the corresponding column, the small figures underneath indicating the number of observations from which the mean value was determined. Owing to the range of declination at Middleton and Dryden being rather large, the results at these places were left out of consideration.

At least two observations were taken for dip, one in the morning and one in the afternoon. In case the number of morning and number of afternoon observations differed, the mean of the morning was always combined with the mean of the afternoon values. The horizontal force was obtained from a complete set (oscillations and deflections) both in the morning and afternoon, the mean of the morning being always taken as one observation, the mean of the afternoon values as one, in case there were not the same number of each.

A complete day's observations consisted of the following, and in the order named: Declination (elongation), azimuth, declination, dip, declination, deflections, oscillations, latitude, declination (elongation), oscillations, deflections, azimuth, dip and declination. Frequently, when no astronomical observations were necessary, one or two extra observations for declination were taken. At a number of stations, two complete days' observations were taken.

Before commencing, and after completing the field work for the season, observations were made at the Magnetic Observatory at Agincourt, Ont., for comparing the field instruments with the standard instruments. The following table gives the corrections that were applied to the observed values, not only for the season 1910, but also for the two preceding seasons 1909 and 1908; also the value of log P where P is a constant depending on the distribution of the magnetism in the intensity magnet.

Year.	Tesdorpf 1977		Dover 145.		Tesdorpf 1977 Log P.		Remarks.
	Corr. Decl.	Corr. Hor. Int.	Needle.	Corr. Dip.	Short Dist.	Long Dist.	
1908	+3′·2	−·00061H	....	....	....	....	
1909	+1′·8	−·00104H	No. 1 & 2	−′·5	9·99106	9·99475	
1910	+3′·6	−·00128H	No. 1	−′·8	9·99178	9·99541	Log P, determined from 31 observations, distributed over the entire season.
			No. 2	−′·2			

Note:—Western declination reckoned negative, eastern declination positive.

During the season, 48 stations, lying between Chapleau, Ont., and Moosejaw, Sask., were occupied. Below is given a summary of the work done at each station.

Station.	Date.	No. of Observations for				Remarks.
		Declination.		Dip.	Hor. Int.	
		E. Elong.	W. Elong.			
Chapleau..........	May 7, 9...	2	2	2	4	Relocation of the Carnegie Institution station of 1906. Needle steady. Auroral display on night of 9th.
Wayland..........	May 10-11	1	2	3	4	Weather cold and cloudy. Needle steady. Astronomical observations not completed until May 13.
Missinaibi.........	May 14-16	1	2	4	3	The greatest westerly declination recorded on the 16th occurred about 11 a.m.; not much change for about 5 hours following.
Grasett...........	May 19-20	2	2	3	2	Disturbance on May 18. Needle slightly disturbed on 19th. Declination observations taken during the disturbance on May 18, on which day Halley's comet was nearest the earth, are given below. See p. 65.
White River.......	May 23-25	2	2	4	2	Approximately, a relocation of the Carnegie Institution station of 1906, but, owing to the removal of reference points, it was impossible to be sure of the precise point. Observing was discontinued on May 24, owing to a slight disturbance.
Montizambert.....	May 27-28	2	1	2	2	Faint aurora on night of May 26. Needle slightly unsteady on morning of 27th and again on morning of 28th; however, no observations were discarded.
Heron Bay........	May 30-31	2	2	4	4	Cloudy with snow on 30th; rained nearly all day of 31st, and needle slightly unsteady. Unable to complete the astronomical observations until June 3.

Station.	Date.	No. of Observations for				Remarks.
		Declination.		Dip.	Hor.Int.	
		E. Elong.	W. Elong.			
Middleton.........	June 4.....	1	1	2	2	Considerable local attraction. Range of declination, 19′.6, and dip was 80°20′. Sample of rock taken from cliff near station deflected the needle.
Schreiber.........	June 7–8...	1	1	2	4	Weather fine. Needle remained practically stationary for about two hours on morning of the 7th, and for about same length of time at noon. Disturbance on morning of 8th, so discarded the declination observations.
Gravel...........	June 9–10..	1	1	3	2	Worked only part of the 9th owing to a disturbance.
Nipigon..........	June 11–13.	2	2	4	4	Observed about 15 feet southerly from the Carnegie Institution station of 1906. Weather conditions good for observing.
Dorion...........	June 14.....	1	1	2	2	Only one day spent at Dorion. Needle steady.
Mackenzie........	June 15.....	1	1	2	2	Only one day spent at Mackenzie.
Fort William......	June 17–18.	2	2	4	4	Needle slightly unsteady, probably due to the electric car line which is about ¼ mile to the east.
Kaministikwia....	June 21–22.	1	1	2	2	Discontinued observing on 21st, owing to a disturbance.
Raith............	June 23–25.	2	2	3	2	Weather conditions good for observing. Needle steady.
Savanne..........	June 27–28.	2	2	4	4	Approximately, a relocation of the Carnegie Institution station of 1906. Needle steady.
Niblock..........	June 30–July 1...	2	2	3	3	Smoky owing to bush fires.
Martin...........	July 2–4....	2	2	3	4	The Western elongation about 3′·7 less on July 4th than it was on July 2nd; needle somewhat unsteady at noon on 4th.

Station.	Date.	No. of Observations for: Declination. E. Elong.	W. Elong.	Dip.	Hor. Int.	Remarks.
Ignace	July 6-8	3	3	4	4	Discarded observation of July 5th, owing to a disturbance. Slight disturbance on July 7th. Thunder storms on 6th and 7th.
Taché	July 11-12	2	2	4	4	No astronomical observations, except latitude obtained on the 11th, owing to clouds and showers. Thunder and hail storm about noon on the 12th, and unsettled during most of the afternoon.
Wabigoon	July 13-14	1	2	3	3	Conditions on both days satisfactory for observing.
Dryden	July 16-17	2	2	2	2	Judging from the results obtained here there is apparently considerable local attraction, although the surface conditions do not indicate it.
Eagle	July 18-20	2	2	2	2	Approximately, a relocation of the Carnegie Institution station of 1906. Conditions favourable for observing.
Vermilion	July 21	1	1	2	2	Completed the work in one day. Needle steady.
Hawk Lake	July 23-24	2	2	4	4	Weather conditions not very favourable; otherwise everything was quite satisfactory.
Kenora	July 26-27	1	2	2	4	Re-occupied the Carnegie Institution station of 1906. Apparently favourable conditions, though there is a good deal of rock in the vicinity.
Kalmar	July 28-29	1	1	2	2	Had difficulty in locating a suitable place for observing, owing to the uneven nature of the locality, which is, for the most part, covered with small trees.
Rennie	July 29-30	2	2	3	3	Conditions favourable for observing.

Station.	Date.	No. of Observations for				Remarks.
		Declination.		Dip.	Hor.Int.	
		E. Elong.	W. Elong.			
Whitemouth.......	Aug. 1-2...	1	2	2	3	The needle manifested a slight unsteadiness on Aug. 1st and 2nd, though the variation during the day seems quite regular. The range is rather large, being 18′.2. Observed for declination on Aug. 3rd, but discarded the results, as there was a marked disturbance.
Norquay..........	Aug. 4-5...	1	2	3	3	There was no apparent disturbance at the time of observing, though the range seems rather large, being 18′.2.
Winnipeg..........	Aug. 8-9...	1	2	3	4	The station is a relocation of the Carnegie Institution station of 1906. Point is marked by a stone pier marked 'C. I. 1908.' The needle showed signs of unsteadiness. There was an auroral display on the 9th.
Marquette........	Aug. 11-12	1	2	2	2	Conditions favourable for observing.
Portage-la-Prairie.	Aug. 15-16.	1	2	2	4	Thunder storms on afternoon and evening of the 15th; otherwise, conditions were favourable.
McGregor.........	Aug. 17-18.	1	1	2	2	Needle slightly unsteady on the morning of the 18th.
Carberry.........	Aug. 19-20.	2	2	4	4	Needle slightly unsteady Aug. 19.
Brandon........ .	Aug. 23-25.	3	3	4	4	Was unable to occupy the Carnegie Institution station of 1906, owing to the erection of buildings in the vicinity. Located on the Experimental Farm. Was unable to complete the astronomical work until the 25th.
Griswold..........	Aug. 26....	2	2	2	2	Completed the work in one day.
Virden............	Aug. 27-28	2	1	2	2	Slight unsteadiness of the needle on the 28th. Took an eastern elongation on the 29th, but a disturbance apparently existed.

Station.	Date.	No. of Observations for Declination. E. Elong.	W. Elong.	Dip.	Hor. Int.	Remarks.
Kirkella...........	Aug. 30–31	1	2	2	3	The station is approximately a relocation of the Carnegie Institution station of 1906. Range only 11′·2.
Wapella...........	Sep. 1–2....	2	2	4	4	Rained most of day of 1st. Fine and warm on 2nd.
Broadview........	Sep. 3–5....	2	2	4	4	Station approximately a relocation of the Carnegie Institution station of 1906. Unable to complete the astronomical work until Sept. 8th, owing to bad weather.
Wolseley..........	Sep. 9–10...	1	2	2	2	Slight disturbance on morning of 10th, and cold and windy during day.
Indian Head......	Sep. 12–13.	1	2	2	2	Located on the Experimental Farm. Unable to find a place where it was possible to take the bearings of a number of well-defined objects, owing to the level nature of the land, and the trees surrounding the fields. Needle slightly disturbed on morning of the 13th.
Balgonie..........	Sep. 14–15..	1	2	2	3	Conditions favourable for work.
Regina............	Sep. 16–17..	1	2	2	4	Unable to occupy the Carnegie Institution station of 1906. Located about one-fourth of a mile in a southwesterly direction, on the jail grounds. No apparent disturbance, though there was only about 3′ change in declination between 10–30 and the western elongation. Observations on the two days are concordant.
Pense............	Sep. 19....	1	1	2	2	Completed the work in one day, conditions being quite favourable.
Moosejaw.........	Sep. 20–23..	3	4	4	4	Disturbance, though slight, on 20th, 21st and 22nd. Range on 21st, 22nd and 23rd was 6′.5, 6′.2, and 11′.3, respectively.

OBSERVATIONS for Declination, taken at Grasett, Ont., on May 18, 1910, preceding, during, and following the computed passage of Halley's Comet.

75th Mer. Time.			Declination.			Temp.	Remarks.
h.	m		°	′			
7	25	a.m.	3	56·8	W. of N.		Snowing.
	30	"		56·8	"		
	35	"	4	2·6	"		
	40	"		2·6	"		
	43	"		4·4	"		
	45	"		4·4	"		
	46	"		4·2	"		
	48	"		3·6	"		
	50	"		4·4	"		
	55	"		4·6	"		
8	00	"		7·0	"		
	05	"		7·8	"		
9	35	"		2·8	"		
	36	"		2·2	"		
	37	"		1·4	"		
	40	"	3	59·2	"		
	45	"		59·2	"		
	50	"		58·6	"		
	55	"	4	3·0	"		
10	00	"		3·2	"		
	05	"		4·4	"		
	10	"		5·2	"		
	15	"		5·6	"		
	20	"		8·6	"		
	25	"		13·2	"		
	30	"		13·8	"		
	35	"		15·0	"		
	40	"		16·2	"		
	45	"		11·0	"		
	50	"		11·4	"		
	55	"		12·4	"		
11	00	"		16·4	"		
	15	"		12·4	"		
	20	"		10·8	"		
	25	"		10·6	"		
	30	"		8·8	"		
	35	"		10·4	"		
1	30	p.m.		00·4	"		
	35	"	3	59·2	"		
	40	"		56·4	"		
	45	"		56·8	"		
	50	"		56·8	"		
2	05	"		55·0	"	58°·0 *F*	
	15	"		54·4	"		
	20	"		52·6	"		
	30	"		55·8	"		
	35	"		54·4	"		
	40	"		53·2	"	56°·0 *F*	
	50	"		54·4	"		
3	00	"		52·4	"		
	15	"		47·4	"		
	25	"		48·8	"		
	50	"		50·4	"		
4	00	"		49·2	"		
	50	"		48·8	"		
5	00	"		46·0	"	52°·0 *F*	
	40	"		46·8	"		

OBSERVATIONS for Declination, taken at Grasett, Ont., on May 18, 1910, preceding, during, and following the computed passage of Halley's Comet.—*Con.*

75th Mer. Time.	Declination.	Temp.	Remarks.
h. m.	° ′		
6 10 p.m.	3 48·8 W. of N.	52°·0 *F*	
20 "	47·2 "	....	
30 "	47·8 "	....	
40 "	45·4 "	....	
7 25 "	45·2 "	46°.0 *F*	Clouds and showers.
35 "	42·2 "	....	
40 "	43·2 "	....	
45 "	39·2 "	....	
50 "	47·0 "	....	
55 "	43·4 "	....	
8 00 "	43·2 "	....	
05 "	43·2 "	....	
10 "	43·2 "	....	
20 "	49·2 "	....	
25 "	56·4 "	....	
30 "	54·2 "	46°·0 *F*	Clouds.
35 "	54·8 "	....	Showers.
40 "	49·6 "	....	
45 "	48·4 "	....	
50 "	49·4 "	44°·0 *F*	
55 "	50·6 "	....	
9 00 "	47·6 "	....	Clouds.
05 "	46·4 "	....	
10 "	43·4 "	....	
15 "	45·2 "	....	
20 "	36·4 "	....	
25 "	39·0 "	....	
30 "	32·2 "	....	
35 "	35·4 "	....	
40 "	39·0 "	....	
45 "	37·2 "	42°·0 *F*	
50 "	38·4 "	....	
10 00 "	38·8 "	....	
05 "	35·2 "	....	
10 "	36·8 "	....	
15 "	39·8 "	....	
20 "	28·4 "	....	
22 "	52·6 "	....	
24 "	4 2·8 "	....	
26 "	10·8 "	....	
30 "	8·2 "	....	
35 "	10·0 "	....	Cloudy and showery during the night, but rifts in the clouds revealed what appeared to be an auroral display.
40 "	3 54·4 "	....	
45 "	52·2 "	44°·0 *F*	
50 "	55·0 "	....	
55 "	4 01·2 "	....	
11 00 "	01·2 "	....	
05 "	01·2 "	....	
10 "	3·0 "	....	
15 "	8·2 "	....	
20 "	3 58·2 "	....	
25 "	4 3·0 "	....	
30 "	3 53·6 "	....	
35 "	52·8 "	....	
40 "	45·2 "	....	
45 "	39·2 "	....	
50 "	29·4 "	38°·0 *F*	

AGINCOURT.

(Base station)

Month	Declination.			Inclination.			Horizontal Intensity.		
	1906.	1910.	Diff. 06–10	1906.	1910.	Diff. 06–10.	1906.	1910.	Diff. 06–10.
	° ′	° ′	′	° ′	° ′	′			
Jan.........	−5 42·8	−6 01·7	18·9	74 35·0	74 38·4	−3·4	·164031	·162860	·00117
Feb.........	43·3	1·7	18·4	35·0	38·3	−3·3	·163971	·162860	·00111
March......	43·5	2·5	19·0	35·3	38·6	−3·3	·163988	·162755	·00123
April.......	43·9	3·0	19·1	35·7	38·4	−2·7	·164074	·162667	·00140
May........	43·7	3·1	19·4	34·3	38·3	−4·0	·164051	·162750	·00130
June........	43·6	3·5	19·9	34·3	37·2	−2·9	·164061	·162840	·00122
July........	44·6	3·7	19·1	34·3	37·8	−3·5	·164056	·162790	·00127
August......	47·3	4·7	17·4	33·1	38·5	−5·4	·163960	·162630	·00133
Sep.........	47·3	5·1	17·8	35·9	38·8	−2·9	·163884	·162610	·00127
Oct.........	47·5	5·4	17·9	36·5	39·4	−2·9	·163857	·162440	·00142
Nov........	47·7	6·1	18·4	35·3	38·8	−3·5	·163887	·162490	·00140
Dec.........	48·9	6·1	17·2	35·5	39·0	−3·5	·163833	·162480	·00135

Results for 1906 taken from Meteorological Service Report for 1906; and results for 1910 taken from the Journal of the Royal Astronomical Society of Canada for 1910.

Description of Magnetic Stations occupied by C. A. French in 1910.

Chapleau, Ont.—The station is a relocation of the Carnegie Institution station. It is near the river bank on the east side of the town, just at the end of the street, lying between the Protestant and Catholic cemeteries. It is 60 feet southeast of the southeast corner of the Protestant cemetery, and 59 feet northeast of the northeast corner of the Catholic cemetery. True bearings of the following points were determined:—

Pole on Algoma hotel, 72° 31′.3 west of south.
Pole on water-tank (R.O.), 73° 21′.1 west of south.

Wayland, Ont.—The station is 244 feet southwesterly from the southwesterly corner of the C. P. R. depot. From the station, all of the depot, except the southerly end, is hidden from view by a large boulder, which is about 94 feet distant in a northeasterly direction. A stake, 2 inches in diameter, and projecting 15 inches above ground, marks the point. True bearings of the following points were determined:—

Chimney on C. P. R. water-tank (R.O.), 19° 14′.2 east of north.
South gable of C. P. R. depot, 41° 57′.8 east of north.

Missinaibi, Ont.—The station is approximately a relocation of the Carnegie Institution station of 1906. It is about one-fourth of a mile west of the old Hudson's Bay Company's post and about 400 feet south of the railroad. From the station the C. P. R. pump-house and tank may be seen slightly to the west of the centre of the top of the Hudson's Bay Company's new store. The point is 56 feet from the southeasterly corner and 49.5 feet from the southwesterly corner of the Episcopal church. True bearings of the following points were determined:—

Chimney on C. P. R. Co.'s water-tank (R.O.), 24° 29′.9 west of north.

Pole on school, 2° 36′.2 west of north.

Southeasterly corner of Hudson's Bay Co.'s store, 19° 8′.5 west of north.

The point is marked by a stake, 2 inches in diameter, and 6 inches above ground.

Grasett, Ont.—The station is in a small clearing northeast of the C. P. R. depot. It is 366 feet northeast of the northeast corner of the section-house on the south side of the C. P. R. tracks. The line joining the station with the corner of the section-house intersects the track 72 feet from the house. The point is marked by a stake, 3 by 3 inches, and projecting 2 inches above ground. True bearings of the following points were determined:—

Pole on east end of south section-house, 136° 26′.5 west of north.

Pole on west end of south section-house, 133° 53′.3 west of north.

Gable of north end of north section-house, 122° 26′.3 west of north.

White River, Ont.—The station is probably within 20 feet of the Carnegie Institution station. It is 110.5 feet east of the Y. M. C. A. building and slightly to the north of a line extending from, and at right angles to, the middle of the eastern side of the building. It is 152.5 feet southeasterly from the southeast corner of the main part of the Methodist church. The tip of the pole on the C. P. R. water-tank may be seen over the east gable of the school, and also over a building used as a dwelling-house and pool-room. True bearings of the following points were determined:—

Tip of ventilator on C. P. R. roundhouse, 63° 5′.4 west of north.

Tip of pole on C. P. R. water-tank, 52° 14′.4 west of north.

Chimney on English church, 22° 4′.5 west of north.

Spire on Catholic church (R.O.), 17° 28′.4 west of north.

The point is marked by a stake, 2 inches by 3 inches, projecting 3 inches above ground.

Montizambert, Ont.—The station is on a clearing, northwest of the C. P. R. depot, being 540 feet westerly from the depot, 165 feet north of the C. P. R. tracks, and 90 feet south of the White river. The east end of the section-house, on the south side of the track, may be seen to the east of a log building, which is distant 51 feet from the station. True bearings of the following points were determined:—

West gable of C. P. R. depot (R.O.), 52° 7′.9 east of north.

East gable of C. P. R. section-house, 133° 55′.1 east of north.

The point is marked by a stake, 2 inches in diameter, and projecting 2 inches above ground.

Heron Bay, Ont.—The station is in a field lying to the northwest of the C. P. R. depot. It is about 325 feet north of the C. P. R. tracks, and is in line with, and 40 feet north of, the end of a fence, which, if continued in a southerly direction, would pass about 20 feet west of the depot. About 30 feet south of the station is a ridge of rock extending 40 feet in an easterly and westerly direction. The point is marked by a stake, 2 inches by 4 inches, and projecting 3 inches above ground. True bearings of the following points were determined:—

North gable of Begg's house and store, 119° 12′.8 east of north.

West gable of C. P. R. depot, 155° 00′.9 east of north.

North gable of Miller's store (R.O.), 172° 22′.1 east of north.

Middleton, Ont.—The station is about 450 feet south of the C. P. R. tracks, and 75 feet north of the edge of a gravel beach on Lake Superior. It is 35 feet west of a rocky bluff and 12 feet north of an excavation. To the west, about 12 feet and beyond, the soil consists, for the most part, of stones and coarse gravel. The point is marked by a stake, 3 inches in diameter, and projecting 1 inch above ground. True bearings of the following points were determined:—

Top of second telegraph pole west of C. P. R. depot, 2° 26′.1 east of north.

West gable of C. P. R. depot (R. O.), 34° 23′.1 east of north.

East gable of C. P. R. depot, 38° 9′.1 east of north.

A piece of rock taken from the bluff to the east of the station showed marked magnetic action.

Schreiber, Ont.—The station is a relocation of the Carnegie Institution station of 1906. It is in an open field about one-third of a mile east of the town, near the cemetery, being 100 feet from the southwest corner, and directly in line with the picket fence on the south side. It is one-quarter of a mile east of the railroad. True bearings of the following points were determined:—

Tip of ventilator on C. P. R. shops, 12° 47′.7 west of south.

Tip of pole on C. P. R. water-tank (R.O.), 28° 56′.3 west of south.

Spire on Presbyterian church, 56° 24′.5 west of south.

East gable of Y. M. C. A. building, 78° 2′.5 west of south.

Tip of belfry on school, 85° 19′.5 west of north.

Gravel, Ont.—The station is at the summit of a slope, 224 feet north of the C. P. R. tracks. It is in line with the east side, and 182 feet from the northeast corner of the C. P. R. depot. It is 97 feet northwest of the northwest corner of a small red house, belonging to Mr. Roy. True bearings of the following points were determined:—

East gable of C. P. R. depot, 34° 9′.8 west of south.

Top of pole on C. P. R. water-tank (R.O.), 78° 55′.4 west of north.

A stake, 2 inches in diameter and projecting 4 inches above ground, marks the point.

Nipigon, Ont.—The station is approximately 11.5 feet south and 5 feet west of the Carnegie Institution station of 1906. It is in the northeastern part of the town, about 400 feet east of the C. P. R. tracks. It is 11.5 feet south of the fence along the north side of the street running from the C. P. R. water-tank eastward to the river, and 17 feet from the bank of the river. True bearings of the following points were determined:—

Spire on Presbyterian church, 142° 40′.1 west of north.

Top of pole on Hudson's Bay Co's store, 118° 52′.1 west of north.

Spire on C. P. R. water-tank, 88° 35′.2 west of north.

Dorion, Ont.—The station is in an open field, north of the C. P. R. tracks and depot. It is 190 feet north of the fence on the south side of the field which is adjacent to the C. P. R., and 84 feet east of the middle of the road which crosses the field. True bearings of the following points were determined:—

South gable of Mr. Kohler's stable, 32° 50′.7 west of north.

South gable of house on farm lying to north of Mr. Kohler's, 28° 28′.8 west of north.

South gable of Mr. Kohler's house, 22° 51′.4 west of north.

Mackenzie, Ont.—The station is on a small clearing northwest of the C. P. R. depot. It is 263 feet north of the tracks, and is in line with the west end of the section-house, being 228 feet from the northwest corner of the main part of the building. True bearings of the following points were determined:—

West gable of C. P. R. depot, 125° 59′.3 east of north.

East pole on section-house, 155° 30′.0 east of north.

West pole on section-house (R.O.), 161° 2′.8 east of north.

Tip of pipe on C. P. R. water-tank, 176° 56′.8 east of north.

Fort William, Ont.—The station is in an open field, lying north of Leith street and west of Archibald street. It is 22 feet west of the west side of Archibald street, and is north of, and in line with, the east end of the 'Arena,' being 96.5 feet north of the fence on the north side of the enclosure surrounding the building. True bearings of the following points were determined:—

Bottom of flagstaff on school, 3° 41′.2 east of north.

Pole on C. P. R. elevator B, 40° 0′.1 east of north.

Top of pole on Central school, 140° 55′.3 east of north.

Top of pole on City hall (R.O.), 160° 1′.8 east of north.

Top of pole on the 'Arena,' 0° 6′.6 west of south.

Kaministikwia, Ont.—The station is about 380 feet north of the C. P. R. tracks. It is almost in line with the easterly end, and is 99 feet southerly from the southeasterly corner of a log house on the west side of the road, and further, is 109 feet southwesterly from the southwest corner of another log house on the east side of the road. These are the only houses in the immediate vicinity.

The point is marked by a stake, 2 by 3 inches, and projecting 2 inches above ground. True bearings of the following points were determined:—

West gable of C. P. R. freight-shed, 59° 18′.2 west of south.

Northwest corner of C. P. R. depot, 74° 39′.0 west of south.

Top of pole on C. P. R. water-tank (R.O.), 64° 28′.4 west of north.

Raith, Ont.—The station is 150 feet north of the Grand Trunk Pacific railway. It is in line with the south side of Mr. Johnson's house, and 240 feet east of the southeast corner.

A stake, 2 by 4 inches, and 1 inch above ground, marks the point. True bearings of the following points were determined:—

Top of pole on C. P. R. water-tank, 78° 13′.6 west of south.

East gable of C. P. R. depot, 75° 17′.4 west of north.

Top of pole on G. T. P. water-tank (R.O.), 64° 37′.1 west of north.

East gable of C. P. R. section-house, 54° 56′.0 west of north.

Savanne, Ont.—This is approximately a relocation of the Carnegie Institution station of 1906. The station is near the Savanne river, about one-quarter of a mile south of the C. P. R. tracks. It is about 54 feet north of the bank of the river, in a path which leads south from the railroad, leaving the railroad at a point 800 feet east of the depot. There is a telegraph pole about 20 feet west of the continuation of a line joining the station and the pole on the Hudson's Bay Company's store (now vacated). The point is marked by a stake, 3 inches in diameter, and projecting 3 inches above ground. True bearing of the following point was determined:—

Pole on Hudson's Bay Company's store, 24° 30′.1 east of north.

Niblock, Ont.—The station is on a small clearing southwest of the C. P. R. depot, being on the summit of a small ridge which runs in an easterly and westerly direction. It is 270 feet southwesterly from the southwest corner of the main part of the depot. The point is marked by a stake, 2 inches in diameter, and projecting 3 inches above ground. True bearings of the following points were obtained:—

South gable of small car-house west of depot (R.O.), 7° 21′.1 east of north.
Southwest corner of main part of C. P. R. depot, 62° 7′.8 east of south.

Martin, Ont.—The station is near the northeasterly corner of a field surrounding the section-house, being 17 feet from the fence on the northerly side and 24 feet from the fence on the easterly side of field. It is 226 feet in a northerly direction from the C. P. R. tracks, and 206 feet northeasterly from the northeast corner of the section-house. A stake, 2 inches in diameter and projecting 3 inches above ground, marks the point.

The east gable of the section-house bears 76° 18′.2 east of north.

Ignace, Ont.—The station is approximately a relocation of the Carnegie Institution station of 1906. It is in an open field, about 500 feet south of the C. P. R. tracks and about 600 feet southeast of the C. P. R. roundhouse. It is 208 feet east of the east side of the first street east of the Y. M. C. A. building, and 52 ft. north of the fence on the south side of the field. True bearings of the following points were determined:—

Tip of pole on C. P. R. water-tank, 61° 15′.8 west of north.
Tip of pole on Y. M. C. A. building (Ignace hotel) (R.O.), 35° 18′.9 west of north.
East gable of store, 26° 30′.1 west of north.

Taché, Ont.—The station is east of the river, and 260 feet south of the C. P. R. tracks. It is about 12 feet east of a point which is in line with the east end of the railway bridge over the river, 18 feet from the edge of a small ravine on the west, and 15 feet from the edge of one on the south. The point is marked by a stake, 2 inches in diameter, and projecting 3 inches above ground. True bearings of the following points were determined:—

East gable of C. P. R. depot (R. O.), 16° 24′.9 west of north.
Top of pipe on chimney of C. P. R. depot, 16° 6′.2 west of north.
Tip of pole on C. P. R. water-tank, 6° 25′.8 east of north.
South gable of car-house, 61° 22′.7 east of north.

Wabigoon, Ont.—The station is 34 feet south of the foot of a ridge of rock which terminates Stanley avenue at its northerly end, and is in line with the fence on the easterly side of the street. The point is marked by a stake, 2 inches by 3 inches, projecting 3 inches above ground. True bearings of the following points were determined.

Top of cross on English church, 44° 51′.7 east of south.

Pole on Imperial hotel (R.O.), 28° 54′.9 east of south.

Gable of house on southerly side of bay, 16° 44′.5 west of south.

Dryden, Ont.—The station is about ¼ of a mile northeast of the town on the east side of the Wabigoon river. It is on an unused portion of the Government road which runs from the river into the country in a northeasterly direction, and is about midway between the river and the end of Florence street, which intersects the road at right angles. The road leading from the town meets the main road where the latter and Florence street intersect. The pole on the C. P. R. water-tank may be seen about midway between the cross on the English church and the pole on the Central hotel. The point is 34 feet from the southerly side of the Government road and 290 feet from the northeasterly corner formed by the intersection of Florence street and the Government road. The point is marked by a 3 by 3-inch stake, projecting 2 inches above ground. True bearings of the following points were determined:—

North chimney on Mr. Swanson's house, 99° 32′.3 east of north.

Cross on English church, 121° 51′.4 east of north.

Pole on C. P. R. water-tank (R. O.), 123° 00′.0 east of north.

Eagle, Ont.—The station is approximately a relocation of the Carnegie Institution of 1906. It is about ¼ of a mile east of the C. P. R. depot (moved since 1906), and about 500 feet south of the C. P. R. tracks. A line, which is a continuation of the east side of Mr. J. A. Gardiner's house (formerly the Central hotel) in a southerly direction, intersects a line joining the station and pole on the C. P. R. water-tank, 177 feet from the southeast corner of the house and 64 feet westerly from the station. True bearings of the following points were determined:—

Top of pole on C. P. R. water-tank (R. O.), 74° 33′.8 west of south.

East gable of C. P. R. depot, 77° 24′.5 west of south.

Bottom of pole on 'Blue' store, 74° 37′.4 west of north.

Left edge of chimney on Mrs. Mitchell's house, 60° 55′.9 west of north.

East gable of Mrs. Mitchell's house, 58° 27′.5 west of north.

Vermilion, Ont.—The station is north of the C. P. R. tracks about 400 feet. It is 6 feet west of being in line with the west side of the Grand Trunk house, and is 158 feet north of the northwest corner of the main part of the building. It is 30 feet west of being in line with the west side of the C. P. R. depot, and is 288 feet north of the fence on the north side of the C. P. R. yard. A stake, 2 by 2 inches, and 2 inches above ground, marks the precise point. True bearings of the following points were determined:—

East gable of freight-shed, west of C. P. R. tank (R. O.), 34° 52′.5 west of south.

Top of pole on C. P. R. water-tank, 24° 43′.3 west of south.

East gable of C. P. R. depot, 14° 0′.9 east of south.

Hawk Lake, Ont.—The station is located on a clearing slightly to the west of south from the C. P. R. depot, and about 300 feet south of the C. P. R. tracks. It is 25 feet from the shore of the lake and 100 feet southwesterly from a rocky beach, exposed part of the rock being about 20 feet in width. The central portion of this part of the beach is in line with the west end of the C. P. R. depot. The point is marked by a stake, 2 inches in diameter, and projects 4 inches above ground. True bearings of the following points were determined:—

West gable of C. P. R. depot (R.O.), 9° 40′.4 west of north.
East gable of C. P. R. depot, 1° 27′.2 west of north.
First telegraph pole east of C. P. R. depot, 6° 52′.2 east of north.

Kenora, Ont.—The station is approximately a relocation of the Carnegie Institution station of 1906. The point is west of and slightly to the north of being in line with the front of Mr. Wilson's house. It is 58 feet west of the fence along the west side of Mr. Wilson's lot, and 16 feet north of the north side of Park street (East Third street). True bearings of the following points were determined:—

Spire on Knox church (R. O.), 67° 24′.0 west of south.
Pole on Central school, 84° 43′.4 west of north.
Spire on Episcopal church, 78° 7′.1 west of north.
Spire on Catholic church, 74° 38′.6 west of north.

Kalmar, Ont.—The station is on a level portion of ground near the summit of a slope lying to the east of the western section-house. It is reached by a path, which leaves the C. P. R. tracks at a point about 50 feet east of the section-house. It is about 245 feet north of the tracks, and about 300 feet northeast of the north-east corner of the house. The point is marked by a stake, 2 inches in diameter, and projecting 1 foot above ground. A mound of stones surrounds the stake.

The east gable of the section-house bears 57° 30′.1 west of south.

Rennie, Man.—The station is on the property of Mr. Shepherd. It is about 300 feet northeast of the C. P. R. depot, being near the southeast corner of the second enclosure, east of the C. P. R. tracks. It is 33 feet north of the fence on the south, and 90 feet west of the fence on the east side of the enclosure. A stake, 3 inches in diameter and 6 inches above ground, marks the precise point. True bearings of the following points were determined:—

Top of pole on C. P. R. water-tank (R. O.), 56° 21′.1 east of south.
Left edge of east chimney on C. P. R. depot, 52° 38′.1 west of south.

Whitemouth, Man.—The station is northeast of the C. P. R. depot, and about 600 feet north of the C. P. R. tracks, being on property belonging to Mr. McKinley. It is at the summit of a slope adjacent to the river, and is 15 feet north of the fence which marks the northerly limit of the first enclosure north of the main street of the village. It is 75 feet west of a gate which is on the west side of a lane running from the main street to the river; 140 feet northeast of a church, and about 225 feet west of the C. P. R. pump-house. A stake, 2 inches in diameter and 4 inches above ground, marks the precise point. True bearings of the following points were determined:—

Top of pole on C. P. R. water-tank (R. O.), 35° 34′.0 west of south.
Pole on east end of C. P. R. depot, 53° 41′.4 west of south.

Norquay, Man.—The station is in an open field belonging to Mr. Black. It is 360 feet south of the south limit of the C. P. R. right-of-way, and 140 feet east of the west limit of the Government road allowance. A squatter's house is about 100 feet northwesterly from the station. True bearings of the following points were determined:—

East gable of section-house (R. O.), 26° 16′.0 west of north.
West gable of C. P. R. depot, 4° 1′.6 east of north.

Winnipeg, Man.—The station is a relocation of the Carnegie Institution station of 1906. A stone pier, marked 'C. I., 1908,' represents the precise point. It is in River park, about one-half mile east of the park entrance, in the first cleared space beyond the grove of small trees that surround the entrance. It is about 45 feet from the top of the north bank of the Red river, and in line with 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:—

Pole on red water-tank (R. O.), 23° 36′.9 east of north.
Smoke-stack near International elevator, 39° 17′.1 east of north.
West gable of large white house, 47° 25′.9 east of north.

Marquette, Man.—The station is about 300 feet southwesterly from Mr. Smith's store, and about 500 feet south of the C. P. R. tracks. It is 76 feet east of the middle of a north-south road, 161 feet north of the middle of the east-west road, and 169 feet southwest of the southwest corner of a red barn. Mr. Smith's store appears midway between the west end of the C. P. R. depot and the east end of the C. P. R. section-house. A stake, 2 inches in diameter and 3 inches above ground, marks the point. True bearings of the following points were determined:—

West gable of C. P. R. freight-shed, 45° 57′.9 east of north.
West gable of C. P. R. depot, 49° 15′.5 east of north.
East gable of C. P. R. section-house, 64° 4′.7 east of north.
Pole on west end of Mr. Brown's stable (R.O.), 121° 37′.2 east of north.

Portage-la-Prairie, Man.—The station is on the grounds of the Agricultural Association, near the east end of the enclosure, which is inside the race-track. It is 132 feet west of the easterly extremity of the curved portion of the fence, 190 feet north of the fence on the south side, and 200 feet south of the fence on the north side of the enclosure. True bearings of the following points were determined:—

Bottom of pole on judges' stand, near barns (R. O.), 77° 52′.5 west of north.
West pole on grandstand, 63° 39′.3 west of north.
East pole on grandstand, 54° 10′.6 west of north.
Bottom of pole on pavilion, 46° 38′.8 west of north.

McGregor,[3] *Man.*—The station is near the northwest corner of a small field belonging to Mr. F. E. Lewin. The field is adjacent to the south side of the school grounds and the street which passes to the west of the school. The point is 26 feet south of the fence on the south side of the school grounds, and 38 feet east of the street fence. The point is marked by a stake, 2 inches by 4 inches, and projecting 2 inches above ground. True bearings of the following points were determined:—

Tip of pole on C. P. R. water-tank, 16° 25′.2 east of south.

Bottom of spire on Methodist church (R. O.), 43° 37′.6 east of south.

Tip of pole on public school, 62° 6′.9 east of north.

Carberry, Man.—The station is in an open field in the northwestern part of the town, being in block 6, between First and Second avenues, on the north and south, and Dufferin and Lisgar streets on east and west, respectively. It is 88 feet east of Lisgar street, and 172 feet south of First avenue. The point is marked by a 2-by 2-inch stake, driven flush with the ground. True bearings of the following points were determined:—

Top of short pole on front of public school, 89° 13′.9 east of south.

Spire on Presbyterian church, 65° 16′.6 east of south.

Top of pole on bell-tower near town-hall, 52° 4′.8 east of south.

Top of pole on town-hall, 50° 54′.6 east of south.

Spire on English church, 24° 42′.6 east of south.

Top of pole on elevator (R. O.), 12° 42′.2 east of south.

Brandon, Man.—The station is on the Dominion Experimental Farm, being near the summit of the second small ridge lying to the northeast of the farm buildings. It is 231 feet east, and 180 feet north of the southeast corner of the large barn (trees preventing measurements being taken from the northeast corner), 230 feet northwesterly from the Meteorological station, and 24 feet southeast of a flag-pole. A stake, 2 by 4 inches, driven flush with the ground, marks the point. True bearings of the following points were determined:—

West gable of the Superintendent's house, 55° 15′.2 east of south.

Spire on Catholic church in city, 43° 41′.0 east of south.

Top of dome of public school in city, 29° 8′.2 east of south.

Top of central dome of Brandon college, 23° 22′.2 east of south.

Smokestack on mill, 2° 19′.8 east of south.

Griswold, Man.—The station is in an open field, south of the C. P. R. tracks and in line with the west end of the C. P. R. depot. It is 460 feet south of the tracks, and 123 feet south of a well, which is about 6 feet east of a line joining the southwest corner of the C. P. R. depot and station. True bearings of the following points were determined:—

South gable of elevator No. 188, 21° 26′.0 west of north.

West pole of C. P. R. depot, 12° 56′.7 west of north.

East pole of C. P. R. depot, 9° 27′.7 west of north.

East pole on hotel (R. O.), 2° 32′.7 east of north.

South gable of Ogilvie's elevator, 19° 43′.4 east of north.

South gable of International Elevator Company's elevator, 33° 17′.1 east of north.

Virden, Man.—The station is located near the northeast corner of the Agricultural grounds. It is about 70 feet outside the race-track, 57 feet west of the fence on the east side, and 63 feet south of the fence on the north side of the grounds.

The top of the C. P. R. depot may be seen a little to the left of the pole on the Alexandra hotel. The point is marked by a 2 by 2-inch stake which projects 1 inch above ground. True bearings of the following points were determined:—

Bottom of pole on C. P. R. water-tank, 68° 27′.0 west of south.

Bottom of pole on Alexandra hotel (R. O.), 89° 32′.9 west of south.

East gable of Ogilvie's elevator, 83° 2′.4 west of north.

East gable of Impl. Elevator Co's elevator, 69° 29′.7 west of north.

Kirkella, Man.—The station is approximately a relocation of the Carnegie Institution station of 1906. It is southeast of the group of houses comprising the village. It is in line with the west end and 112 feet south of the southwest corner of the main part of the Episcopal church, 109 feet east of the east boundary of the school yard, and 42 feet west of the west side of the street which passes to the rear of the church. A stake, 2 by 2 inches, and 3 inches above ground, marks the point. True bearings of the following points were determined:—

Southeast corner of upper part of elevator No. 27, 37° 54′.5 west of north.

South gable of elevator No. 27 (R. O.), 37° 53′.7 west of north.

Left edge of west chimney on C. P. R. depot, 14° 59′.6 east of north.

Left edge of east chimney on C. P. R. depot, 17° 55′.9 east of north.

Wapella, Sask.—The station is northeast of the town near the northwest corner of the Agricultural grounds. It is 51 feet south of the north fence, and 156 feet east of the west fence. The point is marked by a stake, 4 by 4 inches, and projecting 4 inches above ground. True bearings of the following points were determined:—

North gable of elevator No. 158, 57° 10′.9 west of south.

Top of pole on C. P. R. water-tank 79° 58′.9 west of south.

Bottom of spire on English church, 87° 5′.3 west of north.

Tip of belfry on school (R. O.), 72° 20′.9 west of north.

Broadview, Sask.—The station is a relocation of the Carnegie Institution station of 1906. The point is 54 feet southwest from the southwest corner of the main part of the Grenfell Milling Company's implement house, and 61 feet northwesterly from the southwest corner of the shed at rear of and adjoining the building. True bearings of the following points were determined:—

Southwest corner of stone house on hill (R.O.), 77° 16′.9 west of north.

Southwest corner of west abutment of C. P. R. bridge, 33° 53′.6 west of north.

Spire on Baptist church, 35° 4′.3 east of south.

Wolseley, Sask.—The station is in an open field north of the town, being 40 feet east of a fence which is in line with the west side of the street passing the town-hall. It is west of and in line with the south side of a white cottage, and about 520 feet north of the street passing along the north side of the court-house grounds. True bearings of the following points were determined:—

Tip of spire on German church, 76° 28′.4 east of south.

Bottom of pole on court-house, 9° 33′.8 east of south.

Bottom of pole on town-hall, 3° 32′.2 west of south.

Tip of cross on Catholic church (R.O.), 63° 41′.4 west of south.

Indian Head, Sask.—The station is on the Dominion Experimental Farm, being about 650 feet southeast of the barns. It is on a low-lying field, and about 50 feet northwesterly from a slough. It is 57 feet east of a row of trees on the east side of a lane which passes to the east of the barns, 42 feet northwesterly from the middle of a road running along the north side of the slough, and 190 feet northeasterly from a windmill. A stake, 2 by 2 inches, and 2 inches above ground, marks the point.

The east ventilator of a barn, south of the C. P. R. tracks, bears 4° 56′.6 west of south.

Balgonie, Sask.—The station is in the northeastern part of the town. It is in line with the south side and 119 feet east of the southeast corner of the Methodist church. The point is marked by a stake, 2 inches in diameter and 3 inches above ground. True bearings of the following points were determined:—

Tip of spire on English church (R. O.), 48° 29′.3 west of south.
Bottom of pole on town-hall, 74° 30′.2 west of south.
South gable of elevator No. 77, 63° 33′.6 west of north.
Northwest corner of lower part of elevator No. 11, 1° 49′.9 west of north.

Regina, Sask.—The station is about one-quarter mile southwesterly from the Carnegie Institution station of 1906. It is on the south side of the city, in an open field, which is part of the jail property. It is approximately in the centre of Osler street produced, is 51 feet south of the south side of 16th avenue, and 300 feet east of the east side of Broad street. True bearings of the following points were determined:—

Flag pole in yard south of jail, 44° 49′.2 west of south.
Top of cross on Catholic church, 31° 16′.5 west of north.
Top of cross on Roumanian church, 19° 3′.5 east of north.
Northeast corner of Regina General Hospital, 31° 0′.1 east of north.
Southeast corner of Regina General Hospital, 35° 22′.5 east of north.

Pense, Sask.—The station is in an open field, about 470 feet south of the C. P. R. tracks. It is in line with the east side of the main part of elevator No. 78, and is 450 feet south of the south side of the shed adjoining the elevator. The west chimney of the C. P. R. depot appears slightly to the right of the elevator, and the spire of the English church appears midway between the chimney and north end of 'Hardware' store. True bearings of the following points were determined:—

Southwest corner of Springrice's elevator, 34° 12′.2 west of north.
Spire of English church (R. O.), 21° 55′.0 west of north.
South gable of elevator No. 78, 11° 9′.3 west of north.
South gable of Winnipeg Elevator Co's. elevator, 11° 2′.0 east of north.

Moosejaw, Sask.—The station is in the northern part of the city, being near the southeast corner of the enclosure comprising the Agricultural grounds. The point is 108 feet north of the south fence, 122 feet west of the east fence of grounds, and 73 feet southeast of the fence around the race-course. The point is marked by a 2 by 4-inch stake, which projects 3 inches above ground. True bearings of the following points were obtained:—

Spire on English church at corner of East High street and 10th avenue, 10° 33′.2 west of south.

Pole on Collegiate Institute (R. O.), 53° 50′.4 west of south.

Spire on dome of house over reservoir, 85° 7′.4 west of south.

Spire on dome west of grandstand, 87° 51′.0 west of north.

Description of Magnetic Stations occupied by J. W. Menzies in 1910.

Napanee.—The station is situated on the circus grounds which border on the third street southwest from the G. T. R. station. The grounds are owned by Sir Richard Cartwright. Transit was placed 162 feet east of the west limit of the street on the west of the grounds and 291 feet north of the north limit of the street bordering the circus grounds on the south. The transit station was also 35.5 feet from the rear lot line of lots facing on the west side of the next street to the east and 55 feet from the intersection of this rear lot line with the street bounding the grounds on the north. The magnetometer was placed 10.3 feet behind the transit and on line with the reference object and the transit. The following true bearings were obtained from the transit station:—

Spire, Western Methodist church, 40° 44′.6 east of south.

Spire, Roman Catholic church, (R.O.), 28° 54′.9 east of south.

Flag pole on High school, 21° 33′.9 west of south.

Belleville.—The station is situated in West Belleville in rear of a lot owned by Mr. Harris, market gardener. The station was 294.5 feet west of the west side of the road allowance in front of Mr. Harris' lot. The Agricultural grounds are in a southerly direction along this road. It is also 51 feet from the south limit of the road allowance on the south of Mr. Harris' lot and 55 feet from a line fence running north from this limit, the road allowance ending at this fence. Mr. Harris' lot does not extend back to this line fence. The following true bearings were obtained from the transit station;—

Spire on church (in Belleville), 80°41′.7 east of north.

Largest spire on tower, which has 3 smaller ones, 82°08′.9 east of south.

Spire, Western Methodist church (R.O.), 75°46′.3 east of south.

A large grove of pine trees is situated in the field south of the station.

Brighton.—The station is situated in a field on the west side of the town, the field belonging to Mr. Nesbitt. This field is in the second block west of Station street, and is the second field north of the C. N. R. tracks. The transit was placed 128.5 feet west of the west side of the first street west of Station street and 118 feet north of the line fence on the south of this field. A large elm tree stands in the northeast corner of this field. The magnetometer was placed 12.3 feet behind the transit and on line with the transit and the reference object. The following true bearings were determined from the transit station:—

Spire of St. Andrews church (R. O.), 42°51′.8 east of north.

Cross on Roman Catholic church, 78° 54′.5 east of north.

Ornament on centre of Nesbitt's barn, 67° 05′.2 west of north.

Peterborough.—The station is on a plot of ground in rear of a lot owned by Mr. Rogers, a veterinary surgeon. Mr. Rogers' lot is on the south side of Charlotte street about one mile west of the G. T. R. tracks. Lot on which station is placed faces on a private lane running south from Charlotte street. The transit was 123 feet west from the west side of this lane and 52 feet north of the line fence bounding this lot on the south. It was also 91 feet and 91.5 feet respectively from the southwest and southeast corners of Mr. Rogers' carriage shed. The magnetometer was placed 11.2 feet behind the transit and on line with the transit and reference object. A large grove of pine trees was just west of the station. The following true bearings were determined from the transit station:—

Pole on stone tower, 65° 34′.7 east of north.

Top of belfry on town-hall (R. O.), 74° 59′.7 east of north.

Top of Rogers' house, 33° 47′.0 west of north.

Newcastle.—The station is situated in a field north of the G. T. R. tracks and in the second block west of the street running under the tracks. The field is owned by Mr. Montague. A creek, dry at times, runs lengthwise of the lot. The transit was placed 144 feet west of the westerly limit of the first street west of the above-mentioned street, and 58.5 feet from the fence on the northerly boundary. It is also 83 feet and 64 feet respectively from the furthest easterly and westerly of five small trees along the north side of the creek. The magnetometer was placed 10.4 feet behind the transit and on line with transit and reference object. The following true bearings were determined from the transit station:—

English church spire, 2° 51′.7 east of north.

Pole on school belfry, 50° 21′.7 east of north.

Spire on Methodist church (R. O.), 5° 20′.6 west of north.

Kinmount.—The station is in a field, belonging to Mr. Craige, which is on the north side of the road in front of Mr. Craige's house and is also about 500 feet east of said house. The station is on the south side of a rocky hill, and transit was placed 266 feet from the easterly side of the only gate on the south side of the road and 239 feet from the intersection of the road fences at the fork of the roads. An abandoned iron mine is on the northerly slope of the hill. The magnetometer was placed 8.5 feet behind the transit and on line with transit and reference object. The following true bearings were determined from the transit station:—

Flag pole on grandstand, 41° 42′.2 east of north.

South side of chimney on house at foot of road, 71° 15′.1 east of north.

Cross on Roman Catholic church, 17° 33′.3 west of south.

Pole on public school belfry (R. O.), 55° 54.′7 west of south.

Lindsay.—The station is situated in the same field as the waterworks pump-house, the pump-house being on the southerly limits of the town and on the west bank of the river flowing through the town. The remaining part of the field belongs to the Roman Catholic parish. The transit was placed 154 feet from the south side of the road alongside the pump-house, and 22 feet from the fence on the westerly boundary of said field, and is also 8 feet to the west of the easterly side of street running into the field. The magnetometer was placed 12.4 feet behind transit and on line with transit and reference object. The following true bearings were determined from the transit station:—

Middle of iron smoke-stack, 29° 07′.9 east of north.

East corner of pump-house chimney (at top), 60° 30′.7 east of north.

Cross on Roman Catholic church (R. O.), 9° 51′.0 west of north.

Pickering.—The station is situated in the second field north of the G. T. R. tracks, and on west side of the road leading to the grist-mill. This field is used as a pasture, but the southeast corner of the field is fenced off and cultivated. The cemetery is just across the road from the cultivated portion. The transit was placed 128 feet from the westerly side of above-mentioned road and 34 feet from the northerly boundary of cultivated portion, and is also 130 feet in a southerly direction from a large elm tree. The magnetometer was placed 11.4 feet behind transit and in line with transit and reference object. The following true bearings were obtained from the transit station:—

Ornament on town-hall tower, 22° 23′.1 east of north.

Cross on Roman Catholic church (R. O.), 39° 21′.8 east of north.

Flag pole on grist-mill, 13° 30′.7 west of north.

Niagara Falls (Stamford).—The station is situated in a large open field belonging to Mr. Emmet, on the south side of the road leading westwards at the fork of the main road at Stamford Green. The station is about one-quarter of a mile westerly along this road and is on a clear patch between a grapery and a raspberry patch. The transit was placed 55 feet from the west side of the berry patch and 116 feet from the east side of the grapery and 63 feet from the southerly side of the road allowance. The Niagara, St. Catharine and Toronto Electric Ry. is distant about 1½ miles in a southerly direction. The magnetometer was placed 11.2 feet behind the transit and on line with the transit and reference object. The following true bearings were determined from the transit station:—

North gable of house on main road, 75° 53′.5 east of south.

Pole on school-house tower (R. O.), 34° 23′.1 east of south.

Windmill on Mr. Emmet's barn, 13° 01′.1 west of south.

Beaverton.—The station is situated in a large open field at the end of the road leading from the G. T. R. tracks on the east side of the G. T. R. station. The field is used as a pasture and is full of small hummocks, the ground being generally of marshy nature. Mr. Trelevan is the owner of the field. The transit was placed 129 feet from the south side of the road running westerly along the southerly boundary of the field, and 28.5 feet from the westerly boundary fence of the field. The above-mentioned boundary road ends at this line fence. The magnetometer was placed 2 feet behind transit and on line with transit and reference object. The following true bearings were determined from the transit station:—

Spire on Roman Catholic church, 3° 55′.6 east of south.

Spire on St. Andrews (Presbyterian) church (R. O.), 7° 39′.4 west of south.

Pole on water-tank, 58° 41′.4 west of south.

Port Colborne.—The station is situated in a field on the south side of the G. T. R. tracks. The field is on the east side of the fourth street from the station running in a southerly direction. The station was about 1,000 feet from the tracks. The transit was placed 52 feet from the easterly limit of the street and 37 feet from the northerly limit of the third street south of the tracks. It was also 355 feet from the southerly limit of the second street south of the tracks. An oil well is situated in the next block to the west. The following true bearings were determined:—

Round iron smoke-stack, 28° 51′.8 west of south.

Top of lighthouse tower (R. O.), 43° 00′.0 west of south.

Storm signal post, 88° 42′.3 west of south.

Orillia.—The station is situated in a large marshy field at the end of the first street south of Watson's brickyards, which street runs westerly from the street crossing the G. T. R. tracks west of the station. The clay pits of the brickyard are in this field. The transit was placed 89.5 feet from the westerly boundary of the last lot facing on first street mentioned above, and 104 feet from the intersection of this lot line with southerly street line, and was also 69 feet from the end of the southerly street line fence. A small sand pit is about 150 feet to southwest. The magnetometer was placed 14.2 feet behind the transit and on line with transit and reference object. The following true bearings were determined from the transit station:—

Easterly tower on Orillia asylum, 22° 22′.5 west of south.

Southerly tower on town-hall, 55° 58′.3 west of north.

Spire of Anglican church [largest in sight] (R.O.), 39° 18′.5 west of north.

Beamsville.—The station is situated in the second field north from the G. T. R. tracks. The field is not cultivated, but is dotted with scrubby trees and has a grove of trees in the northern part. The field which is on the west side of the road leading to the lake is owned by Rev. Mr. Trueaxe. The transit was placed 26 feet from the westerly boundary fence and 83 feet from the southerly boundary fence of above field. Surrounding fences were of the irregular, rail variety and measurements were taken to the inside fence line. The magnetometer was placed 11 feet behind the transit and on line with the transit and reference object. The following true bearings were determined from the transit station:—

Church spire, visible just over G. T. R. freight-shed (R. O.), 1° 09′.4 west of south.

Factory chimney (middle), 88° 44′.7 west of south.

Barrie.—The station is situated in the northwestern portion of the town, in a field belonging to Mr. Hickey, and just west of the field in which Mr. Hickey's house stands. The transit was placed 86.5 feet from the northerly limit of the street marking the southerly boundary of the field, and 58 feet from the westerly limit of street marking the easterly boundary. The magnetometer was placed 10.8 feet behind the transit and on line with transit and reference object. The following true bearings were determined from the transit station:—

Cross on separate school, 52° 19′.0 west of south.

Cross on Roman Catholic church (R. O.), 62° 00′.2 west of south.

North side of water-tower, 76° 36′.5 west of south.

Brampton.—The station is situated in a pasture field at the end of Nelson street. The field is owned by Mr. Ackroyd. The station is on line with the westerly side of Nelson street produced, and is 248 feet from the intersection of this line with the northerly limit of West street. Reference object was spire of Grace Methodist church.

Azimuth of R. O., 22°52′ east of north.

Cayuga.—The station is situated in the third field south of the G. T. R. tracks and on the east side of the road leading to the town. A group of elm trees is situated in the southeast part of the field. The transit was placed 31.5 feet from the northerly boundary fence of said field and 53 feet from the easterly limit of road leading to the town. The field is about 800 feet from the track. The magnetometer was placed 10.3 feet behind the transit and on line with the transit and reference object. The following true bearings were determined from the transit station.

Pole on water-tank (R. O.), 45° 05′.9 east of north.

Lightning conductor on northwest gable of house across the road, 81° 08′.3 west of north.

Hamilton.—The station is situated in the second field west of the road leading from the Incline railway and fronting on the Chedokee road. A grove of trees lies just over the south boundary of this field. The transit was placed 79 feet from the east boundary fence of said field and 99 feet from the south boundary fence. The magnetometer was placed 11 feet behind the transit and on line with the transit and the reference object. The following true bearings were obtained from transit station:—

Flag pole of tower on a house, 67° 04′.7 east of north.

Top of tower on school-house, 87° 06′.0 east of north.

Flag pole on concert hall on main road (R. O.), 39° 27′.6 west of north.

Penetanguishene.—The station is situated in a field lying on the east side of the fourth parallel street east from the G. T. R. depot. The field lies immediately behind Mr. Gendron's lot, which fronts on the first street from the depot running eastward off Main street. The transit was placed 114 feet north from the southerly boundary and 184 feet from the easterly limit of the above first-mentioned street. It is also 34 feet and 32 feet respectively from two apple trees, one about north and one about northwest from the transit. The following true bearings were determined:—

West end of cross on Catholic church (R. O.), 30° 38′.1 west of south.

Top of small tower on school hill, 35° 04′.1 west of south.

Orangeville.—The station is situated in the third field east from the C. P. R. tracks and fronting on the south side of Chisholm street. Mr. Augustine, who owns the field, lives just east of it. The transit was placed 181 feet from the southerly limit of Chisholm street and 64.5 feet from the westerly boundary of said field. The magnetometer was placed 10.8 feet behind the transit and in line with transit and reference object. The following true bearings were determined from the transit station:—

Top of windmill on hill, 60° 46′.8 east of north.

West side of chimney on cement mills, 35° 29′.3 west of south.

Spire on church in Orangeville (R. O.), 49° 09′.9 west of north.

Guelph.—The station is situated in a pasture field in the northern limits of the town. The field fronts on the east side of Lemon street, and is on the south side of the first road north of and parallel to Stewart street. The magnetometer was placed 222 feet east of the easterly limit of Lemon street and 68 feet south of the southerly limit of above-mentioned road, and is also 508 feet from the northerly limit of Stewart street. The transit was placed 11 feet in front of the magnetometer and on line with magnetometer and reference object. The following true bearings were obtained from the transit station:—

Flag pole on General Hospital (R. O.), 80° 18′.5 west of north.

Eastern gable on Macdonald's barn, 4° 33′.3 west of north.

Brantford.—The station is situated in the rear of a field owned by Mr. Hull, whose house is at the southwest corner of Market street and Grandview avenue. The station was 27 feet at right angles from the south limit of Grandview avenue and 85 feet from the westerly boundary fence. The station is on a hill overlooking the town to the south. The following true bearings were determined:—

Spire of Congregational church (right-hand spire), 1° 34′.7 west of south.

Tower, market-hall, 4° 07′.9 west of south.

Pole on belfry, 11° 41′.0 west of south.

Simcoe.—The station is situated in a field fronting on the south side of the first street, running east and west, north of the grist-mill on Norfolk street. The field contains some sand pits which are on the east side of Norfolk street. The station was 25.8 feet from the boundary fence on the east and 40 feet from the south limit of the above-mentioned street. The station was on the hill above the sand pits. The following true bearings were determined:—

Ornament on grist-mill, 57° 09′.4 west of south.

Ornament on station tower (R. O.), 49° 33′.3 west of north.

Pole on barn just visible over a clump of trees, 14° 49′.4 west of north.

The first street mentioned above ends at easterly boundary fence of the field.

Port Rowan.—The station is situated in the southerly part of the field south of the brick-yards at the G. T. R. tracks. The transit was placed 234 feet from the east side of street bordering this field on the west, and 17 feet north from the north street line produced, of the street which runs westward from the Free Methodist church. The magnetometer was placed 11.3 feet behind transit and on line with transit and reference object. The following true bearings were determined from the transit station:—

Tower on Free Methodist church, 48° 01′.9 west of south.

Windmill on barn (R. O.), 48° 49′.8 west of north.

Berlin.—The station is about 1½ miles west of the town on the north side of the St. Petersburg road, and is situated in a field belonging to Mr. J. Shafer. The above field is the first field west of the field in front of Mr. Shafer's house. The transit was placed 126 feet from the northerly limit of the road, and 104 feet from the easterly boundary fence of said field. The magnetometer was placed 13 feet behind transit and on line with reference object and transit. The following true bearings were determined from the transit station:—

North side of large water-tower, 15° 35′.8 east of north.

Church spire in Berlin, 59° 30′.2 east of north.

Bottom of lightning rod on Shafer's barn (R. O.), 64° 11′.2 east of south.

Flesherton.—The station is situated in a field belonging to Mr. Gullinson and is at the northwest corner of the intersection of the first cross-road eastwards from the C. P. R. on the road to Flesherton. The transit was placed 24.5 feet from westerly boundary fence and 117 feet from the southerly boundary fence. The above-mentioned road forms the southerly boundary for about one-half the length of the field. The magnetometer was placed 11 feet behind transit and on line with reference object and transit. The following true bearings were determined at transit station:—

Belfry pole on school (R. O.), 32° 30′ east of south.

North gable of grain elevator, 18° 18′.3 west of south.

Church spire, Flesherton, 49° 12′.5 east of north.

Woodstock.—The station is situated in a small pasture field belonging to Mr. Hart. This field is on the south side of a short street running easterly from the street bounding Woodstock College grounds on the east, and adjoins Mr. Hart's house and lot at the intersection of the above-mentioned streets. The transit was placed 51.5 feet from the westerly boundary fence and 75 feet from the southerly limit of above-mentioned short street. The magnetometer was placed 13.8 feet behind transit and on line with transit and reference object. The following true bearings were determined from the transit station:—

Top of Hydro-electric tower, 10° 13′.0 west of south.

Top of tower Woodstock college [one on which are the wind gauges] (R. O.), 77° 26′.3 west of south.

Smoke-stack on grist-mill, 41° 30′.9 west of north.

Mount Forest.—The station is situated in a small field belonging to Mr. Duke, about one-quarter of a mile west of the G. T. R. tracks on the main road. A short road runs into the main road from the north at this point at an angle, making the field triangular in shape. This field adjoins the field on which Mr. Duke's house is placed. The transit was placed 178 feet from the easterly boundary fence and 65 feet at right angles from the easterly limit of the short road. A large maple tree stands on the northerly part of the field. The magnetometer was placed 11.4 feet behind transit and on line with transit and reference object. The following true bearings were determined from the transit station:—

Spire of Methodist church [left hand spire] (R. O.), 75° 01′.1 east of north.

Church spire, Mount Forest, 82° 42′.4 east of north.

Top of station tower, 87° 21′.1 east of north.

Port Burwell.—The station is situated in a field on the north side of Pitt street and adjoining the English church on the east side. A creek runs across the easterly part of the field. The station was 49 feet from the westerly boundary fence and 135 feet from the northerly limit of Pitt street. The following true bearings were determined:—

Southeast corner of Baptist church tower, 54° 23′.2 east of north.

Tower, English church, 73° 48′.3 west of south.

Belfry on school-house (R.O.), 10° 31′.4 west of north.

Owen Sound.—The station is situated in the Agricultural grounds on top of hill in the easterly section of the town. The transit was placed 202.5 feet from the northeast corner of north wing and 235 feet from the southeast corner of south wing of the main building; also 97.2 feet from northwest corner of the grandstand. Magnetometer was placed 13.3 feet behind transit and on line with transit and reference object. The following true bearings were determined from the transit station:—

Spire on Roman Catholic church (R. O.), 12° 21′.0 east of north.

Flag pole on Strathcona school, 81° 19′.3 west of north.

Stratford.—The station is situated in Queens park, near the Avon river. The station was 230 feet east of the east side of the Normal school and 580 feet north of the north side of the school. It was also 198 feet from the westerly tree of a clump of three trees on the river bank and 171 feet from the easterly tree. The following true bearings were determined:—

Flag pole on Normal school, 23° 02'.4 west of south.

Spire, Knox Presbyterian church (R. O.), 67° 05'.4 west of south.

Top of house with peculiar mushroom top, 64° 23'.1 west of north.

Port Stanley.—The station is situated in a small pasture field belonging to Mr. Mitchell, on the road leading westerly from the town and about one-half mile distant. This field is between Fraser Heights and the road, and is the second field west of the second road leading up to Fraser Heights. There is a line of apple trees along the boundary fence at the road. The transit was placed 121.5 feet from the westerly boundary fence and 103.3 feet from the southerly limit of the road. The magnetometer was placed 8.4 feet behind the transit and on line with transit and reference object. The following true bearings were determined from the transit station:—

Small church spire, pyramid in form (R. O.), 55° 52'.7 east of north.

Flag pole on hotel on Fraser Heights, 47° 18'.3 east of south.

South gable of red brick house, 5° 26'.4 west of north.

London—The station is situated in a field belonging to Mr. D. Barclay and is on the north side of the road leading westerly from the G. T. R. station. This field adjoins, on the east side, the field in which Mr. T. Lewis' house is situated. The magnetometer was placed 49 feet from the westerly boundary fence and 26 feet from the northerly limit of the road. The following true bearings were determined from the transit station which was 81 feet in a northeasterly direction from the magnetometer station:—

Middle of three lightning roads on red barn north of tracks (R. O.), 24° 43'.4 east of north.

South gable of barn, 46° 30'.4 east of north.

Wingham—The station is situated in a small field at the northeast corner of the intersection of St. Patrick street and Carling avenue. The transit was placed 78 feet from the northerly limit of St. Patrick street, and 62.5 feet from the easterly limit of Carling avenue. The magnetometer was placed 15 feet behind the transit and on line with transit and reference object. The following true bearings were determined from the transit station:—

Top of G. T. R. semaphore, 45° 41'.3 east of north.

East side of water-tower, 24° 04'.8 west of south.

Lightning rod on south end of red barn north of tracks (R. O.), 11° 17'.2 west of north.

Lucan.—The station is situated in a field west of the G. T. R. station and south of the tracks. The field, which belongs to Mr. J. Babb, adjoins on the west side the field in which Mr. Babb's house is placed. The transit was placed 43 feet north of the southerly boundary fence and 363 feet west of the easterly boundary fence. The magnetometer was placed 10 feet behind the transit and on line with transit and reference object. The following true bearings were determined from the transit station:—

North side chimney on grist-mill, 51° 53′.1 east of north.

Windmill, 67°10′.4 east of north.

Tower on High school (R. O.), 3° 39′.1 west of north.

Kincardine.—The station is situated in a field across the road from the High school in a southerly direction and bordering the Penetangore on the west side. The field is owned by Miss McCaskey. The transit was placed 170.5 feet from the southerly limit of the road and 38 feet from the easterly boundary fence. The magnetometer was placed 13 feet behind the transit and on line with transit and reference object. The following true bearings were determined from the transit station:—

Ornament on western gable of Methodist church (R. O.), 73° 24′.1 west of south.

Flag pole on post-office, 89° 54′.6 west of south.

Spire, Presbyterian church, 47° 46′.9 west of north.

Rodney.—The station is situated in a small pasture field on the south side of Harper street. This field is owned by Mr. Hugo and is the second field west of the first street intersection on Harper street west of Furnivale street. Mr. Hugo's house is on the southeast corner of this intersection. The station was 131 feet from the westerly boundary fence, and 56 feet from the southerly limit of Harper street. The following true bearings were determined:—

Smoke-stack on planing mill, 2° 59′.7 east of north.

Spire on Presbyterian church (R. O.), 43° 23′.6 east of north.

Smoke-stack on box factory, 75° 13′.1 east of south.

Goderich.—The station is situated on the commons bordering on the G. T. R. tracks and opposite to McEwan's wood-yard. The station was 524 feet from the northerly limit of the street and 209 feet from the fence bordering the commons on the east. This last measurement was taken on a line parallel to the road. The following true bearings were determined:—

Top of station tower (R. O.), 14°43′.9 east of south.

Church spire, Goderich, 77° 01′.1 west of south.

Forest.—The station is situated in the Agricultural grounds on Argyle street. The station was 87 feet from the southerly boundary fence of grounds and 107 feet from the westerly boundary fence. The following true bearings were determined:—

Spire, Roman Catholic church 69°15′.2 east of north.

Spire, Presbyterian church (R. O.), 88°48′.9 east of north.

Tower on High school, 46° 04′.2 east of south.

Chatham.—The station is situated in a field fronting on the north side of the first road south of Queen street, and running parallel with it. The field is opposite the Agricultural grounds on Queen street and is owned by Mr. Hoff. The transit was placed 46.8 feet from the easterly boundary fence and 137.3 feet from the northerly limit of the above-mentioned road. The magnetometer was placed 10.8 feet behind the transit and on line with transit and reference object. The following true bearings were determined from the transit station:—

Flag pole on main building of Agricultural grounds (R. O.), 30°55′.6 east of north.

Church spire (only one to be seen), 13°05′.4 west of north.

Top of G. T. R. water-tank, 32°11′.4 west of north.

Sarnia.—The station is in a field on the east side of Telford street and south of Russell street. The field adjoins, on the north side, a lot containing a house and orchard. The field is owned by Mr. Shannon and is south of his house which fronts on Wellington street. The transit was placed 57 feet from the southerly boundary fence and 190.5 feet from the easterly limit of Telford street. The magnetometer was 10.5 feet behind the transit and on line with transit and reference object. The following bearings were observed from the transit station:—

School tower (Russell street), 24°49′.2 west of south.

Flag pole on post-office, 77°50′.8 west of north.

Spire, St. Andrews church (R. O.), 54°28′.2 west of north.

Port Lambton.—The station is situated in rear of a large cultivated field east of the Pere Marquette railway. This field belongs to Mr. McDonald and adjoins, on the north side, his large pasture field. The field is also about 1,000 feet north of the road leading east from the railway station. The transit was placed 87.5 feet from the easterly boundary fence and 72.5 feet from the southerly boundary fence. The magnetometer was 10 feet behind the transit and in line with transit and reference object. The following true bearings were determined from the transit station:—

South end of the only barn to be seen in this direction, 35°47′.0 east of north.

North end of red barn, 48°11′.3 west of south.

Flag pole on the 'Ohio' cottage (R. O.), 48°08′.9 west of north.

Belle River.—The station is situated in a field about one-quarter mile east of the town and on the north side of Main street produced. The field is owned by Mr. Dube and adjoins, on the east side, a field containing a house and a large vegetable patch. The transit was placed 238 feet from the easterly boundary fence and 246 feet from the northerly limit of road. The magnetometer was 11.3 feet behind the transit and on line with transit and reference object. The following true bearings were determined from the transit station:—

Spire, Roman Catholic church (R. O.), 75°49′.1 west of south.

Tower on school-house, 85°10′.5 west of south.

Smoke-stack on cannery, 76°10′.5 west of north.

Kingsville.—The station is situated in a field on the west side of a private lane which turns off the Main street, produced, at Mr. C. McDonald's house. This field is the second field from the main road and belongs to Mr. C. McDonald. The transit was placed 204.6 feet from the northerly boundary fence and 149 feet from the westerly limit of private lane. The magnetometer was 9.3 feet behind the transit and on line with transit and reference object. The followiug true bearings were determined from the transit station:—

Spire, Roman Catholic church (R. O.), 71°35′.5 east of south.

North end of McDonald's barn, 23°06′.1 east of south.

N.W. gable of barn, 75°16′.9 west of south.

Windsor.—The station is situated in a large pasture field on the north side of the Tecumseh road and about 700 feet east of the intersection of the C. P. R. branch to the Walkerville Bridge and Iron works and the Tecumseh road. The field, which is owned by Mr. Stanley, is full of stumps and many small bushes are scattered about. The transit was placed 186 feet from the westerly boundary fence and 244 feet from the northerly limit of the Tecumseh road. The magnetometer was placed 9.3 feet behind the transit and on line with transit and reference object. The following true bearings were determined from the transit station:—

East gable of red barn, 13°01′.3 west of south.

Spire, St. Alphonse church (R. C.), 57°34′.8 west of north.

Spire on tower close to large building in Detroit, 26°26′.1 west of north.

MAGNETIC RESULTS FOR 1910—ONTARIO.

OBSERVER, J. W. MENZIES.

Station	φ °	φ ′	λ °	λ ′	Date 1910	Decl. °	Decl. ′	Dip. °	Dip. ′	Hor. Int.	Total Int.
Napanee	44	15·9	77	00·0	Nov. 9, 11	10	36·8W	74	25·2	·16369	·60946
Belleville	44	9·2	77	25·5	" 12–16	8	55·0W	74	55·0	·15760	·60563
Brighton	44	2·0	77	44·0	" 19	8	42·0W	74	48·6	·15957	·60900
Peterborough	44	18·6	78	18·5	" 5, 7	8	45·5W	74	42·6	·16327	·61914
Newcastle	43	54·3	78	31·8	" 22	7	47·5W	74	43·3	·16083	·61034
Kinmount	44	47·1	78	38·0	" 3, 4	8	40·6W	75	16·9	·15488	·60960
Lindsay	44	21·0	78	44·0	Oct. 26–29	7	35·6W	75	09·9	·15726	·61421
Pickering	43	51·3	79	4·3	Nov. 2	7	07·9W	74	44·1	·16124	·61242
Niagara Falls	43	07·7	79	6·3	Sept. 20, 21	6	00·3W	74	12·0	·16490	·60562
Beaverton	44	26·0	79	07·0	Oct. 25	7	31·8W	75	3·2	·15802	·61267
Port Colborne	42	53·2	79	14·3	Sept. 17	5	47·5W	73	58·1	·16754	·60666
Orillia	44	35·8	79	25·3	Oct. 22, 24	5	38·6W	75	29·7	·15389	·61442
Beamsville	43	11·5	79	28·5	Sept. 22	5	51·3W	74	31·4	·16481	·61762
Barrie	44	23·7	79	42·5	Oct. 18, 19	6	46·1W	75	20·1	·15535	·61363
Brampton	43	40·9	79	45·5	Aug. 1, 2	5	56·5W	74	34·7	·16293	·61270
Cayuga	42	58·0	79	51·0	Sept. 16	6	34·7W	73	50·3	·17041	·61233
Hamilton	43	14·4	79	54·0	" 23–27	5	32·4W	74	19·2	·16534	·61177
Penetanguishene	44	46·4	79	58·0	Oct. 20, 21	7	29·6W	75	32·4	·15318	·61345
Orangeville	43	54·7	80	05·0	" 17	6	01·8W	74	42·9	·16190	·61414
Guelph	43	33·0	80	15·0	Aug. 4	5	50·0W	74	28·2	·16438	·61395
Brantford	43	08·7	80	15·5	Sept. 29	4	43·8W	74	13·8	·16623	·61164
Simcoe	42	51·0	80	19·5	" 5, 6	4	54·2W	74	05·8	·16805	·61329
Berlin	43	26·9	80	30·0	" 15	5	34·0W	74	27·7	·16467	·61471
Port Rowan	42	38·0	80	27·5	Aug. 6, 8	4	39·6W	73	49·3	·17033	·61132
Flesherton	44	14·9	80	33·5	Oct. 15	5	26·2W	74	56·6	·15592	·60021
Woodstock	43	07·5	80	43·5	Sept. 30, Oct. 1	3	53·6W	74	07·8	·16730	·61180
Mount Forest	43	59·2	80	45·0	Oct. 11, 12	5	07·0W	74	46·4	·16086	·61248
Port Burwell	42	38·9	80	49·0	Sept. 2	4	15·1W	73	45·9	·17014	·60856
Owen Sound	44	33·3	80	55·0	Oct. 13, 14	6	01·5W	75	13·4	·15703	·61568
Stratford	43	21·8	80	58·5	Aug. 10, 11	3	48·5W	74	24·8	·16545	·61575
Port Stanley	42	39·9	81	13·5	" 30, 31	2	40·7W	74	05·4	·16705	·60939
London (Hyde Park Jct.)	42	59·3	81	19·0	Oct. 3	3	34·0W	73	59·8	·16795	·60919
Wingham	43	54·1	81	20·8	" 8	4	30·4W	74	39·7	·16241	·61398
Lucan	43	10·7	81	24·8	Aug. 12	3	55·9W	74	03·1	·16832	·61258
Kincardine	44	10·3	81	37·5	Oct. 10	5	25·6W	74	38·0	·16333	·61635
Rodney	42	34·0	81	41·0	Aug. 29	3	29·9W	73	47·3	·17138	·61373
Goderich	43	45·7	81	42·5	Oct. 5, 7	4	32·3W	74	31·6	·16379	·61393
Forest	43	05·6	82	00·8	Aug. 13	3	41·3W	73	57·8	·16907	·61201
Chatham	42	23·1	82	10·0	" 19, 20	2	25·9W	73	37·5	·17252	·61194
Sarnia	42	57·7	82	22·5	" 16	3	01·3W	73	50·5	·17015	·61248
Port Lambton	42	39·0	82	30·0	" 17, 18	2	18·7W	73	33·0	·17333	·61209
Belle River	42	17·1	82	41·8	" 22, 23	1	49·8W	73	21·7	·17443	·60919
Kingsville	42	02·2	82	45·8	" 26, 27	1	32·1W	73	06·9	·17664	·60816
Windsor	42	17·9	83	15·0	" 24, 25	1	59·0W	73	14·6	·17547	·60862

MAGNETIC RESULTS FOR 1910—ALONG MAIN LINE, CANADIAN PACIFIC RAILWAY

OBSERVER, C. A. FRENCH.

Station.	φ	λ	Date.	Decl.	Dip.	Hor. Int.	Total Int.	Diurnal Range in Dec.
	° ′	° ′	1910.	° ′	° ′			′
Ottawa........	45 23·6	75 43·0	Apr. 1 to 20......	13 2·2W	75 39·8	·15114	·61037	9·2
Agincourt......	43 47·0	79 16·0	May	6 3·1W	74 38·3	·16275	·61436	9·2
Chapleau.......	47 50·3	83 25·6	" 7, 9	4 16·4W	77 51·7	·13219	·62866	14·8
Wayland.......	48 2·4	83 49·9	" 10, 11........	5 8·8W	77 58·0	·13067	·62677	12·2
Missinaibi......	48 18·8	84 5·2	" 14, 16.......	5 48·8W	77 49·9	·13272	·62965	13·6
Grasett.......	48 27·3	84 37·6	" 19, 20........	3 46·1W	78 9·6	·12878	·62765	12·6
White River....	48 35·2	85 16·3	" 23, 25........	3 11·9W	78 19·4	·12768	·63087	15·5
Montizambert..	48 41·3	85 38·6	" 27, 28........	2 22·3W	78 25·3	·12698	·63266	12·6
Heron Bay.....	48 39·3	86 17·3	" 30, 31.......	2 33·4W	78 3·9	·13087	·63283	13·6
Middleton.....	48 47·7	86 40·3	June 4...........	17 48·9E	80 22·0	·10418	·62256	19·6
Schreiber......	48 48·5	87 16·6	" 7...........	0 31·7W	78 26·2	·12626	·62988	12·9
Gravel.........	48 54·7	87 43·6	" 10...........	0 25·1E	78 35·0	·12453	·62912	11·5
Nipigon........	49 0·7	88 15·9	" 11, 13........	1 7·0E	78 29·6	·12653	·63429	14·2
Dorion........	48 46·8	88 32·0	" 14...........	1 39·3E	78 17·3	·12826	·63186	11·3
Mackenzie.....	48 33·0	88 58·5	" 15...........	2 49·3E	78 13·6	·13021	·63816	11·3
Fort William...	48 23·9	89 14·9	" 17, 18........	3 16·5E	77 49·4	·13322	·63159	12·2
Kaministikwia.	48 31·5	89 35·1	" 22...........	0 25·3E	80 3·5	·10746	·62243	15·8
Raith.........	48 49·8	89 53·6	" 23-25.........	3 49·8E	78 11·0	·12954	·63258	12·5
Savanne.......	48 57·0	90 14·0	" 27, 28........	4 28·1E	78 12·2	·12951	·63349	15·2
Niblock........	49 16·3	90 41·3	" 30, July 1....	4 54·5E	78 10·8	·13018	·63553	15·0
Martin.........	49 15·3	91 7·9	July 2, 4........	4 58·1E	78 9·3	·13089	·63766	14·0
Ignace.........	49 25·4	91 40·5	" 6-8...........	6 10·5E	78 30·1	·12678	·63600	14·6
Taché.........	49 35·0	92 10·7	" 11, 12........	6 57·4E	78 22·9	·12772	·63419	14·1
Wabigoon......	49 43·6	92 36·8	" 13, 14........	7 39·0E	77 49·6	·13364	·63376	15·5
Dryden........	49 47·4	92 50·1	" 16, 17........	8 14·1E	79 22·6	·11565	·62733	20·6
Eagle.........	49 47·7	93 11·1	" 18-20.........	6 34·7E	78 10·4	·13050	·63674	17·2
Vermilion......	49 51·3	93 23·5	" 22...........	7 42·8E	78 59·9	·12180	·63824	17·1
Hawk Lake....	49 58·3	93 59·7	" 23, 24........	7 28·4E	78 26·8	·12806	·63941	17·7
Kenora........	49 46·2	94 29·0	" 26, 27........	10 0·4E	77 59·4	·13122	·63062	14·8
Kalmar.......	49 45·7	94 58·0	" 28, 29........	9 31·7E	77 52·7	·13345	·63551	12·5
Rennie.........	49 51·5	95 33·3	" 29-31.........	10 19·7E	77 27·7	·13779	·63471	12·6
Whitemouth ..	49 57·0	95 57·8	Aug. 1, 2.........	10 57·0E	78 10·3	·13083	·63826	18·2
Norquay.......	49 59·6	96 33·9	" 4, 5.........	11 23·0E	78 41·5	·12549	·63996	18·2
Winnipeg......	49 51·9	97 7·9	" 8, 9.........	13 56·7E	78 11·3	·13061	·63807	13·8
Marquette.....	50 4·1	97 43·0	" 11, 12........	13 17·7E	78 5·9	·13039	·63225	15·2
Portage-la-Prairie......	49 58·5	98 17·9	" 15, 16........	9 26·9E	78 29·0	·12810	·64161	15·9
McGregor......	49 58·4	98 47·4	" 17, 18.......	13 9·6E	77 40·4	·13502	·63246	17·4
Carberry.......	49 52·5	99 21·6	" 19, 20........	15 44·0E	77 39·1	·13529	·63263	15·6
Brandon.......	49 52·0	99 58·8	" 23–25........	15 3·9E	77 32·2	·13687	·63420	16·8
Griswold.......	49 46·9	100 28·7	" 26	16 4·6E	77 15·9	·14005	·63531	13·5
Virden.........	49 51·3	100 55·7	" 27, 28.......	16 43·1E	77 10·1	·13976	·62930	13·0
Kirkella.......	50 1·9	101 22·4	" 30, 31........	16 13·9E	77 17·5	·13931	·63326	11·2
Wapella........	50 15·8	101 58·4	Sept. 1, 2.........	17 50·6E	77 22·9	·13803	·63185	15·2
Broadview.....	50 22·3	102 34·7	" 3, 5.........	17 13·3E	77 38·9	·13515	·63180	13·8
Wolseley......	50 26·3	103 15·5	" 9, 10........	18 18·1E	77 20·7	·13850	·63219	17·8
Indian Head....	50 32·2	103 39·5	" 12, 13........	19 32·7E	77 3·6	·14147	·63176	13·4
Balgonie......	50 29·6	104 16·1	" 14, 15........	18 57·6E	77 3·8	·14071	·62852	12·7
Regina.........	50 26·9	104 36·8	" 16, 17........	19 26·8E	76 58·3	·14210	·63034	12·4
Pense..........	50 24·7	104 59·1	" 19...........	19 45·5E	76 53·6	·14222	·62717	14·0
Moosejaw......	50 23·9	105 30·9	" 20–23	19 52·9E	77 0·6	·14096	·62709	11·3
*Agincourt.....	43 47·0	79 16·0	Oct.	6 5·4W	74 39·4	·16244	·61391	9·2
Ottawa........	45 23·6	75 43·0	" 20–26........	13 3·2W	75 41·1	·15096	·61053	11·2

* The values for Agincourt represent the means of the month, and were obtained from the Journal of the Royal Astronomical Society of Canada for May-June, and for November-December, 1910.

Secular Change.

We have now for a few stations in our survey, data wherefrom we can deduce secular change in declination, by comparison of the magnetic results obtained by the Carnegie Institution in 1906 and by the Dominion Observatory in 1910 at corresponding stations, as shown in the following table. From them is deduced the average annual change for the mean period of the respective observations.

Westerly declination is negative, easterly declination positive. In the column "Average Annual Change" for declination, a minus sign indicates that western declination is increasing, and eastern declination decreasing, while the plus sign means the reverse.

Station.	Declination.					Dip.			Horizontal Intensity.		
	Carnegie Institution, 1906		Dom. Observatory, 1910		Average Annual Change	Carnegie Ins. 1906	Dom. Obs. 1910	Average Annual Change.	Carnegie Ins. 1906	Dom. Obs. 1910	Average Annual Change
		° ′		° ′	′	° ′	° ′	′	C. G. S.	C. G. S.	γ
Ottawa..	Oct.	−12 11·4	Oct.	−13 03·2	− 4·7	75 39·1	75 41·1	0·5	·15222	·15096	31
Chapleau	"	− 4 04·1	May	− 4 16·4	− 3·5	77 50·6	77 51·7	0·3	·13292	·13219	20
Missinaibi...	Sep.	− 5 39·1	"	− 5 48·8	− 2·7	77 51·6	77 49·9	−0·5	·13303	·13272	8
White River..	"	− 3 00·6	"	− 3 11·9	− 3·1	78 15·9	78 19·4	0·9	·12909	·12768	38
Schreiber....	"	− 0 22·4	June	− 0 31·7	− 2·5	78 21·8	78 26·2	0·4	·12707	·12626	22
Nipigon*......	"	1 17·5	"	1 07·0	− 2·8	78 28·6	78 29·6	0·3	·12712	·12653	21
Fort William†.	"	3 37·2	"	3 16·5	− 5·5	77 48·0	77 49·4	0·4	·13414	·13322	25
Savanne......	"	4 33·8	"	4 28·1	− 1·5	78 09·9	78 12·2	0·6	·13038	·12951	23
Ignace......	"	6 11·6	July	6 10·5	− 1·1	78 27·4	78 30·1	0·7	·12791	·12678	29
Eagle.........	"	6 39·7	"	6 31·7	− 1·3	78 07·8	78 10·4	0·7	·13135	·13050	22
Kenora	"	9 54·1	"	10 00·4	+ 1·6	77 58·9	77 59·1	0·1	·13176	·13122	11
Winnipeg ..	"	13 59·0	Aug.	13 56·7	− 0·6	78 07·4	78 11·3	1·0	·13163	·13061	26
Brandon†..	"	15 00·2	"	15 03·9	+ 0·9	77 28·7	77 32·2	0·9	·13807	·13687	31
Kirkella ..	"	16 02·4	"	16 13·9	+ 2·9	77 17·7	77 17·5	0·1	·13996	·13931	17
Broadview....	"	17 05·7	Sept.	17 13·3	+ 1·9	77 37·5	77 38·9	0·3	·13588	·13515	18
Regina†.......	"	19 12·0	"	19 26·8	+ 3·7	76 56·8	76 58·3	0·4	·11285	·11210	19

* C. I. Station about 15 feet from D. O. Station.
† C. I. Station and D. O. stations not identical.

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.

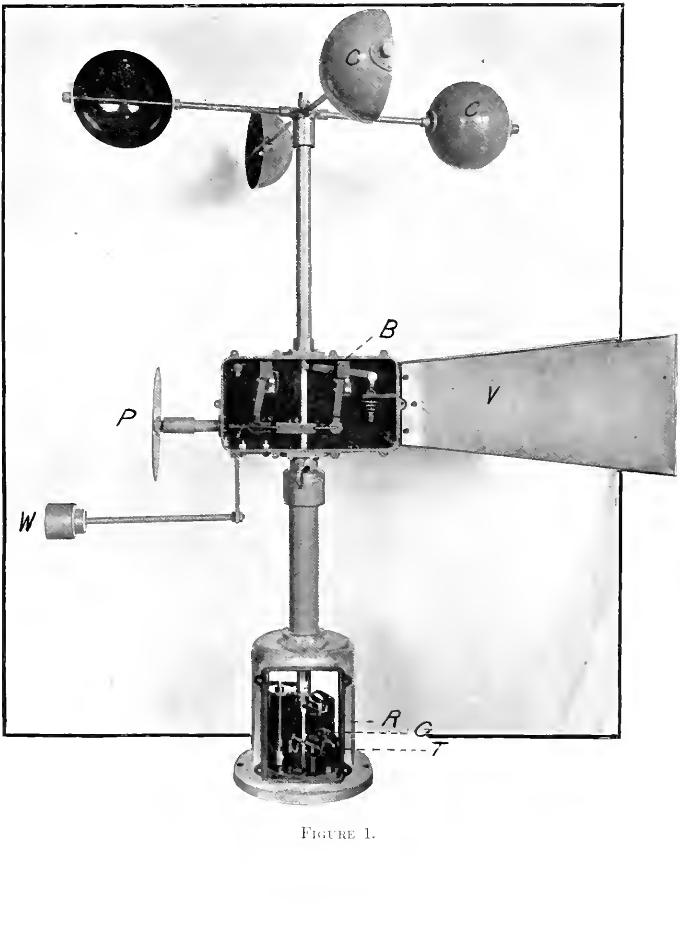


FIGURE 1.

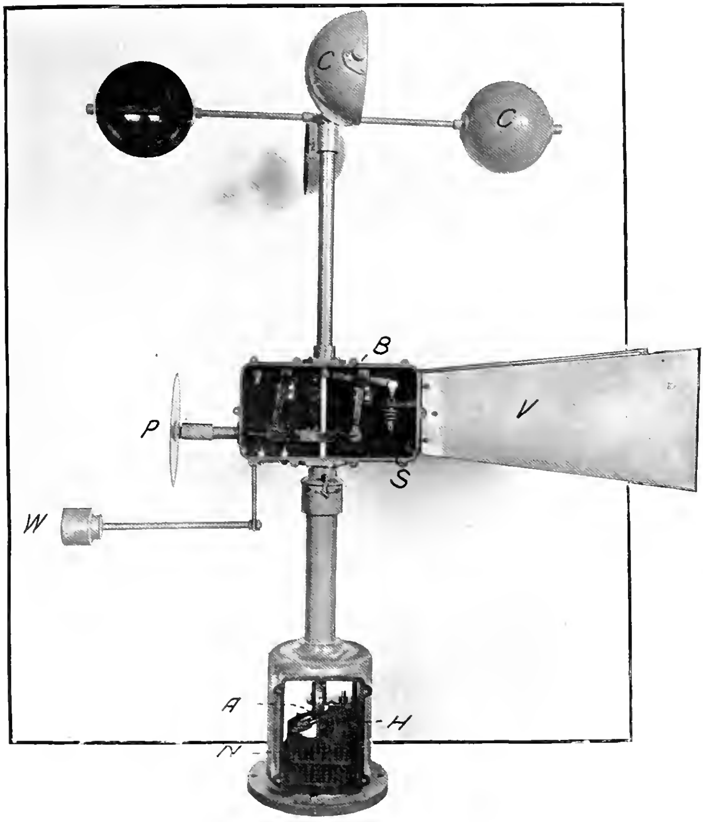


Figure 2

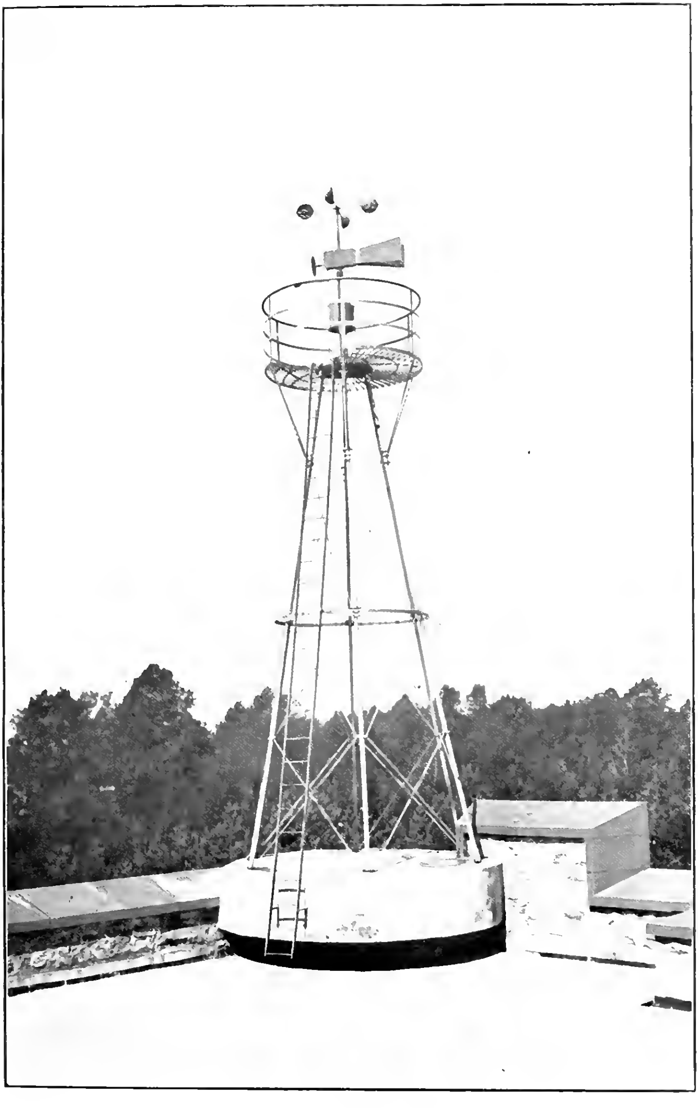


Figure 3.

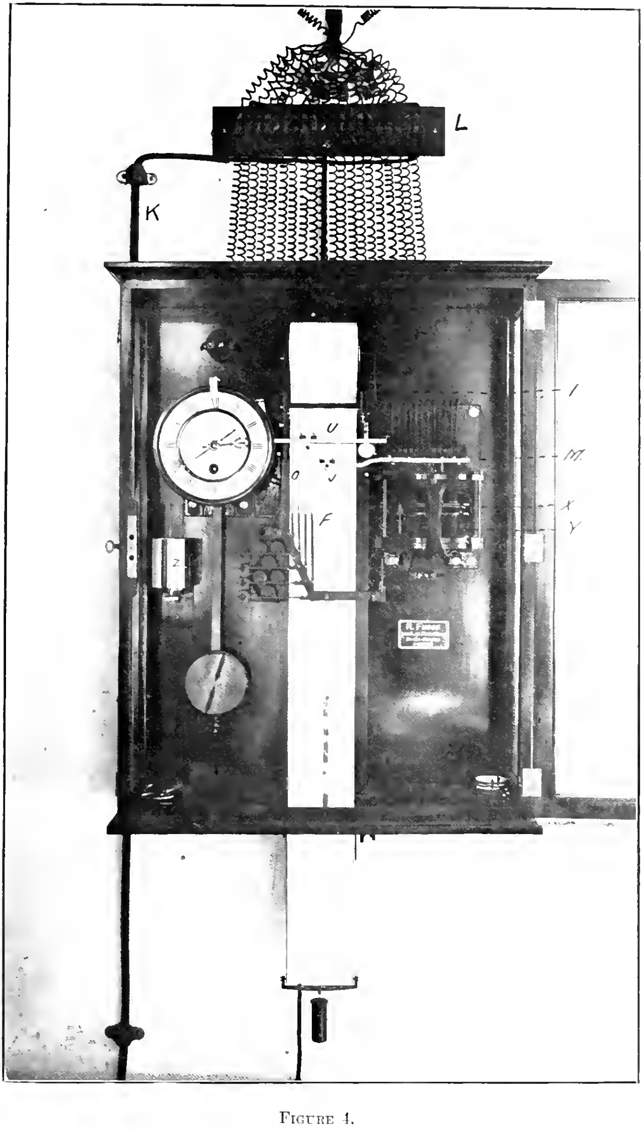
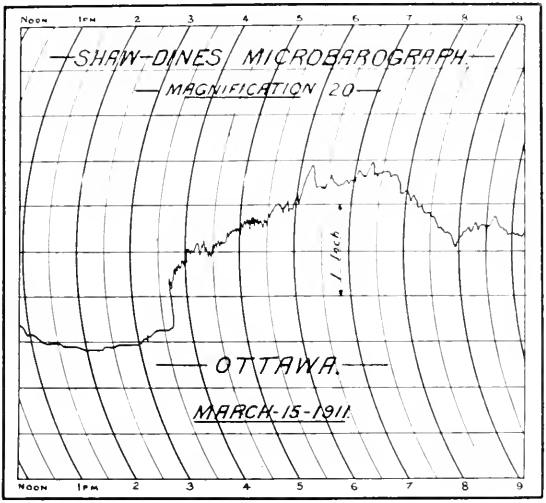


Figure 4.


Noon 1PM 2 3 4 5 6 7 8 9
SHAW-DINES MICROBAROGRAPH.
MAGNIFICATION 20
1 Inch
OTTAWA.
MARCH-15-1911.
Noon 1PM 2 3 4 5 6 7 8 9

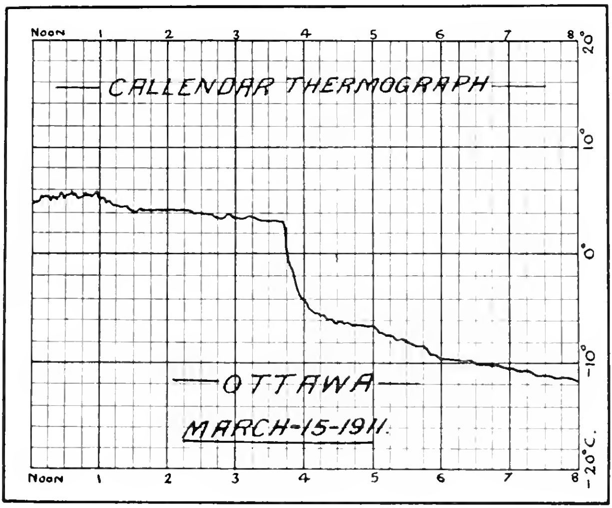

Noon 1 2 3 4 5 6 7 8
CALLENDAR THERMOGRAPH
OTTAWA
MARCH-15-1911.
20° 10° 0° -10° -20°C.
Noon 1 2 3 4 5 6 7 8

FIGURE 5.

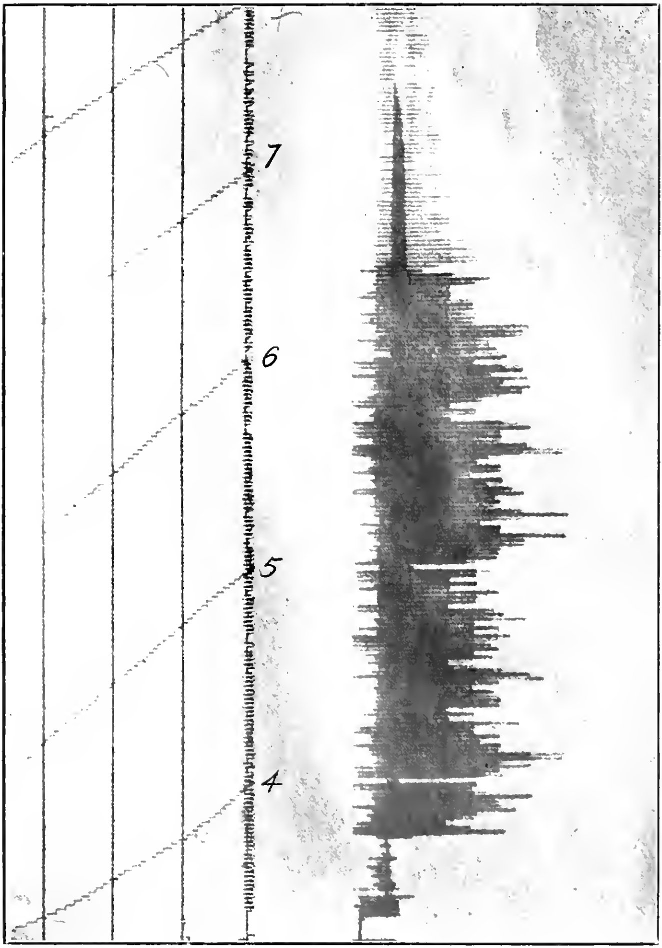


FIG. 6.—Anemogram March 15, 1911.

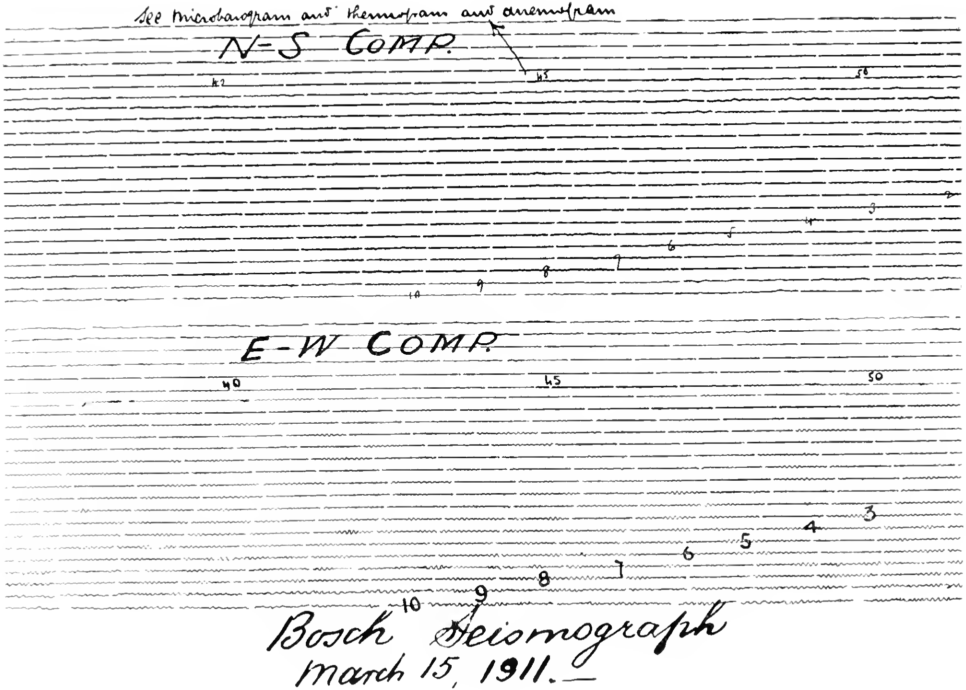
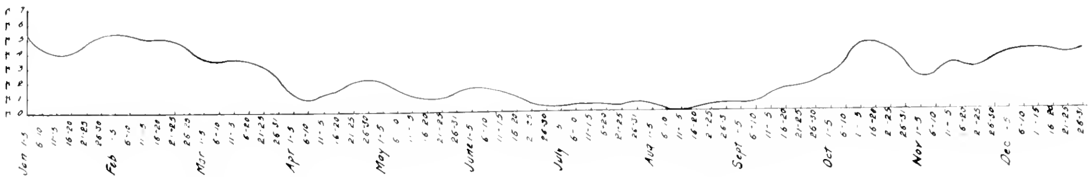

See microbarogram and thermogram and anemogram
N-S COMP.
E-W COMP.
40
45
50
Bosch Seismograph
March 15, 1911.

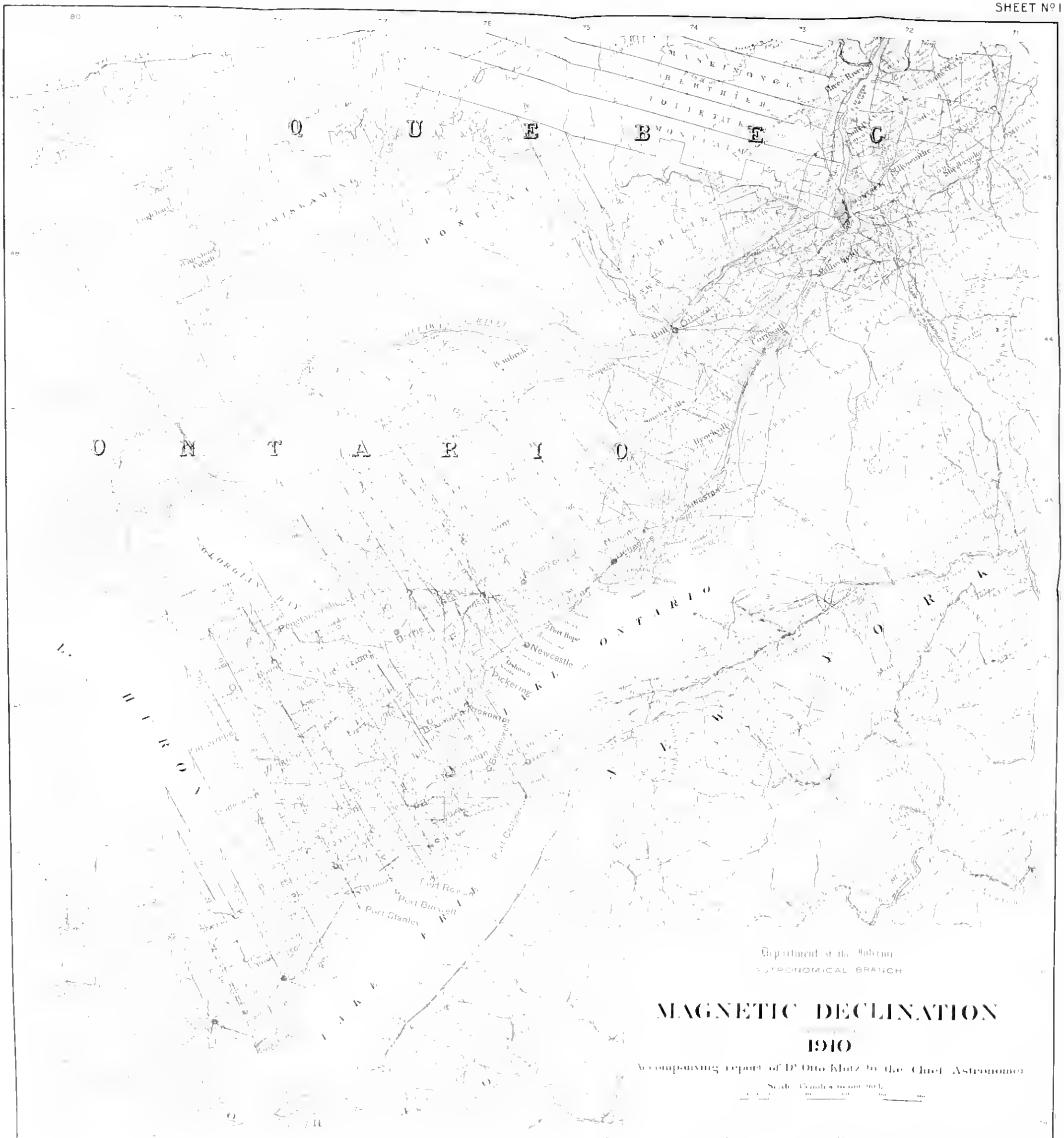
FIGURE 7.



MICROSEISMS. SEASONAL CHANGE 1910.

FIGURE 8.

1913



Chief Astronomer ... for year ending 31st March, 191

SHEET No 2

SASKATCHEWAN
MANITOBA
ONTARIO
SUPERIOR
MAGNETIC DECLINATION
1910

APPENDIX 2.

REPORT OF THE CHIEF ASTRONOMER, 1911.

ASTROPHYSICAL WORK

BY

J. S. PLASKETT, B.A.

CONTENTS.

Appendix D.—Solar Physics.—Ralph E. De Lury, M.A., Ph.D. (continued). PAGE

Appendix E.—R. M. Motherwell, M.A.

ILLUSTRATIONS

APPENDIX 2.

ASTROPHYSICAL WORK BY J. S. PLASKETT, B.A.

OTTAWA, CANADA, April 1, 1911.

W. F. KING, ESQ., C.M.G., LL.D.,
Chief Astronomer,
Ottawa.

SIR.—I have the honour to submit the following report upon the work carried on in the Astrophysical Division and in other departments of the work of the Observatory during the past year.

This report contains a summary of the whole work of the division followed by detailed accounts, generally in the form of appendices, of the various pieces of work carried on by the observers under my charge. Each of these appendices, as in former years, is written by the observer responsible for the work and appears over his signature, and in this regard I can only repeat the commendation given in previous reports of the zeal and efficiency of my assistants, to which is due in a large measure the amount and quality of the work.

For convenience of treatment the work will be classified under the following headings:—

1. *Stellar Spectroscopy.*—The main work under this heading is the determination of the radial velocities of selected stars. These consist almost wholly of spectroscopic binaries whose velocity curves and orbits are being investigated, but a few star spectra for other purposes have been obtained.

2. *Solar Research.*—This subdivision includes the work on the solar rotation and allied investigations with the coelostat telescope and grating spectrograph, daily solar photographs with the equatorial telescope, and miscellaneous work along similar lines.

3. *Micrometric and Photographic Work.*—This includes the measurement of the position angle and distance of double stars, the observation of the occultation of stars by the moon, and comet and stellar photography.

4. *Mechanical Work.*—The work of the mechanicians and carpenter in the construction of new and the repair and alteration of existing instruments is also included as being under my charge.

5. In addition to the above, directly in connection with and purely the work of the Observatory, it seems desirable to add a subdivision for the work being done by myself as representing the Observatory on several international committees dealing with important astrophysical questions. These committees were organized last

year, and I was appointed thereon at the meetings of the 'Astronomical and Astrophysical Society of America' at Cambridge, Mass., and of the 'International Union for Co-operation in Solar Research' at Mount Wilson, Cal., which I had the honour of attending as the representative of this Observatory. A report of these meetings and of the work of the committees will be given later.

The division of the work has followed practically the same lines as last year. Messrs. Harper, Cannon and Parker devoting their whole time to radial velocity work, Dr. DeLury to solar and allied chemical research, and Mr. Motherwell to the micrometric and photographic work, and to the supervision of the surveying and astronomical instruments. My own time has been occupied principally with stellar spectroscopy and work on the solar rotation. The radial velocity work having become well systematized and arranged, has left me free to devote more time to other branches of the work, and consequently considerable of my energy has been devoted to working with Dr. DeLury in the difficult problem of the Spectroscopic Determination of the Solar Rotation.

Stellar Spectroscopy.

As in previous years, satisfactory progress has been made in the determination of stellar radial velocities, especially of spectroscopic binaries. Part of my own time and the whole time of Messrs. Harper, Cannon and Parker is devoted to this work. The observing is divided between the four above mentioned, about nine half nights per week being allotted for work with the spectrograph. A regular programme of observation is followed, no attempt being made to have any observer secure the spectra of any particular stars. After the spectra are obtained, however, a division is made, each one undertaking the measurement and reduction of all the plates of one or more binaries and the computation of the orbits, this arrangement tending to more uniform treatment of the binaries and also making the work much more interesting. Following this scheme, as in former years, each observer discusses the work he has done and this appears as an appendix to this report.

A change has been made this year in the method of publishing the measures of the spectra. For the last two years all the measures have been published in an appendix by themselves, so that in the discussion of the orbit only the summary of the plate velocities appeared. This was for the purpose of preventing the breaking up of the continuity of the text by the introduction of many pages of measures, but had the disadvantage that each orbit was in a sense incomplete as the individual measures were not included. Furthermore, owing to the large number of measures of the year before last, this part of the report occupied a very disproportionate amount of the space, and it was felt desirable to abbreviate it if possible. Various schemes were considered, and the one appearing in the present report was finally adopted as containing all the necessary information in less than a quarter of the space. This saving was effected, in the first place, by omitting the micrometer settings and corrections for the star and comparison lines, and, in the second place, by grouping a number of plates together so that the annual diurnal and curvature corrections occupy relatively much less space. The velocities for each star line measured with their weights, the weighted mean and the final radial velocity of the plate are given in a tabular and compact form. This change would have been applied last year but for the fact that the long delay in the publication of the reports prevented us from realizing how much space the measures actually occupied. It is believed that in this new method there will not be more than three or four pages of measures for an average spectroscopic binary.

In obtaining the spectra discussed herein, five different adaptations of two spectrographs have been used, designated as I L, III L, III S, III R and I. The following table gives some of the constants of the instruments:—

SPECTOGRAPHS.

Designation.	Spectrograph.	No. of Prisms.	Focus of Coll.	Focus of Camera.	Å per mm. at H_γ.
I L	Ottawa Spectrograph...	1	525 mm.	525 mm.	30.2
III L	" " ..	3	525 "	525 "	10·1
III S	" " .	3	525 "	300 "	17·5
III R	" " ..	3	525 "	260 "	20·2
I	New Single-Pr. Spect...	1	765 "	455 "	33·4

The Ottawa spectrograph referred to above was described in my report of 1906–7, p. 73, while the new single-prism spectrograph was described in my report of 1908–9, p. 163. The differences in III L, III S and III R consist only in the camera objectives employed. III L has a Hartmann-Zeiss 'chromat' objective; III S a Bausch and Lomb Zeiss-Tessar and III R a specially designed Ross homocentric. The form of field of all these three objectives and of the others used has been fully discussed and described in my report for 1908–9, p. 170.

Since my last report only changes in minor details of these instruments have been made. No material improvements have suggested themselves, as they all work satisfactorily. As will be mentioned more fully later, it is proposed to design and construct a grating spectrograph as soon as a grating giving a sufficiently bright first order spectrum has been obtained.

The method of measurement and reduction follows that already fully described in the report for 1906–7, p. 95, 1907–8, p. 84, and 1908–9, p. 175, so far as micrometer measures are concerned. The stereo-comparator has been used on the plates of ε Ursæ Minoris which have been measured and reduced as described in the 1908–9 report, p. 177. It may be as well to state that the method of reducing the micrometer measures which has been followed for five years has proved itself eminently satisfactory, requiring a minimum amount of labour—a couple of subtractions from tabular values to get the millimetre displacement, which latter is multiplied by a tabular velocity constant to give the radial velocity—and giving equal accuracy with other methods requiring several times the work.

The observing weather during the year covered by this report has been very poor, the worst on record since the Observatory was organized. This will be evident by a comparison of the spectra obtained in the last three years; details of which are given in the annexed table.

SPECTRA OBTAINED.

Month.	1908–9		1909–10		1910–11	
	Spectra.	Nights.	Spectra.	Nights.	Spectra.	Nights.
April	65	8	77	11	51	14
May	49	11	22	5	44	10
June	90	16	49	12	41	11
July	108	20	94	15	49	11
August	100	16	77	16	55	10
September	43	8	59	12	103	17
October	47	8	94	13	76	11
November	38	9	57	11	23	5
December	99	15	94	14	101	13
January	129	18	84	11	68	10
February	102	15	89	12	53	12
March	141	14	115	15	118	16
Totals	1011	158	911	147	782	140

It will be noticed that not only have the number of spectra and the number of nights steadily decreased, but the average number of spectra obtained per night has decreased from 6.4 in 1908–9 to 6.2 in 1909–10 and to 5.6 in 1910–11.

Of the 782 spectra obtained during the past year, 111 are of the binaries completed during the year, 524 are of binaries under observation, 75 of binaries, work on which has been discontinued, 50 are additional plates of binaries previously completed in which for various reasons it was felt desirable to obtain further observation, and 22 are spectra of various stars obtained for miscellaneous purposes.

There have been completed, during the interval covered by this report, the elements of the orbits of five spectroscopic binaries, some details of which are given in the annexed table.

DATA OF BINARIES COMPLETED.

Star.	R. A. 1900.	Decl. 1900.	Visual Mag.	Type.	No. of Plates used.	Computer.
	h. m.	° ′				
7 Camelopardalis	4 49·3	+53 35	4·44	A2	44	W. E. Harper.
ν Orionis	6 1·9	+14 47	4·40	B2	117	"
ω Ursæ Majoris	10 48·2	+43 43	4·84	A	60	T. H. Parker.
93 Leonis	11 42·8	+20 46	4·54	F8	72	J. B. Cannon.
ε Ursæ Minoris	16 56·2	+82 12	4·40	G5	42	J. S. Plaskett.

ELEMENTS OF ORBITS.

Star.	Period.	e	K	ω	γ	Julian Day.	$a \sin i$
	days.		km.	°	km.		km.
7 Camelop	3·8846	·013	35·15	217·14	− 8·93	2418281·176	1877000
ν Orionis	131·26	·599	34·09	1·58	+22·10	2417975·16	49270000
ω Ursæ Majoris	15·840	·264	20·64	11·95	−18·45	2417991·101	4336000
93 Leonis	71·70	·008	26·54	270·81	+ 0·17	2418088·405	26170000
ε Ursæ Minoris	39·482	·0113	31·954	359·76	−11·398	2418005·75	17346000

Complete data including measures will be given of these five spectroscopic binaries later, of ε Ursæ Minoris above my own signature and of the other four in the Appendices A, B and C to this report above the signatures of the observers who measured the plates and computed the orbits. Although there is a reduction from last year in the number of orbits published, from eight to five, this reduction is perhaps more apparent than real, for only three of the eight of last year were new orbits, the remainder being new discussions of previously published results to which further data had in some cases been added. However, a reduction in the number of orbits is to be expected from two reasons—first, on account of the poorer observing weather and fewer spectra obtained, and second, because of the fact that the brighter spectroscopic binaries are rapidly becoming exhausted and it is necessary to observe fainter stars requiring more exposure time. This last cause will tend to become more serious as time goes on, for the number of spectroscopic binaries brighter than the fifth magnitude, which is approaching the practical limit with our equipment, is rapidly becoming smaller. There is a still further reason which leads us to expect that the number of orbits obtained must necessarily decrease, and that is the fact that the binaries selected for observation first, are those in which a large range of velocity combined with lines suitable for fairly accurate measurement enables the elements of the orbit to be comparatively easily determined. As time goes on, however, and selection has to be made from stars whose spectra are poor or which have only a small range of velocity, it is evident that many more plates will be required to obtain a statisfactory orbit even if it is possible to determine the orbit at all. In previous reports I have mentioned the abandonment of work on two binaries, δ Aquilæ and o Andromedæ. As stated above, 75 spectra were obtained of eight stars on which work has been discontinued for the reasons stated above, and, although it by no means follows that the orbits of these stars cannot be determined, yet, as we have 23 binaries under observation where the chances of securing orbits with a reasonable number of plates seem greater, the others were discontinued for the present. In order to render the measures we have obtained available for others working along similar lines, who may desire to take up any of these binaries, it has been decided to publish these measures at once, and they will be found in Appendices A, B and C, given by the observers who have measured the plates. There are thus given the measures of 119 plates of 11 stars. For convenience, the principal data of the stars observed and the plates measured are collected in the following tables, while the observing records and detailed measures are given in the appendices just cited.

MISCELLANEOUS MEASURES.

Star.	R.A.		Dec.		Type.	Mag.	No. of Plates.	Measurer.
	h.	m.	°	′				
9 Camelopardalis	4	44.1	+66	10	B	4·4	4	Cannon.
μ Orionis	5	56·9	+ 9	39	B3	3·4	2	Harper.
φ Ursæ Majoris	9	45	+54	32	A	4·7	1	"
π^3 Virginis	11	56	+ 7	06	A	4·6	2	"
ε Ursæ Majoris	12	49·6	+56	30	A*p*	1·7	2	"
α Ophiuchi	17	30·3	+12	38	A5	2·1	24	Cannon.
ζ Aquilæ	19	01	+13	43	A	3·3	12	Parker.
ι Cygni	19	27	+51	32	A	3·9	7	Cannon.
ν Cygni	20	53	+40	47	A	4·2	7	Parker.
o Andromedæ	22	57·3	+41	47	B3	3·4	50	Harper.
σ Cassiopeiæ	23	54	+55	12	B5	5·1	8	Cannon.

SUMMARY OF MEASURES.

9 Camelopardalis.

Plate.	G. M. T. Date.	Year.	Velocity.	Plate.	G. M. T. Date.	Year.	Velocity.
2805	Sept. 20·78.	1909	−6·4	2874	Oct. 8·79	1909	−1·7
2842	Oct. 4·74	"	+2·2	2875	" 8·79......	"	−7·3
2874	" 8·79	"	+1·5	2875	" 8·79......	"	−7·4

μ Orionis.

Plate.	G. M. T. Date.	Year.	Velocity.	Plate.	G. M. T. Date.	Year.	Velocity.
1139	Nov. 11·88......	1907	+68·4	1159	Nov. 23·75......	1907	+50·3

φ Ursæ Majoris.

Plate.	G. M. T. Date.	Year.	Velocity.	Plate.	G. M. T. Date.	Year.	Velocity.
1176	April 13·72......	1908	−11·0				

π^8 Virginis.

Plate.	G. M. T. Date.	Year.	Velocity.	Plate.	G. M. T. Date.	Year.	Velocity.
3349	Mar. 18·88......	1910	−28·5	3383	Apr. 11·77......	1910	−20·2

ε Ursæ Majoris.

Plate.	G. M. T. Date.	Year.	Velocity.	Plate.	G. M. T. Date	Year.	Velocity.
456	Dec. 11·75......	1906	−0·4	489	Dec. 18·69......	1906	−7·0

α Ophiuchi.

Plate.	G. M. T. Date.	Year.	Velocity.	Plate.	G. M. T. Date.	Year.	Velocity.
1481	Apr. 13·86 ...	1908	− 4·8	1752	July 31·68......	1908	+ 1·4
1542	May 18·83.....	"	+15·4	1765	Aug. 5·67......	"	+15·4
"	" 18·83	"	+ 0·1	1819	" 24·61......	"	+ 3·5
1549	" 22·83....	"	+16·3	"	" "	"	−14·7
1612	June 17·81.....	"	+ 9·3	1834	" 27·55	"	+ 2·3
"	" "	"	+ 5·6	1843	" 28·56......	"	+17·7
1632	" 24·74.....	"	+17·7	1854	" 31·61......	"	+28·5
1649	" 27·74 ...	"	+13·1	1862	Sep. 3·55......	"	+ 8·3
1654	July 1·74 ..	"	+15·9	1863	" 3·56......	"	+18·2
1688	" 10·71.....	"	+13·4	1884	" 14·56......	"	+ 2·8
1701	" 13·74	"	− 0·8	1885	" 14·57......	"	+23·0
1702	" 13·76	"	− 7·3	"	" "	"	+39·9
1715	" 15·79.....	"	− 0·1	1890	" 16·53	"	+ 0·9
1724	" 24·60.....	"	+14·4	1891	" 16·55......	"	+ 3·9

o Andromedæ.

Plate.	G. M. T. Date.	Year.	Velocity.	Plate.	G. M. T. Date.	Year.	Velocity.
369	Aug. 6·80.....	1906	− 4	970	July 27·80......	1907	−10·8
374	" 8·81.....	"	− 1	977	Aug. 1·77	"	+ 5·3
379	" 15·77.....	"	− 4	984	" 5·77......	"	−17·3
401	Sep. 27·69.....	"	0	999	" 8·76	"	−22·1
410	Oct. 16·71.....	"	− 8	1002	" 10·70	"	−10·9
414	" 23·64.....	"	− 2	1008	" 12·75	"	−24·9
419	Nov. 1·74.....	"	−20	1021	" 22·78......	"	−30·4
432	" 8·71.....	"	−11	1035	Sep. 6·70	"	−13·8
439	" 19·60.....	"	−13	1042	" 12·82	"	−17·5
450	Dec. 11·53	"	−10	1044	" 14·78	"	− 9·2
462	" 13·61.....	"	−15	1052	" 18·71......	"	−12·8
482	" 18·46.....	"	−24	1053	" 18·74......	"	−24·5
491	" 19·53.....	"	−30	1065	" 20·71	"	−16·1
526	Jan. 11·55.....	1907	−19	1066	" 20·75	"	−11·7
531	" 15·47.....	"	−19	1087	Oct. 1·67......	"	−16·8
538	" 16·60.....	"	−13	1088	" 1·69	"	− 6·6
865	June 14·84.....	"	−12·9	1130	Nov. 8·65......	"	− 5·2
867	" 20·81.....	"	− 5·9	1131	" 8·68	"	−15·4
874	" 21·83.	"	−12·9	1133	" 11·62......	"	− 2·0
899	" 27·82.....	"	−17·0	1134	" 11·65	"	−19·6
907	July 2·83.....	"	− 4·7	1151	" 18·57......	"	− 7·9
935	" 9·82.....	"	− 9·0	1152	" 18·62......	"	− 9·9
948	" 16·77.....	"	−10·4	1174	Dec. 4·65	"	−15·6
954	" 18·75.....	"	−19·7	1175	" 4·67......	"	−18·7
960	" 20·79	"	−20·6	1176	" 4·70......	"	−15·5

ζ Aquilæ.

Plate.	G. M. T. Date	Year.	Velocity.	Plate.	G. M. T. Date.	Year.	Velocity.
805	May 31·83.....	1907	−29·6	1802	Aug. 20·72.....	1908	− 26·5
852	June 14·77.....	"	−34·0	1821	" 24·66.....	"	− 14·8
864	" 20·76.....	"	−41·4	" *p*	" "	"	+111·0
947	July 16·73.....	"	−31·0	" *s*	" "	"	− 26·9
1039	Sep. 12·67.....	"	−22·3	" *p*	" "	"	+116·3
1644	June 26·85	1908	−18·0	" *s*	" "	"	− 21·7
1680	July 8·82.....	"	−68·4	1856	" 31·63.....	"	− 16·3
"	" "	"	−37·1	1887	Sep. 14·61.....	"	− 8·2
1778	Aug. 7·78.....	"	−50·1	.....	.....	.....	.....

p Primary. *s* Secondary.

ι Cygni.

Plate.	G. M. T. Date.	Year.	Velocity.	Plate.	G. M. T. Date.	Year.	Velocity.
932	July 9·74.....	1907	−20·2	1824	Aug. 24·76.....	1908	−18·7
1718	" 15·85.....	1908	− 4·7	1839	" 27·70.....	"	−15·9
1804	Aug. 20·76.....	"	−20·9	1845	" 28·63.....	"	−21·0
"	" "	"	−19·9	1886	Sep. 14·61.....	"	−22·0
1824	" 24·76.....	"	−23·1	...	.....	.....	.....

ν Cygni.

Plate.	G. M. T. Date	Year.	Velocity.	Plate.	G. M. T. Date.	Year.	Velocity.
934	July 9·78.....	1907	−46·6	1825	Aug. 26·81.....	1908	− 5·1
1758	" 31·83....	1908	−35·6	1846	" 28·67.....	"	−19·2
1830	Aug. 24·81.....	"	−32·4	1857	" 31·72	"	−57·0
"	" "	"	−10·8	1892	Sep. 16·59.....	"	−29·1

σ Cassiopeiæ.

Plate.	G. M. T. Date.	Year.	Velocity.	Plate.	G. M. T. Date.	Year.	Velocity.
2660	July 14·86.....	1909	−21·3	2902	Oct. 20·70.....	1909	−28·7
2680	" 27·83.....	"	−21·8	"	" "	"	−30·0
2784	Sep. 14·57.....	"	−16·6	3009	Dec. 2·42....	"	−38·8
2839	Oct. 4·66.....	"	+ 4·9	3521	July 11·77....	1910	+ 6·0
"	" "	"	+ 3·6	3527	" 13·73....	"	−25·6

The spectroscopic binaries under investigation are contained in the following table. The arrangement given here is arbitrary following the order in which the stars were selected from the observing list.

ρ Leonis
β Coronæ Borealis
72 Ophiuchi
γ Corvi
d Boötis
B. A. C. 5890
γ Aquarii
ε Cygni
ε Cassiopeiæ
θ^2 Tauri
69 (*υ*) Tauri
ξ Tauri
b Persei
ξ Persei
τ Orionis
ν Geminorum
γ Geminorum
86 *ρ* Tauri
23 Comæ
α Pegasi
σ Geminorum
68 Ophiuchi
γ Ophiuchi

The above list includes the majority of the discovered binaries (whose orbits are undetermined and which are not under observation at other places) in which the range of velocity and character of the spectrum offer a reasonable chance of obtaining an orbit. In the other 200 or so spectroscopic binaries, the chances of obtaining satisfactory orbits, or even any orbit at all, are, in the majority of cases, poor. This is owing chiefly, as stated above, to a total range of velocity not sufficiently greater than the probable error of measurement to allow the period to be easily determined. If the period were known it is likely that a sufficient number of observations would enable a fairly satisfactory orbit to be obtained.

The method of selection of binaries for observation depends then, first, on the character of spectrum or type of star, and second, on the range of velocity observed. A low range is evidently due either to a long period or to a small inclination of the orbital plane to the tangent plane, to the sphere, or to a combination of both causes. There is an objection to such a method of selection of stars, that the material obtained will not be representative of the stars as a whole, and that general conclusions cannot safely be drawn from the discussion of data limited in this peculiar way. But under present conditions such a method of selection cannot well be remedied, as, even in the cases which are apparently most suitable, it is sometimes difficult to secure an orbit and it would be simply a waste of time to obtain observations on many of the discovered binaries. Indeed, in my opinion, judging from our experience with early type spectra, the range of velocity obtained in many of the published binaries is insufficient to prove that they are binaries.

It is evident from the foregoing that our output in radial velocity observations of spectroscopic binaries is likely to diminish materially under present conditions, instead of increasing as is to be wished. The only remedy for this state of affairs is an increase in telescope aperture. Such an increase would not only enable us to keep up our work on spectroscopic binaries but to take part in the great work of obtaining the radial velocities of the fainter stars, a work than which none is more urgent and none offers greater returns for the labour expended. As is well known, the radial velocities of all stars with spectra reasonably accurately measurable, brighter than 5.0 visual magnitude are now practically completed by the ability and energy of Dr. W. W. Campbell, director of the Lick Observatory. But the radial velocities of stars fainter than 5.0 visual magnitude are needed, and there seems no immediate prospect of obtaining them. If our Observatory could take part in such work it would place it in the first rank among observatories, and would undoubtedly give Canada a very high standing in the scientific world.

The desired increase in telescopic aperture can be most economically obtained by the use of a reflecting telescope, which can be erected for less than a quarter the cost of a refractor of the same aperture, and which, for spectroscopic use, is almost equally efficient and indeed possesses some advantages over the refractor, notably in that it is perfectly achromatic and that the shorter, photographic, wave lengths of light are not absorbed to the same extent as when passing through glass. As to the size of aperture desirable I would say, after the performance of the 5-foot reflector on Mount Wilson, that we should not be satisfied with a smaller aperture, but, on the contrary, perhaps aim at something greater, 6-foot say, which would give us the distinction of having the largest in the world, and, a far more important consideration, enable us to reach fainter stars and to obtain sufficient exposure on the brighter ones in considerably less time. The question of covering such an instrument by a movable roof, which can be rolled back out of the way when obvervations are to be made, instead of by the ordinary dome, is worth considering, for, if a suitable wind shield could be devised, there is a decided advantage so far as the seeing is concerned in working in the open, and, in addition, a building with a movable roof would only cost a small fraction of one with a dome.

I would, therefore, strongly urge upon you the desirability of the installation of a large reflecting telescope principally for radial velocity investigations, though it would be desirable to make it suitable for other lines of work also, especially as this can be done without much additional cost. Such an instrument would place our Observatory in the first rank, so far as equipment goes, among observatories, and would enable our staff, who have already obtained an enviable record for the quantity and quality of the work done with a very modest equipment, to excel that record and to place our Observatory in the forefront in the production of valuable scientific work. There is, as I have previously stated, a pressing need for just the kind of work that we would be best prepared to do with such a telescope, and our taking up of this work would add much to our prestige as an Observatory and as a nation. It may not be amiss to point out that, as it would take two or three years to construct such a telescope, all that would be necessary in the meantime would be to have its construction authorized, no money would require to be voted for the present. Some further remarks concerning this question will be found under the report of my attendance at the two notable astronomical meetings of last year.

The only spectroscopic binary on which the measures and discussion have been made by myself is the last in the preceding list, ε Ursæ Minoris, whose orbit will now be given, those of the others appearing in the appendices.

The Spectroscopic Binary ε Ursæ Minoris.

The star ε Ursæ Minoris ($\alpha = 16^h 56.2^m, \delta = +82° 12'$) was announced to be variable in its velocity by Professor Campbell in 1899.* It was placed on our observing list with the three-prism spectrograph in 1908 and a few plates were obtained. The star, however, is so faint—photographic magnitude 5·3—that even two and one half hours' exposure gave only a very weak spectrum, quite unsuitable for accurate measurement. When a short-focus camera was applied to the three-prism spectrograph in 1909, the star was again observed, and although greater intensity of spectrum was obtained the exposure time was inconveniently long. If the Lumiere "Sigma" plates were used, a fair spectrum could be obtained in an hour if the night was reasonably good, but these plates have the disadvantage of being very coarse grained, thus diminishing considerably the ease and accuracy of measurement. Consequently, the spectra obtained were not felt to be of satisfactory quality, and after May, 1910, the star was observed with the new single-prism spectrograph on Seed "27" plates. Even with this low dispersion over an hour's exposure was required, and many of the spectra obtained were of poor quality. It almost seemed, therefore, that this star was below the effective range of our equipment, and it was thought preferable to work up the plates already obtained, even if of inferior quality, than to attempt to obtain good high dispersion plates of so faint an object. Of the 55 plates obtained of this star, 42 of the best were selected for use in determining the orbit, but the majority even of these 42 were not of good quality.

The star is of the spectral class G5 with good lines only slightly advanced in type beyond the sun, and consequently well adapted for the employment of the spectro-comparator, on which all the plates were measured and which is quite a satisfactory method for stars of this type. The record of observations is given below, followed immediately by the detailed measures which are placed in a similar form to that described above for those measured on the micrometer microscope.

As has been described in the two previous reports, the spectro-comparator determines the actual linear displacement of the star lines relatively to the displacement of the lines in a spectrum of the sun. The measurements of these lines are made at a number of selected regions of the spectrum, and the number of these regions measured varies from plate to plate, depending on the quality. In the tables of measures the wave length of the centre of the region is given in the first column and the kilometre values of the measured displacements in the succeeding columns. The tables are grouped so that the measures of plates made on each form of the spectrograph, of which III L, III S, III R and I were employed, are kept together, the spectrograph used being indicated at the head of the table.

* Astrophysical Journal, Vol. X., p. 179, October 1899.

RECORD OF SPECTROGRAMS.

P. Plaskett.
H. Harper.
P[1]. Parker.
C. Cannon.

Star.	No. of Neg.	Camera	Plate.	Date.	Middle of Exposure G.M.T.		Duration	Hour Angle at End.		Temperature Centigrade. Room. Beg.	Room. End.	Prism Box. Beg.	Prism Box. End.	Slit Width in Inches.	Seeing.	Observer	Remarks.
				1908.	h	m	m	h	m								
ϵ Ursæ Minoris	1418	III L	Seed 27	Mar. 20	17	17	115	3	50 E	− 5·2	− 6·0	0·9	1·0	·0018	Fair	P	Hazy 30[m]
"	1454	"	"	Apr. 3	17	33	115	2	45 E	− 7·5	− 9·0	1·7	1·7	·0017	....	P	
"	1516	"	"	May 4	20	22	110	2	05 W	7·2	6·3	13·4	13·4	·0018	....	P	
"	1530	"	"	" 15	17	20	120	0	05 E	14·5	13·5	18·7	18·7	"	Good	P–H	
"	1555	"	"	" 25	18	30	160	2	05 W	19·6	16·0	25·5	25·7	"	....	P[1]–H	Off 45[m]
"	1587	"	"	June 6	19	02	135	3	00 W	20·5	19·8	25·2	25·3	"	Fair	P	
"	1868	"	"	Sept. 7	14	52	135	5	10 W	17·4	15·0	21·1	21·1	·0015	"	P	
				1909.													
"	2917	III S	"	Oct. 29	14	00	100	7	20 W	3·0	1·5	7·0	7·0	·002	5	H	
"	3023	"	Σ	Dec. 11	10	34	72	6	30 W	− 3·8	− 4·8	− 1·4	− 1·6	·0016	3–4	P	
"	3042	"	"	" 18	11	00	80	....		− 4·0	− 5·5	− 3·2	− 3·2	"	"	P	
"	3053	"	"	" 27	10	29	75	7	30 W	− 7·5	− 9·4	− 5·9	− 6·0	"	"	P	
"	3067	"	"	" 30	11	15	70	8	25 W	− 8·0	− 8·6	− 3·0	− 3·1	"	4	P	
				1910.													
"	3081	"	"	Jan. 4	11	10	70	8	40 W	−15·5	−15·0	− 9·5	− 9·5	·002	3	P	
"	3084	"	"	" 7	10	45	70	8	25 W	.....	.....	.....	.....	"	3	P	Temperature uncertain.
"	3117	"	"	" 15	11	05	80	9	20 W	− 9·5	− 9·0	− 1·0	− 1·1	·0016	3–4	P	
"	3131	"	"	" 19	11	21	77	9	55 W	− 1·0	− 1·7	2·5	2·5	"	"	P	
"	3151	"	"	" 25	23	30	60	1	40 E	− 9·8	−10·5	− 5·2	− 5·3	"	"	P	
"	3183	"	"	Feb. 10	17	37	75	6	25 E	−15·8	−16·1	− 6·9	− 6·9	"	4	P	
"	3224	"	"	" 24	15	37	80	7	35 E	−13·5	−14·0	0·0	0·3	·0017	4–5	H	
"	3292	III R	"	Mar. 5	19	40	70	2	50 E	1·2	0·5	10·6	10·6	"	3	P	
"	3310	"	"	" 10	17	15	60	5	00 E	− 1·1	− 1·4	9·4	9·4	·002	4	P	

RECORD OF SPECTROGRAMS.—*Concluded.*

P. Plaskett.
H. Harper.
P¹. Parker.
C. Cannon.

Star.	No. of Neg.	Camera	Plate.	Date.	Middle of Exposure. G.M.T.	Duration	Hour Angle at End.	Temperature. Centigrade. Room. Beg.	Room. End.	Prism Box. Beg.	Prism Box. End.	Slit Width in Inches.	Seeing.	Observer	Remarks
				1910.	h m	m	h m								
ε Ursæ Minoris	3326	III R	Σ	Mar. 11	21 50	90	0 05 E	−2·0	−3·4	3·0	2·9	·0017	5–4	P¹	
"	3337	"	"	" 17	16 40	70	5 00 E	−9·6	−10·0	1·5	1·6	·0018	3–4	P	
"	3359	"	"	" 26	19 05	110	1 40 E	3·0	2·5	7·1	7·1	·002	3–4	P	Off 20ᵐ
"	3372	"	"	Apr. 2	18 40	80	1 55 E	6·0	4·5	12·5	12·5	"	"	P	
"	3426	I	Seed 27	May 5	16 32	75	1 50 E	9·0	8·5	14·1	14·4	"	"	P	
"	3427	III R	Σ	" 5	18 05	70	0 30 E	8·5	8·0	12·5	12·5	"	"	P	
"	3435	I	Seed 27	" 7	18 26	57	0 05 E	13·1	12·6	18·2	18·2	"	3	P	
"	3439	"	"	" 10	18 47	55	0 30 W	9·6	9·0	15·7	15·7	"	1	C	
"	3448	"	"	" 12	16 22	75	1 35 E	6·0	6·7	17·7	17·6	"	3–4	P	Off 15ᵐ
"	3455	"	"	" 19	16 52	75	0 45 E	11·8	10·5	17·9	17·8	"	4	P	Off 15ᵐ
"	3461	"	"	" 27	20 28	33	3 05 W	11·0	11·0	17·0	17·8	"	3	P¹	
"	3463	"	"	" 28	16 55	60	0 10 E	17·6	17·0	23·6	23·6	"	3	P	
"	3470	"	"	June 4	17 12	95	0 50 W	10·0	9·5	21·9	22·2	"	4	P	Off 25ᵐ
"	3476	"	"	" 9	18 01	57	1 45 W	12·0	12·5	19·8	20·2	"	4	P¹	
"	3492	"	"	" 23	16 40	80	1 30 W	18·4	16·5	27·7	27·7	"	2–3–4	P	
"	3495	"	"	" 25	16 50	80	1 50 W	19·2	18·5	25·0	21·9	"	3	P	
"	3554	"	"	Aug. 2	18 37	115	6 15 W	18·1	17·0	22·8	22·4	"	0 1 3	P¹	
"	3566	"	"	" 11	16 50	70	5 00 W	19·2	17·8	23·6	23·6	"	1	P	Off 15ᵐ
"	3611	"	"	Sept. 1	16 12	96	5 43 W	11·0	12·0	20·8	20·4	"	4–5	H	
"	3630	"	"	" 9	14 13	80	4 05 W	......	.....	15·9	15·8	"	4	C	
"	3732	"	"	Oct. 12	13 25	64	5 20 W	3·5	2·6	10·4	10·1	"	5	P¹	

COMPARATOR MEASURES OF ε URSÆ MINORIS (III L).

Centre of Region	1418 Vel.	1454 Vel.	1516 Vel.	1536 Vel.	1555 Vel.	1587 Vel.	1568 Vel.
4669·0	−35·31	− 6·92	−38·53	+ 6·92	......	−36·06	−22·23
4628·7	32·12	1·43	38·08	7·14	+20·47	37·60	23·32
4590·2	35·33	1·18	39·02	7·82	23·18	30·30	25·25
4554·6	33·90	2·66	39·00	9·32	21·05	33·24	22·60
4523·9	33·52	7·30	39·53	8·16	22·55	33·52	21·48
4492·0	32·20	6·65	35·33	7·90	22·42	32·01	21·20
4460·3	31·31	5·22	35·35	9·24	19·06	23·70	26·11
4429·6	35·32	....	36·11	10·10	20·20	....	....
4402·1	31·03	....	....	9·03	22·93	....	....
4374·5	37·12	....	....	10·94	22·40	....	....
4346·5	....	....	....	8·10	21·60	....	....
4322·8	....	....	....	10·25	20·16	....	....
Weighted mean	−33·40	− 4·48	−37·62	+ 8·84	+21·47	−32·60	−23·17
V_a	− 8·18	− 8·21	− 6·64	− 5·63	− 4·54	− 3·07	+ 7·59
V_d	+ 0·03	+ 0·03	− 0·01	+ 0·03	− 0·01	− 0·02	− 0·03
Correction to Standard	+ 0·35	+ 0·35	+ 0·35	+ 0·35	+ 0·35	+ 0·35	+ 0·35
Radial Velocity	−41·2	−12·3	−43·9	+ 3·6	+17·3	−35·3	− 15·3

COMPARATOR MEASURES OF ε URSÆ MINORIS (III S).

Centre of Region.	2917 Vel.	3023 Vel.	3042 Vel.	3053 Vel	3067 Vel.	Vel.
4669·0	−22·35	....	....	....	....	....
4628·7	25·51	−34·57	....	+ 3·29	....	+28·80
4590·2	20·52	33·94	−41·83	+ 1·58	+11·05	26·83
4554·6	24·27	32·62	42·48	− 1·52	12·14	18·20
4523·9	24·16	35·14	46·12	+ 1·46	9·52	19·77
4492·0	25·39	35·97	43·72	− 5·64	5·64	16·92
4460·3	23·75	35·29	43·44	− 2·04	6·21	....
4429·6	26·08	32·59	46·94	·00	11·73	....
4402·1	26·50	35·97	46·06	− 1·26	10·73	....
4374·5	27·40	37·14	46·27	− 1·83	10·96	....
4346·5	28·15	36·36	45·75	− 5·28	....	....
4322·8	24·42	34·64	42·58	− 1·70	....	....
4298·2	24·15	....	....	− 6·03	....	....
Weighted mean	−24·82	−34·93	−44·52	− 1·58	+ 9·75	+22·10
V_a	+ 7·26	+ 2·62	+ 1·63	+ 0·32	− 0·12	− 0·86
V_d	− 0·04	− 0·04	− 0·04	− 0·04	− 0·04	− 0·04
Correction to Standard	− 0·30	− 0·30	− 0·30	− 0·30	− 0·30	− 0·30
Radial Velocity	− 17·9	− 32·6	− 43·2	− 1·6	+ 9 ·3	+ 20·9

COMPARATOR MEASURES OF ε URSÆ MINORIS (III S).

Centre of Region.	3084 Vel.	3117 Vel.	3131 Vel.	3151 Vel.	3183 Vel.	3224 Vel.
4628·7	+23·04	−13·17	−30·45	−39·16	....	....
4590·2	17·36	9·57	27·62	36·41	+23·68	−15·39
4554·6	18·20	12·14	26·55	38·07	22·75	12·14
4523·9	21·96	13·18	29·28	35·26	22·70	12·08
4492·0	23·98	12·69	25·39	36·65	23·27	13·75
4460·3	23·08	11·54	27·15	33·90	23·75	14·93
4429·6	20·21	10·43	24·77	35·31	21·51	10·43
4402·1	22·09	10·10	25·24	35·92	25·67	13·88
4374·5	20·70	11·57	28·00	37·54	24·96	....
4346·5	....	9·97	28·74	35·05	....	....
4322·8	....	11·93	28·39	36·22	....	....
4298·2	....	13·72	30·73	37·12	....	....
Weighted mean	+21·18	−11·63	−27·52	−36·53	+23·54	−13·53
V_a	− 1·29	− 2·44	− 2·99	− 3·85	− 5·67	− 6·99
V_d	− 0·04	− 0·04	− 0·04	+ 0·02	+ 0·04	+ 0·04
Correction to Standard	− 0·30	− 0·30	− 0·30	− 0·30	− 0·30	− 0·30
Radial Velocity	+ 19·5	− 14·4	− 30·8	− 40·7	+ 17·7	− 20·2

COMPARATOR MEASURES OF ε URSÆ MINORIS (III R).

Centre of Region.	3292 Vel.	3310 Vel.	3326 Vel.	3337 Vel.	3359 Vel.	3372 Vel.	3427 Vel.
4588·3	−34·51	−26·68	− 9·66	+10·14	+33·60	− 0·92	+24·40
4538·0	34·47	22·26	16·66	9·17	31·40	+ 5·68	27·50
4489·5	33·58	27·77	17·83	10·77	35·21	+ 1·66	26·12
4439·8	33·71	28·60	21·15	12·55	29·40	+ 4·32	24·31
4398·1	33·61	27·28	14·96	10·47	29·13	+ 3·74	27·30
4356·8	33·42	21·83	22·05	11·37	29·52	+ 4·98	28·78
4316·6	36·19	24·71	18·30	8·46	25·04	− 1·69	22·34
4276·2	36·30	23·77	....	9·00	25·40	+ 1·29	27·00
4239·3	35·82	23·27	....	....	....	+ 3·98	....
4209·9	32·97	....	....	....	....	....	....
Weighted mean	−34·39	−24·97	−17·47	+10·41	+29·52	+ 2·77	+25·99
V_a	− 7·60	− 7·85	− 7·90	− 8·10	− 8·25	− 8·23	− 6·60
V_d	+ 0·03	+ 0·04	+ 0·01	+ 0·04	+ 0·02	+ 0·02	+ 0·01
Correction to Standard	+ 0·26	+ 0·26	+ 0·26	+ 0·26	+ 0·26	+ 0·26	+ 0·26
Radial Velocity	− 41·8	− 32·5	− 25·1	+ 2·3	+ 21·5	− 5·4	+ 19·6

COMPARATOR MEASURES OF ϵ URSÆ MINORIS (I).

Centre of Region.	3426 Vel.	3435 Vel.	3439 Vel.	3448 Vel.	3455 Vel.	3461 Vel.	3463 Vel.
4590	......	+15·74	......	− 7·52	−33·54	−37·65	−28·75
4525	+27·57	11·82	+ 9·20	7·22	41·40	30·85	21·67
4464	28·90	19·50	10·70	1·89	36·51	28·95	25·80
4403	27·20	18·15	11·48	·00	31·43	29·01	24·80
4349	30·25	16·60	4·65	1·16	34·91	27·35	26·20
4290	29·06	21·26	6·71	7·83	36·32	37·50	30·21
4244	28·01	17·23	2·69	8·62	35·02	...	30·73
4199	31·70	20·30	5·20	7·01	35·39	......	22·89
4148	31·03	18·12	......	5·77	35·20	......	......
4101	24·53	18·77	......	......	34·68	......	......
Weighted mean	+28·40	+18·07	+ 7·05	− 5·00	−35·40	−31·85	−26·42
V_a	− 6·60	− 6·43	− 6·16	− 5·98	− 5·04	− 4·35	− 4·25
V_d	+ 0·02	+ 0·01	·00	+ 0·02	+ 0·02	− 0·02	+ 0·01
Correction to Standard	+ 0·26	+ 0·26	+ 0·26	+ 0·26	+ 0·26	+ 0·26	+ 0·26
Radial Velocity	+ 22·1	+11·9	+ 1·1	− 10·7	− 40·2	− 36·0	− 30·4

COMPARATOR MEASURES OF ϵ URSÆ MINORIS (I).

Centre of Region.	3470 Vel.	3476 Vel.	3492 Vel.	3495 Vel.	3551 Vel.	3566 Vel.	3611 Vel.
4590	+ 5·48	......	......	−23·98	−27·40	......	+ 2·05
4525	2·62	+14·44	−21·67	24·94	29·53	−36·73	5·91
4464	1·26	17·00	25·80	26·42	30·20	51·00	8·81
4403	3·02	19·37	20·57	27·21	28·42	49·59	9·15
4349	1·75	14·55	20·94	27·91	31·41	49·45	9·35
4290	·00	19·57	18·45	29·62	30·74	47·52	4·47
4244	·54	12·93	21·01	26·93	28·55	44·16	10·70
4199	6·76	20·29	20·28	27·02	27·04	49·92	10·40
4148	1·50	18·02	21·53	......	28·04	......	6·51
4101	......	......	17·31	......	......	......	10·51
Weighted mean	+ 2·58	+17·22	−20·71	−26·91	−29·01	−47·04	+ 7·90
V_a	− 3·39	− 2·75	− 0·88	− 0·61	+ 4·38	+ 5·38	+ 7·20
V_d	·00	− 0·01	− 0·01	− 0·01	− 0·03	+ 0·02	− 0·02
Correction to Standard	+ 0·26	+ 0·26	+ 0·26	+ 0·26	+ 0·26	+ 0·26	+ 0·26
Radial Velocity	− 0·5	+ 14·7	− 21·3	−27·3	− 24·4	− 41·4	+ 15·3

COMPARATOR MEASURES OF ε URSÆ MINORIS (1).

Centre of Region.	3630 Vel.	3732 Vel.	Vel.	Vel.	Vel.	Vel.	Vel.
4590....	−23·30	− 5·48	....	....	....	....	....
4525....	28·87	+ 3·94	....	....	....	....	....
4464....	27·89	+ 7·55	....	....	....	....	....
4403....	27·81	+ 3·02	....	....	....	....	....
4349....	23·27	+ 2·91	....	....	....	....	....
4290....	24·60	− 2·80	....	....	....	....	....
4244....	24·80	+ 2·15	....	....	....	....	....
4199....	20·80	+ 1·56	....	....	....	....	....
4148....	26·04	....	....	....	....	....	....
Weighted mean	−25·14	+ 1·63	....	....	....	....	....
V_a	+ 7·67	+ 8·09	....	....	....	....	....
V_d	− 0·02	− 0·03	....	....	....	....	....
Correction to Standard	+ 0·26	+ 0·26	....	....	....	....	....
Radial Velocity	−17·2	+ 10·0	....	....	....	....	....

Collecting together the above measures we have the following table in which, in addition to the plate number, the dispersion, the Julian date, and the velocity, we have the phase and the residual (O-C) computed from the final elements.

MEASURES OF ε URSÆ MINORIS.

Plate Number.	*Dispersion.	Julian Date.	Phase.	Velocity.	Residual O - C.
1418	III L	2,418,021·72	21·72	−41·2	− 3·7
1454	"	035·73	35·73	−12·3	− 2·0
1516	"	066·85	27·368	−43·9	− 2·15
1530	"	077·73	38·248	+ 3·6	+ 1·2
1555	"	087·77	8·806	+17·3	+ 0·2
1587	"	099·79	20·826	−35·3	− 0·6
1868	"	192·62	34·992	−15·3	− 1·5
2917	III S	609·58	17·35	−17·9	+ 2·3
3023	"	652·44	20·728	−32·6	+ 1·8
3042	"	659·46	27·748	−43·2	− 2·0
3053	"	668·44	36·728	− 1·6	− 3·5
3067	"	671·47	0·276	+ 9·3	+ 0·6
3081	"	676·47	5·276	+20·9	+ 0·15
3084	"	679·45	8·256	+19·5	+ 1·1
3117	"	687·46	16·266	−14·4	+ 0·6
3131	"	691·47	20·276	−30·8	+ 1·9
3151	"	697·98	26·786	−40·7	+ 1·7
3183	"	713·73	3·054	+17·7	·0
3224	"	727·65	16·974	−20·2	− 1·8
3292	III R	736·82	26·144	−41·8	+ 1·0
3310	"	741·72	31·044	−32·5	− 0·6
3326	"	742·91	32·234	−25·1	+ 1·9
3337	"	748·70	38·024	+ 2·3	+ 1·0
3359	"	757·79	7·632	+21·5	+ 2·1
3372	"	764·78	14·622	− 5·4	+ 1·1
3426	I	797·69	8·05	+22·1	+ 3·4
3427	III R	797·75	8·11	+19·6	+ 1·0
3435	I	799·77	10·13	+11·9	− 1·4
3439	"	802·78	13·14	+ 1·1	+ 0·1
3448	"	804·69	15·05	−10·7	− 2·1
3455	"	811·70	22·06	−40·2	− 1·7
3461	"	819·85	30·21	−36·0	− 1·0
3463	"	820·70	31·06	−30·4	+ 1·4
3470	"	827·72	38·08	− 0·5	− 2·1
3476	"	832·75	3·628	+14·7	− 4·2
3492	"	846·70	17·578	−21·3	·0
3495	"	848·70	19·578	−27·3	+ 2·6
3554	"	886·77	18·166	−24·4	+ 0·6
3566	"	895·70	27·096	−41·4	+ 0·7
3611	"	916·67	8·584	+15·3	− 2·2
3630	"	924·52	16·434	−17·2	− 1·6
3732	"	957·56	9·992	+10·0	− 3·7

* III L 10·1, III S 18·6, III R 20·2, I 33·4 tenth-metres per mm. at H_γ.

The period was soon seen to be in the neighbourhood of 40 days, and, when all the observations were plotted and compared with the early measures of Campbell in 1897 and 1899, the period was finally accurately determined as 39.482 days, which can hardly be in error more than one figure in the last place. The initial epoch was taken as Julian Day 2,418,000 and with this and the period of 39.482 days the phases given in the fourth column were computed.

As it was intended to apply a least-squares correction to the graphically determined orbit, the above 42 plates were collected into 14 normal places well distributed over the velocity curve and with no great difference of phase in any one group. Through these normal places various velocity curves with slightly differing values of the elements were rapidly drawn by your graphical method. The curve best fitting the observations had the following values for elements:—

Period, $U = 39.482$ days
Eccentricity, $e = 0.05$
Half Amplitude, $K = 32.0$ km.
Long. of Apse, $\omega = 0°$
Time of Periastron, $T = 5.75$ days = Julian Day 8,005.75
Velocity of System, $\gamma = -12.1$ km.
Greatest Positive Velocity, $X_1 = +21.5$
" Negative " $X_2 = -42.5$.

The phase from periastron of the normal places given in the table below was obtained from the above value of the time of periastron passage, and the preliminary residuals were computed from the above elements by the help of Astrand's tables.

NORMAL PLACES OF ε URSÆ MINORIS.

No. of Group.	Phase.	Phase from Periastron.	Velocity.	Residual Preliminary	Residual Corrected.	Wt.	Eph.-Eqn.
1	7·907	2·157	+20·86	−1·70	−1·79	$\frac{1}{4}$	+·03
2	8·586	2·836	+17·70	−0·08	+0·01	$\frac{2}{3}$	−·05
3	10·084	4·334	+11·27	+1·49	+2·24	$\frac{1}{3}$	−.08
4	14·128	8·378	− 3·23	−2·83	−0·68	$\frac{1}{3}$	−·05
5	16·056	10·306	−14·80	−1·03	+1·17	$\frac{1}{2}$	+·13
6	17·392	11·642	−19·83	−2·42	−0·47	$\frac{3}{4}$	+·06
7	20·106	14·356	−31·58	−1·53	−0·56	$\frac{1}{2}$	+·04
8	21·132	15·382	−35·92	−0·38	+0·22	$\frac{2}{3}$	+·07
9	27·021	21·271	−42·39	+0·57	+0·13	1	·00
10	31·267	25·517	−31·06	−0·74	−0·04	$\frac{3}{4}$	+·07
11	35·361	29·611	−13·80	+0·11	+1·74	$\frac{1}{2}$	+·01
12	37·791	32·041	+ 1·59	−2·88	−1·48	1	−·05
13	1·761	35·493	+13·00	+1·03	+1·25	$\frac{2}{3}$	−·05
14	5·276	39·008	+20·90	+0·49	−0·11	$\frac{1}{8}$	−·01

From these normal places and the preliminary elements given above, observation equations were computed by the method of Lehmann-Filhés.* When the eccentricity is very small, experience has shown that it is quite useless to carry through corrections for both ω and T. Moreover, the period was considered determined, and hence equations connecting the values of $\delta\gamma$, δK, δe and $\delta\omega$ with the residuals were computed.

* *A. N.* 3242.

OBSERVATION EQUATIONS ϵ URSÆ MINORIS.

$\delta\gamma$	δK	$K\delta e$	$K\delta\omega$	V	Weight.	Sum.
1·00	+ ·979	+ ·719	− ·370	− 1·70	$\frac{1}{2}$	+ ·628
"	+ ·929	+ ·533	− ·477	− 0·08	$\frac{2}{3}$	+1·905
"	+ ·777	+ ·037	− ·686	+ 1·49	$\frac{1}{3}$	+2·618
"	+ ·189	− ·973	− ·990	− 2·83	$\frac{1}{3}$	−3·604
"	− ·116	− ·941	− ·986	− 1·03	$\frac{1}{2}$	−2·073
"	− ·317	− ·718	− ·930	− 2·42	$\frac{3}{4}$	−3·385
"	− ·656	+ ·014	− ·708	− 1·53	$\frac{1}{2}$	−1·860
"	− ·756	+ ·303	− ·591	− 0·38	$\frac{2}{3}$	− ·414
"	− ·926	+ ·906	+ ·219	+ 0·57	1	+1·769
"	− ·615	− ·098	+ ·746	− 0·74	$\frac{3}{4}$	+ ·293
"	− ·050	− ·980	+ ·995	+ 0·11	$\frac{1}{2}$	+1·075
"	+ ·338	− ·853	+ ·958	− 2·88	1	−1·437
"	+ ·817	+ ·157	+ ·642	+ 1·03	$\frac{2}{3}$	+3·646
"	+1·046	+ ·986	+ ·083	+ 0·49	$\frac{1}{8}$	+3·605

The above observation equations gave the following normals:—

$$\begin{array}{rrrrrcl} 8{\cdot}292\,x & -\ {\cdot}094\,y & -\ {\cdot}673\,z & -\ {\cdot}328\,u & -6{\cdot}759 & = & 0 \\ -\ {\cdot}094\,x & +3{\cdot}781\,y & -\ {\cdot}149\,z & +\ {\cdot}206\,u & +\ {\cdot}118 & = & 0 \\ -\ {\cdot}673\,x & -\ {\cdot}149\,y & +3{\cdot}829\,z & -\ {\cdot}239\,u & +5{\cdot}133 & = & 0 \\ -\ {\cdot}328\,x & +\ {\cdot}206\,y & -\ {\cdot}239\,z & +4{\cdot}478\,u & +1{\cdot}293 & = & 0 \end{array}$$

$$\text{where}\quad x = \delta\gamma,\quad y = \delta K,\quad z = K\delta e,\quad u = K\delta\omega$$

Their solution gives the following values to the corrections:—

$$\begin{aligned} \delta\gamma &= +{\cdot}7022 \\ \delta K &= -\ {\cdot}046 \\ \delta e &= -{\cdot}0387 \\ \delta\omega &= -{\cdot}0094 = -0^\circ{\cdot}54 \end{aligned}$$

Applying these corrections to the preliminary values above, we obtain the following elements for ϵ Ursæ Minoris with their probable errors:—

Period, $U = 39.482$ days
Eccentricity, $e = 0.0113 \pm .0103$
Half Amplitude, $K = 31.954$ km. $\pm .330$ km.
Longitude of Apse, $\omega = 359^\circ.46 \pm 0^\circ.55$
Velocity of System, $\gamma = -11.398 \pm .224$ km.
Time of Periastron Passage, $T =$ J. D. 2,418,005.75
Greatest Pos. Velocity $N_1 = +20.918$
" Neg. " $N_2 = -42.990$

Projection of Semi-Axis Major $a \sin i = 17{,}346{,}000$ km. This solution has resulted in the reduction of Σpv^2 from 20.80 to 9.21 and from this we get the probable error of a normal place of unit weight as ± 0.64 km. per second.

The residuals in the table of measures above were obtained by careful sealing from the final velocity curve. The probable error of a plate was computed from these residuals with the following values:—

Probable error average plate,	±1.23 km.
" " three-prism plate,	±1.11 "
" " one- " "	±1.64 "

Considering the quality of most of the plates and the fact that the best of the three-prism plates were made on the coarse-grained 'sigma' emulsion, and with a dispersion of 17.6 and 20.2 Å per millimetre at H_γ these values are as low as could reasonably be expected. Moreover, the three-prism and one-prism probable errors bear about the same relation to one another, as that obtained in the investigation upon the 'Probable Errors of Radial Velocity Determinations' described in last year's report.

Furthermore, an examination of the run of the residuals for the different dispersions gives no indication of any systematic difference in the velocity measures obtained from different spectrographs.

The velocity curve corresponding to the final elements with the positions of the normal places plotted as circles is shown in Fig. 1.

Solar Research.

As is evident from previous reports, the progress made in work with the coelostat telescope and solar spectrograph has not been as good as could be wished. This has been due to a variety of causes, to delay in the completion of the coelostat house and connecting tunnel, to the floor of the laboratory being torn up for the installation of pipes and pump for draining the meridian circle piers, and, after this, to the fact that only an inferior grating could be obtained for use in the spectrograph. The investigation into the properties of this grating is described by Dr. De Lury in Appendix D, and need not be entered into here. The curious focal properties it possesses are not of so much moment as the fact that it gives poor definition and cannot be satisfactorily used for the determination of the solar rotation, the principal problem for which it was planned to use the equipment. Fortunately, we were able to obtain from Prof. Michelson a large plane grating in April of last year, whose properties are also fully described in Appendix D. It will suffice to state that it gives excellent definition and is very bright in the second and third orders on one side, but has considerable astigmatism and gives considerable diffused light, so that the spectrum lines are partially blocked up, the contrast diminished, and the ease and accuracy of their measurement decreased.

When this grating arrived I felt that it was necessary to get the equipment into active and useful work as soon as possible, and, in order to hasten matters, determined to devote a considerable portion of my time to working with Dr. De Lury in the large amount of experimental investigation necessary for determining, first of all, the most advantageous conditions of use of the grating, and secondly, the exacting instrumental precautions necessary in obtaining accurate values of the solar rotation. I was enabled to spend considerable time at this work, because the radial velocity work had become fairly well systematized, the experimental stage had passed, and the observation and measurement had taken on more of a routine character than had been the case heretofore.

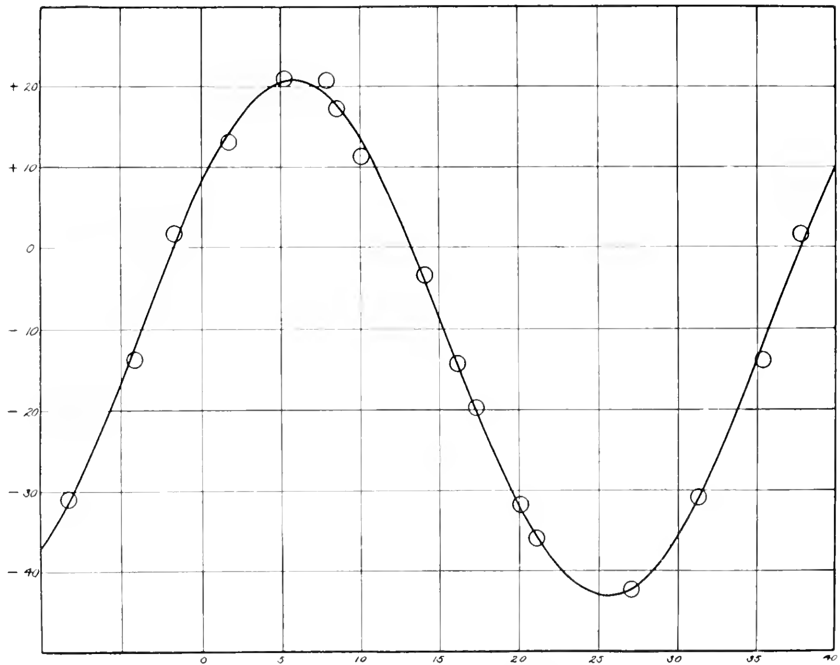


Fig. 1.—Velocity Curve ε Ursæ Minoris.

A short account of the various steps taken and experiments conducted during the year may be of interest. The new grating was received about the middle of April, and some visual tests of its focal properties were made by Dr. De Lury. Early in May the photographic testing of its properties began, and it was soon discovered that its astigmatism was due to the lines of the ruling being crooked, so that when about two-fifths of the length of the lines at one end are occulted, the astigmatism entirely disappears. Our diagnosis of the trouble was acknowledged correct by Prof. Michelson when I met him in August. He said the crookedness of the lines was due to the fact that the machine had been mostly used for ruling gratings with lines about 6 cm. long, and that portion of the slide became more worn than the rest. When a line 11 cm. long was ruled, as in this grating, the different conditions at different parts of the slide produced a bend in the line, which caused the diffracted spectrum to be displaced in a direction parallel to the lines, to the amount of about 1 mm. in a focal length of nearly 7000, or about 30 seconds of arc. The superposition of the spectra from these two parts of the ruling gave the astigmatic appearance at the edges of the spectra. The definition given by this grating is excellent, its chief defect seeming to be an excessive amount of diffused light which tends to block up the absorption lines and reduce the ease and accuracy of measurement. Experiments were then undertaken to determine whether diminishing the width of the ruling from either side would help matters, and it was found that successive improvement was noticed as more and more of the ruling at one side was occulted until after 5 cm. was cut off, when no appreciable improvement appeared. Consequently, one corner of the grating was used of an area about 6 by 8 cm. instead of the original area 11 by 13 cm. Nevertheless, owing to the brilliancy of the grating, the exposure times are still comparatively short, about 30 seconds in the third order at the limb of the sun in the region λ 4500. The position of the grating in its holder and on its rotating carriage was changed to bring the used portion centrally within the beam of light coming from the collimator.

Having obtained, after nearly two months' experimenting, the best conditions of use of the grating, our energies were turned towards obtaining spectra for the determination of the solar rotation. The region with centre at λ 4500, and extending on the 12-inch plates used upwards of 100 Å on each side, was selected primarily for observation. This region contains numerous well-defined lines, is well within the range of sensitiveness of the fine-grained Seed process plates proposed to be used with it, and is at a different place from any regions previously investigated.

My experience in stellar radial velocity investigations had shown the necessity of the greatest care being taken in observations of this nature to prevent spurious systematic displacements of the lines, which may arise from a large number of causes. In stellar spectroscopy we have found that relative displacements of stellar and comparison lines may arise from temperature changes, from flexure of the spectrograph, from faulty guiding resulting in the star image not being on the whole symmetrically situated with respect to the slit, from non-uniform illumination of the objectives and prisms by star or spark light, from imperfect focussing of the camera and probably from other causes as well. It was very important, therefore, in the case of the solar rotation where the Doppler displacements are relatively small, to ensure that no spurious displacements occurred. The first rotation plates made were consequently more in the nature of trial plates than for actual determinations, and were made only at the solar equator where the displacement is greatest and approximately known.

Numerous experimental rotation plates were made during June and July, and a number of these were measured. The general tendency of the measures gave a rather lower value of the velocity than had previously been accepted. It may be mentioned that one observer, Halm, claims to have found a variation in the rate of rotation, obtaining rotational values lower than given by these plates. However, owing to the fact that our plates were experimental and taken under conditions inferior to those with which later plates were made, they are not put forward as giving any definite value of the rotation, but simply as examples of the method and to indicate the magnitude of the errors and variations to be expected. The detailed measures of some of them are given below.

It was soon found that the principal difficulty consisted in obtaining uniform illumination of the grating surface from the two opposite limbs. The light from opposite limbs is brought simultaneously to positions side by side on the slit by two pairs of reflecting prisms. This device was designed by myself, constructed by the J. A. Brashear Co., and has been described by De Lury in the report of 1908–9, p. 252. Dr. De Lury inserted screws through the top of the prism holders to enable them to be adjusted for uniform illumination of the grating surface, but these were found insufficient for the exact adjustment necessary. Moreover, owing to the narrowness of the small windows in the guide plate (1908–9 report, p. 253) which admit light to the prisms and which are only slightly over a millimetre wide, the width of the image on the grating is further limited, rendering more precise adjustment necessary than would otherwise be the case. A further difficulty is experienced in the adjustment of the three prisms above the slit, two at the east and one at the west, to enable a strip of spectrum from the east limb to be placed centrally between two strips from the west limb. It was felt necessary to change the design in some way to admit of more positive and exact adjustment of these prisms, and to avoid the limiting of the illumination produced by the narrow windows above mentioned. This was postponed until after my return from the meeting of the Solar Union, although the general nature of the improvements had been thought out previously. They consisted essentially in mounting the prisms in small carriages adjustable in every direction, in obtaining new prisms to replace the three used over the slit, a single one at the west for the east limb and a wider notched one at the east for the west limb, in the substitution of an improved guide plate and in focussing the solar image on the slit instead of the guide plate which, taking account of the length of path traversed by the light, is optically about 14 cm. in front of the slit. In order to make the changes more readily understood the new arrangement on the front of the spectrograph will be described later.

Owing to the co-operative arrangement entered into at the Solar Union, details of which are fully described under the heading of 'Committee Work,' the region to be observed at Ottawa is from $\lambda\,5500-\lambda\,5700$ and the general region near $\lambda\,4250$. Consequently, upon my return in September, further experimental work on the plates and developers most suitable for these parts of the spectrum had to be undertaken. The plates used at $\lambda\,4500$ had been the regular Seed Process plates which have a fine grain and are clean-working. The contrast in the resulting spectra was not as great as it should be, and, although this was ascribed mostly to the diffused light given by the grating, it was thought that a change of developer or plate might help matters. No material improvement resulted from change of developer although several different contrast formulæ were tried. I learned, however, that the Seed Co. made a Contrast Process plate which, on trial, gave much more vigorous results than the other, and hence more suitable for the measurement of spectrum lines. This plate answers admirably for the violet region at $\lambda\,4250$, but is, of course, not sensitive to the yellow green at $\lambda\,5600$.

I sensitized some of these Contrast Process plates by bathing in a solution of erythrosine. These, upon testing, were fairly suitable, although the sensitiveness began to diminish to the red side of $\lambda\,5600$, but, owing to the troublesome nature of the staining and drying process and to the poor keeping qualities of the bathed plates, it was felt that commercially orthochromatized plates with fine-grained emulsion would be more convenient and satisfactory. Unfortunately the Seed Dry

Plate Co. do not make Ortho Process plates. A trial of the Wellington and Cramer Orthochromatic Process emulsions, which were available, resulted in favour of the Cramer as giving more contrast and being somewhat finer in grain, but it is decidedly coarser than the Seed Contrast, and consequently will not give quite as satisfactory plates for measurement in the λ 5600 region as the Seed Contrast Process does in the λ 4250 region. However, its better keeping qualities and more uniform sensitiveness in the required region over the bathed plate more than outweighed the relative coarseness of grain, and it was chosen for use at λ 5600.

It was while these experiments were being carried on that a new grating, which had been most generously offered to us by Prof. Michelson, was received. A very exhaustive test of this grating in comparison with the one in use was carried out, and, without going into details, it was decided to keep the original grating because of its superior brightness and its finer ruling with correspondingly greater dispersion. By this time the improvements in the reflecting prism attachment and the new guide plate had been completed, and further test rotation plates were made from time to time, measures of some of which are also given below. The conditions during the winter months were, however, so inferior to those in warmer weather, especially in regard to the solar definition and the short time available for exposure during the day, that no attempt was made to get any definitive series of rotation plates. Considerable time was spent, however, in obtaining plates in the region around λ 4250 having impressed upon them an arbitrary displacement of the spectral lines of the same order as the Doppler displacement, only produced by a special slit in such a way that it was bound to be the same for each line on a plate and for successive plates. The purpose was to determine personal errors in measurement for different lines. This investigation is, however, fully discussed by Dr. De Lury in Appendix D, and need not be further referred to here except to say that measurements were made by each of us of 12 spectra from which some interesting conclusions were drawn.

Although the work of the year has not resulted in any definitive values of the solar rotation, there has nevertheless been a great deal of preliminary experimental work done which has been necessary to learn the best conditions of use of the grating, the best plate and developer, the indispensable instrumental and other precautions required for accurate work, and many other details. The measurement of the plates secured has also enabled us to learn something concerning the most suitable optical system and magnification to be used and the personal and systematic errors to be expected. We are now ready to secure a definitive series of rotation plates which will be made as soon as the weather becomes more suitable.

Before giving the measures of the trial plates made during the year, it will be desirable to give a short description of the slit end of the spectrograph, which has been considerably altered during the year.

In designing the new apparatus it was deemed essential to avoid the limiting of the pencil incident upon the prisms by the narrow openings in the old guide plate, which had cut off some of the marginal pencils. Indeed, as they were only slightly over a millimetre wide, as the optical path between them and the slit was between 13 and 14 cm. and the focal length of the collimator objective about 700 cm., 23 feet, it is evident that the width of the pencil transmitted through them on the collimator and grating, omitting diffractional spreading, will be $\frac{1}{13.5} \times 700 = 5.2$ cm. The actual width of the used surface of the grating is 8 cm. The inclination of the grating reduces this somewhat, so that the projected width is in the neighbourhood of 7 cm. If the pencil from the mirror, which is 18 inches diameter and 80-foot focus, goes through unobstructed, the diameter of the beam on the grating will be $\frac{23}{80} \times 18 = 5.2$ inches, or 13 cm. This diameter would require a width of window in the guide plate approximately 2.5 mm. Such a size of opening would render the effective position of the point on the sun's image from which the light was taken, consequently the latitude and distance from the limb, uncertain. It was consequently felt preferable, which opinion was confirmed by learning the experience of other observers at the Solar Union meeting, to avoid limiting the pencil at the prisms but to focus the sun's image on a point as far behind the prisms as the distance of the optical path between its first incidence on the prisms and the slit—in other words, to bring the focus on the slit itself. Then the area on the sun's surface from which the light is taken is limited to the length and width of the slit and there is no diaphragming of the pencils; hence the diameter of the beam incident upon the collimator objective and grating is 13 cm., a factor of safety of nearly two. The distance from the limb at which the light is taken is determined by measuring the distance apart of two wires or strips placed in front of the outside prisms which cast shadows centrally on the circles of light thrown on the grating. This distance has to be increased slightly, by an amount readily calculated, owing to the distance of the wires optically in front of the slit and the consequent speading of their shadows at the slit.

A diagrammatic representation of the reflecting prism arrangement is shown in Fig. 2, where A and B are the prisms receiving light from the west and east limbs of the sun respectively, and C and D the prisms above the slit which reflect the light down through the slit in the manner shown. As stated before, the centre prisms were replaced by new ones last fall. Formerly the function of C was fulfilled by two prisms similar to D which were considerably more difficult to adjust, and a single prism with a notch cut in it, as shown, was substituted. The two pencils from the west limb passing through the slit are then bound to produce coincident circles of illumination on the collimator objective. The method of adjusting these prisms is clearly shown by the plan and elevations. Each prism is mounted in a small brass box and adjusted laterally in these boxes by the adjusting screws, E, E, at the one side. A spring at the opposite side keeps constant pressure against the adjusting screws, while a spring at the top keeps them seated on a piece of blotting paper at the bottom. The adjustment of the boxes is effected in the one plane by rocking on the knife edges, F, F, shown in the upper elevation, by means of the screws, H, H, and in the plane perpendicular to this by the adjusting screws, I, I, and opposing springs, S, S, shown in the lower elevation. The plates on which the adjustable holders of the outer prisms are fastened are movable in and out by rack and pinion to vary the distance from the limb at which the light is taken, and the plate on which the holders of the two centre prisms are fastened is also movable by rack and pinion to enable the centre strip, the one from the east limb, to be made wider or narrower, the width of the outer strips being changed by occulting plates sliding in grooves just below the prism. However, it was soon decided to make all three spectra of the same width, about 0.8 mm., separated by spaces about 0.5 mm. to ensure absolutely uniform conditions for measurement. This was effected by removing the occulting plates just mentioned and inserting a single plate with three slots 0.8 mm. wide cut in it, these slots being separated by spaces of 0.5 mm. This not only ensures absolute uniformity, but prevents any stray light reflected from the edges of the prisms from causing trouble. The arrangement has been found to answer admirably, not only in the uniformity of the spectra produced and in ease of adjustment, but also the placing of the narrow strip from one limb exactly midway between two strips of the same width from the other limb, ensures ease and accuracy of measurement, as the measured displacement has no dependence on the orientation of the wire.

This prism arrangement projects about 5 cm. in front of the front plate of the spectrograph, and is covered and protected from dust and injury by the guide plate shown in Fig. 3. This guide plate consists, in reality, of two plates. The first is a rectangular brass plate, A, A, about 2 mm. thick, which is rigidly attached to four

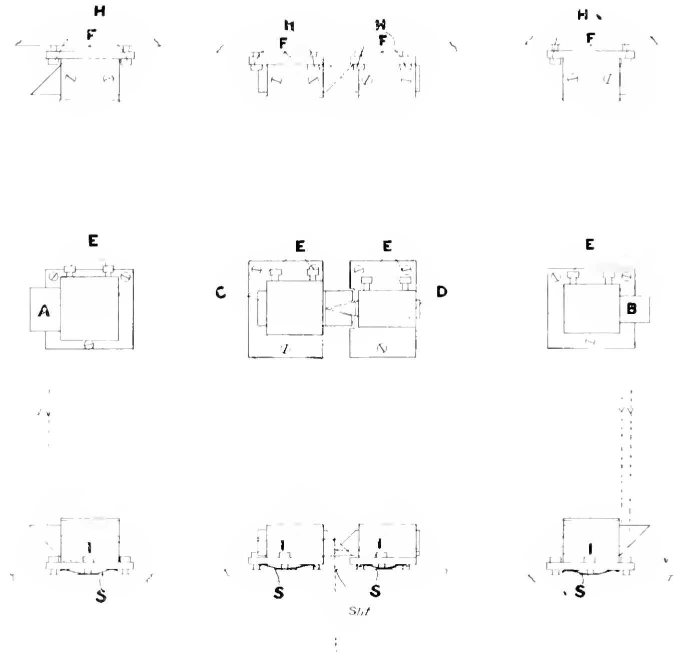


FIG. 2.—Reflecting Prism Arrangement.

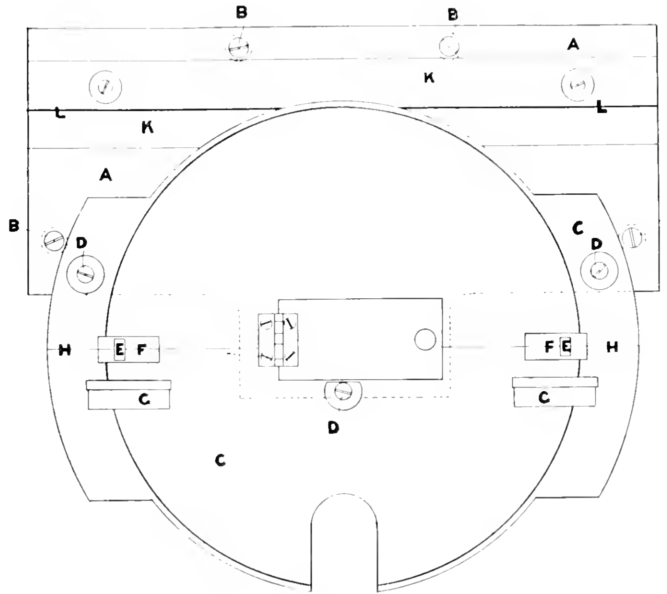


Fig. 3.—Guide Plate.

brass studs 5.5 cm. long, screwed into the front plate of the spectrograph by means of the screws, B, B. Dowel-pins in two of these studs ensure that if the plate is taken off it will return to exactly the same position. The second is a plate, C, C, of circular form attached to the base plate by three screws, D, D. The holes through the plate are considerably larger than the screws, allowing movement under the washers shown and final clamping when the adjustment is completed. A door in the centre admits of adjusting the centre prisms and changing the width of the slit without removing the whole plate. Light is admitted to the outer prisms through two openings, E, E, in small rectangular brass plates sliding in ways underneath the plate, C, C. The large opening, F, F, cut in C, C, being sufficiently long to allow the light to be taken at any distance from the limb up to nearly one-third the radius. The openings, E, E, are about 4 × 6 mm., sufficiently wide to avoid any danger of limiting the pencil, and yet small enough to prevent much dust getting into the prisms. A further protection is given by the yellow filters used in the λ 5600 region to absorb the violet of higher orders, which are placed in the brass receptacles, G, G.

For the purposes of adjustment, the centre line, H, H, and the dark circle 228 mm. diameter, the mean size of the solar image, near the periphery of the outer plate are ruled on the brass. The outer prisms and the openings, E, E, are adjusted until they are the desired distance from the limb and equidistant from this dark circle, from the centre of the plate and the slit. The actual positions at which the light enters these prisms is obtained by sliding a vertical wire or narrow tongue of brass, less than a millimetre wide, in front of E, E, and observing the shadow cast on the circle of illumination on the collimator and grating through an opening in the camera back behind the slot, I, which is placed there to allow the use of an eyepiece. Then, by using a horizontal occulting strip, the centre line, H, H, is adjusted, by loosening the screws, D, D, to be directly over the centre of the points where light enters the prisms. Hence we are sure, if the sun's image is kept concentric with the circle, that light is being taken from two points, on a diameter of the sun, equidistant from the limb. For convenience in obtaining the east and west line, a plate of thin celluloid, K, K, on which is ruled a black line, L, L, is adjustably attached to the base plate, the line, L, L, being made accurately parallel to H, H.

It is evident, when these adjustments have been made, that the observed reading of the graduated circle on the end of the spectrograph, when the limb of the sun drifting across the guide plate remains tangent to L, L, corresponds to the position where the light entering the slit comes from a diameter of the sun due east and west. If the spectrograph be rotated by the amount given in the ephemeris as the position angle of the sun's axis, it is evident that the observed points on the solar disc are at right angles to the axis and along a diameter and, if the pole of the sun is in the limb, are on the solar equator. All that is now necessary to make a rotation plate for any latitude is to rotate the spectrograph through the required position angle and keep the sun guided centrally on the guide plate during the exposure.

MEASURES OF PLATES.

Of the numerous test plates made during the year, practically all at the solar equator, a number were selected for measuring, the selection being made on the basis of the most suitable intensity for measurement of a number from each series, and the measures of 20 of these are given below. As will have been gathered from what has been given previously, each exposure contains three narrow strips of spectrum each about 0.8 mm. wide separated by strips of clear glass about 0.5 mm. wide, the central strip of spectrum being from the east limb and the two outer strips from the west limb of the sun. As the sun is rotating so that the east limb approaches and the west limb recedes from us with a velocity of about 2 km. per second at the equator, it is evident that the lines in the centre strip will be displaced towards the violet with respect to those on the outside strips. This displacement, with the dispersion used here, varies between 55 and 90 thousandths of a millimetre according to the region used and the order of the spectrum.

In making measures of these plates, all that requires to be measured is the magnitude of this displacement, a differential measurement only, and consequently as the lines in the strips are, or should be, exactly similar in appearance, one in which apparently there should not be much danger of personal or systematic errors. However, we had not gone very far before we began to suspect the presence of such errors and one attempt to investigate this problem is given by Dr. De Lury in Appendix D. But the last word has not yet been said on this question, and I have no doubt that it will recur later.

The measurements were all made on the special Toepfer measuring machine obtained some time ago for this work, which has not hitherto been described. The principle of its action is similar to that in the machine used for measuring star spectra, by the same maker, and already described in my report of 1905–6, page 62, the optical parts being exactly the same. The plate is placed on a carriage, moved by means of a micrometer screw of 0.5 mm. pitch and of a usable length of 300 mm. Thus the whole length of the plates made in the solar spectrograph can be measured without changing their position on the carriage. It consists essentially, as can be seen by the photograph (Fig. 4), of a massive cast-iron base having, at the front, ways on which the microscope carriage slides. The turning of a clamping lever allows this carriage to be pushed along these ways to any position, indicated by a millimetre scale. This movement not only permits the microscope to be at once brought to any desired position on the plate, without moving the main carriage, by means of the micrometer screw, which might be a rather slow process as there are over 600 turns in its length, but also allows the plate to be rapidly aligned on the carriage, as the ways on which the microscope slides are adjustable and can readily be made exactly parallel with the ways on which the carriage moves. The micrometer carriage itself, which is inclined at an angle of about 45°, rests on its lower edge on a pair of steel balls about a centimetre in diameter, which are maintained at a fixed distance apart in the ways. The latter consist of a V-shaped groove in the base and in the carriage which hence moves by rolling friction very easily and smoothly. At the centre of the upper edge of the carriage a small wheel is pivoted which rolls along a plane surface on the base. Hence the movement of the carriage is practically frictionless and it is easily kept up to its work by a comparatively small weight which maintains a small constant uniform thrust on the micrometer screw. A hardened small spherical surface on the end of the micrometer screw resting against a hardened steel plate takes up this thrust, and by this means all back lash is prevented and the screw and the carriage work exceptionally freely and smoothly, especially when the comparatively large mass of the latter is considered. On the main carriage are also secondary ways parallel to the main ways which permit the plate to be adjusted to any desired position by a small micrometer screw. This secondary carriage has also a movement of rotation to allow the alignment of the spectrum parallel to the motion of the carriage, this being effected by a thrust screw and spring. The spectrum plate rests on a piece of plate-glass in the carriage, being held there by spring clips and capable of transverse adjustment.

The micrometer head, movable by a handle for long runs or by a large or small knurled head for fine adjustment, is divided into 500 parts. As the screw is 0.5 mm. pitch, it reads directly to microns and by estimation to tenths of microns or 0.0001 mm. Two rows of numbering on the head facilitate the reading of the

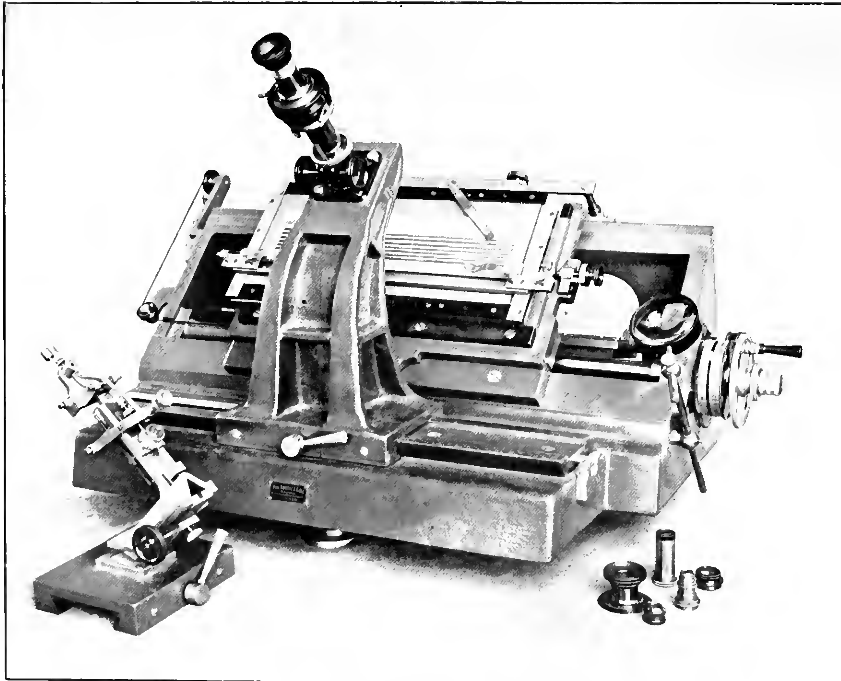


Fig. 1.—Toepfer Measuring Machine.

divisions, while a second auxiliary head beside the principal one, geared at the proper rate enables single millimetres to be determined at the same time. Divisions of ten millimetres are given on a scale beside the carriage. An adjustable magnifying glass over the head enables the readings to be made without shifting the position of the eyes to any extent.

The microscope is provided with objective and ocular giving any range of magnification between 2 and 100, and is focussed by rack and pinion. The reticle has two parallel wires which can be made to coincide or can be separated any desired distance and can be given any desired position angle. By rotating a knurled ring on the microscope head, a pair of shade glasses limit the field to any desired width perpendicular to the wires.

The instrument is a magnificent piece of workmanship and performs very satisfactorily. The only improvements that suggest themselves are a registering attachment and a means of more rapidly rotating the screw when long distances are to be moved over. The former has been applied to a later machine of the same design made for the Astrophysical Observatory at Potsdam and must add considerably to its usefulness. Although no tests of the accuracy of the screw have been made, yet if we may judge from the tests of similar screws by the same makers it is of very high accuracy. In the manner of measuring the small differential displacements in rotation work, any errors of even comparatively great amount would be compensated, and consequently no investigation of the screw has yet been undertaken.

The method of measuring these plates is practically the same as that followed with star spectra. After the plate is placed on the carriage and adjusted, a matter of a minute or so, the first line to be measured is brought under the wire. Four settings are made on the centre strip and two each on upper and lower strips. As the appearance of the lines is practically identical, there seems little chance for the personal error found when measuring both emission and absorption lines in star spectra. In order to avoid any possibility of this, however, after all the lines have been measured the plate is reversed on the carriage and remeasured. Even if there is no systematic difference between the measurements, one sees the lines differently and the measurement is for this reason, and for the added number of settings, more accurate.

The reduction of the measured displacements is quite simple. Although the spectra given by this form of spectrograph are not normal, the deviation from a linear relation of micrometer value and wave lengths is so small as to be inappreciable in the range of about 200 Å on a plate. Consequently the only thing necessary is to obtain at say half a dozen places on the plate the linear dispersion by dividing the distance between two lines by the difference in wave length. Obtaining in the well-known way the kilometre value of one millimetre at these regions and plotting them on cross-section paper with wave length as abscissa and velocities as ordinates, these values are found to lie, within the errors of measurement, on a straight line. Consequently the velocity value of a millimetre displacement at all the lines measured can be at once tabulated and we get the constant multipliers of the displacements, giving the velocities.

In the region centre at λ 4500, 29 lines were measured and in the last 5 plates at λ 5600 from 16 to 18 lines. These lines were selected to include as many elements as possible and for their quality for measurement. The wave length, element, intensity and kilometre constant are given in the following table. The value of the velocity in kilometres per second for a displacement of one millimetre on the plate is in these tables divided by two, so that the double displacement due to the spectrum lines from the east limb being displaced to the violet and from the west limb an equal amount to the red is reduced to the velocities of one limb with respect to the centre.

After the table of wave lengths are given the measures of the 20 plates selected. At the head of this table are given the plate number and the date in eastern standard time. In the first column are the wave lengths of the different lines measured followed by, in parallel columns, the displacement in ten thousandths of millimetres and the velocity in kilometres. At the foot of the columns are given the mean velocities for the plates and the probable error of measurement of a single line obtained from the residuals in the well-known way.

DATA OF LINES MEASURED

Wave Length.	Elt.	Int.	Vel. per mm. II Order.	Vel. per mm. III Order.	Wave Length.	Elt.	Int.	Vel. per mm.
4432·736	*Fe*	1	33·08	20·64	5506·095	*Mn*	1	25·888
4435·321	*Fe*	2	33·05	20·62	5507·000	*Fe*	7	25·881
4438·510	*Fe*	1	33·03	20·60	5525·765	*Fe*	4	25·763
4415·641	*Fe*	1	32·97	20·55	5528·641	*Mg*	8	25·742
4454·552	*Fe*	3	32·88	20·49	5544·157	*Fe*	2	25·650
4464·617	*Ti?*	2	32·76	20·39	5562·933	*Fe*	2	25·531
4468·663	*Ti*	5	32·76	20·39	5576·320	*Fe*	4	25·450
4484·392	*Fe*	4	32·61	20·28	5578·946	*Ni*	1	25·434
4489·911	*Fe*	4	32·57	20·25	5582·198	*Ca*	4	25·413
4502·388	*Mn*	2	32·46	20·15	5590·343	*Ca*	3	25·363
4508·455	*Fe?*	4	32·40	20·11	5618·858	*Fe*	1	25·186
4512·906	*Ti*	3	32·38	20·08	5634·171	*Fe*	3	25·090
4518·198	*Ti*	3	32·34	20·04	5638·488	*Fe*	3	25·063
4523·572	*Mn?*	1	32·28	20·01	5655·715	*Fe*	2	24·956
4527·101	*Ca?*	1	32·24	19·98	5658·097	.....	2	24·936
4531·801	*Fe*	2	32·20	19·94	5662·744	*Fe*	4	24·912
4534·953	*Ti*	4	32·18	19·92	5682·869	*Na*	5	24·790
4546·129	*Ca*	3	32·07	19·84	5688·436	*Na*	6	24·757
4548·938	*Ti*	2	32·06	19·83				
4564·211	*Ba*	8	32·00	19·78				
4555·662	*Ti*	3	31·99	19·77				
4558·827	*C?*	3	31·97	19·75				
4563·939	*Ti*	4	31·92	19·71				
4571·275	*Mg*	5	31·86	19·66				
4572·156	*Ti*	6	31·85	19·65				
4578·732	*Ca*	3	31·80	19·61				
4590·126	?	3	31·70	19·53				
4602·183	*Fe*	3	31·60	19·45				
4603·126	*Fe*	6	31·58	19·44				

MEASURES OF ROTATION PLATES.

Line.	493a		493b.		497a.		527a.		527b.	
	June 21, 11.00		June 21, 11·00		June 21, 12·00		June 30, 10·30		June 30, 10·30	
	Disp.	Vel.	Disp.	Vel.	Disp.	Vel.	Disp.	Vel.	Disp.	
4432·736........	·0539	1·783	·0586	1·938	·0867	1·790	·0531	1·756	·0536	1·773
4435·321........	541	1·788	550	1·818	921	1·899	529	1·748	537	1·774
4438·570........	548	1·810	531	1·754	891	1·835	532	1·757	550	1·816
4445·641........	....	......	581	1·915	913	1·876	528	1·741	541	1·783
4454·552........	541	1·779	546	1·795	837	1·716	544	1·788	539	1·773
4464·617........	530	1·738	546	1·790	850	1·736	530	1·739	538	1·765
4468·663........	548	1·795	577	1·890	909	1·853	524	1·717	535	1·753
4484·392........	539	1·758	540	1·761	836	1·695	540	1·761	537	1·752
4489·911........	543	1·768	565	1·840	879	1·779	524	1·707	548	1·784
4502·388.......	542	1·759	551	1·788	888	1·790	547	1·776	541	1·756
4508·455........	555	1·798	533	1·727	893	1·795	552	1·788	561	1·817
4512·906........	550	1·781	596	1·930	876	1·759	558	1·806	559	1·810
4518·198........	545	1·762	533	1·723	904	1·811	540	1·745	513	1·755
4523·572........	551	1·788	531	1·714	957	1·915	558	1·801	563	1·817
4527·101........	556	1·793	557	1·796	913	1·821	561	1·808	554	1·786
4531·801........	541	1·742	563	1·812	930	1·855	557	1·794	552	1·777
4534·903........	550	1·769	541	1·741	885	1·763	554	1·783	553	1·780
4546·129.......	545	1·748	535	1·716	905	1·795	550	1·764	554	1·776
4548·938........	544	1·744	546	1·750	836	1·658	555	1·779	553	1·772
4554·211........	549	1·757	580	1·856	880	1·740	554	1·773	552	1·767
4555·662........	555	1·774	592	1·891	934	1·846	543	1·738	555	1·775
4558·827........	555	1·776	598	1·912	893	1·764	561	1·793	554	1·772
4563·939........	563	1·797	552	1·761	870	1·715	562	1·793	546	1·743
4571·275........	546	1·740	570	1·815	887	1·743	561	1·787	551	1·755
4572·156........	560	1·783	539	1·717	887	1·743	544	1·733	560	1·783
4578·732........	574	1·825	614	1·952	968	1·898	564	1·793	578	1·837
4590·126........	559	1·772	580	1·838	824	1·609	563	1·785	519	1·740
4602·183........	575	1·817	569	1·798	949	1·845	576	1·820	562	1·776
4603·126........	566	1·787	544	1·718	919	1·786	561	1·772	581	1·835
Means..............	......	1·776	......	1·809	....	1·787	......	1·770	....	1·780
Probable Error, Single Line..	....	± ·015	......	± ·050	....	± ·018	.....	± ·019	......	± ·011

MEASURES OF ROTATION PLATES—(*Continued*).

Line.	528a.		531a.		531b.		550a.		553d.	
	July 5, 10·35		July 5, 2·50		July 5, 2·50		July 13, 10·30		July 13, 11·20	
	Disp.	Vel.	Disp.	Vel.	Disp.	Vel.	Disp.	Vel.	Disp.	Vel.
4432·736........	·0569	1·882	·0570	1·885	·0573	1·895	·0538	1·780	·0549	1·816
4435·321........	559	1·848	572	1·890	574	1·897	541	1·788	556	1·837
4438·570........	569	1·880	573	1·892	570	1·882	556	1·836	534	1·764
4445·641........	562	1·852	559	1·843	567	1·869	542	1·786	535	1·763
4454·617........	557	1·832	565	1·858	563	1·852	565	1·857	548	1·802
4464·617........	571	1·873	575	1·886	577	1·892	535	1·755	529	1·735
4468·663........	571	1·870	564	1·848	573	1·877	562	1·841	554	1·814
4484·392........	578	1·882	570	1·858	566	1·846	548	1·787	561	1·829
4489·911........	581	1·892	570	1·857	572	1·863	555	1·807	550	1·790
4502·388........	580	1·882	576	1·869	575	1·866	556	1·805	551	1·788
4508·455........	588	1·905	571	1·850	574	1·860	559	1·811	550	1·782
4512·908........	570	1·846	569	1·843	584	1·891	540	1·749	560	1·813
4518·198........	585	1·890	580	1·874	586	1·894	558	1·803	558	1·804
4523·572........	585	1·888	597	1·926	587	1·894	547	1·765	553	1·785
4527·101........	571	1·841	584	1·883	584	1·879	558	1·800	550	1·777
4531·801........	573	1·845	583	1·877	581	1·871	556	1·790	553	1·780
4534·903........	580	1·866	592	1·905	584	1·879	548	1·764	557	1·792
4546·129........	579	1·857	579	1·857	571	1·832	560	1·796	562	1·802
4548·938........	585	1·875	591	1·894	590	1·891	569	1·821	555	1·779
4554·211........	576	1·813	582	1·862	591	1·891	572	1·830	565	1·808
4555·662........	574	1·837	582	1·862	586	1·875	558	1·786	563	1·801
4558·827........	589	1·883	579	1·851	576	1·841	555	1·775	554	1·772
4563·939........	587	1·873	585	1·867	575	1·835	572	1·825	571	1·822
4571·275........	586	1·867	585	1·864	575	1·832	557	1·775	560	1·784
4572·156........	589	1·875	587	1·869	594	1·892	574	1·828	571	1·818
4578·732........	578	1·838	586	1·863	591	1·879	559	1·778	555	1·765
4590·126........	577	1·829	576	1·826	597	1·892	580	1·838	564	1·787
4602·183........	597	1·886	589	1·861	593	1·874	560	1·770	563	1·779
4603·126........	593	1·873	579	1·829	582	1·839	571	1·803	571	1·803
Means..............	....	1·866	.....	1·868	......	1·872	....	1·798	....	1·793
Probable Error, Single Line........		± ·014	.....	± ·015	......	± ·015	......	± ·019	....	± ·015

MEASURES OF ROTATION PLATES—(*Continued*).

Line.	558a.		566a.		566b.		570a.		577d.	
	July 14, 9·55		July 16, 11·10		July 16, 11·12		July 18, 11·00		July 25, 9·55	
	Disp.	Vel.	Disp.	Vel.	Disp.	Vel.	Disp.	Vel.	Disp.	Vel.
4432·735........	·0551	1·822	·0556	1·839	·0573	1·893	·0551	1·822	·0550	1·841
4435·321........	555	1·854	557	1·840	555	1·834	546	1·805	563	1·884
4438·370........	548	1·810	552	1·823	563	1·859	550	1·816	545	1·818
4445·641........	548	1·806	548	1·807	557	1·836	563	1·855	553	1·838
4454·552........	551	1·811	543	1·786	556	1·829	559	1·839	559	1·856
4464·617........	554	1·817	562	1·843	553	1·814	554	1·801	545	1·807
4468·663........	561	1·837	564	1·847	567	1·857	557	1·814	553	1·828
4484·392........	557	1·816	568	1·852	570	1·858	566	1·817	558	1·839
4489·911........	557	1·814	553	1·801	565	1·841	562	1·843	557	1·832
4502·388........	549	1·782	554	1·798	553	1·795	553	1·824	571	1·870
4508·455........	561	1·818	568	1·841	566	1·834	568	1·792	564	1·839
4512·906........	556	1·800	573	1·855	560	1·813	564	1·839	559	1·821
4518·198........	561	1·813	566	1·830	572	1·849	572	1·823	571	1·850
4523·572........	560	1·807	576	1·858	572	1·846	557	1·846	572	1·849
4527·101........	560	1·806	565	1·822	569	1·835	561	1·796	580	1·870
4531·801........	559	1·800	561	1·806	558	1·796	567	1·806	561	1·809
4534·903........	557	1·793	580	1·866	572	1·840	562	1·824	559	1·799
4546·129........	568	1·821	575	1·844	571	1·832	571	1·803	564	1·809
4548·938........	566	1·815	564	1·808	574	1·840	563	1·830	564	1·808
4554·211........	565	1·808	572	1·850	577	1·846	571	1·802	567	1·815
4555·662........	569	1·820	571	1·827	569	1·821	553	1·824	573	1·833
4558·827........	574	1·835	576	1·841	572	1·829	566	1·768	568	1·810
4563·939........	579	1·848	567	1·810	577	1·841	577	1·807	571	1·818
4571·275........	573	1·825	572	1·822	570	1·816	570	1·838	572	1·819
4572·156........	575	1·831	573	1·825	578	1·840	575	1·815	576	1·826
4578·732........	570	1·813	575	1·829	570	1·812	570	1·828	575	1·817
4590·126........	576	1·826	580	1·838	574	1·819	565	1·791	587	1·849
4602·183........	575	1·817	564	1·792	579	1·829	562	1·776	575	1·806
4603·126........	578	1·826	576	1·820	571	1·804	571	1·803	586	1·839
Means........	....	1·816	....	1·828	....	1·834	....	1·816	....	1·831
Probable Error, Single Line..	....	± ·009	....	± ·013	....	± ·015	....	± ·014	....	± ·014

MEASURES OF ROTATION PLATES.—*Concluded.*

Line.	600c.		601d.		609a.		610a.		610d.	
	Nov. 9, 3·20.		Nov. 9, 3·37.		Dec. 6, 2·00.		Dec. 6, 2·55.		Dec. 6, 3·00.	
	Disp.	Vel.	Disp.	Vel.	Disp.	Vel.	Disp.	Vel.	Disp.	Vel.
5506·095........	·0693	1·791	·0672	1·740	·0696	1·802	·0660	1·708	·0684	1·771
5507·000........	659	1·706	670	1·734	689	1·788	673	1·742	672	1·739
5525·765........	691	1·780	715	1·842	713	1·856	697	1·795	707	1·821
5528·641........	685	1·763	690	1·776	688	1·771	690	1·776	707	1·820
5544·157........	702	1·787	696	1·772	709	1·819	717	1·839	706	1·811
5562·933........	692	1·760	708	1·799	683	1·744	690	1·762	707	1·804
5576·320........	701	1·781	708	1·796	715	1·819	686	1·745	695	1·769
5578·946........	688	1·745	708	1·792	700	1·780	674	1·715	690	1·755
5582·198........	682	1·726	713	1·787	708	1·799	711	1·807	689	1·748
5590·343........	703	1·762	725	1·810	709	1·797	685	1·737	680	1·724
5618·858........	705	1·759	719	1·793	724	1·824	665	1·675	721	1·815
5634·171........	692	1·726	715	1·781	723	1·814	716	1·796	722	1·812
5638·488........	686	1·709	724	1·798	718	1·799	689	1·726	730	1·829
5655·715........	702	1·743	707	1·780	721	1·799	677	1·689	736	1·836
5658·097........	704	1·745	677	1·730	708	1·766	695	1·733	722	1·800
5662·744........	698	1·730	708	1·780	735	1·830	713	1·776	707	1·761
5682·869........	......	......	...	......	737	1·831	719	1·782	714	1·770
5688·436........	......	....	...	......	718	1·778	694	1·718	717	1·775
Means........	......	1·752	......	1·786	....	1·800	....	1·751	....	1·787
Probable Error, Single Line....	......	± ·018	......	± ·020	......	± ·017	......	± ·029	....	± ·023

Having obtained the measured values of the velocity, three corrections require to be applied. In the first place, the observation must be made at a certain distance within the limb, and the first correction is to reduce this measured velocity to that at the limb. This is effected by multiplying the velocity by the ratio of the solar radius to the radius or distance from the centre of the observed point. In the second place, owing to the fact that the equator of the sun and the ecliptic are inclined about 7°15′ to one another the direction of the measured velocity does not coincide with the actual velocity, and requires to be multiplied by the secant of the angle of inclination. This angle can be readily computed but is most conveniently obtained from tables prepared by Dunér*. These two corrections give the velocity relative to the earth or the synodic value of the rotation. Owing to the movement of the earth around the sun, the sidereal rate of the solar rotation is appreciably greater. Tables of this correction have also been computed by Dunér† and have been used here. The corrected values of the velocity are given in the following table with the probable error of the final mean velocity and of a single plate.

* Dunér: "Über die Rotation der Sonne, zweite Abhandlungen", Nova Acta Regiae Societatis Scientiarum Upsaliensis, Series 4, I, No. 6, 1906.
† Ibid.

SUMMARY OF ROTATION VALUES.

Plate.	Measured Velocity.	Probable Error, Single Line.	Correction to Limb.	Correction for Inclination.	Sidereal Correction.	Total Velocity.
493a	1·776	± ·015	+ ·040	+ ·001	+ ·133	1·950
493b	1·809	·050	·041	·001	·133	1·984
497a	1·787	·018	·041	·001	·133	1·962
527a	1·770	·019	·044	·002	·133	1·949
527b	1·780	·014	·045	·002	·133	1·960
528a	1·866	·014	·050	·003	·133	2·052
531a	1·868	·015	·050	·003	·133	2·054
531b	1·872	·015	·050	·003	·133	2·058
550a	1·798	·019	·128	·005	·133	2·064
553d	1·793	·015	·127	·005	·133	2·058
558a	1·816	·009	·049	·005	·133	2·003
566a	1·828	·013	·047	·006	·133	2·014
566b	1·834	·015	·046	·006	·133	2·019
570a	1·816	·014	·050	·006	·133	2·005
577d	1·831	·014	·047	·008	·133	2·019
600c	1·752	·018	·092	·003	·140	1·987
601d	1·786	·020	·094	·003	·140	2·023
609a	1·800	·017	·105	·000	·141	2·046
610a	1·751	·029	·099	·000	·141	1·991
610d	1·787	·023	·102	·000	·141	2·030

Mean value of velocity = 2·011 ± ·0056km.
Probable error, single plate = ± ·026km.

Only a few words need be said in discussion of these results. The mean value, 2.01 km., is about 2 per cent. lower than the accepted value. Owing, however, to the preliminary character of the observation, not much importance should be attached to such a difference which is, after all, comparatively small and which may possibly be instrumental or may even be due to personal habits of measurement. While at Mt. Wilson last summer, Miss Lasby, who has measured most of Adams' plates, and myself measured a number of these displacements on both the Mt. Wilson and Ottawa plates. My measures were consistently approximately 2 per cent. lower than hers, an amount sufficient to explain the discrepancy. Again, the instrumental conditions under which the majority of these plates were obtained were not entirely satisfactory, principally on account of inadequate means of adjusting the reflecting prisms and the limiting of the pencil by the narrow windows. The velocities of the different plates show moderately good agreement, the probable error of a single plate being ± .026 km., and of the mean of all the plates ± .0056 km. The probable error of measurement of a single line is on the average ± .018, while the probable error of a single plate determined from the internal error of measurement is little more than ± .003 km., about one-eighth of that obtained by comparing different plates. This ratio is rather greater than it should be, but even Adams' values show a ratio which, though not so great, is still of the same order. Our experience in radial velocity measurements shows us that instrumental errors causing relative displacements of the lines as a whole are always much greater than errors of measurement in spectra with moderately good lines, and some such effect even though without any known cause is to be expected in this work.

Considering the relative dispersions in the two cases, the probable error of measurement of a single line is of about the same magnitude as those obtained by Adams, and corresponds to a linear error of less than half a micron, which is very good measuring for spectrum lines.

We may consider from these results that satisfactory values of the solar rotation can be obtained when the weather again becomes suitable, and we will hope in the next report to be able to give some definite results.

COMMITTEE WORK.

I had the privilege of attending two important astronomical meetings last year as a representative of our Observatory.

Our representation at the meetings resulted in unmistakable evidences of the standing we have already attained among observatories and scientific institutions, and will undoubtedly result in further increasing our reputation abroad.

The first of these was the annual meeting of the Astronomical and Astrophysical Society of America, which was held at Harvard College Observatory, Cambridge, August 17–19, and the second, the Triennial Conference of the International Union for Co-operation in Solar Research, which was held at the Mt. Wilson Solar Observatory, California, from August 31 to September 2.

At the first of these meetings, a very representative gathering of the leading astronomers of America, and also many noted astronomers of Europe, on their way to attend the Solar Conference, spent three days in the reading and discussion of papers on many phases of astronomical work. Several of the European astronomers presented papers on both astronomical and astrophysical problems, and their participation in the proceedings was much appreciated by the Society, to which several of them were elected to membership. A report containing abstracts of the papers read has been published in *Science*, and it is not necessary to repeat them here. It may be of interest to mention that my paper on 'The Probable Errors of Radial Velocity Determinations' was well received; and that I was chosen, in the absence of the author, Professor W. W. Campbell, to read what was undoubtedly the most important paper of the meeting, 'Some Preliminary Results deduced from Observed Radial Velocities of the Stars.' The substance of my own paper was given in detail in my report of last year, while Professor Campbell's discussed some very important results obtained from a study of the radial motion of the stars observed under his direction.

The reading of the papers was pleasantly varied on the afternoon of the 17th August by an excursion to the Blue Hill Meteorological Observatory, reached by electric car from Boston, where the meteorological apparatus, including the famous box kites, and the methods of observation, were examined by and explained to us. On the afternoon of the second day, an excursion to the observatory and astronomical department of Wellesley College was made, in which the majority of the members participated. Many original and ingenious methods in teaching astronomy were shown and explained to us, and we were also much interested in examining some of the novel apparatus in this finely-equipped students' observatory. The party were taken for a drive through the beautiful college grounds in automobiles, and before returning were served with tea. The social features of these functions added much not only to their pleasure but to the benefit derived from the meetings, in that they increased the good fellowship always so evident in astronomical gatherings, and thereby prepared the way for fruitful and useful discussions between the different members. On the afternoon of the third day, we were entertained at Harvard Astronomical Laboratory, where the students of Harvard College receive their astronomical training. After luncheon and inspection of the various original methods and apparatus employed in the teaching of astronomy here, the papers requiring lantern illustrations were then disposed of and the meeting was concluded.

Part of the work of this society is performed by means of committees appointed to deal with specific questions, the two already formed being on luminous meteors and on comets. The committee on comets presented a valuable report dealing with the preparations for and the results of the observations of Halley's comet, and, as a result of its labours, the comet was observed photographically at Hawaii by Mr. Ellerman and an important result was obtained from consecutive observations at Williams Bay, at Hawaii and at Beirut, Syria, on the acceleration of parts of the comet's tail, due to the repulsive force of the sun.

On the suggestion of Professor W. W. Campbell, a new committee to consider the question of co-operation in stellar radial velocity determinations was appointed and I have the honour to be one of its members. This committee consists of the following members: W. W. Campbell, Director Lick Observatory, California; E. B. Frost, Director Yerkes Observatory, Wisconsin; Frank Schlesinger, Director Allegheny Observatory, Pennsylvania; Karl Schwarzschild, Director Potsdam Observatory, Germany; H. F. Newall, Director University Observatory, Cambridge, England; and J. S. Plaskett, Dominion Observatory, Canada.

You will immediately recognize the five institutions named above as being the foremost in the world in astrophysical research, and that a representative of our observatory is included is, it seems to me, valuable evidence of the high standard of the work we are turning out and a tangible recognition of the standing obtained by the Dominion Observatory. This committee held a meeting on Mt. Wilson and discussed many of the questions involved. A report of the proceedings will be given below.

In accordance with the scheme carefully planned by Professor Hale to make the the solar conference as great a success as possible, the meeting of the Astronomical and Astrophysical Society was arranged for a date about two weeks previous to that of the Solar Union. This was done to enable many of the European astronomers to attend the earlier meeting, and then to travel across the continent with those members of the Astronomical Society who proposed to attend the Solar Union. This plan worked admirably, and a most congenial party of over thirty of the most eminent astronomers of the world travelled from Boston to Pasadena together in two special cars, starting from Boston on August 20, spending Sunday the 21st at Niagara Falls, and Monday, August 22, at Chicago. While in Chicago we were the guests of the University of Chicago, were driven to the grounds, had dinner at the University Club, and inspected the buildings and laboratories in the afternoon. I was particularly interested in the Ryerson Physical Laboratory and in the Michelson Ruling Engine, with which the grating whose tests are described in another place was ruled. Professor Michelson informed me that our diagnosis of the cause of the blurred edges of the spectra was correct and due to the lines of the ruling not being quite straight, and he promised to replace it by a better one.

The party was joined at Chicago by several American astronomers and travelled directly from there to Flagstaff on the Santa Fe railroad. The temperature on this part of the journey was excessively high, the thermometer being considerably over 90° in the cars. Nevertheless, the heat, although inducing the removal of all superfluous clothing, seemed to have little effect in quenching the astronomical enthusiasm of the party, and very interesting discussions on different phases of astrophysical research, especially stellar evolution, took place. Besides this, several committee meetings in preparation for the business of the Solar Union were held en route. The time of the whole journey passed most pleasantly and profitably, and the purposes of organizing the party in this way for promoting sociability, good feeling and astronomical discussion was very successfully carried out.

At Flagstaff the cars were placed on a siding to wait for a later train, and, by invitation of Director Lowell, the whole party visited the Lowell Observatory. The train arrived in Flagstaff about nine o'clock in the evening, and conveyances were waiting to drive us to the Observatory, where we were most hospitably received and shown the work of the Observatory. This was displayed by means of illuminated transparencies covering many branches of photographic astronomy, many of them being masterpieces of their kind. The photographs of the planets and of various regions of the sky were very fine, but, to my mind, the photographs of Halley's comet were superb, so far as I know much the best of any obtained. Photographic spectra, some of them most interesting, were also in abundance, and many other interesting examples of the Observatory's work. After being entertained at a supper by Mr. and Mrs. Lowell, the party were driven back to their cars where they spent the night. Many of us walked to the Observatory in the morning and saw the apparatus. Since my last visit a 4-foot reflecting telescope has been mounted, but has not yet, I believe, been much used. I should imagine the mounting was not sufficiently good for the best photographic work.

It had been planned that the party should make a stay of a couple of days at the Grand Canyon of the Colorado. Leaving Flagstaff at 11 o'clock on Thursday morning, August 25, the canyon was reached about 6 p.m. Two very pleasant days were spent here, one large excursion party and numerous small ones were organized, and astronomical discussions were still the rule, although not so universally so as on the train for the first few days. Some further additions to the party were made at the canyon. The last stage of the journey was begun on the evening of the 27th, and Pasadena was reached on Sunday, August 28, about 2 p.m. At the headquarters in Pasadena, the Hotel Maryland, a comfortable and homelike place, many members of the Solar Observatory staff were on hand to receive and welcome the members.

On the morning of the 29th, the Observatory offices, laboratories and shops were open for inspection by the visitors, and much admiration was expressed at the fine equipment. I was much interested in many parts of the equipment. In the spectroscopic laboratory a powerful grating spectrograph of 30-foot focal length is mounted vertically in a pit in the centre of the laboratory, and the various means of producing the light sources are arranged around this as a centre. Electric arc, spark and furnace, sunlight, luminous gases under pressure, powerful magnets for producing the Zeeman effect, indeed, practically everything that could be thought of is at hand and ready to be used at once without any delay in setting up and adjusting apparatus. A great deal of valuable work in connection with solar spectroscopy, such as the mapping of the effect of a magnetic field on the lines of the elements (Zeeman effect), the change in the character of a spectrum under different conditions of the light source, and different methods of producing the light source has been and is being done in this laboratory.

Much interest was evinced in the large grinding machine for grinding and polishing the 100-inch mirror. The imperfect disc for this mirror, which is being given by Mr. Hooker of Los Angeles, was in the shop, but at that time was not being worked on. Since then, however, as the prospects of obtaining a perfect disc were poor, grinding operations have been begun.

The star spectroscope, for use with the 60-inch reflector, had just been completed and was on view at the shop. It is arranged to use from 1 to 3 prisms, giving a large range of dispersion. Spectra made with a focal plane spectroscope of some interesting faint stars were on exhibition, and also some high dispersion spectra of the brighter stars made by means of the Cassegrain form of the reflector where the beam of star light is reflected down through the polar axis to a stationary spectroscope of high dispersion.

The various measuring machines and the methods of testing optical surfaces came in for a good share of interest, while the workshop and instruments under construction also commanded attention. The Solar Observatory, so far as instrumental equipment and appliances go, easily holds the first place in the world.

On Tuesday morning, August 30, about 9 o'clock, a start was made for the summit of Mt. Wilson, which is at an elevation of nearly 6,000 feet. There are three methods of reaching the summit, on foot, on horse, mule or donkey back, and by carriage. There were only one or two enthusiasts who essayed the climb on foot, the trail having a length from the valley of about nine miles. A few went on the back of animals, but the majority seemed to prefer carriages. As I had previously made the trip on horseback I tried a carriage, but found it a change for the worse. The carriages go by what is called the new trail, a road built by the Observatory to enable the parts of the 60-inch reflector to be hauled to the summit. It is, however, a long and excessively dusty drive, it being well on towards evening before the peak was reached, and everyone being well coated with dust.

The party were accommodated at the Mt. Wilson hotel, sleeping in cottages and tents and getting their meals at the hotel proper. Considering the difficulty of getting supplies, the accommodation was good and the charges reasonable. A feature of the sessions was the afternoon tea at the Monastery, the bachelor quarters of the Observatory staff, a pleasant social function given by the lady members of the Observatory staff and much enjoyed by every one.

Much interest and admiration were felt by the delegates in the magnificent equipment for solar and stellar research on Mt. Wilson, and, before speaking about the sessions of the Union, it might be of advantage to briefly describe some of the most original and ingenious of the instruments used. I have, already, in my 1907 report to you (page 53) described the instrumental equipment of the Solar Observatory in 1906, and it will, therefore, suffice to speak of what has since been added, the two tower telescopes and the 60-inch reflector.

The 60-foot tower telescope is a radical departure from the horizontal coelostat telescope (the 'Snow' telescope) already described, in that the beam of light forming the solar image is vertical instead of horizontal. The coelostat and secondary mirrors are at the top of a steel tower 60 feet high, and the image is formed at a convenient distance above the surface of the ground by a 12-inch objective of 60 feet focus at the top of the tower. The spectrograph is consequently vertical, is of 30 feet focus and is placed in a pit 30 feet deep. There are evidently many advantages in this type of instrument over the 'Snow' telescope. The great height of the mirrors above the surface removes, or considerably reduces, the effect of the hot air rising from the earth and consequently improves the definition. The vertical direction of the image-forming beam reduces the danger of disturbance of definition arising from stratification or convection of the air. The placing of the spectrograph below the surface ensures that the lens and grating, which are nearly 30 feet down, are at almost absolutely constant temperature, a very important desideratum in accurate work. Finally, the difficulty due to the heating of the mirrors and the consequent change of focus and astigmatism produced, has been much reduced by making the coelostat and secondary mirrors about three times as thick as usual. It was shown by Ritchey that this change of focus was due to the heating of the front surface by the sun causing an actual bending of the mirror so that the surface became convex instead of plane, that this change of form was nearly regular, and, if the incidence was normal, would result in a lengthening of the focus without seriously affecting the definition. But, owing to the fact that the beam is rarely or never incident normally on the plate mirrors, there results astigmatism and consequent disturbance of the definition. It was found that when the mirrors were made thick, as in this case (coelostat mirror 17 inches diameter, 12 inches thick), that the front surface became very slightly concave instead of convex owing probably to the heating of the edge of the mirror contained in the cell, and that possibly better results would be obtained if they were not quite so thick. The definition is in all cases considerably better than given by the 'Snow' telescope, and it can be used for long exposures without difficulty due to astigmatism or change of focus. Professor Hale showed us the image formed by this telescope and the Zeeman effect produced by the magnetic field around sunspots on the day he was on the mountain.

The 150-foot tower telescope was under construction last September, though so far completed that the solar image, about 17 inches in diameter, could be observed. When I saw it, however, the definition was not very good, and I have learned since that some difficulty has been experienced in getting good images. This may be due mostly to the much more perfect atmospheric conditions requisite with such an enormous focal length, and possibly partly to optical imperfections in some of the reflecting surfaces or in the image-forming objective employed. The well below the tower has a depth of nearly 80 feet, allowing the use of spectrographs of 75 feet focus, and enabling all the researches so successfully undertaken at Mt. Wilson to be prosecuted much further with this much more powerful equipment, to say nothing of the possibilities of other original work rendered feasible by the very large image and extraordinary dispersion available. The design of the whole telescope has been well thought out, all contingencies have been provided for, and it is most complete and will be most convenient in operation.

Probably the 60-inch reflecting telescope was the instrument which created the greatest interest and admiration, and excited the greatest envy among the visiting astronomers. It is certainly a magnificent instrument, complete in all details and leaving practically nothing to be desired so far as its optical and mechanical performance and the convenience, completeness and mechanical perfection of the details and accessories are concerned. It will not be necessary to give any description of the instrument here as that has been already given by the designer, Prof. Ritchey, in the 'Contributions from the Solar Observatory', Nos. 36 and 47. It will suffice to say that the completeness and the optical and mechanical properties of the reflector surprised every astronomer present. I think I am not mistaken when I say that very few astronomers expected that it would be possible, owing principally to atmospheric and to temperature changes, to obtain the wonderful definition that this instrument is capable of giving. Its photographic definition is very clearly shown by the examples of photographs of nebulæ, star clusters, etc., made by it. The wonderful detail in the nebulæ, and the surprising smallness of the star images excited the admiration of all. Through the kindness of Professor Ritchey, during two evenings on Mt. Wilson, the reflector was arranged for visual observations in the Cassegrain form, and every astronomer present observed several objects through it. It gave beautiful definition and showed wonderful light gathering power. Clusters, nebulæ and the planet Saturn were all observed, and those who had had experience with the largest refractors were convinced that it surpassed the best of them in many respects. Professor Ritchey is justly proud of his masterpiece, and he undoubtedly deserves great credit for the optical perfection of the mirrors and the excellent qualities of the mechanical design. On one of the nights spent on Mount Wilson the low dispersion spectrograph used in getting spectra of faint stars was attached, the reflector being used in the Newtonian form, the slit of the spectrograph being placed in the prime focus. The star images given were beautifully hard and crisp and the exposures required to get measurable spectra surprisingly short. A spectrum of a fifth magnitude star, requiring upwards of an hour with our refractor, can be photographed with the same linear dispersion in about five minutes, an efficiency that particularly excited my admiration and even envy when I thought how our work could be extended if we had such an instrument.

The sessions of the Solar Union began on Wednesday morning, August 31, at 9.30, and continued for three days, Wednesday, Thursday and Friday. On motion of Professor Schuster, chairman of the Executive Committee, Professors Pickering of Harvard, Campbell of Lick, and Frost of Yerkes Observatories were chosen as chairmen for the three days of the meeting.

The opening business was an address by Professor Hale, who welcomed heartily all the delegates to the conference, and who then gave a desription of the work and instruments of the Solar Observatory and a discussion of some of the results achieved, with many suggestions for future efforts. This address was much appreciated, as, owing to a partial breakdown from overwork, it was the only meeting Professor Hale was able to attend. This was a source of great disappointment and regret to all the delegates, and must also have been very disappointing to Professor Hale himself who had worked so hard for the success of the meeting, and who was precluded from taking the prominent part in the meetings that he was so well fitted and entitled to do.

Professor Schuster read the report of the Executive Committee which referred to the loss to the Union by death of several members, it recommended the Union to urge the establishment of a solar observatory in Australia, and stated that the Royal Astronomical Society of Canada and the Bologna Academy had been elected constituents of the Union. It may be as well to state that the Union is composed of representatives or delegates from Societies and Academies, and that the work of the Union is done by committees representing the different phases of its work, these committees reporting at the meeting where the questions touched upon are discussed generally. There are committees on the determination of standard wave lengths, the measurement of the solar radiation, the spectra of sun spots, eclipse work, spectroheliographic work, and on the determination of the solar rotation by the displacement of the spectral lines.

After Professor Hale's address, Professor Kayser, the chairman, presented the report of the committee on the determination of standard wave lengths, which indicates a marked step forward in this important problem. Although Rowland's tables of wave lengths were, at the time of their introduction, a very great advance in accuracy over those previously in use, more recent work has shown that they are not sufficiently accurate for present-day research. Not only is the absolute value of the standard he employed in error, every wave length being too great by about one part in 30,000, which is not a matter of much moment, but that also there are relative errors of the order of one part in 100,000 among the different lines, which is much more serious than errors in the absolute values. These errors, due to unknown defects in the gratings employed, were only discovered when new measurements were made by a different method, that of interference. The work of this committee has been the determination by interferometer methods of the wave lengths of 50 lines in the iron arc between λ 4282 and λ 6495, which are called the secondary standards. The primary absolute standard is the wave length of the red line of cadmium, determined by Michelson in 1892 by actually counting the number of waves of this red line in a known fractional part of the standard metre. He found that there were 1,553,163.5 waves in a metre or that the wave length was 6438.4722 A. The secondary standards have been determined by differential interference methods by three observers, Fabry and Buisson, at Marseilles; Eversheim, at Bonn; and Pfund, at Baltimore. The accordance of these measures is so good that the range is generally less than one part in a million and the mean of the three is probably correct within that margin of error. The means of the three observers were adopted as the secondary standards. The following recommendations of the committee on wave lengths were, after discussion, adopted:—

1. In the region of the spectrum in which three independent measurements by the interferometer method of the lines of the iron arc are available, i. e., between λ 4282 and λ 6495, the arithmetical mean of the three measurements shall be adopted as definite international standards of second order, provided there is sufficient agreement between them.

2. The committee be given authority to publish these standards as soon as possible.

3. For the part of the spectrum in the neighbourhood of λ 5800, where the number and character of the iron lines is not satisfactory, the committee proposes the use of barium lines as additional standards.

4. Laboratories or observatories possessing first-rate concave gratings are invited to determine by interpolation, as soon as possible, standards of the third order in the spectrum of the iron arc within the above range (i. e., λ 4282 to λ 6495.)

5. The measurement of standards of the second order shall be extended to shorter and longer wave lengths, and the arithmetical mean of three independent determinations shall be adopted as secondary standards.

6. Standards of the third order shall then be obtained in the manner indicated.

7. The above system of standards shall be called the international system, the unit on which it is based being called the international unit (denoted I. A.) as defined by the conference of 1907.

8. It is very desirable that in different laboratories, possessing concave gratings of the first quality, photographs of arc, spark, and solar spectra and new measurements according to the international system shall be taken as soon as possible.

It will be noted that in the determination of the tertiary standards and in the new measurements of arc, spark, and solar spectra, it is expressly stated that first quality concave gratings be used to make the photographs. In view of the fact that there are now many plane gratings in use in an autocollimation or Littrow form of spectrograph, of which our solar spectrograph is an example, it seemed desirable to get an expression of opinion from the committee as to the suitability of such instruments for this purpose, and I therefore proposed that the plane grating might be used in this work. Professor Kayser, the chairman of the committee, was strongly opposed to the idea for the reason that the spectra formed were not normal, even though, as I pointed out, the deviation from normality was small and could readily be allowed for. The matter was allowed to stand there until it was brought up at a later meeting, when my views were strongly supported by Messrs. Adams, St. John, Newall, and others, who gave examples of the accuracy attainable with the plane grating used in the way stated above, and it was finally agreed that the tertiary standards and new measurements of spectra might be obtained with the plane grating.

This is a work that might well be undertaken here by the use of the first-rate plane grating we now possess and the excellent Toepfer measuring machine which are both well adapted for the purpose. It would be necessary to obtain an additional assistant for the purpose of measuring the plates, as there would be so great a quantity required, entirely beyond our present capacity unless the other work were neglected.

The work of this committee is perhaps of the greatest present importance of any dealt with by the Solar Union, and I have therefore presented it in some detail.

In the evening, Director C. G. Abbot, of the Smithsonian Astrophysical Observatory, gave a popular lecture on the 'Solar Constant of Radiation,' outlining the history of the subject, naming the various values of the constant accepted at different times, and giving a brief account of his own work. Mr. Abbot presented a strong plea for the support of a project to equip and maintain another station in a suitable locality, where independent similar and simultaneous observations might be secured to substantiate the value of the constant and determine if there is any fluctuation.

On Thursday morning, the first business taken up was the report of the committee on the measurement of the solar radiation, which was presented by Professor Abbot. The gist of the report was that numerous independent and concordant observations made at Washington and Mount Wilson in recent years have shown the value of the solar constant to be about 2 0 calories per square centimetre per minute, and that fairly well warranted indications of variability to the extent of 5 or 10 per cent. were indicated. It was recommended that an additional station for continuous observation of the solar constant over a considerable period be equipped in a suitable location. A discussion took place on the relative merits of different types of pyrheliometers and on the durability of measuring the radiation over different portions of the solar disc.

The report of the committee on the spectra of sunspots was next presented by Professor A. Fowler, the chairman. One of the most important statements in this report was that the spectra of sunspots are as constant in nature as the ordinary Fraunhofer spectrum. Father Cortie said he had examined them for twenty years and thinks them quite unchanged through periods of maximum and minimum spot activity. After some discussion the following resolutions were adopted:—

1. That the reports of the committee and the co-operating observers be printed in the Transactions of the Union in full, or in abstract as circumstances may determine.

2. That notwithstanding the photographic results, visual observations are desirable and the committee should be continued.

3. That the committee be requested to prepare and circulate a revised scheme of observations.

4. In view of the fact that several observers have prepared catalogues of great numbers of sunspot lines, it is desirable that these results be collated.

5. It is desirable that the new map of the sunspot spectrum do not exceed 60 cm. in length and be on a scale of 5 mm. to one Angstrom.

The report of the eclipse committee, in the absence of the chairman, Sir Norman Lockyer, was presented by the secretary, Comte A. de la Baume Pluvinel, and excited some little discussion over the method of recording angles of position around the sun's disc, which was finally decided in favour of from north toward east.

The desirability of co-operation in observing the chromospheric spectrum was discussed, and Professor Campbell described a method of using a moving plate holder for recording the flash spectrum.

This closed the formal business for Thursday, but in the evening, Professor Kapteyn gave an extremely interesting lecture on 'Star Streaming of Stars of the Orion Type' which, in addition to being the record of a notable piece of work, was presented in a very pleasing and lucid manner and was much enjoyed by the large number present. He finds that two large groups of Orion type stars, containing nearly all of this type in the sky, are moving, when the solar motion is allowed for, in opposite directions at the same rate.

On Friday morning the report of the committee on the determination of the solar rotation by means of the displacement of spectral lines was presented by Mr. Adams. As this committee is one of which I am a member a full report will be given later.

In the absence of Professor Hale, the chairman, the report of the committee on spectroheliographic work was presented by Professor Frost. It included separate reports from Father Cirera, of Tortosa, Spain, on the classification of faculæ, from Professor Ricco, of Catania, Sicily, and Professors Fox and Slocum of the Yerkes Observatory, giving details of spectroheliograph plates obtained. The resolutions proposed by the committee and adopted by the Union are substantially as below:—

1. That daily photographs of calcium flocculi be continued.
2. That provision be made for the measurement of the photographs.
3. That the Japanese Government be approached in regard to the establishment of a solar observatory in Japan.
4. That the observatories of Tacubaya, Mexico, and Madrid, Spain, be added to the list of co-operating observatories.
5. That the committee recognises the advisability of the use of spectroheliographs of high dispersion.
6. That the fund raised in Italy as a memorial of Father Secchi be devoted to the construction of a tower telescope.

On Friday afternoon the question as to whether the field of the Solar Union should be extended to include the study of stellar spectra was discussed. It was pointed out by Professor Newall that the recent work of Campbell, Kapteyn, Russell, and others, tended to upset our notions of the manner of evolution of stellar systems and would render the problem of discussing stellar types somewhat unsettled, and he questioned the necessity of appointing a committee. Professor Schuster remarked that the same persons who are studying the sun are studying the stars, and that some have not joined the Solar Union because it is devoted only to the sun. It would soon be necessary to consider the question of stellar classification and there was no body so representative as this for doing so, while it would naturally devolve on the Union, sooner or later, to take up stellar questions with which solar research is so intimately connected. Professor Turner referred to the work of the Astrographic Chart which was also being extended, and he thought that the course of events would be such that the two international organizations would fill the field of astrometry and astrophysics. Other members spoke in favour of extending the scope of the Union, and the motion was carried unanimously. A full report of the deliberations of the committee on spectral classification, which was immediately appointed, and of which I have the honour to be a member, is given below.

After the decision to hold the next meeting at Bonn, in 1913, the appointing of committees, and the passing of resolutions of thanks, the 1910 sessions of the International Union for Co-operation in Solar Research was formally closed. There remained, however, the journey down the mountain which only occupied about four hours and was much more pleasant than the climb up, and the closing function, a banquet given by Professor and Mrs. Hale to the members and those accompanying them, about one hundred in all, at the Hotel Maryland, on Saturday evening. Owing to the indisposition of Professor Hale, to the disappointment of many there, there was no toast list. Professor Kayser proposed very pleasantly the health of Professor and Mrs. Hale, which was fittingly responded to by Professor Hale. The preparations had been made with the greatest care and the menu and service were excellent. It was a fitting close to a memorable meeting.

By Sunday evening nearly every delegate had left Pasadena, most of them going northward and visiting the Lick Observatory and the University of California before going east. I spent one night at the Lick Observatory and renewed acquaintance with the staff and the methods before starting homeward.

Aside from the direct advantages derived from my attendance as representative of our Observatory at these meetings, which will be referred to later, it is possible that such direct advantages are more than outweighed by the indirect benefits such as, the inspiration received, and the enthusiasm heightened by the association and discussion of questions of mutual interest with fellow astronomers. This is especially true in the present case owing to the notable character of the gathering, the most representative and world-wide meeting of astronomers ever held in America.

I propose to give a more full account of the three committees to which I had the honour of being appointed, inasmuch as they have a more direct bearing on our work than the others above mentioned. The first of these connected with the Astronomical and Astrophysical Society of America was:

The Committee on Co-operation in the Determination of Stellar Radial Velocities.

As previously stated, this committee was organized at the request of Professor Campbell, Director of the Lick Observatory, at the Boston meeting of the Society, and consists of the following members:—

W. W. Campbell,	Director,	Lick Observatory.
E. B. Frost,	"	Yerkes "
Frank Schlesinger,	"	Allegheny "
Karl Schwarzschild,	"	Potsdam "
H. F. Newall,	"	University Observatory, Cambridge.
J. S. Plaskett, Dominion Observatory.		

The other five institutions represented in this committee are the foremost in the world in astrophysical research, and it is an honour for the Dominion Observatory to be associated with them.

This committee held a meeting on Mount Wilson on Thursday afternoon, September 1, when the six above mentioned attended, and, by invitation, Professor J. Hartmann, of Göttingen, and V. M. Slipher, of Flagstaff. At this meeting, the question of the necessity and advisability of co-operation in determining the radial velocities of stars fainter than the fifth visual magnitude was discussed. It seemed to be the general opinion that it was impracticable for any observatory, with its present equipment, other than the Lick, with its large and efficient telescope and unrivalled climate, to take any effective part in obtaining high dispersion spectra of such faint stars, no matter how willing they would be to co-operate in such work. An informal discussion took place upon possible means of overcoming the enormous wastefulness of light in the modern stellar spectrograph, and two or three schemes were suggested for helping matters. Professor Newall proposed to use a crystal of some neodymium salt, or other absorbing material capable of producing lines, in place of the slit, where approximately nine-tenths of the light is lost, so that the spectrograph would act similarly to an objective prism and yet have the good qualities as regards temperature correction and freedom from flexure of the modern spectrograph. Professor Campbell proposes to use a single-prism spectrograph for the fainter stars, but to avoid some of the absorption and reflection troubles and difficulties with flexure of the ordinary one-prism type, to make it of the Littrow form, using a half-prism silvered to return the light back along its original path, and tipping the prism slightly to bring the spectrum to one side of the slit. Other suggestions in regard to the use of objective prisms were made, but no definite plans proposed. I proposed to try a grating as the dispersion piece if one sufficiently bright in one order could be obtained. As in the prism train of the modern spectrograph, about 70 per cent. of the light is lost by absorption and reflection, it is evident that a grating throwing say 60 per cent. of the incident light into one order will effect a considerable saving. Unfortunately, although such a grating was ordered six months ago, it has not yet been obtained, but, when it is, should be well worth trying. It was tacitly agreed that as much as possible along the lines of improving the efficiency of the spectrograph should be done before the next meeting of the committee. It was also understood that any one of the members having the good fortune to secure a telescope of larger aperture, should co-operate with Professor Campbell in obtaining the spectra of the fainter stars. The radial velocities of practically all stars to 5.0 visual magnitude have already been obtained at the Lick Observatory and its southern branch at Santiago de Chile. The determination of the radial velocities of stars fainter than the fifth magnitude is one of the most pressing problems of modern astronomy, as upon the knowledge of such radial velocities depends the solution of many statistical studies of the constitution, motions, and dimensions of the sidereal universe.

The observatory that is able to take an active and efficient part in obtaining such radial velocities will deservedly take high rank in the scientific world. It seems to me to be an opportunity for enhancing our country's reputation that should not be missed, for a telescope, larger than any in use and one which will enable correspondingly fainter stars to be observed, can be obtained at a comparatively moderate outlay. Some approximate information in regard to this has been given previously. With our experience and record in obtaining accurate radial velocities with the smallest telescope in use in this work, there should be no difficulty in making, with the largest instrument, an unrivalled and exceedingly valuable series of observations; and also, for Canada's Observatory, a reputation second to none.

Since the meeting and in preparation for the coming meeting of the Astronomical and Astrophysical Society to be held in Ottawa next August, I, with the other members, have received a provisional report of the proceedings of the committee from Professor Campbell, with a request to criticise it and to supply any omissions. I give here a copy of his report and of my reply, which should be self explanatory.

Professor W. J. Hussey, Secretary,
The Astronomical and Astrophysical Society of America,
Detroit Observatory,
Ann Arbor, Mich.

Dear Sir,—In response to my letter of suggestion and recommendation, dated August 9, 1910, that the Society appoint a committee 'to study and report upon the subject of co-operation on the part of observatories engaged in the measurement of stellar radial velocities,' your letter of August 22, 1910, informed me that my communication was presented to the Council and that 'the matter was discussed and then referred to a committee consisting of the following persons, with power to add to their number:—

W. W. Campbell.	J. S. Plaskett.
E. B. Frost.	Karl Schwarzschild.
Frank Schlesinger.	H. F. Newall.'

The suggestion of the Council that this committee might well hold a meeting at the time of the Solar Union Conference was adopted, and the committee met at Mount Wilson on September 1, 1910. Present: Campbell, Frost, Schlesinger, Plaskett, Schwarzschild, Newall; and by invitation, Hartmann, of Göttingen, and Slipher, of Flagstaff.

The credentials of the committee seemed to be ambiguous as to whether the committee was empowered to present a report upon the main question, or whether its duties were limited to considering and reporting upon the wisdom of appointing a committee to deal with the main question; but we adopted the former of the two views, and we discussed the points which co-operation would bring up first for decision.

My original letter had made prominent the desirability of co-operation in determining the radial velocities of stars fainter than 5.0 visual magnitude in the 'Revised Harvard Photometry'; co-operation on stars brighter than 5.0 not seeming essential, as the programme of the Lick Observatory, on Mount Hamilton and at Santiago, Chile, embracing stars down to 5.0, were essentially complete, not including the investigation of spectroscopic binary systems, nor stars whose spectra contain lines too poor for satisfactory measurement under high dispersion.

I expressed the hope that we should be able, within one or two years, to begin upon an extensive programme for the determination of radial velocities of stars between 5.0 and 6.0 visual magnitude, and that this work might be shared by several observatories. The response of nearly all those present (except myself) was to the effect that, however strongly they might desire to engage in the suggested co-operative plans, their instrumental resources were too weak to give promise of coping successfully with many stars fainter than 5.0 visual magnitude; and, further, that their fields of greatest present usefulness consisted in the study of specially interesting stars, such as the known spectroscopic binary systems, which are for the most part brighter than 5.0 visual magnitude. In effect, the committee decided that co-operation in the determination of radial velocities for stars fainter than 5.0 visual magnitude is at the present time not practicable, and I was requested to present a report embodying this decision.

At that time it was not known that the Carnegie Solar Observatory contemplated the making of stellar radial velocity determinations. A few months following the meeting of the committee, Professor Walter S. Adams, acting director of the Carnegie Solar Observatory, consulted with me concerning a practicable programme of radial velocity determinations for the Solar Observatory, and we have been considering the subject in correspondence. It is not improbable that the main radial velocity programmes of the Lick Observatory on Mount Hamilton and in Chile, and of the Solar Observatory during the next few years will be upon a co-operative basis, to the extent that the Lick Observatory programme will include stars between 5.0 and 5.5 visual magnitude, and the Solar Observatory programme (for observation with the 60-inch reflector) will be composed of stars fainter than 5.5 visual magnitude. However, the decision of many questions relating hereto awaits the return of Professor Hale to active duty in the Solar Observatory.

No action was taken as to recommending that the committee be continued or discharged.

I personally regret that the number of observatories prepared to engage in co-operative programmes is so small, and hope that the not distant future may lead to a decision more favourable to co-operative plans. Those of us who have had occasion to base investigations concerning the sidereal system upon radial velocity results have constant regret that the number of available velocities is not greater. The number of stellar radial velocities now known, not counting uninvestigated spectroscopic binary systems nor stars whose spectral lines are too poor for satisfactory measurement, is in the neighbourhood of 1200. It is my hope and personal belief that within two decades we shall know the radial velocities of as many stars as are now contained in catalogues of stars whose proper motions are fairly determined.

Respectfully submitted for the committee,

W. W. Campbell,
Chairman.

Professor W. W. Campbell,
Chairman Committee on Co-operation in Radial Velocities.

Dear Sir,—In reference to the provisional report of the committee on co-operation in radial velocity work, which you have been so good as to send me, I would say that it represents to the best of my recollection the general trend of the discussion at the meeting on Mount Wilson.

There seemed to be, however, at the meeting a feeling that, although the instrumental equipment at most observatories was not sufficiently powerful to successfully undertake the observation of stars fainter than 5.0 visual magnitude, it might be possible to overcome part of the enormous loss of light which takes place in the modern spectrograph, and to so increase the efficiency that, even with the present light gathering power, fainter stars might be successfully observed. It was agreed, I believe, that those who were unable to co-operate at present should endeavour, by investigation and experiment, to evolve a method by which some of the great loss of light might be obviated. There was some discussion in regard to the use of the objective prism with the absorbing screen devised by Professors Pickering and Wood, and I understand that Professor Newall is to experiment along that line. A further proposal was to experiment with gratings so ruled as to diffract the greater part of the light into one order. I may say that we have an order at Baltimore for such a grating with good prospects that the order will soon be filled. We have at present a 6″ plane grating in which about 45% of the incident light is thrown into the 1st order on one side, an efficiency which is considerably greater than that given by the prism train of the modern three-prism spectrograph. You, I believe, propose to use the Littrow form of spectrograph with a silvered half-prism as dispersing piece.

I feel personally much regret that at present we are unable to co-operate in determining the radial velocities of stars fainter than 5.0 visual magnitude, and can assure you that if we had the necessary equipment we would be not only willing but anxious to engage in such a scheme. Furthermore, as soon as we are able to obtain greater light gathering power we would be glad to devote the greater part of the time in such a cause, which is I think one of the most urgent in present day astronomy.

In regard to the last paragraph of the report I see no reason whatever why it should not be included and heartily concur in the hope therein expressed.

Yours very truly,

J. S. PLASKETT.

Committee on the Determination of the Solar Rotation by the Displacements of the Spectral Lines.

A committee on this research was originally appointed at the Meudon meeting of the Solar Union, but, as no secretary was appointed nor scheme outlined, little has been done in the direction of co-operative work. Previous to the meeting at Mount Wilson, Mr. Adams, who has completed a splendid determination of the solar rotation, sent a letter, somewhat along the lines of the report below, to those whom he thought would be interested in the work. As a result of this letter, a meeting was held on the afternoon of Thursday, September 1, at which were present all the members who had undertaken or were likely to undertake work along this line. This meeting was most enthusiastic and business-like, and as every one was in earnest a definite working programme was soon outlined. Co-operation was carried in this scheme to an extent sufficient to prevent overlapping, to enable accurate comparisons of results, etc., to provide for elimination of systematic errors, without in any way hampering individuality of treatment or originality of methods. The basis of the agreement as will be seen in the report was the division of the spectrum into 7 regions, one for each member of the committee. These regions extend from λ 3800 to λ 6250. Each observer is to determine the rotation from the region of spectrum allotted to him about 200 A in length and in addition from a general or common region observed by all. This region was chosen between λ 4220 and λ 4280, the centre of the region used by Adams in his determination.

The latitudes to be observed are 0°, 15°, 30°, 45°, 60° and 75°, and, if possible, higher latitudes between 75° and the pole in the special regions, and 0°, 30° and 60° in the common region.

At the meeting of the Union on Friday morning, the provisional report was read, including the basis of agreement reached in the organization meeting, and was accepted with little discussion, but with congratulations on the business-like and complete nature of the report, and the following committee was formally appointed as the Rotation Committee of the International Solar Union. I give here the region of spectrum allotted to each.

3800—4000	Bélopolsky	Pulkova
4000—4140	Schlesinger	Allegheny
4300—4500	Newall	Cambridge
4500—4700	Adams	Mt. Wilson
5100—5300	Adams	Mt. Wilson
5500—5700	Plaskett	Ottawa
6250—6350	Dyson	Edinburgh

A copy of the report is herewith appended.

'The organization of the Committee on the Rotation of the Sun appointed at the Meudon meeting of the International Solar Union has never been completed by the appointment of a secretary, and little has been done in the direction of co-operative work. At a meeting of the committee yesterday, however, a temporary organization was effected and a full programme of work discussed.

'The principal objects of a study of the sun's rotation by means of the displacements of the spectrum lines may be referred to under five heads:—

1. The accurate determination of the angular velocity of rotation at various latitudes, and the derivation of a formula representing with a high degree of precision the variation of velocity with latitude.

2. A definite conclusion as to the existence of secular or periodic variations in the sun's rate of rotation.

3. The investigation of the rate of rotation as shown by the lines of different elements, and of the arc and enhanced lines of the same element, with a view to determining whether either the absolute rate of rotation or the law of variation with latitude differs for different substances.

4. The study of lines selected from different regions of the spectrum.

5. The detection of possible systematic proper motions or drifts in the sun's reversing layer.

'At the present time the evidence appears to be strong that the type of formula

$$\xi = a + b \cos^2 \phi$$

connecting angular velocity ξ and latitude ϕ, first suggested by Faye as the result of his discussion of the observations of the motion of sun-spots, represents with a considerable degree of accuracy the results obtained from spectrographic observations. The series of observations by Dunér, Halm and Adams are all tolerably accordant in this respect. It is, however, by no means certain that a term in $\cos^4 \phi$ may not exist. The effect of such a term would, of course, be most marked in the higher latitudes where observations are most difficult and the influence of errors in position angle is most serious. At 75° of latitude, for example, an error of 0°.38 in position angle would correspond to about 0.01km. in linear velocity or 0°.3 in angular velocity. It is clear that observations in the higher latitudes are greatly needed, and that for this purpose a large solar image is very desirable.

'The question of a variation in the sun's rate of rotation is still an open one, although the evidence at present is rather opposed to the existence of short period variations of any considerable amount. Systematic observations covering at least two sun-spot maxima and minima are required for the purpose of determining a possible relationship between the sun's activity and its rate of rotation.

'The observations of Pérot' Schlesinger and Adams during the last two years are all in agreement in showing that the lines of different elements give different rotational velocities. The elements showing the greatest apparent differences of level in the sun's atmosphere appear to give the largest differences in rotational velocity. Among the high level elements are hydrogen and calcium, and among the low level elements cyanogen and lanthanum. The number of elements investigated should be considerably increased in future work, and in particular such should be included as are of low or very high atomic weight. The important result, apparently indicated by the Mount Wilson observations, that the law of change of velocity with latitude as well as the absolute velocity differs for different elements, requires much additional study. It now seems probable that the investigation of the behavior of special lines will soon form one of the most important branches of the subject of the sun's rotation.

'The change from visual to photographic methods of observation has led naturally to a change in the region of the spectrum employed from the longer to the shorter wave-lengths. Thus at the present time, Professor Plaskett is using the region from about λ 4430 to λ 4600, Dr. Schlesinger λ 4060 to λ 4140, and the Mount Wilson observers from λ 4100 to λ 4300. As compared with these, the visual observations of Dunér and Halm were made on two iron lines near λ 6300, while the interferometer results of M. Pérot were based on two lines of calcium at λ 5349 and λ 6122. It seems very desirable, in view of the possibility of a relationship between the values of the rotational velocity and the region of the spectrum observed, that a large range of spectrum be covered by the various series of observations.

'With the recent marked improvements in methods of sensitizing photographic plates to the less refrangible part of the spectrum, it will not be difficult to secure satisfactory photographs on fine-grained plates of any portion of the visible spectrum.

'The fifth and last point under consideration in the general discussion is that of proper motions in the sun's reversing layer. A striking case of this sort in the vicinity of two sun-spots was observed by Adams at Mount Wilson in 1908, but, except for this isolated case, practically nothing is known regarding their occurrence in the solar atmosphere. Any knowledge as to their prevalence or direction of motion will prove of the greatest importance in the theory of the general solar circulation.

'In view of these considerations regarding the present condition of our knowledge of the rotation of the sun, the committee at its meeting undertook the organization of co-operative work, and to this end made the following recommendations to observers:—

1. That the observers select, at least to a partial extent, different regions of the spectrum so that the total range of wave-length under observation may be as great as possible.

'By general consent of those present at the meeting of the committee, the following regions of the spectrum were selected by the various observers:—

3800—4000	Bélopolsky.
4000—4140	Schlesinger.
4300—4500	Newall.
4500—4700	Adams.
5100—5300	Adams.
5500—5700	Plaskett.
6250—6350	Dyson.

2. That within these regions the selection of lines be made with a view to the inclusion of a considerable number of elements, particularly such as are of very high or very low atomic weight, as well as the enhanced and the arc lines of the same element.

3. That an agreement be made upon the latitudes to be observed.

'After considerable discussion the committee decided to recommend the following points of heliographic latitude:—

0°, 15°, 30° 45°, 60°, 75°.

4. That an especial attempt be made to secure observations in the highest latitudes, particularly between 75° and 90°.

'One or two of the observers present expressed their willingness to attempt determinations at latitudes 80° and 85°.

5. That a short list of selected lines be employed by all of the observers in common, the results to serve as a check upon instrumental or personal errors, and that a list of the points of latitude to be observed accompany this list.

'The Committee selected for this purpose the portion of the spectrum between λ4220 and λ4280, and the three points of latitude 0°, 30° and 60°. The secretary was authorized to choose a list of lines and forward it to the various observers for approval.

6. That an attempt be made to secure at least one independent series of observations in each of the solar hemispheres with a view to determining a possible difference in the rate of rotation.

'Several observers expressed their willingness to undertake such observations of this character as the construction of their instruments would permit.

'Since the meeting held yesterday is the first since its appointment, the committee does not desire at this time to offer a formal set of resolutions, but rather to secure authorization from the International Union for Co-operation in Solar Research to proceed along the lines indicated in this report until the next meeting in 1913. At that time it should be possible to offer a definitive series of conclusions for action by the International Union.'

There is little to add to the above report, which practically tells the whole story of what has been arranged as regards co-operative work on the solar rotation. Since the meeting Professor Adams sent around a list of six iron lines for observing in the common region. At my suggestion the list was increased to ten an d was slightly changed to include some of those observed by Adams to give either higher or lower values than the general reversing layer. The following are the ten lines selected with the element, intensity and whether it gives high or low velocity as observed by Adams. In addition to the ten I propose to measure five other lines which gave varying velocities according to Adams. The latter are given below the general list.

Lines to be measured in General Region.

Line.	Element.	Intensity.	Remarks.
4220·509	....	3	
4225·619	....	3	
4232·887	....	2	
4241·285	....	2	
4246·996	....	5	
4257·815	....	2	High Value.
4258·477	... ...	2	
4266·081	....	2	High Value.
4268·915	....	2	
4276·836	. ...	2	

Additional Lines.

Line.	Element.	Intensity.	Remarks.
4196·699	....	2	Low Value.
4197·257	....	2	Low Value.
4216·136	....	2	Low Value.
4290·377	....	2	Low Value.
4291·630	....	2	High Value.

The result of the measurement of these lines should be of considerable interest on comparison with the values obtained by Adams.

Committee on Classification of Stellar Spectra.

The discussion resulting in the appointment of this committee has already been given in this report. Immediately after the close of the general meeting on Friday, this committee at the call of the chairman met and discussed the question informally. The gist of that discussion is given in a circular letter issued later by the secretary, Dr. Schlesinger, which is given in full below. Beneath it is a copy of my reply to the questions raised therein. The members of the committee, which is very representative, including practically everyone working on stellar spectroscopy, are given in the secretary's letter.

Allegheny Observatory, Nov. 7, 1910.

Dear Mr. Plaskett.—At the Fourth Conference of the International Union for co-operation in Solar Research, the following gentlemen were appointed to serve as a "Committee on the Classification of Stellar Spectra":—Messrs. Adams, Campbell, Frost, Hale, Hamy, Hartmann, Kapteyn, Newall, Pickering (*Chairman*), Plaskett, Russell, Schlesinger (*Secretary*) and Schwarzschild.

This committee met on Mount Wilson on September 2, immediately after the adjournment of the conference itself. In accordance with power to add to their number, it was unanimously decided to ask Mr. Küstner to serve, and he was present at this meeting. Messrs. Hale and Campbell, who had already left the mountain, were the only absentees.

The chairman called upon each member in turn to express his views concerning the classification of stellar spectra and his opinion as to what the scope of the committee should be. A brief summary of this discussion follows:—Mr. Adams preferred the Draper Classification*, and thought that, if the members of the committee themselves would use this classification exclusively, until say the next meeting of the Solar Union, it would go far toward establishing uniformity. Mr. Küstner preferred the Draper Classification and was using it exclusively. Mr. Hartmann thought that the Draper Classification was the best that had been proposed, but hoped that an effort would be made to retain the Roman numerals of Secchi, that have now become classic, and that the subdivisions be made as in the Draper system by the addition of Arabic numerals; thus, II,3. Mr. Schwarzschild expressed similar views, and thought that it might be advantageous to employ both Secchi's numerals and Pickering's letters; thus, IIG5. Mr. Russell suggested the advisability of substituting some method for *measuring* the type of spectrum for the *estimations* that are now employed, and asked whether this could not be applied to the Draper Classification. Mr. Plaskett preferred the Draper Classification, but said that as he believed uniformity to be the prime consideration he would gladly adopt whatever system could be agreed upon. Mr. Frost thought that the committee should make no recommendation at the present time but should first canvass the whole subject thoroughly; it appeared to him desirable to investigate the visual end of the spectrum in connection with the photographic before arriving at a definite conclusion. Mr. Schlesinger preferred the Draper Classification and had decided to use it exclusively; he called attention to the desirability of making further distinction among the numerous spectra that are now classified as A without any modifying number; he thought that any attempt to establish a temporary uniformity now might prove an obstacle to the universal adoption of some more

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* This classification is described in the Annals of Harvard College Observatory, Volume LVI, page 66. The letters O, B, A, F, G, K, M and N are used to designate the sequence of the spectra. Numerals from 1 to 9 after the letter denote intermediate spectra; thus, B3 would be assigned to a spectrum between B and A, but more nearly resembling the former.

definite system later. Mr. Newall asked whether a spectrum might not be intermediate between two letters in the Draper Classification that are not consecutive, as A5G. Mr. Pickering said in reply that such cases have not arisen in practice. Mr. Newall raised the question whether the committee should not consider the matter of stellar evolution. The members present seemed to be of the opinion that this was legitimately within the scope of the committee, but that its immediate business should be the establishment of a uniform system for classification. Messrs. Russell, Hartmann, Kapteyn and Schlesinger urged that no evolutionary basis for a classification be adopted at the present time; astrophysicists are not agreed as to the proper sequence from this point of view; if our ideas upon this matter should be modified in the near future (as seems very possible), then it would be necessary to modify or to abandon altogether any system of classification based upon these ideas. For similar reasons Mr. Russell asked that the use of such terms as "early" and "late," now so frequently used in describing spectra, be discontinued in favor of "white" and "red."

The secretary was directed to secure by correspondence as full an expression of opinion as possible, from the members of the committee and others, on the matters that had been discussed. The meeting adjourned.

In accordance with this request, the following questions have been framed*, and you are asked to reply to them at length. In addition it is hoped that you will give your view in full upon any other points that may occur to you as being important in this connection.

(1). It will be noticed that, at the meeting reported above, there seemed to be a practically unanimous opinion that the Draper Classification is the most useful that has thus far been proposed. Do you concur in this opinion? If not, what system do you prefer?

(2). In any case, what objections to the Draper Classification have come to your notice, and what modifications do you suggest?

(3). Do you think it would be wise for this committee to recommend at this time or in the near future, any system of classification for universal adoption? If not, what additional observations or other work do you deem necessary before such recommendation should be made? Would you be willing to take part in this work?

(4). Do you think it desirable to include in the classification some symbol that would indicate the width of the lines, as was done by Miss Maury in Annals of the Harvard College Observatory, Volume XXVIII?

(5). What other criteria for classification would you suggest?

Although it is not the intention of the committee to frame a formal report at once, it is desirable that your answers to some of these questions should be forthcoming very soon; this is particularly the case with the third question. May I therefore request that your reply be sent, if possible, so as to reach me not later than the end of this calendar year? If you can secure an expression of opinion from any other qualified astronomer, it will be very welcome.

Very respectfully yours,

FRANK SCHLESINGER,

Secretary of the Committee.

* The general form that these questions should take was discussed at several informal meetings on the train coming east from the meeting at Pasadena. There were present at these meetings the Chairman and the Secretary of the Committee, Mr. Russell and (by invitation) Father Cortie.

Ottawa, Ont., Jan. 26, 1911.

DR. FRANK SCHLESINGER,
*Secretary International Committee on
Classification of Stellar Spectra.*

DEAR SIR.—In reply to the questions formulated in your letter of November 7th last, in regard to the Classification of Stellar Spectra, I have pleasure in presenting the following.

1. The Draper Classification is the most useful scheme hitherto proposed, but it is possible that it might be improved upon in some respects.

2. The principal objection to the Draper Classification occurring to me is that the designations of the different types of spectra do not of themselves suggest anything in regard to the character of the spectra, and are in this respect arbitrary and unsatisfactory. It is of course true that familiarity with and use of the Draper system soon diminishes the weight of this objection, but for those using or referring to it occasionally a system of nomenclature which would at once suggest the type of spectrum designated would be a decided advantage, and I would suggest that the committee consider the possibility of such a modification. Would it be possible to combine the simplicity and the universally known features of Secchi's nomenclature with the more complete, systematic, and consecutive division of the spectral types in the Draper Classification? There is of course the objection that one would have a tendency to associate the order of the numerals therein used with the order of stellar development, and this, considering the present state of our knowledge of stellar evolution, would be inadvisable. A similar objection may be urged to the designation of the Draper subdivisions in that they are always used in one order; thus, always A4F never F6A, tacitly assuming that stars develop from the A to the F types and not, as may be possible, from F to A.

3. In my opinion, the question in all its bearings should be discussed as fully as possible by correspondence, so that at the next meeting of the Solar Union at Bonn in 1913, the committee may be prepared to recommend some scheme of spectral classification for universal adoption. It does not seem to me advisable to formulate any system before that date, as it can only be put into satisfactory shape after personal meetings and discussions among the members, and such meetings will not likely be possible until the next Solar Conference. On the other hand, the only thing that would justify a longer delay than that necessary for a full consideration of the question would be the chance of obtaining, in the near future, some more positive knowledge of the order and process of stellar evolution than we at present possess. The probability of a final solution of that problem is not in my opinion sufficiently great to justify a long postponement of the advantages that will undoubtedly accrue from the adoption of some uniform system of spectral classification.

It seems to me desirable before a definite classification is adopted that some work be done on the red end of stellar spectra up to and including H_α. It is possible that very valuable criteria for the division and distinction of the various types may be obtained from the behaviour of some of the lines, such as the sodium "*D*", the helium "D_3" and the magnesium "*b*", between H_α and H_β. It would be necessary to obtain, with a reasonably high dispersion, not less than 50 *A* per mm., photographs of the red end of the spectrum of representative stars of the different spectral subdivisions, before it could be determined whether any modifications of existing divisions would be required. Such work and any further work that might develop I would be willing to take part in.

4. It seems to me to be essential, or at least very desirable, in any complete system of classification to introduce some method of representing the width of the lines. It is undoubtedly true that there is frequently much greater difference in the appearance of two stars of the same type, one with wide and one with narrow lines, than between two stars, each with narrow lines, of types one or more subdivisions apart. It may not be necessary to introduce a separate symbol to represent the character of the lines. If we consider all spectra with sharp or moderately sharp lines as normal and represent them in the ordinary way, then spectra with diffuse lines might be differentiated from the normal by the use of the same distinguishing letters and figures, but in different type, e.g., sloping or italic.

5. No other criterion necessary in a scheme of classification occurs to me.

Yours very respectfully,

J. S. Plaskett.

It will be seen from this report of the proceedings of these two meetings, how essential it is that the Observatory should be personally represented at such important meetings as these. The appointment of its representative, myself, on three committees dealing with far reaching international astronomical questions is an evidence I take it of the standing our Observatory has already attained by its work. I take it as a personal compliment, as well as a recognition of our scientific standing, to be associated with such men as Hale, Pickering, Campbell, Frost, Adams and Schlesinger of America, Dyson (Astronomer Royal), and Newall of England, and Kapteyn, Schwartzschild, Hartmann and others of Europe in the discussion of and co-operation in the three important and far-reaching problems above dealt with. I am satisfied that our work in the future will, at least, not lessen the estimation in which we are held, but will increase it. This will especially be the case if it were possible for us to take the great step forward of securing adequate telescopic power which has been already referred to.

It may be of interest to give a brief summary of the advantages accruing to the Observatory from my attendance as its representative at these two meetings. The indirect advantages have been already referred to previously, but there is the one direct advantage of the clear cut understanding arrived at in regard to the work on the solar rotation, which enables us to work most effectually along definitely laid down lines with no danger of duplication of work, and, at the same time, without in the least hampering originality of method or individuality of treatment. Furthermore, we are well assured by its inclusion in the work of the Solar Union of the great value and usefulness of the work when completed. Although it was not possible to arrange such a definite scheme of co-operation in stellar radial velocity investigation, the work of this committee is at least equally valuable and will undoubtedly also have most important results. So far as the question of spectral classification is concerned, the removal of the confusion at present existing in defining the spectral type of the stars is of great moment to the future progress of astronomy, and the representative committee at work on this question should be able to eventually formulate a permanent scheme.

To these direct advantages, to the advantage of the formal association of our Observatory with the greatest observatories of the world effected by my attendance at these meetings, is to be added the indirect benefit derived by me and, through me I hope, to my work by the inspiration received, and the enthusiasm renewed and increased from the association with fellow astronomers and the informal discussion of questions of mutual interest.

I desire here to express my thanks to you for the privilege and honour of attending these meetings as the representative of the Observatory.

Micrometric Work and Celestial Photography.

This work has been energetically carried on as in former years by Mr. Motherwell, and the detailed measures and descriptions are given by him in Appendix E. The unusually poor observing weather of the past year has, as in the radial velocity work, reduced the number of measures and also very seriously hindered effective photographic work on Halley's comet. The weather during May and June, when the comet was brightest, was very poor as indicated in the table given above of the number of observing nights and spectra obtained. In addition to this, on many of the nights which were otherwise fine, successful photography of the comet was prevented by moonlight, and the photographic record of this much heralded visitor is disappointingly small. It is, of course, true that the attachment of the camera to the equatorial telescope frequently hinders its use in photographing, but that difficulty will likely soon be overcome by the provision of a separate mounting and building which should enable a much greater quantity of work of improved quality to be done.

Since the refiguring of the 8-inch doublet it has performed very satisfactorily, and the 12-inch focus 3.5 Zeiss Tessar objective also gives good results. Its principal defect seems to lie in the diminution of the illumination towards the edges of the field, but this is inevitable in a lens of this type and is, of course, only especially noticeable when there is sky fog due to moonlight or to photographing, as is sometimes necessary in comet work, when the sun is not sufficiently far below the horizon.

Mechanical Work.

The two mechanicians, Messrs. Mackey and Lucas, have been employed during the past year chiefly in repair work and in various attachments and alterations to the meridian circle and auxiliary apparatus. In addition some minor alterations have been made in the details of the stellar spectroscopes; and the new reflecting prism and guide plate attachments to the solar spectrograph, described above, have been constructed. Considerable work has also been done on adjustable slides to be used in the standardizing building and other miscellaneous work.

On account of the illness of Mr. Mackey during the last four or five months of the year, the work got behind to some extent, but it is hoped that on his return we may be able to catch up with the arrears, although of course, it is likely, where there are so many instruments, many of them complicated and delicate, in constant use that more work will be always coming in. In addition, when we consider that desirable improvements in existing instruments are bound to suggest themselves to the intelligent and enthusiastic worker, it is evident that the workshop will continue to be as indispensable in the future as it has been in the past, and that there is no immediate prospect of any lack of work. We may congratulate ourselves on having two such skilful mechanicians to look after this important work. Mr. Dunn also has proved himself capable and satisfactory in looking after the carpentry work required.

General.

Before closing this report there are one or two other matters that may with advantage be briefly referred to.

The attendance at the Saturday evening open-nights with the telescope has not been as great as in former years, which is probably partly due to the fact that the weather has not been as favourable. During the time when Halley's comet was at its brightest, however, there were record attendances of visitors who had to be convinced by ocular demonstration that a good naked eye comet is a much finer object by unaided vision than through any telescope. On every fine Saturday evening there is always a good attendance, although not the overcrowding that sometimes occurred previously. Our other method of stimulating interest in astronomy by means of the meetings of the Royal Astronomical Society has also fulfilled its purpose, although the attendance at some of the evening meetings has not been as large as we would like.

The afternoon meetings continue to prove very useful to the members of our own staff in disseminating knowledge of the various branches of the work and increasing interest and esprit de corps among the officers.

The papers contributed by this division to the Royal Astronomical Society during the period covered by this report are:—

1910.		
Apl. 21, 8 p.m.	Stellar Evolution and Theories of World Building	J. S. Plaskett.
May 3, 3 p.m.	Diffraction Grating of the Solar Spectroscope	R. E. DeLury.
Nov. 10, 3 p.m.	Irregularities in the Velocity Curves of some Stars with suggested explanations.	W. E. Harper.
1911.		
Jan. 12, 3 p.m.	Notes from two Recent Astronomical Gatherings	J. S. Plaskett.
Feb. 23, 8 p.m.	Some Recent Interesting Developments in Astronomy.....	J. S. Plaskett.

At the Harvard meeting of the Astronomical and Astrophysical Society of America, the following paper was read:—

Probable Errors of Radial Velocity Determinations..... J. S. Plaskett.

At the meeting of the Royal Society, September, 1910, the following paper was read:—

Probable Errors of Radial Velocity Determinations..... J. S. Plaskett.

A list of papers written by members of this division and appearing in scientific publications during the year is given here.

1. The Orbit of η Boötis. Jourl. R. A. S. C., IV, 191, by W. E. Harper.
2. The Orbit of φ Persei. Jourl. R. A. S. C., IV, 195, by J. B. Cannon.
3. Halley's Comet. Notes and Photographs. Jourl. R. A. S. C., IV, 224, by R. M. Motherwell.
4. Slit Width and Errors of Measurement in Radial Velocity Determinations. Jourl. R. A. S. C., IV, 345, by J. S. Plaskett.
5. The Astronomical and Astrophysical Society of America. Jourl. R. A. S. C., IV, 373, by J. S. Plaskett.
6. Double Star Measures. Jourl. R. A. S. C., IV, 447, by R. M. Motherwell.
7. Probable Errors of Radial Velocity Determinations, Astrophysical Jourl., XXXII, 230, by J. S. Plaskett.

8. The Collimation of the Correcting Lens. Astrophysical Jourl., XXXII, 243, by J. S. Plaskett.
9. The Spectroscopic Binary ε Ursæ Minoris. Jourl. R. A. S. C., IV, 462, by J. S. Plaskett.
10. Probable Errors of Radial Velocity Determinations. Trans. R. S. C., 1910, by J. S. Plaskett.
11. The Elements of 93 Leonis. Jourl. R. A. S. C., IV, 452, by J. B. Cannon.
12. The Orbit of ν Orionis. Jourl. R. A. S. C., V, 16, by W. E. Harper.
13. Changes in Focus produced by Plane Gratings. Jourl. R. A. S. C., V, 26, by R. E. DeLury.
14. A Device for Guiding the Image from a Coelostat Telescope. Jourl. R. A. S. C., V, 33, by R. E. DeLury.
15. The Spectroscopic Binary 7 Camelopardalis. Jourl. R. A. S. C., V, 112, by W. E. Harper.

It will be noticed in the above list that No. 7 and 10 by myself have the same title, but the papers are not the same, the first one being more condensed and more in the nature of a summary of the work and results, while the second contains the full tabular material necessary in a complete treatment.

It is not right to close this report without expressing my gratitude for your unfailing interest in and encouragement of my work and for your readiness to meet any needs in the way of apparatus and material required or deemed useful in increasing its efficiency.

I have the honour to be, Sir,

Your obedient servant,

J. S. PLASKETT.

APPENDIX A.

THE ORBIT OF ν ORIONIS. THE SPECTROSCOPIC BINARY 7 CAMELOPARDALIS. MEASURES OF ο ANDROMEDAE AND ε CASSIOPEIAE. MISCELLANEOUS MEASURES.

W. E. Harper, M.A.

The Orbit of ν Orionis.

The spectroscopic binary ν Orionis ($\alpha = 6^h\ 02^m$, $\delta = +14°\ 47'$, photographic magnitude about 4.2) was discovered* by Frost and Adams in 1903. The range in velocity of their three plates is approximately 70 km., which is in fact about the total range for the star. Their first observation was made at a fortunate time, it falling on the crest of the velocity curve which rises rapidly to a high positive value and falls again as rapidly. On this account this observation has been of material assistance in getting a more accurate value of the period than could be obtained from our own observations.

Work was commenced on the star here Nov. 11, 1907, and from that time to Dec. 30, 1910, one hundred and nineteen plates were secured. The first season's work gave the general form of the curve and during the three succeeding seasons efforts were made to obtain a full series of observations around periastron, where the curve, as previously mentioned, changes so rapidly. In this we have been only partially successful, as cloudy weather at each return to periastron prevented our obtaining all the observations desired. Nevertheless quite a number of reliable plates have been secured for this part of the curve, and the determination of the orbit has accordingly been proceeded with.

The spectrum is of type B2 and has numerous lines suitable for measurement. The hydrogen lines H_β, H_γ, H_δ and H_ϵ appear in the range of spectrum measured but the latter was scarcely ever measured, owing to the close proximity of the H line of calcium and consequent overlapping. The helium series λλ 4713, 4471, 4388, 4143, 4121, 4026 and 4009 are all measurable and these, excepting the first and last, were among the most frequently used. The magnesium λ 4481 and the calcium K λ 3933 are not so intense as either the helium or hydrogen series and do not appear in many of the spectra.

In view of the fact that a number of binaries have recently been discovered in which the calcium lines H and K give different velocities to the other lines, it may be noted here, that this is not the case with ν Orionis; the velocities of the K line agree with those of the other lines. Another good line is the carbon λ 4267. These were the lines most frequently measured but additional lines in a number of cases have been seen, and where these have been measured the resulting velocities were always in agreement with the lines most commonly used. Among these additional lines may be mentioned: λλ 4572, 4563, 4549, 4528, 4452, 4383, 4325, 4308, 4233, 4131 and 4128. There are also indications of the second series of hydrogen.

*Astrophysical Journal, Vol. XVIII., p. 386.

On the first one hundred plates all the lines that were at all measurable were used. When the results were plotted with the provisional period of 131·4 days there were many little irregularities in the curve; its appearance was that of a wavy line. As no indications of a second spectrum had been detected, even though a fine-grained plate had been used at the time of maximum positive velocity, it was difficult to account for this. It was thought that a possible cause might exist in the selection of lines varying from one plate to another. To decide this point and incidentally see if the wave-lengths used needed any arbitrary correction, a table was constructed of the residuals for each line from the mean of the plate. The result is contained in the accompanying table. Besides the twelve lines here listed there were various others which did not occur frequently enough to make mention of. The lines are arranged in order of frequency of measurement, the total number of plates being 100.

LINES MEASURED IN ν ORIONIS.

λ	Number of Times Measured.	Average Residual.	Corresponding Correction to Wave-length.
4340.634	97	−1.39 km.	+.020 t.m.
4388.100	94	−0.43 "	+.007 "
4471.676	94	+1.51 "	−.022 "
4143.928	86	−0.03 "	.000 "
4026.352	75	+1·67 "	−·022 "
4267·301	68	−2·45 "	+·035 "
4121·016	63	−0·11 "	+·002 "
4481·400	62	+1·95 "	−·029 "
4101·890	56	+0·99 "	−·011 "
4713·308	20	−1·48 "	
4861·527	19	+3·70 "	
3933·825	13	+1·40 "	

No corrections to wave-length are given for the last three as the observations were deemed too few in number and, furthermore, the ends of the spectrum may not always have been in focus thereby causing these residuals to be abnormal. The residuals in the above table are, in general, small relative to the probable error of a plate and while somewhat better accordance among the different lines on a plate would be secured by adopting an arbitrary set of wave-lengths based on the corrections, yet none of the residuals are so abnormal as to warrant such a procedure and accordingly the normal values have been retained. In subsequent measuring the first nine lines of the table were the only ones used, and the other hundred plates were recomputed using these lines alone so that the results ought, at least from a consideration of wave-length, to be consistent.

Plates from 1140 to 2257 were made with the single-prism spectrograph I L as first constructed, the dispersion at $H\gamma$ being 30.2 tenth-metres per millimetre. The balance were made with the new single-prism instrument, designated I, whose dispersion is 33.4 tenth-metres per millimetre at the same region. Plates 3369, 3847, 3865 and 3890 were made on Seed 23 plates, the remainder on Seed 27 emulsion. The four Seed 23 plates were made at times of high positive velocity to see if any trace of the second spectrum could be detected. No indications of such were seen.

Two plates have been omitted in the discussion, one, 2098, which gives a residual of 25 km. where the curve is well defined in the flat part. This is probably owing to some instrumental error. The other case is that of plate 1315 which was taken immediately following plate 1314 under almost identical conditions and yet gives a decidedly greater positive velocity. The plate is somewhat underexposed, but there would seem to be some additional cause for the great difference in velocity, and as these observations occur around periastron this was one reason why a continuous series of plates at this phase was wished for. The intention is to make a few more plates next season at this critical place in the curve.

The observational data of the various plates is contained in the table following, the columns being self-explanatory. Then follows the measures of the plates in detail. The numbers of the plates are given in the top row and where these are followed by a capital, as is the case in some half-dozen instances, it means that that particular plate has been remeasured by another person. The abbreviations are:—

W = C. R. Westland.
P^1 = T. H. Parker.
C = J. B. Cannon.

P—Plaskett.
H—Harper.
P[1] Parker.
C- Cannon.

RECORD OF SPECTROGRAMS

Star	No. of Neg.	Camera	Plate	Date	Middle of Exposure G.M.T.	Duration	Hour Angle at End.	Temperature. Room Beg.	Room End.	Prism Box. Beg.	Prism Box. End.	Slit Width	Seeing	Observer	Remarks.
				1907.	h m	m	h m								
ν Orionis.	1140	I. L.	Seed 27	Nov. 11	22 16	67	3 04 W	− 3·0	− 2·5	5·5	5·5	·0014	Fair	H	Heavy fog.
" ..	1160	"	"	" 23	18 45	30	0 00	− 0·5	− 0·5	6·7	6·7	·0013	"	P	
" ..	1184	"	"	Dec. 4	22 00	40	4 05 W	−13·7	−14·0	0·8	0·7	·0015	Good	P	
" ..	1185	"	"	" "	22 47	45	4 55 W	−14·0	−14·7	0·7	0·7	"	"	P	
" ..	1197	"	"	" 28	17 30	35	1 05 W	− 7·0	− 7·8	3·1	3·1	·0016	"	P	
" ..	1198	"	"	" "	18 00	27	1 35 W	− 7·8	− 8·0	"	"	"	"	P	
				1908											
" ..	1217	"	"	Jan. 3	17 37	20	1 30 W	− 7·0	− 6·5	− 4·4	− 4·4	·0013	....	P	Cloudy 10[m]
" ..	1223	"	"	" 13	19 20	30	4 00 W	−13·2	−15·5	− 0·8	− 1·3	"	. . .	P	Control off.
" ..	1224	"	"	" "	20 05	30	4 45 W	−15·5	−16·0	− 1·3	− 1·3	"		P	
" ..	1229	"	"	" 14	20 14	38	5 00 W	−16·0	−17·0	− 5·1	− 5·3	"	Hazy	H	
" ..	1235	"	"	" 16	13 00	25	2 13 E	−13·5	−13·5	− 6·0	− 6·0	"	Poor	P-H	
" ..	1250	"	"	" 20	17 06	33	2 13 W	− 6·0	− 7·3	− 6·9	− 6·9	"		P H	
" ..	1251	"	"	" "	17 39	30	2 45 W	− 7·3	− 8·0	"	"	"		H P	
" ..	1261	"	"	" 22	18 41	38	4 00 W	−10·2	− 9·8	0·1	0·0	"		P	Unsteady
" ..	1273	"	"	" 24	14 05	30	0 30 E	−15·6	−16·0	− 9·0	− 9·0	"		P	
" ..	1282	"	"	" 27	13 49	25	0 40 E	−13·3	−14·6	−11·1	−11·1	"	Good	P	
" ..	1302	"	"	" 29	15 39	30	1 20 W	−22·3	−22·5	− 8·7	− 8·7	"		H	Unsteady.
" ..	1303	"	"	" "	16 06	22	1 43 W	−22·5	−23·0	− 8·7	− 8·6	"	Fair	H	
" ..	1314	"	"	Feb. 3	14 48	23	0 45 W	−19·5	−19·5	− 7·7	− 7·8	"	"	H	
" ..	1315	"	"	" "	15 47	26	1 40 W	−19·5	−20·0	− 7·8	− 7·8	"	Only Fair	H	
" ..	1320	"	"	" 8	16 47	25	3 05 W	−17·5	−18·0	−10·2	−10·2	"		P	
" ..	1325	"	"	" 17	15 30	24	2 23 W	−14·0	−11·0	− 2·3	− 2·4	"	Fair	H	
" ..	1326	"	"	" "	15 56	27	2 50 W	−14·0	−14·5	− 2·4	− 2·5	"	"	H	
" ..	1335	"	"	" 20	13 36	18	0 30 W	− 7·1	− 7·5	− 1·1	− 1·1	·0015	Good	P	
" ..	1337	"	"	" 21	16 40	30	3 50 W	− 4·0	− 4·4	0·6	0·5	·0013	Fair	P	
" ..	1348	"	"	" 22	17 20	50	4 45 W	−13·5	−15·0	− 4·6	− 4·6	"	"	P	Spectrum wide.
" ..	1352	"	"	" 24	14 50	20	2 10 W	−11·8	−12·0	− 2·1	− 2·1	"		P	
" ..	1377	"	"	Mar. 4	16 15	46	4 21 W	− 7·5	− 8·5	0·3	0·6	"	Fair	H	Off 10[m]
" ..	1385	"	"	" 9	16 17	35	4 35 W	− 9·5	−10·8	0·3	0·4	"	Good	P	
" ..	1396	"	"	" 16	12 48	21	1 30 W	− 5·8	− 6·0	2·4	2·4	·0011	Fair	P	
" ..	1485	"	"	Apr. 15	13 22	40	4 15 W	2·5	2·0	8·2	8·0	·0015	....	H	

P—Plaskett.
H—Harper.
P¹—Parker.
C—Cannon.

RECORD OF SPECTROGRAMS—(Continued).

Star.	No. of Neg.	Camera	Plate.	Date.	Middle of Exposure. G.M.T.	Duration	Hour Angle at End.	Temperature. Room. Beg.	Room. End.	Prism Box. Beg.	Prism Box. End.	Slit Width.	Seeing.	Observer	Remarks.
				1908.	h m	m	h m								
ν Orionis.	1197	I L	Seed 27	Apr. 17	12 50	40	3 55 W	8·6	7·0	11·0	10·9	·0015	Fair	P	
"	1503	"	"	" 22	13 11	18	4 32 W	10·5	9·0	14·0	14·0	"	"	H	
"	1916	"	"	Oct. 2	22 35	19	0 41 E	3·3	3·3	13·0	13·0	"	…	C	
"	1943	"	"	" 19	23 00	65	0 20 W	5·0	5·0	16·2	16·2	"	Very poor	H	
"	2009	"	"	Dec. 7	20 23	40	2 45 W	−9·5	−9·5	−0·8	−0·8	"	…	H	Windy.
"	2010	"	"	" "	21 00	31	3 15 W	"	"	"	"	"	Hazy	H	
"	2019	"	"	" 9	20 51	32	3 20 W	−20·0	−20·0	−2·0	−2·0	"	Fair	C	
"	2020	"	"	" "	21 33	43	4 03 W	"	"	−2·0	−2·4	"	"	C	
"	2025	"	"	" 10	16 02	55	1 15 E	−17·5	−17·5	−7·9	−7·8	"	…	P¹	Cloudy.
"	2034	"	"	" 16	19 42	45	2 42 W	−10·5	−10·8	2·8	2·8	"	Good	C	
"	2035	"	"	" "	20 28	44	3 27 W	−10·8	−11·6	2·8	2·7	"	"	C	
"	2061	"	"	" 21	20 21	38	3 35 W	−13·8	−14·5	−2·0	−2·0	"	"	C	
				1909											
"	2133	"	"	Jan. 13	18 51	72	3 55 W	−15·0	−16·4	−12·2	−12·2	·0016	Hazy	C H	Off 15ᵐ
"	2147	"	"	" 15	18 49	45	3 50 W	−17·6	−18·5	−5·5	−5·5	"	Good	P¹	Off 15ᵐ
"	2230	"	"	Feb. 3	16 53	67	3 17 W	−12·0	−13·5	−3·7	−3·9	"	"	H	Off 20ᵐ
"	2257	"	"	" 8	17 11	58	3 55 W	−16·6	−16·0	−5·6	−5·3	"		P¹	
"	2339	I	"	Mar. 8	16 54	42	5 15 W	−4·0	−5·4	3·2	3·0	·002	Good	P¹	
"	2380	"	"	" 15	16 36	42	5 30 W	−4·0	−4·2	0·5	−0·4	"	Fair	P¹	Changed relay cells.
"	2410	"	"	" 22	16 10	20	5 25 W	−0·2	0·0	5·5	5·5	"	Hazy	P¹	
"	2428	"	"	" 23	15 47	54	5 15 W	0·5	0·0	7·6	7·6	"		C	Off 10ᵐ
"	2446	"	"	" 31	15 00	50	4 55 W	5·0	6·0	10·0	10·0	"		H	
"	2524	"	"	Apr. 28	13 18	60	5 06 W	3·0	3·0	8·9	8·9	"	Good	H	
"	2781	"	"	Sept. 7	21 27	16	2 00 E	8·5	8·0	11·6	11·7	"	5	P¹	"Seeing" in future rated from 0 to 5.
"	2808	"	"	" 20	21 10	40	1 35 E	11·6	11·6	20·0	20·0	"	5	C	
"	2809	"	"	" "	21 53	13	0 51 E	11·6	11·5	"	"	"	5	C	
"	2831	"	"	" 28	21 16	40	1 00 E	7·5	6·6	10·8	10·8	"	1·5	C	
"	2832	"	"	" "	21 58	43	0 15 E	6·6	6·3	10·8	10·7	"	1	C	
"	2844	"	"	Oct. 4	19 29	41	2 07 E	11·0	11·0	22·9	22·7	"	5	H	
"	2876	"	"	" 8	20 17	33	1 15 E	12·7	12·1	22·7	22·7	"	5	P¹	
"	2877	"	"	" "	20 52	35	0 45 E	12·1	11·8	"	"	"	5	P¹	

"	..	2898	"	"	"	19	22	47	25	1	46 W	2·0	1·6	7·9	7·9	"	5	C	
"	..	2907	"	"	"	20	20	04	82	0	05 W	− 0·1	− 0·2	6·8	6·8	"	1–1–5	C	
"	..	2908	"	"	"	"	21	36	39	0	45 W	− 0·2	− 0·2	"	"	"	5	C	
"	..	2927	"	"	"	29	20	45	50	0	40 W	− 1·1	− 1·5	5·5	5·6	·0017	4	P1	
"	..	2928	"	"	"	"	21	36	48	1	25 W	− 1·5	− 1·8	5·6	5·6	"	5	P1	
"	..	2939	"	"	Nov.	8	22	50	50	3	20 W	1·5	1·5	5·7	5·7	·002	5	H	
"	..	2942	"	"	"	9	21	10	40	1	40 W	− 0·5	− 1·2	0·6	0·4	"	2–0	C	
"	..	2948	"	"	"	12	18	29	51	0	45 E	7·5	7·1	15·6	15·6	"	5	P1	
"	..	2949	"	"	"	"	19	33	73	0	25 W	7·1	6·2	"	"	"	5–1–3	P1	
"	..	2957	"	"	"	15	19	39	48	0	40 W	2·0	1·5	15·7	15·8	"	5	P1	
"	..	2958	"	"	"	"	20	30	50	1	30 W	1·5	0·6	15·8	15·9	"	5	P1	
"	..	2969	"	"	"	23	18	42	45	0	10 W	− 7·5	− 8·0	4·1	3·6	"	5	H	
"	..	2970	"	Seed 23	"	"	19	41	71	1	22 W	− 8·0	− 9·0	3·6	3·6	"	5	H	
"	..	2977	"	Seed 27	"	26	15	45	44	2	35 E	1·0	1·0	6·5	6·4	"	5	H	
"	..	2978	"	"	"	"	16	40	43	1	40 E	1·0	0·5	6·4	6·4	"	5	H	
"	..	2986	"	"	"	30	21	00	40	2	55 W	− 3·8	− 3·5	4·2	4·2	"	....	C	Clouds after 10m.
"	..	2998	"	"	Dec.	1	16	17	35	1	50 E	0·0	− 0·5	6·6	6·6	"	4	P	
"	..	2999	"	"	"	"	16	50	29	1	20 E	− 0·5	− 0·9	"	"	"	4	P	
					1910														
"	..	3094	"	"	Jan.	10	15	20	55	0	00	−15·0	−16·5	− 3·8	− 3·6	"	2–0	H	
"	..	3099	"	"	"	12	14	26	37	1	05 E	− 8·0	− 8·5	− 3·2	− 3·2	"	4–0	P1	
"	..	3100	"	"	"	13	16	10	40	0	55 W	− 7·0	− 9·0	− 0·2	− 0·2	"	3–4	P	
"	..	3101	"	"	"	"	17	00	56	1	50 W	− 9·0	−10·2	"	"	"	2–3–4	P	
"	..	3143	"	"	"	25	19	02	45	4	35 W	− 6·8	− 7·1	− 3·2	− 3·3	"	4–3	P	
"	..	3159	"	"	"	31	15	15	40	1	10 W	− 8·3	− 8·8	1·7	1·7	"	4–5	C	
"	..	3160	"	"	"	"	16	03	54	2	15 W	− 8·8	− 9·0	1·7	1·8	"	4–5	C	Off 15m
"	..	3203	"	"	Feb.	21	14	48	40	2	05 W	− 4·0	− 4·6	3·2	3·0	"	4–5	C	
"	..	3319	"	"	Mar.	11	13	34	42	2	03 W	2·0	1·5	6·0	6·0	"	5	H	
"	..	3320	"	"	"	"	14	18	43	2	50 W	1·5	1·0	"	"	"	5	H	
"	..	3351	"	"	"	16	14	30	50	3	25 W	− 6·0	− 7·5	4·2	4·0	"	4	P1	Windy.
"	..	3352	"	"	"	"	15	21	48	4	15 W	− 7·5	− 9·0	4·0	4·0	"	4	P1	
"	..	3356	"	"	"	23	15	07	66	4	30 W	3·5	2·6	9·0	9·0	"	1–0–3	P1	
"	..	3361	"	"	"	28	14	05	40	3	45 W	13·8	12·7	19·0	19·8	"	4	C	
"	..	3362	"	"	"	"	14	48	44	4	30 W	12·7	11·6	19·8	19·5	"	4	C	
"	..	3369	"	Seed 23	Apr.	1	13	12	100	3	32 W	10·0	8·5	14·5	14·3	"	2	H	
"	..	3370	"	Seed 27	"	2	12	35	40	2	30 W	11·8	11·0	15·2	15·2	"	4	P	
"	..	3373	"	"	"	3	12	30	45	2	30 W	8·5	7·5	10·4	10·3	"	4	H	
"	..	3374	"	"	"	"	13	17	45	3	18 W	7·5	6·7	10·3	10·1	"	5	H	
"	..	3390	"	"	"	13	13	40	60	4	30 W	8·5	7·6	10·0	10·0	"	3	P1	
"	..	3401	"	"	"	22	13	11	55	4	33 W	18·0	15·5	19·2	18·8	"	3–4	H	Windy.
"	..	3404	"	"	"	25	13	25	50	4	55 W	16·7	16·1	17·3	17·2	"	2	C	
"	..	3653	"	"	Sept.	14	22	01	30	1	15 E	8·8	8·6	16·7	16·7	"	4–5	C	
"	..	3670	"	"	"	16	21	00	40	2	00 E	10·2	10·3	20·2	20·0	"	4	P1	
"	..	3671	"	"	"	"	21	46	48	1	10 E	10·3	10·5	20·0	20·0	"	4–3	P1	
"	..	3688	"	"	"	21	21	47	46	0	55 E	4·8	4·8	16·5	16·7	"	4–5	C	

RECORD OF SPECTROGRAMS—(Concluded).

P—Plaskett.
H—Harper.
P^1—Parker.
C—Cannon.

Star.	No. of Neg.	Camera	Plate.	Date.	Middle of Exposure G.M.T.	Duration	Hour Angle at End.	Temperature. Room. Beg.	Temperature. Room. End.	Temperature. Prism Box. Beg.	Temperature. Prism Box. End.	Slit Width.	Seeing.	Observer	Remarks.
				1910	h m	m	h m								
ν Orionis.	3703	I	Seed 27	Sept. 28	21 05	50	1 06 E	7·5	6·6	17·8	17·9	·002	3-4	C	
" ..	3704	"	"	" "	21 56	50	0 17 E	6·6	6·4	17·9	"	"	3	C	
" ..	3822	"	"	Dec. 5	20 47	45	3 00 W	−12·3	−13·0	− 2·4	− 2·1	"	3	H	
" ..	3823	"	"	" "	21 40	56	4 05 W	−13·0	−13·5	− 2·4	− 2·1	"	3	H	
" ..	3828	"	"	" 6	21 22	65	3 50 W	−16·7	−17·0	− 5·6	− 5·6	"	4-2	P^1	
" ..	3837	"	"	" 8	17 07	45	0 30 E	−13·0	−15·0	0·3	0·2	"	4-5	H	
" ..	3847	"	Seed 23	" 9	19 47	86	2 40 W	−20·0	−20·8	− 8·1	− 9·0	"	4-5	P^1	
" ..	3865	"	"	" 12	21 29	98	4 38 W	−12·5	−11·5	− 4·7	− 4·9	"	3-4-5	H	
" ..	3878	"	Seed 27	" 16	16 39	55	0 20 E	−16·0	−16·0	− 7·8	− 7·8	"	3-4	H	
" ..	3879	"	"	" "	17 33	50	0 35 W	"	−17·8	"	− 7·7	"	4	H-P^1	
" ..	3890	"	Seed 23	" 21	18 01	90	1 39 W	−16·6	−17·0	− 0·4	− 1·0	"	5	P^1-H	
" ..	3908	"	Seed 27	" 30	18 11	46	2 02 W	−27·5	−26·0	− 8·2	− 8·3	"	5	H	
" ..	3909	"	"	" "	18 58	45	2 50 W	−26·0	−27·2	− 8·3	− 8·5	"	5	H	

DETAILED MEASURES OF ν ORIONIS.

λ	1140W.		1140.		1140.		1160W.		1160		1160.		1184W.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481	....	....	− 7·1	½	....	....	....	....	−24·4	½	+ 0·8	¼	....	....
4471	−32·9	½	−35·1	1	−39·1	¼	− 1·9	1½	0·0	1	....	....	−20·7	1
4388	26·6	1	−25·5	1	−22·7	½	+ 1·2	1	− 7·2	1½	−13·8	½	....	....
4340	10·7	1	− 9·5	1½	−16·8	½	+ 0·6	1	+10·0	1	+ 0·8	½	+13·0	½
4267	....	....	−30·9	½	....	....	....	....	+14·1	¾	....	....	....	....
4143	....	....	....	....	....	....	....	....	+20·2	½	− 2·7	½	....	....
4121	....	....	− 7·3	½	+ 1·1	½	....	....	+ 3·0	1	− 4·0	½	....	....
4101	−13·0	½	+ 5·0	1	+ 4·4	1	− 5·0	½	− 7·2	¾	− 8·1	¼	+ 2·6	½
4026	....	....	−27·1	½	....	....	+11·6	1	− 9·8	1	− 9·8	¼	+ 2·7	1
Weighted Mean	−20·08		−15·00		− 8·95		+ 1·61		− 0·56		− 4·95		− 3·40	
V_a	+19·43		+19·43		+19·43		+14·45		+14·45		+14·45		+ 9·17	
V_d	− ·19		− ·19		− ·19		+ ·02		+ ·02		+ ·02		− ·26	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Vel.	− 1·1		+ 4·0		+10·0		+15·8		+13·6		+ 9·2		+ 5·2	

DETAILED MEASURES OF ν ORIONIS—(Continued).

λ	1184.		1185W.		1185.		1197.		1198.		1217.		1223.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481	....	....	....	....	−19·8	½	....	....	....	....	....	....	....	....
4471	−33·1	1	+ 8·2	1	+ 1·3	½	+ 5·4	1	+ 4·3	1	+32·7	1¼	+36·3	3
4388	−19·7	1	−20·5	½	− 9·1	¾	+17·9	½	− 0·8	½	22·5	2	44·8	1
4340	+ 9·9	1½	− 9·5	1	− 2·7	¾	+13·7	2	+ 8·0	2	32·3	2	38·2	1½
4267	....	....	....	....	+12·9	¼	....	....	....	....	....	....	....	....
4143	....	....	....	....	− 1·6	½	+21·0	1	+45·7	1	20·4	2	20·5	½
4121	....	....	....	....	− 1·5	1	....	....	....	....	35·8	½	....	....
4101	+ 9·5	1	−12·5	½	....	....	+39·6	½	+ 9·3	1	22·3	1½	24·2	1
4026	+ 1·3	1	− 2·7	1	− 5·3	1¼	+11·2	½	+37·4	1½	+14·8	1½	+37·6	1½
Weighted Mean	− 4·94		− 5·12		− 4·34		+16·03		+18·72		+24·64		+35·51	
V_a	+ 9·17		+ 9·17		+ 9·17		− 3·12		− 3·12		− 6·12		−11·25	
V_d	− ·26		− ·29		− ·29		− ·06		− ·12		− ·12		− ·20	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Vel.	+ 3·7		+ 3·5		+ 4·3		+12·6		+15·2		+18·1		+23·8	

DETAILED MEASURES OF ν ORIONIS—(Continued).

λ	1224.		1229.		1235.		1250.		1251.		1261.		1273.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481					+32·8	½	+52·7	½			+39·5	½	+68·4	½
4471	+43·5	1½	+47·2	½	34·4	2	62·3	2½	+60·8	½	61·8	3	73·6	2
4388	47·3	1½	32·4	1	32·6	1	49·1	1	45·5	½	63·7	1½	61·6	1½
4340	32·4	1	57·8	½	32·9	1	51·9	2	57·2	½	38·3	1½	44·8	2
4267									45·0	1			55·8	1
4143	48·1	½	27·2	½	54·8	½	53·0	1	49·7	½			61·2	1½
4121	+39·2	½			48·2	1	43·1	1½	26·8	½	52·3	½	53·0	1½
4101							26·8	½	61·9	½	39·5	½	47·9	½
4026			+45·3	½	+19·9	1	+64·6	½	+64·6	¾	+49·8	1	+41·8	1
Weighted Mean	+42·45		+40·38		+35·16		+52·51		+51·43		+53·40		+57·94	
V_a	−11·25		−11·75		−12·56		−14·50		−14·50		−15·43		−16·30	
V_d	− ·28		− ·28		+ ·19		− ·15		− ·18		− ·26		+ ·06	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	+30·6		+28·1		+22·5		+37·6		+36·5		+37·4		+41·4	

DETAILED MEASURES OF ν ORIONIS—(Continued).

λ	1282.		1282.		1302.		1303.		1314.		1314.		1315.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt	Vel.	Wt.	Vel.	Wt
4481	+80·6	½			+67·1	1	+75·6	1½						
4471	72·0	1½	+66·0	½	69·5	1½	69·5	1½	+85·8	2	+83·7	1½	+170·5	1
4388	82·1	1	78·1	¾	67·0	1	75·4	1½	90·7	½	98·5	¾	167·4	¼
4340	59·6	2	60·9	¾	72·2	1½	86·9	1½	111·7	1	119·5	1	166·7	1½
4267	65·5	1	79·1	½			85·7	1	71·0	½	81·3	½		
4143	78·7	½	56·0	¼	65·5	1½	69·6	1	74·5	½	79·6	½		
4121	83·2	1	73·9	½	64·0	1	101·0	½						
4101	+75·9	½	+60·2	½	83·4	1½	82·7	1	84·5	½	87·4	½	+153·0	½
4026					+62·2	1	+82·2	½	+117·2	½	118·3	¾		
Weighted Mean	+71·95		+68·77		+69·62		+79·07		+91·32		+96·69		+165·83	
V_a	−17·51		−17·51		−18·30		−18·30		−20·30		−20·30		− 20·30	
V_d	+ ·09		+ ·09		− ·09		− ·12		− ·04		− ·04		− ·12	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	+54·2		+51·1		+51·0		+60·4		+70·7		+76·1		+145·0	

DETAILED MEASURES OF ν ORIONIS—(Continued).

λ	1315.		1315.		1315.		1320.		1325.		1325P[1]		1326.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481..........	......	...	......	...	......	...	+86·3	½	+73·7	½	+50·1	1	......	...
4471..........	+179·2	1	+184·4	½	+180·8	¼	69·1	2	45·7	1½	71·5	1	......	...
4388..........	......	...	180·0	⅛	114·4	¼	85·9	2	62·7	2	73·5	1	+31·9	1½
4340..........	130·8	½	128·7	¾	107·1	½	74·4	2	53·2	2	77·1	1	42·8	1½
4267..........	......	...	......	...	......	...	77·1	½	45·9	½	......	...	......	...
4143..........	......	...	......	...	......	...	72·2	1	44·4	1	40·8	1	32·1	1
4121..........	......	...	......	...	......	...	74·2	1	59·7	1	47·3	1	34·4	1
4101..........	154·1	¼	162·4	½	+137·6	½	50·6	½	48·9	1	44·8	1	43·9	1
4026..........	+136·3	¼	+130·2	¼	......	...	+81·7	2	+64·1	1	+68·8	1	+53·6	1½
Weighted Mean......	+158·61		+152·94		+130·78		+76·14		+50·75		+59·24		+40·39	
V_a	− 20·30		− 20·30		− 20·30		−22·16		−24·95		−24·95		−24·95	
V_d	− ·12		− ·12		− ·12		− ·22		− ·17		− ·17		− ·19	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity...	+138·0		+132·0		+110·0		+53·5		+25·3		+33·8		+15·0	

DETAILED MEASURES OF ν ORIONIS—(Continued).

λ	1326.		1335.		1335P[1]		1337.		1348.		1352.		1377.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481..........	......	...	+52·0	1	+52·7	1	+52·5	1	+30·5	1½	+62·6	1	......	...
4471..........	......	...	63·1	2	64·9	1	59·0	1½	64·3	1	60·2	1½	+41·6	1
4388..........	......	...	41·9	1	47·6	1	59·9	1½	65·7	1	44·2	1½	43·3	1
4340..........	+55·3	1	26·8	1½	27·1	1	52·9	1½	70·2	2	61·2	2	30·9	½
4267..........	......	...	55·9	1½	60·3	1	74·9	1	58·0	½	47·4	½	......	...
4143..........	33·2	1¼	48·6	1	46·1	1	49·7	1	76·1	1	40·8	½	64·2	1
4121..........	26·6	¾	65·7	½	......	...	......	...	44·9	1	59·7	½	42·7	½
4101..........	+41·1	1	49·5	1½	49·7	1	48·9	1½	55·8	½	56·7	1¼	64·5	1
4026..........	......	...	+37·8	1	+37·5	1	+62·3	1½	+32·3	1	+39·1	1	+50·5	1
Weighted Mean......	+39·65		+48·88		+48·24		+57·30		+55·40		+53·90		+50·17	
V_a	−24·95		−25·74		−25·74		−26·01		−26·28		−26·82		−28·34	
V_d	− ·19		− ·04		− ·04		− ·25		− ·29		− ·15		− ·15	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity...	+14·2		+22·8		+22·2		+30·8		+28·5		+26·7		+21·4	

DETAILED MEASURES OF ν ORIONIS—(Continued).

λ	1385.		1396.		1485.		1497.		1503.		1916P[1]		1916.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481..........	+36·1	1½	+47·8	½	....		+22·6	½	....		−15·3	1	−17·4	½
4471..........	42·0	1½	41·0	3	....		32·5	1	+26·9	1½	+14·6	1	− 8·1	1
4388..........	44·3	2	50·8	2	+52·9	¾	42·4	1½	....		+ 9·1	½	− 6·9	½
4340..........	54·6	1½	32·4	2	34·4	½	35·6	1½	....		− 1·2	½	− 6·7	½
4267..........	42·7	1	57·4	2	+37·5	¼	49·4	½	+23·7	1½	....		....	
4143..........	34·5	1	25·0	1	....		34·1	1½	....		....		+ 8·6	¼
4121..........	28·0	½	46·0	1½	....		....		....		....		+ 1·2	¼
4101..........	29·0	1	18·0	1½	....		36·5	2	....		−28·4	½	....	
4026..........	+47·8	1½	+44·8	2	....		+33·7	1½	....		−23·5	½	−19·7	1
Weighted Mean......	+41·70		+44·11		+44·20		+36·02		+25·30		− 5·67		−10·24	
V_a	−28·95		−29·43		−26·72		−26·23		−25·03		+28·95		+28·95	
V_d	− ·29		− ·11		− ·28		− ·25		− ·28		+ ·09		+ ·09	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity...	+12·2		+14·3		+16·9		+10·3		−0·03		+23·0		+18·0	

DETAILED MEASURES OF ν ORIONIS—(Continued).

λ	1943.		2009P[1]		2009.		2010.		2019.		2020·		2025.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481..........	....		−26·0	1	....		− 3·2	½	....		....		−23·5	½
4471..........	....		− 9·4	1	+ 4·6	1	− 6·8	½	+ 1·2	1	− 2·0	1	− 0·2	1½
4388..........	+50·2	¾	− 6·5	½	−11·0	1	....		+ 0·2	1	....		− 6·9	1
4340..........	45·2	¼	+15·9	1	− 2·6	1	....		−15·7	½	33·8	¼	+ 3·1	1½
4267..........	....		+ 0·4	½	+ 3·4	1	....		....		10·7	¼	−12·6	2
4143..........	....		+17·3	1	± 0·0	1	....		− 0·5	½	− 0·4	½	−19·7	1
4121..........	+24·7	1	....		+17·1	½	....		....		....		....	
4101..........	....		+24·8	½	+ 8·0	½	....		....		....		−24·8	½
4026..........	....		− 3·3	1	− 6·7	1	....		....		....		−16·3	1
Weighted Mean.......	+36·81		+ 0·60		+0·03		− 5·00		− 2·25		− 5·51		−9·78	
V_a	+26·31		+ 7·31		+7·32		+ 7·32		+ 6·36		+ 6·36		+5·89	
V_d	+ ·03		− ·19		− ·19		− ·22		− ·22		− ·26		+ ·14	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity...	+63·0		+ 7·4		+6·9		+ 2·0		+ 3·6		+ 0·3		−4·0	

DETAILED MEASURES OF ν ORIONIS—(Continued).

λ	2025.		2034.		2034C.		2035.		2035.		2061.		2061.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481..........	......	....	−1·6	½	−3·9	½	−15·7	½	.....	..	−17·9	1	−8·3	½
4471..........	−16·8	½	+9·5	1¼	−8·7	1	−15·3	½	−24·3	½	−4·0	1	−8·8	¾
4388..........	+2·1	½	+5·7	¾	−4·2	½	±0·0	½	−0·8	¾	+15·4	1	+20·4	1
4340..........	±0·0	½	+19·7	1	+19·3	1	−1·4	½	−9·3	½	−0·8	½	.....	...
4267..........	−0·8	½	+6·8	½	+19·6	⅛	.		−9·0	¾	+15·4	½	+11·5	½
4143..........	−14·7	½	−0·4	½	−16·0	⅛	+8·8	½	+3·7	½	−19·6	1	−8·8	1
4121..........	......	....	+12·9	1	+8·4	¼		.	+2·5	½	.....		+9·8	¼
4101..........	.....	...	...	.	. .	.					+21·6	½	. . .	...
4026..........	−18·2	½	+7·8	1	+9·9	1	.				+14·1	1	+10·2	1
Weighted Mean.......	−8·14		+9·43		+4·22		−4·16		−6·02		+0·94		+4·39	
V_a	+5·89		+2·71		+2·71		+2·71		+2·71		+·09		+·09	
V_d	+·14		−·18		−·18		−·22		−·22		−·23		−·23	
Curv.	−·28		−·28		−·28		−·28		−·28		−·28		−·28	
Radial Velocity...	−2·4		+11·3		+6·5		−1·9		−3·8		+0·5		+4·0	

DETAILED MEASURES OF ν ORIONIS—(Continued).

λ	2133.		2147.		2230.		2257.		2339.		2380.		2410	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481..........	+19·0	1	...		+27·7	½	+54·7	½	+81·4	½	+75·1	¼	+38·5	1
4471..........	25·4	1½	+17·1	1	19·5	1½	35·8	2	74·4	1	69·2	1½	40·0	½
4388..........	23·6	2	+7·7	½	21·3	1	38·5	1½	91·2	2	61·4	1	53·3	½
4340..........	24·1	1½	+35·0	½	18·6	1½	55·2	½	84·3	1	72·1	¾	76·2	½
4267..........	......	....	....	..	34·9	1	55·4	½	79·3	2	75·1	½	+77·7	1½
4143..........	22·3	1¼	......		43·8	1	57·2	½	80·8	1½	60·0	½	.....	..
4121..........	19·4	1	....	...	31·0	1	. .	.	+68·4	1	...	.....	.....	.
4101..........	26·4	½	......	...	31·7	½	+36·3	½			. .	.	...	.
4026..........	+17·1	1	.....	.	+45·9	1	......	.			+47·5	½	....	..
Weighted Mean.......	+22·36		+19·25		+32·97		+43·12		+81·11		+65·87		+59·94	
V_a	−11·60		−12·54		−20·64		−21·89		−28·81		−29·38		−29·38	
V_d	−·23		−·25		−·20		−·25		−·30		−·31		−·31	
Curv.	−·28		−·28		−·28		−·28		−·28		−·28		−·28	
Radial Velocity...	+10·3		+6·2		+11·8		+20·7		+51·7		+35·9		+30·0	

DETAILED MEASURES OF ν ORIONIS—(Continued).

λ	2428.		2446.		2524.		2781.		2808.		2809.		2831.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481	+53·9	1	+37·4	¾	....	....	−9·8	½	−23·6	½	−22·9	½	....	....
4471	67·1	1½	32·3	¾	+33·1	2	13·3	1½	16·2	1½	19·0	1½	−3·9	1
4388	55·8	1½	60·7	1	54·7	1½	7·3	1½	20·4	1	23·5	1	22·1	1½
4340	41·3	1½	50·4	1½	39·3	2	6·9	½	34·0	½	21·3	1½	22·7	1
4267	67·9	2	66·7	2	31·8	1½	....	....	....	....	11·8	½	31·1	1½
4143	45·8	½	52·4	1	35·9	1	5·6	1½	20·3	½	44·5	½	6·1	½
4121	70·6	½	61·6	1½	....	....	26·2	1	−14·9	½	14·2	½	30·1	¾
4101	....	....	68·3	1	20·5	½	−26·6	1½	....	....	....	....	10·9	¾
4026	+64·2	1	+38·0	1½	+26·8	1	....	....	....	....	−35·3	½	−21·6	1
Weighted Mean	+61·01		+53·83		+36·55		−14·22		−20·25		−22·04		−20·23	
V_a	−29·49		−29·05		−23·40		+28·28		+29·39		+29·39		+29·22	
V_d	− ·30		− ·29		− ·30		+ ·17		+ ·15		+ ·10		+ ·11	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	+30·9		+24·2		+12·6		+14·0		+9·0		+7·1		+8·8	

DETAILED MEASURES OF ν ORIONIS—(Continued).

λ	2832.		2844.		2876.		2877.		2898.		2907.		2908.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481	....	....	−31·8	¾	....	....	−28·4	1	−8·4	1	−34·3	½	−6·4	1
4471	−4·6	1	28·1	1	−31·6	1½	50·6	1	3·9	1½	−40·1	½	6·1	1
4388	26·4	1	26·9	1	22·6	1	24·1	1	0·2	½	−23·1	1½	1·2	1½
4340	21·2	1	24·2	1½	9·2	1	22·3	1	7·3	1	−27·0	1½	6·9	2
4267	....	....	10·9	1½	14·8	½	23·2	1	....	....	+1·1	1	0·4	1
4143	1·8	½	11·4	1	....	....	21·7	½	0·0	1	−10·0	1	7·1	1
4121	23·5	½	38·0	½	28·7	1	20·3	1	....	....	+3·5	1	....	....
4101	21·6	¾	−33·0	½	....	....	....	....	....	....	−1·7	½	3·6	1
4026	−26·0	1¼	....	....	−30·4	1	−36·0	½	−16·3	1	−20·7	1	−13·0	1
Weighted Mean	−18·92		−23·08		−24·27		−28·23		−6·32		−16·39		−5·49	
V_a	+29·22		+28·74		+28·35		+28·35		+26·35		+26·17		+26·17	
V_d	+ ·04		+ ·19		+ ·12		+ ·07		− ·12		+ ·02		+ ·04	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	+10·1		+5·6		+3·9		+0·1		+19·6		+9·5		+20·4	

DETAILED MEASURES OF ν ORIONIS—(Continued).

λ	2927.		2928.		2939.		2942.		2948.		2949.		2957.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481..........	.....	.....	+ 0·4	1½	+32·9	½	+39·1	¼	.....	.....	+23·7	1½	+26·5	¾
4471..........	−10·0	2	− 1·0	1	14·8	1¾	11·7	½	+27·0	1½	43·8	1½	49·7	1
4388..........	− 4·1	1½	+ 2·4	1	14·0	1	15·7	½	54·3	1½	12·6	1½	36·4	1
4340..........	− 9·0	1½	+ 2·3	1½	18·9	1	46·6	¼	47·2	1½	44·4	1½	66·0	1
4267..........	−23·8	1	.....	.....	19·1	1	.....	.....	41·4	1	30·1	1½	42·8	¾
4143..........	−11·4	1½	− 5·0	1	19·9	1	+37·7	½	37·0	1	25·8	1	60·0	1
4121..........	+ 4·9	1	−14·9	1½	10·4	¾	.....	.....	22·4	1	30·1	1½	52·9	½
4101..........	−12·2	1	− 4·5	1	29·8	½	.....	.....	24·9	½	22·1	½	46·3	¾
4026..........	+ 3·6	1½	+ 2·8	1	+28·0	¼	.....	.....	+22·5	1½	+33·3	1½	+25·4	¼
Weighted Mean......	− 7·50		− 2·48		+18·57		+27·00		+35·76		+30·32		+47·37	
V_a	+23·78		+23·78		+20·38		+20·04		+18·91		+18·91		+17·71	
V_d	− ·02		− ·09		− ·22		− ·11		+ ·10		+ ·02		− ·02	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity.	+16·0		+20·9		+38·4		+47·0		+54·5		+49·0		+64·8	

DETAILED MEASURES OF ν ORIONIS—(Continued).

λ	2958.		3404		2970.		2977.		2978.		2986.		2998.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481..........	+33·5	½	+50·7	1¼	+60·3	¾	+39·5	½	+38·2	¾	.....	.....	+7·9	½
4471..........	31·2	1½	48·9	1¼	45·5	1½	.....	.....	46·6	1	+52·4	½	3·7	¾
4388..........	35·1	¾	63·1	1	66·3	1	54·7	½	32·4	1	37·0	¾	14·2	1
4340..........	49·7	1½	80·4	1	68·4	1½	46·9	1¼	48·1	1½	20·2	¼	26·7	¾
4267..........	49·4	1	55·2	1½	60·8	1	60·9	½	.....	.....	+35·1	½	23·1	1½
4143..........	50·3	¾	68·4	1	54·7	1¼	46·3	1	51·4	1	.....	.....	16·6	1⅓
4121..........	.....	.....	41·6	1	+57·4	1	43·8	1	41·8	1	.....	.....	10·2	½
4101..........	26·7	½	.....	.....	.....	.....	53·2	1	36·5	1	.....	.....	.....	.....
4026..........	+70·1	½	+67·0	1½	.....	.....	+41·0	1	+48·2	¾	.....	.....	+18·1	1½
Weighted Mean.......	+42·92		+59·10		+58·62		+47·48		+43·21		+38·29		+16·58	
V_a	+17·71		+14·23		+14·23		+12·82		+12·82		+10·97		+10·51	
V_d	− ·09		+ ·02		− ·06		+ ·17		+ ·10		− ·18		+ ·14	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity...	+60·3		+73·1		+72·5		+60·2		+55·8		+48·8		+27·0	

DETAILED MEASURES OF ν ORIONIS—(Continued).

λ	2999. Vel.	Wt.	3094. Vel.	Wt.	3099. Vel.	Wt.	3100. Vel.	Wt.	3101. Vel.	Wt.	3143. Vel.	Wt.	3159. Vel.	Wt.
4481											+39·3	½		
4471	+31·8	1	+12·2	1	+26·0	¼			+11·8	¾	27·5	¾	+29·6	½
4388	19·6	1½	11·8	1½	17·2	¾	+14·6	½	24·4	½	22·5	½	31·9	½
4340	16·9	1	17·2	½	24·0	½	13·5	½	10·3	1	18·7	1	23·1	¾
4267	3·0	¾	5·5	1	+18·5	½	27·9	1	17·5	1½	24·1	½	37·3	1
4143			+15·3	½			+27·3	½	2·8	¾	12·7	1	22·1	¾
4121	39·0	¾							18·8	1	22·9	¾	+49·8	½
4101	29·3	¾												
4026	+ 7·3	1½							+20·0	½	+17·4	½		
Weighted Mean	+19·64		+11·49		+21·10		+22·24		+14·42		+21·97		+31·73	
V_a	+10·51		− 9·95		−10·91		−11·43		−11·43		−16·97		−19·37	
V_d	+ ·11		+ ·04		+ ·12		− ·04		− ·11		− ·28		− ·06	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	+30·0		+ 1·3		+10·0		+10·5		+ 2·6		+ 4·4		+12·0	

DETAILED MEASURES OF ν ORIONIS—(Continued).

λ	3160. Vel.	Wt.	3203. Vel.	Wt.	3319. Vel.	Wt.	3320. Vel.	Wt.	2898. Vel.	Wt.	3352. Vel.	Wt.	3356. Vel.	Wt.
4481					+57·4	½			+76·5	½	+49·5	¼	+67·6	¼
4471	+37·1	¾	+52·7	1	66·0	¾	+35·9	1	53·0	1	60·1	1¼	51·1	¾
4388	33·9	½			60·1	1	43·1	¾	49·9	1½	44·9	1	89·8	½
4340	23·7	1¼	39·8	¾	53·1	1½	35·4	¾	55·0	1¼	62·5	1½	60·6	½
4267			40·6	¼	62·6	1	45·0	¾	52·7	¼	62·9	1		
4143	+ 4·4	½	42·8	1	50·6	1	58·2	½	66·9	1	45·2	½		
4121			43·1	¾	54·3	½								
4101			32·5	1¼	44·3	½	43·0	1	58·9	½	43·4	½		
4026			+49·1	1	+45·2	1	+53·9	1	+58·1	1	+47·5	1	+82·3	½
Weighted Mean	+25·54		+42·92		+54·92		+44·27		+57·50		+54·41		+67·75	
V_a	−19·37		−26·11		−29·00		−26·11		−29·41		−29·41		−29·50	
V_d	− ·13		− ·13		− ·12		− ·18		− ·22		− ·24		− ·24	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	+ 5·8		+16·4		+25·4		+17·7		+27·6		+24·5		+37·7	

DETAILED MEASURES OF ν ORIONIS—(Continued).

λ	3361.		3362.		3369.		3370.		3373.		3374.		3390.	
	Vel.	Wt.	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481..........	+68·8	1	+111·3	1	+131·7	¾	+86·6	¾	+97·0	¾	+98·4	½	......	...
4471..........	90·6	1	107·1	½	101·3	¾	82·9	1¼	98·8	1	89·1	½	+50·0	1½
4388..........	97·3	1	111·1	¾	99·8	1½	90·5	1	99·2	1	104·0	1	......	...
4340..........	116·1	1	77·0	¾	113·8	½	114·7	1	100·7	1	96·5	1	72·1	1
4267..........	......	...	109·4	1	124·0	1	100·1	1¼	109·7	¾	91·9	½	72·8	1
4143..........	125·4	¾	106·7	½	+103·6	¾	88·7	1	63·8	¾	82·6	1	40·6	1
4121..........	+80·4	1	100·0	½	......	...	99·6	½	......	...	103·0	1	54·7	1
4101..........	......	...	121·0	½	......	...	......	...	99·9	½	92·0	1	......	...
4026..........	......	...	+108·6	½	......	...	+107·1	1	+97·8	¾	+90·5	1½	+52·3	½
Weighted Mean......	+ 95·17		+105·65		+111·06		+ 96·04		+ 96·17		+ 94·13		+ 56·90	
V_a	− 29·30		− 29·30		− 28·99		− 28·88		− 28·78		− 28·78		− 27·23	
V_d	− ·24		− ·28		− ·19		− ·16		− ·15		− ·21		− ·28	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity...	+ 65·3		+ 75·8		+ 81·6		+ 66·7		+ 67·0		+ 64·9		+ 29·1	

DETAILED MEASURES OF ν ORIONIS—(Continued).

λ	3401.		3404.		3653.		3670.		3671.		3688.		3703.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481..........	+57·6	½	......	...	......	...	......	...	− 5·7	½	−22·4	¼	......	...
4471..........	31·3	¾	......	...	+ 3·8	½	......	...	32·9	½	6·6	½	......	...
4388..........	43·0	¾	+46·6	¾	− 1·1	½	− 1·5	½	37·6	½	4·2	¾	−20·8	½
4340..........	39·7	1	+47·0	½	−24·9	½	−18·5	½	23·5	1	18·1	1¼	−17·9	½
4267..........	32·0	1	......	...	......	...	−16·3	¼	......	...	17·3	¾	......	...
4143..........	57·8	¾	......	...	−16·6	½	−14·6	¼	17·3	1	......	...	......	...
4121..........	......	...	......	...	− 6·6	½	......	...	......	...	......	...	−12·0	¼
4101..........	......	...	......	...	−20·2	½	......	...	−13·2	½	......	...	+ 4·5	½
4026..........	+32·0	½	......	...	......	...	......	...	......	...	−26·3	½	−15·4	½
Weighted Mean.......	+41·08		+46·72		−10·92		−11·80		−21·38		−11·95		−12·34	
V_a	−25·17		−24·35		+28·99		+29·13		+29·13		+29·32		+29·23	
V_d	− ·28		− ·29		+ ·12		+ ·18		+ ·12		+ ·10		+ ·12	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity...	+15·3		+21·8		+17·9		+17·2		+ 7·6		+17·2		+16·7	

DETAILED MEASURES OF ν ORIONIS—(Continued).

λ	3704.		3822.		3823.		3828.		3837.		3847.		3865.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481..........	......	...	+ 4·5	½	+18·5	½	......	...	......	...	+37·1	½	+34·0	¾
4471..........	−38·2	½	31·7	½	36·0	¾	+12·0	¾	+44·5	¾	44·5	1	56·6	½
4388..........	6·4	¾	23·6	¾	10·5	¾	45·8	¾	47·9	½	28·7	1	51·1	¾
4340..........	11·1	½	......	...	26·2	¾	21·9	[illegible]	33·6	1	45·6	1	38·2	¾
4267..........	29·8	½	17·8	½	47·1	½	23·4	½	38·4	1	36·6	1	72·1	½
4143..........	1·8	½	34·8	¾	+19·9	½	36·1	½	42·1	½	59·3	¾	59·8	[illegible]
4121..........	17·8	¼	31·9	½	......	...	......	...	32·6	¾	45·6	1	+47·1	1
4101..........	......	...	......	...	......	...	50·2	½	35·0	1	42·3	¾	......	...
4026..........	−42·3	½	+14·8	½	......	...	+10·2	½	+28·6	1	+46·8	1	......	...
Weighted Mean.......	−22·57		+24·23		+25·94		+27·82		+36·37		+42·82		+49·75	
V_a	+29·23		+ 8·60		+ 8·60		+ 8·05		+ 7·14		+ 6·57		+ 5·00	
V_d	+ ·06		− ·19		− ·25		− ·23		+ ·07		− ·15		− ·26	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity...	+ 6·4		+32·4		+34·0		+35·4		+43·3		+48·0		+54·2	

DETAILED MEASURES OF ν ORIONIS—(Concluded).

λ	3878.		3879.		3890.		3908.		3909.					
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481..........	+69·2	1	......	...	+96·5	¼	+28·1	½	+ 9·3	¼	......	...	......	...
4471..........	71·3	1	+78·0	½	66·6	¾	17·7	½	38·5	1	......	...	......	...
4388..........	82·7	1	81·0	1	73·8	¾	33·2	¾	36·1	1	......	...	......	...
4340..........	61·8	1	70·3	1	59·0	1	66·5	¾	46·3	1	......	...	......	...
4267..........	84·7	1	76·2	1	86·7	½	60·5	½	32·0	½	......	...	......	...
4143..........	93·2	¼	73·3	½	81·2	¾	29·9	½	......	...	......	...	......	...
4121..........	73·9	½	......	...	74·9	½	36·7	½	31·9	¾	......	...	......	...
4101..........	69·7	¾	89·8	¾	87·9	1	52·4	½	29·8	1	......	...	......	...
4026..........	+76·0	1	+87·2	¾	+57·5	1	+23·5	1	+50·3	½	......	...	......	...
Weighted Mean.......	+74·43		+79·28		+73·16		+38·35		+36·36		....		....	
V_a	+ 3·04		+ 3·04		− 0·09		− 4·30		− 4·30		....		....	
V_d	+ ·06		− ·01		− ·08		− ·13		− ·19		....		....	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		....		....	
Radial Velocity...	+77·5		+82·0		+72·7		+33·6		+31·6		....		....	

The velocities of the 117 plates used in this discussion and other data regarding them is summed up in the following table of measures. The phases are reckoned from the periastron finally adopted, Julian Date 2,417,975.16 and the residuals are scaled to about ±0.2 km. from the curve representing the final elements.

MEASURES OF ν ORIONIS.

Plate.	Julian Date.	Phase.	Vel.	Wt.	O−C.
1140	2,417,891·93	48·03	+ 5·0	4	− 4·4
1160	903·78	59·88	+12·0	3	+ 3·4
1184	914·92	71·02	+ 4·5	5	− 4·3
1185	914·95	71·05	+ 3·9	5	− 4·9
1197	938·73	94·83	+12·6	6	− 0·3
1198	938·75	94·85	+15·2	4	+ 2·3
1217	944·73	100·83	+18·1	6	+ 2·7
1223	954·81	110·91	+23·8	5	+ 1·1
1224	954·84	110·94	+30·6	5	+ 7·9
1229	955·84	111·94	+28·1	3	+ 3·3
1235	957·54	113·64	+22·5	4	− 1·5
1250	961·71	117·81	+37·6	6	+ 4·8
1251	961·73	117·83	+36·5	3	+ 3·7
1261	963·78	119·88	+37·4	5	0·0
1273	965·59	121·69	+41·4	6	− 1·3
1282	968·58	124·68	+52·6	4	− 1·6
1302	970·65	126·75	+51·0	7	−11·5
1303	970·67	126·77	+60·4	6	− 2·1
1314	975·62	0·46	+73·5	4	− 2·7
1320	980·70	5·54	+56·1	7	+ 0·5
1325	989·65	14·49	+29·5	6	+ 0·7
1326	989·66	14·50	+14·7	3	−15·5
1335	992·57	17·41	+22·5	5	− 2·1
1337	993·69	18·53	+30·8	7	+ 7·6
1348	994·72	19·56	+28·5	6	+ 6·2
1352	996·62	21·46	+26·7	6	+ 6·4
1377	2,418,005·68	30·52	+21·4	4	+ 7·0
1385	010·68	35·52	+12·2	6	− 0·1
1396	017·53	42·37	+14·3	6	+ 3·8
1485	047·56	72·40	+16·9	2	+ 8·1
1497	049·53	74·37	+10·3	6	+ 1·4
1503	054·55	79·39	− 0·3	2	− 9·6
1916	217·94	111·52	+20·0	3·5	− 3·4
1943	234·96	128·54	+63·0	1·5	− 7·5
2009	283·85	46·17	+ 7·1	5	− 2·6
2010	283·87	46·19	+ 2·0	1·5	− 7·7
2019	285·87	48·19	+ 3·6	3	− 5·7
2020	285·90	48·22	+ 0·3	2·5	− 9·0
2025	286·67	48·99	− 3·0	3	−12·2
2034	292·82	55·14	+ 8·9	5	0·0
2035	292·85	55·17	− 2·8	4	−11·7
2061	297·85	60·17	+ 2·6	5	− 6·0
2133	320·79	83·11	+10·3	7·5	+ 0·4
2147	322·78	85·10	+ 6·2	2	− 4·1
2230	341·70	104·02	+11·8	6	− 6·2
2257	346·72	109·04	+20·7	6	0·0
2339	374·70	5·76	+51·7	6	− 3·0
2380	381·69	12·75	+35·9	5	+ 3·2
2410	388·67	19·73	+30·0	4	+ 8·0
2428	389·66	20·72	+30·9	6	+ 9·9
2446	397·62	28·68	+24·2	7	+ 9·0
2524	425·55	56·61	+12·6	7	+ 3·8

MEASURES OF ν ORIONIS—(Continued).

Plate.	Julian Date.	Phase.	Vel.	Wt.	O–C.
2781	2,418,557·89	57·69	+14·0	7	+ 5·3
2808	570·88	70·68	+ 9·0	4	+ 0·2
2809	570·91	70·71	+ 7·1	6	− 1·7
2831	578·89	78·69	+ 8·8	8	− 0·4
2832	578·92	78·72	+10·1	7	+ 0·8
2844	584·81	84·61	+ 5·6	6	− 4·6
2876	588·84	88·64	+ 3·9	5	− 6·0
2877	588·87	88·67	+ 0·1	4	−10·8
2898	599·95	99·75	+19·6	5	+ 4·7
2907	600·84	100·64	+ 9·5	6	− 5·7
2908	600·90	100·70	+20·4	8	+ 5·0
2927	609·86	109·66	+16·0	8	− 5·3
2928	609·90	109·70	+20·9	8	− 0·3
2939	619·95	119·75	+38·4	8	+ 1·4
2942	620·88	120·68	+47·0	2	+ 7·1
2948	623·77	123·57	+54·5	7	+ 5·0
2949	623·81	123·61	+49·0	8	− 0·5
2957	626·82	126·62	+64·8	7	+ 2·0
2958	626·85	126·65	+60·3	7	− 2·5
2969	634·78	3·32	+73·1	8	+ 6·1
2970	634·82	3·36	+72·5	7	+ 5·5
2977	637·66	6·20	+60·2	6	+ 7·7
2978	637·69	6·23	+55·8	7	+ 3·3
2986	641·87	10·41	+48·8	2	+10·8
2998	642·68	11·22	+27·0	7	− 8·6
2999	642·70	11·24	+30·0	8	− 5·5
3094	682·64	51·18	+ 1·3	5	− 7·7
3099	684·60	53·14	+10·0	2	+ 1·0
3100	685·67	54·21	+10·5	3	+ 1·6
3101	685·71	54·25	+ 2·6	6	− 6·2
3143	697·79	66·33	+ 4·4	5	− 4·3
3159	703·63	72·17	+12·0	4	+ 3·2
3160	703·67	72·21	+ 5·8	3	− 3·0
3203	724·62	93·16	+16·4	8	+ 4·0
3319	742·57	111·11	+25·4	9	+ 2·3
3320	742·60	111·14	+17·7	7	− 5·4
3351	747·60	116·14	+27·6	7	− 2·2
3352	747·64	116·18	+24·5	8	− 5·3
3356	754·63	123·17	+37·7	3	− 6·7
3361	759·59	128·13	+65·3	7	− 3·7
3362	759·62	128·16	+75·8	6	+ 6·8
3369	763·55	0·83	+81·6	5	+ 6·0
3370	764·52	1·80	+66·7	8	− 6·0
3373	765·52	2·80	+67·0	7	− 2·0
3374	765·55	2·83	+64·9	9	− 4·1
3390	775·57	12·85	+29·1	7	− 3·0
3401	784·55	21·83	+15·3	5	− 4·7
3404	787·56	24·84	+21·8	1	+ 3·0
3653	929·92	35·94	+17·9	3	+ 5·6
3670	931·87	37·89	+17·2	2	+ 5·4
3671	931·91	37·93	+ 7·6	4	− 4·2
3688	936·91	42·93	+17·2	4	+ 6·9
3703	943·88	49·90	+16·7	2	+ 7·5
3704	943·91	49·93	+ 6·4	3	− 2·8
3822	2,419,011·87	117·89	+32·4	4	− 0·6
3823	011·90	117·92	+34·0	4	+ 1·0
3828	012·89	118·91	+35·4	5	+ 0·4
3837	014·71	120·73	+43·3	6	+ 3·3

MEASURES OF ν ORIONIS—(Concluded).

Plate.	Julian Date.	Phase.	Vel.	Wt.	O−C.
3847	2,419,015·82	121·84	+48·0	8	+ 5·0
3865	018·89	124·91	+54·2	4	+ 0·2
3878	022·69	128·71	+77·5	7	+ 5·8
3879	022·73	128·75	+82·0	5	+10·3
3890	027·75	2·51	+72·7	6	+ 1·4
3908	036·76	11·52	+33·6	5	− 1·4
3909	036·79	11·55	+31·6	6	− 3·4

For convenience of reference the early measures of Frost and Adams are appended:—

YERKES MEASURES OF ν ORIONIS.

Date.	Julian Date.	Phase.	Vel.	Residual from Ottawa Curve.
1903. Jan. 22	2,416,137·85	0·33	+81	+4·8
Oct. 31	419·94	19·90	+21	−0·8
Nov. 14	433·90	33·86	+12	−0·8

The first plate was stated to have such broad and fuzzy lines, owing to the dispersion of three prisms used, that the result was considered only a rough approximation. In a personal communication to the writer Professor Frost gives the velocities from the different lines used. These agree among themselves very closely and he suggests that the plate should be given considerable weight, and, no doubt, its result is close to the actual velocity. The period that suits all observations best is that given, viz.: 131.26 days, though possibly the first decimal place is as close as this can be relied on.

With this period the plates were grouped according to phase into fourteen normal places. The weight given to each group was approximately the sum of the weights of the individual plates comprising the group.

NORMAL PLACES

	Mean Phase.	Mean Vel.	Weight.	O−C.	Equation-Ephemeris.
1	2·77	+69·23	5·	− ·28	−·05
2	5·93	55·25	3·	+ ·50	+·10
3	11·75	31·69	4·5	−3·22	+·12
4	18·99	26·21	5·	+3·47	+·05
5	41·55	11·18	7·	+ ·56	−·04
6	56·46	7·99	4·5	− ·65	−·04
7	71·13	7·59	4·5	−1·07	−·06
8	84·52	8·38	5·	−1·83	−·05
9	99·65	15·46	4·5	+ ·68	−·03
10	109·27	21·98	5·5	+ ·82	−·03
11	116·95	30·66	4·5	− ·63	+·01
12	121·63	44·27	6·	+1·73	+·18
13	126·82	61·19	5·	−2·06	+·40
14	130·10	+78·79	2·5	+3·19	+·17

Preliminary elements were obtained by the graphical method of Dr. King,* as follows:—

$$P = 131.26 \text{ days.}$$
$$e = .575$$
$$\omega = 0°$$
$$K = 33 \text{ km.}$$
$$\gamma = +21.53 \text{ km.}$$
$$T = \text{J. D. } 2417974.69.$$

With these elements it was decided to make a least-squares solution. Using the differential form† of Lehmann-Filhés, fourteen observation equations were formed connecting the residuals with the elements γ, K, e, ω and T. The period was considered determined as closely as could be. For sake of homogeneity the following substitutions were made:—

$$x = \delta\gamma$$
$$y = \delta K$$
$$z = K.\delta e = 33\ \delta e$$
$$u = K.\delta\omega = 33\ \delta\omega$$
$$v = \frac{K}{(1-e^2)^{\frac{3}{2}}}.\mu.\delta T = [0.46003]\ \delta T$$

OBSERVATION EQUATIONS FOR ν ORIONIS.

	Weight.	x	y	z	u	v	− n
1	5	1·000	+1·362	− ·395	− ·617	+1·302	−2·76=0
2	3	"	+ ·972	−1·804	− ·918	+1·384	−1·66
3	4·5	"	+ ·415	−1·778	− ·987	+ ·814	+3·52
4	5	"	+ ·046	− ·823	− ·848	+ ·411	−3·18
5	7	"	− ·347	+ ·670	− ·388	+ ·086	−1·09
6	4·5	"	− ·415	+ ·959	− ·138	+ ·026	− ·17
7	4·5	"	− ·420	+ ·981	+ ·095	− ·017	+ ·06
8	5	"	− ·374	+ ·786	+ ·314	− ·065	+ ·79
9	4·5	"	− ·229	+ ·188	+ ·595	− ·172	−1·49
10	5·5	"	− ·022	− ·592	+ ·802	− ·346	−1·19
11	4·5	"	+ ·308	−1·563	+ ·964	− ·691	+1·04
12	6·	"	+ ·670	−2·041	+ ·995	−1·107	− ·64
13	5	"	+1·275	− ·829	+ ·714	−1·405	+2·42
14	2·5	"	+1·564	+ ·916	+ ·148	− ·365	−5·66

These were transformed into the normal equations :—

$$\begin{aligned}
66.500x + 18.304y - 25.698z + 5.476u - 3.667v - 37.475 &= 0\\
33.604y - 30.393z + 1.271u - 1.157v - 22.581 &\\
86.463z - 6.882u + 6.306v - 22.973 &\\
31.941u - 30.289v + 13.267 &\\
38.621v - 26.839 &
\end{aligned}$$

* Astrophysical Journal, Vol. XXVII, p. 125.
† Astronomische Nachrichten 3242.

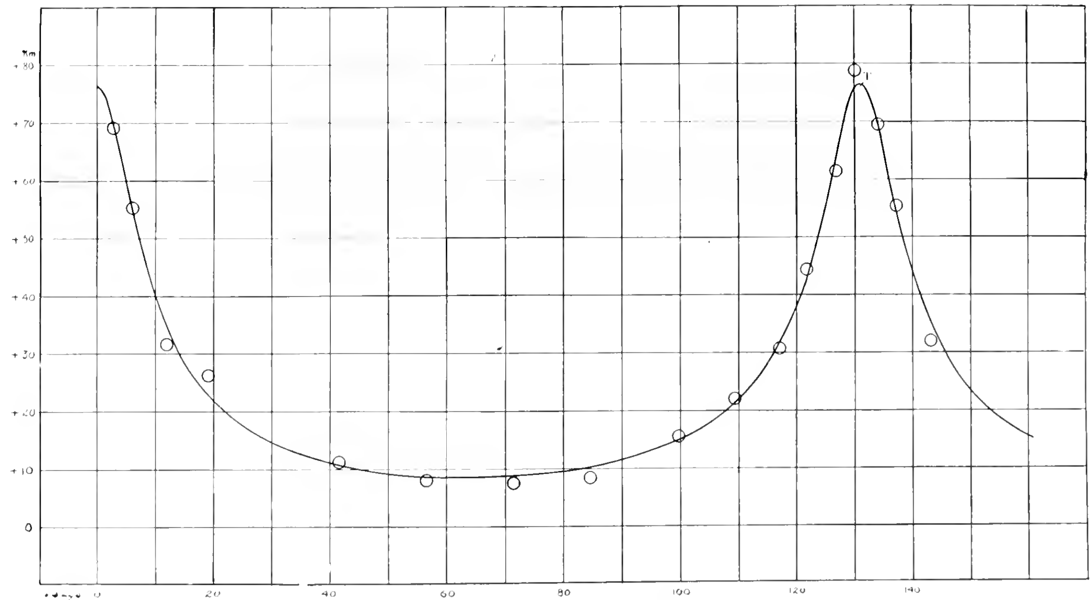


Fig. 5.—Velocity Curve of ν Orionis.

The following corrections resulted:—

$$\delta\gamma = + .57 \text{ km.}$$
$$\delta K = +1.09 \text{ km.}$$
$$\delta e = + .024$$
$$\delta\omega = +1^\circ.58$$
$$\delta T = + .47 \text{ d.}$$

giving as the corrected elements, with their probable errors:—

$$P = 131.26 \text{ days.}$$
$$e = .599 \pm .014$$
$$\omega = 1^\circ.58 \pm 2^\circ.12$$
$$\gamma = + 22.10 \text{ km.} \pm .47 \text{ km.}$$
$$K = 34.09 \text{ km.} \pm .75 \text{ km.}$$
$$T = \text{J.D. } 2417975.16 \pm .38 \text{ days.}$$
$$A = 54.50 \text{ km.}$$
$$B = 13.68 \text{ km.}$$
$$a \sin i = 49{,}270{,}000 \text{ km.}$$

The sum of the squares for the normal places was reduced from 298.5 to 205.9 about 31 per cent. The residuals given in the table of normal places are those from the final elements. The agreement between equation and ephemeris residuals was satisfactory, so that no further solution was necessary.

The probable error of a single observation obtained from columns 5 and 6 of the measures is ±3.47 km. per sec. For this type of spectrum one would expect that this value should be somewhat lower, but remeasurement of many of the plates giving large residuals failed to make any sensible difference in the results. In a few cases as may be noted in the measures, plates made consecutively on the same night differ from each other by 10 to 12 km. per sec., so that the above value was not unexpected.

Quite recently Mr. Jordan*, of the Allegheny Observatory, in discussing the orbit of π Andromedæ calls attention to the large gap between the short and long periods for the helium stars. The star under discussion here furnishes another illustration of the marked increase of eccentricity with period, the value of e being .60 for an orbital period of 131 days.

The curve shown (Fig. 5) represents the corrected values of the elements.

The Spectroscopic Binary 7 Camelopardalis.

This star ($\alpha = 4^h\ 49^m.3$, $\delta = +53^\circ\ 35'$, photographic magnitude about 4.6) was announced as a spectroscopic binary by Campbell and Moore in 1907.† Work was commenced on the star here in December, 1908, and continued till March of the present year, when forty-four spectrograms in all had been secured.

The first eight plates were made with the single-prism instrument as first constructed, linear dispersion at $H\gamma$ being 30.2 tenth-metres per millimetre and

* Publications of the Allegheny Observatory. Vol. II. No. 8.

† Astrophysical Journal, Vol. XXVI, p. 292.

the remaining number with the new instrument whose dispersion at the same region is 33.4 tenth-metres per millimetre. Somewhat over a year ago a solution was made from the thirty-nine plates then secured and elements agreeing very closely with the present ones were obtained. Some slight irregularities in the curve seemed to indicate the presence of a second spectrum and five fine-grained plates have since been made at the crests of the curve for the sole purpose of deciding this question.

On plate 3555, which is weak, the *Mg.* line λ 4481 might be suspected as a double, but none of the other plates show any evidence whatever of the presence of the second spectrum.

This star is of type A2, Harvard classification, and has lines well adapted for measurement. Among the most frequently used were λλ 3933, 4101, 4233, 4340, 4481 and 4549. Many other lines mostly metallic were present, and when measured gave velocities in good agreement with the principal lines.

The wave-lengths of the lines employed in determining the velocities are given in the accompanying table.

LINES USED IN 7 CAMELOPARDALIS.

Element.	Wave-Length.	Element.	Wave-Length.
Fe	4584·018	*Ti*	4300·211
Fe	4549·766	*Fe-Fe*	4271·760
Ti	4534·139	*Fe*	4233·328
Mg	4481·400	*He*	4143·928
Fe	4404·927	*Si*	4128·211
Ti-V-Zr	4395·286	*H*	4101·890
H	4340·634	*Fe*	4045·975
Fe	4308·081	*Ca*	3933·825

The observational data of the plates is contained in the accompanying table which is taken from the regular observing book for spectrographic work, but somewhat abridged. This table is followed by the detailed measures of each plate showing the velocities deduced from each line.

RECORD OF SPECTROGRAMS

P—Plaskett.
H—Harper.
P[1]—Parker.
C—Cannon.

Star.	No. of Neg.	Camera	Plate.	Date.	Middle of Exposure. G.M.T.	Duration	Hour Angle at End.	Temperature Centigrade. Room. Beg.	Room. End.	Prism Box. Beg.	Prism Box. End.	Slit Width in Inches.	Seeing.	Observer	Remarks.
				1908	h m	m	h m								
7 Camelop.	1997	1 L	Seed 27	Dec. 2	15 35	70	0 50 E	− 8·4	− 8·8	− 2·0	− 2·0	·0016	Fair	H	
"	2013	"	"	" 9	14 12	64	1 57 E	−14·0	−13·5	− 1·0	− 1·1	·0015	"	H	
"	2013	"	"	" 18	15 01	60	0 28 E	− 7·8	− 8·0	− 4·3	− 4·6	"	Good	C	
"	2052	"	"	" 21	13 52	65	1 25 E	− 7·2	−10·5	− 1·5	− 1·5	"	"	P[1]	
				1909											
"	2089	"	"	Jan. 6	12 20	60	1 58 E	−10·5	−12·0	− 2·5	− 2·5	"	"	H	
"	2137	"	"	" 15	13 01	60	0 45 E	−13·8	−12·5	− 4·4	− 4·4	·0016	"	C	
"	2222	"	"	Feb. 3	11 32	55	0 57 E	− 5·5	− 6·5	− 3·2	− 3·2	"	"	H	
"	2218	"	"	" 8	12 56	59	0 45 W	−10·5	−13·5	− 5·1	− 5·1	"	Fine	P[1]	
"	2338	1	"	Mar. 8	15 57	55	5 35 W	− 4·0	− 4·0	2·8	3·2	·002	Good	P[1]	Off 10[m]
"	2409	"	"	" 22	15 29	52	6 00 W	4·0	− 0·2	5·6	5·5	"	Fair	P[1]	
"	2507	"	"	Apr. 23	11 47	46	7 25 W	5·5	4·5	10·8	10·8	"	Good	C	
"	2519	"	"	" 26	15 11	68	8 20 W	6·0	5·4	9·4	9·3	"	Fair	P[1]	
"	2835	"	"	Sept. 30	16 24	41	4 45 E	10·1	10·1	14·0	13·9	"	5	P[1]	
"	2843	"	"	Oct. 4	18 37	45	2 00 E	11·0	11·0	23·0	22·9	"	5	H	
"	2856	"	"	" 6	15 38	54	4 40 E	14·6	14·2	20·5	20·4	"	3	P[1]	
"	2872	"	"	" 8	16 58	54	3 18 E	14·5	15·5	22·9	22·8	"	5	H	
"	2909	"	"	" 20	22 05	5	2 12 W	− 0·2	+ 0·5	6·9	6·9	"	1	C	
"	2950	"	"	Nov. 12	20 26	18	2 00 W	6·2	6·0	15·6	15·4	"	1 0	P[1]	
"	2975	"	"	" 26	11 12	56	2 50 E	1·5	1·5	6·6	6·4	"	3	H	Haze.
"	2992	"	"	Dec. 1	13 15	40	3 35 E	1·5	1·0	6·5	6·4	"	1	P	
"	3066	"	"	" 29	15 50	41	0 30 W	−16·5	−16·5	− 8·0	− 8·0	"	3 0	H	
"	3075	"	"	" 30	11 45	60	0 05 E	−11·8	−11·0	− 7·0	− 7·0	"	3 2	P	
"	3080	"	"	" 31	14 40	80	0 00	....	....	....	....	....	2 0	H	
				1910											
"	3093	"	"	Jan. 10	14 17	55	0 10 W	−13·5	−15·0	− 3·7	− 3·8	"	3	H	
"	3098	"	"	" 12	13 27	65	0 30 E	− 6·7	− 8·0	− 3·0	− 3·2	"	1 3 1	P[1]	
"	3111	"	"	" 14	18 27	55	4 35 W	−14·0	−14·5	− 7·8	− 8·8	"	5	H-P[1]	
"	3125	"	"	" 15	19 05	50	5 15 W	−14·0	−14·0	− 9·3	− 9·3	"		P	
"	3138	"	"	" 19	14 51	38	2 10 W	− 4·0	− 4·3	− 0·9	− 0·7	"	1 0	P[1]	
"	3154	"	"	" 28	11 05	67	1 15 W	− 5·6	− 6·5	1·4	1·2	"	4 3 2	C	
"	3157	"	"	" 31	13 00	71	0 15 W	− 6·4	− 7·5	1·6	1·6	"	1 5	C	

P—Plaskett.
H—Harper.
P[1]—Parker.
C—Cannon.

RECORD OF SPECTROGRAMS—(Concluded).

Star.	No. of Neg.	Camera	Plate.	Date.	Middle of Exposure. G.M.T.	Duration	Hour Angle at End.	Temperature Centigrade. Room. Beg.	Room. End.	Prism Box. Beg.	Prism Box. End.	Slit Width in Inches.	Seeing.	Observer	Remarks.
				1910	h m	m	h m								
7 Camelop.	3185	1	Seed 27	Feb. 14	12 08	50	0 10 W	0·4	− 2·0	3·2	2·9	·002	3–4	P	
"	3191	"	"	" 16	14 00	89	2 30 W	−12·4	−11·5	− 4·3	− 4·4	"	3–0	P[1]	
"	3195	"	"	" 18	13 06	47	1 28 W	−10·0	−10·0	− 2·5	− 2·5	"	3–4	H	
"	3204	"	"	" 21	15 46	57	4 25 W	− 4·6	− 6·8	3·0	2·7	"	4–5	C	
"	3207	"	"	" 23	12 30	50	1 20 W	− 9·0	−10·9	− 3·9	− 4·1	"	4	P[1]	
"	3246	"	"	" 28	14 35	50	3 40 W	5·2	3·6	10·4	9·9	"	3–4–5	C	
"	3254	"	"	Mar. 2	13 40	51	2 55 W	4·0	2·9	10·6	10·6	"	4–2–0	P[1]	
"	3295	"	"	" 9	15 29	52	5 10 W	− 4·2	− 4·5	1·4	1·3	"	4	P[1]	
"	3339	"	"	" 18	12 33	53	2 47 W	− 1·0	− 0·5	3·2	3·0	"	1	H	
"	3555	"	"	Aug. 2	20 26	78	4 00 E	17·0	15·5	22·4	22·0	"	4	P[1]	
"	3561	"	Seed 23	" 8	18 57	85	6 08 E	18·0	16·5	26·8	26·2	"	4–5	H	Off 10^m
"	3608	"	"	" 31	21 10	80	1 25 E	13·5	13·0	22·3	22·3	"	4	C	
				1911											
"	4058	"	"	Mar. 6	14 35	90	4 20 W	− 4·0	− 5·5	0·6	0·2	"	4–5	C	
"	4079	"	"	" 8	15 32	105	5 30 W	− 4·2	− 6·4	3·6	3·3	"	4	P[1]	

DETAILED MEASURES OF 7 CAMELOPARDALIS.

λ	1997.		2013.		2043.		2052.		2089.		2137.		2222.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4549			− 5·4	1	+27·6	1	+9·5	½	+31·8	¾				
4481	+14·3	1½	−29·8	½	28·7	1½	0·7	1	57·3	½			+35·6	2
4340	16·8	1¼			28·1	1	15·8	½	35·8	1			57·6	1
4143					25·2	1	9·0	1	28·9	½				
4128							22·8	½	46·0	1				
4101	25·5	¾							33·9	½	+ 6·1	1	47·0	1
4071							7·6	½						
3933	+21·5	1½			+19·7	1	+ 7·7	1½	+32·9	1½	+15·5	1½	+40·7	1
Weighted Mean	+18·77		−13·58		+26·11		+ 8·93		+37·42		+11·74		+43·32	
V_a	+ 3·12		− ·02		− 4·09		− 5·41		−12·20		−15·65		−21·50	
V_d	+ ·08		+ ·12		+ ·05		+ ·10		+ ·12		+ ·04		+ ·08	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	+21·7		−13·8		+21·8		+ 3·3		+25·0		− 4·1		+21·6	

DETAILED MEASURES OF 7 CAMELOPARDALIS—(Continued).

λ	2222. (check)		2248.		2338.		2409.		2507.		2519.		2835.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4549			− 9·7	1	+ 6·8	1	− 9·6	½	−30·4	1	−12·7	½		
4481	+32·4	2	17·3	1½	− 6·1	1½	+11·4	2	−30·6	1¼	+ 8·7	1¼	−43·9	2
4340	55·1	¾	22·9	½	+ 7·9	1	+25·2	1			− 0·9	¼	36·7	1½
4233					+ 8·1	½								
4143			13·2	½										
4101	23·1	¼					+ 7·6	¾						
3933	+42·7	1½	−30·1	½	− 2·4	1	+31·5	½					−47·0	1½
Weighted Mean	+39·09		−17·19		+ 1·21		+13·60		−30·52		+ 2·14		−41·42	
V_a	−21·50		−22·66		−25·72		−24·97		−18·15		−17·19		+23·92	
V_d	+ ·08		− ·01		− ·19		− ·21		− ·19		− ·18		+ ·19	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	+17·4		−40·1		−25·0		−11·9		−49·1		−15·5		−16·6	

DETAILED MEASURES OF 7 CAMELOPARDALIS—(Continued).

λ	2843.		2856.		2872.		2909.		2950.		2950. (check)		2975.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4549	−50.3	½	−40.0	1					−12·9	1	−12·0	1		
4531									22·3	½	23·9	½		
4481	37·1	½	32·3	1½	−36·3	1	+ 9·9	1	2·3	2½	3·3	2½	−23·2	1
4400													42·0	1½
4340	21·3	1			25·7	1			22·7	¼	23·2	¼	33·5	1
4233	45·6	½	31·2	1					−28·8	¼	−25·5	¼	22·3	1
4128					19·2	½								
4101	25·5	½			16·3	1								
4063					30·6	½								
4045					32·9	½							36·8	½
3933	−20·4	1½	−44·4	½	−32·9	2							−36·3	1½
Weighted Mean	−29·15		−35·44		−28·64		+ 9·91		− 9·50		−10·00		−32·17	
V_a	+23·26		+22·92		+22·56		+19·58		+11·69		+11·69		+ 5·92	
V_d	+ ·12		+ ·19		+ ·17		− ·10		− ·13		− ·13		+ ·15	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	− 5·0		−12·6		− 6·1		+29·1		+ 1·8		+ 1·3		−26·4	

DETAILED MEASURES OF 7 CAMELOPARDALIS—(Continued).

λ	2992.		3066.		3075.		3080.		3093.		3098.		3111.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4563									+47·0	½				
4549	−36·7	1			+32·1	1	−16·7	½	34·0	½	−36·0	1	+45·0	½
4534									54·9	½				
4481	36·2	2	+31·5	½	17·5	1½	8·7	¾	22·7	½	26·1	1½	54·1	1½
4352									25·0	¾				
4340	36·2	1	14·6	1	28·9	1			45·9	¾			40·5	1
4300					27·8	½								
4233	24·6	1	41·8	½	49·3	½	−32·1	½	43·9	½	17·8	½		
4101	26·5	½			18·9	1			36·8	½			31·7	½
4045	41·1	½											40·2	½
3933	−43·3	1	+10·6	2	+12·6	2			+39·3	1	−26·0	1	+45·0	2
Weighted Mean	−35·51		+18·13		+22·70		−17·62		+39·03		−25·05		+44·98	
V_a	+ 3·72		− 8·84		− 9·25		− 9·67		−13·71		−14·45		−15·22	
V_d	+ ·18		·00		+ ·03		+ ·03		+ ·01		·00		− ·14	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	−31·9		+ 9·0		+13·2		−27·5		+25·0		−39·8		+29·3	

DETAILED MEASURES OF 7 CAMELOPARDALIS—(Continued).

λ	3125.		3138.		3154.		3157.		3185.		3191.		3195.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4584.........					−31·6	½								
4549.........	−22·7	½	+12·9	1½	31·0	½			+30·7	½	−56·0	½		
4534.........					40·9	¼								
4481.........	− 0·2	1½	0·0	1½	15·9	1¼	− 5·1	1	59·4	1	2·5	1¼	+55·3	1¼
4404.........							+ 8·8	1						
4340.........	+ 5·3	1	9·7	½	32·4	1½	+ 9·3	¾	45·1	1½	15·6	1	40·0	1
4271.........					24·7	½								
4233.........	+ 2·2	1					+ 4·3	½			− 2·7	¼		
4143.........	−19·1	½												
4128.........	+14·6	½												
4101.........	+ 7·1	½							56·3	1			48·1	½
3933.........	− 1·7	2	+ 8·0	½	+13·0	1½	−15·8	1¼	+45·9	2			+49·9	1¼
Weighted Mean.......	− 0·82		+ 7·08		−22·99		− 1·54		+48·44		−15·83		+48·91	
V_a	−15·65		−16·99		−19·83		−20·66		−23·76		−24·06		−21·36	
V_d	− ·15		− ·07		− ·03		− ·01		+ ·01		− ·07		− ·05	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity...	−16·9		−10·3		−43·1		−22·5		+24·4		−40·2		+24·2	

DETAILED MEASURES OF 7 CAMELOPARDALIS—(Continued).

λ	3204.		3207.		3246.		3254.		3295.		3339.		3555.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4563.........											+11·4	½		
4549.........	0·0	½	+ 1·6	½	−17·6	1			+32·0	½	7·6	½		
4481.........	+29·3	¾	23·6	1½	23·6	1	+52·1	1	52·3	1½	51·3	½	−61·8	¼
4395.........													−86·0	¼
4340.........	28·3	1¼	19·8	¾	21·5	1	30·1	½	53·2	1½	33·3	1½		
4308.........									41·5	1				
4233.........			20·4	¾	4·3	½								
4227.........											36·4	½		
4143.........									65·7	¼	29·3	¾		
4128.........											26·8	¾		
4101.........	24·1	1			14·4	¾	50·0	¼			26·4	1		
3933.........	+16·6	1½	+11·6	½	−27·2	1	+49·7	1¼	+58·7	¼	+28·7	2		
Weighted Mean....	+21·29		+18·03		−19·60		+47·29		+47·90		+28·68		−67·89	
V_a	−24·81		−25·11		−25·45		−25·56		−25·72		−25·37		+19·99	
V_d	− ·18		− ·05		− ·15		− ·10		− ·19		− ·11		+ ·19	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity...	− 4·0		− 7·3		−45·5		+21·3		+21·7		+ 2·9		−48·0	

DETAILED MEASURES OF 7 CAMELOPARDALIS—(Concluded).

λ	3561.		3608.		4058.		4079.							
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4584					+54·2	½								
4572	+ 0·1	¼												
4549	− 9·8	¾	− 3·3	½	52·7	1	−19·2	1						
4534							12·4	½						
4481	− 0·1	1½	+ 6·7	1	54·6	1½	−17·5	1½						
4233	+10·0													
4227					52·1	½								
3933					+55·7	1½								
Weighted Mean	− 0·83		+ 3·40		+54·28		−17·21							
V_a	+21·45		+25·00		−25·70		−25·72							
V_d	+ ·21		+ ·10		− ·16		− ·19							
Curv.	− ·28		− ·28		− ·28		− ·28							
Radial Velocity	+20·5		+28·2		+28·1		−43·4							

The following table contains a summary of the measures. The phases are reckoned from periastron passage J. D. 2,418,281.176 using the period 3.8846 days. The residuals in the last column are scaled from the curve representing the final elements.

MEASURES OF 7 CAMELOPARDALIS

Plate.	Julian Date.	Phase.	Vel.	Number of lines.	Weight.	O−C.
1997	2,418,278·649	1·358	+21·7	5	4	−2·9
2013	285·591	·530	−13·8	2	1	−2·8
2043	294·628	1·798	+21·8	5	5	−0·7
2052	297·578	·864	+ 3·3	7	5	−4·2
2089	313·514	1·261	+25·0	7	6	+2·2
2137	322·542	2·520	− 4·1	2	2	+4·9
2222	341·480	2·035	+19·1	4	5	+3·9
2248	346·539	3·209	−40·1	5	4	+0·4
2338	374·664	·258	−25·0	5	5	+0·5
2409	388·645	2·585	−11·9	5	5	+0·6
2507	420·616	3·479	−49·1	2	2	−4·6
2519	423·633	2·611	−15·5	3	2	−1·3
2835	580·683	·393	−16·6	3	5	+2·2
2843	584·776	·601	− 5·0	6	5	+2·2
2856	586·652	2·477	−12·6	4	4	−6·1
2872	588·707	·648	− 6·1	7	6	−1·6
2909	600·920	1·207	+29·1	1	1	+7·8
2950	623·851	·830	+ 1·5	5	5	−4·5
2975	637·591	2·916	−26·4	6	6	+3·6
2992	642·552	·108	−31·9	7	7	+0·6
3066	670·660	1·024	+ 9·0	4	4	−6·0
3075	671·614	1·978	+13·2	7	7	−3·8
3080	672·611	2·975	−27·5	3	2	+5·0
3093	682·595	1·305	+25·0	9	5	+1·2
3098	684·561	3·271	−39·8	4	4	+2·3

MEASURES OF 7 CAMELOPARDALIS—(Concluded).

Plate.	Julian Date.	Phase.	Vel.	Number of lines.	Weight.	O—C.
3111	2,418,686·769	1·595	+29·3	7	7	+3·7
3125	687·795	2·621	−16·9	8	7	−2·4
3138	691·619	2·560	−10·3	4	4	+0·7
3154	700·586	3·758	−43·1	7	6	−2·1
3157	703·542	2·829	−22·5	5	4	+3·7
3185	717·506	1·255	+24·4	5	6	+1·6
3191	719·583	3·332	−40·2	4	3	+2·9
3195	721·546	1·410	+24·2	4	4	−1·0
3204	724·657	·636	− 4·0	5	5	+0·7
3207	726·521	2·500	− 7·3	5	4	+0·7
3246	731·607	3·702	−45·5	6	5	−3·5
3254	733·570	1·780	+21·3	4	3	−1·9
3295	740·646	1·087	+21·7	6	4	+4·2
3339	749·523	2·194	+ 2·9	9	8	−5·1
3555	886·853	3·564	−48·0	2	1	−3·8
3561	892·790	1·732	+20·5	4	3	−3·2
3608	8,915·882	1·516	+28·2	2	2	+2·2
4058	9,102·607	1·780	+28·1	4	5	+5·1
4079	9,104·647	3·820	−43·4	3	3	−3·9

Through the kindness of Professor Campbell the G. M. T. of the Lick plates were obtained and for completeness those observations are given here.

LICK OBSERVATIONS

Date.	Julian Date.	Phase.	Vel.	O—C.
1902. Nov. 4 ...	2,416,058·987	3·687	−36·5*	+6·0
1903. Dec. 6....	6,455·971	·557	−18·5*	−9·2
1907. Feb. 7....	7,614·721	1·696	+20·5	−4·4
" 27....	7,634·694	2·246	− 3·2	−8·7
Mar. 13....	7,648·724	·738	− 1·8	−2·6
Apr. 22....	7,688·692	1·860	+22·5	+1·5
Aug. 8....	7,796·976	1·375	+23·0	−2·0

There is some uncertainty as to the exact period. Our own observations gave the value 3.885 days, and when the Lick observations were used in conjunction with our own, a period of 3.8848 days was obtained. This satisfied all their observations well, except the second which had a residual of −15 km. As the agreement of the two approximate measures made on this plate seemed to make it trustworthy, it was thought best to equalize the residuals by changing the period to 3.8846 and this is the value here accepted.

The observations were now grouped into sixteen normal places, the weights assigned each group being in general one-tenth of the sum of the weights of the individual plates comprising the group.

* Means of two approximate measures.

NORMAL PLACES

	Mean Phase	Mean Vel.	Wt.	O – C.		Mean Phase	Mean Vel.	Wt.	O—C.
1	·170	–29·02	1·0	+1·29	9	2·002	+15·66	1·0	– ·95
2	·416	–16·13	·5	+1·29	10	2·194	+ 2·90	·5	–5·45
3	·630	– 5·10	1·5	+ ·03	11	2·495	– 8·78	1·0	–1·20
4	·847	+ 2·10	·8	–4·31	12	2·581	–11·97	1·0	+ ·42
5	1·055	+15·35	·7	– ·80	13	2·697	–18·94	·9	– ·15
6	1·268	+25·03	2·0	+2·22	14	2·931	–26·67	·6	+3·90
7	1·486	+26·19	2·0	+ ·42	15	3·311	–41·25	1·5	+1·61
8	1·777	+23·13	2·0	+ ·17	16	3·717	–44·65	1·5	–2·59

Preliminary values of the elements were obtained by Dr. King's graphical method, and then a least-squares solution was made. As the eccentricity was small the time of periastron passage was taken as fixed and a value of ω assumed, so that only the four elements γ, K, e and ω entered into the solution.

For the sake of homogeneity, the following substitutions were made:—

$$
\begin{aligned}
x &= \delta\gamma \\
y &= \delta K \\
z &= K.\delta e = 35.\delta e \\
u &= K.\delta\omega = 35.\delta\omega
\end{aligned}
$$

OBSERVATION EQUATIONS FOR 7 CAMELOPARDALIS.

	Weight.	x	y	z	u	$-n$
1	1·0	1·000	–·585	–·343	+ ·811	– ·65=0
2	·5	"	–·225	+·431	+ ·975	– ·94
3	1·5	"	+·119	+·908	+ ·963	+ ·06
4	·8	"	+·453	+·964	+ ·891	+4·25
5	·7	"	+·722	+·588	+ ·692	+ ·72
6	2·0	"	+·913	–·061	+ ·407	–2·27
7	2·0	"	+·998	–·693	+ ·067	– ·47
8	2·0	"	+·920	–·991	– ·393	– ·44
9	1·0	"	+·719	–·649	– ·695	+ ·31
10	·5	"	+·473	–·085	– ·881	+4·45
11	1·0	"	+·006	+·776	–1·000	– ·22
12	1·0	"	–·133	+·919	– ·991	–1·88
13	·9	"	–·315	+·999	– ·949	–1·30
14	·6	"	–·644	+·747	– ·765	–5·07
15	1·5	"	–·967	–·376	– ·254	–1·80
16	1·5	"	–·921	–·991	+ ·389	+3·21

whence the normal equations:—

$$
\begin{array}{rrrrr}
18.500x + 3.338y & - \ .773z & - \ .091u & - 5.148 & = 0 \\
9.927y & - 1.617z & + \ .232u & - 1.471 & \\
 & 10.151z & + \ .063u & - 4.003 & \\
 & & 8.569u & + 6.821 &
\end{array}
$$

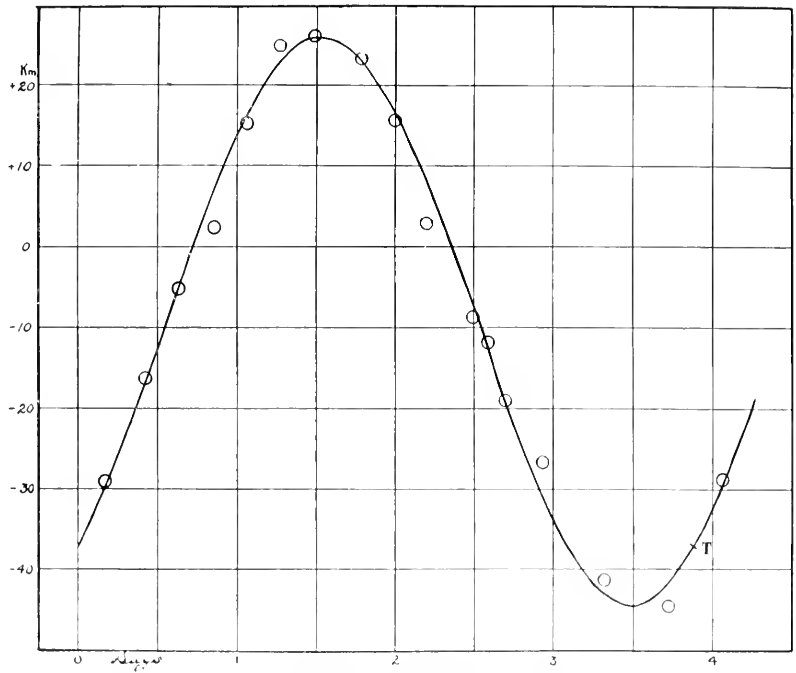


FIG. 6.—Velocity Curve of 7 Camelopardalis.

The following corrections resulted:—

$$\begin{aligned} \delta\gamma &= +\ \ .27 \text{ km.} \\ \delta K &= +\ \ .15 \text{ "} \\ \delta e &= +\ .013 \\ \delta\omega &= -1^\circ.31 \end{aligned}$$

so that the final values with their probable errors are the following:—

$$\begin{aligned} P &= 3.8846 \text{ days} \\ e &= .013 \pm .020 \\ \omega &= 217^\circ.14 \pm 1^\circ.20 \\ K &= 35.15 \text{ km.} \pm .72 \text{ km.} \\ \gamma &= -8.93 \text{ km.} \pm .51 \text{ km.} \\ T &= \text{J. D. } 2418281.176 \\ A &= 34.79 \text{ km.} \\ B &= 35.51 \text{ km.} \\ a \sin i &= 1{,}877{,}000 \text{ km.} \end{aligned}$$

The sum of the squares of the residuals for the normal places was reduced from 77.6 to 68.5 and satisfactory agreement was obtained between equation and ephemeris residuals, the greatest difference being 0.03 km. The probable error of a plate obtained from columns six and seven of the table of measures is ±2.18 km. per sec.

The curve shown (Fig. 6) represents the final elements.

While the irregularity in the curve is still noticeable, the three normal places which show it most have weights below the average and the peculiar trend of the residuals might be treated as accidental. The writer, however, is rather inclined to believe that the second spectrum is present, and, though faint, has sufficient influence on the measures to account for the deviations shown.

o Andromedae.

This star (α 22^h 57^m.3, δ 41°47′, photographic magnitude 3.4, type B3) was announced by Wright in 1902 as a spectroscopic binary from four plates, viz.:—

1900.	Oct. 9	—	11.
	Dec. 17	—	16.
1901.	June 25	—	20.
	Aug. 12	—	12.

The measures were based on the excellent H_γ line, but mention was made of the composite nature of the spectrum.

Fifty plates of the star were secured here in 1906 and 1907, and it was then abandoned until such time as an instrument more suitable for photographing its spectrum was available. The first sixteen plates were made with the Universal three-prism spectrograph and the measures depended solely on H_γ, which was a good line. With the exception of two, numbers 999 and 1002, which were made with the three-prism instrument, III L, all the rest were secured with single-prism dispersion, the spectrograms showing H_β, H_γ, H_δ and occasionally H_ϵ as measurable lines. The K line of calcium was noted on a few of the latter plates, but, owing to its poor quality it could not be stated definitely whether the velocity given by it agreed with that of the hydrogen lines. The data of the plates and detailed measures of all but the first sixteen are appended.

P—Plaskett.
H—Harper.
T—Tribble.

RECORD OF SPECTROGRAMS

Star.	No. of Neg.	Camera	Plate.	Date.	Middle of Exposure. G.M.T.	Duration	Hour Angle at End.	Temperature. Room. Beg.	Room. End.	Prism Box. Beg.	Prism Box. End.	Slit Width in Inches.	Seeing.	Observer	Remarks.
					h m	m	h m	Fahrenheit.		Centigrade.					
				1906											
o Andromedæ	369	U	Seed 27	Aug. 6	19 10	70	0 43 W	69·4	68·8	28·0	27·9	·001	Good	..	
"	374	"	"	" 8	19 30	65	1 10 W	71·6	70·2	28·3	28·1	"	"	..	
"	379	"	"	" 15	18 35	60	0 40 W	63·3	59·8	24·9	24·9	"	"	H	
"	401	"	"	Sept. 27	16 38	60	1 30 W	57·3	55·0	21·8	21·5	"	"	H	
"	410	"	"	Oct. 16	17 05	70	3 20 W	54·7	53·8	17·6	17·6	"	"	H	
"	414	"	"	" 23	15 17	75	2 00 W	46·0	44·1	15·4	15·2	"	"	H	
"	419	"	"	Nov. 1	17 40	60	4 55 W	34·0	33·5	7·7	7·8	"	"	H	
"	432	"	"	" 8	17 05	60	4 45 W	35·4	34·0	9·6	9·8	"	"	H	
"	439	"	"	" 19	14 30	55	2 50 W	40·4	38·0	10·0	10·1	·0013	Fair	H	
"	450	"	"	Dec. 11	12 43	43	2 23 W	16·0	14·0	− 3·5	− 3·7	"	Good	H	
"	460	"	"	" 13	14 40	30	4 12 W	20·5	20·0	− 0·5	− 0·5	·0014	......	H	
"	482	"	"	" 18	11 04	42	1 05 W	17·3	16·3	− 1·9	− 2·1	"	......	H	
"	491	"	"	" 19	12 52	45	3 05 W	14·0	13·8	− 7·5	− 7·4	"	..	P	
				1907											
"	526	"	"	Jan. 11	13 20	30	5 00 W	19·6	17·5	− 8·0	− 7·9	.0015	Good	P	
"	531	"	"	" 15	11 20	40	3 15 W	6·3	5·5	−12·8	−12·8	"	......	H	
"	538	"	"	" 16	14 25	50	6 35 W	− 1·0	− 2·0	−17·9	−17·8	"	...	P	
								Centigrade.							
"	855	1 L	"	June 14	20 07	25	2 15 E	18·3	17·6	23·0	23·0	·0012	Good	P	
"	867	"	"	" 20	19 34	35	2 15 E	19·0	18·8	25·2	25·2	"	Hazy	H	
"	874	"	"	" 21	20 00	30	1 30 E	21·6	21·0	29·0	29·0	·0013	....	P	
"	899	"	"	" 27	19 42	35	1 45 E	18·6	18·6	24·5	24·5	·0014	Good	H	
"	907	"	"	July 2	19 53	33	1 10 E	13·5	12·5	17·0	16·8	"	"	H	
"	935	"	"	" 9	19 39	31	0 58 E	19·0	18·0	25·0	25·0	"	"	H	
"	948	"	"	" 16	18 27	34	1 42 E	23·0	22·5	26·6	26·6	"	Fair	H	
"	954	"	"	" 18	17 54	31	2 08 E	22·0	22·0	28·4	28·4	·0012	....	H	
"	960	"	"	" 20	18 55	30	1 00 E	17·2	17·6	21·4	21·4	"	....	P	
"	970	"	"	" 27	19 15	38	0 00	19·4	19·2	22·3	22·3	"	....	P	
"	977	"	"	Aug. 1	18 37	36	0 29 E	20·0	19·3	24·8	25·0	"	Very hazy	T	
"	984	"	"	" 5	18 33	33	0 25 E	16·0	15·8	21·0	21·0	"	Cloudy	P	

"	999	III L	"	"	8	18	17	85	0	05 W	17·5	16·5	25·1	25·0	·002	Poor	H	
"	1002	"	"	"	10	17	07	75	1	00 E	22·1	22·0	28·7	28·7	"	Fair	P	
"	1008	I L	"	"	12	17	57	34	0	25 E	21·5	20·5	29·0	29·0	"		H	
"	1021	"	"	"	22	18	41	37	1	09 W	16·2	16·0	24·0	24·0	·0014	Hazy	H	
"	1035	"	"	Sept.	6	16	49	46	0	07 W	17·5	16·2	20·5	20·5	·0012	"	T	
"	1042	"	"	"	12	19	45	65	3	40 W	14·0	14·0	20·6	20·6	·0014	Poor	H	
"	1044	"	"	"	14	18	50	50	2	45 W	19·0	19·2	20·8	20·8	·0011	"	P	
"	1052	"	"	"	18	17	02	40	1	07 W	10·4	10·4	17·0	17·0	·0014	Good	T	
"	1053	"	"	"	"	17	46	43	1	52 W	10·4	11·0	"	"	"	"	T	
"	1065	"	"	"	20	17	20	35	1	30 W	21·0	20·5	22·6	22·6	"	Fair	H	
"	1066	"	"	"	"	18	00	41	2	13 W	20·5	20·0	22·6	"	"	Good	H-T	
"	1087	"	"	Oct.	1	16	05	30	0	56 W	9·0	7·5	14·1	14·0	"		H	
"	1088	"	"	"	"	16	36	30	1	30 W	7·5	7·0	14·0	13·9	"		H	
"	1130	"	"	Nov.	8	15	30	60	3	05 W	4·6	4·0	5·8	5·7	·0012	Steady	P	Cloudy.
"	1131	"	"	"	"	16	20	35	3	45 W	4·0	3·6	5·7	5·6	"	Fair	P	
"	1133	"	"	"	11	15	00	30	2	30 W	0·0	−0·2	5·7	5·6	·001	"	P	
"	1134	"	"	"	"	15	32	20	3	00 W	−0·4	−0·7	5·6	"	·0014	"	P	
"	1151	"	"	"	18	13	52	40	2	00 W	3·9	3·6	5·0	5·0	·0013	Hazy	P	
"	1152	"	"	"	"	14	50	60	3	05 W	3·6	3·3	"	"	"	"	P	
"	1174	"	"	Dec.	4	15	35	35	4	41 W	−10·5	−12·5	1·0	1·0	·0015	Good	H	
"	1175	"	"	"	"	16	10	30	5	15 W	−12·5	−11·0	"	"	"	"	H	
"	1176	"	"	"	"	16	44	32	5	30 W	−11·0	−12·0	"	0·6	"	"	H	

DETAILED MEASURES OF o ANDROMEDÆ

λ	855.		867.		874.		899.		907.		926.		935.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4861·527......	−27·2	3	−27·2	2	−45·6	2	−30·1	2	−25·6	2	......	....	−28·6	2
4340·634......	36·7	2	21·7	2	31·0	2	37·4	2	23·1	2	−41·7	1	32·6	2
4102·000......	31·5	1½	−35·9	1	−21·7	1½	−49·3	1½	−30·8	1	......	....	−27·0	1½
3970·177......	−35·7	½	......	....	......	....	......	....	......	....	......	....	......	....
Weighted Mean......	−32·29		−26·72		−33·76		−37·96		−25·65		−44·71		−29·62	
V_a	+20·55		+20·94		+20·99		+21·14		+21·09		+20·85		+20·79	
V_d	+ ·15		+ ·15		+ ·11		+ ·12		+ ·10		+ ·08		+ ·08	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity.	−12·9		− 5·9		−12·9		−17·0		− 4·7		−24·1		− 9·0	

DETAILED MEASURES OF o ANDROMEDÆ—(Continued).

λ	948.		954.		960.		964.		970.		977.		984.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4861·527......	−28·1	2	−53·1	1	−34·9	2	......	....	−26·6	2	−19·3	½	−33·4	2
4340·634......	31·0	1½	37·9	2	18·8	2	−61·7	1	−31·9	2	−10·0	1½	34·0	2
4102·000......	−33·1	1½	−36·7	1½	−35·2	1½	−54·8	½	......	....	......	....	−35·0	1½
Weighted Mean......	−30·48		−39·55		−30·17		−59·41		−29·24		−12·29		−34·09	
V_a	+20·20		+19·98		+19·73		+19·33		+18·70		+17·81		+16·98	
V_d	+ ·12		+ ·15		+ ·08		+ ·12		+ ·02		+ ·05		+ ·05	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity...	−10·4		−19·7		−20·6		−40·2		−10·8		+ 5·3		−17·3	

DETAILED MEASURES OF *o* ANDROMEDÆ—(Continued).

λ	999.		1002.		1008.		1021.		1035.		1042.		1044.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4861·527......	−55·5	½	−16·5	1	−46·0	1¼	−38·8	½	−17·6	1	−28·0	½	−14·1	2
4340·634......	−32·4	1½	−31·6	2	36·5	2	40·1	2	21·5	2	−21·2	1½	5·8	2½
4102.000......	......	...	......	...	−45·1	¼	−57·6	½	−25·8	1	......	...	31·9	1
3970·177......	......	...	......	...	......	...	......	...	......	...	......	...	19·3	½
Weighted Mean......	−38·20		−26·56		−40·50		−42·81		−21·58		−22·95		−14·05	
V_a	+16·35		+15·91		+15·40		+12·73		+ 8·07		+ 5·97		+ 5·25	
V_d	+ ·03		+ ·10		+ ·05		− ·05		+ ·01		− ·20		− ·13	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity...	−22·1		−10·9		−24·9		−30·4		−13·8		−17·5		− 9·2	

DETAILED MEASURES OF *o* ANDROMEDÆ—(Continued).

λ	1052.		1053.		1065.		1066.		1087.		1088.		1130.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4861·527......	......	...	......	...	−27·4	1	−22·9	½	−20·9	½	− 3·9	2	+13·9	1
4340·634......	−13·6	2½	−26·0	2½	−19·5	3	8·2	1½	−13·0	1	1·4	2	12·5	2
4102·000......	−22·9	1	−37·2	½	+ 2·9	½	−24·4	½	......	...	−16·3	1	+ 1·7	1½
Weighted Mean......	−16·24		−27·87		−18·80		−14·41		−15·66		− 5·39		+ 9·24	
V_a	+ 3·72		+ 3·72		+ 3·10		+ 3·10		− 0·85		− 0·85		−13·92	
V_d	− ·05		− ·10		− ·08		− ·12		− ·05		− ·05		− ·23	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity...	−12·8		−24·5		−16·1		−11·7		−16·8		− 6·6		− 5·2	

DETAILED MEASURES OF o ANDROMEDÆ—(Continued).

λ	1131.		1133.		1134.		1151.		1152.		1174.		1175.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4861·527......	−11·3	2	+16·0	3	− 0·4	2½	+ 5·4	1½	+ 7·1	1½	+12·5	1	+ 2·9	1
4340·634......	+ 8·3	2	+21·4	2	− 7·9	2	+21·6	1½	+12·2	1½	+14·3	1½	+18·2	1
4102·000......	± 0·0	2	− 2·6	1½	− 7·5	1½	− 6·7	1	− 2·9	1	− 9·1	1	− 6·2	1
3970·177......	.....	.....	+10·5	½	± 0·0	½	.....	.....	.....	.....	−10·8	½	−18·5	½
Weighted Mean......	− 1·00		+13·15		− 4·33		+ 8·44		+ 6·50		+ 4·85		+ 1·61	
V_a	−13·92		−14·77		−14·77		−15·90		−15·90		−19·90		−19·90	
V_d	− ·25		− ·17		− ·22		− ·13		− ·19		− ·28		− ·30	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	−15·4		− 2·0		−19·6		− 7·9		− 9·9		−15·6		−18·7	

DETAILED MEASURES OF o ANDROMEDÆ—(Concluded).

λ	1176.													
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4861·527......	+ 9·1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4340·634......	+14·2	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4102·000......	− 0·2	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3970·177......	−27·9	¼	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Weighted Mean......	+ 4·98		.....		.....		.....		.....		.....		.....	
V_a	−19·90		.....		.....		.....		.....		.....		.....	
V_d	− ·31		.....		.....		.....		.....		.....		.....	
Curv.	− ·28		.....		.....		.....		.....		.....		.....	
Radial Velocity...	−15·5		.....		.....		.....		.....		.....		.....	

MEASURES OF o ANDROMEDÆ

Date.			Velocity.	Wt.	Date.			Velocity.	Wt.
1906.	Aug.	6	− 4	2	1907.	July	27	−11	4
	"	8	− 1	2		Aug.	1	+ 5	2
	"	15	− 4	2		"	5	−17	5½
	Sep.	27	0	2		"	8	−22	2
	Oct.	16	− 8	2		"	10	−11	3
	"	23	− 2	3		"	12	−25	3½
	Nov.	1	−20	2		"	22	−30	3
	"	8	−11	2		Sep.	6	−14	4
	"	19	−13	2		"	12	−17	2
	Dec.	11	−10	2		"	14	− 9	6
	"	13	−15	2		"	18	−13	3½
	"	18	−24	2		"	18	−24	3
	"	19	−30	2		"	20	−16	4½
1907.	Jan.	11	−19	3		"	20	−12	2½
	"	15	−19	2		Oct.	1	−17	1½
	"	16	−13	1½		"	1	− 7	5
	June	14	−13	7		Nov.	8	− 5	4½
	"	20	− 6	5		"	8	−15	6
	"	21	−13	5½		"	11	− 2	7
	"	27	−17	5½		"	11	−20	6½
	July	2	− 5	5		"	18	− 8	4
	"	9	− 9	5½		"	18	−10	4
	"	16	−10	5		Dec.	4	−16	4
	"	18	−20	4½		"	4	−19	3½
	"	20	−21	5½		"	4	−15	3

ε Cassiopeiæ.

This star ($\alpha = 1^h\ 48^m.0$, $\delta = +63°\ 11'$, photographic magnitude 3.5, type B5), was placed on our observing programme as one of those stars having sharp *H* and *K* lines; the presence of which in spectra having for the most part diffuse lines is sometimes considered as indicating the presence of a second body in the system.

Four plates had been secured at Yerkes Observatory and measured by Frost and Adams* as follows:—

		Adams.	Frost.
1901.	Oct. 3	−7·1	−2·6
	" 23	−5·8	−8·5
	" 25	−7·6	−5·0
1902.	Aug. 27	−4·3	−6·0

The mean of their plates, as well as of all their measures, was −5.9 km. per sec. The results of our first four plates were considerably different from this mean value, and when further plates showed a greater range it was considered that this star was very probably a spectroscopic binary. As the dependable range seemed quite small it was decided to make several plates on each night the star was observed, the mean of the night being used. In this way thirty-nine plates on Seed 27 Emulsion were made without giving any further proof of the reality of the variation, other than that some of them seemed to show a few lines as complex. Fine-grained plates of the Seed 23 Emulsion were then used in the hope of recording the

* Decennial Publications of University of Chicago, VIII., page 191.

spectrum of the second component if the star were really a spectroscopic binary. Sixteen such plates were secured without much additional evidence, and as a last resource the three-prism spectrograph was employed. Only a few plates have so far been made, but they do not show any definite doubling of the lines. A few plates from time to time will be made with the three-prism camera; in the meantime one cannot say with certainty whether or not this star is a spectroscopic binary.

The observational data for the plates and the detailed measures are given· After most of the plates had been measured, using every available line, a set of eight lines was chosen for velocity determination. For the same quality of a line the weight assigned the first season is somewhat higher than for the second.

These are the lines:—

Mg	4481·400	He	4143·928
He	4471·676	H	4101·890
He	4388·400	He	4026·352
H	4340·634	Ca	3933·825

RECORD OF SPECTROGRAMS

H—Harper.
P¹—Parker.
C—Cannon.

Star.	No. of Neg.	Camera.	Plate.	Date.	Middle of Exposure. G.M.T.	Duration.	Hour Angle at End.	Temperature, Centigrade. Room. Beg.	Room. End.	Prism Box. Beg.	Prism Box. End.	Slit Width in Inches.	Seeing.	Observer.	Remarks.
				1909	h m	m	h m								
ε Cassiopeiæ	2623	1	Seed 27	July 6	19 11	32	4 20 E	16·5	14·2	25·1	24·5	·002	Good	C	
"	2644	"	"	" 9	20 22	30	3 00 E	15·0	14·6	25·3	25·1	"	"	C	
"	2693	"	"	" 30	19 45	20	2 23 E	19·4	19·0	24·8	24·8	"	5	C	
"	2788	"	"	Sept. 14	16 54	12	2 15 E	20·0	20·0	27·0	27·1	"	4	H	
"	2868	"	"	Oct. 8	15 06	19	2 27 E	19·5	18·0	22·9	22·9	"	5	H	Off 4ᵐ.
"	2869	"	"	" "	15 25	16	2 10 E	18·0	17·5	"	"	"	5	H	
"	2937	"	"	Nov. 8	17 31	30	2 05 W	2·5	2·2	5·6	5·6	"	4-5	C	
"	2964	"	"	" 18	13 12	15	1 39 E	− 3·0	− 3·0	1·2	1·1	"	5	H	
"	2991	"	"	Dec. 1	12 43	13	1 20 E	1·8	1·5	6·6	6·5	"	4	P	
"	3021	"	"	" 10	14 49	18	1 25 W	− 5·5	− 5·5	− 3·6	− 3·6	"	2-3-4	H	
"	3022	"	"	" "	15 08	18	1 44 W	"	"	"	"	"	3-4	H	
"	3063	"	"	" 29	13 58	15	1 15 W	−16·0	−16·0	− 8·0	− 8·0	"	5	H	
"	3064	"	"	" "	14 17	20	2 05 W	"	"	"	"	"	4	H	
"	3065	"	"	" "	14 37	18	2 25 W	"	"	"	"	"	4-3	H	
				1910											
"	3090	"	"	Jan. 10	13 00	15	1 35 W	−13·5	−13·5	− 3·5	− 3·6	"	4-5	H	
"	3091	"	"	" "	13 16	15	1 51 W	"	"	− 3·6	"	"	"	H	
"	3092	"	"	" "	13 33	17	2 09 W	"	"	"	− 3·7	"	"	H	
"	3192	"	"	Feb. 18	11 57	15	3 05 W	− 8·0	− 8·5	− 2·5	− 2·5	"	"	H	
"	3193	"	"	" "	12 14	16	3 23 W	− 8·5	− 9·0	"	"	"	5	H	
"	3194	"	"	" "	12 32	16	3 40 W	− 9·0	−10·0	"	"	"	4	H	
"	3243	"	"	" 28	13 23	15		5·6	5·3	10·4	10·4	"	4	C	
"	3244	"	"	" "	13 39	15	5 30 W	5·3	5·2	"	"	"	4-5	C	
"	3245	"	"	" "	13 57	16		5·2	"	"	"	"	"	C	
"	3584	"	"	Aug. 19	21 08	10	0 15 W	21·7	21·7	13·1	13·0	"	4	P¹	
"	3585	"	"	" "	21 22	16		21·7	21·8	13·0	12·9	"	4	P¹	
"	3586	"	"	" "	21 38	14	0 45 W	21·8	"	12·9	12·8	"	4	P¹	
"	3591	"	"	" 26	20 42	15	0 15 W	11·5	11·2	19·7	19·6	"	5	C	
"	3592	"	"	" "	20 58	15	0 31 W	11·2	"	19·6	"	"	5	C	
"	3593	"	"	" "	21 14	15	0 49 W	"	11·1	"	"	"	5	C	
"	3605	"	"	" 31	19 47	15	0 35 E	14·2	13·5	22·3	22·3	"	4	C	
"	3606	"	"	" "	20 03	14	0 20 E	13·5	"	"	"	"	4-5	C	

H—Harper.
P¹—Parker.
C—Cannon.

RECORD OF SPECTROGRAMS (Concluded).

Star.	No. of Neg.	Camera.	Plate.	Date.	Middle of Exposure. G.M.T.	Duration.	Hour Angle at End.	Temperature, Centigrade. Room. Beg.	Room. End.	Prism Box. Beg.	Prism Box. End.	Slit Width in Inches.	Seeing.	Observer.	Remarks.
				1910.	h m	m	h m								
ε Cassiopeiæ	3607	I	Seed 27	Aug. 31	20 18	14	0 05 E	13·5	13·5	22·3	22·3	·002	4	C	
"	3620	"	"	Sept. 7	20 07	15	0 30 W	14·2	14·0	19·8	19·8	"	4-5	C	
"	3621	"	"	" "	20 23	15	0 46 W	14·0	13·7	"	"	"	"	C	
"	3622	"	"	" "	20 40	15	1 03 W	13·7	13·6	"	"	"	"	C	
"	3647	"	"	" 14	19 02	15		11·0	10·7	16·7	16·7	"	"	C	
"	3648	"	"	" "	19 18	15		10·7	10·4	"	"	"	"	C	
"	3649	"	"	" "	19 32	11	0 25 W	10·4	10·2	"	"	"	"	C	
"	3655	"	"	" 15	19 33	12	0 25 W	10·0	9·7	14·9	14·8	"	5	H	
"	3656	"	Seed 23	" "	19 51	21		9·7	9·4	14·8	14·7	"	5	H	
"	3657	"	"	" "	20 15	23	1 12 W	9·4	9·2	14·7	"	"	5	H	
"	3681	"	"	" 21	19 50	20	1 10 W	5·4	4·8	16·3	16·4	"	4-5	C	
"	3685	"	"	" "	20 11	20	1 31 W	4·8	5·0	16·4	"	"	"	C	
"	3686	"	"	" "	20 32	20	1 52 W	5·0	4·8	"	"	"	"	C	
"	3699	"	"	" 28	18 51	20	0 37 W	9·0	8·9	17·7	17·7	"	"	C	
"	3700	"	"	" "	19 12	20	0 58 W	8·9	8·8	"	"	"	"	C	
"	3701	"	"	" "	19 35	25	1 19 W	8·8	8·6	"	"	"	"	C	
"	3717	"	"	Oct. 7	17 55	20	0 25 W	7·0	5·2	18·3	18·2	"	5	P¹	
"	3718	"	"	" "	18 16	21	0 47 W	5·2	"	18·2	"	"	5	P¹	
"	3719	"	"	" "	18 41	24	1 15 W	"	3·5	"	18·1	"	5	P¹	
"	3735	"	"	" 12	16 42	20	0 40 E	1·5	1·3	10·2	10·1	"	5	P¹	
"	3736	"	"	" "	17 03	20	0 19 E	1·3	"	10·1	"	"	5	P¹	
"	3737	"	"	" "	17 24	21	0 05 W	"	1·2	"	"	"	5	C	
"	3748	"	"	" 17	17 36	24	0 40 W	8·1	8·0	17·4	17·4	"	4-0	P¹	
"	3749	"	"	" "	18 19	60	1 40 W	8·0	"	"	"	"	2	P¹	

DETAILED MEASURES OF ε CASSIOPEIÆ

λ	2623.		2623.		2644.		2693.		2788.		2868.		2869.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481	−24·0	1	−27·5	1	−38·5	1½	−22·9	½	.....	..	−28·7	¼	−14·4	½
4471	34·1	1½	34·4	1½	36·0	1	13·5	½	−35·6	1	1·9	½	.....	....
4388	48·7	1	43·3	1	38·1	1	.....	....	.....	....	.....	....	.....	....
4340	25·8	2	28·5	2	38·9	2	35·2	1½	24·7	1½	13·3	1	13·4	1
4143	50·2	1	45·0	1	.....	....	31·1	1	.....	....	20·5	¾	22·3	½
4101	32·6	1	28·3	1½	40·3	2	15·7	1	54·5	½	25·0	1	2·9	¾
4026	31·3	1	20·7	1	26·6	1	47·6	1½	−32·2	2	22·2	¾	−19·9	¾
3933	−17·9	2	−12·2	1½	−16·0	2	−40·4	1	.....	...	−18·0	1	.....	....
Weighted Mean	−30·98		−29·12		−33·22		−32·80		−32·86		−18·37		−13·96	
V_a	+15·37		+15·37		+15·99		+19·05		+17·46		+12·22		+12·22	
V_d	+ ·10		+ ·10		+ ·10		+ ·06		+ ·11		+ ·12		+ ·11	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	−15·8		−13·9		−17·4		−14·0		−15·6		− 6·3		− 1·9	

DETAILED MEASURES OF ε CASSIOPEIÆ—(Continued).

λ	2937.		2937.		2964.		2991.		3021.		3022.		3063.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481	.....	....	.....	....	− 9·0	½	+11·5	1	.....	....	+ 5·1	¾	.....	....
4471	.....	....	.....	....	+19·5	¾	.....	....	.....	....	+ 8·1	½	.....	....
4388	.....	....	.....	....	.....	....	.....	....	.....	....	− 9·9	¾	+ 2·4	½
4340	+ 0·9	1½	± 0·0	1½	+ 2·1	1¼	+14·9	1½	− 7·7	¾	− 8·1	1	− 2·0	¾
4143	.....	....	.....	....	+16·8	1	+ 7·9	1	9·6	½	.....	....	− 6·6	¾
4101	−19·6	1	−16·8	1	− 4·1	¾	+ 1·2	½	5·2	1¼	+ 6·9	½	+ 6·2	1
4026	−24·4	1	−16·3	1	−19·9	1	− 1·2	1½	− 8·8	½	+ 9·0	1½	.....	....
3933	+ 1·7	1	+ 0·5	1	.....	....	− 1·2	1½	.....	....	.....	....	+10·8	½
Weighted Mean	− 9·11		− 7·24		+ 1·25		+ 5·53		− 7·19		+ 1·88		+ 1·82	
V_a	+ 2·31		+ 2·31		− 1·16		− 5·69		− 8·73		− 8·73		−14·28	
V_d	− ·11		− ·11		+ ·11		+ ·09		− ·04		− ·05		− ·13	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	− 7·2		− 5·3		− 0·1		− 0·3		−16·2		− 7·2		−12·9	

DETAILED MEASURES OF ε CASSIOPEIÆ—(Continued).

λ	3064.		3065.		3065.		3090.		3091.		3092.		3192.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481..........	......	...			− 3·8	½			− 3·7	1	+11·1	½	......	...
4471..........	+ 5·2	¾	− 1·2	½	+19·6	½	+12·7	1¼	+ 0·6	1¼	− 8·0	¾	......	...
4388..........	......		......		......		+12·0	1	+18·8	½	+29·7	¼	......	...
4340..........	− 3·9	1	− 6·1	1	− 4·6	1	+17·3	¾	+10·8	1	+ 8·9	1¼	+16·4	½
4143..........	+17·1	¾	+ 8·6	1	+ 9·0	1	+19·9	½	− 7·5	½	− 3·7	¾	......	...
4101..........	+12·5	1¼	−10·8	1	− 8·2	1	− 3·8	½	+25·9	¾	+21·2	½	15·3	1
4026..........	− 0·7	¾	+ 1·3	1	+ 2·1	1	− 2·9	½	+ 9·1	½	+15·8	1¼	+16·2	¾
3933..........	− 5·5	½	− 2·8	½	− 8·3	½	−13·3	½	....		− 8·3	½	......	...
Weighted Mean.......	+ 5·03		− 1·79		+ 0·38		+ 8·15		+ 6·81		+ 7·25		+15·84	
V_a	−14·28		−14·28		−14·28		−17·00		−17·00		−17·00		−20·24	
V_d	− ·09		− ·10		− ·10		− ·05		− ·07		− ·09		− ·11	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity...	−10·4		−16·4		−15·0		− 9·2		−10·5		−10·1		− 4·8	

DETAILED MEASURES OF ε CASSIOPEIÆ—(Continued).

λ	3193.		3194.		3243.		3244.		3245.		3584.		3585.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481..........	......	...	......		......	...	......	...	+ 5·0	¾	......	...	......	...
4471..........	......	...	......	...	+25·6	½	......	...	22·1	½	......	...	......	...
4388..........	......	...	......	...	27·4	¾	......	...	18·0	½	......	...	......	...
4340..........	+19·7	½	+11·6	½	15·0	2	+11·6	1	+12·7	1¼	−23·3	1	−16·3	¾
4143..........	......	...	......	...	......	...	......	...	......	...	......	...	23·7	½
4101..........	18·5	¾	+21·5	1	+26·4	¾	5·1	¾	......	...	39·2	¾	35·5	¾
4026..........	+18·3	½	......	...	......	...	+12·6	1	......	...	−36·5	½	29·3	¾
3933..........	......	...	......	...	......	...	......	...	......	...	......	...	−36·5	¾
Weighted Mean.......	+18·79		+18·18		+20·78		+10·18		+13·23		−31·53		−28·59	
V_a	−20·24		−20·24		−19·56		−19·56		−19·56		+19·82		+19·82	
V_d	− ·11		− ·12		− ·15		− ·15		− ·15		− ·01		− ·03	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity...	− 1·8		− 2·5		+ 0·8		− 9·8		− 6·8		−12·0		− 9·1	

DETAILED MEASURES OF ε CASSIOPEIÆ—(Continued).

λ	3586.		3591.		3592.		3593.		3605.		3606.		3607.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481					−30·9	½							−28·7	1
4471					33.0	½								
4388					53·6	½			−45·8	¾				
4340	−27·1	1	−31·4	½	34·6	¾	−34·6	¾	27·7	½	−30·7	½	−11·8	1½
4143														
4101	25·3	1½	39·4	¾	25·0	¾			−14·9	¾	−24·0	½		
4026	31·3	1	−31·3	¾	−14·4	¼	−49·0	¼						
3933	−25·0	½												
Weighted Mean	−27·21		−34·36		−33·00		−38·20		−29·70		−27·35		−18·93	
V_a	+19·82		+19·56		+19·56		+19·56		+19·21		+19·21		+19·21	
V_d	− ·04		·00		− ·03		− ·04		+ ·04		+ ·03		+ ·01	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	− 7·7		−15·1		−13·8		−19·0		−10·7		− 8·4		± 0·0	

DETAILED MEASURES OF ε CASSIOPEIÆ—(Continued).

λ	3620.		3621.		3622.		3647.		3648.		3649.		3655.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4471	−16·9	½					−12·6	½	−16·4	½	−31·1	½	−21·1	½
4340	20·4	1	−29·3	¾	−36·1	1	16·5	½	5·0	½	29·2	½	17·3	¾
4143			31·6	½					24·2	½				
4101			34·4	¼	31·0	½	42·7	½	34·8	½	31·7	1	34·3	¾
4026	−20·0	½	−18·8	½	−31·3	¾	35·0	½	−40·3	½	−23·0	½	−41·9	½
3933							−31·7	¼						
Weighted Mean	−19·45		−27·90		−33·40		−27·25		−24·14		−29·32		−28·09	
V_a	+18·48		+18·48		+18·48		+17·48		+17·48		+17·48		+17·31	
V_d	− ·02		− ·03		− ·04		·00		·00		− ·02		− ·02	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	− 1·3		− 9·7		−15·2		−10·0		− 6·9		−12·2		−11·1	

DETAILED MEASURES OF ε CASSIOPEIÆ—(Continued).

λ	3656.		3657.		3684.		3685.		3686.		3699.		3700.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481	......	...	......	...	−23·3	½	−32·3	½	−26·2	¼	......	...	......	...
4471	−18·1	1	−19·6	¾	29·4	½	15·9	½	31·2	½	......	...	−13·9	¾
4388	23·5	½	......	...	17·2	½	25·0	1	20·8	1	−32·6	¼	26·3	½
4340	5·3	1½	18·9	1	42·1	½	19·6	¾	25·7	1½	29·3	½	−11·5	1
4143	20·7	½	......	...	......	...	14·6	½	......	...	......	...	......	...
4101	20·2	½	−19·9	1	......	...	16·5	½	......	...	−26·9	½	......	...
4026	10·2	½	......	...	−33·8	½	−17·6	¾	−19·8	1	......	...	......	...
3933	−12·6	1	......	...	......	...	......	...	......	...	......	...	......	...
Weighted Mean	−13·81		−19·35		−29·16		−20·50		−23·84		−28·99		−15·60	
V_a	+17·31		+17·31		+16·22		+16·22		+16·22		+14·74		+14·74	
V_d	− ·04		− ·03		− ·03		− ·04		− ·07		− ·03		− ·03	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	+ 3·2		− 2·6		−13·2		− 4·6		− 8·0		−14·6		− 1·2	

DETAILED MEASURES OF ε CASSIOPEIÆ—(Continued).

λ	3701.		3717.		3718.		3719.		3735.		3736.		3737.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481	......	...	−28·0	½	−25·8	½	−18·4	¾	− 5·5	¾	− 0·0	½	−13·2	½
4471	......	...	30.0	¾	22·4	¾	25·3	1	+ 3·2	1	2·5	½	16·0	½
4388	......	...	32·8	½	24·1	½	27·0	¾	−12·9	½	14·2	½	16·0	½
4340	−23·0	½	−43·4	¾	−30·5	¾	−31·2	½	−21·3	¾	35·8	¾	23·4	¾
4143	......	...	......	...	......	...	......	...	......	...	14·9	½	16·9	½
4101	20·2	¼	......	...	......	...	......	...	......	...	− 9·2	¾	45·1	½
4026	−28·4	¼	......	...	......	...	......	...	−12·2	¾	......	...	− 8·6	½
3933	......	...	......	...	......	...	......	...	−12·9	½	......	...	......	...
Weighted Mean	−23·63		−34·18		−25·84		−25·00		− 9·16		−14·14		−20·12	
V_a	+14·74		+12·51		+12·51		+12·51		+11·14		+11·14		+11·14	
V_d	− ·04		− ·01		− ·03		− ·04		+ ·04		+ ·03		− ·01	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	− 9·2		−22·0		−13·6		−12·8		+ 1·7		− 3·2		− 9·3	

DETAILED MEASURES OF ε CASSIOPEIÆ—(Concluded).

λ	3748.		3749.											
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4481..........	−17·8	½	......	....	......	....	......	....	......	....	......	....	......	....
4471..........	8·8	½	− 6·1	¾	......	....	......	....	......	....	......	....	......	....
4388..........	17·3	½	......	....	......	....	......	....	......	....	......	....	......	....
4340..........	15·0	¾	−18·5	½	......	....	......	....	......	....	......	....	......	....
4143..........	26·5	¼	......	....	......	....	......	....	......	....	......	....	......	....
4101..........	−12·5	¼	......	....	......	....	......	....	......	....	......	....	......	....
Weighted Mean.....	−15·62		−11·04		....		....		....		....		....	
V_a	+ 9·65		+ 9·65		....		....		....		....		....	
V_d	− ·03		− ·04		....		....		....		....		....	
Curv.	− ·28		− ·28		....		....		....		....		....	
Radial Velocity...	− 6·3		− 1·7		....		....		....		....		....	

MEASURES OF ε CASSIOPEIÆ

Date.	Velocity.	Line.	Date.	Velocity.	Line.
1909. July 6......	−15·	8	1910. Aug. 26......	−19·	2
" 9......	−17·	7	" 31......	−11·	3
" 30......	−14·	7	" 31......	− 8·	2
Sep. 4......	−16·	4	" 31......	0·	2
Oct. 8......	− 6·	7	Sep. 7......	− 1·	3
" 8......	− 2·	5	" 7......	−10·	4
Nov. 8......	− 6·	4	" 7......	−15·	3
" 18......	0·	6	" 14......	−10·	5
Dec. 1......	0·	6	" 14......	− 7·	5
" 10......	−16·	4	" 14......	−12·	4
" 10......	− 7·	6	" 15......	−11·	4
" 29......	−13·	5	" 15	+ 3·	7
" 29......	−10·	6	" 15......	− 3·	3
" 29......	−16·	6	" 21......	−13·	5
1910. Jan. 10......	− 9·	7	" 21......	− 5·	7
" 10......	−10·	7	" 21......	− 8·	5
" 10......	−10·	8	" 28......	−15·	3
Feb. 18......	− 5·	3	" 28......	− 1·	3
" 18......	− 2·	3	" 28	− 9·	3
" 18......	− 2·	2	Oct. 7......	−22·	4
" 28......	+ 1·	4	" 7......	−14·	4
" 28......	−10·	3	" 7......	−13·	4
" 28......	− 7·	4	" 12	+ 2·	6
Aug. 19......	−12·	3	" 12......	− 3·	6
" 19......	− 9·	5	" 12......	− 9·	7
" 19......	− 8·	4	" 17......	− 6·	6
" 26......	−15·	3	" 17......	− 2·	2
" 26......	−14·	6			

MISCELLANEOUS.

The following measures of miscellaneous plates of the stars μ Orionis, ϵ Ursæ Majoris, ϕ Ursæ Majoris and π^{6} Virginis are published. The plates are not as good as would be obtained when once the right exposure had been determined, but the measures may serve a purpose to other observers engaged in determining their orbits. I believe Professor Frost of the Yerkes Observatory is working on μ Orionis at present.

μ ORIONIS

Plate 1139 taken 1907, Nov. 11, G. M. T. 21ʰ 10ᵐ
" 1159 " " " 23 " 18 03

Line.	1139.		1159.	
	Vel.	Wt.	Vel.	Wt.
4861·527	+43·1	1	+44·8	2
4549·766	57·3	1½	27·9	1½
4481·400	61·8	1½	44·9	2
4395·286	39·0	1	26·0	1½
4352·006	40·7	1½	45·0	2
4340·634	53·7	1½	44·1	2
4325·939	45·2	1	24·0	1½
4315·178	36·1	1½	19·5	1
4271·760	56·3	1½	43·9	1
4260·640	54·1	1	46·0	1½
4233·328	55·4	1	40·7	1½
4215·897	+53·8	2	+25·4	2
Weighted Mean	+50·19		+36·86	
V_a	+18·65		+13·70	
V_d	− ·12		+ ·07	
Curv	− ·28		− ·28	
Radial Velocity	+68·4		+50·3	

ϵ URSÆ MAJORIS

Plate 456 taken 1906, Dec. 11, G. M. T. 17ʰ 06ᵐ
" 489 " " " 18 " 16 26

Line.	456.		489.	
	Vel.	Wt.	Vel.	Wt.
4584·018	.....	.....	−25·7	1
4558·827	−26·7	2	17·4	1
4549·642	2·1	2	25·2	2
4522·855	39·1	1	.....	.....
4515·508	14·5	3	13·9	1
4501·448	13·0	2	.....	.....
4481·400	21·1	3	20·1	3
4340·634	.....	.....	−33·4	2
4233·328	−13·2	1	.....	.....
Weighted Mean	−17·33		−23·45	
V_a	+17·25		+16·68	
V_d	+ ·15		+ ·15	
Curv	− ·50		− ·50	
Radial Velocity	− 0·4		− 7·0	

φ URSÆ MAJORIS

Plate taken 1908, April 13, G. M. T. $17^h\ 22^m$

Line.	Velocity.	Weight.
4549·766	+ 7·3	2
4481·400	5·6	2
4325·939	9·9	2
4308·081	29·3	1½
4271·760	15·4	2
4246·996	16·5	1
4063·756	13·4	1
4045·975	+ 5·8	2

Weighted Mean.....	+11·99	
V_a..............	−22·50	
V_d..............	− ·18	
Curv...........	− ·28	
Radial Velocity..............		−11·0

π^3 VIRGINIS

Plate 3349 taken 1910, March 18, G. M. T. $20^h\ 50^m$
" 3383 " " April 11 " 18 32

Line.	3349.		3383.	
	Vel.	Wt.	Vel.	Wt.
4584·018..................	−31·9	¼	....	....
4549·766..................	19·7	½	....	....
4481·400..................	−22·3	¾	−24·5	¾
4340·634..................	....	....	+ 0·8	1½
4143·928..................	....	....	− 9·5	¼
Weighted mean..........	−27·64		− 7·62	
V_a..................	− ·35		−12·10	
V_d..................	− ·26		− ·21	
Curv................	− ·28		− ·28	
Radial Velocity.........	−28·5		−20·2	

δ HERCULIS.

Thirty-seven plates of this star ($\alpha = 17^h\ 11^m$, $\delta = +24°\ 57'$) were made in the years 1907, 1908 and 1909, and from measures of some of the early plates it was announced as a spectroscopic binary. The spectrum is of A type but the hydrogen lines are unusually broad, often a width corresponding to 500 or 600 km. per sec., and hence a great deal of uncertainty is unavoidable in the results. The measures made on twenty-five plates run all the way from − 20 km. to − 80 km. per sec. but a considerable portion of this range, though not all, may be ascribed to accidental error of setting on such diffuse lines. Consequently the star was dropped from our programme for the time being.

APPENDIX B.

THE ELEMENTS OF 93 LEONIS, MEASURES OF ι CYGNI, α OPHIUCHI, σ CASSIOPEIÆ, AND 9 CAMELOPARDALIS.

J. B. Cannon, M.A.

The Elements of 93 Leonis.

The star 93 Leonis, ($\alpha = 11^h\ 43^m$, $\delta = +20°\ 46'$) was announced to be a binary by Campbell and Wright in 1900* from the measures of four plates taken by them in that year. It belongs to the group F8 of Miss Cannon's classification. It was under observation here at three different periods in the years 1908, 1909 and 1910. During that time seventy-two plates were taken, the instruments used being the old and new single-prism spectrographs.

The lines are not at all well defined and in many cases large differences result between the velocities given by the various lines and the mean of the plate. The lines appearing are chiefly due to Iron, Hydrogen, Magnesium, Titanium and Carbon. Several lines of each element were measured, but in the determination of the elements the Titanium lines were discarded, as so great differences between the velocities from its various lines existed that no dependence could be placed on them. A list follows giving the wave-lengths of the lines used and the element to which each is due:—

Wave-Length.	Element.	Wave-Length.	Element.
4861·527	H	4260·640	C
4549·766	Fe	4250·616	Fe
4481·400	Mg.	4227·010	Fe
4415·301	Fe	4216·351	Fe
4404·927	Fe	4101·890	H
4352·006	Mg. Cr.	4071·901	Fe
4340·634	H	4063·756	Fe
4325·939	Fe	4045·975	Fe
4271·760	Fe	3933·825	Ca

The period of oscillation was determined by the aid of the results obtained by Campbell and Wright from their measures of 1900 and found to be 71.70 days. This was taken as being close enough, their observations being some forty periods away from the date of the first plate obtained here.

At the maximum of the curve the determination was somewhat unsatisfactory, the weather unfortunately being very bad at each return of the star to that part of the curve so that only a few observations were obtained. Sometime later a few plates may be taken to verify the results accepted.

The record of the observations made and the detailed measures obtained will now be given followed by a summary giving the plate number, the Julian date, the phase, the accepted velocity, the weight and the residuals obtained from the two methods of measurement.

* Astrophysical Journal, 12, 255, 1900.

P—Plaskett.
H—Harper.
P¹—Parker.
C—Cannon.

RECORD OF SPECTROGRAMS

Star.	No. of Neg.	Camera.	Plate.	Date.	Middle of Exposure. G. M. T.	Duration.	Hour Angle at End.	Temperature. Room. Beg.	Room. End.	Prism Box. Beg.	Prism Box. End.	Slit Width.	Seeing.	Observer.	Remarks.
				1908	h m	m	h m								
93 Leonis...	1311	1L	Seed 27	Feb. 21	20 11	60	1 54 W	− 5·5	− 6·5	0·7	0·6	·0013	Hazy ½ time	H	
"	1356	"	"	" 24	17 39	32	25 E	−14·8	−14·6	− 2·3	− 2·3	"	Fair	P	
"	1381	"	"	Mar. 4	19 52	45	2 15 W	− 9·5	−10·0	+ 0·7	+ 0·7	"	....	P	
"	1388	"	"	" 9	18 27	45	1 22 W	− 9·5	−11·5	1·0	1·0	"	Fairly good	H	
"	1398	"	"	" 16	19 00	50	2 15 W	−10·0	−12·0	2·3	2·3	·0014	Good	H	
"	1498	"	"	April 17	13 40	40	1 00 E	7·0	6·6	10·9	10·8	·0015	Fair	P	
"	1534	"	"	May 18	13 55	50	1 20 W	21·5	20·5	21·3	23·9	·0016	Good	P	
"	1562	"	"	June 1	14 15	70	2 45 W	19·7	18·5	21·5	21·5	·0015	Poor	P	
"	1599	"	"	" 12	15 02	75	4 20 W	21·5	20·0	25·1	25·1	·0017	Good	H	
"	1627	"	"	" 24	14 25	90	4 30 W	23·5	21·6	28·0	27·5	·0015	Fair	P	
"	2022	"	"	Dec. 9	23 32	56	15 W	−20·0	−20·0	− 2·0	− 1·8	"	"	C	
"	2062	"	"	" 21	21 19	62	55 W	−14·5	−15·5	− 2·0	− 2·0	"	Good	C	
				1909											
"	2100	"	"	Jan. 6	22 29	67	1 25 W	−19·8	−20·0	− 3·3	− 3·2	"	Good	C	
"	2134	"	"	" 13	20 08	60	35 E	−16·4	−17·2	−12·2	−12·4	·0016	Fair	C	
"	2231	"	"	Feb. 3	18 08	65	1 10 E	−13·5	−12·0	− 3·9	− 4·0	"	"	C	
"	2262	"	"	" 8	21 05	70	2 10 W	−17·5	−19·0	− 5·5	− 5·3	"	"	H	
"	2300	"	"	" 22	19 45	60	1 40 W	− 5·4	− 5·4	1·0	0·8	"	"	C	
"	2341	1	"	Mar. 8	18 47	65	1 40 W	− 6·0	− 8·0	3·2	3·8	·002	Good	H	
"	2355	"	"	" 12	17 51	49	50 W	− 0·6	− 1·4	2·2	2·0	"	"	C	
"	2381	"	"	" 15	17 21	51	40 W	− 4·3	− 4·5	− 0·4	− 0·6	"	"	P¹	
"	2437	"	"	" 29	15 43	73	00	3·5	....	5·6	....	"	Poor	P¹	
"	2448	"	"	" 31	16 52	50	1 07 W	6·0	2·0	9·5	9·6	"	....	H	
"	2469	"	"	Apr. 1	20 23	64	4 50 W	− 1·5	− 1·5	8·2	8·3	"	Very hazy	P¹	
"	2481	"	"	" 8	16 05	70	1 00 W	4·0	3·0	8·0	8·0	"	Fair	P	
"	2501	"	"	" 19	18 12	55	4 00 W	3·2	2·7	6·4	6·4	"	Fair	P¹	
"	2509	"	"	" 23	16 42	75	2 40 W	3·5	3·5	10·6	10·6	"	Good	C	
"	2521	"	"	" 26	17 51	120	4 25 W	4·8	3·5	9·3	9·3	"	Very poor	P¹	
"	2528	"	"	" 28	16 22	75	2 40 W	3·0	0·5	8·9	9·0	"	Good	H	
"	2536	"	"	May 3	14 46	58	1 15 W	6·9	5·0	7·9	7·9	"	"	P¹	
"	2548	"	"	" 24	11 20	50	2 10 W	20·0	17·0	22·65	22·75	"	Hazy	P	
"	2562	"	"	June 9	11 27	95	3 35 W	21·0	19·2	24·4	24·2	"	Fair to poor	P	

P—Plaskett.
H—Harper.
P—Parker.
C[1]—Cannon.

RECORD OF SPECTROGRAMS—(Concluded).

Star.	No. of Neg.	Camera.	Plate.	Date.	Middle of Exposure. G. M. T.	Duration.	Hour Angle at End.	Temperature. Room. Beg.	Temperature. Room. End.	Temperature. Prism Box. Beg.	Temperature. Prism Box. End.	Slit Width.	Seeing.	Observer.	Remarks.
				1909	h m	m	h m								
93 Leonis...	2582	I	W. & W.	June 24	14 15	50	4 10 W	26·0	25·1	28·3	28·2	·002	Fair	P	
"	2586	"	Seed 27	" 25	13 47	55	3 35 W	23·5	22·5	26·7	26·7	"	Good	C	
"	2595	"	"	" 28	13 47	55	3 55 W	24·2	23·2	27·2	27·1	"	Fair	C	
"	2604	"	W. & W.	" 30	14 05	80	4 32 W	28·0	26·0	30·0	29·9	"	Hazy	H	
"	2633	"	Seed 27	July 8	14 00	62	4 45 W	21·0	21·0	24·8	24·4	"	Good	H	
"	2637	"	"	" 9	13 45	60	4 40 W	22·2	20·2	26·0	25·9	·0018	Fair	C	
"	2645	"	"	" 13	13 39	53	5 00 W	21·2	20·5	24·1	24·3	·002	Good	C	
"	2665	"	"	" 20	13 45	60	5 20 W	22·0	21·2	26·1	26·0	"	Hazy	C	
"	2700	"	"	Aug. 2	13 39	60	6 07 W	24·5	24·0	26·3	26·3	"	3-4	H	
"	2929	"	"	Oct. 29	22 35	50	3 10 E	−1·8	−1·9	5·6	5·8	·0017	5-3	P[1]	
				1910											
"	3116	"	"	Jan. 14	23 21	68	2 45 W	−16·5	−16·8	−8·3	−9·4	·002	5-3	P[1]	
"	3145	"	"	" 25	20 57	47	55 W	−7·8	−8·5	−3·1	−3·4	"	3	P	
"	3162	"	"	" 31	18 35	75	52 E	−10·0	−10·5	1·5	1·5	"	5-3-4	H	
"	3190	"	"	Feb. 18	18 17	141	25 W	−15·3	−17·5	−2·8	−3·8	"	...	H	
"	3211	"	"	" 23	16 26	60	1 35 E	−13·0	−14·1	−4·5	−4·6	"	5	P[1]	
"	3249	"	"	" 28	17 34	52	15 E	2·3	2·0	9·2	9·4	"	4-5	C	
"	3257	"	"	Mar. 2	17 43	63	10 W	0·5	0·3	10·6	10·6	"	5-4-2	P[1]	
"	3271	"	"	" 3	16 22	65	1 05 E	0·2	0·1	7·9	7·8	"	3	P	
"	3297	"	"	" 9	17 49	52	40 W	−4·5	−5·4	1·4	1·5	"	1-5	P[1]	
"	3322	"	"	" 11	16 26	73	27 E	1·0	1·0	6·0	5·8	"	5	H	
"	3342	"	"	" 18	16 02	86	21 E	−2·5	−4·0	2·8	2·6	"	3-1	H	
"	3365	"	"	" 28	17 27	50	1 27 W	10·3	9·6	18·5	18·4	"	5	C	
"	3376	"	"	Apr. 6	16 50	100	1 30 W	10·0	8·1	16·6	16·5	"	3-0	P[1]	
"	3379	"	"	" 11	15 45	60	45 W	4·6	3·5	9·6	9·5	"	4	C	
"	3387	"	"	" 12	18 32	65	3 35 W	0·0	−0·6	6·8	6·8	"	4	P[1]	
"	3396	"	"	" 14	17 10	90	2 40 W	9·6	8·2	12·1	12·0	"	3	P	
"	3398	"	"	" 20	17 46	120	3 50 W	10·7	9·0	15·9	16·0	"	2-0-2	P[1]	
"	3408	"	"	" 27	16 19	72	3 35 W	3·5	3·0	14·7	14·8	"	5	P[1]	
"	3420	"	"	May 4	17 12	65	3 45 W	9·4	8·6	13·6	13·6	"	4	C	
"	3423	"	"	" 5	14 10	60	50 W	11·5	9·7	11·4	14·4	"	3-1	P	
"	3438	"	"	" 10	17 22	60	4 15 W	10·0	9·6	15·8	15·7	"	4	C	

"	3442	"	"	"	11	16 27	66	3 28 W	7·0	7·0	16·3	15·5	"	3–4	H	
"	3447	"	"	"	12	15 06	59	2 05 W	7·0	6·0	18·0	17·8	"	...	P	
"	3450	"	"	"	16	16 20	120	4 07 W	14·1	14·0	21·6	21·4	"	2–3	C	
"	3452	"	"	"	19	13 50	60	1 20 W	14·3	13·3	18·4	18·4	"	4	P	
"	3459	"	"	"	27	17 07	65	5 15 W	......	12·0	......	16·1	"	4	P[1]	
"	3469	"	"	June	4	13 45	60	2 20 W	14·3	13·0	22·0	22·7	"	4	C	
"	3472	"	"	"	8	13 47	65	2 38 W	17·5	16·0	20·1	19·8	"	4	H	
"	3474	"	"	"	9	13 47	65	2 42 W	17·5	17·0	21·2	21·05	"	4–5	H	
"	3479	"	"	"	15	14 56	62	4 10 W	20·5	20·2	26·2	26·0	"	4	P[1]	
"	3494	"	"	"	24	13 48	24	....	22·0	......	25·5	......	"	4–0	H	Clouded.

MEASURES OF 93 LEONIS

(Comparator Measures, Standard Sun Plate 3755).

Region.	1341.		1356.		1381.		1388.		1398.		1498.		1498.*	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4	−28·73	...	−19·48	...	−28·11	...	...	...	+12·58	...	+50·55	...	+53·88	...
5	−25·54	...	−18·06	...	−24·71	...	...	...	...	...	+46·63	...	+36·83	...
6	...	...	...	...	...	...	...	...	...	...	+24·84	...	...	...
7	−29·00	...	−15·75	...	−20·09	...	−17·92	...	+ 6·52	...	+41·27	...	+30·41	...
8	−30·57	...	−22·66	...	−20·03	...	−16·13	...	+ 3·69	...	+37·94	...	...	...
9	−24·72	...	−20·68	...	−19·37	...	− 5·85	...	+ 6·56	...	+33·30	...	...	...
10	−31·43	...	−17·89	...	−19·34	...	−13·73	...	...	...	+36·75	...	...	...
11	−36·45	...	...	...	−18·09	...	−14·88	...	...	...	+41·45	...	...	...
12	...	...	...	...	−18·90	...	−15·30	...	...	...	+35·10	...	...	...
13	...	...	...	...	−27·95	...	...	...	...	...	...	...	...	...
Weighted Mean	−29·49		−19·09		−21·84		−14·45		+5·53		+38·62		+39·89	
V_a	+ 7·96		+ 6·07		+ 2·08		− ·37		−3·83		−17·81		−17·81	
V_d	− ·12		+ ·06		− ·16		− ·09		− ·16		+ ·10		+ ·10	
R. V. of Sun	− ·48		− ·48		− ·48		− ·48		− ·48		− ·48		− ·48	
Rad. Velocity	−22·1		−13·4		−20·4		−15·3		+1·0		+20·4		+21·7	

MEASURES OF 93 LEONIS—(Continued).

(Comparator Measures, Standard Sun Plate 3755).

Region.	1534.		1562.		1599.		1599.*		1627.		2100.		2134.		2231.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4	+10·11	..	+46·24	..	+51·79	..	+42·91	..	+36·84	..	− 9·86	..	+19·97	..	...	..
5	...	..	36·83	..	45·14	..	42·76	..	30·65	..	−10·69	..	9·74	..	−17·58	..
6	...	..	...	..	47·42	..	...	..	...	..	...	..	...	..	...	..
7	13·57	..	41·59	..	39·10	..	42·57	..	40·18	..	− 4·13	..	16·51	..	19·87	..
8	8·43	..	42·69	..	41·11	..	40·89	..	40·58	..	+ 2·32	..	+14·23	..	9·17	..
9	12·31	..	39·55	..	34·31	..	...	..	+36·83	..	− 3·03	..	...	..	22·00	..
10	7·25	..	+41·58	..	40·61	..	+34·04	..	...	..	...	..	...	..	−18·37	..
11	11·11	..	...	..	33·91	..	...	..	...	..	...	..	...	..	...	..
12	9·18	..	...	..	+36·90	..	...	..	...	..	...	..	...	..	...	..
13	+13·89	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..
Weighted Mean	+10·73		+41·41		+41·14		+40·63		+37·02		− 5·08		+14·63		−17·40	
V_a	−26·28		−27·80		−27·92		−27·92		−26·96		+25·48		+23·47		+15·89	
V_d	− ·09		− ·16		− ·20		− ·20		− ·25		− ·05		+ ·09		+ ·13	
R.V. of Sun	− ·48		− ·48		− ·48		− ·48		− ·48		− ·48		− ·48		− ·48	
Radial Velocity	−16·1		+13·0		+12·5		+12·0		+ 9·3		+19·9		+37·7		− 1·9	

* Check Measurement.

MEASURES OF 93 LEONIS—(Continued).

(Comparator Measures, Standard Sky Plate 3172).

Region.	2341.		2355.		2381.		2437.		2448.		2481.		2501.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4	+ 6·82	...	+19·45	...	...	...	...	...	...	...	...	...	+ 1·37	...
5	10·07	...	22·57	...	...	...	+42·64	...	+35·42	...	+18·11	...	+13·38	...
6	3·63	...	21·40	...	+30·84	...	34·24	...	39·66	...	32·73	...	− 9·44	...
7	14·20	...	22·99	...	25·65	...	35·94	...	38·11	...	18·15	...	+ 5·81	...
8	+11·74	...	16·88	...	23·63	...	43·65	...	36·67	...	31·08	...	+ 5·59	...
9	...	...	17·33	...	27·71	...	+53·10	...	+36·89	...	20·35	...	+ 6·71	...
10	...	...	9·69	...	+29·29	...	...	...	...	...	+20·46	...	+ 0·86	...
11	...	...	+10·40	...	...	...	...	...	...	...	...	...	...	...
Weighted Mean	+ 9·29		+17·59		+27·68		+40·67		+37·61		+23·48		+ 3·47	
V_a	+ ·24		− 1·72		− 3·09		− 9·81		−10·74		−14·19		−20·25	
V_d	− ·09		− ·04		− ·02		+ ·04		− ·06		− ·04		− ·23	
R. V. of Sun	+ ·26		+ ·26		+ ·26		+ ·26		+ ·26		+ ·26		+ ·26	
Radial Velocity	+ 9·7		+16·1		+24·8		+31·2		+27·1		+ 9·5		−16·8	

MEASURES OF 93 LEONIS—(Continued).

(Comparator Measures, Standard Sky Plate 3172).

Region.	2509.		2521.		2528.		2536.		2548.		2562.		2582.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4	+10·27	...	− 9·18	...	...	...	...	...	...	...	...	...	+28·77	...
5	6·56	...	− 9·84	...	+11·81	...	+ 0·26	...	+49·86	...	+45·92	...	26·50	...
6	2·77	...	− 8·81	...	+11·33	...	− 7·18	...	42·18	...	41·80	...	28·58	...
7	9·07	...	− 4·23	...	+ 6·65	...	− 4·23	...	43·32	...	46·22	...	27·59	...
8	+ 1·75	...	+ 0·93	...	−11·41	...	+ 8·38	...	38·18	...	51·80	...	+28·52	...
9	...	...	...	...	− 7·27	...	+ 2·80	...	44·16	...	50·09	...	...	...
10	...	...	...	...	− 4·52	...	...	...	+45·77	...	53·31	...	...	...
11	...	...	...	...	+ 4·16	...	...	...	...	...	+49·92	...	...	...
12	...	...	...	...	+ 0·80	...	...	...	...	...	...	...	...	...
Weighted Mean	+ 6·34		− 6·06		+ 1·70		+ 0·03		+44·17		+48·70		+27·99	
V_a	−19·90		−20·87		−21·51		−22·59		−27·09		−28·41		−26·97	
V_d	− ·14		− ·23		− ·14		− ·07		− ·13		− ·21		− ·27	
R.V. of Sun	+ ·26		+ ·26		+ ·26		+ ·26		+ ·26		+ ·26		+ ·26	
Radial Velocity	−13·7		−26·9		−19·7		−22·4		+17·2		+20·3		+ 1·0	

MEASURES OF 93 LEONIS—(Continued).
(Comparator Measures, Standard Sky Plate 3172).

Region.	2586.		2595.		2633.		2637.		2645.		2665.		2700.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4	+13·51	...	+11·81	...	...	...	-16·03	...	- 5·75	..	- 2·06	...	...	...
5	16·37	...	8·81	...	+ 4·59	...	19·02	...	- 3·67	...	12·86	...	+16·40	...
6	25·65	..	11·74	..	7·30	..	13·85	...	+ 0·63	...	6·04	...	31·21	...
7	18·86	...	10·71	...	1·81	...	5·81	...	- 1·45	...	3·87	...	30·85	...
8	14·35	...	12·30	..	3·26	...	4·42	..	- 7·22	..	10·13	...	35·00	...
9	16·91	...	10·23	..	5·59	...	12·30	..	- 5·59	.	8·94	...	+19·01	...
10	+16·83	..	13·00	..	4·85	...	5·17	...	- 7·75	...	-14·00	...	...	...
11	...	...	+10·81	..	2·39	...	6·97	...	- 9·05	...	...	...	...	...
12	...	...	...	...	+ 4·00	...	- 8·01	.	...	...	...	...	...	...
Weighted Mean	+17·76		+11·44		+ 4·22		- 9·92		- 4·98		- 8·27		+29·92	
V_a	-27·30		-26·44		-24·84		-24·35		-23·26		-21·35		-16·92	
V_d	- ·21		- ·23		- ·28		- ·27		- ·28		- ·28		- ·29	
R.V. of Sun	+ ·26		+ ·26		+ ·26		+ ·26		+ ·26		+ ·26		+ ·26	
Radial Velocity	- 9·5		-15·0		-20·6		-34·5		-28·3		-29·6		+13·0	

MEASURES OF 93 LEONIS—(Continued).
(Comparator Measures, Standard Sky Plate 3172).

Region.	2929.		3116.		3140.		3162.		3199.		3249.		3257.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4	+ 1·64	...	+18·08	..	-10·00	...	-40·83	..	...	...	...	...	...	...
5	3·28	...	15·09	..	14·04	.	40·41		...	..	-10·23	...	- 4·66	...
6	4·41	.	7·30	.	20·14	.	39·03	.	-30·85	...	7·55	.	- 0·97	...
7	3·39	.	6·05	.	22·02	...	42·11	..	42·11	...	11·49	..	+ 2·50	...
8	3·72	...	+ 8·38	..	17·23		35·85		36·67	...	14·55	.	+ 1·12	...
9	6·37	...	...	..	-13·64	.	40·02		42·26	...	11·74		- 3·23	...
10	1·40	...	...		...	.	34·68		42·22		13·78	..	- 4·16	...
11	4·16	..	...		..	.	-37·23	•	-41·81	.	16·12	...	- 2·50	...
12	+ 6·01	...	...		...	...	...	..	...	...	-16·52	...	...	...
Weighted Mean	+ 3·95		+10·45		-15·92		-38·51		-39·06		-12·75		- 1·69	
V_a	+21·75		+22·33		+19·49		+17·20		+ 9·18		+ 4·34		+ 3·36	
V_d	+ ·30		- ·14		- ·04		+ ·11		+ ·06		+ ·06		- ·03	
R.V. of Sun	+ ·26		+ ·26		+ ·26		+ ·26		- ·26		+ ·26		+ ·26	
Radial Velocity	+26·3		+32·9		+ 3·8		-20·9		-29·6		- 8·1		+ 1·9	

MEASURES OF 93 LEONIS—(Continued).

(Comparator Measures, Standard Sky Plate 3172).

Region.	3271.		3297.		3322.		3342.		3365.		3379.		3387.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4	+ 1·37										+11·37		+ 1·10	
5	+ 1·57						+20·99				10·50		− 6·30	
6	− 0·63		+20·40		+ 4·41		34·24		+34·87		11·58		+ 6·55	
7	− 2·42		16·34		15·12		32·06		35·69		9·32		− 0·24	
8	± 0·00		13·39		12·80		35·15		24·21		13·73		+ 7·92	
9	− 1·12		19·79		20·68		38·01		34·43		13·97		− 1·12	
10	− 0·54		17·45		20·46		29·83		16·69		6·25		+ 1·61	
11	+ 1·87		17·47		18·93		24·96		28·08		10·61		− 3·85	
12	− 4·80		+16·72		+22·22		24·02		31·03		+ 5·00			
13							24·56							
14							+28·06		+30·19					
Weighted Mean	− 0·52		+17·63		+16·63		+29·19		+29·40		+10·26		+ 0·97	
V_a	+ 2·89		− 0·12		− 1·08		− 4·51		− 9·27		−15·33		−15·78	
V_d	+ ·11		0·00		+ ·09		+ ·09		− ·09		− ·02		− ·21	
R.V. of Sun	+ ·26		+ ·26		+ ·26		+ ·26		+ ·26		+ ·26		+ ·26	
Radial Velocity	+ 2·7		+17·8		+15·9		+25·0		+20·3		− 4·8		−14·8	

MEASURES OF 93 LEONIS—(Continued).

(Comparator Measures, Standard Sky Plate 3172).

Region.	3396.		3398.		3408.		3420.		3423.		3438.		3442.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4	− 5·75		−12·33				+ 3·70							
5	− 0·26				+ 1·71		2·36		+13·12		+21·91		+15·74	
6	− 1·01		−11·58		+15·74		0·25		8·81		19·51		16·37	
7	− 9·32		3·87		−10·04		0·24		10·89		18·15		21·17	
8	+ 0·58		11·87		−12·80		5·24		15·13		16·30		25·03	
9	− 4·14		7·27		− 3·58		1·12		+16·43		21·47		21·80	
10	− 1·94		5·60		−10·45		0·86				22·40		23·15	
11	− 4·99		6·45		− 2·68		8·01				19·97		+26·52	
12	− 3·50		−11·71		−15·01		5·50				15·82			
13	+ 0·48				− 2·89		6·93				+23·11			
14	− 3·44				−10·22		+ 5·11							
Weighted Mean	− 3·03		− 6·95		− 5·01		+ 3·83		+12·88		+20·11		+21·40	
V_a	−16·52		−18·79		−21·12		−23·17		−23·40		−24·65		−24·86	
V_d	− ·14		− ·21		− ·21		− ·21		− ·03		− ·20		− ·21	
R. V. of Sun	+ 0·26		+ 0·26		+ 0·26		+ 0·26		+ 0·26		+ 0·26		+ 0·26	
Radial Velocity	−19·4		−25·7		−26·1		−19·3		−10·3		− 4·5		− 3·4	

MEASURES OF 93 LEONIS—(Continued).
(Comparator Measures, Standard Sky Plate 3172).

Region.	3441.		3450.		3452.		3459.		3469.		3172.		3474.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4							+53·43		+38·36		+41·10			
5	+31·49						51·82		43·30		45·66		+50·12	
6	28·33		+36·76		+14·69		45·32		56·28		54·13		54·77	
7	22·63		38·18		37·75		58·08		53·48		42·96		42·35	
8	23·28		39·58		38·99		55·52		55·29		44·00		41·32	
9	19·57		29·96		41·92		43·04		46·96		55·00		49·19	
10	+24·77		+28·00		45·77		+49·22		46·31		48·46		42·54	
11					43·16				48·36		45·97		35·67	
12					44·54				+40·04		45·54		44·81	
13					38·81						41·60		46·22	
14					+42·92						+42·27		+49·70	
Weighted Mean	+24·23		+34·82		+42·32		+50·92		+47·60		+46·32		+45·67	
V_a	−25·07		−25·87		−25·26		−27·20		−27·91		−27·99		−27·99	
V_d	− ·11		− ·21		− ·09		− ·30		− ·13		− ·14		− ·12	
R. V. of Sun	+ 0·26		+ 0·26		+ 0·26		+ 0·26		+ 0·26		+ 0·26		+ 0·26	
Radial Vel.	− 0·7		+ 9·0		+17·2		+23·7		+19·8		+18·4		+17·8	

MEASURES OF 93 LEONIS—(Continued).
(Micrometer Measures).

λ	1341.		1341.*		1356.		1381.		1388.		1398.		1498.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4549	−36·24	1	−31·27	2	−21·43	½	−22·03	2	−10·84	½	+10·47	1		
4481													+32·92	½
4415	−25·96	1	−34·00	1	−28·05	1	−38·94	1	−25·63	1	−20·35	2	+31·35	2
4404	−40·84	1	−52·86	1	−25·35	1	−15·62	2	−25·66	2	− 0·87	2	+29·16	2
4352					−11·57	1	− 7·26	2	− 7·78	1	−13·68	½		
4340	−37·50	1	−30·38	2	−25·26	1	− 5·22	1	−21·30	2	+15·35	1½	+33·72	1
4325	−35·33	½	−42·35	1	−21·03	1			−10·23	2	−14·56	2		
4315	−37·10	1												
4271	−17·16	1½	−16·76	2			−25·10	1	+ 8·04	1½			+24·10	2
4260	−31·00	1	−34·42	2							+ 3·25	2	+37·00	1
4227	−22·14	1½	−37·98	2	−14·86	1	−25·03	1	−16·11	2	− 2·78	1		
4202			−31·90	2	−21·64	1								
4143	−28·60	½	−33·85	1					−21·46	1				
4132	−22·69	1	−25·23	2										
4092	−25·72	1												
4102			−37·58	1					−14·15	1	−32·72	½		
4071	−23·02	1												
4063	−34·94	1												
4045	−31·79	½											+23·87	
Weighted Mean	−30·00		−32·45		−21·18		−18·42		−17·25		− 6·28		+28·98	
V_a	+ 7·96		+ 7·96		+ 6·07		+ 2·08		− ·37		− 3·83		−17·81	
V_d	− ·12		− ·12		+ ·06		− ·16		− ·09		− ·16		+ ·10	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Vel.	−22·4		−24·2		−15·3		−16·8		−18·0		−10·5		+15·6	

* Check measurement.

MEASURES OF 93 LEONIS—(Continued).
(Micrometer Measures).

λ	1534.		1562.		1599.		1627.		2022.		2062.		2100.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861													−18·46	½
4549	+ 0·60	2	+33·35	2	+37·68	½	+32·39	1	−59·28	¼	−40·26	½	− 5·68	½
4481					+40·63	½	+58·35	¼			−18·38	½	+ 0·69	½
4454							+26·35	½					+ 4·28	1
4415	+12·76	2	+58·19	1			+47·39	1						
4404	+ 9·39	3	+45·32	2										
4383									−57·67	¼	−18·72	¼		
4352	+11·89	2			+51·02	1							+15·88	½
4340	+18·16	2	+41·45	2	+48·44	1	+33·62	1½	−30·56	¼			+11·44	1
4325			+24·07	2			+59·23	1	−38·75	¼			+ 8·31	½
4271	+18·05	2			+37·30	½					−12·98	¼	− 8·59	½
4260	+ 2·07	1												
4227	+11·03	1	+35·58	2	+32·99	½	+38·17		−63·47	¼				
4167							+46·99	½						
4143	− 4·49	1	+31·70	1										
4123					+28·82	1								
4102			+23·87	1									− 5·42	½
4092	+ 7·58													
Weighted Mean	+ 9·71		+36·56		+40·52		+41·32		−49·91		−24·83		+ 1·63	
V_a	−26·28		−27·80		−27·92		−26·96		+28·84		+27·40		+25·48	
V_d	− .09		− ·16		− ·20		− ·25		+ ·02		− ·03		− ·05	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Vel.	−16·9		+ 8·3		+12·1		+13·8		−21·3		+ 2·3		+26·8	

MEASURES OF 93 LEONIS—(Continued).
(Micrometer Measures).

λ	2134.		2231.		2262.		2300.		2341.		2355.		2381.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861	− 5·53	½	−19·81	½			−26·32	½						
4549			−40·86	¼	−52·35	½	−52·71	¼	+ 6·53	1			+ 9·20	½
4481	+ 3·01	¼					−37·11	¼	− 7·27	¼	+13·26	½	+38·14	½
4443							−46·13	½						
4415			−16·92	½	−49·01	¼								
4404			−24·92	¼	−27·23	¼								
4395			−14·29	¼										
4352									+ 6·88	½	+ 5·84	½	+30·80	½
4340	− 7·24	½	−16·80	1	−24·46	½	−25·93	½	+ 0·23	½	+33·50	½	+16·67	½
4325			−43·09	¼										
4315	− 7·65	½							− 6·70	½				
4308									− 3·05	½				
4271	−13·69	½	−33·33	½	−22·78	¼	−22·78	¼	− 0·77	1	+19·16	½		
4227			−16·52	½	−10·69	¼			− 3·62	½				
4143			−28·05	½										
4102	−27·82	¼	−33·25	1			−45·24	½			+ 3·08	1		
Weighted Mean	− 3·50		−25·12		−32·92		−35·98		− 0·17		+12·99		+23·70	
V_a	+23·47		+15·89		+13·63		+ 7·11		+ 0·24		− 1·72		− 3·09	
V_d	+ ·09		+ ·13		− ·11		− ·09		− ·09		− ·04		− ·02	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Vel.	+19·8		− 9·4		−19·7		−29·4		− 0·3		+11·3		+20·3	

MEASURES OF 93 LEONIS—(Continued).

(Micrometer Measures).

λ	2437.		2448.		2469.		2481.		2501.		2509.		2521.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4549			+21·31	½					− 2·80	½	+15·32	¼	+17·98	½
4481	+29·30	½	+18·98	¼	+20·00	¼	+15·80	1	+18·73	½				
4352	+28·54	½	+18·18	½	+52·19	½	+26·80	½	+13·23	½	+ 2·21	½	+16·66	¼
4340	+45·66	½	+51·43	½	+33·29	½	+19·07	1	+14·45	1			− 7·51	¼
4325							+16·58	½	− 5·15	½				
4315											− 3·97	½		
4271	+23·85	½	+31·07	¼			+16·27	½	+11·10	1				
4227	+39·29	½			+48·87	½	+28·79	½	+ 5·42	½			+14·66	½
4102							+10·48	1	−10·39	½				
4063							+25·44	½						
4045							+28·17	½						
Weighted Mean	+33·33		+38·13		+41·24		+19·66		+ 7·01		+ 2·35		+12·40	
V_a	− 9·81		−10·74		−10·27		−14·19		−20·25		−19·90		−20·87	
V_d	+ ·04		− ·06		− ·28		− ·04		− ·23		− ·14		− ·23	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	+23·3		+22·7		+30·4		+ 5·1		−13·8		−18·0		− 9·0	

MEASURES OF 93 LEONIS—(Continued).

(Micrometer Measures).

λ	2528.		2536.		2548.		2562.		2582.		2586.		2595.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4549	− 7·19	¼	+21·85	¼					+12·64	½			+27·14	½
4481	− 7·52	¼	+30·32	½	+15·39	½					+31·93	½		
4395									+29·87	½				
4383			+32·06	½					+39·51	½				
4352	+10·95	½			+43·15	½	+62·14	1	+32·71	1	+44·90	1	+10·82	½
4340	+ 8·67	½	+ 4·28	¼	+39·12	½	+51·24	1	+11·08	1	+11·08	½	+16·85	1
4325									+42·60	½	+31·40	1		
4300					+26·56	¼								
4271	+ 9·34	¼	+ 5·82	½							+13·39	½	+27·48	½
4233													+31·47	¼
4227	−12·32	½	− 0·11	¼	+29·91	½	+44·02	½			+17·28	½	+23·97	½
4216	−19·50	¼												
4102							+21·99	¼					+16·33	½
4045													+27·67	½
Weighted Mean	− 1·01		+14·04		+31·30		+51·24		+23·80		+28·28		+21·51	
V_a	−21·51		−22·59		−27·09		−28·41		−26·97		−27·28		−26·44	
V_d	− ·14		− ·07		− ·13		− ·21		− ·27		− ·21		− ·23	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	−23·0		− 8·9		+ 3·8		+22·3		− 3·7		+ 0·4		− 5·5	

MEASURES OF 93 LEONIS—(Continued).
(Micrometer Measures).

λ	2604.		2633.		2637.		2645.		2665.		2700.		2929.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861			+33·82	¼	−10·74	½	+13·94	½	+ 9·94	½	+30·80	¼		
4549	+30·60	½			− 6·79	½	+28·07	½	+15·97	½	+14·23	1		
4481			− 8·78	1			+ 9·03	¼	− 0·25	½	+ 9·67	½	− 2·68	½
4352	+12·57	½	+18·38	1	−15·71	½	+10·24	1	+26·41	¼	+26·31	½	− 1·87	¼
4340	+ 8·54	¼	+11·43	½	− 1·27	1	+13·62	½	+ 4·15	½	− 5·65	½	+ 8·80	1
4325					+20·67	½			+29·08	½				
4271	+24·14	¼	− 5·93	¼							+37·08	½	+ 7·27	1
4260													+19·60	½
4227			+ 3·61	1	+12·09	½							+10·00	1
4216			−20·52	½										
4143									− 2·29	¼				
4102													+ 6·94	½
4063													+19·32	½
4045													+ 5·79	¼
Weighted Mean	+19·84		+ 3·48		+ 0·43		+14·66		+11·01		+17·12		+ 8·94	
V_a	−26·12		−24·84		−24·35		−23·26		−21·35		−16·92		+ 21·75	
V_d	− ·28		− ·28		− ·27		− ·28		− ·28		− ·29		+ ·20	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	− 6·9		−22·0		−24·0		− 9·2		−10·9		− 0·4		+ 30·6	

MEASURES OF 93 LEONIS—(Continued).
(Micrometer Measures).

λ	3116.		3145.		3162.		3190.		3211.		3249.		3257.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861			−39·83	½	−43·36	½					− 8·67	¼		
4549					− 3·47	½			−16·95	½	−16·27	½	+ 4·13	¼
4481					−49·11	¼							− 3·18	½
4352	+21·71	½											+ 7·22	½
4340	− 4·40	½	−28·69	1	−28·93	1	−21·52	1	−50·10	½	−19·21	½	− 0·92	1
4325			−27·48	½	−34·35	½					−32·98	¼	− 7·78	½
4308			−11·98	½									+ 4·06	½
4271	+ 0·11	½	−25·21	½										
4216			−44·20	¼					−47·37	½				
4102	+ 8·19	½			−58·65	¼			−31·12	1	−17·24	1	+ 2·12	½
4071	+ 0·09	1												
4063									−35·93	½	± 0·00	¼	− 1·12	¼
4045			−13·51	½							−16·91	½		
Weighted Mean	+ 4·29		−26·33		−32·15		−21·52		−35·43		−16·56		+ 0·26	
V_a	+22·33		+19·49		+17·20		+ 9·18		+ 6·81		+ 4·34		+ 3·36	
V_d	− ·14		− ·04		+ ·11		+ ·06		+ ·14		+ ·06		− ·03	
Curv.	− ·28		− ·30		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	+26·3		− 7·2		−15·1		−12·6		−27·8		−12·4		+ 3·3	

MEASURES OF 93 LEONIS—(Continued).
(Micrometer Measures).

λ	3271.		3297.		3222.		3342.		3365.		3376.		3379.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861			+ 8·02	¼	+ 9·31	½	+ 7·23	¼	+51·78	¼			+19·09	½
4549	+ 4·80	¼	+26·11	½			+ 9·60	½	+23·81	¼	+25·14	½	+10·26	½
4481	− 8·54	½	−12·23	¼	− 3·95	¼			+31·04	½	+13·10	¼	+ 6·62	½
4404			+ 5·08	½	+13·90	¼								
4352	− 0·58	½	+ 8·16	¼	+22·25	½	+25·44	½	+25·03	½	+10·94	¼	+14·10	½
4340	+ 6·13	1	+24·85	1	+23·70	1	+23·95	1	+22·85	1	+12·00	½	+ 0·23	1
4325	+ 1·14	½			+12·24	½	+23·70	¼	+18·04	¼			+ 6·06	¼
4271													+17·36	½
4250			+22·05	¼										
4227			+21·88	½									+16·99	½
4102	−10·97	½	+ 5·96	1	− 0·19	½	+12·04	1	+21·22	½				
4071			+22·42	¼	+25·42	½							+26·93	¼
4063	− 8·39	¼					+18·20	½						
4045	− 3·21	½							+17·31	½			+ 1·74	¼
Weighted Mean	− 1·46		+15·43		+16·29		+17·59		+24·95		+16·39		+10·24	
V_a	+ 2·89		− 0·12		− 1·08		− 4·51		− 9·27		−13·27		−15·33	
V_d	+ ·11		·00		+ ·09		+ ·09		− ·09		− ·07		− ·02	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	+ 1·3		+15·0		+15·0		+12·9		+15·3		+ 2·8		− 5·4	

MEASURES OF 93 LEONIS—(Continued).
(Micrometer Measures).

λ	3387.		3396.		3398.		3408.		3420.		3423.		3438.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861	+16·36	½					− 5·46	½					+ 4·65	½
4549			+17·85	½					− 4·13	½	+ 4·93	¼	+16·52	½
4481	−10·27	¼	+ 8·79	½					− 3·82	¼	− 1·27	½		
4415	+ 3·26	½	+25·58	½										
4404					+ 1·09	½	− 3·02	½	− 3·63	¼	− 2·18	½	+22·50	¼
4352	+10·36	½	+ 5·36	1	+ 4·19	¼	−15·26	½			+ 0·93	½	+ 3·61	¼
4340	+ 2·66	1	+11·56	1	− 7·62	1	− 8·44	½	+ 9·02	1	+ 5·43	½	+ 4·05	½
4325	+10·18	½	− 5·95	½	− 9·02	¼	− 8·01	½	+ 6·06	½	+ 0·57	½	+ 4·92	½
4271	+18·24	½	+ 0·77	1			+ 2·42	½	+ 9·67	½				
4227	+ 7·22	½	+ 6·69	½	−13·16	½	− 4·89	½			+ 2·87	½	+ 9·98	½
4198			+12·57	½			− 9·95	½						
4102									− 2·12	½	−11·74	¼	− 2·69	¼
4063	+21·71	¼									− 4·85	½	+ 8·11	½
4045	− 3·68	¼			+12·00	½			+13·95	½			+ 4·04	½
Weighted Mean	+ 7·88		+ 8·40		− 2·11		− 6·00		+ 4·72		− 0·25		+ 7·36	
V_a	−15·78		−16·52		−18·79		−21·12		−23·17		−23·40		−24·65	
V_d	− ·21		− ·14		− ·21		− ·21		− ·21		− ·03		− ·20	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	− 8·4		− 8·5		−21·4		−27·7		−18·9		−24·0		−17·8	

MEASURES OF 93 LEONIS—(Continued).

(Micrometer Measures).

λ	3442.		3447.		3450.		3452.		3459.		3469.		3472.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861	.....	...	.....	...	.....	...	+30·94	½	.....	...	+44·56	½	.....	...
4549	.....	...	+24·34	½	+18·75	¼	.....	...	+54·66	½	+42·69	1	+29·39	½
4520	.....	...	.....	...	.....	...	.....	...	.....	...	.....	...	+68·67	¼
4481	+27·86	¼	+26·84	¼	+11·70	¼	.....	...	+36·38	¼	.....	...	+45·66	½
4415	.....	...	.....	...	+10·82	½	.....	...	.....	...	+51·92	¾	+62·38	½
4404	+ 4·95	½	+16·31	½	+28·75	½	+16·67	½	+61·73	½	+44·21	¾	.....	...
4352	+29·49	½	+ 6·63	¼	+44·35	½			+55·29	½	+48·66	¼	.....	...
4340	+18·35	1	+16·04	½	+39·12	½	+42·01	1	+62·43	½	+50·54	½	+53·31	1
4325	+ 8·11	½	.....	...	.....	...	+23·87	½	.....	...	.....	...	.....	...
4315	.....	...	.....	...	.....	...	+24·25	½	+78·91	½	.....	...	.....	...
4271	+31·94	½	+20·29	½	.....	...	+39·60	½	.....	...	.....	...	+49·14	½
4260	.....	...	.....	...	.....	...	.....	...	.....	...	+42·72	1	+57·24	½
4227	.....	...	+22·71	½	+29·39	½	.....	...	.....	...	.....	...	+46·05	½
4143	.....	...	.....	...	.....	...	.....	...	.....	...	.....	...	+43·73	½
4102	+39·46	¼	.....	...	.....	...	+34·37	½	+61·44	½	+41·28	1	+44·74	½
4071	.....	...	.....	...	.....	...	+39·77	½	.....	...	+52·00	1	.....	...
4063	+37·68	½	.....	...	.....	...	.....	...	+48·73	¼	.....	...	.....	...
4045	.....	...	.....	...	.....	...	+20·70	½	.....	...	.....	...	.....	...
Weighted Mean	+22·31		+19·41		+27·91		+31·42		+56·35		+46·00		+49·46	
V_a	−24·86		−25·07		−25·87		−25·26		−27·20		−27·91		−27·99	
V_d	− ·21		− ·11		− ·21		− ·09		− ·30		− ·13		− ·14	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	− 3·0		− 6·0		+ 1·6		+ 5·8		+28·5		+17·7		+21·0	

MEASURES OF 93 LEONIS—(Concluded).

(Micrometer Measures).

λ	3474.		3479.		3494.									
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861	+48·73	½	.....	...	.....	...	.....	...	.....	...	.....	...	.....	...
4549	+59·05	½	+10·64	¼	.....	...	.....	...	.....	...	.....	...	.....	...
4481	+52·15	¼	+41·98	¼	.....	...	.....	...	.....	...	.....	...	.....	...
4415	.....	...	+51·10	½	+ 0·37	½	.....	...	.....	...	.....	...	.....	...
4404	+43·00	½	.....	...	+ 5·56	¼	.....	...	.....	...	.....	...	.....	...
4352	+34·45	½	+10·48	½	+28·28	½	.....	...	.....	...	.....	...	.....	...
4340	+51·24	½	+35·20	½	.....	...	.....	...	.....	...	.....	...	.....	...
4271	+59·35	1	.....	...	− 7·90	½	.....	...	.....	...	.....	...	.....	...
4227	+45·84	½	.....	...	.....	...	.....	...	.....	...	.....	...	.....	...
4102	+49·54	½	.....	...	.....	...	.....	...	.....	...	.....	...	.....	...
Weighted Mean	+50·17		+33·67		+ 6·72		.....		.....		.....		.....	
V_a	−27·99		−27·81		−27·02		.....		.....		.....		.....	
V_d	− ·12		− ·27		− ·27		.....		.....		.....		.....	
Curv.	− ·28		− ·28		− ·28		.....		.....		.....		.....	
Radial Velocity	+21·8		+ 5·3		−20·8		.....		.....		.....		.....	

SUMMARY OF OBSERVATIONS

Plate No.	Julian Date.	Phase.	Velocity.	Weight	Residual M.	Residual C.
1341	2,417,993·84	36·29	−23·6	6	− 4·1	+ 1·5
1356	996·73	39·18	−15·3	4	+ 4·6	+12·3
1381	8,005·82	48·27	−16·8	4	+ 3·0	+ 0·8
1388	010·77	53·22	−15·2	3	− 0·7	+ 2·0
1398	017·79	61·04	−10·5	3	−11·0	− 2·0
1498	049·57	20·32	+ 8·1	5	+ 3·1	+13·0
1534	080·57	51·32	−16·9	6	± 0·0	± 0·0
1562	094·59	66·14	+ 8·3	4	− 4·0	− 0·7
1599	105·62	4·67	+12·1	3	−14·0	−14·0
1627	117·60	16·65	+14·0	5	+ 2·0	− 4·7
2022	285·98	41·63	−21·3	3	− 1·5	....
2062	297·89	53·54	+ 2·3	2	+15·3	....
2100	313·94	70·39	+26·8	6	+ 6·4	− 1·5
2134	320·83	4·78	+19·8	3	− 4·0	+11·6
2231	341·67	25·62	− 9·4	5	− 4·0	+ 1·2
2262	346·88	30·83	−19·7	2	− 6·3	....
2300	360·82	44·77	−29·0	3	− 8·0	....
2341	374·78	59·53	− 0·3	3	+ 2·0	+ 8·0
2355	378·74	63·49	+11·3	4	+ 6·0	+ 6·1
2381	381·72	66·47	+20·3	3	+ 6·5	+ 8·5
2437	395·66	7·91	+23·3	3	− 0·8	+ 5·0
2448	397·70	9·95	+22·7	3	+ 0·7	− 2·3
2469	398·85	11·10	+30·4	1	+ 9·8	....
2481	405·67	17·92	+ 5·1	5	− 4·1	− 2·2
2501	416·76	29·01	−13·8	4	+ 1·6	− 3·8
2509	420·69	32·94	−18·0	2	− 3·0	+ 6·1
2521	423·74	35·99	− 9·0	3	+10·0	+ 3·8
2528	425·68	37·93	−23·0	4	− 0·8	+ 5·1
2536	430·61	42·86	− 8·9	2	+ 6·1	+ 3·6
2548	451·60	64·65	+ 3·8	4	− 5·2	+ 4·4
2562	467·60	8·15	+22·3	4	− 1·5	− 5·9
2582	482·60	23·15	− 3·7	2	− 3·0	+ 0·5
2586	483·58	24·13	+ 0·4	2	+ 2·5	− 7·9
2595	486·58	27·13	− 5·5	5	+ 2·0	− 6·5
2604	488·60	29·15	− 6·9	2	+ 4·5	....
2633	496·58	37·13	−22·0	3	+ 0·1	+ 3·8
2637	497·57	38·12	−24·0	3	− 1·8	− 9·3
2645	501·57	42·12	− 9·2	3	+13·0	− 2·1
2665	508·57	49·12	−10·9	2	+ 8·5	− 9·6
2700	521·57	62·92	− 0·3	2	− 5·0	+ 3·7
2929	610·05	7·09	+30·6	4	+ 5·5	− 0·5
3116	686·97	12·42	+26·3	3	+ 7·5	+11·0
3145	697·87	23·32	− 7·2	4	− 6·0	+ 3·5
3162	703·77	29·23	−15·2	1	− 4·4	− 8·0
3199	721·76	46·21	−12·6	2	+ 8·5	− 6·3
3211	726·68	52·13	−27·8	2	−12·3	....
3249	731·73	57·98	−12·4	4	− 5·5	− 5·3
3257	733·74	59·99	+ 3·3	5	+ 4·8	− 0·6
3271	734·68	60·93	+ 1·3	4	− 1·2	− 1·8
3297	740·74	66·99	+15·0	4	+ 0·5	+ 0·5
3322	742·68	68·93	+15·0	3	− 2·8	− 4·8
3342	749·67	3·42	+12·9	3	−12·1	− 0·5
3365	759·73	13·48	+15·3	6	− 1·8	+ 0·3
3376	768·70	22·45	+ 2·8	2	+ 2·5	....
3379	773·66	27·41	− 5·4	4	+ 2·5	+ 4·5
3387	774·77	28·52	− 8·4	3	+ 1·5	− 3·5
3396	776·72	30·47	− 9·4	4	+ 3·5	− 3·9
3398	782·74	36·49	−21·4	3	+ 1·1	− 1·7

SUMMARY OF OBSERVATIONS—(Concluded).

Plate No.	Julian Date.	Phase.	Velocity.	Weight	Residual M.	Residual C.
3408	2,418,789·68	43·43	−27·7	5	− 5·5	− 0·5
3420	796·72	50·47	−18·9	5	− 0·8	− 1·5
3423	797·59	51·34	−24·0	4	− 7·0	+ 5·9
3438	802·72	57·27	−17·8	5	−10·8	− 0·2
3442	803·69	58·24	− 3·0	5	+ 2·0	− 1·4
3447	804·62	59·17	− 6·0	4	− 2·5	− 1·2
3450	808·68	63·23	+ 1·6	2	− 4·0	− 0·8
3452	811·58	66·13	+ 5·8	4	− 6·7	+ 2·5
3459	819·71	1·76	+28·5	4	+ 5·0	− 1·9
3469	827·57	9·62	+17·7	4	− 4·6	− 5·2
3472	831·57	13·62	+21·0	5	+ 3·5	− 1·5
3474	832·57	14·62	+21·8	5	+ 6·3	− 0·2
3479	838·62	20·67	+ 5·3	2	+ 0·7	....
3494	847·58	29·63	−20·8	2	− 8·1	....

Notes 1. Phases are from J. D. 2,418,029·255.
2. Weights are reckoned on standard 10, 5 for character of plate and 5 for agreement in measurement of lines.
3. Residual M is that from Micrometer measurement.
" C " " " Comparator "

The seventy-two observations were grouped into the following normal places:—

NORMAL PLACES

	Julian Date.	Phase.	Velocity.	Residual, O-C.	Weight.
1	2,418,317·48	37·28	−20·2	−0·12	3
2	515·92	43·02	−20·9	+1·25	2
3	497·50	48·93	−16·1	+3·18	1·5
4	338·54	52·02	−17·3	−1·55	2
5	672·90	57·74	−10·0	−4·12	2
6	649·39	60·11	+ 1·5	+2·26	2
7	480·61	64·81	+10·1	+0·23	2·5
8	456·85	69·10	+22·9	+4·46	1
9	543·96	4·35	+22·0	−3·13	2
10	556·70	9·61	+22·6	−0·01	2
11	804·94	13·88	+19·1	+2·36	2
12	267·14	18·58	+ 8·6	+0·46	2
13	626·12	23·27	− 3·0	−2·05	1
14	554·60	27·22	− 7·1	+0·94	2
15	601·07	30·09	−15·0	−2·55	2

Dr. King's graphic method was then used in determining the preliminary elements.

These were:—

$$\gamma = -0.578 \text{ km.}$$
$$K = 24 \text{ km.}$$
$$e = .1$$
$$\omega = 330^\circ$$
$$T = 2{,}418{,}028.85$$
$$P = 71.7 \text{ days.}$$
and $$\Sigma pvv = 147.1$$

It was decided to apply the method of least-squares to reduce this value of Σpvv if possible. Observation equations were formed by means of the formula of Lehmann-Filhés.*

OBSERVATION EQUATIONS

x	y	z	u	v	C-O-N	Weight.
1·000	− ·838	+ ·962	− ·332	+ ·310	−0·48	3
"	− ·913	+ ·838	+ ·078	− ·023	−1·59	2
"	− ·800	+ ·096	+ ·513	− ·415	−3·67	1·5
"	− ·656	− ·402	+ ·720	− ·630	+0·98	2
"	− ·242	−1·026	+ ·995	− ·980	+3·62	2
"	− ·024	−1·010	+1·044	−1·075	−2·66	2
"	+ ·437	− ·383	+ ·987	−1·087	−0·18	2·5
"	+ ·811	+ ·523	+ ·739	− ·830	−4·01	1
"	+1·086	+ ·883	+ ·066	− ·019	+3·50	2
"	+ ·954	− ·023	− ·447	+ ·548	−0·27	2
"	+ ·689	− ·744	− ·748	+ ·818	−3·14	2
"	+ ·320	− ·990	− ·922	+ ·918	−1·50	2
"	− ·057	− ·656	− ·940	+ ·871	+1·05	1
"	− ·345	− ·121	− ·852	+ ·759	−1·76	2
"	− ·526	+ ·289	− ·741	+ ·651	+1·81	2

in which

$$x = \delta\gamma$$
$$y = \delta K$$
$$z = K\delta e = 24\ \delta e$$
$$u = K\delta\omega = 24\ \delta\omega$$
$$v = \frac{K\mu}{(1-e^2)^{\frac{3}{2}}}\ \delta T = 2.135\ \delta T$$

From the above observation equations there result the following normal equations:—

$29\cdot000x$	$-\ 1\cdot182y$	$-\ 2\cdot673z$	$+\ \cdot426u$	$-\ \cdot436v$	$-\ 12\cdot375=0$
	$12\cdot975y$	$-\ 2\cdot954z$	$-\ \cdot632u$	$+\ \cdot715v$	$+\ 3\cdot205=0$
		$14\cdot556z$	$-\ 2\cdot571u$	$+\ 2\cdot620v$	$+\ 5\cdot272=0$
			$15\cdot578u$	$-15\cdot517v$	$+\ 4\cdot554=0$
				$15\cdot601v$	$-\ 4\cdot601=0$

The solution of which gives

$$x = +\ .3791$$
$$y = -\ .3354$$
$$z = -\ .4327$$
$$u = +\ .4741$$
$$v = +\ .8652$$

Hence the corrections

$$\delta\gamma = +\ \ .379\text{ km.}$$
$$\delta K = -\ \ .335\text{ km.}$$
$$\delta e = -\ \ .018$$
$$\delta\omega = +\ 1''.146$$
$$\delta T = +\ \ .405$$

* A.N. No. 3242.

These results gave satisfactory differences between the residuals from observation equations and the computed residuals, the highest difference being .06. Σpvv was reduced to 137.4.

The probable error of a normal place was found to be ± 2.5 and that of an average plate—found by scaling residuals from the curve — to be ± 3.4. Probable errors of the elements were also found and are given below together with the final values accepted.

$$\begin{aligned} \gamma &= -.20 \text{ km.} \pm .31 \\ K &= 23.665 \text{ km.} \pm .48 \\ e &= .082 \pm .02 \\ \omega &= 331°.15 \pm 0°.72 \\ T &= 2{,}418{,}029.255 \; J.D. \pm 2.1 \text{ days} \\ P &= 71.7 \text{ days.} \\ a \sin i &= 23{,}250{,}000 \text{ km.} \end{aligned}$$

Thinking the probable error of a plate rather high for this type of star, it was decided to try measuring the plates with the spectro-comparator. All the plates, with the exception of ten which were too faint for this method, were re-measured. The standard plates used were Nos. 3172 and 3755, the former a sky plate taken with the new single-prism spectrograph and the latter a sun plate taken with the old.

The measures were grouped into fifteen normal places as before, each plate being placed in the same normal place as in the former work. These places are given below with the mean Julian Day, the phase from final T, the mean velocity, weight and residual from final curve.

NORMAL PLACES

	Julian Day.	Phase.	Velocity.	Weight.	Residual O-C.
1	2,418,317·48	49·83	−22·7	5	+2·09
2	631·43	55·47	−26·2	2	−0·11
3	497·50	61·48	−22·9	3	−2·38
4	285·08	64·31	−14·0	3	+1·75
5	672·90	70·79	− 3·5	4	−2·32
6	649·52	1·76	+ 5·8	3	+1·11
7	480·61	6·32	+17·2	5	+2·57
8	456·85	10·22	+18·5	2	−2·82
9	543·96	16·96	+25·0	3	−1·66
10	558·42	21·89	+24·7	3	−0·15
11	804·94	26·43	+18·9	3	−0·30
12	190·95	30·85	+13·7	3	+2·77
13	590·48	36·03	− 0·4	2	+0·22
14	562·36	39·55	− 8·8	3	−0·28
15	652·17	42·60	−18·4	3	−3·65

These normal places were plotted and the following preliminary elements were obtained graphically:—

$$\begin{aligned} \gamma &= 0 \\ K &= 26 \text{ km.} \\ e &= 0 \\ \omega &= 270° \\ T &= 2{,}418{,}088.405 \; J.D. \\ P &= 71.70 \text{ days.} \end{aligned}$$

The value of Σpvv was computed and found to be 207. One least-squares solution was applied to the above elements. As seen above the eccentricity is zero. T and ω have been given values for the purposes of the solution. The value of T was taken as fixed, for with e zero and ω 270° it would be impossible to obtain corrections to e, ω and T as two of the equations would be identical. Observation equations were formed and normal equations found from them, as follows:—

$47x$	$+ \cdot 183y$	$+ 1\cdot 657z$	$+ 2\cdot 498u$	$- 9\cdot 340 = 0$
	$21\cdot 018y$	$- \cdot 967z$	$+ \cdot 800u$	$- 11\cdot 176 = 0$
		$23\cdot 699z$	$+ \cdot 887u$	$- 5\cdot 108 = 0$
			$25\cdot 985u$	$- 10\cdot 570 = 0$

The solution of these equations gave the following corrections to the elements:—

$$\delta\gamma = + .17 \text{ km.}$$
$$\delta K = + .54 \text{ km.}$$
$$\delta e = + .008$$
$$\delta\omega = + 0°.81$$

Hence the corrected values of the elements:—

$$\gamma = + .17 \text{ km.}$$
$$K = 26.54 \text{ km.}$$
$$e = .008$$
$$\omega = 270°.81$$
$$T = 2{,}418{,}088.405\ J.D.$$
$$P = 71.70 \text{ days.}$$
$$a \sin i = 26{,}170{,}000 \text{ km.}$$

These elements gave a new value of Σpvv of 196. This is a very small reduction — about 5%, — but the excellent agreement between the residuals, computed and observation equations, showed that further application of least-squares would be useless.

The probable error of a normal place and of an average plate were computed and found to be ± 2.85 and ± 3.4 respectively. There were three plates 1498, 1599 and 2134 which for some unknown reason gave abnormally high residuals, being — 14.0, + 11.6 and + 13.0 respectively. If these be omitted the probable error of an average plate becomes ± 2.87.

The probable errors of the elements were also computed and are attached to the final values in the table below. The table gives the elements obtained in the two ways of measurement with their probable errors.

Element.	Micrometer.	Comparator.
γ	— ·20 km ± ·31	+ ·17 km ± ·42
K	23·665 km ± ·18	26·54 km ± ·62
e	·082 ± ·02	·008 ± ·02
ω	331°·15 ± ·0°·72	270°·81 ±1°·26
T	2,418,029·255 J.D. ± 2·1 d.	2,418,088·405 J.D.
P	71·70 days.	71·70 days.
a sin i	23,250,000 km.	26,170,000 km.
Probable error of average plate	±3·5	±3·4 ±2·9*
Probable error of average normal place	±1·5	±1·4

* Omitting plates 1498, 1599 and 2134.

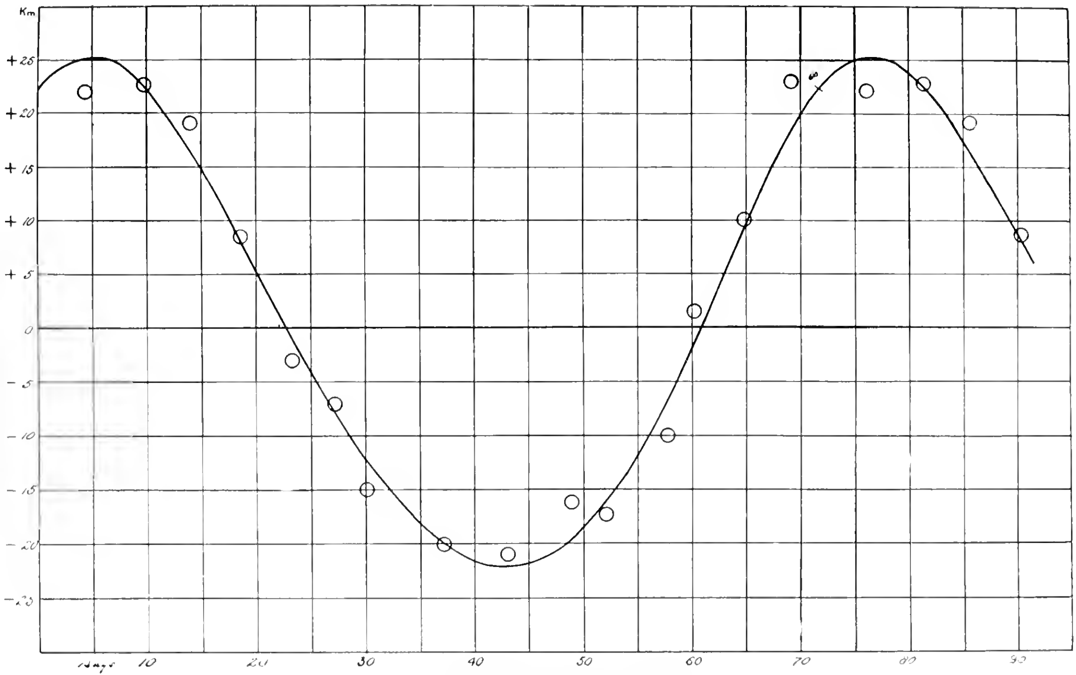


FIG. 7.—Velocity Curve of 93 Leonis.

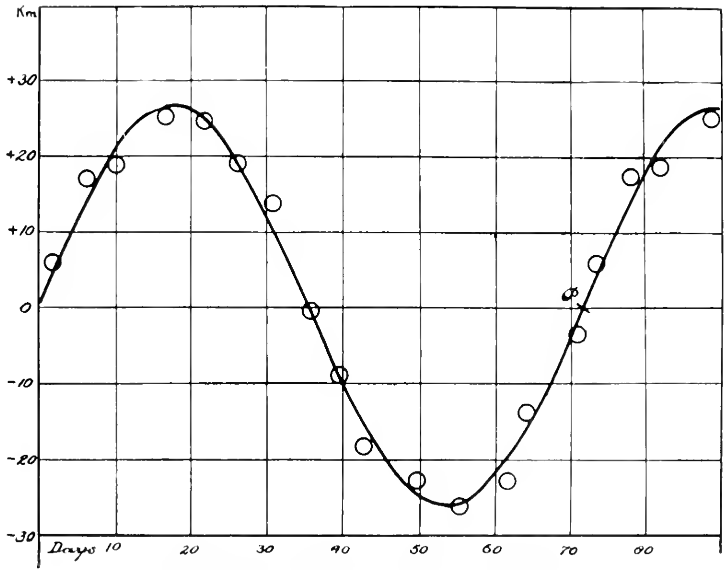


Fig. 8 Velocity Curve of 93 Leonis (Comparator Measurement).

Judging from the probable error of an average plate, there is little difference between the two methods of measurement. There is something to be said in favour of each. Underexposed plates may be measured by the micrometer, which would not permit of measurement by the comparator. On the other hand it is impossible to obtain good agreement in the velocities obtained from the various lines in a spectrum like that of this star, and on such a spectrum perhaps the best work can be done with the comparator, which enables the measurer to strike a mean all along the plate.

As regards the elements obtained, K is the only one, which shows a change worthy of note. The eccentricity is very small in both cases and the differences in ω need not be remarked upon.

ι Cygni.

Seven plates of this star were taken and measured. The spectrum shows the hydrogen lines, β, γ, δ and ϵ, and the calcium line K. The magnesium line λ 4481 appears occasionally but is barely discernible. The lines are all very broad and difficult to measure accurately, as is shown by the widely different velocities obtained from the various lines on the same plate. The star was dropped from the observing list here on account of the programme being so full at that time. The measures follow:—

P—Plaskett.
H—Harper.
P[1]—Parker.
C—Cannon.

RECORD OF SPECTROGRAMS

Star.	No. of Neg.	Camera.	Plate.	Date.	Middle of Exposure G.M.T.	Duration.	Hour Angle at End.	Temperature. Room. Beg.	Room. End.	Prism Box. Beg.	Prism Box. End.	Slit Width.	Seeing.	Observer.	Remarks.
				1907	h m	m	h m								
ι Cygni.....	932	I L	Seed 27	July 9	17 52	15	0 53 E	20·2	19·7	25·0	24·9	·0011	Good.......	H	
"	1718	"	"	" 15	20 22	55	3 55 W	11·5	13·5	21·9	21·9	·0015	Fair........	H	
"	1804	"	"	Aug. 20	18 19	15	5 30 W	15·3	14·2	22·2	22·1	"	Fair........	P[1]	
"	1824	"	"	" 21	18 22	55	4 35 W	14·2	13·5	22·6	22·7	"	Good.......	P[1]	
"	1839	"	"	" 27	16 52	55	3 12 W	16·3	15·0	22·8	22·8	"	"	C	
"	1845	"	"	" 28	15 05	55	1 28 W	17·0	16·1	23·2	23·2	"	"	C	
"	1886	"	"	Sept. 14	14 34	52	2 05 W	16·9	15·5	21·6	21·5	"	Fair.......	P	

MEASURES OF ι CYGNI.

λ	932.		1718.		1804.		1804.		1824.		1824.		1839	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861·527......							−12·18	1	− 3·62	½	+ 1·16	½	−33·23	½
4481·400......	− 6·79	½												
4340·634......	−44·37	1½	− 2·40	1½	− 9·60	1	+ 1·35	½	−24·01	1	−14·51	1	− 8·87	1
4101·890......	− 9·29	1	−19·70	1	−34·46	½	−44·26	½	−31·24	1	−52·16	½	+ 7·55	¼
3933·825......									+ 4·94	½	+ 5·84	½	− 4·27	½
Weighted Mean......	−26·41		− 9·32		−17·89		−16·82		−18·20		−14·84		−11·45	
V_a	+ 6·44		+ 5·07		− 2·56		− 2·56		− 3·41		− 3·41		− 4·03	
V_d	+ ·03		− ·16		− ·21		− ·21		− ·18		− ·18		− ·13	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity...	−20·2		− 4·7		−20·9		−19·9		−23·1		−18·7		−15·9	

MEASURES OF ι CYGNI—(Concluded).

λ	1845.		1886.											
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861·527......	−17·99	½	−37·58	½										
4304·634......	−22·34	1	11·48	1										
4101·890......	+ 1·90	½	1·21	1										
3933·825......	−19·32	1	33·29	½										
Weighted Mean......	−16·57		−14·37											
V_a	− 4·24		− 7·31											
V_d	− ·05		− ·09											
Curv.	− ·28		− ·28											
Radial Velocity...	−21·1		−22·0											

SUMMARY OF MEASURES OF ι CYGNI

Plate.	Date.	Vel.	Plate.	Date.	Vel.
932	July 9 1907........	−20·2	1824	August 24 1907........	−18·7
1718	" 15 "	− 4·7	1839	" 27 "	−15·9
1804	August 20 "	−20·9	1845	" 28 "	−21·1
1804	" 20 "	−19·9	1886	September 14 "	−22·0
1824	" 24 "	−23·1			

α Ophiuchi

This star was under observation during the summer of 1908, when twenty-four plates were taken. These were all measured and considerable range was found in the velocities obtained. The lines, however, are all broad and it is hard to get satisfactory agreement in the measurement of them. The lines appearing are the hydrogen lines β, γ, δ and ϵ, the magnesium line λ 4481, and the calcium K. It may be stated that the magnesium line was measured in many cases but does not appear in the measures following, for the reason that it differed to such a degree from the other lines. Whether this is a real difference or an error due to the character of the line it is hard to say. More plates will probably be taken and an attempt made to solve the system.

P —Plaskett.
H —Harper.
P[1]—Parker.
C —Cannon.

RECORD OF SPECTROGRAMS

Star.	No. of Neg.	Camera.	Plate.	Date.	Middle of Exposure. G.M.T.	Duration.	Hour Angle at End.	Temperature Centigrade. Room. Beg.	Room. End.	Prism Box. Beg.	Prism Box. End.	Slit Width.	Seeing.	Observer.	Remarks.
				1908	h m	m	h m								
α Ophiuchi.	1481	I L	Seed 27	Apr. 13	20 35	16	0 20 W	1·0	0·0	8·0	8·0	·0018	Good.......	H	
"	1542	"	"	May 18	19 52	19	1 15 W	16·0	15·5	23·4	23·4	·0016	"	H	
"	1549	"	"	" 22	19 59	20	1 37 W	19·0	19·0	25·0	25·0	·0017	"	H	
"	1612	"	"	June 17	19 37	15	3 00 W	14·5	14·4	21·8	21·6	·0016	"	P[1]	
"	1632	"	"	" 24	17 42	10	1 30 W	19·2	19·0	27·5	27·5	·0015	"	P	
"	1649	"	"	" 27	17 45	10	1 40 W	19·8	19·5	23·7	23·6	·0014	"	P	
"	1654	"	"	July 1	17 50	10	2 05 W	19·7	19·6	25·8	25·7	·0015	Fair.......	P	
"	1688	"	"	" 10	17 07	14	1 55 W	21·0	20·5	27·4	27·3	·0016	Good.......	H	
"	1701	"	"	" 13	17 51	13	2 49 W	18·8	18·7	23·0	23·0	·0015	Fair.......	P	
"	1702	"	"	" 13	18 13	22	3 15 W	18·7	18·5	23·0	"	"	"	P-P[1]	
"	1715	"	"	" 15	18 57	12	4 06 W	14·5	14·5	22·0	22·0	"	Good......	H	
"	1724	"	"	" 24	14 39	11	21 W	23·0	23·0	26·2	26·2	·0016	"	H	
"	1752	"	"	" 31	16 13	13	2 30 W	20·0	19·6	26·0	26·0	·0015	"	P[1]	
"	1765	"	"	Aug. 5	16 00	13	2 28 W	21·6	21·6	26·9	26·9	"	......	P	
"	1819	"	"	" 24	14 42	14	2 27 W	17·0	17·0	23·2	23·4	"	"	H	
"	1834	"	"	" 27	13 09	12	1 04 W	19·4	19·0	23·6	23·4	"	"	C	
"	1843	"	"	" 28	13 31	12	1 32 W	18·3	18·5	23·2	23·2	"	"	C	
"	1854	"	"	" 31	14 38	17	2 53 W	22·0	21·5	27·8	28·0	"	Fair.......	H	
"	1862	"	"	Sept. 3	13 11	15	1 40 W	18·8	18·0	21·1	21·0	"	Good......	P	
"	1863	"	"	" 3	13 27	15	1 57 W	18·0	17·8	21·0	"	"	" ...	P	
"	1884	"	"	" 14	13 26	15	2 38 W	18·2	17·8	21·7	21·6	"	Fair.. ..	P	
"	1885	"	"	" 14	13 46	18	3 00 W	17·8	17·0	21·6	"	"	"	P	
"	1890	"	"	" 16	12 46	23	2 10 W	19·5	19·0	21·7	21·7	"	"	P	
"	1891	"	"	" 16	13 12	25	2 35 W	19·0	18·2	"	21·6	"	"	P	

MEASURES OF α OPHIUCHI

λ	1481.		1542.		1542.		1549.		1612.		1612.		1632.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861·527......	−13·06	½	+ 6·52	½	− 7·25	½	+11·75	¼	......		......		+29·16	½
4549·766......	−21·43	½	......				......		......		......		......	
4481·400......	−29·00	½			−11·86	½	......				......		......	
4340·634......	−26·00	1	+ 2·71	1	−11·53	1½	+31·11	1	+28·08	1	+32·57	¾	+43·01	1
4101·890......	+ 8·76	½	+ 0·87	1	− 6·03	1	− 3·30	½	− 4·07	1	+17·36	½	+13·10	1
3933·825......	......		+23·21	½	+ 6·44	¼	......		......		......		+ 9·04	1
Weighted Mean......	−17·79		+ 6·14		− 9·17		+18·51		+12·00		+ 8·27		+23·07	
V_a	+13·24		+ 9·67		+ 9·67		+ 8·16		− 2·17		− 2·17		− 4·92	
V_d	·00		− ·09		− ·09		− ·12		− ·21		− ·21		− ·12	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Vel......	− 4·8		+15·4		+ 0·1		+16·3		+ 9·3		+ 5·6		+17·7	

MEASURES OF α OPHIUCHI—(*Continued*).

λ	1619.		1654.		1688.		1701.		1702.		1715.		1724.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861·527......	+29·16	½	+21·04	½	+21·47	½	......		+24·95	½	+28·58	½	+22·49	½
4340·634......	+27·35	½	+26·52	1½	+16·70	1	+12·21	1	+ 3·96	½	+ 3·86	1	+ 0·63	¼
4101·890......	+ 6·77	½	+23·78	1	+34·72	1	+ 1·61	½	−10·15	½	− 1·13	½	+52·42	½
3933·825......	+17·15	1	+15·43	¼	......		+20·82	½	+ 1·72	½	+30·56	½	+30·56	1
Weighted Mean......	+19·51		+23·98		+24·86		+11·72		+ 5·12		+13·15		+30·30	
V_a	− 5·98		− 7·63		−11·00		−12·01		−12·01		−12·72		−15·58	
V_d	− ·12		− ·15		− ·14		− ·22		− ·22		− ·28		− ·02	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Vel...	+13·1		+15·9		+13·4		− 0·8		− 7·3		− 0·1		+14·4	

MEASURES OF α OPHIUCHI—(*Continued*).

λ	1752.		1765.		1819.		1819.		1834.		1843.		1854.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861·527......	+34·10	½	+25·39	½	+39·47	½	+13·92	½	+14·95	½	+54·70	½	+79·08	½
4340·634......	+ 4·17	1	+35·45	1½	+13·36	1	+ 3·54	1	+30·59	1	+47·50	1	+44·47	1
4101·890......	+36·30	½	+50·84	¼	+53·76	¼	+ 0·86	1	+19·01	½	+26·90	½	+31·07	¼
3933·825......	+19·02	¼	+25·02	1	.....	.	+19·99	1	+33·33	½	+35·65	1	......	...
Weighted Mean.......	+19·61		+34·95		+26·60		+ 8·46		+25·69		+41·32		+52·45	
V_a	−17·72		−19·11		−22·66		−22·66		−23·05		−23·18		−23·49	
V_d	− ·19		− ·18		− ·18		− ·18		− ·09		− ·12		− ·21	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Vel...	+ 1·4		+15·4		+ 3·5		−14·7		+ 2·3		+17·7		+28·5	

MEASURES OF α OPHIUCHI—(*Concluded*).

λ	1862.		1863.		1884.		1885.		1885.		1890.		1891.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861·527......	+21·33	½	+ 4·35	½	+37·00	½	+26·70	½			+23·07	½	+61·66	½
4340·634......	+42·70	½	+50·73	1	+11·17	½	+56·48	1	+62·74	1	+16·18	1	+14·92	¼
4101·890......	+22·05	¼	+62·49	½	+28·03	½	+65·71	½	+67·27	½	+26·90	½	+ 8·50	½
3933·825......	+38·05	½	+42·69	½	+32·13	½	+32·06	½			+28·38	1	+13·78	½
Weighted Mean.......	+32·31		+42·20		+27·33		+47·48		+64·25		+23·18		+26·15	
V_a	−23·58		−23·58		−24·02		−24·02		−24·02		−21·80		−21·80	
V_d	− ·12		− ·14		− ·21		− ·21		− ·21		− ·15		− ·15	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Vel...	+ 8·3		+18·2		+ 2·8		+23·0		+39·7		+ 0·9		+ 3·9	

SUMMARY OF MEASURES OF α OPHIUCHI

Plate No.	Date.	Vel.	Plate No.	Date.	Vel.
1481	April 13, 1908	− 4·8	1752	July 31, 1908	+ 1·4
1542	May 18 "	+15·4	1765	Aug. 5 "	+15·4
	" 18 "	+ 0·1	1819	" 24 "	+ 3·5
1549	" 22 "	+16·3		" 24 "	−14·7
1612	June 17 "	+ 9·3	1834	" 27 "	+ 2·3
	" 17 "	+ 5·6	1843	" 28 "	+17·7
1632	" 24 "	+17·7	1854	" 31 "	+28·5
1649	" 27 "	+13·1	1862	Sept. 3 "	+ 8·3
1654	July 1 "	+15·9	1863	" 3 "	+18·2
1688	" 10 "	+13·4	1884	" 14 "	+ 2·8
1701	" 13 "	− 0·8	1885	" 14 "	+23·0
1702	" 13 "	− 7·3		" 14 "	+39·2
1715	" 15 "	− 0·1	1890	" 16 "	+ 0·9
1724	" 24 "	+14·4	1891	" 16 "	+ 3·9

σ Cassiopeiae

This star was under observation here during the summer and fall of 1909. A number of plates were taken and measured. The spectrum is of the helium type—hydrogen, helium, the calcium *K*, and one or two faint iron lines showing. The lines are all broad and ill-defined and measures on them are liable to be greatly in error.

P —Plaskett.
H —Harper.
P¹—Parker.
C —Cannon.

RECORD OF SPECTROGRAMS

Star.	No. of Neg.	Camera.	Plate.	Date.	Middle of Exposure. G.M.T.	Duration.	Hour Angle at End.	Temperature Centigrade. Room. Beg.	Room. End.	Prism Box. Beg.	Prism Box. End.	Slit Width.	Seeing.	Observer.	Remarks.
				1909	h m	m	h m								
σ Cassiopeiæ	2660	I	Seed 27	July 14	19 35	60	1 20 E	18·6	17·5	26·2	26·2	·002	Fair........	P	
"	2680	"	"	" 27	19 00	70	1 00 E	21·6	21·0	29·0	29·2	"	"	C	
"	2784	"	W&W X	Sept. 14	13 40	90	2 58 E	24·5	22·0	27·4	27·2	"	3.........	H	
"	2839	"	Seed 27	Oct. 4	15 45	60	22 W	13·8	13·1	23·21	23·00	"	5......	C	
"	2902	"	"	" 20	16 47	65	2 15 W	2·0	2·0	6·9	6·8	"	5-3-4.......	P¹	
"	3009	"	"	Dec. 2	10 00	72	3 20 W	0·5	0·0	2·2	2·0	"	4-0........	P¹	
				1910											
"	3521	"	"	July 11	18 32	76	2 30 E	19·0	17·5	27·0	26·8	"	3-4-5......	C	
"	3527	"	"	" 13	17 37	55	3 27 E	20·5	19·5	25·5	25·3	....	5..........	P¹-C	

MEASURES OF σ CASSIOPEIAE.

λ	2660.		2680.		2784.		2839.		2839.		2902.		2902.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861·527......					−88·95	¼	+ 5·77	½	−11·86	½				
4471·676......	−60·90	¼	−50·69	½	−54·23	¼	+ 5·81	½	+ 2·65	½	−48·60	1	−45·41	1
4404·927......			−45·87	½							−24·98	½	−31·31	¼
4388·100......	−75·34	¼			+ 2·27	½								
4340·634......	−26·08	1	−27·35	1	−15·46	1	− 6·46	½	+10·96	½	+ 4·51	½	+ 1·50	¼
4282·722......													−45·99	¼
4143·928......	−30·12	½	−65·20								−17·41	¼	−29·75	¼
4121·016......	−39·63	½	−33·03	1										
4101·890......	−25·63	1	−19·68	¼	−30·62	¼	−15·07	½	−10·75	½				
4026·352......	−53·34	1	−60·01	½	−69·02	½	− 5·76	½					− 7·83	¼
4009·417......	−40·36	¼									−54·74	¼		
3933·825......	−34·03	½	−46·29	¼			− 3·15	½	−13·23	½	− 7·06	¼	− 2·49	¼
Weighted Mean.......	−38·30		−40·34		−33·56		− 3·15		− 4·45		−28·59		−29·92	
V_a	+17·20		+18·78		+17·08		+ 8·34		+ 8·34		+ 0·23		+ 0·23	
V_d	+ ·10		+ ·07		+ ·17		·00		·00		− ·08		− ·08	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity....	−21·3		−21·8		−16·6		+ 4·9		+ 3·6		−28·7		−30·0	

MEASURES OF σ CASSIOPEIAE—(*Concluded*).

λ	3009.		3521.		3527.									
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4481·400......	−21·02	½												
4471·676......	−22·65	½												
4404·927......	−17·33	¼			+17·79	¼								
4340·634......	−39·30	¼	−34·97	½	− 1·85	½								
4250·616......	−19·47	¼												
4143·928......			+17·40	½	+15·11	½								
4101·890......			−11·23	¼	+32·26	½								
4026·352......			+ 6·85	½										
3933·825......			−26·56	1	−44·43	1½								
Weighted Mean.......	−25·34		−12·63		−44·43*									
V_a	−13·11		+18·78		+18·88									
V_d	− ·12		+ ·14		+ ·18									
Curv.	− ·28		− ·28		− ·28									
Radial Velocity...	−38·8		+ 6·0		−25·6									

* Last line only.

SUMMARY OF MEASURES OF σ CASSIOPEIAE

Plate No.	Date.	Vel.	Plate No.	Date.	Vel.
2660	July 14, 1909	−21·3	2902	Oct. 20, 1909	−28·7
2680	" 27 "	−21·8		" 20 "	−30·0
2784	Sept. 14 "	−16·6	3009	Dec. 2 "	−38·8
2839	Oct. 4 "	+ 4·9	3521	July 11, 1910	+ 6·0
	" 4 "	+ 3·6	3527	" 13 "	−25·6*

9 Camelopardalis.

Four plates of this star were taken and measured here in the autumn of 1909. The spectrum shows quite a large number of lines due to hydrogen, helium and calcium, and a few faint ones due to iron, together with the lines λλ 4096 and 4089. The interesting thing about the star is the fact that the calcium lines *H* and *K* show velocities different from the other lines. Observations were being taken of this star at the Yerkes Observatory, and our measures of it were sent to them and consequently it was dropped from our list.

* One line—*K*.

RECORD OF SPECTROGRAMS

C—Cannon.
P[1]—Parker.

Star.	No. of Neg.	Camera.	Plate.	Date.	Middle of Exposure. G.M.T.	Duration.	Hour Angle at End.	Temperature. Room. Beg.	Room. End.	Prism Box Beg.	Prism Box End.	Slit Width.	Seeing.	Observer.	Remarks.
				1909	h m	m	h m								
9 Camelop.	2805	I	Seed 27	Sept. 20	18 44	42	2 45 E	11·5	11·7	20·3	20·2	·002	5........	C	
"	2842	"	"	Oct. 4	17 43	53	2 45 E	12·0	11·0	22·85	23·0	"	5........	C	
"	2874	"	"	" 8	18 52	46	1 15 E	14·1	12·4	22·6	22·7	"	5........	P[1]	
"	2875	"	"	" 8	19 36	38	35 E	12·4	12·7	22·7	"	"	5........	P[1]	

MEASURES OF 9 CAMELOPARDALIS

λ	2805.		2842.		2874.		2874.		2875.		2875.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4861·527			−17	½			−57	¼	−16	¼	−40	¾
4471·676	+23·6	½	−21	½	+15	1	+18	¾	−19	½	−20	¾
4437·718					−14	¼						
4388·100	+14·0	¼										
4340·634	+12	1	+16	1	− 8	1	+20	½	− 1	1	− 3	1
4143·928			+34	½								
4116·4	−13	1	−19	¼	−31	¼			−18	¼		
4101·890	−21	½	+29	¼	−23	1	+19	½	+12	½	+25	¼
4096·9	+24	½	+48	¼								
4089·1	−24	½	− 5	¼	−15	½	−23		−24	¼	−40	¼
4026·352	−21	½	+25	½	− 8	½	−21	½				
3970·177			− 5	½	+13	½			+17	¼		
3968·625	−28	1	−23	1	−25	1	−25	1	−30	1½	−30	1½
3933·825	−27	½	−14	1½	−13	1½	−18	1½	−21	1	−23	1½
*Weighted Mean	−27·50		−17·60		−17·60		−20·80		−26·40		−26·50	
V_a	+21·28		+19·95		+19·35		+19·35		+19·35		+19·35	
V_d	+ ·10		+ ·10		+ ·04		+ ·04		+ ·04		+ ·04	
Curv	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	− 6·4		+ 2·2		+ 1·5		− 1·7		− 7·3		− 7·4	

SUMMARY OF MEASURES OF 9 CAMELOPARDALIS

Plate.	Date.	Vel.	Plate.	Date.	Vel.
2805	September 20, 1909	− 6·4	2874	October 8, 1909	− 1·7
2842	October 4 "	+ 2·2	2875	" 8 "	− 7·3
2874	" 8 "	+ 1·5	"	" 8 "	− 7·4

* Last two lines only.

APPENDIX C.

THE ORBIT OF ω URSAE MAJORIS. MEASURES OF ζ AQUILAE AND ν CYGNI.

T. H. Parker, M.A.

The Orbit of ω Ursae Majoris.

The star ω Ursae Majoris ($\alpha = 10^h\ 48^m$, $\delta = +43°\ 43'$, phot. mag. 4.8) was announced as a spectroscopic binary by Vogel in 1903.* It was included in a list of 528 stars whose spectra were investigated by Vogel and Wilsing at Potsdam. Vogel states that on one plate he found an indication of the doubling of the *K* line, and the *Mg* line λ 4481 doubled on one or two others.

It was first observed here in Feb. 1908 and since then sixty-nine spectrograms have been obtained—fifteen with the old, and the remainder with the new single-prism spectrograph. This star is an A type, according to the Harvard classification, the principal lines measured being the *Mg* λ 4481, the hydrogen series and *K*. Only three of the plates obtained here show definite double lines. This is probably due to the faintness of the secondary component, whose mass as seen later is only about one-sixth that of the primary, as well as to insufficient dispersion in separating the two spectra. The length of exposure required for a star of this magnitude forbade the use of the three-prism instrument. On this account also Seed 27 plates were used for the majority of the spectrograms. Six were taken, however, on Seed 23, and the finer grain gave a much better spectrum. The average length of exposure required for these was 90 minutes. The blending of the lines of the two spectra made the measurement of the plates rather unsatisfactory. In one plate in which the lines were separated, those which showed doubling were the *Mg* line λ 4481 and the two iron lines λ 4325 and λ 4308. In another, the lines λ 4308 and λ 4101 (H_δ) were found to be doubled, with faint indications also of a secondary spectrum in iron lines λ 4549, λ 4325 and λ 4260. In the third plate, only λ 4308 was measurable. No trace of a doubling of the *K* line was found on any of our plates.

The lines measured were as follows:—

Elements.	Wave-Length.	No. of times measured.
H_β	4861·527	12
Fe	4549·766	46
Mg	4481·400	69
H_γ	4340·634	58
Fe	4325·939	5
Fe	4233·328	7
Si	4128·211	9
H_δ	4101·890	33
Ca (*K*)	3933·825	39

* Astronomische Nachrichten, 163, p.145, 1903.

The hydrogen lines with the exception of H_γ are broad and diffuse. The *Mg* λ 4481 is the best line in the spectrum and was measured on every plate, as will be seen in the table above. Metallic lines other than *Mg* λ 4481, *Fe* λ 4549 and *K* do not occur frequently. As different lines on the same plate in many cases gave widely differing velocities, the determination of the period offered some difficulty. Several such plates were re-measured or 'checked' by other observers, and the resulting means taken. These measures were usually in fair agreement. From the consideration of the velocities of the *Mg* line alone, the period was found to be between fifteen and sixteen days. Several trials using the velocities of whole plates gave 15.84 days as the most satisfactory period.

Following is the record of observations and detailed measures of the plates, and this is followed by a summary of the measures containing the velocities and the phases and residuals from the final elements.

P—Plaskett.
H—Harper.
P^1—Parker.
C—Cannon.

RECORD OF SPECTROGRAMS

Star.	No. of Neg.	Camera.	Plate.	Date.	Middle of Exposure. G.M.T.	Duration.	Hour Angle at End.	Temperature Centigrade. Room. Beg.	Room. End.	Prism Box. Beg.	Prism Box. End.	Slit Width in Inches.	Seeing.	Observer.	Remarks.
				1908	h m	m	h m								
ω Ursæ Majoris.	1340	1 L	Seed 27	Feb. 21	17 15	43	1 47 W	− 5·0	− 5·5	0·8	0·7	·0016	Fair........	H	
"	1386	"	"	Mar. 9	17 07	55	55 W	−10·5	− 9·5	0·4	0·9	"	Fair........	P	Off 10 min.
"	1489	"	"	Apr. 15	16 42	45	2 50 W	0·0	− 2·0	8·0	8·0	"	Good.......	H	
"	1499	"	"	" 17	14 32	25	30 W	6·5	6·0	10·8	10·8	"	Fair........	P	Clouded over
"	1537	"	"	May 18	15 52	45	4 15 W	19·8	19·0	23·4	23·4	"	Fair........	P	
"	1579	"	"	June 5	15 45	64	5 23 W	19·0	19·0	24·7	24·7	"	Fair........	H	
"	1637	"	"	" 26	14 55	90	6 11 W	22·5	21·0	30·0	30·0	"	Good.......	H-C	
"	2021	"	"	Dec. 9	22 34	52	23 W	− 2·0	− 2·0	− 2·4	− 2·0	·0015	Fair........	C	
"	2037	"	"	" 16	22 30	50	45 W	−11·0	−11·8	2·8	2·8	"	Good.......	C	
"	2063	"	"	" 21	22 24	61	1 05 W	−15·5	−15·5	− 1·9	− 1·9	"	"	C	
				1909											
"	2099	"	"	Jan. 6	21 24	62	1 10 W	−19·0	−19·8	− 3·7	− 3·3	"	"	C	
"	2232	"	"	Feb. 3	19 22	75	1 05 W	−12·0	−12·0	− 4·0	− 4·0	·0016	Very Hazy..	C	
"	2259	"	"	" 8	19 05	50	53 W	−17·0	−17·0	− 5·3	− 5·3	"	Fair........	H	
"	2299	"	"	" 22	18 10	70	1 00 W	− 4·0	− 3·9	1·0	1·0	"	Hazy.......	C	
"	2321	"	"	Mar. 3	18 00	70	1 35 W	− 5·2	− 5·6	− 0·9	− 0·6	"	"	C	
"	2354	I	"	" 12	16 22	45	15 W	− 0·6	− 0·6	2·8	2·8	·0018	Good.......	C	
"	2369	"	"	" 13	16 39	42	35 W	− 0·4	− 0·5	3·2	3·1	·002	"	P	
"	2411	"	"	" 22	16 47	35	1 15 W	0·0	− 0·9	5·5	5·4	"	"	P^1	
"	2431	"	"	" 23	17 15	30	1 40 W	0·0	− 0·5	7·6	7·6	"	....	C	
"	2447	"	"	" 31	16 07	35	1 05 W	6·0	6·0	10·0	9·5	"	....	H	
"	2466	"	"	Apr. 1	18 52	35	4 00 W	− 0·3	− 0·6	8·2	8·2	"	Hazy.......	P^1	
"	2480	"	"	" 8	15 00	40	40 W	4·5	4·0	8·1	8·0	"	....	P	
"	2494	"	"	" 12	15 11	32	1 00 W	9·5	9·5	10·8	10·8	"	Fair........	C	Clouded over
"	2500	"	"	" 19	17 15	50	3 35 W	3·8	3·2	6·4	6·4	·0015	"	P^1	
"	2508	"	"	" 23	15 38	43	2 15 W	4·5	3·5	10·8	10·6	·002	Good.......	C	
"	2520	"	"	" 26	16 23	43	3 15 W	5·0	4·8	9·3	9·3	"	"	P^1	
"	2535	"	"	May 3	13 49	42	1 05 W	7·5	6·9	8·0	7·9	"	Hazy.......	P^1	
"	2549	"	"	" 24	15 22	45	4 05 W	17·0	15·0	22·75	22·7	"	....	P	
"	2551	"	"	" 26	16 32	55	5 20 W	18·0	17·6	23·2	23·2	"	Cloudy.....	P^1	

"	2552	"	"	" 31	16 37	45	5 45 W	18·0	16·5	21·2	21·0	"	Good.......	P	
"	2557	"	"	June 2	14 22	105	4 10 W	20·9	20·8	27·0	27·0	"	Poor........	P	
"	2571	"	W & W Extra Speedy	" 15	16 02	95	6 30 W	17·2	16·8	21·3	21·2	"	Poor........	P¹	
"	2583	"	"	" 24	15 17	55	6 05 W	25·1	24·0	28·2	28·1	"	Fair........	P	On scale of 5.
"	2878	"	Seed 27	Oct. 8	21 45	46	3 30 E	11·7	11·8	22·7	22·5	"	4...........	P¹	
"	2959	"	"	Nov. 15	21 35	56	2 10 E	0·5	2·0	15·9	14·7	"	5-3.........	P¹	
				1910											
"	3112	"	"	Jan. 14	19 30	51	20 E	−14·5	−15·4	−8·8	−9·0	"	4...........	P¹	
"	3144	"	"	" 25	20 03	55	55 W	−7·1	−7·8	−3·3	−3·4	"	4...........	P	
"	3161	"	"	" 31	17 10	60	1 30 E	−9·0	−10·0	1·8	1·6	"	4-5.........	C	
"	3198	"	"	Feb. 18	16 30	67	1 00 E	−14·5	−15·3	2·7	2·8	"	3-4	H	
"	3205	"	"	" 21	16 52	55	28 E	−6·8	−7·5	2·7	2·7	"	4-5.........	C	
"	3212	"	"	" 23	17 21	38	00	−14·1	−14·1	−4·6	−4·6	"	5...........	P¹	
"	3248	"	"	" 28	16 30	60	20 E	2·5	2·3	9·6	9·2	"	4-5.........	C	
"	3282	"	"	Mar. 3	19 21	77	2 55 W	−1·0	−1·8	7·8	7·6	"	3-2.........	C	
"	3321	"	"	" 11	15 16	50	56 E	1·0	1·0	6·0	6·0	"	5...........	H	
"	3340	"	"	" 18	13 35	50	2 10 E	−0·5	−2·0	3·0	2·8	"	4...........	H	
"	3353	"	"	" 16	16 45	96	1 10 W	−9·0	−7·9	4·0	3·7	"	4-0..........	P¹	
"	3357	"	"	" 23	16 12	55	50 W	2·5	0·2	9·0	8·8	"	3...........	P¹	
"	3364	"	"	" 28	16 20	80	1 30 W	11·4	10·3	18·7	18·5	"	1-5.........	C	
"	3377	"	"	Apr. 8	16 00	60	1 45 W	6·0	4·5	17·4	17·2	·0025	3-4	P¹	
"	3388	"	"	" 12	19 37	50	5 15 W	−0·7	−1·0	6·8	6·8	·002	4...........	P¹	
"	3391	"	"	" 13	14 40	49	30 W	7·6	7·0	10·0	9·9	"	3-0.........	P¹	
"	3395	"	"	" 14	15 30	90	1 50 W	10·0	9·6	12·1	12·1	"	2-3-1.......	P	
"	3397	"	"	" 20	16 02	75	2 15 W	12·2	10·7	15·9	15·9	"	0-3.........	P¹	
"	3406	"	"	" 25	15 01	47	1 45 W	15·5	15·1	17·0	16·85	"	4-2.........	C	
"	3407	"	"	" 27	15 03	63	2 10 W	5·0	3·5	14·8	14·7	"	4...........	P¹	
"	3416	"	"	" 28	14 16	50	1 12 W	6·0	6·0	11·1	10·0	"	4...........	H	
"	3422	"	"	May 5	13 10	50	45 W	12·3	11·5	11·4	14·4	"	3-1.........	P	
"	3441	"	"	" 11	15 20	60	3 15 W	9·0	7·4	16·2	16·4	"	4-2-4.......	C	
"	3454	"	"	" 19	15 40	60	1 00 W	12·5	11·9	18·2	18·0	"	3-1.........	P	
"	3866	"	Seed 23	Dec. 9	23 10	90	1 28 W	−14·5	−15·0	−4·9	−1·5	"	4-5.........	H	
"	3893	"	"	" 21	21 07	81	4 E	−19·0	−19·0	−0·9	−1·1	"	4-5.........	H	
				1911											
"	4094	"	"	Mar. 10	19 49	91	3 55 W	−5·9	−6·9	4·4	4·6	"	4-5.........	P¹	
"	4182	"	"	Apr. 10	18 52	95	5 00 W	1·1	−0·4	10·0	9·9	"	5...........	P¹	
"	4231	"	"	" 21	16 49	85	3 35 W	3·4	2·6	11·7	11·5	"	1...........	P¹-C	
"	4267	"	"	" 26	18 30	90	5 33 W	11·0	10·4	20·3	20·3	"	5...........	C	

MEASURES OF ω URSAE MAJORIS

λ	1340.		1340.*		1386.		1386.*		1489.		1489.*		1499.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4549......	+ 0·48	1	− 8·19	½										
4481......	− 4·26	2	− 9·65	2	− 6·56	1½	−12·43	1	−14·27	1½	−12·72	½	+17·26	2
4340......	−17·23	1½	−16·81	1	−12·01	1½	−13·78	½	−19·94	1½	−15·45	1		
4233......	− 9·45	1												
4128......	+ 4·43	½												
4101......	−13·19	1			−16·93	1			−17·88	1	−23·93	1	...	
3933......					−16·63	1			−23·74	2	−33·56	2	...	
Weighted Mean.......	− 7·76		−11·48		−12·28		−12·89		−19·44		−23·84		+17·26	
V_a	− 2·79		− 2·79		−11·33		−11·33		−21·45		−21·45		−21·82	
V_d	− ·10		− ·10		− ·03		− ·03		− ·15		− ·15		− ·01	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity...	−10·9		−14·6		−23·9		−24·5		−41·3		−45·8		−4·8	

MEASURES OF ω URSAE MAJORIS—(*Continued*).

λ	1499.*		1537.		1537.*		1579.		1579.*		1637.		2021.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861..........	......		......		......		−15·09	½	−19·88	½	......		......	
4549..........	......		......		......		−15·89	½	−15·29	¼	+ 2·95	1	−61·28	½
4481..........	+14·85	1	+ 4·60	2	+ 7·13	1½	+10·13	2	+14·15	1	− 3·90	2	−61·31	1
4340..........	......		......		......		+ 0·52	½	− 6·68	¼	......		......	
4233..........	......		......		......		−19·38	1	......		......		......	
3933..........	......		......		......		− 4·04	1	− 0·52	½	......		......	
Weighted Mean......	+14·85		+ 4·60		+ 7·13		− 3·35		− 0·68		− 1·62		−61·30	
V_a	−21·82		−24·63		−24·63		−23·18		−23·18		−20·18		+23·29	
V_d	− ·01		− ·17		− ·17		− ·22		− ·22		− ·21		− ·03	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity..	− 7·2		−20·5		−17·9		−27·0		−24·4		−22·3		−38·3	

* Check measurement.

MEASURES OF ω URSAE MAJORIS—(*Continued*).

λ	2037.		2063.		2099.		2232.		2259.		2299.		2321.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861			−55·83	½			−22·89	½			−11·77	½	+18·74	½
4549	−23·82	1	−73·87	½	−47·27	1	−19·34	2	−18·44	½	−46·31	½	+ 5·91	1
4481	−21·11	1½	−42·77	2	−36·61	1½	−17·74	2	−28·43	1	−21·30	1	+ 8·89	1
4340	−26·76	1	−40·76	1	−29·30	1	−16·48	1			−14·33	1	+13·40	½
4101			−57·20	½	−54·09	½	−22·14	½			−26·60	½		
3933	−30·24	½	−52·54	1½	−41·33	1	− 6·03	1			−21·61	2	+ 2·71	1
Weighted Mean	−24·34		−49·76		−39·97		−17·03		−25·20		−22·05		+ 8·39	
V_a	+21·91		+20·72		+21·61		+ 4·70		+ 2·58		− 3·54		− 7·36	
V_d	− ·03		− ·03		− ·03		− ·03		− ·03		− ·03		− ·07	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	− 2·74		−29·3		−18·7		−12·7		−22·9		−26·0		+ 0·7	

MEASURES OF ω URSAE MAJORIS—(*Continued*).

λ	2354.		2369.		2411.		2431.		2447.		2466.		2480.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4549							+10·67	1					− 4·27	1
4481	−15·94	1	−25·43	1½	+ 0·93	1	+19·69	1	+ 1·08	2	− 4·33	2	−12·19	1
4340	−28·69	1	−14·89	1½	+ 2·54	1	− 0·40	1	− 1·50	1	− 0·75	1	− 5·55	1
4101	−30·14	1	−18·20	1					+ 1·64	½			− 7·70	½
3933	−18·39	1	−15·22	1									+ 5·02	½
Weighted Mean	−23·29		−18·78		+ 1·72		+10·00		+ 0·42		− 3·14		− 5·84	
V_a	−10·95		−11·34		−15·21		−16·00		−17·54		−17·87		−19·74	
V_d	·00		·00		− ·07		− ·10		− ·07		− ·19		− ·03	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	−34·5		−30·4		−13·8		− 6·4		−17·5		−21·5		−26·1	

MEASURES OF ω URSAE MAJORIS—(*Continued*).

λ	2494.		2500		2508.		2520.		2525.		2535.		2549.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4549					+10·94	1	−13·34	½					+14·67	
4481	−12·56	1	+21·76	1	+26·79	1	− 8·99	1	−26·90	1	+17·47	1	+23·71	1½
4340	− 6·57	¼	+28·00	1	+ 9·49	½	−10·17	1	−21·98	1	+15·15	½	+26·61	1½
4101							−10·50	½						
Weighted Mean	−11·36		+24·88		+16·96		−10·36		−24·44		+16·70		+23·17	
V_a	−20·72		−22·15		−22·99		−23·31		−23·69		−23·27		−24·41	
V_d	− ·06		− ·18		− ·15		− ·18		− ·10		− ·05		− ·19	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	−32·4		+ 2·3		− 6·4		−34·1		−48·5		− 6·9		− 1·7	

MEASURES OF ω URSAE MAJORIS—(*Continued*).

λ	2549.*		2551.		2552.		2557.		2571.		2583.		2878.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4549	+20·11	¼	+ 3·87	¼	−31·95	½	− 9·98	½	−24·01	½			−40·36	½
4481	+21·28	¾	+23·71	1	− 9·69	1	−20·10	½	−15·44	½	+18·42	2	−35·53	1
4340	+26·36	1			− 3·01	½	−15·92	¼			+22·35	1	−46·12	½
4233	+20·31	¼												
Weighted Mean	+23·30		+19·75		−13·58		−15·22		−19·72		+19·73		−39·38	
V_a	−24·41		−24·26		−23·82		−23·61		−21·50		−19·96		+19·48	
V_d	− ·19		− ·23		− ·25		− ·18		− ·25		− ·25		+ ·21	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	− 1·6		− 5·1		−37·9		−39·3		−41·7		− 0·6		−20·0	

* Check measurement.

MEASURES OF ω URSAE MAJORIS—(Continued).

λ	2959.		3112.		3112.*		3144.		3144.*		3161.		3198.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861									−40·31	½				
4549	−37·80	½	−14·41	1	−11·33	½	−33·55	½	−31·48	1				
4481	−40·83	2	−13·15	1	−14·92	1	−47·30	1	−48·21	1	+ 8·83	1	−16·21	1½
4340	−28·58	1					−30·54	1	−33·20	1	+ 5·24	1		
4325	−25·92	¼												
4233							−34·21	½						
4101	−48·86	½					−27·25	¼	−31·01	½	+ 9·63	½		
3933	−38·67	½	−13·48	½	− 8·15	½	−39·44	½	−39·27	½	+ 3·33	½	−16·79	½
Weighted Mean	−37·78		−13·72		−12·32		−36·90		−37·37		+ 6·85		−16·35	
V_a	+25·23		+13·22		+13·22		+ 8·83		+ 8·83		+ 6·32		− 1·66	
V_d	+ ·15		+ ·04		+ ·04		− ·03		− ·03		+ ·12		+ ·10	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	−12·7		− 0·7		+ 0·7		−27·8		−28·8		+13·0		−18·2	

MEASURES OF ω URSAE MAJORIS—(Continued).

λ	3205.		3212.		3248.		3282.		3321.		3321.*		3340.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4549			−39·09	1	−30·68	½	+11·72	¼	−27·31	1			+ 9·60	1
4481	−31·75	2	−34·07	½	−17·23	1	− 2·42	2	− 5·73	1	− 9·94	1	+ 7·08	2
4340	−34·01	½			−17·59	½	+ 5·09	1	− 8·90	1½	− 9·13	1	+15·38	1
4325					−17·86	½								
4101	−26·00	1					− ·28	½	−10·87	1			+ 7·22	1
3933	−33·11	1					+10·55	1	−27·92	1	−24·43	1		
Weighted Mean	−31·10		−37.95		−20·11		+ 3·18		−15·50		−14·50		+ 9·27	
V_a	− 2·85		− 3·85		− 5·97		− 7·26		−10·45		−10·45		−14·17	
V_d	+ ·04		+ ·03		+ ·06		− ·12		+ ·10		+ ·10		− ·15	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	−34·2		−42·0		−26·3		− 4·5		−26·2		−25·2		− 5·3	

* Check measurement.

MEASURES OF ω URSAE MAJORIS—(*Continued*).

λ	3353.		3357.		3364.		3364.*		3375.		3375.*		3377.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861......													+ 4·65	½
4549......	− 2·93	½					−22·38	½						
4481........	+ 1·02	1	− 8·28	1	−12·74	2	−11·85	1	+27·39	1½	+22·06	1½	+ 4·83	1
4340.......	+ 2·31	½	−13·75	½	− 8·79	1½	−10·98	1	+32·71	1½	+30·08	1	+11·08	1½
4233........									+12·07	1				
4128.........	− 0·49	½												
4101..........									+11·86	1			− 2·97	½
3933.......			−14·62	¼	− 7·72	½	− 6·65	1	+18·28	1			−10·99	1
Weighted Mean.......	+ ·20		−10·73		−10·63		−11·51		+22·06		+24·07		+ 2·52	
V_a	−12·39		−14·88		−16·54		−16·54		−19·16		−19·16		−19·70	
V_d	− ·03		− ·04		− ·06		− ·06		− ·06		− ·06		− ·08	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity ..	−12·5		−25·9		−27·5		−28·4		+ 2·6		+ 4·6		−17·5	

MEASURES OF ω URSAE MAJORIS—(*Continued*).

λ	3377.*		3377.*		3388.		3388.*		3391.		3391.*		3395.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861.........					−27·76	¼								
4549.........					− 9·46	½			−20·74	½				
4481.........	+ 0·76	½	− 2·42	1	−15·92	2	− 6·25	1½	−19·71	½	−19·10	½	− 4·50	1½
4340.........	+ 0·93	1	− 2·08	1	− 6·24	1	− 9·83	½	−12·92				− 2·23	1
4233.........													− 2·03	1
4128.........													− 9·63	½
4101.........			− 2·40	¼									− 7·89	½
3933.........	− 2·00	½	− 3·15	1½	−21·19	½							−10·55	½
Weighted Mean.......	+ 0·15		− 2·62		−14·20		− 7·14		−17·80		−19·10		− 5·01	
V_a	−19·70		−19·70		−20·75		−20·75		−20·95		−20·95		−21·12	
V_d	− ·08		− ·08		− ·25		− ·25		·00		·00		− ·07	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity...	−19·9		−22·7		−35·5		−28·3		−39·0		−40·3		−26·5	

*Check measurement.

MEASURES OF ω URSAE MAJORIS—(*Continued*).

λ	3395.*		3397.		3397.*		3406.		3407.		3407.*		3416.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4549..........	.....		+18·90	½	+25·60	½	− 4·80	1	− 8·65	½	− 4·66	½	−14·38	½
4481..........	−16·70	1	+32·56	1½	+26·90	½	−12·72	1	−12·59	1	−19·08	1	−15·29	1
4340..........	− 9·49	½	+32·19	2	+27·07	1	− 4·50	2	+ 4·50	1	+ 6·57	1	−20·11	1
4233..........	.....		+31·98	½							.....		.....	
4128..........	.....		.....		.....		− 2·55	¼	− 3·14	½	.....		.....	
4101..........	.....		+37·44	1					+ 6·05	½	+ 2·49	½	−14·52	½
3933..........	.....		+45·12	1			−25·70	½	−23·10	1	−27·40	½	−17·95	1
Weighted Mean.......	−14·29		+35·60		+26·66		− 8·42		− 7·55		− 7·80		−16·95	
V_a	−21·12		−22·32		−22·32		−21·33		−23·41		−23·41		−23·53	
V_d	− ·07		− ·12		− ·12		− ·09		− ·12		− ·12		− ·07	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity...	−35·8		+12·9		+ 4·0		−30·1		−31·3		−31·6		−40·8	

MEASURES OF ω URSAE MAJORIS—(*Continued*).

λ	3422.		3441.		3454.									
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4549..........	+39·56	1	.....		+ 3·06	1								
4481..........	+26·12	1	− 7·25	1	+26·38	½								
4340..........	+32·45	1	− 8·08	1½	+17·31	1								
4325..........	+30·40	½	.....		.....									
4308..........	+13·64	½	.....		.....									
4271..........	+13·21	½	.....											
4101..........	+11·63	½	.....		+16·03	½								
3933..........	+18·57	1	− 7·33	1	+ 1·08	½								
Weighted Mean.......	+25·20		− 7·62		+12·05		....		....		....		....	
V_a	−24·24		−24·68		−24·63		....		....		....		....	
V_d	− ·02		− ·14		− ·19		....		....		....		....	
Curv.	− ·28		− ·28		− ·28		....		....		....		....	
Radial Velocity...	+ 0·7		−32·7		−13·0		....		....		....		....	

*Check measurement.

MEASURES OF ω URSAE MAJORIS—(*Continued*).

λ	3866.		3866.*		3893.*P*		3893.*S*		4094.*P*		4094.*S*		4182.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861·527													−11·55	½
4549·766	−25·75	1	−23·74	1½			−56·34	½			−10·39	½	− 7·19	½
4481·400	−12·76	1	− 9·31	1	+58·86	⅛	−54·91	1			−10·83	1	− 7·14	½
4340·634													−15·69	½
4325·939			− 8·36	1	+80·99	⅛	−44·96	⅛						
4308					+117·98	¼	−51·03	¼	+104·32		−20·77	½		
4128·211			− 4·19	½										
3933·825	−19·47	½	−16·39	1							−27·84	½	−10·13	½
Weighted Mean	−19·28		−15·32		+93·94		−54·61		+104·32		−16·12		−10·34	
V_a	+22·83		+22·83		+20·86		+20·86		− 20·18		−20·18		−20·17	
V_d	− ·09		− ·09		+ ·07		+ ·07		− ·18		− ·18		− ·28	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	+ 3·2		+ 7·2		+114·6		−34·0		+ 83·7		−36·8		−31·1	

MEASURES OF ω URSAE MAJORIS—(*Concluded*).

λ	4231.		4267.											
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861·527	+23·91	¼	−13·47	¼										
4549·766	+ 7·59	1	− 4·92	½										
4481·400	+20·38	1	− 8·90	1										
4340·634	+ 8·09	½	+ 2·19	¼										
4128·211	+17·60	½												
3933·825	+ 9·97	½	−19·71	¼										
Weighted Mean	+14·90		− 8·50											
V_a	−22·46		−23·26											
V_d	− ·22		− ·30											
Curv.	− ·28		− ·28											
Radial Velocity	− 8·1		−32·3											

*Check measurement.
P—Primary.
S—Secondary.

SUMMARY OF MEASURES

Plate.	Julian Date.	Phase from final T.	Velocity.	No. of Lines.	Weight.	O–C
1340	2,417,993·802	2·701	−12·1	6	5	+ 5·1
1386	8,010·713	3·772	−24·1	4	6	+ 0·9
1489	047·695	9·074	−43·5	4	4	−12·1
1499	049·605	10·979	− 6·0	1	2	+18·3
1537	080·661	10·360	−19·2	1	2	+ 8·0
1579	098·656	12·515	−27·5	6	3	−13·2
1637	119·621	1·799	−22·3	2	2	−14·3
2021	285·941	9·720	−38·3	2	2	− 8·8
2037	292·938	0·877	− 2·7	4	4	− 4·2
2063	297·934	5·873	−29·3	6	6	+ 3·4
2099	313·897	5·996	−26·9	5	5	+ 5·9
2232	341·807	2·226	−12·7	6	7	0·0
2259	346·795	7·214	−22·9	2	2	+10·9
2299	360·757	5·136	−26·0	6	4	+ 5·6
2321	369·750	14·329	+ 0·7	5	4	− 0·4
2340	374·741	3·479	−31·7	2	2	− 8·3
2354	378·681	7·420	−34·5	4	4	− 0·8
2369	379·694	8·433	−30·4	4	6	+ 2·4
2411	388·699	1·598	−13·8	2	4	− 8·2
2431	389·719	2·618	− 6·4	3	3	+ 9·6
2447	397·671	10·570	−17·5	2	5	+ 8·7
2466	398·786	11·685	−21·5	2	4	− 1·0
2480	405·625	2·679	−20·7	5	6	− 3·6
2494	413·633	10·692	−32·4	2	2	− 6·8
2500	416·510	13·569	+ 2·3	2	4	+ 7·8
2508	420·443	1·662	− 6·4	3	3	− 0·6
2520	423·682	4·901	−34·1	4	6	− 3·6
2525	425·621	6·840	−48·5	2	2	−14·3
2535	430·577	11·796	− 6·9	2	3	+12·8
2549	451·640	1·179	+ 0·2	3	6	+ 1·0
2551	453·688	3·227	− 5·1	2	2	+16·0
2552	458·692	8·231	−37·9	3	1	− 5·8
2557	460·598	10·137	−39·3	3	2	−11·3
2571	473·667	7·366	−41·7	2	1	− 8·0
2583	482·637	0·496	0·0	2	5	− 4·9
2878	588·906	11·725	−20·0	3	4	+ 0·1
2959	626·899	2·198	−12·5	6	6	+ 0·3
3112	686·822	14·601	0·0	3	6	− 3·3
3144	697·833	9·772	−28·2	6	7	+ 1·2
3161	703·715	15·654	+13·0	4	6	+ 5·5
3198	721·687	1·946	−18·2	2	3	− 8·6
3205	724·702	4·961	−34·2	4	6	− 3·8
3212	726·723	6·982	−42·0	2	2	− 8·3
3248	731·687	11·946	−26·3	4	4	− 8·0
3256	733·688	13·947	− 9·4	2	2	− 7·2
3282	734·807	15·066	− 4·5	5	3	−10·6
3321	742·636	7·055	−25·7	5	4	+ 8·0
3340	749·566	13·985	− 5·3	4	5	− 3·3
3353	747·697	12·116	−12·5	4	5	+ 4·7
3357	754·674	3·253	−25·9	3	3	− 4·2
3364	759·680	8·259	−27·9	3	5	+ 4·9
3375	768·639	1·378	+ 8·4	6	4	+11·2
3377	770·666	3·409	−20·0	5	6	+ 2·9
3388	774·817	7·556	−33·1	5	5	+ 0·2
3391	775·611	8·350	−39·8	3	4	− 7·0
3395	776·646	9·385	−29·6	6	5	− 0·9
3397	782·666	15·405	+ 9·9	6	6	+ 2·5
3406	787·625	4·524	−29·3	5	6	− 0·2
3407	789·627	6·526	−31·5	6	4	+ 2·0
3416	790·594	7·493	−40·8	5	6	− 7·1

SUMMARY OF MEASURES—(*Concluded*).

Plate.	Julian Date.	Phase from final T.	Velocity.	No. of Lines.	Weight.	O–C.
3422	2,418,797·549	14·418	+ 2·8* −115·1	5	6	+ 0·7
3441	803·639	4·698	− 32·7	3	5	− 2·9
3454	811·653	12·712	− 13·0	5	4	0·0
3866	9,018·965	14·101	+ 5·2	6	2	+ 6·0
3893	027·880	7·179	+114·6* − 34·0	3	4	− 0·2
4094	106·826	6·925	+ 83·7* − 36·8	4	3	− 3·1
4182	137·786	6·205	− 31·1	5	5	+ 2·0
4231	148·700	1·279	− 8·1	6	4	− 6·1
4267	153·771	6·350	− 32·3	5	3	+ 0·9

* Double Spectrum.

The phases are computed from the final value of *T*, and the residuals are scaled from the correeted curve. The plates were grouped into seventeen normal plaees, according to phase, and each weighted as in table below.

NORMAL PLACES FIRST SOLUTION

No.	Julian Date.	Phase.	Velocity.	Weight.	Residuals O−C.
1	2,418,393·130	1·210	+ 1·50	1·0	+4·53
2	712·924	1·733	− 1·75	2·0	−4·49
3	743·191	2·793	+11·44	1·0	+1·68
4	419·903	4·224	− 2·87	2·0	−3·96
5	448·543	5·567	−13·22	2·5	+1·86
6	754·423	6·105	−21·02	1·0	−1·74
7	020·966	6·155	−19·24	1·5	+1·30
8	770·127	7·831	−32·05	2·0	−2·19
9	349·629	8·623	−29·49	2·0	+2·68
10	771·435	10·293	−34·45	2·0	−0·45
11	391·880	10·847	−33·95	1·5	−0·13
12	746·138	12·149	−30·70	2·0	+1·52
13	058·684	12·600	−35·40	·5	−4·17
14	391·700	13·159	−27·95	1·0	+0·68
15	079·036	15·040	−18·90	·5	+2·82
16	476·591	14·834	−16·97	1·0	+4·75
17	762·449	15·349	−16·90	1·5	+2·23

A velocity curve was drawn through the normal places by the graphical method of Dr. King, giving the following preliminary elements:—

$$
\begin{aligned}
P &= 15.84 \text{ days.} \\
e &= .30 \\
\omega &= 10^\circ \\
K &= 22 \text{ km.} \\
\gamma &= -\ 18.50 \text{ km.} \\
T &= 2{,}417{,}991.168\ J.D.
\end{aligned}
$$

A least-squares solution with these elements gave the following corrections:—

$$\delta P = + \quad .00008 \text{ days.}$$
$$\delta\gamma = + 0.17 \text{ km.}$$
$$\delta K = - 2.03 \text{ km.}$$
$$\delta e = - \quad .060$$
$$\delta\omega = +4° \; 13$$
$$\delta T = + 0.018 \text{ days.}$$

The value of Σpvv was reduced from 193 to 137. On substitution in the observation equations it was found that the computed and ephemeris residuals did not agree closely. A second solution was accordingly made. The velocities of six additional plates were included which had been obtained after the first solution was made. The number of normal places was reduced to ten and the period taken as fixed at 15.8401 days. The normal places for the second solution follow. In the last column will be found the residuals from the final curve.

No.	Julian Date.	Phase.	Velocity.	Weight.	Residual.
1	2,418,682·660	1·541	− 0·44	3	−1·0
2	743·191	2·791	+11·45	1	+3·9
3	568·528	4·280	− 2·76	3	−1·8
4	379·090	5·464	−14·59	3	−0·8
5	450·809	6·616	−24·09	2	−0·2
6	537·746	8·269	−30·62	4	+0·4
7	740·258	10·118	−34·32	4·5	−0·5
8	574·889	12·012	−32·45	3	−0·6
9	343·848	13·460	−26·61	1	+0·5
10	536·191	15·092	−17·25	3	+1·1

The solution of these gave as further corrections:—

$$\delta\gamma = + \quad .51 \text{ km.}$$
$$\delta K = + \quad .39 \text{ km.}$$
$$\delta e = + \quad .024$$
$$\delta\omega = -2°.177$$
$$\delta T = - \quad .085 \text{ days.}$$

The definitive elements of the orbit now were:—

$$P = 15.8401 \text{ days.}$$
$$e = .264$$
$$\omega = 11°.95$$
$$K = 20.64 \text{ km.}$$
$$\gamma = -18.45$$
$$T = 2{,}417{,}991.101 \; J.D.$$

The value of Σpvv was reduced from 43 to 33, and the agreement between the computed and ephemeris residuals was now satisfactory, the greatest difference being .08 km. The table below gives a summary of the values of the elements after each solution.

Element.	Preliminary Values.	First corrected Values.	Final Values.
P	15·84 days.	15·8401 days.	15·8401 days.
e	·30	·24	·264 ± ·024
ω	10°	14°·13	11°·95 ± 5°·57
K	22 km.	20·25 km.	20·64 ± 0·40
γ	−18·50 km.	−18·96 km.	−18·45 ± 0·32
T	2,417,991·168 J.D.	2,417,991·186 J.D.	2,417,991·101 J.D. ± ·208
$a \sin i$	....	....	4,336,000 km.

In the column of final values is also given the probable error for each element. The probable error of a normal place of unit weight was ± 1.7 km., and that of a plate of average weight was computed from the residuals scaled from the final curve and found to be ± 4.1 km.

Although there are only three measures of the secondary component, an approximation to the value of K was arrived at by substitution in the equation:—

$$\frac{dz}{dt} = \gamma + K (\cos u + e \cos \omega)$$

giving the velocity at any point in the orbit. The values of e, ω and γ being known, that of u was determined in the usual way from the mean anomalies at the observed velocities. Successive trials of the values of K in the above equation gave 120 km. as the most satisfactory. Hence a comparison of the masses of the system may be had from the relation:—

$$M_1 : M_2 = K_2 : K_1 = 120 : 20.6 = 5.8 : 1.$$

It is interesting to note that if further measures of the secondary component substantiate this value of K, this proportion of the masses is one of the highest yet obtained. It is probably due to the resulting faintness of the companion that more plates showing the double spectrum were not obtained.

ζ Aquilae.

This star ($\alpha = 19^h\ 1^m$, $\delta = +13°\ 43'$; mag. 3.3) was first observed here in May, 1907. Five plates were taken in that year and in the following year seven more were obtained. It was one of those which were placed on the observing list to measure for variable velocity. The star is of A-type according to Harvard classification, and the lines measured are those of hydrogen H_β, H_γ, and H_δ. These are broader again than in the spectrum of ν Cygni. No other lines were measurable on the plates obtained. A summary of the measures follows. There is a range of 60 km. in the resulting velocities, but as an equal range occurs in the measures of several of the individual plates not much confidence can be placed in them. In one of the plates (1821) there were indications of the lines being doubled, and these were measured and "checked." As will be seen from the summary, the measures of the stronger component in H_γ and H_δ agree fairly well while that of H_β differs widely. The agreement in the secondary is not good. It is probable that the star is a spectroscopic binary, and that the width and diffuseness of the lines is due to the blending of the two spectra. As the accuracy of the measures was a good deal in doubt, further work on this star for the present was discontinued.

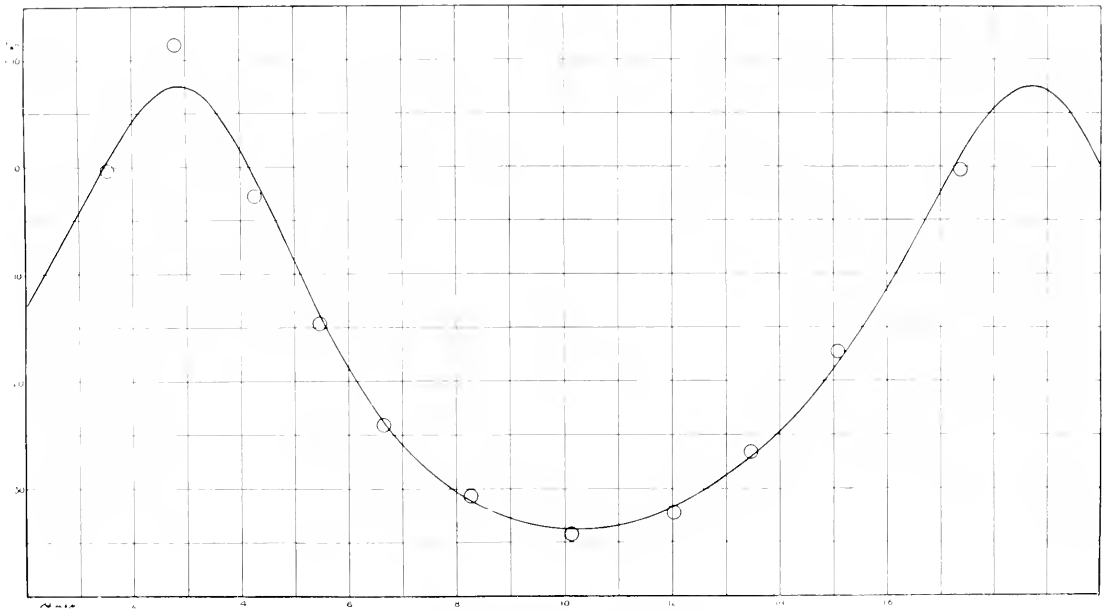


Fig. 9. -Velocity Curve of ω Ursæ Majoris.

RECORD OF SPECTROGRAMS

P—Plaskett.
H—Harper.
P¹—Parker.
C—Cannon.
T—Tribble.

Star.	No. of Neg.	Camera.	Plate.	Date.	Middle of Exposure. G.M.T.	Duration.	Hour Angle at End.	Temperature Centigrade. Room. Beg.	Room. End.	Prism Box. Beg.	Prism Box. End.	Slit Width.	Seeing.	Observer.	Remarks.
				1907	h m	m	h m								
ζ Aquilæ....	805	1 L	Seed 27	May 31	19 57	15	30 W	11·5	11·0	18·8	18·75	·001	Good.......	P	
" ..	852	"	"	June 14	18 25	20	00	19·8	20·3	23·0	23·0	·0012	"	P	
" ..	864	"	"	" 20	18 15	22	15 W	20·0	19·5	25·4	25·4	·0013	"	H	
" ..	947	"	"	July 16	17 37	26	1 20 W	23·0	......	26·6	....	·0014	....	T	
" ..	1039	"	"	Sept. 12	16 06	39	3 45 W	15·6	15·6	20·9	20·9	·0012	Fair........	T	
				1908											
" ..	1644	"	"	June 26	20 22	35	3 00 W	17·3	17·0	30·0	30·0	·0016	Good....	P¹	
" ..	1680	"	"	July 8	19 47	25	3 03 W	17·0	15·5	21·6	21·6	·0015	"	H	
" ..	1778	"	"	Aug. 7	18 40	46	4 00 W	18·8	18·6	23·1	23·1	·0015	Fair......	C	
" ..	1802	"	"	" 20	17 17	31	3 26 W	16·5	16·0	22·2	22·2	·0015	......	H	
" ..	1821	"	"	" 24	15 53	30	2 16 W	16·0	15·2	23·1	23·0	"	Good.......	H	
" ..	1856	"	"	" 31	16 13	34	3 05 W	21·5	21·5	27·7	27·7	"	Fair.......	H	
" ..	1887	"	"	Sept. 14	15 45	80	3 55 W	15·5	14·6	21·5	21·3	"	Bad.....	P	

MEASURES OF ζ AQUILAE

λ	805.		852.		864.		947.		1039.		1644.		1680.	
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861·527......	−52·38	1	−35·55	1	−60·36	½	−26·41	1½	+ 9·87	1	−13·50	½	−19·73	½
4340·634......	−29·55	½	−33·09	1	−41·34	1	−34·56	½	−37·06	½	−24·53	¾	−99·18	¾
4101·890......	−41·32	¼	−82·81	½	−58·42	¼	.		+ 4·25	1½	−37·58	¼	−74·65	¼
Weighted Mean......	−44·27		−41·02		−49·21		−28·45		− 0·76		−23·03		−68·61	
V_a	+15·01		+10·29		+ 8·08		− 2·14		−21·00		+ 5·46		+ 0·72	
V_d	− ·03		·00		·00		− ·09		− ·25		− ·17		− ·22	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity...	−29·6		−34·0		−41·4		−31·0		−22·3		−18·0		−68·4	

MEASURES OF ζ AQUILAE—(*Continued*).

λ	1680.*		1778.		1802.		1821.		1856.		1887.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4861·527..........	−15·96	½	+ 1·01	¾	−33·22	½	−31·19	½	+22·92	½	+15·23	½
4340·634..........	−41·50	½	..	..	−14·61	½	+ 3·86	½	−28·60	¼	− 5·63	½
4101·890..........	−54·51	½	−68·48	1	+16·23	½	+33·50	½	+24·21	½	+33·50	½
Weighted Mean..........	−37·32		−38·70		−10·53		+ 2·05		+13·12		+14·36	
V_a	+ 0·72		−10·87		−15·25		−16·48		−18·38		−22·12	
V_d	− ·22		− ·25		− ·22		− ·15		− ·22		− ·22	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity.......	−37·1		−50·1		−26·5		−14·8		−16·3		− 8·2	

* Check measurement.

MEASURES OF ζ AQUILAE—(*Concluded*).

λ	1821*P		1821*S		1821*P		1821*S					
	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt	Vel.	Wt
4861·527...........	+ 44·69	1/8	−197·19	1/8	+ 46·87	1/4	−180·79	1/16	......	...	......	...
4340·634...........	+122·04	1/2	− 30·69	1/4	+127·58	1/4	− 34·56	1/8	......		......	...
4101·890...........	+139·75	3/4	+ 31·33	3/8	+139·75	1/8	+ 25·09	1/8	......	...	......	...
Weighted Mean...........	+127·90		−10·02		+133·25		− 4·74		......		......	...
$H\gamma$ and $H\delta$ V_a	− 16·48		−16·48		− 16·48		− 16·48		......		......	...
V_d	− ·15		− ·15		− ·15		− ·15		......		......	...
Curv.	− ·28		− ·28		− ·28		− ·28		......		......	
Radial Velocity...	+111·0		−26·9		+116·3		− 21·7		......		......	...

ν Cygni.

The star ν Cygni ($\alpha = 20^h 53^m$, $\delta = +40° 47'$, phot. mag. 4.2), was placed on the observing list here in July, 1907. Only one plate was taken in that year. Six more were obtained in July, August, and September of the following year for the purpose of discovering whether the star was of variable velocity. The star is of A type, the lines measured — H_β, H_γ, H_δ, and *Mg*. λ 4481. The lines measured, and those of hydrogen in particular, are too broad and diffuse for accurate measurement. Appended are the data of the observations and a summary of the measures. As will be seen from the latter it is probable that ν Cygni is of variable velocity though it is felt that the results cannot be greatly depended upon. On this account the star was dropped from our observing list for the present.

* Check measurement.
P—Primary.
S—Secondary.

P—Plaskett.
H—Harper.
P[1]—Parker.
C—Cannon.

RECORD OF SPECTROGRAMS

Star.	No. of Neg.	Camera.	Plate.	Date.	Middle of Exposure. G.M.T.	Duration.	Hour Angle at End.	Temperature Centigrade. Room. Beg.	Room. End.	Prism Box. Beg.	Prism Box. End.	Slit Width.	Seeing.	Observer.	Remarks.
				1907	h m	m	h m								
ν Cygni...	934	1 L	Seed 27	July 9	18 52	45	25 W	19·2	19·0	25·2	25·0	·0014	Good......	H	
				1908											
" ..	1758	"	"	July 31	19 58	40	3 00 W	17·0	16·0	25·3	25·6	·0015	Good.....	H	
" ..	1825	"	"	Aug. 24	19 22	45	4 00 W	13·5	13·0	22·7	22·6	·0015	Good.. .	P[1]	
" ..	1830	"	"	" 26	19 17	65	4 10 W	14·9	14·2	19·4	19·5	"	Hazy... .	P[1]	
" ..	1846	"	"	" 28	16 02	45	55 W	16·1	16·1	23·2	23·2	"	Good.. ...	C	
" ..	1857	"	"	" 31	17 22	45	2 30 W	21·0	20·8	27·5	27·6	"	Good.	H	
" ..	1892	"	"	Sept. 16	14 17	85	35 W	18·2	17·6	21·6	21·5	"	Fair.......	P	Smoky.

MEASURES OF ν CYGNI

λ	934.		1758.		1830.		1830.*		1825.		1846.		1857.		1892.	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4861·527...	−78·20	½	−50·63	½	−44·40	½	....	..	−23·65	¼	−37·14	½	−68·19	½	−25·80	½
4481·400...	....	..	....	..	48·91	½	....	..	−20·95	½	....	..	....	..	....	..
4340·634...	64·72	1	−37·27	1	19·52	½	−10·47	½	+11·38	½	−21·92	½	58·46	½	17·43	½
4101·890...	−35·06	½	−43·92	1	−15·53	½	....	..	+10·59	¼	+ 3·47	½	−38·79	½	−25·98	½
Weighted Mean...	−60·67		−42·57		−32·09		−10·47		− 5·36		−18·53		−55·11		−23·06	
V_a	+12·35		+ 7·42		+ ·15		+ ·15		+ ·72		− ·39		− 1·57		− 5·78	
V_d	− ·03		− ·19		− ·19		− ·19		− ·19		− ·03		− ·12		·00	
Curv.	− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28		− ·28	
Radial Velocity	−46·6		−35·6		−32·4		−10·8		− 5·1		−19·2		−57·0		−29·1	

* Check measurement.

APPENDIX D.

SOLAR PHYSICS.

RALPH E. DE LURY, M.A., PH.D.

INVESTIGATIONS WITH THE TWENTY-THREE FOOT SOLAR SPECTROGRAPH.

1. *Outline of the Work done with the Spectrograph.*

A brief outline of the work done with the Solar Littrow Spectrograph during the year ending March 31, 1911, will first be given, followed by detailed discussions of several points occurring in connection with the work.

Owing to the poor qualities of the first grating (described in the Report of the Chief Astronomer for 1909, 251-256), a new grating was ordered. This grating, No. 55, was freshly ruled by the Michelson engine at Chicago University and it arrived here on April 15, 1910. Work with the Solar Spectrograph was immediately resumed, Mr. Plaskett joining me in it.

Visual measurements of the focal curves for the different orders from both sides of the grating were made to see if the irregularities which occurred in the case of the first grating were present. The focal curves were practically symmetrically arranged about the normal, little change in focus for a given wave-length being noticed in the different orders. Later photographic measures for certain wave-lengths showed discrepancies in the focal-lengths for different orders caused, possibly, by errors in the spacing of the lines, and the deviations from the visual measures are probably due to the fact that the photographic determinations were made using just that part of the grating which gave no astigmatism. The visual measurements are given below along with those of the first grating, and a discussion of the probable causes of the irregularities of the latter.

Grating No. 55 possesses considerable astigmatism, but I noticed that when the upper half was alone illuminated the astigmatism disappeared. The greater part of this astigmatism is due to the bottom 2 cm. of the ruled surface. By masking 4 cm. the astigmatism is nearly eliminated, while cutting off 5 cm. removes it entirely. By masking 5 cm. off one side of the grating, the definition of the spectrum lines produced is greatly improved. The grating which has a ruled surface 11 cm. × 13 cm. with nearly 700 rulings to 1 mm., is thus masked down to an area 6 cm. × 8 cm. in one corner, to give a spectrum of the best definition and one free from astigmatism. Thus masked, the grating is so brilliant that it is possible to photograph spectra of the rotation effect in 30 seconds, which with the first grating required 10 or 12 minutes to obtain; the definition is also much better with the new instrument. As a result the efficiency of the spectrograph is indefinitely increased, and the purchase of the new grating is entirely justified.

During April, May and June the grating was thoroughly tested and numerous photographs were taken. The second and third orders from one side and the first order from the other side were found to be particularly bright. The tests were made chiefly about the region λ 4500 in the second and third orders—a suitable wave-length at dispersions sufficient for work on the Solar Rotation. These test photographs number from *L*420 to *L*475. From the middle of June to near the end of July, spectra of the rotation effect at λ 4500 in the second and third orders from one side of the grating were photographed (Plates *L*476 to *L*578). These plates were in the nature of trials, and were made in the face of certain difficulties which I had experienced when taking similar plates with the first grating. The chief of these was the adjustment of the prisms to give the best illumination of the grating. I had constructed a temporary adjustment consisting of adjusting screws working in the thin brass envelopes of the prisms which rested on thin strips of paper about which they could be tilted. This served the purpose only fairly well, and I recommended the construction of a more perfect apparatus working on the same or on the ball and socket principle. The above series of plates impressed on us the necessity of attending carefully to this important point, as well as to having a more accurately adjusted and convenient guide-plate for the sun's image. A more detailed description of these rotation plates will be given below along with measurements of some of them.

During the few satisfactory days in the autumn, plates of the rotation were taken in the regions λ 4250 and λ 5600 in accordance with the recommendations of the Union for Co-operation in Solar Research. Improvements were made in the spectrograph along the lines mentioned above. A new guide-plate was made and better prism adjustments were fitted to the slit-attachment. Mr. Plaskett devised a notched prism to replace the two prisms formerly used above the slit to reflect beams from one limb on both sides of the beam from the other limb. This device simplified greatly the adjusting of the prisms. The scale for reading the angles of inclination of the grating was moved to the top of the spectrograph where they could be more conveniently read, the vernier-pointer being fastened to an arm screwed to the back of the grating-mounting. This arm is bent up behind the grating and continues out through the spectrograph in the axis of rotation of the grating. This necessitated a hole in the box just above the face of the grating. This hole admitted cold air currents to flow over the face of the grating and the definition of the spectrum was injured, as described below. To remedy this the holes were plugged with cotton waste and the end of the spectrograph was boxed in and lined with felt throughout. Truss rods were added to make the spectrograph more rigid. The spectrograph as it now appears is represented in section in Figure 10, the lettering being the same as used in the description given in the Report of 1909, *e.g.*, *S*, slit; *L*, lens; *G*, grating; *C*, photographic plate-holder; *V*, vernier-pointer; and *E*, the scale used with it to read the angles of inclination of the grating, etc.; the double-door, *D′*, and the felt and truss rods recently added are also shown. During the course of the work another difficulty presented itself, namely, the atmospheric distortion and dispersion of the solar image during the winter months when the declination is low. Measurements of this effect made on one occasion are given below.

On December 13, 1910, arrived the Michelson grating No. 43, (7 cm. × 16 cm. surface ruled 680 lines to 1 mm.) made famous by its excellent performance in the fourth order in the work on the satellites of certain mercury lines, (Henry G. Gale and Harvey B. Lemon, Astrophysical Journal, 31, 78-87). This grating was tested and carefully compared with grating No. 55 from the point of view of its applicability to the rotation problem.

Grating No. 43 appeared by direct reflection from one side to have two areas, two-fifths and three-fifths of the grating respectively, of different character, one of these areas giving a red the other a blue reflection, pointing to some difference in the rulings. When viewed from the other side, however, the grating appeared to be of uniform character, and the spectra taken from this side were brighter and sharper than those taken from the other side, the fourth order being particularly brilliant.

The second and third orders were not so bright or so sharp as those from one side of grating No. 55, and consequently the latter was chosen as the better grating for investigating the solar rotation, though undoubtedly grating 43 is an excellent instrument for examining spectrum detail such as the investigation of the mercury lines mentioned above. With some regret this grating was returned. Work with grating 55 on the sun's rotation and related problems was carried on through the rest of the winter.

During the year I endeavoured to determine three known or suspected sources of error in connection with the investigation of the solar rotation, namely, Sky Spectrum, Personal Errors in Measuring the Displacements of Spectral Lines, and Convection in the Sun's Atmosphere. These subjects are interesting and important in themselves, but in studying the sun's rotation they demand particular attention and should be worked out simultaneously with it. I devised methods for studying these subjects and they with other points will be discussed in detail in what follows.

2. *Changes in Focus Produced by Plane Gratings.*

Under the above heading I published a paper in the Journal of the Royal Astronomical Society of Canada, V, 26-32, discussing the changes in focus of the first grating, the measurements of which are given in the Report for 1909. In that paper, grating (*a*) and grating (*b*) refer respectively to the first grating and No. 55 mentioned in the outline above. Subsequent photographic determinations of the foci for λ 4250 and λ 5600 in the second and third orders from the brighter side of grating 55 with all masked but the 6 cm. × 8 cm. surface described in the outline above, showed differences greater than obtained visually from the whole grating, but the arrangement seems to be, as in the case of the visual measures, symmetrical about the normal, and is likely due to periodic errors in the spacing of the lines. What follows is quoted from the above paper:

"Two plane gratings of speculum metal have been tested in the Littrow Spectrograph of the Observatory. One of these, grating (*a*), having a 10 cm. × 12 cm. ruled surface and about 500 rulings to 1 mm., exhibited peculiarities in its focal properties, produced poor spectra and lacked brilliancy to a decided degree; the definition of spectral lines produced by it was greatly improved by masking 2.5 cm. or more off each end of the rulings and 6 or 7 cm. off one side of the grating where it was seen by direct reflection to be of different character from the rest of the grating. It was finally returned to the makers and one of their latest products, grating (*b*), having a 11 cm. × 13 cm. ruled surface and about 700 rulings to 1 mm., was obtained. This grating showed nearly normal properties and proved to be much more brilliant than the first grating; and when 5 cm. off one end of the rulings and about the same off one side of the grating were masked, the definition of the spectral lines became excellent. The peculiar changes in focus found in the case of the first grating do not in themselves lessen its value, but they are probably intimately connected with its defects and may possibly serve to indicate their cause.

"The optical part of the spectrograph (see, Report of the Chief Astronomer for the year ending March 31, 1909, p. 251) consists of a slit, a 15 cm. (6 in.) lens placed at its focal length (nearly 7 m., or 23 ft.) from the slit, and a grating mounted about 18 cm. back of the lens in its mean position, with its rulings parallel to the slit. Light is directed through the slit so as to nearly fill the lens, which when placed its focal length from the slit, for the wave-lengths under consideration, throws a parallel beam on the grating. The grating diffracts the light back through the lens which focusses the spectrum at the slit. By tilting the grating forward

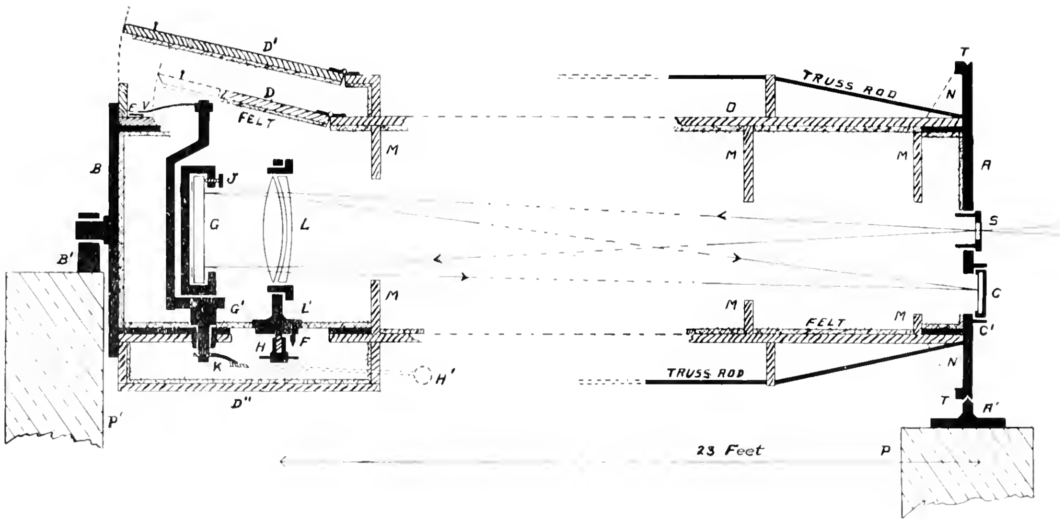


Fig. 10.—The Solar Spectrograph

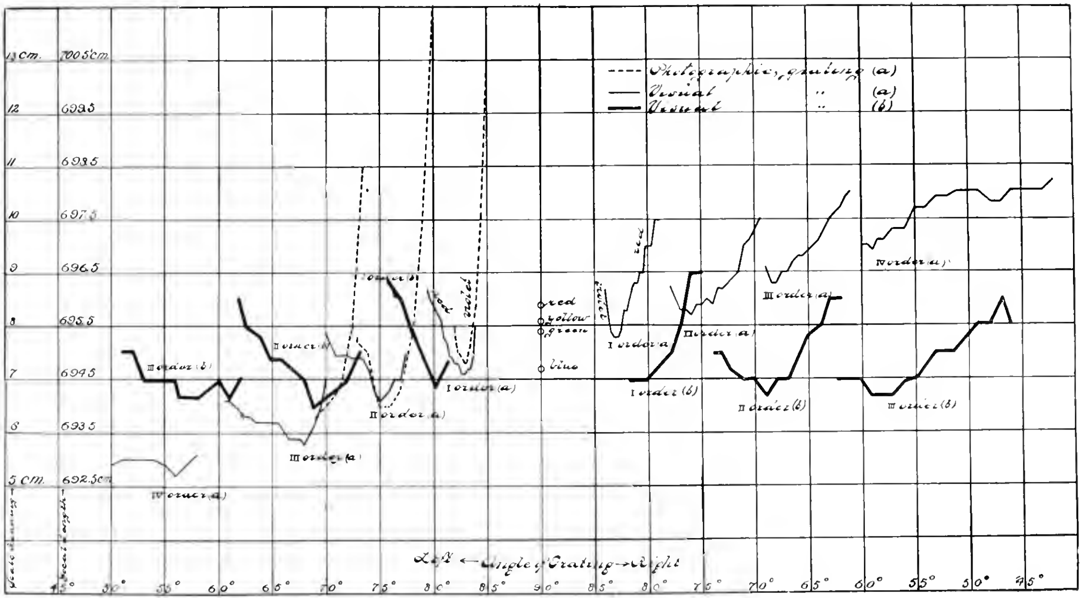


Fig. 11.—Focal Curves from two Plane Gratings in the Solar Spectrograph.

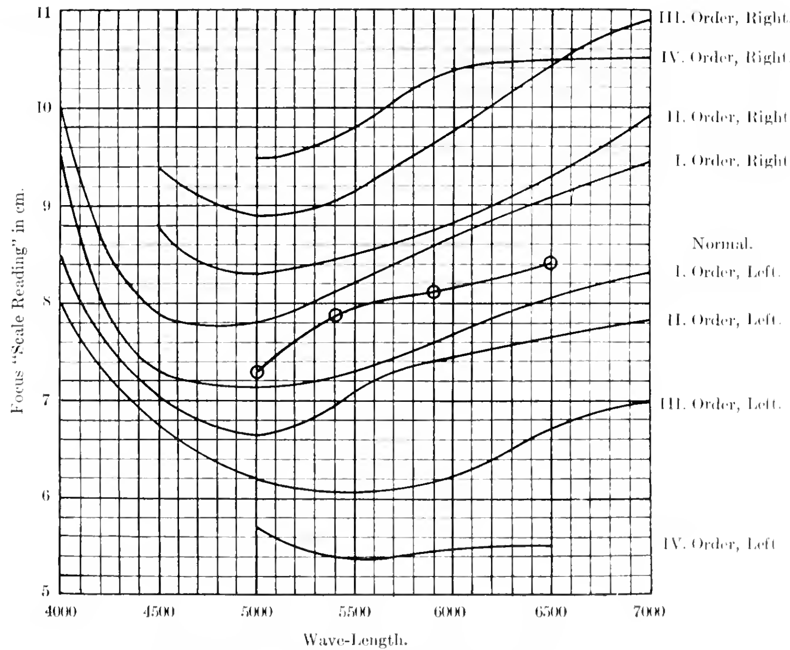


Fig. 12.—Focal Irregularities due to a Plane Grating.

slightly, the spectrum is focussed a little below the slit where it may be conveniently photographed or examined with the aid of an eye-piece. To avoid light reflected from the surfaces of the lens, it is necessary to mask a strip across the middle of the lens, or better, to tilt the lens slightly, as suggested by Mr. R. M. Stewart. The former method was employed in the measurements recorded below, but the latter arrangement has since been adopted: in either case the axis of the lens passed through a point midway, or a little below midway, between the slit and the place where the spectrum was focussed. However, since the distance between the slit and the point where the spectrum was focussed is only 10 cm., it may be assumed for the purposes of this note that the slit and spectrum are coincident on the principal axis of the lens.

"If the grating be placed normal to the beam of light it will act as a plane mirror and reflect back the light through the lens which will focus the light of different wave-lengths at various distances from the slit. By sliding the lens back and forth the different colored images of the slit may be focussed in turn at the slit, employing suitable filters to cut off the light of other colors. This has been done for the colors admitted through the red, green and blue filters of an Ives' tricolor outfit, and a 'Filtergelb' screen; and the distances of the lens from the slit, or the foci, for these colors have been recorded. If the grating be turned about a vertical axis to either the left or the right, the orders will appear in succession from violet to red. The distances of the lens from the slit necessary to focus the light of the different orders at the slit have been determined for the various angles of turning of the grating. All these observations are plotted in Figure 11 for both gratings, (*a*) and (*b*). The measurements were nearly all made visually, and individual observations may be in error from 2 to 6 mm. The measurements for grating (*a*) were made at a temperature of about 20°–21° C., while those of grating (*b*) were made at about 18°C. A few observations indicate that a decrease in temperature of 1° C. increases the focus of the lens nearly 1 mm.

"A reference to Figure 11 shows that the focus for any color or wave-length varies progressively from order to order of grating (*a*), while it remains nearly constant in the different orders of grating (*b*). This will be more apparent if it is remembered that, $n.\ \lambda = 2.\ \frac{1}{s} \cdot \sin\theta$, for a Littrow spectroscope, n being the order, λ the wave-length in 10^{-10} metres, s the number of rulings to the mm. — 500 and 700 for gratings (*a*) and (*b*) respectively—and θ the angle of inclination of the grating from the normal, *i.e.*, 90° minus the 'angle of grating' given in the Figure.

"The relation between change of focus and wave-length for the different orders of grating (*a*) is more clearly shown in Figure 12, where the wave-lengths and focus 'scale-readings' are the abscissae and ordinates respectively. The 'normal' focal curve is not known accurately since the average wave-length transmitted by the filters employed is not known very closely and the measurements of focus could not be made with great accuracy on account of the diffraction fringes; however, it is safe to assume that it lies nearly as represented in Figure 12, about midway between the focal curves of the two first orders. A close inspection of these curves shows that, within the limits of the errors of measurement, the change in focus is proportional to the wave-length and to the order, being negative when the grating is turned to the left, and positive and of the same magnitude when it is turned to the right. A fairly accurate value of the decrease or increase in focus for any wave-length in any order is found by taking half the difference between the foci for the wave-length in the right and left focal curves of that order. Such differences are given in the following table:

	I, R.—I, L.	II, R.—II, L.	III, R.—III, L.	IV, R.—IV, L.
4500	0·6 cm.	1·7 cm.	2·7 cm.	—
5000	0·7	1·7	2·7	3·8 cm.
5500	0·9	1·4	3·1	4·4
6000	1·0	1·4	3·5	4·9
6500	1·1	1·7	3·7	5·0
7000	1·2	2·1	3·9	—

"From this table a mean value of the change in focus from the normal of $\pm$ n. 0.5 cm. for say λ 5750 may be derived, and for any wave-length, λ, the change in focus,

$$d = \pm n \;.\; 0.5 \frac{\lambda}{5750}.\ \text{cm.}$$

Hence, substituting the value for $n \;.\; \lambda$ mentioned above, it follows that,

$$d = \pm \frac{10^7}{500} \cdot \frac{\sin \theta}{5750}\ \text{cm.}$$

Thus it appears that the change in focus is proportional to the sine of the angle of inclination of the grating, being negative when the grating is turned to one side and positive when it is turned to the other. This fact is of great importance in deciding on a theory to account for these changes.

"After I made the focal measurements for this grating, two theories to account for the changes in focus suggested themselves; one, to Mr. Plaskett, that the changes in focus were due to curvature of the ruled lines; the other, to me, that it is due to the curvature of the grooves caused by the ruling point pressing over the ridge between the last furrow made and the one being made, thus producing a concave and a convex side to each furrow. If the latter theory were correct, the second grating should show a somewhat similar behaviour to the first; it behaves quite normally, however, and the proportionality of the changes to the sine of the angle of inclination of grating (a) taken along with this fact makes it seem quite probable that the former theory is the correct one. If, then, it be assumed that the changes in focus are caused by curvature of the ruled lines, it is possible to calculate the amount of the curvature from the changes in focus, as follows:

"Let the normal focus of the lens for any wave-length be f cm., (*i.e.*, the lens must be f cm. from the slit in order to focus the light of the particular wave-length at the slit). Let the focus be changed to $f+d$ on account of the curvature of the ruled lines; the light emerging from the lens to the grating will be convergent or divergent as d is positive or negative. Now, in order that the spectrum may be focussed at the slit, the grating must return the light along the same path, *i.e.*, it must act as a convex or a concave mirror depending on whether d is positive or negative respectively. Suppose the grating does this, then its radius of curvature, r, is given by the formula,

$$\frac{1}{f} = \frac{1}{f+d} - \frac{1}{r},\ \text{or,}\ -\frac{1}{r} = \frac{d}{f^2}$$

r being negative (*i.e.*, as for a convex mirror) when d is positive, and positive (*i.e.*, as for a concave mirror) when d is negative. It is desired to know the curvature of the lines measured in the plane of the grating, *i.e.*, corresponding to the value of d when $\theta = 90°$, a value, of course, impossible in practice. For this value of θ, $d = \pm \frac{10^7}{500} \cdot \frac{1}{5750}$ cm., or, $\pm$ 3.5 cm., and the normal value of f for λ 5750, is about 695.5 cm. Consequently, r is found to be about 140,000 cm. This would mean, in a ruling 10 cm. long, a departure at the ends from the position of the centre of the ruling of about 0.00008 cm., or about half the distance between two successive lines of the grating. Such a condition would account for all the defects of the grating in question, and possibly irregularities in the form of the grooves would help to account for its exceptional dimness.

"It may here be mentioned that such measurements as recorded above may sometimes serve to point out—to those who have undertaken the extremely difficult task of ruling gratings—slight errors in the ruling mechanism which may be removed."

3. *Plates of the Solar Rotation Effect, with some Measurements of the Rate of Rotation at the Solar Equator.*

During the year, about 130 plates of the solar rotation effect, having from 4 to 6 exposures on each, were made by Mr. Plaskett and myself for the most part working together. These plates may be grouped in several series according to the region in which they were taken. In the summer of 1910 the plates were made in the region λ 4500 in the second and third orders from the brighter side of the grating (No. 55). All these plates were taken with 5 cm. masked off the bottom of the grating to remove astigmatism. In the second order, 17 plates, $L476-L487$ and $L491-L496$, were made with the whole width of the grating, and 66 plates, $L527-L535$ and $L538-L578$, were made with 5 cm. masked off one side of the ruled surface to improve the definition of the spectrum lines. In the third order, the whole width of the grating was used in taking plates, $L488-L510$; various widths in taking plates, $L511-L517$; and the 8 cm. width remaining when the 5 cm. mentioned above was masked off to give the best definition, was used in making plates $L518-L526$, a total of 33 plates being made in the third order. All plates after $L538$ were made with the best 6 cm. $\times$ 8 cm. area of the grating so mounted that it was placed symmetrically opposite the centre of the lens. In making these photographs, great difficulty was experienced in keeping the prisms adjusted so as to properly reflect the beams of light to the grating. The three beams—two from the West and one from the East limb of the Sun—should each evenly illuminate the grating, for otherwise there would be displacements of the spectra in case the photographic plate was slightly out of focus. The prisms were adjusted so that the beams from each limb evenly filled the unmasked rectangle of the grating, but these were usually of uneven intensity and the exposures for the West and East limbs were, on the average, about 20 and 25 seconds respectively. On some of the plates the two strips from the West limb were found to be of uneven intensity which probably points to an uneven illumination of the grating. After taking some of the plates, the illumination was found to have changed as if due to a temperature effect. To remove these difficulties, stronger and more positive adjustments were made and the two prisms above the slit which were used to reflect the two beams from the West limb were replaced by a single prism, notched as suggested by Mr. Plaskett, to receive the prism which reflected the beam from the East limb. A more perfect and convenient guide-plate replaced the old one, and the scale for reading the angles of inclination of the grating was more conveniently placed, as mentioned in the outline given above. A series of plates, $L600-L629$, were then taken in the few available good hours in November and December. This series was made about the λ 5600 region as recommended by the International Union for Co-operation in Solar Research (see Mr. Plaskett's Report). A few more plates, *L*713 – *L*717, were taken in this region in March 1911, making a total of 30 plates taken at λ 5600. For taking the photographs at this wave-length, the Seed Process plates, which were sufficiently sensitive at λ 4500, were sensitized with erythrosine and ammonia by Mr. Plaskett. The fresh Seed red "0" Process plates gave the best results when thus stained. The plates were taken at latitudes 0°, 15°, 30°, 45°, 60°, 75°, and 90° with some at 80° and 85° in the λ 5600 part of the spectrum. The settings at these angles were made by rotating the spectrograph (as described in the Report for 1909) after having first determined the "East and West" line which makes a known angle with the Sun's equator at any time. Rotating the spectrograph changes the position of the focussed spectrum on the photographic plate, and consequently a table of corrections had to be made so that a series of exposures at different latitudes could be made on the one plate without danger of having them overlap.

The winter proved to be a very unsatisfactory period for taking rotation spectra photographs. The definition of the solar image was usually poor, the coelostat-house is in shadow except in the afternoon when atmospheric distortion and dispersion of the solar image is apt to occur, and convection currents in the spectrograph occurred when the room was cooled suddenly by opening the doors to the coelostat-house, though this difficulty was finally overcome as described below.

During the course of the above work measurements of the equatorial displacements of selected lines were made in the exposures, *L*528*a*, *L*531*a*, *L*531*b*, *L*569*d*, and *L*570*a* at λ 4500, and *L*600*c*, *L*600*d*, *L*601*d*, *L*610*e*, and *L*616*a* at λ 5600. These measurements are given in the Tables below, along with a description of the plates and an explanation of the symbols used. From these Tables it will be seen that the values of the equatorial rate of rotation of the sun as determined from the different exposures in kilometres per second, are,—*L*528*a*, 2.038; *L*531*a*, 2.038; *L*531*b*, 2.148; *L*569*d*, 1.956; *L*570*a*, 1.901; *L*600*c*, 1.962; *L*600*d*, 1.936; *L*601*d*, 2.021; *L*610*e*, 1.993; *L*616*a*, 1.905. The mean of the first five exposures (at λ 4500) is 2.016, and the mean of the last five (at λ 5600) is 1.964; or the mean of the whole ten exposures is 1.990, a value which is about 4 per cent. lower than the ordinarily accepted value, (Adams found 2.074 for 1906–7, and 2.062 for 1908). This difference may point to a change in the rate of rotation of the sun's reversing layer (as Halm has suggested) possibly accompanying the sun-spot cycle of changes, for 1906-7-8 follow the sun-spot maximum and 1910 approaches the minimum. However, it would not be safe to draw this conclusion from so few measures, particularly since they disagree so much among themselves and in such a manner as to suggest the presence of grave errors:—For example, *L*531*a* and *L*531*b*, taken from the same positions on the sun about 1 minute apart, show a difference of 0.110 km. per second. For these same exposures Mr. Plaskett's measurements give for the value of the equatorial rotation, 2.056 and 2.060 km. per second respectively, the difference in our determinations being therefore due to errors of measurement (this subject is discussed below). Furthermore, the deviations of the means for the various lines from the means of all lines in the two series at λ 4500 and λ 5600 are decidedly great in some cases. Though these results seem to agree with the general conclusions of Adams, I prefer to regard them as due to errors of measurement until many more measurements and the simultaneous investigation of these errors are made; and as will be seen from the results of such an investigation given below, it is not safe to draw any such conclusions from our measurements until the systematic errors of measurement are eliminated. The striking case of the *Si* line λ 5690.646 may be noted. As will be seen from the tables for λ 5600, this line gives on the average a value about 0.36 km. per second lower than the means for the other lines. This may be due to errors of measurement for the continuous spectrum grows suddenly weaker near this line; or it may be caused by the overlapping of an atmospheric line which is not displaced by the sun's rotation, the highest value for this line being on the dense exposure *L*616*i* which was taken two hours nearer noon than the other measured plates were, when consequently the atmospheric line would be weaker and its effect less. One is tempted to explain this great difference to the presence of *Si* some distance outside of the sun, but as I have pointed out such conclusions are not safe until further measurements are made. Besides errors of measurement the following errors may also be present, and all of these must be reckoned with before accurate values of the solar rotation are deducible and any slight changes which may occur in it may be detected:—Errors due to: Convection in the sun's atmosphere; Changes in the illumination of the grating brought about by temperature effects on the prisms or prism-mountings as suggested above; Alterations in the figures of the mirrors due to heating, with consequent changes in focus and definition of the solar image; Overlapping of the spectrum of the sky and possibly too of matter outside of the sun; etc.

As already stated, however, the above plates and the few measures made of representative exposures, have revealed to us the presence of irregularities, and to remove these and to find out their causes a very careful check must be made of all the numerous variables of which we know to affect the result sought.

In the following Record of Observations for the exposures taken at the equator whose measurements are given in the Tables below, the number of the plate is given followed by a letter denoting the exposure on the plate, then follow the date in 1910 and hour G.M.T., the duration of the exposure in seconds—and where the times are different for the two limbs they are given following the letters W and E denoting West and East respectively. The diameter of the sun measured in mm. is then given, followed by the distance apart in mm. of the two regions inside the limbs from which the light is reflected by the two outside prisms to the slit. The diameter of the sun was measured on the guide-plate except for *L*610*e* and *L*616*a* when it was measured at a distance back of the guide-plate equal to the path of light from the windows in the guide-plate through the prisms to the slit, the image being focussed at this point, and the distance apart of the two regions investigated is the distance between the two narrow strips of metal held in front of the windows so as to shut out the light from the slit, with, in the case of *L*610*e* and *L*616*a*, a slight correction necessary to project this distance on the focal plane. After *D*, is given the heliographical latitude of the centre of the sun's disc; and after v^1 the correction in km. per second to be added to convert the synodical velocity to the sidereal. Then follow remarks concerning the definition.

At λ 4500.

*L*528*a*,-July 5,3:38 G.M.T.; W. 20, E. 25;226.0:220.0; *D*, + 3°.4; v^1, 0.134; Fair.
*L*531*a*,-July 5,7:46 G.M.T.; W. 20, E. 25:226.0:220.0; *D*, + 3.4; v^1, 0.134; Fair.
*L*531*b*,-July 5,7:47 G.M.T.; W. 20, E. 25:226.0:220.0; *D*. + 3.4; v^1, 0 134; Fair.
*L*569*d*,-July 16, 5:31 G.M.T.; 20 secs.; 225.5:220.0; *D*. + 4.5; v^1, 0.134; Fair.
*L*570*a*,-July 19, 3:59 G.M.T.; 30 secs.; 226.0:220.0; *D*, + 4.8; v^1, 0.134; Clouds.

At λ 5600

*L*600*c*,-Nov. 9, 8:20 G.M.T.; 30 secs., 233.0:220.1, *D*. + 3°.4, v^1, 0.141; Fair.
*L*600*d*,-Nov. 9, 8:21 G.M.T.; 40 secs., 233.0:220.1, *D*, + 3.4, v^1, 0.141; Fair.
*L*601*d*,-Nov. 9, 8:37 G.M.T.; 25 secs., 233.0:220.1, *D*, + 3.4, v^1, 0.141; Fair.
*L*610*e*,-Dec. 6, 7:57 G.M.T.; 30 secs., 234.5:221.5, *D*, 0.0, v^1, 0.141; Fair.
*L*616*a*,-Dec. 9, 5:45 G.M.T.; 35 secs., 236.0:221.9, *D*, − 0.3, v^1, 0.141; Fair.

In the following Tables, under "Line" are given the wave-lengths λ of the lines measured, followed by the chemical symbol of the element whose vapor produces the absorption line and the intensity of the line all as given in Rowland's Tables of Solar Wave-lengths; under *d* are given the measured displacements of the lines in ten-thousandths of 1 mm., determined by measuring the plate one way then turning it through 180° and measuring it again and taking the mean of the two measures, each measure being the difference between the mean of 4 settings on the line in the central strip and the mean of 2 settings on the line in each of the two outside strips: thus, *d* for each line depends on 16 settings; under *v* are given the velocities equivalent to half of *d*, the unit being kilometres per second. The mean value of *v* for each plate is given and below it the value *V* of the sun's rotation calculated from the following equation:—

$$V = v. \frac{Diameter\ of\ sun's\ disc}{Distance\ between\ prisms.} . \sec. D + v^1,$$

where v^1, as mentioned above, is the correction to be added to get the sidereal rotation.

TABLES OF MEASUREMENTS OF SOLAR ROTATION PLATES

Line.			*L*528*a*.		*L*531*a*.		*L*531*b*.		*L*570*a*.	
			d	*v*	*d*	*v*	*d*	*v*	*d*	*v*
4432·736,	*Fe*,	1....	565	1·863	535	1·764	559	1·843	520	1·716
4435·321,	*Fe*,	2....	525	1·730	570	1·878	606	1·996	515	1·610
4438·510,	*Fe*,	1....	550	1·910	550	1·810	627	2·065	560	1·846
4445·641,	*Fe*,	1....	535	1·758	565	1·854	614	2·018	565	1·859
4453·876,	*Ti*,	1....	565	1·854	570	1·870	531	1·742	555	1·823
4464·617,	*Ti*,	2....	560	1·832	580	1·897	586	1·919	515	1·688
4468·663,	*Ti*,	5....	550	1·799	570	1·935	623	2·037	505	1·653
4484·392,	*Fe*,	4....	545	1·775	565	1·841	558	1·818	535	1·745
4489·911,	*Fe*,	4....	575	1·872	555	1·806	613	2·024	555	1·808
4502·388,	*Mn*,	2....	570	1·850	575	1·865	585	1·898	555	1 804
4508·455,	*Fe?*,	4 ...	585	1·897	585	1·897	622	2·017	520	1·687
4512·906,	*Ti*,	3....	575	1·862	585	1·894	587	1·901	510	1·653
4518·198,	*Ti*,	3....	590	1·908	595	1·924	642	2·088	550	1·783
4523·572,	*Mn?*,	1....	600	1·938	590	1·905	620	2·003	540	1·746
4527·101,	*Ca?*,	3....	590	1·904	590	1·904	602	1·943	520	1·681
4531·801,	*Fe*,	2....	540	1·742	560	1·806	664	2·141	525	1·695
4534·953,	*Ti*,	4....	570	1·837	570	1·837	598	1·927	540	1·741
4546·129,	*Fe,Cr*,	3....	565	1·816	550	1·768	612	1·967	510	1·641
4548·938,	*Ti*,	2....	575	1·847	575	1·847	629	2·021	520	1·656
4554·211s,	*Ba*,	8....	600	1·924	580	1·862	623	1·999	530	1·703
4555·162,	*Cr*,	2....	570	1·828	600	1·924	611	1·960	495	1·590
4558·827,	*Cr?*,	3....	605	1·939	575	1·843	596	1·910	490	1·589
4563·939s,	*Ti*,	4....	595	1·905	555	1·777	565	1·809	481	1·537
4571·275s,	*Mg*,	5....	575	1·838	575	1·838	571	1·825	536	1·710
4572·156s,	*Ti*,	6....	585	1·869	565	1·806	558	2·103	555	1·776
4578·732s,	*Ca*,	3....	580	1·851	615	1·962	622	1·984	595	1·900
4590·126s,	*Ti*,	3....	570	1·815	565	1·799	589	1·875	545	1·738
4602·183s,	*Fe*,	3....	620	1·968	580	1·841	629	2·038	505	1·606
4603·126,	*Fe*,	6....	555	1·762	545	1·730	617	1·958	560	1·780
				1·851		1·851		1·959		1·716
				V=2·038		*V*=2·038		*V*=2·148		*V*=1·901

*L*569*d*.

Line.			*d*	*v*	Line.			*d*	*v*
4368·071,	*Fe*,	2....	562	1·881	4512·906,	*Ti*,	3....	573	1·856
4371·442,	*Cr*,	2....	553	1·849	4514·358,	*Fe, Co*,	1....	560	1·809
4374·628,	*Sc, Fe?*,	3....	528	1·764	4518·198,	*Ti*,	3....	578	1·869
4376·107s,	*Fe*,	6....	520	1·736	4533·419,	*Ti*,	4....	618	1·986
4379·396,	*V*,	4....	552	1·841	4534·139,	*Ti, Co*,	6....	546	1·759
4388·057,	*Fe, Co*,	2....	521	1·901	4534·953,	*Ti*,	4....	563	1·813
4388·571,	*Fe*,	3....	541	1·806	4546·129,	*Fe, Cr*,	3....	594	1·844
4389·413,	*Fe*,–,	2....	544	1·811	4548·024,	*Fe*,	3....	585	1·876
4394·225,	*Ti?*,	2....	515	1·713	4548·938,	*Ti*,	2....	574	1·840
4395·201,	*Ti*,	3....	541	1·799	4554·211s,	*Ba*,	8....	612	1·964
4398·178,	*Zr?*,	1....	510	1·695	4555·662,	*Ti*,	3....	517	1·659
4399·935,	*Ti, Cr*,	3....	533	1·770	4556·063,	*Fe*,	3....	609	1·952
4400·555,	*Sc*,	3....	536	1·780	4456·306,	*Fe, Cr*,	4....	631	2·024
4401·709,	*Ni*,	2....	499	1·657	4560·266,	*Fe*,	2....	495	1·587
4415·722,	–,	3....	515	1·704	4563·939s,	*Ti*,	4....	555	1·777
4417·884,	*Ti*,–,	3....	536	1·773	4571·275s,	*Mg*,	5....	577	1·844
4422·741,	*Fe, Y*,	3....	565	1·866	4572·156s,	*Ti*,–,	6....	571	1·825
4425·608s,	*Ca*,	4....	533	1·759	4574·899,	*Fe*,	2....	591	1·882
4430·356,	*Fe*,	1....	563	1·868	4578·732s,	*Ca*,	3....	546	1·742
4430·785,	*Fe*,	3....	568	1·873	4590·126s,	–,	3....	587	1·869
4433·390,	*Fe*,	3....	537	1·770	4600·932,	*Cr*,	3....	540	1·716
4435·851s,	*Ca*,	4....	538	1·773	4602·183s,	*Fe*,	3....	529	1·679
4437·112,	*Fe, Ni*,	2*d?*..	492	1·621	4603·126,	*Fe*,	6....	526	1·670
4443·465,	*Fe*,	3....	586	1·927	4616·305,	*Cr*,	4....	595	1·884
4443·976,	*Ti*,	5....	488	1·603	4625·227,	*Fe*,	5....	569	1·797
4447·302,	*Mn, Fe*,	2....	537	1·764	4626·358,	*Cr*,	5....	565	1·784
4450·654,	*Ti?*,	2....	542	1·780	4629·521s,	*Ti, Co*,	6....	481	1·518
4454·552,	*Fe*,	3....	522	1·713	4630·306,	*Fe*,	4....	530	1·672
4461·818,	*Fe*,	4....	543	1·778	4636·027,	*Fe*,	2....	595	1·875
4468·663,	*Ti*,–,	5....	520	1·701	4637·685s,	*Fe*,	5....	566	1·783
4484·392,	*Fe*,	4....	561	1·825	4638·193s,	*Fe*,	4....	613	1·932
4485·846,	*Fe*,	3....	460	1·498	4643·645s,	*Fe*,	4....	598	1·882
4489·911,	*Fe*,	4....	547	1·780	4646·347,	*Cr*,	5....	514	1·616
4501·448s,	*Ti*,–,	5....	575	1·866	4651·461,	*Cr*,	4....	579	1·819
4508·455s,	*Fe?*,–,	4....	471	1·527	4652·343,	*Cr*,	5....	627	1·976

1·774

V = 1·958

Line			L600c. d	L600c. v	L600d. d	L600d. v	L601d. d	L601d. v	L610c. d	L610c. v	L616a. d	L616a. v
5506·095,	*Mn*,	1......	677	1·753	664	1·719	734	1·900	671	1·737	536	(1·388)
5507·000,	*Fe*,	7......	675	1·747	661	1·711	665	1·720	679	1·757	607	1·571
5525·765,	*Fe*,	4......	684	1·762	558	1·438	697	1·811	621	1·600	660	1·700
5528·641,	*Mg*,	8......	658	1·695	670	1·723	719	1·852	730	1·879	662	1·704
5544·157,	*Fe*,	2......	....	....	....	....	....	....	745	1·911	645	1·654
5562·933,	*Fe*,	2......	....	....	....	....	....	....	680	1·736	620	1·583
5576·320,	*Fe*,	4......	650	1·653	671	1·709	707	1·797	672	1·710	616	1·568
5578·946,	*Ni*,	1......	711	1·810	693	1·763	687	1·747	671	1·707	642	1·633
5582·198,	*Ca*,	4......	711	1·807	680	1·728	698	1·774	694	1·764	712	1·809
5590·343,	*Ca*,	3......	675	1·712	605	1·533	693	1·758	708	1·796	685	1·737
5598·524,	*Fe*,	1......	661	1·673	639	1·617	656	1·662	....	....	....	....
5618·858,	*Fe*,	1......	....	....	....	....	....	....	686	1·728	727	1·831
5634·171,	*Fe*,	3......	....	....	....	....	....	....	670	1·681	616	1·546
5638·488,	*Fe*,	3......	715	1·792	747	1·871	783	1·964	751	1·882	658	1·649
5655·715,	*Fe*,	2......	699	1·744	712	1·778	773	1·929	654	1·632	634	1·582
5658·097,	*Y*,	2......	647	1·612	712	1·775	680	1·694	739	1·843	647	1·613
5662·744,	*Fe*,	4......	653	1·627	695	1·731	728	1·815	669	1·667	660	1·644
5675·647,	*Ti*,	2......	685	1·702	582	1·444	658	1·633	....	....	....	....
5682·869,	*Na*,	5......	667	1·653	738	1·831	687	1·704	694	1·720	734	1·820
5688·436,	*Na*,	6......	708	1·753	696	1·723	657	1·625	....	....	....	....
5690·646,	*Si*,	3......	518	(1·282)	561	(1·388)	559	(1·384)	490	(1·213)	614	(1·519)
				1·718		1·694		1·774		1·750		1·659
			V = 1·962		V = 1·936		V = 2·021		V = 1·993		V = 1·905	

4. *Errors in the Measurement of Spectral Line Displacements.*

The presence of systematic errors of a personal nature in the measurements of the positions of spectrum lines has often been suspected, yet little attempt has been made to determine their character and magnitude. In the present report a method for investigating and eliminating these errors is described along with some measurements made in connection with the problem of the solar rotation, after first briefly mentioning some of the more important questions likely to be affected by such errors.

Systematic personal errors are suspected to occur in the measurements of the following investigations:

(*a*) *The Determination of Wave-lengths.* The greater part of this work involves repeated "settings," on the lines whose wave-lengths are sought and on other lines called "standards" whose wave-lengths are known. These "settings" consist in turnings of a micrometer-screw carrying the measuring microscope or the photograph of the spectrum, until the line or lines of the microscope are placed as closely as the measurer can see, over or symmetrically about the centres, centres of intensity or some other selected part of the spectrum lines and recording the corresponding scale-readings. It is obvious that if one observer uses the centre of the line for his settings and another uses the centres of intensity, systematic errors will occur since for some lines the two "centres" coincide while on others they do not. Again, even if two persons strive to set on the same part of the line such things as unsymmetrical shading of the line, the nearness of other lines, etc., may affect them differently and result in different settings with consequent errors in the determination of the wave-length. Such errors are so small, when the spectrum is on a large scale, that for many purposes the measurements are sufficiently accurate. In the determination of standard wave-lengths, however, an effort should be made to eliminate even these errors. It is generally assumed that the mean of the measurements of several measurers is well within the limits of the accidental errors. This is not necessarily the case, however, for disturbing influences such as those mentioned above may operate on the measurements systematically in the same way for the different persons. There is apparently some evidence of this in the determination by interferometer methods of the "Secondary Standards of Wave-length, International System, in the Arc Spectrum of Iron,"* by Fabry and Buisson, Eversheim and Pfund, as the following quotation from H. Kayser's paper on "Standards of Third Order of Wave-lengths on the International System,"† would seem to show: "I have employed as standards the arithmetical means of the measurements of Fabry and Buisson, Eversheim and Pfund. The portions of spectrum measured were always between three or four successive standards, so that each line is referred to as many neighboring standard lines as possible. It turned out that measurements of the same sharp line on different plates yielded differences of not more than from 0.001 to 0.002 Å, when the same standards were employed; but if different standards were employed, differences as great as about 0.006 occurred. This proves that some of the standards still contain errors of from 0.004 to 0.005 Å, and that measurements of the best plates in the second order give a greater degree of accuracy than that of the secondary standards." I cannot say that I am wholly convinced by the argument. It seems to me quite possible that Kayser's own settings on the secondary standards may contain systematic errors greater than the differences in the "measurements of the same sharp line on different plates." However, the fact remains that in the determinations of either the secondary or the tertiary standards, or both, *there are systematic errors greater than the accidental errors of measurement.*

(*b*) *The determination of Stellar Radial Velocities.* In this work systematic errors of measurement are more likely to occur than in any other involving the measurement of spectra, because the spectra measured—the star spectrum with its usually diffuse absorption lines, and the comparison spectrum with its strong emission lines—are so different in character. Furthermore, since the lines of the star spectrum often differ greatly in appearance and are in regions of the continuous spectrum of different intensity, systematic differences in velocity for the various lines are likely to be found, and since the star spectra are on a very small scale, these may represent variations of several kilometres per second. Such differences have been found, and though there are plausible physical explanations which one can give, such as convection, electrical or magnetic effects, pressure effects, the presence of other bodies or of a hazy envelope about the star having a different motion, etc., yet it would be advisable before employing such theories to eliminate the possibility of systematic errors of measurement.

(*c*) *The comparison of various regions in the Sun with one another and with Standard Spectra.* Much of this work depends on comparative measurements of spectra of different character, and, as pointed out above, is therefore liable to contain systematic error. Among the more important investigations in this field are some of those carried out at Mount Wilson Solar Observatory, on the displace-

* Astrophysical Journal, 32, 215–216.
† Astrophysical Journal, 32, 217–225.

ments of the spectrum lines at the sun's limb,* and the motions of calcium vapor in the solar atmosphere† and over special regions in the sun.§ The accidental errors of measurement in this work are extremely low, a precision of 0.001 A being aimed at, and such being the case it would be well worth while to test for systematic errors which may well exceed this small quantity. Furthermore, in deciding whether the interesting results observed in these researches are due to pressure or to convection very accurate references to laboratory comparison spectra were necessary, and the spectra compared being widely different the decisions may have been affected by systematic error. Even so may be affected the results derived from the comparison of "enhanced" and "arc" lines in the same spectrum.‡

(*d*) *The determination of the rate of the solar rotation.* The method chiefly used at present in the investigation of the rate of the sun's rotation, is that employed by Adams** at the Mount Wilson Solar Observatory, namely, the measurement of the spectral line displacements in adjacent simultaneously taken photographs of the spectra from opposite ends of a diameter of the sun's disc. These measurements differ from those made in the investigations mentioned above, in that the relative positions are sought of *the same spectral lines in two presumably similar spectra*, and consequently it is not so easily imagined, as in the case where *two different spectra* are compared, how systematic errors of measurement may happen. Nevertheless, it was in connection with this very problem that I first suspected the presence of such errors. In 1909, I measured a few plates of the solar rotation effect which I made with the twenty-three foot Littrow spectrograph, using a plane grating which apparently on account of curvature of the lines†† (as shown previously in this report) produced spectra of very poor definition. The spectrum lines were not sharp and the continuous spectrum was nebulous. From my measurements of from 30 to 80 lines on each of three plates, I noted that the greater proportion of the lines giving the largest values of the measured displacements were the broader and more fuzzy lines or those very close to other lines or to nebulous regions of the spectrum. A few scattered measurements on other plates seemed to confirm this observation. Measurements of one of these plates were published along with a description of the spectrograph§§ simply to illustrate the method, but even from these 80 measurements the tendency for the broader and more diffuse lines to give larger values for the displacement is noticeable. The mean velocity-equivalent of the measured displacements is 1.77 km. per second, and of the 9 lines which yield values greater than 1.90 km. per second, 4 are exceptionally broad or fuzzy lines, 1 is in a nebulous region and another is very close to another spectrum line, as follows: 4163.818, fuzzy, 1.95 km.; 4199.257, fuzzy, 2.13, and 1.95 km.; 4236.279, near 4236.112, 1.92, and 1.94 km.; 4246.966, broad and fuzzy, 1.94 km.; 4271.325, broad and fuzzy, 1.91 km.; (4271.934, broad and fuzzy neighboring line gives a value nearly as great, 1.87 km.); 4288.310, nebulous region, 1.98; the other three lines appear to be average lines. These measurements with the others mentioned above certainly warranted the suspicion that the broader and more nebulous lines gave larger values, and so much was I impressed by them that my suspicions extended to the measurements of Adams on the rotation (loc. cit.) values for the two very broad and shaded lines $H\alpha$ and λ 4227, which he found to give larger values for the rate of the sun's rotation than those obtained from the

* Walter S. Adams, Astrophysical Journal, 31, 30–61.
† Charles E. St. John, Ibid, 32, 36–82.
§ Charles E. St. John, Ibid, 34, 57–78.
‡ Walter S. Adams. Some results of a study of the spectra of Sirius, Procyon and Arcturus with high dispersion, Astrophysical Journal, 33, 64–71.
** Ibid, 26, 203; 29, 110; 27, 213.
†† De Lury, Journal Roy. Astron. Soc. Can., 5, 26–32.
§§ Report for 1909, p. 256.

narrower absorption lines. I felt the necessity of making measurements to test these suspicions, but thought it better to wait until a new grating giving sharper spectrum lines was obtained. Consequently, when work with the new grating was well under way and some measurements were made which still showed systematic tendencies, particularly some comparative measures by different persons, I proposed to make tests for systematic errors of measurements to be carried out in connection with the measurements of the plates of the solar rotation effect, in the hope that I could eliminate these errors if they actually existed, and also that I might throw light on my suspicions as to the reality of the results obtained by Adams regarding the systematically different displacements of various lines. I accordingly devised a method of attacking the problem, a description of which, together with some preliminary measures, constitutes the remainder of this section of the report.

The method consists essentially in introducing on the spectrum lines under investigation by mechanical means an arbitrary displacement—of known magnitude if desired—which is the same for all the lines, and which should yield, in the absence of systematic errors, the same measured values within the limits of the accidental errors, and for a large series of observations the same means for all the lines whether measured by the same or different observers; if the means of the measured values in such a series are not close to the same value, then systematic errors are present, and their magnitude and nature can be determined from the differences.

The arbitrary displacement may be introduced by taking the photograph of one spectrum first, then shifting the plate-holder and taking the photograph of the other spectrum. The plate-holder may be moved between stops or moved by means of a micrometer screw. The method is very satisfactory if one is not anxious

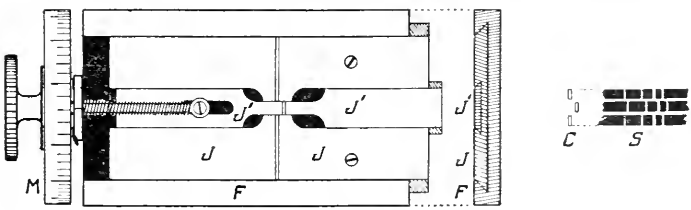


Fig. 13.—Double-Slit Apparatus.

to have the displacements on a series of plates identically the same. For several reasons, however, I desired the latter condition and accordingly devised a second method of obtaining the displacement. This method consists in the taking of spectra from two parallel slits whose widths and distances apart are adjustable and may be kept constant for a series of plates, the distance apart of the slits governing the displacement of the spectra. To reproduce the configuration of the "rotation spectra" taken here, I had the "double-slit" constructed in the form shown in Figure 13, which represents a bird's-eye view of the apparatus. F, is a brass frame with bevelled runs in which the slit-jaws, J, J, work. These jaws are also milled with bevelled runs in which the smaller jaws, J', J', slide. The slit-edges of all these jaws are parallel, and they are bevelled back leaving their sharp edges in the plane of their faces. The smaller jaws were set in the larger and their edges polished simultaneously to insure parallelism, the polishing being done on plate-glass with the finest emery. One of the jaws, J, is screwed to F in a fixed position, while the other may be slid back and forth in F by means of the micrometer, M, with the aid of a coiled spring as in ordinary spectrograph-slits, and the distance between the jaws may be read in ten-thousandths of an inch. The slit between the jaws, J', J', may be adjusted to any desired distance to either side of the slit between the larger jaws. The widths of the two slits will be the same if they are adjusted so that they close simultaneously, since, when jaw, *J*, is moved by the micrometer it carries with it one of the smaller jaws. A mask is next placed over the slits to give the configuration *C*. The double-slit replaces the ordinary slit of the spectrograph, and the spectra taken are represented by *S*. A precisely similar mask is used in taking the rotation spectra, so that the widths of the strips of spectra and the distances apart are exactly the same. Both spectra are taken from the same distance inside the limb of the sun, so that the only difference between them lies in the fact that in the rotation spectra the displacement of the spectral lines is due to the rotation of the sun, while in the double-slit spectra the displacement is caused by the displacement of the slits and is therefore the same for all lines. Measurements of the latter should therefore reveal the exact nature of the errors of measurement of the former. In a somewhat similar manner the double-slit may be employed to investigate the errors of measurement in connection with the other problems mentioned above. If the double-slit is to be used very much it will be found advantageous to provide a micrometer attachment to the right-hand jaw, *J'*, so that its distance from the slit made by the larger jaws may be readily adjusted. For use in the present investigation the displacement was fixed at about 0.07 mm. the value of the displacement at the equator on the rotation plates at λ 4250, the region chosen because it was that employed by Adams in his work on the Solar Rotation and is the common region selected by the International Union for Co-operation in Solar Research.

In making the measurements the large Toepfer measuring machine of the Observatory was used. This instrument has a thread 30 cm. (12 in.) long and of 0.5 mm. pitch and is capable of measuring over the whole range of the 12 in. plates taken in the solar spectrograph. The micrometer reads to microns and estimations to one-tenth of this value, *i.e.*, to one ten-thousandth of a mm., (0.0001 mm.) may be made. The measures given in the following Tables are expressed in this unit. All measurements of the displacement of any line consist in taking the difference between the means of 4 settings on the line in the central strip of spectrum and the mean of 2 settings on the line in each of the two outside strips; when all the lines in question are measured, the plate is turned through 180° and the measurements repeated, the run of the micrometer screw being in the opposite direction: the mean *d*, of the means *d'* and *d''*, from the two runs for each line is the measured displacement for that line, and it thus depends on 16 settings. Before giving the bulk of the measurements of the arbitrary displacement plates, I will present some results illustrating the differences in the measures of the same lines by different observers. In the Tables, *r* denotes the residual obtained by subtracting the mean value of *d* from the *d* in question.

TABLE I.
Plate, *L*570*a*, (Rotation Effect).

	4548·938		4558·827		4564·939		4571·275		Means	
	d	*r*	*d*	*r*	*d*	*r*	*d*	*r*	*d*	*r*
Plaskett	533	− 4	537	+14	540	+25	545	+21	539	+14
Harper	563	+26	515	− 8	510	− 5	510	+26	535	+10
Parker	550	+13	540	+17	500	−15	520	− 4	528	+ 3
Cannon	540	+ 3	552	+29	513	− 2	502	−22	527	+ 2
Motherwell	543	+ 6	500	−23	500	−15	522	− 2	516	− 9
De Lury	493	−44	496	−27	526	+11	507	−17	506	−19
	(520	−17)	(490	−33)	(481	−34)	(536	−12)	(507)	.....
Means	537	.....	523	.....	515	.....	524	.....	525	.....

Note.—The bracketed values are duplicate measures previously made and whose peculiar differences made it desirable to have measurements made by other observers. All but the bracketed values are derived from measures made in only one position of the plate.

TABLE II.

*L*701*f*, Arbitrary Displacement by Double-Slit.

	4220·509, Fe, 3			4225·619, Fe, 3			4232·887, Fe, 2			4241·285, Fe-Zr, 2			4246·996, Sc., 5.			Means.		
	d'	*d''*	*d*	*d'*	*d''*	*d*	*d'*	*d''*	*d*	*d'*	*d''*	*d*	*d'*	*d''*	*d*	*d'*	*d''*	*d*
Plaskett	721	704	713	720	730	725	700	713	706	707	700	701	689	683	686	707	706	707
	(712	697	709)	(687	710	699)	(702	687	695)	(715	718	716)	(688	690	689)	(701	700	700)
Cannon	706	701	704	679	725	702	678	660	669	710	668	689	687	731	709	692	697	694
Parker	648	716	682	663	744	704	709	671	690	691	725	704	663	688	675	675	709	692
Harper	676	700	688	706	742	724	654	666	660	714	681	697	669	671	670	684	692	688
De Lury	669	682	676	733	701	717	649	659	654	710	702	706	653	690	671	683	687	685
	(669	731	700)	(741	726	734)	(691	638	664)	(648	652	650)	(715	660	688)	(693	681	687)
Stewart	658	687	673	656	712	684	683	649	666	663	669	666	705	658	682	673	675	674
Means *d'*	680	......	......	693	......	......	679	......	......	699	......	......	678		......	686	......	......
Means *d''*	......	698	......	......	726		......	669	......	......	689	......	......	686	......	......	694	......
Means *d*	......	......	689	......	......	709	......	...	674	......	......	694			682	......	......	690

Note.—The bracketed values, previously obtained, suggested the advisability of repeating the measurements and having other observers make them also. The bracketed values are not included in taking the means. The values obtained for the whole exposure *L*701*f* at the previous measurement, were, Plaskett, 702; De Lury, 686.

TABLE III.

*L*641, Arbitrary Displacement by moving the Plate-Holder.

Line.	Width.	Remarks.	*L*641*a*.				*L*641*b*.				*L*641*c*.				*L*641*d*.			
			d′	*d″*	*d*	*r*	*d′*	*d″*	*d*	*r*	*d′*	*d″*	*d*	*r*	*d′*	*d″*	*d*	*r*
1, 5506·095, *Mn*, 1...	1286	Weak.....	1053	906	980	+119	641	665	653	+53	658	771	714	−49	999	1037	1018	− 8
2, 5507·000, *Fe*, 7..	1776	Broad, strong..	861	841	851	− 10	611	644	628	+28	792	729	760	−31	999	1037	1018	− 8
3, 5525·765, *Fe*, 4...	1332	Fine.........	801	851	826	− 35	644	615	630	+30	691	728	709	−51	1005	1106	1055	+29
4, 5528·641, *Mg*, 8...	2816	Shaded, fuzzy..	704	969	837	− 24	627	548	588	−12	839	673	756	− 7	951	998	974	−52
5, 5541·157, *Fe*, 2...	1050	Fine.........	874	844	859	− 2	601	614	608	+ 8	742	678	710	−53	1032	1089	1060	+31
6, 5562·933, *Fe*, 2...	1119	Fine.........	827	853	840	− 21	551	648	600	0	742	757	749	−14	1013	957	985	−41
7, 5576·320, *Fe*, 4...	1688	Strong........	833	824	829	− 32	587	642	615	+15	783	814	798	+35	969	1033	1001	−25
8, 5578·946, *Ni*, 1...	1142	Fine.........	902	892	897	+ 36	544	601	573	−27	782	729	755	− 8	1060	1042	1051	+25
9, 5582·198, *Ca*, 4...	1410	Strong........	848	819	833	− 28	602	608	605	+ 5	729	716	722	− 4	1013	977	995	−31
10, 5590·343, *Ca*, 3...	1544	Fine.........	931	938	935	+ 74	563	588	576	−24	741	776	758	− 5	1056	1080	1068	+42
11, 5618·858, *Fe*, 1...	1072	Fine.........	855	875	865	+ 4	585	496	541	−59	787	909	848	+85	1095	1120	1107	+81
12, 5634·171, *Fe*, 3...	1295		822	710	766	− 95	596	664	630	+30	779	773	776	+13	959	943	951	−75
13, 5638·488, *Fe*, 3...	1452		888	911	900	+ 39	576	607	592	− 8	794	818	806	+43	1012	1008	1010	−16
14, 5655·715, *Fe*, 2...	1300		750	905	827	+ 34	580	568	574	−26	857	823	840	+77	1091	998	1044	+18
15, 5658·097, *Y*, 2...	1329		655	813	734	−127	611	638	625	+25	822	749	785	+22	982	1028	1005	−21
16, 5662·744, *Fe*, 4...	1343	Weak region..	885	822	852	− 9	592	668	630	+30	744	788	766	+ 3	1046	1103	1074	+48
17, 5682·869, *Na*, 5...	1536		971	849	910	+ 49	585	734	660	+60	744	778	761	− 2	988	974	981	−45
18, 5688·436, *Na*, 6...	1808		862	822	842	− 19	525	607	566	−34	767	784	775	+12	1027	1099	1063	+37
19, 5690·646, *Si*, 3...	1090	Narrow, weak..	923	1039	981	+120	495	528	512	−88	714	688	701	−62	1030	1012	1021	− 5
		Means *d′*	855	.....	.....	.....	685	.....	.....	.....	764	.....	.....	.....	1018	.....	.....	806
		Means *d″*	.....	867	.....	.....	.....	615	.....	.....	.....	762	.....	.....	.....	1034	.....	820
		Means *d*	.....	.....	861	.....	.....	.....	600	.....	.....	.....	763	.....	.....	.....	1026	813

TABLE IV.

*L*699, Arbitrary Displacement by Double-Slit.

Line.	*L*699*a*.			*L*699*b*.			*L*699*c*.			*L*699*d*.			*L*699*e*.			*L*699*f*.			Means.			
	d'	*d''*	*d*	*d'*	*d''*	*d*	*d'*	*d''*	*d*	*d'*	*d''*	*d*	*d'*	*d''*	*d*	*d'*	*d''*	*d*	*d'*	*d''*	*d*	*r*
1, 4196·699, *La*, 2..	654	639	647	646	730	688	736	795	764	715	721	718	663	719	691	721	689	708	690	716	703	+10
2, 4197·257, *CN*, 2..	614	655	634	798	797	798	711	704	708	675	719	697	633	780	707	690	674	682	687	721	704	+11
3, 4216·136, *CN*, 2..	723	679	701	678	695	686	727	678	702	641	748	695	713	730	721	743	740	741	704	712	708	+17
4, 4220·509, *Fe*, 3..	626	638	632	724	725	725	710	777	744	729	681	705	705	670	688	654	715	685	691	701	696	+ 4
5, 4225·619, *Fe*, 3..	726	743	735	634	631	632	793	711	752	641	638	639	667	692	679	742	712	727	700	688	694	+ 1
6, 4232·887, *Fe*, 2..	696	668	682	697	687	692	755	731	743	675	675	675	666	689	678	611	660	635	683	685	684	− 9
7, 4241·285, *Fe-Zr*, 2..	711	666	688	671	646	658	611	655	633	685	781	733	720	735	727	850	767	808	708	708	708	+15
8, 4246·996, *Sc*, 5?	642	637	639	660	628	644	693	727	710	604	747	676	689	729	709	716	792	754	667	710	689	− 4
9, 4257·815, *Mn*, 2..	642	743	693	604	595	599	600	701	650	657	713	685	631	722	677	705	767	736	640	707	673	−20
10, 4258·477, *Fe*, 2..	687	698	692	673	673	673	699	705	702	712	653	683	705	672	688	664	733	698	690	689	689	− 4
11, 4266.081, *Mn*, 2..	641	635	638	696	738	717	626	726	676	722	686	704	682	670	676	656	689	673	671	691	681	−12
12, 4268·915, *Fe*, 2..	590	589	589	719	659	689	690	609	614	708	681	694	650	696	673	704	686	695	677	653	665	−28
13, 4276·836, *Zr*, 2..	713	717	715	660	680	670	610	658	634	724	724	724	698	705	702	710	675	692	686	692	689	− 4
14, 4290·377, *Ti*, 1..	716	771	744	764	747	755	697	719	708	730	663	697	700	682	691	640	715	678	708	716	712	+19
15, 4291·630, *Fe*, 2..	733	761	747	670	657	664	670	663	667	740	683	711	719	692	700	668	709	688	700	692	696	+ 3
Means *d'*	674	.....	.....	686	.....	.....	689	.....	.....	691	.....	.....	683	.....	.....	699	.....	.....	687	.....	.....	±10·7
Means *d''*	.....	683	.....	.....	686	.....	.....	704	.....	.....	701	.....	.....	706	.....	.....	715	.....	.....	699	.....	
Means *d*	.....	.....	678	.....	.....	686	.....	.....	696	.....	.....	696	.....	.....	694	.....	.....	707	.....	.....	693	

TABLE V.

*L*701, Arbitrary Displacement by Double-Slit.

Line.	*L*701*a*.			*L*701*b*.			*L*701*c*.			*L*701*d*.			*L*701*e*.			*L*701*f*.			Means			
	d'	d''	d	d'	d''	d	d'	d''	d	d'	d''	d	d'	d''	d	d'	d''	d	d'	d''	d	r
1, 4196·699, *La*, 2..	641	606	624	673	736	704	663	616	640	700	742	721	675	724	699	678	757	717	671	697	681	−10
2, 4197·257, *CN*, 2..	647	586	616	654	748	701	622	610	616	758	785	772	674	675	675	586	620	603	657	671	664	−30
3, 4216·436, *CN*, 2..	651	740	696	696	675	686	728	713	720	672	692	682	696	732	714	703	726	715	685	719	702	+ 8
4, 4220·509, *Fe*, 3	762	728	745	748	704	726	707	673	690	612	667	654	687	687	687	669	731	700	702	698	700	+ 6
5, 4225·619, *Fe*, 3 .	686	660	673	754	811	782	729	744	737	791	655	723	747	700	723	741	726	733	740	716	728	+31
6, 4232·887, *Fe*, 2 .	707	651	679	714	736	725	699	702	700	724	713	719	706	670	688	691	638	665	713	685	699	+ 5
7, 4241·285, *Fe-Zr*, 2..	718	755	736	620	681	651	693	737	715	756	747	751	656	672	664	648	652	650	683	707	695	+ 1
8, 4246·996, *Sc*, 5?	660	647	654	641	671	656	674	778	726	636	771	704	646	681	661	715	660	687	629	701	665	−29
9, 4257·815, *Mn*, 2..	675	705	690	765	762	763	744	699	722	623	660	641	685	719	702	816	727	772	718	712	715	+21
10, 4258·477, *Fe*, 2..	697	709	703	694	651	673	698	714	706	666	683	675	682	695	688	680	696	688	687	691	689	− 5
11, 4266·081, *Mn*, 2..	673	677	675	618	614	616	753	765	759	701	748	724	695	636	666	641	650	645	680	682	681	−13
12, 4268·915, *Fe*, 2	655	663	659	665	741	703	636	662	649	682	652	667	700	701	700	633	629	631	661	675	668	−26
13, 4276·836, *Zr*, 2..	746	749	747	697	703	700	737	725	730	709	665	687	668	656	662	667	706	686	703	701	702	+ 8
14, 4290·377, *Ti*, 1..	752	733	743	733	712	737	716	711	714	737	735	735	734	727	730	669	686	678	724	722	723	+29
15, 4291·630, *Fe*, 2..	724	710	717	636	686	661	727	676	701	659	612	636	711	672	692	710	738	724	694	682	688	− 6
Means d'	693			687			702			697			691			683			690			+15·1
Means d''		687			711			702			701			689			689			697		
Means d			690			699			702			699			690			686			694	

TABLE VI.

ERRORS OF SETTING.

*L*699, ARBITRARY DISPLACEMENT BY DOUBLE-SLIT.

Line			Algebraic Means.				Arithmetic Means.				
			1st.	2nd.	3rd.	4th.	1st.	2nd.	3rd.	4th.	Means
1, 4196·699,	*La*,	2......	− 7	+13	− 6	− 1	18	26	12	18	18·6
2, 4197·257,	*Cn*,	2......	0	+ 7	0	−11	28	25	25	20	24·5
3, 4216·136,	*CN*,	2......	+ 7	− 1	+ 8	− 3	40	23	30	31	31·0
4, 4220·509,	*Fe*,	3......	+ 9	+ 2	− 2	− 3	24	16	22	23	21·3
5, 4225·619,	*Fe*,	3......	+20	−12	− 8	0	25	20	28	20	23·3
6, 4232·887,	*Fe*,	2......	−15	+12	− 4	+ 6	21	17	20	14	18·0
7, 4241·285,	*Fe-Zr*,	2......	0	− 7	+ 6	0	25	12	18	21	18·8
8, 4246·996,	*Sc*,	5?......	−14	+ 5	− 7	+18	25	17	21	19	20·5
9, 4257·815,	*Mn*,	2......	+10	− 4	− 6	0	34	19	13	24	22·5
10, 4258·477,	*Fe*,	2......	+13	− 2	−12	+ 1	21	13	12	15	15·3
11, 4266·081,	*Mn*,	2......	−14	+ 1	+12	+ 2	21	16	19	14	17·5
12, 4268·915,	*Fe*,	2......	− 3	−14	+ 4	+12	21	22	11	21	18·8
13, 4276·836,	*Zr*,	2......	− 4	− 7	− 6	+16	14	13	16	20	15·8
14, 4290·377,	*Ti*,	1......	+ 3	0	− 2	− 2	14	18	14	13	14·8
15, 4291·630,	*Fe*,	2......	− 2	− 8	+ 8	+ 3	14	14	18	10	14·0
		Means...	− 1	− 1	0	+ 2	23	18	18·6	19	19·6

NOTE.—The above numbers are the means—algebraic (with regard to sign) and arithmetic (without regard for sign)—of the 1st, 2nd, 3rd and 4th settings on the lines in the central strips of the six exposures, *L*699*a* to *L*699*f*, measured both ways; each mean for each line is therefore the mean of 12 settings made at different times.

TABLE VII.

SUMMARY OF MEASUREMENTS OF ARBITRARY DISPLACEMENTS, PLATES *L*699 AND *L*701. MEASURED BY DE LURY.

Line.		Width.	Remarks.		*L*699. (a)	(b)	(c)	(d)	(e)	(f)	*L*701. (a)	(b)	(c)	(d)	(e)	(f)	Means. d	r	p.r.
1, 4196·599, *La*,	2	2020	Diffuse.	d	647	688	764	718	691	708	624	704	640	721	699	717	694	......	
				r	− 31	+ 2	+ 68	+ 22	− 3	+ 1	− 66	+ 5	− 62	+ 22	+ 9	+ 31	...	0	±26·7
2, 4197·257, *CN*,	2	1660	Asymmetrical.	d	634	798	708	697	707	682	616	701	616	772	675	603	681		
				r	− 44	+112	+ 12	+ 1	+ 13	− 25	− 74	+ 2	− 86	+ 73	− 15	− 83	.....	− 10	42·7
3, 4216·136, *CN*,	2	2052	"	d	701	686	702	695	721	741	696	686	720	682	714	715	705	...	
				r	+ 23	0	+ 6	− 1	+ 27	+ 34	+ 6	− 13	+ 18	− 17	+ 24	+ 29	.....	+ 9	14·6
4, 4220·509, *Fe*,	3	1710	Good.........	d	632	725	744	705	688	685	745	726	690	654	687	700	698	...	
				r	− 46	+ 39	+ 48	+ 9	− 6	− 22	+ 55	+ 27	− 12	− 45	− 3	+ 14	.....	+ 4	23·9
5, 4225·619, *Fe*,	3	1990	"	d	735	632	752	639	679	727	673	782	737	723	723	733	711	...	
				r	+ 57	− 54	+ 56	− 57	− 15	+ 20	− 17	+ 83	+ 35	+ 21	+ 33	+ 47	.....	+ 17	34·0
6, 4232·887, *Fe*,	2	1634	Fine..........	d	682	692	743	675	678	635	679	725	700	719	688	665	692	...	
				r	+ 4	+ 6	+ 47	− 21	− 16	− 72	− 11	+ 26	− 2	+ 20	− 2	− 21	.....	− 2	19·7
7, 4241·285, *Fe-Zr*,	2	1409	"	d	688	658	633	733	727	808	736	651	715	751	664	650	701	..	
				r	+ 10	− 28	− 63	+ 37	+ 33	+101	+ 46	− 48	+ 13	+ 52	− 26	− 36	.....	+ 7	34·4
8, 4246·996, *Sc*,	5	2500	Strong, broad.	d	639	644	710	676	709	754	654	656	726	704	664	687	678	.....	....
				r	− 39	− 42	+ 14	− 20	+ 15	+ 47	− 36	− 43	+ 24	+ 5	− 26	+ 1	.....	− 16	22·7
9, 4257·815, *Mn*,	2	1610	Diffuse.	d	693	599	650	685	677	736	690	763	722	641	702	772	694	.....	..
				r	+ 15	− 87	− 46	− 11	− 17	+ 29	0	+ 64	+ 20	− 58	+ 12	+ 86	.....	0	34·6

10, 4258·477, *Fe*,	2	1925	Broad........	*d*	692	673	702	683	688	698	703	673	706	675	688	688	689	......	......
				r	+ 14	− 13	+ 6	− 13	− 6	− 9	+ 13	− 26	+ 4	− 24	− 2	+ 2	......	− 5	9·7
11, 4266·081, *Mn*,	2	1710	Fair...........	*d*	638	717	676	701	676	673	675	616	759	724	666	645	681	......	......
				r	− 40	+ 31	− 20	+ 8	− 18	− 34	− 15	− 83	+ 61	+ 25	− 24	− 41	......	− 13	27·8
12, 4268·915, *Fe*,	2	1480	Good.. ...	*d*	589	689	649	694	673	695	659	703	649	667	700	631	667	......	......
				r	− 89	+ 3	− 47	− 2	− 21	− 12	− 31	+ 4	− 53	− 32	+ 10	− 55	......	− 27	29·0
13, 4276·836, *Zr*,	2	1590	Diffuse.. ..	*d*	715	670	634	724	702	692	747	700	730	687	662	686	695	......	......
				r	+ 37	− 16	− 62	+ 28	+ 8	− 15	+ 57	+ 1	+ 28	− 12	− 28	0	......	+ 1	22·8
14, 4290·377, *Ti*,	1	2365	Broad. .	*d*	744	785	708	697	691	678	743	737	714	735	730	678	717	......	......
				r	+ 66	+ 69	+ 12	+ 1	− 3	− 29	+ 53	+ 38	+ 12	+ 36	+ 40	− 8	......	+ 23	28·1
15, 4291·630, *Fe*,	2	1900	" ...	*d*	747	661	667	711	700	688	717	661	701	636	692	724	692	......	......
				r	+ 69	− 22	− 29	+ 15	+ 6	− 19	+ 27	− 38	− 1	− 6	+ 2	+ 38	......	− 2	±25·5
				Mean *d*	678	686	696	696	694	707	690	699	702	699	690	686	694		
Probable residual single line = *p.r.*					31·6	33·1	29·2	15·5	11·3	27·9	29·5	29·7	26·5	27·2	14·8	29·3	Mean *p.r.*		±26·1
																	"		±26·5

Probable residual of the displacement for a single exposure = ±8·0.

TABLE VIII.

SUMMARY OF MEASUREMENTS OF ARBITRARY DISPLACEMENTS, PLATES *L*699 AND *L*701. MEASURED BY PLASKETT.

Line.		Width.	Remarks.		*L*699. (a)	(b)	(c)	(d)	(e)	(f)	*L*701. (a)	(b)	(c)	(d)	(e)	(f)	Means. d	r	p.r.
1, 4196·599, *La*,	2	2020	Diffuse........	d	683	692	710	704	709	706	693	717	683	693	711	704	700	....	....
				r	− 9	− 2	+ 8	+ 13	+ 5	+ 3	− 15	+ 11	− 23	− 1	+ 14	+ 2	....	0	±7·6
2, 4197·257, *CN*,	2	1660	Asymmetrical.	d	706	716	714	705	719	700	717	702	715	696	681	699	706	....	....
				r	+ 14	+ 22	+ 12	+ 14	+ 15	− 3	+ 9	− 4	+ 9	+ 2	− 16	− 3	....	+ 6	8·4
3, 4216·136, *CN*,	2	2052	"	d	688	710	689	696	706	702	704	709	699	686	703	705	700	....	....
				r	− 4	+ 16	− 13	+ 5	+ 2	− 1	− 4	+ 3	− 7	− 5	+ 6	+ 3	....	0	5·2
4, 4220·509, *Fe*,	3	1710	Good..........	d	686	693	705	688	695	704	710	694	692	696	706	709	698	....	....
				r	− 6	0	+ 3	− 3	− 9	+ 1	+ 2	− 12	− 14	+ 2	+ 9	+ 7	....	− 2	5·0
5, 4225·619, *Fe*,	3	1990	"	d	703	688	700	686	705	704	696	708	710	696	683	699	698	....	....
				r	+ 11	− 6	− 2	− 5	+ 1	+ 1	− 12	+ 2	+ 4	+ 2	− 14	− 3	....	− 2	4·8
6, 4232·887, *Fe*,	2	1634	Fine..........	d	689	677	695	704	684	696	715	707	703	689	705	695	697	....	....
				r	− 3	− 17	− 7	+ 13	− 20	− 7	+ 7	+ 1	− 3	− 5	+ 8	− 7	....	− 3	6·8
7, 4241·285, *Fe-Zr*,	2	1409	"	d	692	708	704	696	691	710	710	711	707	702	689	716	703	....	....
				r	0	+ 14	+ 2	+ 5	− 13	+ 7	+ 2	+ 5	+ 1	+ 8	− 8	+ 14	....	+ 3	5·8
8, 4246·996, *Sc*,	5	2500	Strong, broad.	d	689	675	693	682	695	700	707	699	701	685	687	689	692	....	....
				r	− 3	− 19	− 9	− 9	− 9	− 3	− 1	− 7	− 5	− 9	− 10	− 13	....	− 8	6·4
9, 4257·815, *Mn*,	2	1640	Diffuse........	d	702	675	693	675	717	708	713	711	713	700	698	698	700	....	....
				r	+ 10	− 19	− 9	− 16	+ 13	+ 5	+ 5	+ 5	+ 7	+ 6	+ 1	− 4	....	0	6·7

10, 4258·477, *Fe*,	2	1925	Broad.........	*d*	691	701	697	691	691	703	715	705	716	689	685	701	699	......	......
				r	− 1	+ 10	− 5	0	− 13	0	+ 7	− 1	+ 10	− 5	− 12	− 1	......	− 1	5·1
11, 4266·081, *Mn*,	2	1710	Fair..........	*d*	679	706	721	682	707	712	698	706	721	700	687	689	701	......	......
				r	− 13	+ 12	+ 19	− 9	+ 3	+ 9	− 10	0	+ 15	+ 6	− 10	− 13	......	+ 1	7·3
12, 4268·915, *Fe*,	2	1480	Good.........	*d*	681	704	698	682	717	707	712	711	708	696	696	710	702	......	......
				r	− 11	+ 10	− 4	− 9	+ 13	+ 4	+ 4	+ 5	+ 2	+ 2	− 1	+ 8	......	+ 2	5·1
13, 4276·836, *Zr*,	2	1590	Diffuse........	*d*	691	691	708	684	700	686	711	705	698	702	712	709	700	......	......
				r	− 1	− 3	+ 6	− 7	− 4	− 17	+ 3	− 1	− 8	+ 8	+ 15	+ 7	......	0	5·8
14, 4290·377, *Ti*,	1	2365	Broad....	*d*	699	686	705	699	706	696	703	695	713	693	709	704	700	......	......
				r	+ 7	− 8	+ 3	+ 8	+ 2	− 7	− 5	− 11	+ 7	− 1	+ 12	+ 2	......	0	4·8
15, 4291·630, *Fe*,	2	1900	"	*d*	700	681	695	686	715	710	713	709	711	684	706	700	701	......	......
				r	+ 8	− 13	− 7	− 5	+ 11	+ 7	+ 5	+ 3	+ 5	− 10	+ 9	− 2	......	+ 1	±5·4
			Mean *d*		692	693	702	691	701	703	708	706	706	691	697	702	700		
			Probable residual single line = *p.r.*		9·1	6·0	6·4	7·2	4·6	5·0	1·2	6·8	3·9	7·4	5·0	5·6	Mean *p.r.*		±6·0
																	"		±5·9

Probable residual of the displacement for a single exposure = ± 1·1.

The discussion of the results given above can best be made under the headings of the various classes of errors investigated:

Systematic differences in the measurements by different measurers.—A glance at Tables I. and II. reveals the fact there are systematic differences in the measurements made by different persons, and in the general trend the results indicate that those who have had considerable experience in the measuring of stellar radial velocity spectrograms get higher values than those who have had little experience in the measurement of spectra. The differences between the highest and lowest values of the mean displacements are, from Table I., 33, *i.e.*, 0.0033 mm., and from Table II., the same value, 33, representing differences of 6.3 per cent. and 4.8 per cent. respectively. These differences are equivalent to differences of 0.13 and 0.10 km. per second in the determination of the equatorial rate of the sun's rotation from similar displacements. This is a striking difference, and the question arises: Which is more nearly the true value, the high measurement or the low one? and further, What is the true value?—for obviously it is not safe to take the mean value of all the measurements when such systematic errors occur. From the results of a large series of measurements, involving double measures on 12 different exposures (summarized in Tables VII. and VIII.) Mr. Plaskett's measurements are seen in the mean to be systematically greater than mine by 6 in a displacement of about 700. This difference is systematically in the same direction with the exception of the measurements for 2 out of the 12 exposures, and 3 out of the 15 lines, one line giving the same mean. This difference corresponds to 0.02 km. per second, a very small quantity, yet it is in the hundredths of a kilometre per second that nearly all of the interest in the determination of the solar rotation lies at the present time in view of the many interesting results obtained by Adams. It is consequently of considerable importance in such investigations to make allowance and correction for the systematic differences in the measurements of different persons.

Systematic differences depending on the direction of measurement.—A very curious systematic difference in the measurement of the displacements presents itself when measures are made one way and the plate is reversed and measured in the other direction, the face of the plate being up in all measurements. This difference, which apparently is in the same sense for all observers, is exhibited in Table II. where measures of 6 lines on one exposure are given for 6 different measurers, and in Tables III., IV. and V., where my own measurements of 16 different exposures are recorded. It will be seen from Table II. that, with the exception of Mr. Plaskett's measurements which do not show the effect, the first measurement, d', is systematically smaller than d'', the second measurement, for each line with one exception, and for each observer. In the mean, $d''-d'=694-686=8$, a difference corresponding to 0.023 km. per sec. In my larger series of measurements this peculiarity is even more strikingly shown. In the values for *L*641, Table III., we have, $d''-d'=820-806=14$, which corresponds in the region of the spectrum measured, to about 0.04 km. per sec. For *L*699, Table IV., the difference, $d''-d'=699-687=12$, corresponds to 0.034 km. per sec.; and for *L*701, Table V., the difference, $d''-d'=697-690=7$, corresponds to 0.02 km. per sec. In all cases for the measurements of d' the configuration of the lines as seen in the eye-piece of the measuring-machine, was ⁝¦, while for the measurements d'', it was the opposite, ¦⁝. Furthermore, the carriage was always advanced so that the spider-line of the eye-piece always passed over the central line first, and the 4 settings were made on the central line before passing to the two outside lines. It is not likely that the fact that the d'' measures were made subsequently to the d' measurements has anything to do with this remarkable difference; nor are temperature differences in the micrometer screw caused by the presence of the measurer while securing the values of d' sufficient to account for the larger values of d''. Nor does the direction of turning the screw account for the difference, for in the measurements of $L641$ the screw was turned in the opposite direction from that used in the other measurements, the central strip being displaced to the red of the two outside strips in it and to the violet side of the spectrum in plates $L699$ and $L701$: to get the same configuration in the microscope for the d' measures it was therefore necessary to start the readings from the opposite ends of the scale for the two opposite displacements. The most plausible explanation of the difference, it seems to me, is a "right-handed and left-handed" effect. The fact that in d' the lines in the two outside strips appear to the right of the line in the central strip, and that in d'' the opposite is the case may produce effects on the eye resulting in this curious difference in the measures of the displacement; and since the right hand turns the screw in opposite ways there may be a muscular effect. I try to eliminate such a thing as "muscular memory" however, by taking a fresh grip on the turning wheel before each setting. Furthermore it must be understood that the field of the microscope is so big that when a setting is made on one of the three lines, the observer is *apparently* not conscious of the presence of the other lines; the above considerations would seem to indicate that the other lines exert some small influence over him nevertheless. In Adams' work on the rotation two strips of spectra were employed, so that the configuration of the lines would be the same in both positions of the plate, and consequently the measured displacements are liable to be too large or too small from such an effect as is here shown to be present. This effect is so large that it must be eliminated from the measurements.

Systematic differences for different lines.—From Table VII. it will be seen that there is a tendency towards negative residuals in my measurements in the cases of lines 8, 11 and 12; and positive residuals for the lines 5 and 14. In Mr. Plaskett's results the tendency to negative residuals occurs in the cases of lines 6 and 8, and positive residuals for lines 2 and 7. Nearly all of these lines have some exceptional characteristic:—line 2, 4197.257, *C.N*, is a weak line slightly diffuse and shaded asymmetrically; line 5, 4225.619, *Fe*, is a good strong line with slightly diffuse edges and it is near the strong, broad and nebulous line of *Ca*, 4227, which appears in the field of the microscope during the measurements of line 5; line 6, 4232.887, *Fe*, is a narrow strong line and a good one for measuring; line 7, 4241.285, *Fe-Zr*, is narrow and weak; line 8, 4246.996, *Sc*, is a strong and very broad line but it has sharp edges and is therefore a fairly good line to measure; 11, 4266.915, *Mn*, 2, is a weak line; line 12, 4268.915, *Fe*, is a narrow line with edges slightly diffuse; line 14, 4290.377, *Ti*, is a very broad line with its edges sharp and strong. As seen in the last paragraph it seems very probable that the configuration of the lines plays some part or has some slight effect on the measurements; such being the case it is reasonable to suppose that this effect will vary with lines of different character, and consequently the measured displacements may vary. I made measurements on three dense exposures of the *Ca* line 4227 to see if any exceptional effects were present such as those obtained for this line and for $H\alpha$ by Adams in his solar rotation work. The errors of setting were very large and nothing definite could be found from so few measures. Such measures should be made, and preferably under the same conditions as the rotation plates were measured by Adams and Miss Lasby. The present results show however that there is a danger of systematic errors being present for the various lines, and the differences obtained for individual lines in the rotation work should be very carefully examined by the person making the measurements, at the time they are made preferably, to see if they are due to such systematic errors of measurement.

It will be seen from Tables VII. and VIII., that the probable residuals for the different lines differ greatly, and that my *p.r.* is much greater than Mr. Plaskett's.

This is probably due to the fact that the latter observer has had a great deal of experience in the measurement of the broad diffuse lines of star spectra, and his eye is accustomed to smoothing out the irregularities in the lines due to the grain of the plate, and that I am still bothered by it and have more difficulty in setting on the centres of intensity of the lines. It is to be hoped that more experience will relieve me of much of this error. These errors are combined accidental and systematic, and probably when the systematic errors are removed the residuals will be greatly lessened.

Systematic errors in setting.—In Table VI. are given my errors of setting for the 4 settings on the lines in the central strips (measured both ways) of Plate, *L*699. The numbers are the means of the residuals, with regard to sign and without regard to sign, obtained by subtracting the mean of the 4 settings on any one line from each of the settings on that particular line and taking the means for each line. Though each line has its own peculiar arrangement of the positive and negative residuals for each of the 4 settings —quite striking in some cases—yet there seems to be no general systematic arrangement of these signs. The means without regard to sign show the peculiar and not unexpected result that the first settings are usually farthest from the mean, while the residuals for the other three settings are of about the same magnitude. This peculiarity may be lessened to some extent by viewing the line as a whole more carefully before taking any settings. The mean error of setting is, ± 19.6, or about 0.002 mm., equivalent to nearly 0.056 km. per sec.

The above results were obtained in the measurement of the simplest class of spectroscopic work, namely, the relative positions of the *same* lines, and where therefore systematic errors are not so likely to occur as in investigations where the relative positions of *different* lines are determined; yet, nevertheless, the results show the presence of systematic errors. It may be taken for granted, then, that similar and larger errors occur in other spectroscopic measurements. And since the errors are sufficiently large that their removal is desirable, a general method for the elimination of such errors is necessary. An obvious method of eliminating some of these errors is to make the configuration the same for each measurement. This may be accomplished in the particular case examined above by masking all but each strip of spectrum in turn by means of a slotted sliding mask having a spring stop for each strip. However, in the general case where different lines are compared this would not remove the individual errors of each line, and would not remove any systematic errors of "memory" if they were present. The "double-slit" used above offers a more complete elimination of the difficulty as follows:—

By means of the double-slit, introduce a displacement, D, on the spectra whose normal displacement, d, is desired to be found. By making D much larger than d, it may be assumed (and this point could easily be tested by means of the double-slit) that the systematic errors in measuring $D + d$ are the same as for the measurement of D. Thus let the measured value of the displacement be $D + d + e$, then the measured displacement of D will be $D + e$, and the difference between the two measurements, $(D + d + e) - (D + e)$, will give the true value, d, of the displacement sought. The method is precisely the same as the "method of differences" used in exact weighings. It would involve two parallel series of measurements, but the determination of $D + e$ would probably not need to be made so frequently as the determination of $D + d + e$, after one became somewhat fixed in his habits of measurement. In the investigation of the solar rotation this method could be readily applied. The displacements, d, in our work here range from a little less than 0.1 mm. down to nearly zero, so that by introducing a displacement $D = 1$ mm. in all the rotation spectra the total displacements would be so nearly constant that very probably the systematic errors of measurement would be the same for all and one determination of $D + e$ for spectra from 6 or 7 different latitudes on each plate would serve to eliminate the systematic errors in the mean. Absolute values, within the limits of the accidental errors, would thus be determined for d, and the results of the measures made by different observers and for different lines should agree very closely. I hope to test the method in the near future and eliminate the errors now present in our work.

Briefly the more important results of the present investigation are:

(1) A method is described for determining the presence and the nature of the errors in the measurements of spectral line displacements.

(2) There are systematic personal errors in the measurements of spectral line positions and displacements.

(3) The errors of measurement, both accidental and systematic, depend on the configuration measured, that is, on the grouping of the several lines in the field of the measuring microscope, and on the characters of these lines.

(4) The effect, on the measurements of different observers, of the configuration employed in the present investigation is in the same sense.

(5) The systematic errors discovered in the present case are sufficiently large to introduce grave errors into one's results and into their interpretation, and consequently one's measurements cannot be accepted as sufficiently accurate without the elimination of these errors. Systematic errors ranging from 0.13 km. per sec. to 0.02 km. per sec. were found in measurements such as made for the determination of the rate of the solar rotation, the value for which at the equator is a little over 2 km. per sec.!

(6) A method for the elimination of these systematic errors is described.

That the systematic errors which occurred in the measurements of the arbitrary displacements, actually occur in the measurements of rotation plates, is seen from the following comparative values of the equivalents (in kilometres per second) to the measured displacements on various plates:

Plates.	*L528a*	*L531a*	*L531b*	*L570a*
Plaskett.............	1.866	1.868	1.872	1.816
De Lury.............	1.851	1.851	1.959	1.716

The necessity for the removal of the errors in our work is thus emphasized. I hope to carry on further work on this question of systematic errors of measurement, and to investigate such influences as intensity of the photographic plate, the magnitude of the displacements, the character of the line with particular reference to the broad lines λ 4227, and $H\alpha$; and especially to test the methods proposed above for the elimination of these errors.

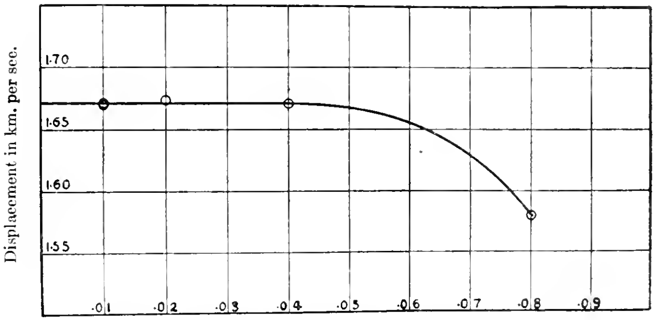
I wish to thank the gentlemen who so kindly made the comparative measurements given here; and Mr. Lucas for constructing the double-slit to work so efficiently.

5. *The Effect of Sky Spectrum on the Determination of the Rate of Rotation of the Sun; and a Note on the General Problem of Blended Spectra.*

The spectrum taken from any point on the sun is made up of two spectra, one from the point in question and the other from the earth's atmosphere—the "sky spectrum" as it is called. The sky spectrum is produced from sunlight reflected from particles in the space surrounding the earth and in its atmosphere, and partly too by refraction in the latter. Since the sunlight thus redirected comes from the whole of the sun's surface facing the earth, the spectrum lines will be broad and diffuse because the wave-length of any particular line varies over the surface of the sun on account of the effects of rotation, convection and pressure; the centres of intensity of the lines, however, will coincide practically with the centres of intensity of the lines in the spectrum from the centre of the sun's disc. When a photograph of the solar rotation effect is taken the lines in the adjacent strips of spectra from opposite limbs are displaced, while the lines in the sky spectrum blended with it have the same wave-lengths in each of the strips. The measured displacements in these two spectra blended will consequently be less than the actual displacements caused by the sun's rotation. This source of error was noted by Halm and by Adams in their investigations on the solar rotation and observations were taken only on days that were comparatively free from haze in the atmosphere, it being assumed that on the more transparent days when the sky spectrum was much weaker than the sun spectrum, the effect due to the former was negligible. However, since the values measured here for the rate of the sun's rotation at the equator were a few per cent. lower than those obtained at Mount Wilson, it occurred to me that—even though errors of measurement might account for the greater part of this discrepancy—the difference might partially, at least, be accounted for by a difference in the intensities of the sky spectrum in Ottawa and Mount Wilson. I therefore proceeded as follows to estimate and eliminate any effect of the sky spectrum on the measurements.

In the first place an estimation of the relative intensities of the sky spectrum and the "rotation spectrum" was made by exposing for the two spectra in succession. The sky spectra were obtained after lowering the solar image from its usual position when rotation spectra are taken until the little windows in the guide-plate were each about 8 or 10 mm. from the edge of the image. The exposures lasted about 20 or 30 minutes, while the rotation spectra taken on the same plate were exposed for varying times from 5 seconds up to the usual exposure given (30 seconds to 1 minute), so that the intensity of the sky spectrum would be somewhere within the range of intensity of these exposures. In this way a rough estimation of the relative intensities was made possible. The same estimation can be made more quickly by observing or photographing the direct images of the slit reflected back by the grating placed normal to the axis of the spectrograph for the sky and limb of the sun in turn. The visual estimations can be made more readily by narrowing the slit when the limb is examined until the intensity of the reflected light is the same as when the sky light is used. Suitable filters should be used in the latter case to avoid any errors that may be caused by selective effects for the wave-length under consideration. This method was further simplified by masking the primary mirror of the coelostat telescope until the intensity of the reflected image of the slit was as weak as when the sky spectrum with the whole mirror was used. By having the two sources of light quickly alternated, and by estimating closely the two areas of the mirror employed a very accurate estimate of the relative intensities of the sun's limb and the sky can readily be made. Observations by this method agreed closely with the results from the comparisons of the intensities of the two spectra, and they have the advantage over the latter, that changes in the intensity of the sky are less likely to occur during the series of observations. Having determined the relative brightness of the sky with respect to the limbs where the rotation spectra are taken from, varying exposures on the sky are superimposed on the regular exposures of the latter. By measuring the displacements on these blended spectra it is possible to find the effect of sky spectrum on the ordinary rotation plates. The decreasing values of the velocity-equivalent of the displacement are plotted as ordinates with the values of the ratio of the intensities of sky spectrum to rotation spectrum as abscissae; the asymptote to this curve will be the true value of the velocity-equivalent of the displacement caused by the rotation, and the amount that this is lessened on account of the sky spectrum present on the regular rotation spectra is easily determined when the time of the latter exposure is known.

Though a number of plates were made only one has so far been measured, and it is sufficient to show that the effect of sky spectrum on the most transparent day is very small. The results are shown in the Table and in Figure 14. Further measurements will be made to ascertain exactly the relation existing between the lessening of the displacements due to sky spectrum and the relative intensities of the two spectra for the varying displacements of the different latitudes, after the errors of measurement of the displacement are under careful control.



Ratio of intensities of overlapping sky and rotation spectra.

FIG. 14.—The Effect of Sky Spectrum on the Measurements of the Solar Rotation.

THE EFFECT OF SKY SPECTRUM IN LESSENING THE MEASURED DISPLACEMENTS OF THE SPECTRUM LINES CAUSED BY ROTATION AT THE SOLAR EQUATOR.

Rotation Exposure Sky Exposure Ratio, Sky: Rotation			1 minute 1 minute 0·01		1 minute 1 minute 0·01		1 minute 2 minutes 0·02		1 minute 4 minutes 0·04		1 minute 8 minutes 0·08	
Line.			*d*	*v*	*d*	*v*	*d*	*v*	*d*	*v*	*d*	*v*
1, *La*,	2,	4196·699	818	1·794	747	1·638	771	1·691	775	1·699	752	1·649
2, *CN*,	2,	4197·257	769	1·686	809	1·774	758	1·662	783	1·717	710	1·557
3, *CN*,	2,	4216·136	773	1·687	762	1·663	793	1·731	748	1·633	674	1·471
4, *Mn*,	3?,	4220·509	749	1·633	773	1·685	755	1·646	790	1·723	763	1·664
5, *Fe*,	3,	4225·619	709	1·544	666	1·450	777	1·692	705	1·535	726	1·581
6, *Fe*,	2,	4232·887	745	1·620	768	1·670	756	1·644	749	1·628	690	1·500
7, *Fe-Zr*,	2,	4241·285	769	1·668	773	1·677	778	1·688	786	1·705	752	1·632
8, *Sc*,	5?,	4246·996	762	1·651	774	1·677	748	1·621	743	1·610	741	1·606
9, *Mn*,	2,	4257·815	748	1·617	760	1·643	797	1·722	780	1·686	702	1·517
10, *Fe*,	2,	4258·477	856	1·850	872	1·884	777	1·679	800	1·729	735	1·588
11, *Mn*,	2,	4266·081	736	1·588	739	1·594	757	1·633	746	1·609	733	1·581
12, *Fe*,	2,	4268·915	759	1·636	811	1·748	795	1·714	771	1·662	740	1·595
13, *Zr*,	2,	4276·836	764	1·644	765	1·646	767	1·650	768	1·653	717	1·543
14, *Ti*,	1,	4290·377	800	1·716	764	1·639	777	1·667	815	1·748	742	1·592
15, *Fe*,	2,	4291·630	804	1·724	768	1·647	781	1·675	803	1·722	757	1·623
		Means		1·671	.....	1·670	....	1·674	.....	1·671	.....	1·580

NOTE.—The intensity of the limb of the sun was approximately 100 times as great as that of the sky when the exposures whose measurements are given in the Table were made. The mean values of *v* for the different values of the ratio, Sky: Rotation intensity are plotted in the accompanying Figure 14. It would appear that somewhere between the values, 0·04 and 0·08 of the ratio of the intensities of the two spectra the weaker begins to affect the measurements of the stronger spectrum. The measurements of the second column are a repetition of those of the first.

The method employed here, namely, the blending of known spectra in known ways and measuring the resultant lines, would yield results of considerable value in the solution of certain astrophysical problems in which the question of blended spectra is an important one. By suitably blending the spectra under consideration, or similar spectra, definite laws could be established connecting the positions, characters and intensities of spectra and of individual lines with the measured positions of the blended spectrum lines, which could be applied to the problem investigated. Such data are necessary in making a complete solution of the following important problems:

(1) The more minute investigation of the spectra of stars the peculiar results from the measurements of which have been explained by the blending of two or more spectra known or suspected to be present.

(2) The determination of the rates of rotation of stars which has been suggested possible in the case of eclipsing variables* by studying spectra taken at various stages of the eclipse. Though there are many difficulties in the way of this problem† one of the first things to consider is the blending of spectra which in general would occur.

(3) The investigation of the question of the presence of an independently moving haze or envelope between the observer and the source of light—a problem which occurs in the investigation of the sun and of variable stars, and for solving which, data concerning blended spectra are necessary.

It thus appears that the study of arbitrarily blended spectra would yield profitable and necessary results. In connection with the solar work I hope to make such arbitrary measurements by blending the spectra from the centre of the disc and limb at the equator to find any general laws connecting the amount of displacement, intensities of the two spectra and character of the spectral lines, with the measured positions of the lines.

6. *Convection in the Atmosphere of the Sun.*

The question of convection in the atmosphere of the sun or of a star is one of very great importance. In our present theories of their constitution convection currents play a vital part. They must operate ceaselessly in all stellar atmospheres to maintain radiation; and variations in the latter may be reasonably attributed to changes in the convection currents supplying it. So much impressed was I by this idea, that in a paper entitled "Convection and Stellar Variation," read before the Royal Astronomical Society of Canada,‡ in March 1909, and before the Royal Society of Canada§ in May of the same year, I attempted to explain in this manner certain general conclusions from the photometric and spectrometric data of variable stars. A quotation from this paper will briefly present views discussed there:

"It is supposed that the star is a body condensing under the action of gravity and developing great quantities of heat which give rise to rapid radial convection currents bearing masses of hot gases from within and cooler and condensed materials back to the interior, and that, in the absence of disturbing agents, a "kinetic equilibrium" is established resulting in a steady and practically constant total emission of light by the star. Since the radiation from the star depends on the velocity and character of its convection currents, any change in these convections causes a change in the heat and light emitted. Consequently, to account for the variations in the light of some stars, it is assumed that there are changes in the convection currents of the stars caused by the changing action of disturbing agents.

* J. Miller Barr, Jour. Roy. Astron. Soc. Can., 3, 50. George Forbes, M.N., LXXI, 578.
† Frank Schlesinger, Pub. Allegheny Obs., I., 134; M.N. LXXI., 719.
‡ Journ. Roy. Astron. Soc. Can., III., 344–355.
§ Trans. Roy. Soc. Can., Series III., Vol. III., Sec. III., 227–236.

"The nature of these convection currents is revealed to some extent by the study of the sun's atmosphere. Short-exposure photographs of parts of the sun's surface taken on a large scale at intervals of less than a minute apart by S. Chevalier* show that the granulation of the photosphere is undergoing very rapid change, and we may attribute this to the rapid radial currents which exist throughout the entire atmosphere of the sun. The spots, faculae and prominences, which may be regarded as accentuated developments of the general currents, change continuously and frequently exhibit great velocities in their radial and transversal movements. The number and areas of these disturbed regions vary in a period of average length about 11.2 years, and in about the same period the regions in which the spots are most abundant change in latitude in the north and south hemispheres. It is not yet known whether the convection currents over the entire surface of the sun vary periodically, yet at least the enlarged convections or their results—if we may so term the spots, faculae and prominences—undergo periodic variations causing changes in the radiation from the regions affected. Now although these changes may not be great enough to modify seriously the total radiation of the sun, nevertheless in the case of variable stars we may assume that similar changes on a larger scale account for the light-variations." . . . The paper then goes on to discuss the possibility of "induced" actions resulting from disturbances in a stellar atmosphere, the different effects for different gases, and the shifts in spectral lines resulting from changes in convection—it being assumed that the ordinary heat convections are accompanied and supplemented by electrical convections and changes in the positions of electrical discharges or glows to account for the largest changes in wave-length; then in the light of this theory the different classes of variations of stars are discussed.

As will be seen from the context I regarded the question as to "*whether the convection currents over the entire surface of the sun vary periodically*" as one of great importance, and I wish to emphasize here the necessity of investigating this subject of convection in the solar atmosphere, and to urge that it be added to our programme of work with the solar spectrograph.

While preparing the above-mentioned paper I made plans for commencing the investigation of general solar convection currents, but during the year 1909 the work with the spectrograph was confined to the problem of the solar rotation and numerous incidental tests, employing the old grating which yielded such poor results; this work was continued in 1910 with new and better gratings, so that it was not until December 1910 that I made the attempt to take plates of the convection effects. However I succeeded in taking only one plate, *L*626, which was underexposed, and as this work seemed to interfere with the work on the solar rotation it was abandoned until a more favorable opportunity presented itself. The method which I proposed to use consisted in taking side by side and simultaneously, spectra from various points on the sun's surface which lie in the plane containing the centre of the earth and the axis of the sun, and which therefore give no displacement of the spectrum lines due to the sun's rotation; measurements of the changes in wave-length in these plates would give data for calculating the magnitude of the convection velocities, though it might be involved with such considerations as blended spectra, pressure, etc. The region selected for *L*626 was at the *D* lines where it was thought the presence of the earth's atmospheric lines would be useful in eliminating instrumental errors and certain errors of measurement. The apparatus necessary is a reflecting prism arranged so as to reflect the light from any point inside the limb of the sun to another prism placed above the slit so as to direct this light through the slit to the grating; at the same time light

* Astrophysical Journ., 27, 12–24, 1908.

from the centre of the sun's disc goes directly through the slit and the spectra from the two points are photographed side by side so that the relative wave-lengths may be determined. Half of the prism system employed in the solar rotation work would serve for this purpose with possibly a longer rack for the limb prism. It may be that the magnitudes of the velocities exhibited by the ordinary absorption lines may not be large enough for my purpose; in that case I would employ the high-level lines *H* and *K* which have in the meantime been investigated by Charles E. St. John.* The results he has found regarding the convectional movements of the vapors producing the various components of these lines are in striking accord with the theories presented in my paper on "Convection and Stellar Variation" quoted above. For example he finds that: "The calcium vapor producing the absorption line K_3 in the solar spectrum has a descending motion over the general surface of the sun of 1.14 km. per second in the mean," and "The calcium vapor to which the bright emission line K_2 is due has an ascending motion over the general surface of the sun of 1.97 km. per second in the mean." Now if on investigation such velocities be found to vary over the sun-spot period, the "convection theory" of the variability of stars would receive some confirmation; but even if these results do not turn out as I hope they will, yet they will be of sufficient importance to warrant the carrying out of the investigation, for the solution of other solar problems is not complete without recognition of the effects of convection.

I wish to suggest therefore that the programme of solar research be widened to include a thorough investigation of the general convections in the solar atmosphere and any periodic changes that may take place in them, and that the necessary conveniences be provided soon to take advantage of the present sun-spot minimum and the sudden rise to maximum which is likely to follow. It seems to me that the problem of the solar rotation—at present the main solar problem under investigation here—should be studied simultaneously with convection effects, pressure effects, sky spectrum and blended spectra, and the incidental errors of measurement, for results may be obtained from the former investigation which would be inexplicable without data of these other effects obtained simultaneously; and, as suggested in the last report, a more perfect photography of the sun should be made with the aid of the reflecting telescope.

7. *The Effect of Air Currents in Spectrographs.*

During the latter part of the autumn of 1910, a puzzling annoyance was encountered while working with the solar spectrograph: the image of the spectrum became disturbed from time to time: the disturbance resembled that which resulted from tapping the spectrograph gently or from kicking the cement piers on which it rested: the trouble was greater on bright frosty days when the sun spectrum was examined, than it was at any time during a couple of weeks of warmer, cloudy and rainy weather when the spectrum from a carbon arc was examined: on several occasions marked disturbances were observed simultaneously with the sound of slamming doors or of heavy waggons rumbling on the road above the tunnel in which one end of the spectrograph is placed.

The definition of the spectrum was so much impaired by the disturbance that for a month no satisfactory spectra could be photographed. We had great difficulty in finding the cause of the trouble. The fact that Dr. Klotz recorded marked microseisms on two of the frosty bright days when the disturbance was exceptionally great, made us suppose that it might be due to some earth waves accompanying those recorded on the seismograph. The vibrations caused by the machinery in the machine-shop adjoining were also suspected, but stopping the

* Astrophysical, Journal, 32, July, 1910.

Fig. 15.—Rotation Spectrum Photographed without and with Air-Currents in the Spectrograph.

machinery did not affect the disturbance. Truss-rods were placed on the spectrograph, but though they gave it necessary strengthening, they did not lessen the trouble. Finally one day when the cold currents blowing in under a door near the grating end of the spectrograph were exceptionally strong, it occurred to me that the disturbance might be due to cold air passing into the spectrograph and over the face of the grating, and sure enough this last guess proved to be right, Mr. Plaskett observing the effect on the next bright day when the sun spectrum was examined. By observing the face of the grating without the eye-piece used in examining the spectrum, waves were seen to be passing over it suggesting the appearance of a volcano.

The greatest effect was caused by the cold air from the room which was suddenly cooled by opening the doors leading to the coelostat-house to admit the light from the reflector; this cold air fell through a small hole which had been placed directly above the face of the grating when some additions were made to the spectrograph earlier in the autumn. In the most extreme cases the room was chilled to a temperature from 10° to 15° C. lower than that in the spectrograph, and the initial influx of air to the latter was so great as to utterly ruin the definition of the spectrum. This effect is illustrated in the accompanying Figure 15, which is taken from plate *L*621, II order, λ 5600, and reproduces a sharply defined rotation spectrum taken in the absence of air currents in the spectrograph—a condition secured by plugging the holes in the spectrograph with felt—and a poorly defined spectrum taken immediately afterwards while air currents were passing over the face of the grating. These currents were caused by leaving the doors open for five minutes and allowing the room to cool from 20° to 12° C. and then removing the plugs of felt from the holes in the spectrograph near the grating. This of course represents an extreme case, but it will serve all the better as a warning to those who are likely to meet with the same trouble in employing spectrographs of the closed-in type.

The disturbance was eliminated by lining the spectrograph with felt, and by putting a double box around the grating end of the spectrograph, lining it and plugging all holes with felt and cotton waste. Conditions were further improved by putting a pane of plate-glass in one of the doors leading out to the coelostat-house, thus making it possible to get light from the reflector to the spectrograph without cooling the room.

The above observations are recorded in the hope that others who are engaged in spectroscopic work may avoid the troubles we have experienced. In the use of stellar spectrographs, it seems to me, there is a danger of similar effects from air currents. The spectrograph is usually kept a few degrees warmer than the room in which it is used by an electrically controlled and heated thermostat, and the resulting convection currents may cause a slight effect; and further, cold air leaking in through the narrow slit may slightly impair the definition of the spectrum and greatly lessen its intensity on account of the changes in refraction which would cause some of the light passing through the slit to be deviated so that it would not fall on the collimating lens and prisms. The point could easily be tested and if the effects were present they could be removed by placing a thin piece of plate-glass over the slit, or immediately under it.

8. *Distortion and Dispersion of the Solar Image by the Earth's Atmosphere.*

Some marked effects of distortion and dispersion of the sun's image, produced by the terrestrial atmosphere, have been noticed from time to time while working with the reflecting telescope and while taking the daily photograph of the sun with the equatorial telescope and solar camera. These effects are most pronounced during the winter months when the declination of the sun is least. On one occasion when the definition produced by the reflector was excellent, the following measurements of these effects were made. The angles refer to the readings on the graduated circular front of the solar spectrograph, corresponding to the direction of the diameter of the solar disc measured; the "diameter over all" includes the colored part due to the spectrum, and "diameter over white" is the diameter leaving out the red and blue edges of the image.

Angle 260°, "East and West line"	Diameter over all	230·0 mm.
	Diameter over white	228·0
Angle 170°, "North and South line"	Diameter over all	226·0
	Diameter over white	224·8
Angle 300°, "No color line"	Diameter	232·0
Angle 305°,	Diameter over all	231·0
	Diameter over white	230·8
Angle 210°–215°, Direction of Spectrum	Diameter over all	224·0
	Diameter over white	222·0
Hence, the length of the spectrum is		2·0
The greatest diameter of the monochromatic image is perpendicular to the direction of the spectrum, and equal to		232·0
The least diameter of the monochromatic image is along the direction of the spectrum, and equal to		223·0
Hence, the distortion effect is		9·0

The observations were made December 12, 1910, 3:35—3:50 p.m. The day was particularly calm and cold, and fairly stable layers at different temperatures may have existed in the atmosphere.

From the above measurements it will appear that when the sun is low it is not safe to make observations where a knowledge of the position of the points on the sun observed is essential; during the winter months observations should be made about the noon hour, when, unfortunately, the coelostat-house is in shadow. Furthermore the photographs of the sun taken in the winter time should be made as near noon as possible. Is it possible that small effects similar to those noted here, may have affected the investigations which have been made to detect any changes in the diameters of the sun? I understand that correction for atmospheric refraction has been made in the ordinary way, but may there not have been present frequent minute irregular distortion effects operating so as to increase the probable errors of the measurements greatly and thus discouraging attempts to detect the most minute changes? It appears that the question has been abandoned even though Poor's investigations—in spite of the large probable errors present—seemed to indicate periodic changes in the diameters of the sun.

9. *Suggestions for Future Work and New Apparatus.*

A brief outline will here be given of suggestions I wish to make relating to future work and new apparatus, the necessity for some of which has been discussed in the preceding part of this report. Nearly all of these suggestions while having a direct bearing on the problem of the solar rotation, relate to questions important in themselves.

(*a*) *Solar Rotation and Related Work.*—In the foregoing Report I have shown the necessity of determining the slight effects on the measurements of the rate of the solar rotation caused by the following:—Errors of Measurement, Sky Spectrum, Convection and Pressure. I have pointed out methods of determining these effects. In this connection the "rotation plates" could be made more valuable by including a simultaneous exposure on the centre of the sun; this could be done with very little extra trouble. It might be advisable to alter the present unsymmetrical configuration of the spectra (which consists of two exposures from one limb and one from the other) and have two strips of spectrum from each limb, with a narrow strip from the centre in between each set. Two settings on the line in each strip—10 settings in all—would yield information regarding pressure and convection effects and would give more data for the determination of the rate of the solar rotation than is given by the 8 settings to a line in the three strips of spectrum now used. The labor and time of making the settings can be much lessened, and the accuracy in recording them can be put beyond question, by employing an automatic register of the settings. I have devised a simple photographic method (see below) of accomplishing this.

(*b*) *Periodic Changes in the Velocity of the General Convection Currents in the Solar Atmosphere.*—As mentioned in the preceding part of the Report, I have raised the question—in a paper entitled, "Convection and Stellar Variation" (*loc. cit.*)—as to periodical changes in the convection currents in the solar and stellar atmospheres and the bearing of such changes on the variation of solar and stellar radiation. I regard the question as a very important one, and it seems to me that much light can be thrown on the general problem by a study of the solar convection currents. Apart from its own importance it may have an important bearing on the problem of the solar rotation. It is quite possible that a thorough knowledge of the convectional movements—their velocities and magnitudes—in the sun's atmosphere, may provide the key to unlock the mystery of the greater angular velocity of the lower latitudes. Indeed, it does not take a very great stretch of the imagination to conceive that the rotation of stars and the consequent throwing off of satellites, may have been developed by the growth of convection currents fed by the energy liberated during the condensation under the action of gravity of matter initially in a very tenuous condition.

I would therefore urge that time and equipment—very little extra apparatus is needed to start the work—be granted me for the investigation of the general solar convection. Very likely the motions of the ordinary absorbing gases are not rapid enough to cause a suitably large displacement for measurement, and particularly for detecting changes in velocity. Adams, in his comparisons of the centre and limb of the sun, finds a slight displacement which he attributes to pressure, but which in the absence of a very accurate laboratory comparison could be ascribed to convection. However, the more rapidly moving high-level vapors of Calcium and Hydrogen can be investigated from their emission and absorption lines, and their velocities are sufficiently large (as St. John has recently shown, for Calcium, *loc. cit.*) to make it possible to detect periodic changes of 1 per cent. or more. In such work it is essential—as I pointed out in the last Report—to photograph simultaneously, a gaseous absorption comparison spectrum produced by tubes of gas of known pressure.

(*c*) *Proposed New Arrangement of Reflecting Prisms for the Solar Rotation Work.*—By using the arrangement of the central reflecting prisms of the solar rotation apparatus shown in Figure 16, the resulting "rotation plates" will be considerably more valuable than the ones taken at present. By this arrangement two sets of rotation spectra are photographed simultaneously with the spectrum from the centre of the sun's disc; the width over all of the five strips and spaces between them could be, conveniently, about 5 mm. In measuring these spectra, two or three settings to a line in each strip would be sufficient. From the double set of rotation measures it would perhaps be possible to cast out honestly, very discrepant individual measures occurring in only one of the sets and independent values for each limb could be determined; and comparisons with the spectrum from the centre of the solar disc could be made to determine the effects of pressure and convection. Likewise changes in the character of the lines between centre and limb would be recorded. Since the tips of the prisms are rather thin, difficulty might be experienced in grinding them out of a solid piece of glass: in that case they could be made from strips of glass of the required thickness cemented to a central block of glass, for convenience of adjustment.

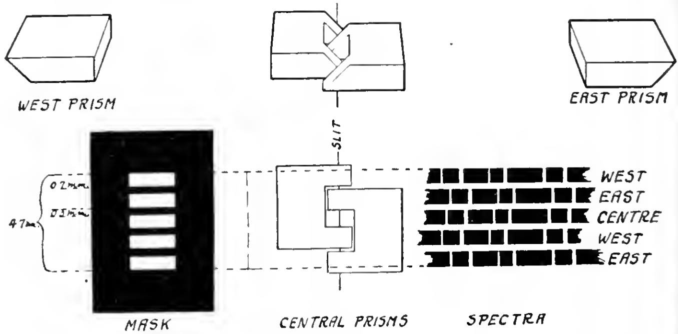


FIG. 16.—A proposed arrangement of Reflecting Prisms for the Solar Rotation Apparatus.

(*d*) *Photographic Method for Recording Micrometer Readings.*—To lessen the labor involved in the measurements of the spectrum line displacements on the "rotation plates," and to increase the accuracy of these measurements I have devised a photographic method of recording the readings on the drum of the micrometer. I understand that the printing method which has been used for this purpose* would be very expensive if applied to the large Toepfer measuring machine; but I think the following apparatus could be constructed at much less expense. The apparatus would consist essentially of a small short focus camera provided with an automatic shutter, and a key (similar in action to a typewriter key) which when pressed after a setting had been made, would release the camera shutter, and which when released would shift the film or plate in the camera over a suitable distance for the next exposure. The camera would be set up so as to photograph the reading on the silvered micrometer drum which would be illuminated by artificial light of sufficient intensity to give a good exposure in say half of a second as regulated by the automatic shutter. Suitable masks would be employed so that only the necessary part of the scale on the drum would appear on the photographic plate or film. The readings would be photographed on such a small scale that a great number could be placed on a small plate or film, and enlarged prints would be made from the negative so that the readings could be readily determined

* Zeit für Instrumentenkunde, p. 169-173, 1910.

without the aid of a magnifying glass. The readings for each spectrum line would be taken in a row and the plate or film advanced slightly for the next row of photographs. By using a small plate in a plate-holder which could be immersed in developer and fixer, the after treatment of the plate could be carried on during other measurements, thus saving much time. The mechanism for shifting the plate from reading to reading, and for advancing it from row to row could be arranged like that of a typewriter for shifting the platen from letter to letter, and for advancing it from line to line. I have discussed these details with Mr. Mackey who thinks he could construct the apparatus without much difficulty and expense, so I would suggest that it be provided for use with the large Toepfer measuring engine.

(*e*) *Apparatus for Removing Systematic Errors of Measurement.*—In the preceding part of this report I have shown that there are systematic errors present in the measurements of the displacements of the spectrum lines in the rotation plates, and that these errors are due to the configuration of the lines visible in the eye-piece of the measuring machine. I suggested there methods of eliminating such errors. One of these methods is to make the configuration the same for the measurements of the spectrum line in each of the strips of spectrum. This can be done by placing a mask just above the photographic plate to be measured, the mask to have a slit just wide enough so that one strip of spectrum may be seen at a time, and the mask to be movable so that the three strips may be seen in turn. Any influence on the setting on any particular spectrum line, by what is visible in the eye-piece will be the same for each strip and consequently the systematic errors due to configuration will be eliminated in the displacement determined by subtracting the readings for one spectrum from the readings for the other. I would suggest that such an apparatus be fitted to the large Toepfer measuring machine. It could be conveniently attached to the sturdy arm supporting the microscope. A light frame holding the slotted slide which can be moved between spring stops bringing the slit above each of the three strips in turn by means of a turning handle on the left side of the eye-piece support, is all that is necessary. More stops than three should at the same time be provided for the measurement of exposures having more than three strips of spectrum, and the slotted slide should be so mounted that it could easily be moved out of place in order to see all the strips of spectrum for purposes of adjustment.

Photography of the Sun.

The photography of the sun with the enlarging camera of the equatorial telescope was continued during the year, photographs being taken on nearly every bright day. On a number of bright days when the sun shone for just a short time, the photograph was missed because I was working with the solar spectrograph. However, nothing of very great importance was missed, it is hoped, because the number and size of spots are fast declining to the minimum. Until nearly the end of January the photographs were taken, as they have been from the beginning, on the coarsely grained Cramer's Medium Isochromatic plates, which are so sensitive to the light admitted through the "Filtergelb K" screen employed. For two reasons the definition on the photographs is not what it should be: firstly, because minute crystals have appeared in the Canada balsam used to stick the Filtergelb plates together—probably due to the action of the sunlight; and secondly, because the grain of the plates is so coarse. Through the end of January and February the finer-grained though somewhat slower Wellington Ortho Process plates were employed; while during March the plates employed were Cramer's Iso Process which proved to be of still finer grain and nearly as fast as the Cramer's Medium Isochromatic plates formerly used.

Regarding the treatment of the plates after being exposed, I would suggest that arrangements be made for developing them immediately after being taken, or perhaps two at a time, rather than having them accumulate month after month as at present.

I would again urge that a camera be installed for use with the reflecting telescope, for special photographs at least. For ordinary purposes the photographs taken as at present may serve; but no record of the white spots and granulation is made on these plates owing to the fact that the yellow filter employed cuts off the violet rays from the Calcium vapor to which the brightness of the white clouds in the sun's atmosphere is chiefly due. Such a record could be made on Process plates with the reflector, and these photographs taken at the time when rotation plates are made would serve perhaps to trace out the cause of certain irregularities appearing in the latter, though a spectroheliograph would do this much better.

Laboratory Work.

Owing to the pressure of other work, little time was found for work in the laboratory outside of the work on testing developers for use with the various photographic plates employed in taking the rotation plates, the plating of the mirrors, and numerous little points occurring in connection with our solar work and that of other members of the staff.

In connection with the investigation of errors of measurement—discussed in the first part of this report—I made 6 plates, $(X_1 - X_6)$, of artificial spectrum lines of varying character and intensity. These artificial lines were made by exposing the photographic plate to a small source of light through the double-slit described above. In this way emission lines displaced similarly to the displacements of the absorption lines on the rotation plates were imitated. By making a positive from this plate the absorption lines were themselves represented. The double-slit was placed close to the photographic plate in a frame in which the plate-holder could be slid from exposure to exposure. The source of light consisted of a ground glass bulb placed behind diaphragms having holes of different shapes. These holes were made in small slides which could be readily interchanged, and their shapes controlled the character of the imitation spectrum lines. A rectangular opening gave a fairly uniform line, a diamond shaped hole gave a shaded line, two holes side by side produced a close double or a blend, etc. By suitably arranging the openings any kind of spectrum line or blend could be very closely imitated, and either emission or absorption lines could be produced. By means of the double-slit adjustments the displacements of these lines and their sharpness could be controlled. It was my intention to obtain from these plates the effects by gradual changes of intensity, character and displacement on the systematic errors of measurement. However, I considered it advisable for the first work in the investigation of errors of measurement, to find the errors in the measurements of the spectrum lines actually employed by us for the determination of the solar rotation, and of those lines found by Adams to give systematic differences from the mean values. In connection with this latter investigation I have devised means of eliminating the errors, so for the present time I have abandoned the work with the artificial lines, though their measurement would probably reveal more readily than any other measures the general effects of the various factors just mentioned, for changes in the latter can be so easily regulated. It might also afford the easiest method of determining one's tendencies in the measurement of blended spectra, for the character, intensity and distances apart of the lines forming the blend can be controlled so perfectly.

In the last Report I emphasized the necessity of employing gaseous absorption spectra photographed simultaneously with the Solar spectra for the purpose of detecting minute changes in the latter. I plan to prepare tubes of various gases and to investigate their absorption spectra. The colored gases such as the halogens, peroxides of nitrogen, chromyl chloride, etc., are available; and possibly too, many of the more transparent gases may be used with the long-focus telescopes and spectrographs now in use. It is possible that a long tube can be filled with several gases to produce absorption lines at the various wave-lengths. Many of these gases should be investigated and the wave-lengths of the best comparison lines determined accurately. Furthermore, it may be practicable to use as comparison substance the vapour of a metal. The metal could be heated in a tube at low pressure and the sun-light passed through it; and if the metal occurred in the Sun, the light from one end of the solar equator could be passed through the tube: with great dispersion the lines would be shifted so much that the fine lines of the solar and comparison spectra would not blend.

APPENDIX E.

DOUBLE STAR MEASURES, OCCULTATIONS, AND HALLEY'S COMET.

R. M. Motherwell, M.A.

Double Star Measures.

The measurement of double stars has been carried on as in former years, but the presence of Halley's Comet interfered considerably with the work. The quick motion attachment for position-angle has been found very satisfactory. Acting on suggestions from Prof. Doolittle and Prof. Fox, I am giving the usual designation to each star in addition to its general catalogue number.

70 OΣ 2.

	°	"
1910·690	224·1	17·32
1910·791	224·3	17·56
1910·741	224·2	17·44

117 Σ 21 rej.

	°	"
1910·796	51·0	7·75
1910·802	51·0	7·48
1910·816	51·6	7·61
1910·805	51·2	7·61

134 H 1015

	°	"
1910·791	143·7	6·34
·796	145·3	6·66
·802	142·9	6·31
1910·796	144·0	6·44

269 Espin

	°	"
1910·701	114·7	5·91
·745	113·6	5·69
1910·723	114·2	5·80

Identified as No. 246 by Burnham in A. N. 4426

319 A. G. 6

	°	"
1910·796	11·0	59·56
·802	11·0	59·28
·816	11·4	59·15
1910·805	11·1	59·33

578 Σ 89 rej.

	°	"
1910·745	159·3	15·64
·796	160·0	15·60
1911·045	159·5	15·74
1910·862	159·6	15·66

684 Kr 11

	°	"
1911·045	240·5	2·35

1002 Σ 183

	°	"
1910·791	164·2	5·65
·796	163·9	5·66
1910·794	164·1	5·66

1186 Tucker

	°	"
1910·802	238·1	2·76

1216 A. G. 36

	°	"
1910·791	224·4	3·55
·816	222·5	3·25
·930	227·4	3·33
1911·046	223·3	3·23
1910·896	224·4	3·34

1223 A. G. 37

	°	"
1910·701	290·9	5·02
·745	291·3	4·79
1910·723	291·1	4·91

1239 A. G. 38

	°	"
1910·701	261·2	34·02
·791	260·5	33·77
·802	260·3	34·02
1910·765	260·7	33·94

1622 A. G. 64

	°	"
1910·791	245·0	8·70
·802	244·1	8·68
1911·046	244·5	8·52
1910·880	244·5	8·63

1655 β 1294

	°	"
1910·791	228·9	6·49
·802	228·1	6·32
1910·797	228·5	6·41

1750 A. G. 68

	°	"
1910·791	248·7	17·22

2043 Σ 72

	°	"
1910·936	322·4	3·84

2119 A. G. 79

	°	"
1910·791	109·8	25·28
·802	110·1	24·83
·904	110·5	24·76
1910·832	110·1	24·96

2232 Σ 556 rej.

	°	"
1910·936	288·1	3·93
1911·046	286·2	4·62
1910·991	287·2	4·28

2536 Σ 643

	°	"
1910·791	300·3	2·74

2634 Σ 678

	°	"
1910·791	99·2	3·26
·802	98·0	3·02
·904	99·2	3·33
1910·832	98·8	3·20

2648 Σ 682 rej.

	°	"
1910·937	98·5	19·01
1911·046	99·4	18·57
1910·992	99·0	18·79

2697 H 364

	°	"
1910·937	141·4	9·87

3334 A. G. 110

	°	"
1910·791	327·3	10·72
·802	327·9	10·55
·904	327·5	10·51
1910·832	327·6	10·59

3348 A. G. 111

	°	″
1911·051	163·4	6·67
·081	164·8	6·76
1911·067	164·1	6·72

3399 A. G. 115

	°	″
1911·051	351·0	3·81

3946 Σ 1058

	°	″
1910·937	281·4	22·11

4530 H 781

	°	″
1911·051	139·6	5·65

5019 Σ 1330 rej.

	°	″
1910·279	302·0	24·99

5125 A 224

	°	″
1910·279	146·1	3·56

5337 Σ 1412 rej.

	°	″
1911·090	294·5	29·83

6030 Σ 1601

	°	″
1910·284	309·5	2·63

6386 β 930

	°	″
1910·284	118·7	....

6415 OΣ 261

	°	″
1910·306	343·7	1·89

6599 Σ 1777

	°	″
1910·251	229·6	3·64

6753 H 3343

	°	″
1910·489	213·4	63·36

7065 OΣ 289

	°	″
1910·306	115·5	4·56
·489	114·4	4·62
1910·398	115·0	4·59

7129·5 A. G. 199

	°	″
1910·254	253·4	9·57

7480 S 676: ρ Coronæ

	°	″
1910·383	76·9	84·55

7604 Σ 2038 rej.

	°	″
1910·306	212·31	16·69

7918 Ho 558

	°	″
1910·572	208·9	7·71

7927 Σ 2141 rej.

	°	″
1910·383	125·7	33·33

7930 Σ 2144 rej.

	°	″
1910·681	180·9	24·56

8003 Σ 2161

	°	″
1910·567	313·6	3·88
·572	313·0	3·67
1910·570	313·3	3·78

8431 H V 93

	°	″
1910·681	136·0	53·82
·706	136·1	53·72
·777	135·9	53·87
1910·721	136·0	53·80

8432 H 856

	°	″
1910·681	62·4	Clouds
·706	62·3	24·50
1910·694	62·4	24·50

8481 H 5494

	°	″
1910·706	70·2	39·43

8504 Σ 2310

	°	″
1910·706	237·5	5·25
·777	236·0	5·18
1910·742	236·8	5·22

9107 Schj. 20

	°	″
1910·638	229·9	59·54
·660	229·8	59·47
1910·649	229·9	54·51

9181 H 5509

	°	″
1910·638	104·8	6·78
·706	103·1	7·10
1910·672	104·0	6·94

9183 A. G. 228

	°	″
1910·651	102·5	36·13
·660	102·3	36·45
·668	102·4	36·53
1910·660	102·4	36·37

B.D. 63°, 1501 and 1502

	°	″
1910·668	156·4	78·66

B.D. 63°, 1505 and 1506.

	°	″
1910·638	103·8	24·54
·660	103·3	24·01
·668	103·4	24·76
1910·655	103·5	24·44

9905 H 1477

	°	″
1910·627	270·8	19·37

9970 Espin 87

	°	″
1910·534	298·5	8·71
·627	298·1	8·92
·638	297·6	8·83
1910·600	298·1	8·82

9986 H 907

	°	″
1910·580	132·5	5·79

10005 Σ 2649

	°	″
1910·627	151·5	23·28
·638	151·4	23·07
·668	151·4	23·56
1910·644	151·4	23·30

10064 Ho 588

	°	″
1910·627	297·5	49·75
·638	297·4	49·79
·668	297·4	49·60
1910·644	297·4	49·71

10066 Ho 455. A and D.

	°	″
1910·690	256·8	32·18

A and E.

	°	″
1910·690	75·8	36·38

10075 Hu 585

	°	″
1910·572	48·8	4·31
·690	49·8	4·51
·701	51·5	4·73
·739	50·3	4·65
1910·676	50·1	4·55

10898 β 1140

	°	″
1910·627	270·0	3·93

10917 H 281

	°	″
1910·580	334·7	13·39
·701	334·3	13·63
·706	336·6	13·72
1910·662	335·2	13·58

10925 Σ 2790

	°	″
1910·660	43·0	4·37
·690	45·2	4·38
1910·675	44·1	4·38

10934 Holmes

	°	″
1910·627	246·1	12·91
·660	244·0	12·51
·668	245·4	12·51
1910·652	245·2	12·64

10943 S 788

	°	″
1910·627	87·7	44·18
·668	89·2	44·31
·796	88·3	44·91
1910·697	88·4	44·47

11021 Espin 100.

	°	″
1910·627	159·7	3·72
·701	159·5	4·06
·739	159·1	3·89
1910·689	159·4	3·89

11037 H 3033

	°	″
1910·796	244·0	24·77
·930	243·5	23·88
1910·863	243·8	24·33

11048 A. G. 272

	°	″
1910·690	184·9	3·93
·701	185·8	3·92
1910·696	185·4	3·93

11487 H 1722

	°	″
1910·701	47·0	17·36
·739	46·5	17·14
1910·720	46·8	17·25

11499 β 697

	°	"
1910·668	94·1	....
·690	93·7	18·95
1910·679	93·9	18·95

11546 A. G. 280

	°	"
1910·745	179·6	11·18

11601 A. G. 281

	°	"
1910·745	22·1	2·56
·796	20·0	2·69
·930	20·0	2·56
1910·824	20·7	2·60

12193 H 3174

	°	"
1910·796	18·4	5·84
·930	19·7	5·68
1910·863	19·1	5·76

12222 H 3176

	°	"
1910·791	164·0	26·07
·796	164·1	26·14
·816	164·4	26·35
1910·801	164·2	26·19

12230 Σ 2991 rej.

	°	"
1910·668	359·2	32·82

12345 β 854

	°	"
1910·791	87·5	....
·796	87·7	2·51
·816	89·2	2·57
1910·801	88·1	2·54

12753 Kr. 67

	°	"
1910·815	160·7	3·14

Occultations of Stars by the Moon.

Date.	Star.	Phenomenon.	Limb.	G. M. Time of Observation.
1910				h m s
August 29..........	40 Geminorum	Disappearance	Bright	19 34 13·2
"	"	Reappearance	Dark	20 24 48·4
September 29.......	46 Leonis.........	Disappearance	Bright	21 21 49·6
"	"	Reappearance	Dark	22 17 56·3
December 10........	54 B Ceti.........	Disappearance	Dark	12 42 01·7
1911				
January 16..........	7 Leonis..........	Disappearance	Bright	16 17 12·5

Halley's Comet.

A search for this famous comet was begun here in July, 1909, the 8-in. photographic doublet being used. During the latter part of July, August and September, exposures were made whenever the telescope was available and the weather clear. The plates were on too small a scale, however, and the discovery was made photographically by Prof. Wolfe of Heidelburg, on Sept. 11, 1909. The comet was first seen here on November 9 with the 15-inch equatorial, the estimated magnitude being about 13. The following observing notes do not furnish a very complete history of the comet owing to the unusually cloudy weather:

1909, Nov. 23—Estimated magnitude 12.5; centre rather star-like.

Nov. 30—Estimated magnitude 12.5; much the same as on Nov. 23.

Dec. 11—Estimated magnitude 12.

Dec. 16—Same as on Dec. 11—Diameter 15″.

1910, Jan. 4—Exposed two hours with Σ plates; no sign of a tail on the negative but side of comet towards the sun was more sharply defined than the opposite side.

Feb. 10—Exposed 1^h 40^m: tail of $\frac{1}{2}°$ showing on negative. Comet quite easily seen in field glasses of power 8.

Feb. 24—Much the same as on Feb. 10.

April 12—First morning observation—Very decided nucleus 6″ or 7″ in diameter—Not visible to naked eye.

April 14—Comet seemed brighter than on April 12, but sky was hazy.

April 21—Observed comet through haze.

April 27—Saw comet with naked eye, 1° of tail being clearly visible—about 3° visible in field glass.

April 30—Magnitude 3.0—Nucleus very star-like—3° of tail visible to eye.

May 3—Magnitude about 3.0—About 8° of tail visible to eye.

May 5—About same brightness—10° of tail visible to eye and quite uniform.

May 9—20° of tail visible to eye.

May 14—Tail over 35° long.

May 15—Tail visible at 13^h 30^m (E.S.T.) and head visible at 15^h 30^m (E.S.T.). Tail about 50° long.

May 16—Tail seemed to extend up to the Milky Way.

May 18 and 19 were unfortunately cloudy.

May 21—Comet visible in western sky—Tail about 15°

May 22—Nucleus brighter than on 21st.

May 26—Tail about 40°—Very sharp nucleus.

May 27—Tail about 50°.

May 28—Had best view of comet—Tail about the same as last night.

June 3—Tail about 15°—Nucleus much smaller.

June 4—Tail about 12°—Magnitude about 7.5.

June 8—Tail about 6°—Nucleus not nearly so sharp as on June 4.

June 9—Tail about 6°.

June 10—Comet very faint owing to haze.

June 28—Magnitude about 8.5.

TABLE OF EXPOSURES

Plate.	Date.	Exposure. Beginning.	Exposure. Duration.	Camera*.
	1910	h m	h m	
1	May 3	20 00	0 37	O
2	May 5	19 48	0 36	O
3	May 9	20 2	0 20	O
a 4	May 27	15 23	0 44	O
a 5	May 27	15 23	0 44	X
a 6	May 28	14 10	1 00	O
a 7	May 28	14 10	1 00	X
a 8	June 3	14 30	1 32	O
a 9	June 3	14 30	1 32	X
a10	June 4	14 32	1 28	O
11	June 4	14 32	1 28	X
12	June 8	14 38	1 17	O
13	June 8	14 38	1 17	X
14	June 9	14 35	1 16	O
15	June 9	14 35	1 16	X

* O refers to the 8-inch Brashear Doublet which gives a field of about 11° on an 8 x 10 plate.

* X refers to a Zeiss lens which gives a field of about 40° on an 8 x 10 plate. This lens has a speed of $f3 \cdot 5$.

a See Plates.

POSITION OBSERVATIONS OF HALLEY'S COMET.

G.M.T. 1909.	No. of Comparisons	Δα	Δδ	α (apparent)	δ (apparent)	log p. Δ α	log p. Δ δ	Star
h. m. s.		m. s.	′ ″	h. m. s.	° ′ ″			
Nov. 30... 15 56 24	8-8	−1 3·04	−2 4·9	4 29 21·85	15 55 35·0	0·187n	0·638	1
Dec. 11... 13 2 4	8-8	−0 53.12	+3 15·9	3 43 2·31	14 45 27·7	0·567n	0·676	2
Dec. 16... 20 8 18	8-8	−0 1·95	+4 49·7	3 19 29·16	14 00 3·5	0·803	0·766	4
1910								
Feb. 24... 12 29 18	8-8	−0 47·98	−11 30·1	0 37 34·88	7 53 12·5	0·785	0.777	5

MEAN PLACES FOR 1909-10 OF COMPARISON STARS.

Star.	α	Reduction to Apparent.	δ	Reduction to Apparent.	Authority.
	h. m. s.	s.	° ′ ″	″	
1	4 30 21·50	+3·39	15 57 29·4	+10·5	A. G. 1231.
2	3 43 51·56	+3·87	14 41 58·7	+13·1	A. G. 1108.
3	3 20 21·10	....	13 46 1·9	....	A. G. 1004.
4	3 19 27·85	+3·26	13 54 59·5	+14·3	B. D. 13°.542. Micrometer comparison with (3).
5	0 38 24·35	−1·85	8 4 50·1	− 7·5	A. G. 232.

No. 4.

No. 5.

Fig. 17.—Photographs of Halley's Comet.

No. 6.

No. 7.

Fig. 18.—Photographs of Halley's Comet.

No. 8.

No. 9.

No. 10.

FIG. 19. Photographs of Halley's Comet

APPENDIX 3.

REPORT OF THE CHIEF ASTRONOMER, 1911.

MERIDIAN WORK AND TIME SERVICE

BY

R. M. STEWART, M.A.

CONTENTS.

TABLES

APPENDIX 3.

MERIDIAN WORK AND TIME SERVICE,
BY R. M. STEWART, M.A.

OTTAWA, CANADA, April 1st, 1911.

DR. W. F. KING, C.M.G.,
Chief Astronomer,
Dept. of Interior,
Ottawa.

SIR,—I have the honour to report as follows on the work carried out under my charge during the fiscal year ending March 31, 1911.

Regular observations with the meridian circle for the measurement of right ascensions were begun in March, 1910. A description of observing list, methods of observation and reduction, and the results of the observations obtained up to the close of the calendar year 1910 will be found below. The observers were Mr. D. B. Nugent and myself.

During the course of the year several alterations to the instrument, which were necessary for the successful prosecution of zenith distance work, were carried out; it was found possible to begin preliminary work in this co-ordinate in January, 1911. Several pieces of work still remain to be done before the instrument will be in first-class working order; progress on these has been extremely slow; apparently the workshop is so overcrowded that it is barely possible to keep abreast of the urgently needed requirements of the moment, no time being left for the overhauling and improvement of instruments.

As it is more convenient to treat the observations of a whole calendar year together, the discussion of the meridian circle observations terminates with the calendar year, 1910.

Observations were made to determine the latitude and longitude of nine stations, the most important of these being Winnipeg, whose longitude was determined from Ottawa with considerable care. The field observations were made by Messrs. McDiarmid and Jaques. Several series of personal equation observations were made, which are discussed in detail below.

The time-service has been maintained as in the past without important change; most of the work in connection with the up-town service has been done, as in previous years, by Mr. D. Robertson. A statement of the number of clocks in operation will be found below.

THE MERIDIAN CIRCLE.

The piers for the two azimuth marks have been erected, and those parts of the apparatus not yet obtained have been ordered. Several alterations required in the meridian circle to fit it for zenith distance work have been completed, and regular work both in right ascension and zenith distance has been begun, the former in March, 1910, the latter in January, 1911. The observing list in right ascension consisted of stars from Newcomb's Fundamental Catalogue north of 10° declination together with a number of selected stars between 70° and 80°; the star-list of the Berlin Jahrbuch was taken as fundamental. Besides systematic differences, there are occasional large discrepancies between the positions of individual stars as given in the two catalogues; an extreme case of this is given by the star ω Herculis, where the difference amounts to .18 sec.; in this case Newcomb's position is undoubtedly wrong, the proper motion having been apparently taken with the wrong sign. It was desired to investigate these differences, as well as to establish a somewhat more extended star-list for use in longitude work. These observations, comprising 5018 transits, with their reduction to mean place, are given below. There were in addition observations on a number of other nights, which for various reasons have been rejected.

With the beginning of zenith distance work in January a more extensive observing list was undertaken. For a number of years a great need has been felt for an extended list of declinations for latitude work, depending on observations of recent date, and it is hoped that these observations may to a certain extent fill that requirement. The observing list comprises those stars which have been used in latitude determinations by this observatory within recent years; the list will be enlarged from time to time as required, by the addition of stars being actually used in the field work.

This report, however, so far as a detailed discussion of the observations is concerned, deals only with the calendar year 1910.

Azimuth Marks.—The piers for the azimuth marks were built during the summer of 1910. Like the other piers, they are constructed of concrete, and in general form are similar to the south collimator pier. The northern part of each pier is penetrated by a pit to allow access to the underground lens which serves as the fixed mark; this part terminates about two and a half feet below the top of the pier proper. Through the centre of the latter is a vertical shaft about eight inches in diameter, extending down to the level of the bottom of the pit, into which it opens by a small arch; at the bottom of the arch the underground lens will be fastened to the footings of the pier.

Provision has been made for the thorough drainage of both piers; each is surrounded by broken stone to about the level of the ground, and the footings are surrounded by a tile drain. In the case of the north pier this is led to a pit dug in the gravelly soil a short distance away, there being sufficient slope to the ground in the immediate vicinity to ensure natural drainage from this point. The drainage of the south pier is effected by means of a cistern built immediately underneath that part of the pier which contains the pit for access to the underground mark; this cistern is connected by a pipe to the same power-pump which is used in connection with the cistern underneath the transit house.

In the absence of provision for the immediate erection of the permanent stone buildings to shelter the piers, temporary wooden shelters were erected, which, though rather unsightly structures, serve the present purpose fairly well. Electric wires have been provided to each shelter to furnish illumination for the marks; this is controlled from the meridian circle room.

Upon the completion of the piers the focal lengths required for the underground lenses were measured and the lenses were ordered. The two six-inch collimating lenses for the azimuth marks, and the two three-inch lenses to serve as underground reference marks for these, were received during the course of the year. Mountings for all six lenses, as well as for the azimuth marks, were ordered.

Each of the long-focus collimating lenses is to be mounted on a slide capable of motion by a micrometer screw in the plane of the prime vertical; on the same slide will be a mark consisting of a platinum wire parallel to the meridian, and also another mark consisting of two parallel platinum wires to be viewed by an eye-piece. The point midway between these marks, which approximately coincides with the centre of the collimating lens, will be in the primary focus of the underground lens serving as reference mark; by the use of a mercury basin underneath the latter, the same point in the collimating lens can be at any time set vertically over the optical centre of the underground lens. A similar arrangement holds in the case of the azimuth marks.

On account of the small angle of dip of the lines of sight to the azimuth marks (one or two degrees), it will be impossible to use the ordinary horizontal collimators, which would interfere with the long-focus lenses. It is hoped that eventually the azimuth marks themselves may be used as collimators, the angle between them being checked up from time to time by reversal of the telescope. Provision has, however, been made for mounting the north collimator directly opposing the south azimuth mark, the two to be used in the same way as the ordinary collimators if desired. Mountings for this purpose have been ordered.

The Observing Room.—Considerable difficulty has been experienced with the temperature of the observing room. The walls of the building are of stone, and the roof of concrete; inside these is a sheeting of galvanized iron, an air-space of a few inches being left next the walls, and of about a foot beneath the roof; a number of louvres are provided to allow circulation of air in this space. Owing to the absorption of heat by the walls and roof during the day, it was found that the temperature within the room did not follow the outside temperature at all satisfactorily, even with the roof shutters open. The effect of this on observations of right ascension would probably be limited mainly to increased unsteadiness of star-images, but in declination observations it would probably introduce serious anomalies of refraction. Two sixteen-inch ventilating fans have been placed in the walls of the room, in the hope that enough outside air might thus be circulated to at least partially remove the difficulty; though these were of some assistance they did not entirely remove the temperature difference. It is proposed to remove the sheet iron covering inside the louvres and replace it by doors which can be left open or closed as desired; this will at least allow a freer circulation of air, which should alleviate the difficulty.

Thermometers and Barometers.—A thermograph has been mounted in a louvred shelter a short distance to the southwest of the transit annex; from the records of this instrument are obtained the temperatures for use in the computations of refraction. To determine its error several comparisons are made, during the course of an evening's observations, with a mercury thermometer mounted beside it. Incidentally it was found that considerable differences of temperature existed between the position of this shelter and that of the one used for the platinum resistance thermometer of the Callendar Recorder, which is situated north of the transit annex. These differences were frequently irregular during the day, as was to be expected under varying conditions of wind and sunshine; during the night, however, they were more regular, the fall of temperature of the northern one being apparently retarded by radiation from the adjacent pinery.

Barometric heights are read from the standard barometer (by Casella) in the Time Room; in case of irregular variations interpolations are made with the assistance of the records of an adjacent barograph.

Instrumental Changes.—As mentioned in my last report, the original mountings of the microscopes were not sufficiently rigid. The microscopes were mounted, not on a continuous ring, but on separate arms extending radially from the standards; slight distortions of these arms, presumably induced by temperature changes, were sufficient to render the nadir decidedly unstable. In order to stiffen them as much as possible, two cast-iron rings were made and carefully fitted to the inner ends of the microscope carriers, thus connecting together each set of four microscopes. Unfortunately the construction of the standards rendered it impossible to make these rings in the form of complete circles, the greatest length attainable being 270°; this no doubt causes the stiffness of the mounting to be very much less than it otherwise would have been. However, the addition of the rings has very materially increased the stability of the microscopes; for ordinary differential work the arrangement will probably be quite satisfactory.

A new mercury basin of amalgamated copper was made to replace the old one, which was not amalgamated; a considerable improvement in the average steadiness of the reflected images has resulted, though at times, especially in winter evenings with rapidly falling temperature, the definition is not very good.

An eye-piece with a reversing prism attachment (power 200) was obtained in June, and has since been regularly used for measurement of collimation and for observations of several stars each night. Eye-pieces of higher power were also obtained for the circle microscopes.

Observations.—Regular observations with the meridian circle were begun in March, 1910; throughout the remainder of the year 1910 it was used as a transit instrument. The observing list comprised most of the stars in Newcomb's Fundamental Catalogue north of 10° declination; a selected list of stars between 70° and 80° declination was also added, in order to provide a greater number of azimuth stars for use in longitude work. In the past the star-places of the Berlin Jahrbuch have been used for longitude work almost exclusively; besides systematic differences, there are occasional fairly large discrepancies between star-places as given in the two catalogues mentioned; it was desired both to investigate these, and to render the remainder of the Newcomb stars, some of whose positions are quite poorly determined, available for use in longitude work.

The Berlin Jahrbuch stars between 10° and 45° declination (as far north as the zenith) were taken as clock-stars; the azimuth stars included all those north of 80° declination whose places were given in any one of the four principal ephemerides, the Berlin Jahrbuch places being given the preference. Observations for level and collimation were made as a rule both before and after the evening's star-observations. After the arrival of the reversing eye-piece it was used for all observations both of stars and collimation; for the latter, half the pointings were made with apparent motion of the wires towards the micrometer head for increasing readings, and half in the opposite direction; in the case of stars, the great mass of the observations were made with the apparent direction of motion normal; each night, however, several stars were observed with the apparent direction of motion reversed; the stars so observed were as far as possible grouped in pairs, each star of a pair having approximately the same declination; usually one star of a pair was observed with eye-piece normal, the other with eye-piece reversed; on the following night the first star was observed with eye-piece reversed, the second with eye-piece normal. In this way sufficient data were accumulated for a fairly rigorous determination of bisection-error for each observer. In the case of the azimuth stars the procedure was somewhat different; one half the observation of each star was made with eye-piece normal, the other half with eye-piece reversed; in this case the error of bisection is entirely eliminated from the complete observation.

Collimation and Level.—The south collimator contained one horizontal and two vertical wires, the vertical wires being separated by about 9″; in the north collimator there were two pairs of wires at right angles, one pair being separated by about 14″, the other pair by about 17″; during a part of the year one of these pairs was set vertical and used for collimation readings, during the remainder the other pair was used. A complete reading for collimation was taken by setting the south collimator on the north ten times, the micrometer head being left at the mean of the ten pointings; the telescope micrometer was then set eight or ten times on each of the collimators. Pointings of the south collimator on the north were made by setting the two vertical wires of the former symmetrically between those of the latter; pointings of the telescope on either collimator were made separately on each collimator wire, by placing the right ascension wires of the telescope (distance about 4″) symmetrically on each side of the collimator wire. The same eye-piece was used for all pointings, giving with the meridian circle a power of about 200, and with the collimator about 130. Beginning with June 23 a reversing prism was attached to the eye-piece, and an equal number of pointings was made in each case with the apparent direction of motion normal and reversed.

The effect of a constant error of setting (to right or left) of the kind eliminated by the reversing prism would appear in the pointings of the telescope on either the north or the south collimator, but would be eliminated from the mean; in the setting of one collimator on the other, however, the error would persist, and would enter the final value of collimation, unless a reversing prism were used. To find what this error (which we may call bisection-error) amounted to, the separate pointings were examined and grouped so as to show the effect, in the case of both the observers engaged. It was found that in setting the telescope on the collimator wires, S* set on the average .03″ too far to the left, N† .02″ in the same direction. All the collimator wires not being quite equal in apparent diameter, the pointings on each wire were grouped separately; it appeared that for the largest wires, whose images more nearly filled the space between the telescope wires, the bisection error was slightly smaller; the evidence was, however, not very conclusive on this point. In the case of pointings of one collimator upon the other, it was found that S was influenced decidedly by the distance between the wires set upon; when the wires 17″ apart were used in the north collimator he set .13″ to the right; with the wires 14″ apart the error was .03″ in the same direction. The observations made by N with the reversing prism were upon the more widely spaced wires only; his error of setting was .09″ to the left. In observations taken after June 23 these errors are all eliminated; in those made prior to that date, without the reversing prism, they were presumably present; no correction has, however, been introduced to allow for them; their effect on differential observations would be practically negligible.

For measurements of instrumental level a mercury trough was used, in conjunction with a Bohnenberger eye-piece of the usual form; by means of slightly oblique illumination the reflected images of the wires were made to appear bright in a dark field; settings were made by obliterating the bright reflected images of the micrometer wires by the wires themselves; to eliminate any errors arising from the obliquity of the illumination the wires were successively illuminated from each side, an equal number of pointings being taken in each case. On account of the fact that the phenomenon watched for is not a coincidence of wires, but simply the position of minimum brightness, there appears to be no room in this observation for a personal effect such as might conceivably enter in the ordinary nadir observation.

Readings of collimation and level were taken in general both before and after an evening's observations, and occasionally at other times. The observed micrometer readings for collimation line and for vertical line are given in Table II., as well

* R. M. Stewart.
† D. B. Nugent.

as the adopted values of collimation and level error, in seconds of time, for those nights on which star-observations were also obtained. In deriving the latter it is to be noted that the micrometer head is on the side next the clamp, and that the micrometer readings increase as the wires move towards the head; the adopted value of one revolution of the micrometer screw was 3.216 sec. Hence if C be the micrometer reading for the collimation line, L for the vertical line, and M for the mean of the contacts on the micrometer head, we have for Clamp East $c = (C-M) \times 3.216$, $b = (C-L) \times 3.216$, and for Clamp West $c = (M-C) \times 3.216$, $b = (L-C) \times 3.216$. The following were the adopted values of M throughout the year; the contact strip was broken about 9^h on March 28, and was replaced by a new one; it was re-adjusted on May 13:—

	r
March 11—March 28, 9^h	9·5880
March 28, 9^h—May 13	9·6006
May 14—Dec. 31	9·6600

It was noticed that the differences between observed values of collimation line before and after an evening's observations were apparently somewhat systematic, the later micrometer reading being quite usually the larger. To investigate this point, the observations for the whole year were grouped in several different ways, the results for the two clamps being treated separately.

Below is a list of the changes arranged chronologically, each period being the interval between successive reversals of the telescope; ΔC is the change in observed micrometer reading for line of collimation during the evening, the positive sign indicating that the later reading was the greater:—

Date.	Clamp.	Average ΔC.	No of nights.
		r	
March 17—April 2	W	·0034	5
April 3—21	E	·0003	9
April 22—May 15	W	·0055	13
May 16—21	E	·0032	4
May 26—June 9	W	·0042	8
June 10—15	E	·0021	3
June 18—25	W	·0038	4
June 28—July 19	E	·0006	9
July 26—August 12	W	·0023	7
August 18—September 15	E	·0004	14
Sept. 16—October 11	W	·0040	13
Oct. 12—November 9	E	—·0005	9
Nov. 27—December 25	W	·0050	5
Mean	W	·0042	55
"	E	·0006	48

From the above table there would appear to be no doubt that on the average there was a small systematic change in collimation during the evening. This is probably not unusual, but there is no apparent reason or explanation for the fact that the change is so much greater in the position Clamp W. than in Clamp E.; that this is not accidental is shown by the fact that the value given for "average ΔC" is in every case less for Clamp E. than either of the adjoining values for Clamp W.

The observations were next grouped as below to investigate the effect of change of temperature during the evening, which seemed the most plausible cause of a change in collimation; Δt denotes the drop in temperature in the observing room between the two readings:—

Clamp West.			Clamp East		
Average Δt	Average ΔC	No. of nights.	Average Δt	Average ΔC	No. of nights.
6·9°C	r ·0037	4	6·3°C	r ·0012	4
5·3	·0053	5	5·3	−·0010	5
4·4	·0055	10	4·5	·0013	12
3·5	·0038	17	3·6	·0013	13
2·5	·0037	8	2·6	−·0008	5
1·1	·0048	5	0·9	·0014	8

It is fairly evident that change of temperature has no effect on the collimation line; a comparison of the values of ΔC for Clamp W. and Clamp E. offers strong confirmatory evidence that the difference between the effects in the two positions of the instrument is real; in every case the value for Clamp E. is decidedly less than the corresponding one for Clamp W.

Grouping the observations again according to the time elapsed between the successive readings we have the following, ΔT denoting the time interval:—

Clamp West.			Clamp East.		
Average ΔT	Average ΔC.	No. of nights.	Average ΔT	Average ΔC	No. of nights.
h. m. 5 18	r ·0049	10	h. m. 5 12	r ·0013	5
4 38	·0065	6	4 40	·0020	10
4 10	·0037	13	4 13	·0006	5
3 39	·0031	11	3 38	·0010	10
3 13	·0037	9	3 04	−·0017	8
2 32	·0049	6	2 32	·0003	10

There is thus no dependence of change of collimation on the time elapsed between readings; or rather, the maximum change takes place within less than 2½ hours after the instrument has been in use; and again the difference between Clamp W. and Clamp E. shows up in every case.

For the sake of completeness, still another grouping was made, dependent on the average temperature during the interval between collimation readings; the result was practically identical with those given above, no effect on the average value of ΔC being visible.

The same process was repeated with respect to the changes in measured level error; the chronological tabulation is given below, Δb denoting the change in level error; *i.e.*, $\Delta b = \Delta (C-L)$ for Clamp E., and $= \Delta (L-C)$ for Clamp W.

Date.	Clamp.	Average Δb.	No. of nights.
		r	
March 17—April 2	*W*	— ·0031	5
April 3—21	*E*	— ·0033	9
April 22—May 15	*W*	— ·0036	13
May 16—21	*E*	— ·0010	4
May 26—June 9	*W*	— ·0002	8
June 10—15	*E*	·0004	3
June 18—25	*W*	·0007	4
June 28—July 19	*E*	·0020	9
July 26—August 12	*W*	·0000	7
Aug. 18—Sept. 15	*E*	·0016	14
Sept. 16—Oct. 11	*W*	·0015	13
Oct. 12—Nov. 9	*E*	·0004	9
Nov. 27—Dec. 21	*W*	— ·0013	4
Mean	*W*	— ·0009	54
"	*E*	·0002	48
Mean	both Clamps	— ·0003	102

There is, as was to be expected, a seasonal effect in evidence here, the western pivot showing a tendency to sink throughout the evening during the months of March, April, May and December, and to rise in the same period throughout the intervening months; the average for the year is practically negligible, nor is there any evident difference in the behaviour of the instrument in Clamp W. and Clamp E.

The last two facts mentioned afford independent evidence of the strongest kind as to the reality of the systematic change in collimation in Clamp W., and the practical absence of such a change in Clamp E. For since the average value of $\Delta b \ (= \Delta \ \overline{C \sim L})$ is practically zero in both positions of the instrument, it follows that if the observed values of ΔL had been tabulated they would have exhibited the same peculiarities as ΔC; that is, measurements of the two entirely independent quantities, collimation line and vertical line, show the same systematic peculiarities; which proves that the change considered is a collimation effect. It is difficult to understand, however, why the effect should be different in the two positions of the instrument; upon this point further light must be awaited. In the meantime, it is not of very great moment so long as only differential observations are considered.

Pivot Errors.—As no rigorous determination had been made of pivot errors, it was assumed that only relative ellipticity of pivots was present. The value adopted for this was that obtained previously in the series of observations for measuring the flexure of the axis.* According to the notation used then, the horizontal component

* Report of the Chief Astronomer, 1910, p 406.

of pivot error introduced by ellipticity may be represented by an expression of the form $\alpha \sin 2 (\theta - \chi)$, where θ and $\theta - \chi$ represent respectively, for Clamp East, the southern zenith distance of the telescope and of the major axis of the (relative) ellipse, a positive value denoting an increase in the instrumental azimuth; the vertical component of pivot error arising from this cause is negligible. Resolving this quantity along the collimation line of the telescope, and expressing it as a correction to the observed collimation, we have for Clamp East:

$$\Delta c = \alpha \sin 2 (\theta - \chi) \sin \theta$$
$$= \tfrac{1}{2} \alpha [\cos (\theta - 2 \chi) - \cos (3 \theta - 2 \chi)];$$

or putting $\theta = 45° 24' - \delta$, and adopting the values $\alpha = .36'' = .024$ sec., $\chi = 96° 30'$,

$$\Delta c = .012 [\cos (\delta + 147° 36') - \cos (3 \delta + 56° 48')].$$

Similarly, for Clamp West,

$$\Delta c = - .012 [\cos (\delta + 121° 36') - \cos (3 \delta + 30° 48')].$$

These values were tabulated and used for correcting all the observations.

Bisection Error.—As stated above, observations of several stars were usually made on each night with the apparent direction of motion reversed by means of a reversing prism. During the summer a preliminary computation of bisection error was made from such observations as were then available, in order to form a basis for proceeding with the regular computations. It was found that the observer N had no appreciable error of bisection, but that S consistently set the micrometer wires too far to the left by about .023 sec. equatorial interval. This value was therefore adopted for his observations, while those of N were left uncorrected.

From a thorough discussion of all the material available at the end of the year, made by Mr. Nugent, it was found that for stars up to 80° declination the error of bisection for S was .026 sec. equatorial interval, while for azimuth stars above 80° it was apparently less. No effect could be found depending on the declination or the magnitude of the stars observed. The bisection error of N again came out practically zero. An account of this investigation is given by Mr. Nugent in Appendix A to this report.

It is to be noted that the correction required for an error of this kind is a constant correction to the observed collimation, changing sign at the zenith. The sign of the correction is of course to be changed for such observations as were made with the apparent direction of motion reversed, and it is not to be applied at all to observations which were made half normal and half reversed.

Reduction of Observations.—In the tables headed "Reduction of Transits Observed" are given the quantities necessary for the computation of each separate observation of right ascension. The first column contains the date, the second a number for reference in the notes, the third the name of the star observed, the Berlin Jahrbuch numbers being used for stars contained in that catalogue. In the fourth column L. C. denotes that the star was observed at lower culmination; *r* denotes that the apparent direction of motion was reversed by the use of the reversing eye-piece; *n r* denotes that the apparent direction of motion for the first and last quarters of the transit was normal, for the middle half reversed; *r n* denotes the converse of this. The fifth column contains the initial denoting the observer, the sixth the mean of the clock-times of the different contacts recorded by the registering micrometer on the chronograph.

Of the quantities in the seventh column, the upper, unbracketed one is the measured value of collimation, taken from Table II.; the quantity immediately underneath this, enclosed in brackets, is the value of the polar deviation of the instrument, as derived from the observations. To the values of collimation given, the following corrections were applied in the computation:

(1) diurnal aberration, $-.015$ sec.

(2) the correction for one-half the width of the contact strip on the registering micrometer; the adopted values for this are as follows:—

March 17—March 26	·014 sec.
April 2—May 12	·013 "
May 15—Dec. 21	·018 "

The total correction for this effect is always positive; hence the correction to be applied to the collimation is positive for stars at upper culmination and negative for those observed below the pole.

(3) ellipticity of pivots; this correction was derived from the formulae given above.

(4) personal error of bisection; for observations by N no correction was applied; for unmarked observations by S a correction of $+.023$ sec. was applied in the case of stars observed facing south, and of $-.023$ sec. for stars observed facing north; in all observations except a few mentioned in the notes, this division line corresponds to the zenith; for those observations by S which are marked *r* the same correction was applied with the opposite sign; for observations marked *n r* or *r n* no correction was applied.

The values of n, the polar deviation of the instrument, were computed as follows:—The correction for collimation, including the above supplementary corrections, having been first applied to each observed time of transit, we have for each star an equation of the form

$$\Delta T + m + n \tan \delta = \alpha - T,$$

where the letters involved have their usual significance, δ being measured through the pole in the case of stars observed at lower culmination. The mean of these equations was taken, for each night, for all stars between 30° and 60° declination whose places are given in the Berlin Jahrbuch; by combining this mean equation with each of those derived from observations of azimuth stars on the same night, as many values of n were obtained as there were azimuth stars observed on that night; the mean of these values of n was adopted for the night. As the clock rate was always small, no correction was applied for this in the computations of n.

The eighth column of the tables contains the seconds of the time of transit, corrected for both collimation and polar deviation; the ninth contains the seconds of tabular apparent right ascension for the date, of all Berlin Jahrbuch stars up to 60° declination, and of all azimuth stars. The tenth column is the difference between the eighth and ninth, exhibiting the value, derived from the observation, for the quantity $\Delta T + m$; it is entered only for clock stars and azimuth stars, the former comprising all Berlin Jahrbuch stars culminating south of the zenith.

In deducing the value of "adopted $\Delta T + m$" given in the eleventh column two corrections were employed, one for clock-rate, the other depending on the declination of the separate stars from which the apparent values of this quantity are deduced in the preceding column. From a preliminary examination of the observations, it was suspected that there was a systematic effect depending on the declination of the stars observed; a thorough investigation of this point was therefore made for the range of declination covered by the clock stars, viz., 10° to 45°.

The observed values of $\Delta T + m$, as given in the tenth column, were grouped for each night into zones covering 5° of declination, and the mean taken for each zone. The mean of the three zones, 30° to 35°, 35° to 40°, 40° to 45°, was taken as a standard of comparison for each night, since stars were observed in each of these zones on almost every night. The differences between this standard and the means for the different zones were then taken, and tabulated with appropriate weights. This was done separately for each of the observers engaged, and for each position of the instrument. The weighted means of the differences are given below, in the sense of a correction to reduce $\Delta T + m$ for each zone to the mean of the three zones taken as standard:—

	Clamp W.		Clamp E.	
	S	*N*	*S*	*N*
10°—15°	·015	·020	·016	·024
15°—20°	·022	·007	·036	·018
20°—25°	·005	·014	·018	·025
25°—30°	·007	·014	·021	·012
30°—35°	·005	·001	·007	·001
35°—40°	·009	·006	·003	·015
40°—45°	—·012	—·008	—·007	—·015

From a careful examination of this table, no systematic effect dependent on the clamp or on the observer appeared to exist; weighted means were therefore taken for each zone as a whole, giving the following system of corrections, each with its appropriate weight:—

Zone.	Correction.	Weight.
10°—15°	·019	97
15°—20°	·017	121
20°—25°	·016	81
25°—30°	·013	129
30°—35°	·003	274
35°—40°	·008	333
40°—45°	—·011	365

These corrections appear to fall naturally into the three groups 0° to 30°, 30° to 40°, 40° to 45°, the separate groups having the following corrections:—

Zone.	Correction.
10°—30°	·016
30°—40°	·006
40°—45°	—·011

Having obtained these differences, it is evidently immaterial which zone is taken as standard; if we adopt the zone 10° to 30°, the above differences become, neglecting the third place of decimals:

Zone.	Correction.
10°–30°	·00 sec.
30°–40°	–·01 "
40°–45°	–·03 "

These were adopted as the definitive corrections to the quantity $\Delta T + m$. It may be remarked here, that if the clock stars observed had each night been uniformly distributed in declination, no effect would result from the application of such corrections except the addition of a constant to the observed right ascensions; since this was not the case, it is necessary to apply the above corrections in order that the right ascensions observed on different nights may be referred to the same zone of fundamental stars, as nearly as may be; this zone is in the present instance 10° to 30°. In view of the sudden change indicated in the correction between the zones 30° to 40° and 40° to 45°, a careful examination was made to decide whether or not it occurred exactly at 40°; this was found to be the case, as nearly as could be determined. The cause of these differences might conceivably lie either in errors in the tabular places of the stars, or in some systematic instrumental effect such as flexure. In the absence of strong evidence to the contrary the presumption would of course be strongly in favor of the latter hypothesis; though in that event it is difficult to understand why the results in the two positions of the instrument should agree as closely as they do.

After the application of the above systematic corrections to the separate observed values of $\Delta T + m$, the mean of the latter was taken for each night's observations, thus giving a value for $\Delta T + m$ for the mean epoch of the observations. For the computation of clock-rates, the above mean values were diminished in each case by the quantity m, as deduced from the ordinary formula $m = b \sec \varphi - n \tan \varphi$, φ being the latitude* and b and n the level error and the polar deviation respectively. The resulting values of ΔT were tabulated for the whole year, and by combining successive determinations by the same observer in the same position of the instrument, a series of clock-rates was obtained for as many epochs as possible. Where these showed continuity over a considerable period, as was the case for the greater part of the year, a formula was derived by least squares on the assumption that the clock-rate changed uniformly during the period considered; the values resulting from the formula were then compared with the observed values, and where they showed reasonable agreement the former were adopted. The adopted values of daily rate in seconds for the period covered by the observations are as follows, T being reckoned in days:—

Mar. 17—Apr. 14	Zero
Apr. 21—Aug. 8	·0882+·0004 (T–June 17)
Aug. 11—Sep. 2	·2614+·0087 (T–Aug. 23)
Sep. 7—Sep. 10	·300
Sep. 13—Sep. 26	–·164
Sep. 27—Sep. 30	Zero
Oct. 3	·120
Oct. 7—Nov. 9	·370+·0027 (T–Oct. 23)
Nov. 20—Nov. 27	–·052
Dec. 5—Dec. 12	·720
Dec. 21	·180

The adopted values of $\Delta T + m$, including the effect of clock-rate, are given in the eleventh column. Where a clock-rate other than zero was adopted, both the value of $\Delta T + m$ for the mean epoch of the observations, and the adopted hourly rate, are given in the notes.

* $\varphi = 45° 23' 38''$

The twelfth and last column of the tables, which is formed by the addition of the eighth and eleventh columns, gives the deduced apparent right ascension for the date, of all except the azimuth stars.

Ledgers of Mean R.A. 1910.0—In the tables with this heading the observations on each star, reduced to mean place for the beginning of the fictitious year, are arranged chronologically, the date, clamp and observer being noted for each observation. The reductions to mean place were effected in the following way. For all stars whose apparent places are given in the Berlin Jahrbuch, the Star-List of the American Ephemeris, or the Nautical Almanac, the difference between the tabular apparent place for the date and the tabular mean place (taken to the nearest second decimal place) was applied; since in these ephemerides the mean right ascensions are given to three decimal places, and the third place used in the computations for apparent right ascension, though in the latter only two decimal places are retained, there remains a further correction necessary in the third decimal place, depending on the third decimal place of the tabular mean right ascension; this has been applied as the correction Δ_1 to the mean of the observed positions. The same applies to stars bracketed in the Berlin Jahrbuch, which do not occur in the other ephemerides, since for these stars the apparent places were computed in conformity with the usage of that catalogue. In the case of a few additional stars, contained in the Connaissance des Temps, but not in the other ephemerides, the reduction to mean place was computed by taking the difference between the tabular mean and apparent places, which in that catalogue are both given to the second decimal place only; in this case the correction Δ_1 is not applied. For all other stars the reduction to mean place (exclusive of proper motion) was computed to the nearest second decimal place for ten day intervals, all short-period terms being omitted, and interpolated for the dates required.

A thorough preliminary examination of the results was made for systematic effects depending on bisection error, on personal error of other kinds, and on the position of the instrument. For the effect of bisection error, means were taken separately of the n and r observations for each observer in each clamp, and the quantities $(r - n) \cos \delta$ tabulated, the sign being changed for stars observed north of the zenith at upper culmination. The resulting values of bisection error were .001 sec. for N and .003 sec. for S, the indicated error of setting being to the left in both cases. If we allow for the correction of .023 sec. applied to the observations of S in the computation, this result agrees with that deduced in Appendix A, as should be the case. As the results for separate stars showed considerable variation, it was not considered that these quantities were much, if any, in excess of their probable error: no correction was therefore applied to the right ascensions for this effect.

To investigate for other personal effects, means were taken separately for the observations of N and S in each clamp, and the results grouped in zones of declination 5° in width; the differences in the various zones, in the sense N − S, with their respective weights, are as follows:—

10°–15°	·008 sec	weight	107
15°–20°	·002 "	"	142
20°–25°	·015 "	"	87
25°–30°	·005 "	"	168
30°–35°	·001 "	"	161
35°–40°	·004 "	"	272
40°–45°	·002 "	"	239
45°–50°	·008 "	"	130
50°–55°	·006 "	"	71
55°–60°	·002 "	"	133
60°–65°	·080 "	"	2
65°–70°	·018 "	"	6
70°–75°	·004 "	"	170
75°–80°	·016 "	"	94
80°–	·157 "	"	6

These results were further weighted according to the cosine of the mean declination of each zone, and combined to deduce a formula for expressing the difference. Several simple formulae were tried; the one which appeared best to satisfy all the observations was N − S = .0032 sec δ; this was accordingly adopted. It is conceivable, however, that a constant correction for all declinations might better have been used; the value derived from the weighted mean of the south stars is .0044 sec.; that from the north stars .0066 sec.; from all stars .0018 sec. It is difficult to understand how any such difference could arise in the case of stars of the same declination as the clock-stars; as shown by the above table, however, it appears to be persistent for all declinations; a correction was therefore applied.

Means were next taken separately of the observations in Clamp West and Clamp East, and the results grouped as before for zones of declination 5° in width; the mean differences, in the sense W − E, are as follows:—

10°–15°	−·006 sec	weight	115
15°–20°	·000 "	"	135
20°–25°	−·008 "	"	91
25°–30°	·002 "	"	169
30°–35°	·003 "	"	171
35°–40°	·002 "	"	263
40°–45°	·007 "	"	231
45°–50°	·005 "	"	130
50°–55°	·019 "	"	68
55°–60°	·021 "	"	143
60°–65°	−·050 "	"	1
65°–70°	·023 "	"	4
70°–75°	·020 "	"	163
75°–80°	·045 "	"	93
80°–	·023 "	"	8

The formula adopted to represent these differences was .0104 tan δ − .0048, which gives a fairly satisfactory representation over the whole range of declination.

As the standard of reference for both the systematic corrections considered above, the mean of an equal number of observations by each observer in each position of the instrument was taken; the corrections to be applied to the right ascensions are therefore as follows:—

Clamp West,	$\Delta\alpha = -\ .0052 \tan\delta + .0024$
Clamp East,	$\Delta\alpha = \ \ .0052 \tan\delta - .0024$
Observations by N,	$\Delta\alpha = -\ .0016 \sec\delta$
Observations by S,	$\Delta\alpha = \ \ .0016 \sec\delta$

These are incorporated in the correction Δ_2 in the tables; it is always small, seldom amounting to more than a very few units in the third place of decimals; its only effect is to refer all observations, as nearly as may be, to the same standard.

Mean Right Ascensions.—In the tables headed "Mean Right Ascensions of Stars Observed in 1910" the final results are collected. The first three columns require no explanation; the fourth contains the approximate declination, merely for convenience of reference. In the fifth column is given the mean right ascension as taken from the ledgers; in the case of stars marked with an asterisk no proper motion was applied in the reduction to mean place for the beginning of the year; for those marked † the reduction to mean place was obtained from one or other of the ephemerides based on Newcomb's Fundamental Catalogue; the proper motions are therefore in this case Newcomb's; all other stars were reduced with the proper motions of Auwers. The sixth column gives the fraction of the year corresponding to the mean epoch of the observations, the seventh the number of observations.

In the next four columns are given, in the case of those stars on which at least ten observations were obtained, the differences between the observed right ascensions and those given in the Berlin Jahrbuch, Boss's "List of 1059 Standard Stars," the Greenwich Nine Year Catalogue for 1900, and Newcomb's Fundamental Catalogue, respectively; the differences are, however, not given for those stars to which no proper motion was applied in the reduction to mean place.

Systematic Corrections.—The differences mentioned above were grouped according to declination, the zones being 5° in width except in the case of 45° to 51½° and 51½° to 60°; as the latitude of Greenwich is approximately 51½°, this was chosen as one of the division points. There were no stars between 60° and 70° on which as many as ten observations were obtained. The means for the different zones are given below, followed in each case by the weight in brackets:—

Zone.	O.−B.J.	O.−B.	O.−G.	O.−N.
10°−15°	·003(11)	·003(11)	·013(6)	−·007(11)
15°−20°	·002(10)	·004(10)	·008(7)	·002(11)
20°−25°	−·001(7)	·003(8)	·001(7)	·004(8)
25°−30°	−·002(12)	·008(13)	−·007(10)	−·004(12)
30°−35°	−·015(10)	−·011(10)	−·011(8)	−·014(15)
35°−40°	−·010(16)	−·005(15)	·002(9)	−·023(18)
40°−45°	−·028(18)	−·013(17)	−·012(6)	−·051(18)
45°−51½°	−·027(12)	−·012(12)	−·020(4)	−·057(11)
51½°−60°	−·040(20)	−·032(19)	−·065(7)	−·065(14)
70°−75°	−·035(6)	−·046(6)	−·089(4)	−·005(5)
75°−80°	−·046(2)	−·096(3)	−·135(1)	−·141(3)

Grouping several of the zones together, we get the following more condensed arrangement, which does not appear to sacrifice accuracy:—

Zone	O.−B.J.	O.−B.	O.−G.	O.−N.
10°−30°	·000(40)	·005(42)	·002(30)	−·002(42)
30°−40°	−·012(26)	−·007(25)	−·004(17)	−·019(33)
40°−51½°	−·028(30)	−·013(29)	−·015(10)	−·053(29)
51½°−60°	−·040(20)	−·032(19)	−·065(7)	−·065(14)
70°−80°	−·038(8)	−·062(9)	−·098(5)	−·056(8)

The following points in this comparison are of special interest:—

(1) The large change in O.−G. at the zenith of Greenwich; this may undoubtedly be set down as a zenith error in the Greenwich observations, due probably to bisection error or some allied effect. The same change is shown in the other catalogues to a less extent; as the Greenwich observations entered largely into the material from which they were compiled, a part of the Greenwich error (assuming that it also existed in previous Greenwich catalogues) may have persisted in them.

(2) The marked change at 40° in O.−B.J. and O.−N., together with its comparative absence in O.−B. and O.−G. The evidence is here divided, but on account of the fairly close agreement of the Ottawa observations in Clamp West and Clamp East it might perhaps be a fair inference that the error is in B.J. and N.

(3) The almost complete absence of any change in the differences at 45°, the approximate latitude of Ottawa; this may be taken as evidence of a satisfactory absence of any appreciable zenith error in the Ottawa observations; it may be remarked that the omission of the correction for bisection error in the observations of S would have caused a change in the differences of over .01 sec. at 45°.

(4) From the evidence of all four catalogues, it appears that the Ottawa right ascensions for stars of over 30° declination are too small; the corrections applicable to reduce them to the Berlin Jahrbuch system may be taken as the following:

10° − 30°	.000 sec.
30° − 40°	.012 "
40° − 51½°	.028 "
51½° − 80°	.039 "

A computation was also made, for stars below 40° declination, of differences of magnitude equation in the sense O.−B.J. and O.−B.; the above systematic corrections were first applied; the differences were not reduced to equatorial interval; the results were as follows:—

$$O. - B.J. = -.005\,(m-4)$$
$$O. - B. = .000\,(m-4)$$

As magnitude equation is supposed to have been eliminated from Boss, this may be taken as showing that the Ottawa observations are practically free from this effect. According to this, the magnitude equation of the Berlin Jahrbuch would be − .005 $(m-4)$ sec. for stars near the equator.

Field Work

During the summer of 1910 the longitudes of Winnipeg, Windsor and Sault Ste. Marie were determined from Ottawa, the observer at the two former stations being Mr. McDiarmid, at the last Mr. Jaques. In addition, the longitudes of six stations in the west were determined from Winnipeg, Mr. Jaques occupying the base station and Mr. McDiarmid the outside stations. The latitudes of all the above stations were also determined.

Longitude of Winnipeg.—Especial care was used in the determination of this station, which will be largely used as a primary base station for western Canada. For the telegraphic exchanges one of the transcontinental copper wires of the Canadian Pacific Telegraph Co. was used; the low resistance and self-inductance of this wire made it possible to dispense completely with repeaters, there being a direct wire from the Observatory to the observing hut at Winnipeg. This materially increased the accuracy of the exchanges; the time of transmission of signals was only .06 sec., and was remarkably constant throughout the series of exchanges. A series of observations for personal equation was made before Mr. McDiarmid's departure for Winnipeg in May; after the longitude observations were concluded he returned to Ottawa, and a further determination of personal equation was made in June.

For the Ottawa observations the meridian circle was used, the two observers S and N participating in the work. The stars used for forming clock-corrections were those of the Berlin Jahrbuch between 30° and 60° of declination, an equal number being usually observed north and south of the zenith; the work was planned in this way in order to eliminate bisection error, as at that time the reversing prism eye-piece had not been received. The computation was the same as that described in the discussion of right ascension observations above, up to the point of formation of "adopted $\Delta T + m$". In the formation of this quantity all Berlin

Jahrbuch stars from 30° to 60° of declination were used; on this account it was possible to use two nights (April 26 and June 23) which were not included in the right ascension computation on account of lack of clock-stars. For south stars the same corrections were applied to "apparent $\Delta T + m$" as in the right ascension computation; for north stars the corrections adopted were −.04 sec. for S and −.02 sec. for N; these were obtained in the same way as the former ones, but the computation included only the period actually covered by the observations involved, Mar. 17 to June 29. As the same corrections were applied to both longitude and personal equation observations, any error in the actual corrections applied would be eliminated from the longitude results.

Personal Equation.—Observations for personal equation were made, as stated above, both before and after the determination of the longitude of Winnipeg. In these observations the two field observers, Mr. McDiarmid and Mr. Jaques (designated hereafter by M and J), as well as the two meridian circle observers N and S took part; in some instances all four observers worked simultaneously, while sometimes only two or three were engaged. Further observations were made in the autumn by M, N and S, J being incapacitated by illness.

The observations of M were made on the eastern transit pier, those of J on the western one, these being respectively .025 sec. and .014 sec. east of the meridian circle. All the observations for personal equation are collected in Table I, the above corrections for longitude, as well as corrections for clock rate between the epochs of observations on the same night, having been first applied to the observations of M and J.

Now take the mean of observations by each meridian circle observer in each clamp as standard, putting the personal difference of clock-correction in the sense S−N equal to 2X, and the instrumental difference in the sense W−E equal to 2C; also let M_1 and M_2 represent the personal equations of M in the spring and autumn respectively.

Then if a standard observation be denoted by A, those of the various observers will be

S, Cl. E.	$A - C + X$
S, Cl. W.	$A + C + X$
N, Cl. E.	$A - C - X$
N, Cl. W.	$A + C - X$
M, spring	$A - M_1$
M, autumn	$A - M_2$
J	$A - J$

Hence from the figures in Table I. we obtain the series of observation equations:

$$
\begin{aligned}
&& s \\
A_1 + C + X &= 4.847 \\
A_1 - M_1 &= 4.823 \\
A_2 + C - X &= 4.951 \\
A_2 - M_1 &= 4.934 \\
\text{etc.}
\end{aligned}
$$

Combining the nights on which the same groups of observers were engaged, these observation equations become:

$$
\begin{aligned}
&& s \\
B_1 + C + X &= 3.991 \\
B_1 - M_1 &= 3.958
\end{aligned}
\quad \text{Weight } 4
$$

$$
\begin{aligned}
B_2 + C - X &= 2.303 \\
B_2 - M_1 &= 2.251
\end{aligned}
\quad \text{Weight } 2
$$

etc.

This combination evidently has no effect on the values deduced for C, X, M_1, M_2 and J (the values of A_1, A_2, etc., we are not particularly concerned with); it has the advantage of reducing the number of the normal equations, the reduction in this case being from 41 to 19.

Forming the normal equations, and solving for the quantities required, we obtain:

C	=	.057 sec.
X	=	.006 "
M_1	=	− .013 "
M_2	=	− .062 "
J	=	.021 "

The corrections applicable to clock-corrections obtained by the various observers are therefore:

S, Cl. E.	.051 sec.
S, Cl. W.	− .063 "
N, Cl. E.	.063 "
N, Cl. W.	− .051 "
M, spring	− .013 "
M, autumn	− .062 "
J	.021 "

For the Winnipeg longitude the value M_1 was adopted as the personal equation of Mr. McDiarmid; for other stations it was computed from the formula $M_1 - .010$ (T − June 1), T being expressed in months.

The most striking point in the above result is the large difference of clock-correction (.114 sec.) obtained on reversal of the instrument. Since the right ascensions obtained Clamp East and Clamp West agree fairly closely, this difference must apparently be due to an error in the adopted level, which would affect clock-corrections but not right ascensions; it could not arise from pivot errors, since these are undoubtedly small.*

It is possible to compute what the observed error in clock-correction due to an error in adopted level should amount to, without knowing the error in level, by comparing the differences in observed azimuth on reversal of the instrument. These, as well as the observed differences of level, are tabulated below under the headings Δa and Δb respectively, the differences being taken in the sense Clamp E. − Clamp W. The intervals between the observations are given in each case; arbitrary weights depending on these intervals have been applied:

Date.	Δa	Δb	Interval.	Weight.
	sec.	sec.	days	
Apr. 2—3	·072	·174	1	1
" 21—22	·055	·148	1	1
May 15—16	·129	·118	1	1
" 21—26	·036	·130	5	¼
June 9—10	·113	·144	1	1
" 15—18	·050	·146	3	½
" 25—28	·038	·169	3	½
July 19—26	·109	·143	7	¼
Aug. 12—19	·074	·164	7	¼
Sep. 15—16	·106	·164	1	1
Oct. 11—12	·103	·199	1	1
Nov. 9—20	−·058	·101	11	¼
Weighted means	·083	·155		

* Report of Chief Astronomer, 1910, p. 407.

This establishes the fact that there is a systematic change in observed azimuth on reversal. Now assume a correction ∂b to the observed level error in Clamp East, and $-\partial b$ in Clamp West. Then since $a = b \tan \varphi - n \sec \varphi$, the letters employed having their usual significance, and since n is measured independently of the observed level, we have

$$\partial a_E = \partial b \tan \varphi$$
$$\partial a_W = -\partial b \tan \varphi$$

From these we obtain

$$\Delta a = \partial a_W - \partial a_E = -2\,\partial b \tan \varphi.$$

Hence, using the above observed mean value of Δa, we have

$$\partial b = -.041 \text{ sec.}$$

Similarly, from the formula $m = b \sec \varphi - n \tan \varphi$ we have for Clamp East

$$\partial m = \partial b \sec \varphi$$
or $$\partial(\Delta T) = -\partial b \sec \varphi = .058 \text{ sec.}$$

The close agreement of this result with that derived above (.057 sec) from the actual personal equation observations is remarkable; it is evident, therefore, that the observed difference in clock-correction might be fully accounted for by a systematic error in the adopted levels. If this is the case it must apparently be caused by some flexure effect which follows different laws when the telescope is pointed above and below the horizon.

Time Service.

The time service has been continued practically unchanged since my last report. Time signals are automatically sent out daily (Sundays excepted) to the Great North Western Telegraph Co., and the time ball on Parliament Hill is dropped daily by the signal clock. Mean and sidereal time are also given by telephone at any time to those requiring them; frequently the clockbeats are transmitted over the telephone line; the number of requests for time has become very large.

The usual amount of routine work has been done in connection with the maintenance of the time service and in testing of chronometers, watches, aneroid barometers, etc. The clock system in the Government Buildings has been in operation as usual; only two clocks have been added, a seconds dial and a minute dial in the residence of the Director. The total number of clocks in operation is now as follows:—

Minute Dials	283
Seconds Dials	6
Tower Clocks	2
Program Clock	1
Secondary Master-Clocks	8
Primary Clocks	4
Total	304

Time signals were exchanged with the Meteorological Observatory in Toronto on one occasion. The Toronto signals as received here were apparently about .1 sec. slow, and the Ottawa signals as received at Toronto were apparently about .2 sec. slow. Hence the Toronto clock was probably about .05 sec. faster than ours.

I have the honour to be, sir,

Your obedient servant,

R. M. STEWART.

APPENDIX A.

PERSONAL ERRORS OF BISECTION IN MERIDIAN CIRCLE WORK.

D. B. Nugent, M. A.

In determining the time of transit of a star over the same meridian, it has been found that the times obtained by two observers differ by a small but constant quantity. One observer, perhaps, acquires the habit of setting his wires always to the left of the star-image regardless of the direction of apparent motion of the star, while the other sets always to the right. In the former case the observer would observe the transits of stars north of the zenith at upper culmination too late and those south of the zenith too soon, and in the case of the latter it would be the reverse. This error of setting always to the left, or to the right, of the true setting is the personal error of bisection.

The object of this paper is to determine the magnitude of these errors in the case of the two observers—R. M. Stewart and D. B. Nugent—who are engaged in transit observations with the Meridian Circle at the Dominion Observatory. In order to do this, certain stars, varying from 10° to 80° in declination, were selected from our observing list and grouped in pairs according to their right ascension and their declination. In most cases the stars of a pair did not differ by more than 10^m in right ascension, and in no case did the difference exceed 30^m, while the difference in declination was always less than 5°. By using a reversing eye-piece, which consists of a glass prism mounted in front of an ordinary eye-piece, the position of the star-image can be turned through 180° by rotating the prism through 90°, and thus the apparent motion of a star across the field of the telescope reversed. If the star, the eye-piece being normal, crossed the meridian from west to east, then on turning the prism through 90° it would appear to cross from east to west. Each night the pairs were observed, one star was taken reversed, the same star being reversed on alternate nights. By comparing the observations on two successive nights the difference between a reversed and a normal observation was obtained.

The apparent right ascension of each star was determined for every night it was observed by using the following equation:

$$\alpha = \Delta T + T + c \sec \delta + m + n \tan \delta$$

where α = the apparent right ascension,
ΔT = the clock correction,
T = the clock time of transit of star;

$c \sec \delta$, m and $n \tan \delta$ are corrections depending on the collimation, level and azimuth of the instrument.

The clock correction $\bar{\Delta}T$ used was that given by 3 or 4 stars whose declinations were not more than 10 degrees greater or less than the pairs to be compared and whose right ascensions were not greater nor less by more than an hour. The m and n were determined from all the stars observed on that night. The difference $\Delta\alpha$ between the value of α thus obtained and α_0, that given by the catalogues, is a measure of the error. The value of $\Delta\alpha$ was found for a reversed and a normal observation and the difference $(r-n)$ was twice the error of bisection. For the sake of comparison these values were all expressed in equatorial interval.

An example of the computation follows:—

Stars.	Date.	ΔT	ΔT	Obs.	T	α	α_0	$\Delta\alpha$
		s	s		s	s	s	s
823	....	14·07	....	....	....	....	....	....
831	....	14·09	14·10	....	....	....	....	....
852	Sept. 28, 1910	14·13	....	....	....	....	....	....
833}	....	....	....	r	2·52	16·49	16·54	−·05
835}	....	....	....	n	47·61	61·58	61·58	·00
823	....	14·12	....	....	....	....	....	....
831	....	14·06	14·08	....	....	....	....	....
852	Sept. 30......	14·07	....	....	....	....	....	....
833}	....	....	....	n	2·57	16·54	16·52	·02
835}	....	....	....	r	47·62	61·59	61·55	·04
		$r-n$	$\cos\delta$		$(r-n)\cos\delta$	$\frac{1}{2}(r-n)\cos\delta$		
833	....	−·07	·841		−·059	−·029		
835	....	·04	·841		·034	·017		

The value of $(r-n)\cos\delta$ was found for each star, the sign being changed for stars north of the zenith, and was weighted according to the number of observations on each and the most probable value obtained from them.

My personal error obtained from 118 $(r-n)$ observations on 48 stars is .0013 sec., weight 118, and that of R. M. Stewart who had 138 $(r-n)$ observations on 70 stars is .0260 sec., weight 138. In my case the value is so small, and quite within the range of accidental errors, that my error of bisection may be taken as zero. In Mr. Stewart's case, however, we see that he has an error of bisection and that he sets his wires behind the star when the transit is north of the zenith and in advance of the star when the transit is to the south.

The results were examined to see if the error in any way depended on the declination of the star. To do this the stars were arranged in groups for every 5 degrees of declination and weighted according to the number of observations in each.

The following tables will show these values:

D. B. Nugent.			R. M. Stewart.		
Declination.	Error.	Weight.	Declination.	Error.	Weight.
10° to 15°.............	·006	12	10° to 15°..........	·016	8
15 " 20.............	−·008	7	15 " 20	·027	5
20 " 25	·003	13	20 " 25	·035	9
25 " 30	·002	4	25 " 30	·021	6
30 " 35	−·008	20	30 " 35	·043	10
35 " 40	·010	21	35 " 40	·022	30
40 " 45	·011	12	40 " 45	·025	14
50 " 55	−·003	6	45 " 50	·031	11
55 " 60	·002	9	50 " 55	·030	5
70 " 75	·001	14	55 " 60	·010	8
			70 " 75	·028	24
			75 " 80	·027	8
	·0016	118		·0262	138

In neither case do we see any systematic change depending on the difference in declination. The difference between the error of any group and the mean error is so small that I think we may take it to be within the limits of accidental errors.

The stars were next grouped according to their magnitudes, the difference between the smallest and the greatest of any group being 0.5 of a magnitude. No relation between the error and the magnitude of the star was established.

D. B. Nugent.			R. M. Stewart.		
Magnitude.	Error.	Weight.	Magnitude.	Error.	Weight.
	s.			s.	
2 to 2·5	— ·005	9	1	·019	1
3 " 3·5	— ·016	5	2 to 2·5	·021	11
3·5 " 4	·006	18	3 " 3·5	·015	8
4 " 4·5	·011	15	3·5 4	·028	13
4·5 " 5	·014	20	4 " 4·5	·030	17
5 " 5·5	— ·005	16	4·5 " 5	·023	20
5·5 " 6	— ·014	16	5 " 5·5	·026	27
6 " 6·5	·004	14	5·5 " 6	·029	23
6·5 " 7	·012	1	6 " 6·5	·028	17
7·2	— ·014	4	7·2	·009	1
	— ·0007	118		·0227	138

For stars over 80° declination, whose motion is slow compared with one at the equator, the method of observation was changed, a reversed and a normal observation being obtained of the same transit instead of taking the whole transit normally one night and reversed the next as was the case with those we have considered.

In following the star across the field of the instrument twenty settings are recorded, which are arranged in four groups of five settings, two groups being placed symmetrically on each side of the line of collimation. With this arrangement the first and the last group may be observed with the eye-piece normal and the second and the third with it reversed, or vice-versa, thus giving the time of transit obtained with the star moving in opposite directions. The difference between a normal and a reversed observation, changing the sign for stars at lower culmination, was taken as twice the error of bisection and for comparison these were reduced to the equatorial interval.

My error, determined from 100 observations on 16 stars, is .0025 sec., which may be considered as zero; and that of Mr. Stewart, determined from 146 observations on 19 stars, .0162 sec., a value slightly smaller than in the case of stars from 10° to 80° declination.

As in the former case the results were examined to see if there were any changes depending on the declination or the magnitude. The error was also determined separately for the stars observed at upper culmination and for those observed at lower. The changes were so small in all four cases for both observers that they were probably due to accidental errors. The following table will show these values for the two observers:—

D. B. NUGENT.			R. M. STEWART.		
Declination.	Error.	Weight.	Declination.	Error.	Weight.
	s.			s.	
80° to 85°	·0013	59	80° to 85°	·0178	71
85 " 90	·0041	41	85 " 90	·0146	75
Magnitudes.			Magnitudes.		
4 to 4·5	·0018	24	2 to 2·5	·0074	8
5 " 5·5	·0007	38	4 " 4·5	·0163	16
5·5 " 6	·0034	13	4·5 " 5	·0154	20
6 " 6·5	·0042	13	5 " 5·5	·0211	40
7 " 7·5	·0062	12	5·5 " 6	·0153	29
			6 " 6·5	·0110	11
			6·5 " 7	·0143	9
			7 " 7·5	·0147	13
Stars at Upper Culmination	·0020	62	Stars at Upper Culmination	·0177	67
Stars at Lower Culmination	·0032	38	Stars at Lower Culmination	·0148	79

The results obtained from the whole investigation may be summarized as follows:—

(*a*) That D. B. Nugent has no personal error of bisection.

(*b*) That R. M. Stewart has an error, always setting the wires to the left of the star image.

(*c*) That in neither case does the error depend upon the magnitude of the star observed or whether it is observed at upper or at lower culmination.

(*d*) That for R. M. Stewart there is a small difference between the value obtained from stars under 80° and that from stars over 80° in declination, but there does not appear to have been any systematic change in either group depending on the declination.

TABLE I.

OBSERVATIONS FOR PERSONAL EQUATION.

(Corrected for clock-rate and difference of longitude).

Date.		Sidereal Time.	Clamp (Mer. Circle)	Clock-correction.			
				S	N	M	J
1910		h. m.		s.	s.	s.	s.
Mar.	17......	9 20	W	4·847	....	4·823	....
"	18......	9 00	W	....	4·951	4·934	....
"	26......	11 20	W	4·474	....	4·439	....
Apr.	2......	11 00	W	3·882	....	3·820	3·778
"	3	10 40	E	3·797	....	3·904	....
"	8......	12 50	E	....	−14·803	−14·697	−14·732
"	10......	10 15	E	−14·823	....	−14·712	....
"	11......	10 20	E	....	−16·705	−16·719	−16·706
"	12......	12 50	E	....	−16·571	....	−16·606
"	13......	10 40	E	− 4·649	....	− 4·592	− 4·673
"	14......	10 20	E	−20·905	....	−20·884	−20·932
"	21......	10 20	E	....	− 1·613	− 1·576	− 1·618
"	22......	10 20	W	....	− 1·511	− 1·495	− 1·534
"	25......	11 15	W	− 1·217	....	....	− 1·298
"	26......	9 45	W	....	− 1·085	....	− 1·160
"	27......	12 45	W	− 1·029	....	− 1·056	− 1·074
"	28......	10 15	W	....	− ·898	− ·941	− ·979
"	30......	11 50	W	− ·834	....	− ·900	− ·952
May	3......	11 45	W	....	− ·664	....	− ·677
"	5......	13 05	W	− ·320	....	− ·488	− ·424
"	6......	13 45	W	....	− ·345	− ·433	....
"	7......	12 50	W	− ·286	....	− ·436	− ·442
June	13......	15 10	E	2·497	2·487	2·539	2·545
"	15......	15 10	E	2·679	2·687	2·791	2·785
"	18......	15 10	W	3·078	3·057	3·051	....
"	19......	15 10	W	3·170	3·110	3·107	....
"	23......	16 10	W	3·269	....	3·232	....
"	25......	16 10	W	3·374	....	3·337	....
"	28......	16 05	E	3·528	....	3·660	....
"	29......	16 05	E	3·673	....	3·785	....
Oct.	19......	21 45	E	....	18·965	19·132	....
"	20......	23 10	E	19·404	....	19·524	....
"	21......	23 25	E	19·754	....	19·859	....
"	26......	21 35	E	....	21·880	21·968	....
Nov.	2......	23 50	E	....	24·790	24·872	....
"	9......	23 20	E	....	27·605	27·752	....

TABLE II.

OBSERVED VALUES OF COLLIMATION AND LEVEL.

Date.	Clamp.	Observer.	Time.	Collimation Line.	Time.	Vertical Line.	Temp. (Cent.)	Adopted Coll.	Adopted Level.
1910			h. m.	r	h. m.	r	°	s.	s.
Mar. 11.....	W	S	9 25	9·5932	11 05	9·6106	.....	.....	.....
" 16.....	E	S	.....	9·6080	.....	9·5426	.....	.....	.....
" 17.....	W	S	8 30	9·6043	8 00	9·6438	.....	—·054	·109
	W	S	10 25	9·6055	11 05	9·6336	.....	.....	.....
" 18.....	W	N	6 55	9·5944	7 20	9·6255	.....	—·018	·103
	W	N	11 05	9·5926	11 25	9·6256	.....	.....	.....
	W	N	23 15	9·5950	22 45	9·6304	.....	.....	.....
" 19.....	W	S	9 40	9·5900	9 55	9·6276	—0·2	.....	.....
" 20.....	W	S	2 20	9·5954	1 50	9·6273	2·8	.....	.....
	W	S	8 00	9·5930	8 20	9·6242	2·8	.....	.....
" 22.....	W	N	4 00	9·5950	4 20	9·6267	.....	.....	.....
	W	CS	23 30	9·6003	.....	9·6304		.....	.....
" 23.....	W	CS	23 30	9·6069	23 40	9·6356	4·7	.....	.....
" 24.....	W	CS	23 20	9·6094	.....	9·6310	9·5	.....	.....
" 25.....	W	S	4 15	9·6087	4 30	9·6279	9·2	.....	.....
	W	CS	23 30	9·6026	.....	9·6314	6·8	.....	.....
" 26.....	W	S	9 20	9·6095	9 35	9·6303	6·8	—·081	·069
	W	S	11 50	9·6167	12 25	9·6388	3·8	.....	.....
" 27.....	W	S	1 45	9·6080	2 00	9·6358	6·9	.....	.....
" 28.....	W	S	2 20	9·6004	2 55	9·6482	13·0	.....	.....
	W	CS	7 25	9·6107	7 15	9·6359	13·2	.....	.....
	W	CS	13 30	9·6166	13 45	9·6386	8·1	.....	.....
	W	N	23 15	9·6118	23 30	9·6389	10·8	.....	.....
" 29.....	W	CS	23 05	9·6174	23 30	9·6382	10·5	.....	.....
Apr. 1.....	W	N	6 35	9·6204	6 50	9·6332	10·2	.....	.....
" 2.....	W	S	8 05	9·6267	8 20	9·6410	10·0	—·091	·038
	W	S	12 30	9·6313	12 00	9·6406	5·8	.....	.....
" 3.....	W	S	6 20	9·6222	6 55	9·6501	10·2	.....	.....
	E	S	8 35	9·6212	8 15	9·5565	9·6	·075	·212
	E	S	11 25	9·6264	11 10	9·5593	6·0	.....	.....
" 4.....	E	N	2 25	9·6247	2 45	9·5556	9·8	.....	.....
" 5.....	E	N	3 05	9·6185	3 20	9·5479	15·4	.....	.....
	E	CS	9 00	9·6209	.....	9·5481	15·3	.....	.....
	E	CS	11 30	9·6248	11 45	9·5568	14·7	.....	.....
" 6.....	E	N	2 50	9·6204	3 20	9·5604	14·4	.....	.....
	E	S	10 20	9·6297	11 40	9·5615	11·0	.....	.....
" 8.....	E	N	2 45	9·6340	3 00	9·5372	6·0	.....	.....
	E	N	10 10	9·6394	10 20	9·5380	5·8	·108	·306
	E	N	13 25	9·6289	13 35	9·5403		.....	.....
	E	CS	23 45	9·6274	24 00	9·5407	5·6	.....	.....
" 10.....	E	S	7 05	9·6310	7 25	9·5400	6·7	·098	·286
	E	S	10 35	9·6312	10 50	9·5443	4·0	.....	.....
" 11.....	E	N	3 50	9·6316	4 05	9·5355	7·7	.....	.....
	E	N	7 00	9·6276	7 10	9·5391	5·9	·092	·280
	E	N	10 30	9·6308	10 45	9·5452	2·8	.....	.....
" 12.....	E	N	10 05	9·6355	10 15	9·5430	2·2	·113	·306
	E	N	12 30	9·6362	12 40	9·5385	2·5	.....	.....
13.....	E	S	7 55	9·6311	8 15	9·5362	6·7	·089	·290
	E	S	10 15	9·6257	10 30	9·5402	6·0	.....	.....
" 14.....	E	S	7 15	9·6250	7 30	9·5459	9·3	·082	·253
	E	S	10 15	9·6275	10 30	9·5493	8·5	.....	.....
" 19.....	E	N	2 45	9·6233	3 00	9·5442	13·2	.....	.....
" 20.....	E	N	3 40	9·6308	4 00	9·5467	12·6	.....	.....

TABLE II.

OBSERVED VALUES OF COLLIMATION AND LEVEL—(Continued).

Date.	Clamp.	Observer.	Time.	Collimation Line.	Time.	Vertical Line.	Temp. (Cent.)	Adopted Coll.	Adopted Level.
1910			h. m.	r	h. m.	r	°	s.	s.
Apr. 21	E	N	6 45	9·6292	7 00	9·5481	12·5	·097	·257
	E	N	9 45	9·6322	10 00	9·5534	11·3		
	E	N	23 15	9·6300	23 40	9·5562	12·8		
" 22	W	N	1 10	9·6447	1 30	9·6779	14·0		
	W	N	6 35	9·6385	6 50	9·6781	15·4	—·129	·109
	W	N	9 45	9·6426	10 00	9·6709	12·6		
" 25	W	S	7 35	9·6409	7 55	9·6688	15·1	—·141	·077
	W	S	9 50	9·6477	10 15	9·6677	13·9		
" 26	W	N	6 35	9·6486	6 50	9·6623	15·8		
27	W	S	8 30	9·6482	8 50	9·6813	10·8	—·162	·102
	W	S	12 00	9·6536	12 25	9·6839	3·3		
" 28	W	N	6 35	9·6427	6 50	9·6834	8·3	—·141	·134
	W	N	9 30	9·6462	9 45	9·6885	6·3		
" 30	W	S	7 00	9·6496	7 15	9·6832	10·5	—·162	·105
	W	S	9 55	9·6521	10 10	9·6811	9·4		
May 3	W	N	6 45	9·6402	7 20	9·6813	9·0	—·139	·123
	W	N	10 15	9·6472	10 30	9·6828	7·6		
" 5	W	S	8 10	9·6486	8 25	9·6810	11·3	—·167	·105
	W	S	11 50	9·6562	12 05	9·6893	7·9		
" 6	W	N	9 20	9·6465	9 35	9·6779	12·4	—·160	·095
	W	N	12 00	9·6544	12 15	9·6821			
" 7	W	S	7 40	9·6486	7 55	9·6722	16·4	—·174	·063
	W	S	12 25	9·6597	12 40	9·6763	11·8		
" 10	W	N	6 45	9·6480	7 00	9·6776	14·0	—·162	·089
	W	N	10 45	9·6540	11 00	9·6800	11·2		
" 11	W	S	7 10	9·6582	6 55	9·6851	12·1	—·196	·082
	W	S	12 30	9·6647	12 45	9·6890	8·4		
" 12	W	N	7 10	9·6551	7 25	9·6811	11·2	—·176	·085
	W	N	11 00	9·6556	11 15	9·6825	5·2		
" 14	W	N	9 40	9·6708	9 55	9·6824	9·3		
" 15	W	S	7 10	9·6583	7 30	9·6806	13·4	·000	·065
	W	S	12 30	9·6620	12 45	9·6799	8·7		
" 16	E	N	7 15	9·6514	7 30	9·5961	15·6	·016	·183
	E	N	11 30	9·6584	11 45	9·6000	11·8		
" 17	E	S	7 55	9·6600	8 15	9·6019	17·8	—·003	·178
	E	S	10 20	9·6582	11 10	9·6054	16·0		
" 18	E	N	6 45	9·6568	7 00	9·5998	11·7		
" 19	E	S	8 25	9·6588	8 40	9·5987	13·3	·004	·199
	E	S	13 10	9·6634	13 30	9·5995	8·8		
" 21	E	N	7 45	9·6512	8 00	9·5909	15·3	·015	·193
	E	N	11 15	9·6593	11 30	9·5997	13·4		
" 22	E	S	9 20	9·6594	9 30	9·5976	16·7		
" 26	W	N	7 45	9·6625	8 00	9·6805	15·7	—·014	·063
	W	N	12 45	9·6662	13 15	9·6872	10·5		
" 27	W	S	8 35	9·6608	8 55	9·6807	15·0	—·011	·065
	W	S	13 35	9·6658	13 50	9·6862	11·4		
" 28	W	N	7 45	9·6599	8 00	9·6797	19·4	—·002	·060
	W	N	11 50	9·6616	12 05	9·6792	15·6		
" 30	W	N	7 15	9·6574	7 30	9·6796	15·4		
June 2	W	S	8 30	9·6632	8 45	9·6816	15·2		
" 3	W	S	7 20	9·6644	7 30	9·6888	13·4	—·025	·084
	W	S	11 50	9·6712	12 05	9·6989	7·8		
" 4	W	S	7 50	9·6633	8 10	9·6851	13·5	—·017	·067
	W	S	12 50	9·6670	13 10	9·6869	9·1		
" 7	W	S	11 40	9·6647	11 50	9·6800	12·5	—·021	·048
	W	S	15 15	9·6685	15 30	9·6832	9·5		

TABLE II.

OBSERVED VALUES OF COLLIMATION AND LEVEL—(Continued).

Date.	Clamp.	Observer.	Time.	Collimation Line.	Time.	Vertical Line.	Temp. (Cent.)	Adopted Coll.	Adopted Level.
1910			h. m.	r	h. m.	r	°	s.	s.
June 8.....	W	N	7 00	9·6612	7 15	9·6805	16·2	—·012	·054
	W	N	11 15	9·6664	11 30	9·6808	12·5		
" 9.....	W	S	7 40	9·6647	7 50	9·6727	17·6	—·021	·027
	W	S	12 00	9·6683	12 15	9·6772	13·2		
	W	S	22 35	9·6604					
	E	S	23 50	9·6637					
" 10.....	E	N	8 30	9·6626	8 45	9·6077	18·4	·003	·171
	E	N	11 10	9·6594	11 20	9·6077	15·6		
" 13.....	E	N	7 00	9·6588	7 20	9·6061	22·2	·002	·172
	E	N	12 10	9·6625	12 25	9·6082	18·5		
" 14.....	E	S	7 25	9·6669	7 45	9·6156	24·2		
" 15.....	E	S	7 15	9·6657	7 35	9·6146	23·9	·028	·168
	E	S	12 05	9·6715	12 15	9·6179	19·0		
" 17.....	E	N	3 00	9·6662	3 15	9·6125			
	W	N	3 50	9·6673	4 05	9·6715			
" 18.....	W	N	7 15	9·6638	7 30	9·6699	23·8	—·020	·022
	W	N	11 15	9·6688	11 30	9·6765	20·4		
" 19.....	W	S	7 10	9·6659	7 25	9·6738	24·9	—·023	·022
	W	S	11 25	9·6687	11 40	9·6747	21·3		
" 23.....	W	S	6 55	9·6667	7 15	9·6698	23·9		
	W	S	12 25	9·6691	12 40	9·6744	17·8		
" 24.....	W	S	8 00	9·6666	8 20	9·6719	23·3		
" 25.....	W	S	7 40	9·6638	7 55	9·6644	25·3	—·020	·004
	W	S	12 15	9·6687	12 35	9·6704	19·9		
" 28.....	E	S	7 25	9·6702	7 40	9·6185	23·8	·038	·173
	E	S	11 55	9·6734	12 15	9·6177	17·6		
" 29.....	E	S	7 45	9·6707	7 55	9·6191	24·2	·035	·166
	E	S	11 55	9·6713	12 10	9·6199	20·6		
July 4.....	E	S	8 30	9·6721	8 45	9·6193	22·8	·042	·180
	E	S	12 05	9·6743	12 25	9·6153	19·0		
" 5.....	E	S	7 20	9·6707	7 35	9·6255	25·2	·032	·153
	E	S	11 50	9·6694	12 05	9·6193	19·1		
" 6.....	E	N	7 30	9·6731	7 45	9·6327	26·0	·038	·126
	E	N	10 30	9·6708	10 45	9·6329	23·0		
" 11.....	E	N	7 15	9·6709	7 45	9·6170	25·4	·037	·174
	E	N	10 35	9·6721	10 50	9·6178	22·2		
" 13.....	E	N	7 00	9·6703	7 15	9·6142	25·2	·034	·173
	E	N	10 50	9·6707	11 05	9·6194	21·2		
" 16.....	E	S	8 30	9·6739	8 50	9·6247	23·3	·047	·170
	E	S	13 05	9·6753	13 25	9·6188	16·4		
" 19.....	E	S	7 55	9·6721	8 10	9·6244	23·2	·040	·158
	E	S	12 30	9·6725	12 50	9·6220	17·8		
" 20.....	E	N	2 10	9·6730	2 25	9·6193	23·4		
	W	N	3 40	9·6715	4 00	9·6752			
" 25.....	W	N	8 40	9·6726	8 55	9·6765	23·2		
" 26.....	W	S	7 55	9·6719	8 10	9·6790	23·9	—·046	·015
	W	S	12 25	9·6769	12 45	9·6792	19·6		
" 28.....	W	N	9 30	9·6754	9 45	9·6788	23·0	—·060	·002
	W	N	12 30	9·6820	12 45	9·6800	15·0		
" 30.....	W	N	9 45	9·6747	10 00	9·6775	21·2	—·034	·024
	W	N	12 45	9·6662	13 00	9·6786	15·4		
Aug. 2.....	W	S	9 00	9·6723	9 15	9·6720	22·2	—·040	—·001
" 4.....	W	S	7 40	9·6734	7 55	9·6665	22·4		
" 7.....	W	S	7 50	9·6724	8 05	9·6705	21·5	—·040	—·001
	W	S	11 45	9·6726	12 00	9·6741	18·3		
" 8.....	W	N	8 15	9·6718	8 30	9·6709	21·5	—·043	—·005
	W	N	11 40	9·6748	11 55	9·6726	18·6		

TABLE II.

OBSERVED VALUES OF COLLIMATION AND LEVEL (Continued).

Date.	Clamp.	Observer.	Time.	Collimation Line.	Time.	Vertical Line.	Temp. (Cent.)	Adopted Coll.	Adopted Level.
1910			h. m.	r	h. m.	r	°	s.	s.
Aug. 9.....	W	S	7 45	9·6714	7 55	9·6674	23·4	....	....
" 11.....	W	S	7 25	9·6704	7 10	9·6808	22·7	—·041	·032
	W	S	12 20	9·6750	12 35	9·6848	18·2	....	....
" 12.....	W	N	7 05	9·6705	7 20	9·6804	24·3	—·042	·031
	W	N	11 15	9·6756	11 30	9·6852	19·0	....	....
" 18.....	E	S	11 35	9·6744	11 50	9·6180	18·6	....	....
	E	S	14 20	9·6731	14 40	9·6162	15·0	....	....
" 19.....	E	N	7 00	9·6703	7 15	9·6097	20·3	·035	·195
	E	N	9 50	9·6713	10 05	9·6105	16·1	....	....
" 20.....	E	S	8 00	9·6733	7 45	9·6103	20·9	·046	·210
	E	S	12 00	9·6754	12 20	9·6080	16·2	....	....
" 26.....	E	N	7 15	9·6771	7 30	9·5982	19·2	·047	·244
	E	N	10 15	9·6723	10 30	9·5994	14·0	....	....
" 29.....	E	N	7 00	9·6753	7 25	9·6019	20·0	·044	·227
	E	N	10 45	9·6718	11 00	9·6038	15·3	....	....
" 31.....	E	N	9 15	9·6723	9 30	9·6106	20·3	·043	·203
	E	N	12 05	9·6744	12 20	9·6097	15·8	....	....
Sept. 1.....	E	S	7 05	9·6775	7 15	9·6072	18·8	·056	·226
	E	S	12 25	9·6776	12 10	9·6071	14·6	....	....
" 2.....	E	N	7 30	9·6731	7 45	9·6015	18·4	·041	·219
	E	N	11 30	9·6726	11 45	9·6047	13·2	....	....
" 7.....	E	S	11 45	9·6751	11 30	9·6075	16·9	·053	·226
	E	S	16 55	9·6782	16 35	9·6049	12·0	....	....
" 8.....	E	CS	7 00	9·6779	....	9·6060	19·0	·055	·236
	E	S	12 10	9·6761	12 25	9·6014	17·8	....	....
" 9.....	E	N	7 30	9·6764	7 15	9·5988	16·5	·051	·250
	E	N	11 00	9·6753	11 15	9·5974	11·4	....	....
" 10.....	E	S	8 10	9·6750	8 00	9·5976	16·0	·056	·269
	E	S	12 50	9·6797	13 10	9·5901	12·1	....	....
" 13.....	E	S	7 05	9·6776	6 50	9·5968	15·0	·059	·265
	E	S	11 50	9·6792	12 10	9·5949	9·0	....	....
" 14.....	E	N	7 40	9·6710	7 20	9·5922	15·4	·035	·256
	E	N	11 15	9·6706	11 30	9·5900	11·3	....	....
" 15.....	E	S	7 35	9·6738	7 25	9·5918	16·2	·048	·269
	E	S	12 15	9·6761	12 30	9·5909	11·4	....	....
" 16.....	W	N	7 30	9·6721	7 15	9·7030	18·0	—·038	·105
	W	N	11 15	9·6717	11 30	9·7059	14·2	....	....
" 17.....	W	S	7 20	9·6739	7 10	9·7004	18·6	—·048	·088
	W	S	10 40	9·6757	10 55	9·7039	15·6	....	....
" 19.....	W	N	7 30	9·6707	7 15	9·7101	13·4	—·040	·124
	W	N	10 45	9·6739	11 00	9·7116	10·8	....	....
" 21.....	W	N	7 00	9·6699	....	9·7059	14·0	—·048	·102
	W	N	12 25	9·6802	12 45	9·7077	8·0	....	....
" 22.....	W	S	7 10	9·6745	7 00	9·7087	13·0	—·053	·119
	W	S	10 40	9·6782	11 10	9·7183	9·2	....	....
" 26.....	W	N	6 45	9·6708	7 00	9·7030	14·8	—·043	·097
	W	N	10 15	9·6762	10 30	9·7042	11·8	....	....
" 27.....	W	S	8 35	9·6705	8 20	9·6997	14·4	—·043	·105
	W	S	13 45	9·6764	14 05	9·7125	10·4	....	....
" 28.....	W	N	7 30	9·6698	7 00	9·7050	13·5	—·042	·111
	W	N	10 45	9·6761	11 00	9·7097	11·4	....	....
" 29.....	W	S	6·45	9·6722	6 35	9·7028	15·3	—·044	·114
	W	S	11 50	9·6752	12 05	9·7153	10·7	....	....
" 30.....	W	N	6 40	9·6720	6 20	9·7056	16·8	—·034	·118
	W	N	10 30	9·6691	10 45	9·7092	14·3	....	....

TABLE II.

OBSERVED VALUES OF COLLIMATION AND LEVEL (Concluded).

Date.	Clamp.	Observer.	Time.	Collimation Line.	Time.	Vertical Line.	Temp. (Cent.)	Adopted Coll.	Adopted Level.
1910			h. m.	r	h. m.	r	°	s.	s.
Oct. 2.....	W	S	8 25	9·6738	8 10	9·7204	11·4	....	....
" 3.....	W	N	7 30	9·6736	....	9·7115	13·2	—·045	·126
	W	N	10 50	9·6742	11 00	9·7147	11·4	....	....
" 7.....	W	N	6 40	9·6715	6 55	9·7381	13·3	—·046	·215
	W	N	10 45	9·6768	11 00	9·7439	9·4	....	....
" 10.....	W	N	6 30	9·6718	6 45	9·7291	11·9	—·048	·180
	W	N	10 40	9·6783	10 55	9·7330	9·7	....	....
" 11.....	W	S	6 25	9·6729	6 10	9·7200	14·6	—·049	·155
	W	S	10 30	9·6776	10 50	9·7270	11·2	....	....
" 12.....	E	N	6 45	9·6807	7 00	9·5721	8·8	·068	·354
	E	N	9 45	9·6817	10 05	9·5700	3·0	....	....
" 17.....	E	N	6 35	9·6731	6 50	9·5815	13·7	·041	·296
	E	N	10 30	9·6723	10 45	9·5799	11·2	....	....
" 18.....	E	S	6 35	9·6747	6 55	9·5862	13·0	·048	·297
	E	S	11 55	9·6752	12 10	9·5789	9·6	....	....
" 19.....	E	N	6 30	9·6729	6 15	9·5805	15·6	·036	·292
	E	N	9 30	9·6695	9 45	9·5800	14·5	....	....
" 20.....	E	S	7 00	9·6784	6 45	9·5818	10·3	·055	·305
	E	S	11 50	9·6761	12 15	9·5833	6·0	....	....
" 21.....	E	S	7 30	9·6799	7 15	9·5758	8·2	·062	·334
	E	S	11 55	9·6785	12 15	9·5747	4·7	....	....
" 26.....	E	N	7 00	9·6747	7 30	9·5742	6·0	·022	·308
	E	N	9 30	9·6592	9 50	9·5683	3·2	....	....
Nov. 2.....	E	N	7 00	9·6556	7 20	9·5661	6·6	·018	·279
	E	N	10 40	9·6756	10 55	9·5913	2·3	....	....
" 3.....	E	S	8 55	9·6781	8 35	9·5844	3·2	....	....
" 4.....	E	N	7 50	9·6742	7 30	9·5838	5·2	·049	·292
	E	N	9 55	9·6762	10 15	9·5849	3·8	....	....
" 8.....	E	S	7 00	9·6753	6 30	9·5846	1·2	·055	·294
	E	S	12 00	9·6792	12 25	9·5869	— 2·7	....	....
" 9.....	E	N	6 30	9·6719	6 05	9·5843	1·8	·041	·285
	E	N	10 05	9·6734	10 20	9·5839	— 1·0	....	....
" 17.....	E	N	7 00	9·6724	7 30	9·5793	— 1·3	....	....
20.....	W	S	5 40	9·6717	5 25	9·7288	— 1·0	—·038	·184
" 27.....	W	S	6 15	9·6707	6 35	9·7183	0·2	—·041	·149
	W	S	9 50	9·6745	10 10	9·7196	— 1·4	....	....
Dec. 3.....	W	S	4 35	9·6776	......	......	— 3·8	....	....
" 5.....	W	N	6 10	9·6829	6 30	9·7524	— 6·2	—·073	·222
	W	N	10 20	9·6828	10 40	9·7516	—10·0	....	....
" 6.....	W	S	4 35	9·6776	9 50	9·7032	— 7·5	....	....
" 8.....	W	S	5 00	9·6299	4 30	9·6837	— 6·0	·074	·184
	W	S	10 20	9·6443	10 45	9·7050	—10·3	....	....
" 9.....	W	N	6 55	9·6476	6 40	9·7093	—11·0	·022	·198
	W	N	10 05	9·6588	10 35	9·7205	—15·2	....	....
" 10.....	W	S	5 05	9·6467	4 30	9·7278	—11·8	·043	·249
	W	S	11 05	9·6748	11 20	9·7487	—14·2	—·048	....
" 12.....	W	N	7 00	9·6644	6 45	9·7632	—10·6	—·020	·319
	W	N	10 15	9·6682	10 30	9·7681	—11·0	....	....
" 16.....	W	N	6 45	9·6698	7 00	9·7686	—11·6	....	....
" 21.....	W	N	7 15	9·6617	7 00	9·7812	— 9·0	—·022	·378
	W	N	10 30	9·6721	10 50	9·7874	—13·0	....	....
" 25.....	W	S	4 20	9·6665	3 40	9·7799	— 8·8	....	....
	W	S	8 50	9·6735	......	......	—12·2	....	....
" 30.....	W	S	5 10	9·6646	7 45	9·7678	—10·0	....	....

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T + m$	Adopted $\Delta T + m$	App. R.A. from Observation
1910					h. m. s.	s.	s	s.	s.	s.	h. m. s.
Mar. 17	1	B.J. 320.......		S	8 27 00·12	−·054	00·44	05·02	4·58	4·54	8 27 04·98
	2	B.J. 323.......		"	32 34·10	(·456)	34·58	39·14	.....		32 39·12
	3	76 Draconis...	L.C.	"	48 59·99		56·96	01·73	4·77		....
	4	B.J. 335.......		"	52 59·36		59·76	04·35	.....		53 04·30
	5	B.J. 339.......		"	54 44·33		44·70	49·25	4·55		54 49·24
	6	B.J. 341.......		"	57 25·52		25·90	30·47	.....		57 30·44
	7	B.A.C. 3097...		"	9 00 44·72		45·04	.....	.....		9 00 49·58
	8	B.J. 346.......		"	07 51·59		51·98	56·57	4·59		07 56·52
	9	B.J. 349.......		"	13 11·13		11·44	15·99	4·55		13 15·98
	10	B.A.C. 7504...	L.C.	"	17 19·49		12·39	17·98	5·59		....
	11	1 H. Draconis		"	24 20·51		23·19	28·10	4·91		....
	12	B.J. 358.......		"	26 47·28		47·73	52·32	.....		26 52·27
	13	B.J. 360.......		"	28 39·21		39·51	44·02	4·51		28 44·05
	14	B.J. 368.......		"	44 32·97		33·60	38·18	.....		44 38·14
	15	B.J. 374.......		"	52 07·07		07·43	12·02	4·59		52 11·97
	16	B.J. 383.......		"	10 11 37·05		37·44	41·98	4·54		10 11 41·98
	17	30 H. Camel..		"	20 14·97		18·16	22·87	4·71		....
	18	B.J. 394.......		"	24 49·67		50·22	54·74	.....		24 54·76
	19	B.J. 398.......		"	29 19·54		20·11	24·71	.....		29 24·65
	20	B.J. 416.......		"	56 22·29		22·85	27·48	.....		56 27·39
Mar. 18	21	B.J. 296.......		N	7 41 37·94	−·018	38·24	42·86	4·62	4·61	7 41 42·85
	22	Groom. 1119..		"	8 08 49·86	(·477)	14·79	22·61	7·82		....
	23	B.J. 314.......		"	16 36·49		36·91	41·57	4·66		8 16 41·52
	24	B.J. 320.......		"	27 00·02		00·38	05·00	4·62		27 04·99
	25	B.J. 323.......		"	32 33·98		34·58	39·12	.....		32 39·19
	26	76 Draconis...	L.C.	"	49 00·32		57·05	01·83	4·78		....
	27	220 H[1]. Drac..	L.C.	"	51 33·56		30·95	35·75	4·80		....
	28	B.J. 339.......		"	54 44·09		44·50	49·24	4·74		54 49·11
	29	B.J. 341.......		"	57 25·31		25·80	30·46	.....		57 30·41
	30	B.A.C. 3097...		"	9 00 44·61		44·97	.....	.....		9 00 49·58
	31	B.J. 346.......		"	07 51·55		51·98	56·56	4·58		07 56·59
	32	B.J. 349.......		"	13 11·05		11·39	15·98	4·59		13 16·00
	33	1 H. Draconis.		"	24 20·13		23·36	28·03	4·67		....
	34	B.J. 358.......		"	26 47·15		47·73	52·31	.....		26 52·34
	35	B.J. 368.......		"	44 32·71		33·49	38·17	.....		44 38·10
	36	B.J. 374.......		"	52 06·99		07·39	12·02	4·63		52 12·00
	37	B.J. 383.......		"	10 11 36·89		37·31	41·97	4·66		10 11 41·92
	38	B.J. 386.......		"	16 54·80		55·21	59·84	4·63		16 59·82
	39	30 H. Camel..		"	20 14·54		18·38	22·83	4·45		....
	40	B.J. 390.......		"	22 37·42		37·76	42·39	4·63		22 42·37
	41	B.J. 394.......		"	24 49·35		50·04	54·74	.....		24 54·65
	42	B.J. 398.......		"	29 19·33		20·05	24 70	.....		29 24·66
Mar. 26	43	B.J. 383.......		S	10 11 37·46	−·081	37·78	41·91	4·13	4·14	10 11 41·92
	44	B.J. 386.......		"	16 55·37	(·421)	55·67	59·78	4·11		16 59·81
	45	30 H. Camel..		"	20 15·82		18·50	22·36	3·86		....
	46	B.J. 394.......		"	24 49·97		50·42	54·66	.....		24 54·56
	47	B.J. 398.......		"	29 19·93		20·40	24·63	.....		29 24·54
	48	37 Leo. Min...		"	33 36·46		36·66	.....	.....		33 40·80

Clamp West. Adopted clock-rate zero.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent ΔT + m	Adopted ΔT + m	App. R. A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Mar. 26	1	B.J. 407.......		S	10 40 48·77	−·081	48·96	53·11	4·15	4·14	10 40 53·10
	2	B.J. 412.......		"	48 13·94	(·421)	14·16	18·32	4·16		48 18·30
	3	47 Urs. Maj...		"	54 22·98		23·27	.....	.....		54 27·41
	4	B.J. 416.......		"	56 22·72		23·17	27·44	.....		56 27·31
	5	B.J. 420......		"	11 04 33·78		34·05	38·27	4·22		11 04 38·19
	6	B.J. 424.......		"	11 35·39		35·73	39·83	.....		11 39·87
	7	B.J. 425.......		"	13 34·38		34·59	38·67	4·08		13 38·73
	8	39 H. Cephei..	L.C.	"	27 21·09		14·79	18·04	3·25		....
	9	B.J. 441.......		"	41 15·62		15·93	20·15	.....		41 20·07
	10	B.J. 447.......		"	49 03·84		04·24	08·49	.....		49 08·38
	11	1 Can. Ven....		"	12 10 13·80		14·20	.....	.....		12 10 18·34
	12	B.J. 458.......		"	11 34·44		34·73	38·91	4·18		11 38·87
	13	Bradley 1672..		"	15 01·57		12·12	16·57	4·45		.....
	14	B.J. 461.......		"	21 22·33		22·59	26·76	4·17		21 26·73
	15	B.J. 467.......		"	25 43·58		44·08	48·13	.....		25 48·22
	16	B.J. 470.......		"	29 25·51		25·81	30·05	4·24		29 29·95
	17	32² H. Camel.		"	48 34·77		37·84	42·07	4·23		....
	18	43 H. Cephei..	L.C.	"	55 54·66		49·90	54·37	4·47		....
Apr. 2	19	B.A.C. 7504...	L.C.	S	9 17 23·45	−·091	17·67	22·08	4·41	3·50	....
	20	1 H. Draconis.		"	24 20·78	(·415)	22·92	26·65	3·73		....
	21	B.J. 358.......		"	26 48·10		48·44	52·04	.....		9 26 51·94
	22	B.J. 360.......		"	28 40·07		40·29	43·83	3·54		28 43·79
	23	B.J. 368.......		"	44 33·81		34·30	37·88	.....		44 37·80
	24	B.J. 374.......		"	52 08·05		08·33	11·86	3·53		52 11·83
	25	B.J. 383.......		"	10 11 38·12		38·41	41·84	3·43		10 11 41·91
	26	30 H. Camel..		"	20 15·62		18·16	21·66	3·50		....
	27	B.J. 398.......		"	29 20·51		20·95	24·53	.....		29 24·45
	28	37 Leo. Min...		"	33 37·10		37·29	.....	.....		33 40·79
	29	B.J. 420.......		"	11 04 34·38		34·64	38·23	3·59		11 04 38·14
	30	B.J. 424.......		"	11 35·96		36·27	39·80	.....		11 39·77
	31	B.J. 425.......		"	13 34·95		35·14	38·66	3·52		13 38·64
	32	39 H. Cephei..	L.C.	"	27 21·96		15·92	19·07	3·15		....
	33	B.J. 441.......		"	41 16·21		16·51	20·14	.....		41 20·01
	34	Groom. 1830..		"	47 45·62		45·86	.....	.....		47 49·36
	35	B.J. 467.......		"	12 25 44·23		44·70	48·17	.....		12 25 48·20
	36	B.J. 470.......		"	29 26·27		26·55	30·09	3·54		29 30·05
	37	B.J. 483.......		"	50 03·04		03·46	07·03	....		50 06·96
Apr. 3	38	B.J. 368.......		S	9 44 33·35	·075	34·27	37·86	.....	3·60	9 44 37·87
	39	B.J. 374.......		"	52 07·68	(·488)	08·24	11·84	3·60		52 11·84
	40	B.J. 383.......		"	10 11 37·62		38·21	41·82	3·61		10 11 41·81
	41	B.A.C. 3495...		"	16 46·34		52·00	55·81	3·81		....
	42	30 H. Camel..		"	20 13·83		18·11	21·59	3·48		....
	43	B.J. 390.......		"	22 38·13		38·62	42·27	3·65		22 42·22
	44	B.J. 394.......		"	24 50·03		50·86	54·54	.....		24 54·46
	45	B.J. 398.......		"	29 19·97		20·83	24·51	.....		29 24·43
	46	37 Leo. Min...		"	33 36·73		37·15	.....	.....		33 40·75
	47	B.J. 407.......		"	40 49·04		49·44	53·06	3·62		40 53·04
	48	B.J. 412.......		"	48 14·24		14·70	18·27	3·57		48 18·30

From March 26 Clamp West: from April 3 Clamp East. Adopted clock-rate zero.
5,29. Observed facing north.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Apr 3	1	47 Ursæ Maj..		S	10 54 23·12	·075	23·67	....	......	3·60	10 54 27·27
	2	B.J. 416.......		"	56 22·89	(·488)	23·73	27·37	......		56 27·33
	3	B.J. 420.......		"	11 04 34·01		34·57	38·22	3·65		11 04 38·17
	4	B.J. 424.......		"	11 35·47		36·13	39·79	....		11 39·73
	5	39 H. Cephei..	L.C.	"	27 25·32		15·61	19·18	3·57		....
Apr. 8	6	B.J. 456.......		N	12 11 15·16	·108	16·15	01·28	......	−14·88	12 11 01·27
	7	Bradley 1672..		"	15 11·01	(·512)	30·19	15·39	−14·80		....
	8	B.J. 461.......		"	21 41·12		41·68	26·81	−14·87		21 26·80
	9	B.J. 467.......		"	26 02·03		03·08	48·17	...		25 48.20
	10	B.J. 470.......		"	29 44·30		44 90	30·10	−14·80		29 30·02
	11	32² H. Camel..		"	48 51·17		56·83	42·15	−14·68		....
	12	B.J.485........		"	52 05·28		05·83	50·94	−14·89		51 50·95
	13	43 H. Cephei..	L.C.	"	56 16·70		08·92	54·37	−14·55		....
	14	19 Can. Ven...		"	13 11 45·31		45 90	...	......		13 11 31·02
	15	B.J. 494.......		"	13 46·66		47·25	32·37	−14·88		13 32·37
	16	23 Can. Ven...		"	16 33·14		33·72		......		16 18·84
	17	B.J. 497.......		"	20 34·78		35·70	20·83	......		20 20·82
	18	α Urs. Min....	L.C.	"	26 20·53		52·43	37·74	−14·69		....
	19	25 Can. Ven...		"	33 43·84		44·35	....	......		33 29·47
	20	B.J. 509.......		"	44 16·06		16·82	01·96	......		44 01·94
	21	B.J. 527.......		"	14 13 13·94		14·63	59·77	......		14 12 59·75
Apr. 10	22	B.A.C. 7504...	L.C.	S	9 17 49·17	·098	39·03	24·47	−14·56	−14·92	....
	23	1 H. Draconis.		"	24 36·70	(·516)	40·66	25·76	−14·90		....
	24	B.J. 358.......		"	27 06·02		06·80	51·87	......		9 26 51·88
	25	B.J. 360.......		"	28 58·11		58·65	43·72	−14·93		28 43·73
	26	B.J. 368.......		"	44 51·60		52·62	37·68	......		44 37·70
	27	B.J. 374.......		"	52 26·05		26·66	11·74	−14·92		52 11·74
	28	B.J. 383.......		"	10 11 56·01		56·65	41·73	−14·92		10 11 41·73
	29	B.A.C. 3495...		"	17 03·53		09·74	54·80	−14·94		....
	30	30 H. Camel..		"	20 31·14		35·83	20·84	−14·99		....
	31	B.J. 390.......		"	22 56·58		57·12	42·20	−14·92		22 42·20
	32	B.J. 394.......		"	25 08·44		09·35	54·41	......		24 54·43
	33	B.J. 398.......		"	29 38·34		39·28	24·39	......		29 24·36
	34	37 Leo. Min...		"	33 55·15		55·62	...	......		33 40·70
	35	B.J. 407.......		"	41 07·46		07·91	53·01	−14·90		40 52·99
	36	B.J. 412.......		"	48 32·57		33·07	18·22	−14·85		48 18·15
	37	B.J. 416.......		"	56 41·27		42·19	27·28	......		56 27·27
	38	B.J. 420.......		"	11 04 52·40		53·02	38·17	−14·85		11 04 38·10
	39	B.J. 424.......		"	11 53·95		54·67	39·73	......		11 39·75
	40	39 H. Cephei..	L.C.	"	27 46·37		35·76	20·26	−15·50		....
Apr. 11	41	1 H. Draconis.		N	9 24 38·29	·092	42·57	25·63	−16·94	−16·84	....
	42	B.J. 358.......		"	27 07·85	(·545)	08·69	51·85	......		9 26 51·85
	43	B.J. 360.......		"	29 00·00		00·52	43·70	−16·82		28 43·68
	44	B.J. 368.......		"	44 53·36		54·46	37·65	......		44 37·62
	45	B.J. 374.......		"	52 27·96		28·56	11·72	−16·84		52 11·72
	46	B.J. 383.......		"	10 11 57·89		58·52	41·71	−16·81		10 11 41·68
	47	B.A.C. 3495...		"	17 04·41		11.11	54·61	−16·50		....

Clamp East. Adopted clock-rate zero.

3,38. Observed facing north.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit.	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T + m$	Adopted $\Delta T + m$	App. R.A. from Observation.
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Apr. 11	1	30 H. Camel..		N	10 20 32·51	·092	37·59	20·69	−16·90	−16·84	...
	2	B.J. 390.......		"	22 58·45	(·545)	58·97	42·18	−16·79		10 22 42·13
	3	B.J. 394.......		"	25 10·26		11·24	54·39	......		24 54·40
	4	B.J. 398.......		"	29 40·23		41·25	24·37	......		29 24·41
	5	B.J. 407.......		"	41 09·43		09·86	53·00	−16·86		40 53·02
	6	B.J. 412.......		"	48 34·54		35·03	18·21	−16·82		48 18·19
	7	47 Urs. Maj....		"	54 43·49		44·08	..	......		54 27·24
	8	B.J. 416.......		"	56 43·11		44·10	27·26	......		56 27·26
	9	B.J. 420.......		"	11 04 54·34		55·02	38·15	−16·87		11 04 38·18
	10	B.J. 424.......		"	11 55·86		56.65	39·71	......		11 39·81
	11	B.J. 425.......		"	13 54·93		55·40	38·61	−16·79		13 38·56
	12	39 H. Cephei..	L.C.	"	27 47·79		37·17	20·50	−16·67		...
Apr. 12	13	Groom. 1830		N	11 48 05·59	·113	06·16	...	......	−16·70	11 47 49·46
	14	B.J. 447.		"	49 24·17	(·541)	25·11	08·43	......		49 08·41
	15	B.J. 456.......		"	12 11 16·72		17·77	01·26	......		12 11 01·07
	16	Bradley 1672..		"	15 09·04		29·28	14·25	−15·03		...
	17	B.J. 461		"	21 42·89		43·47	26·80	−16·67		21 26·77
	18	B.J. 467.......		"	26 03·75		04·86	48·15	......		25 48·16
	19	B.J. 470.......		"	29 46·15		46·79	30·10	−16·69		29 30·09
	20	9 Can. Ven....		"	34 44·39		45·02	...	......		34 28·32
	21	32[2] H. Camel..		"	48 52·62		58·59	42·04	−16·55		...
	22	B.J. 485.......		"	52 07·09		07·66	50·95	−16·71		51 50·96
	23	43 H. Cephei..	L.C.	"	56 19·13		10·89	54·68	−16·21		...
	24	14 Can. Ven...		"	13 01 49·93		50·47	...	......		13 01 33·77
	25	B.J. 491.......		"	06 13·27		13·85	57·15	−16·70		05 57·15
	26	19 Can. Ven...		"	11 47·18		47·81	...	......		11 31·11
	27	B.J. 494.......		"	13 48·43		49·05	32·39	−16·66		13 32·35
	28	23 Can. Ven...		"	16 34·98		35·60	...	......		16 18·90
	29	B.J. 497.......		"	20 36·54		37·51	20·85	......		20 20·81
	30	α Urs. Min....	L.C.	"	26 22·80		53·07	38·23	−14·84		...
	31	25 Can. Ven...		"	33 45·77		46·32	...	......		33 29·62
Apr. 13	32	B.J. 383.......		S	10 11 45·82	·089	46·50	41·68	− 4·82	−4·81	10 11 41·69
	33	B.A.C. 3495...		"	16 52·30	(·567)	58·96	54·25	− 4·71		...
	34	30 H. Camel..		"	20 20·25		25·28	20·43	− 4·85		...
	35	B.J. 390.......		"	22 46·41		46·98	42·16	− 4·82		22 42·17
	36	B.J. 394.......		"	24 58·16		59·13	54·35	......		24 54·32
	37	B.J. 398.......		"	29 28·07		29·07	24·33	......		29 24·26
	38	37 Leo. Min...		"	33 44·97		45·46	...	......		33 40·65
	39	B.J. 407.......		"	40 57·25		57·72	52·97	− 4·75		40 52·91
	40	B.J. 412.......		"	48 22·45		22·97	18·18	− 4·79		48 18·16
	41	47 Urs. Maj...		"	54 31·34		31·98	...	......		54 27·17
	42	B.J. 416.......		"	56 31·02		32·00	27·22	......		56 27·19
	43	B.J. 420.......		"	11 04 42·27		42·93	38·13	− 4·80		11 04 38·12
Apr. 14	44	B.A.C. 7504...	L.C.	S	9 17 57·29	·082	46·46	25·81	−20·65	−21·12	...
	45	1 H. Draconis.		"	24 41·95	(·572)	46·18	25·26	−20·92		...
	46	B.J. 358.......		"	27 12·07		12·89	51·78	......		9 26 51·77
	47	B.J. 360.......		"	29 04·16		04·72	43·65	−21·07		28 43·60

Clamp East. Adopted clock-rate zero.

43. Observed facing north.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date.	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Apr. 14	1	B.J. 368.......		S	9 44 57·57	·082	58·64	37·57	....	−21·12	9 41 37·52
	2	B.J. 374.......		"	52 32·07	(·572)	32·71	11·67	−21·04		52 11·59
	3	B.J. 383.......		"	10 12 02·15		02·83	41·66	−21·17		10 11 41·71
	4	B.A.C. 3495...		"	17 08·79		15·43	54·09	−21·34		....
	5	B.J. 398.......		"	29 44·39		45·39	24·31	....		29 24·27
	6	37 Leo. Min...		"	34 01·30		01·79	....			33 40·67
	7	B.J. 407.......		"	41 13·58		14·04	52·96	−21·08		40 52·92
	8	B.J. 412.......		"	48 38·77		39·28	18·17	−21·11		48 18·16
	9	B.J. 416.......		"	56 47·31		18·28	27·20	.....		56 27·16
	10	B.J. 420.......		"	11 04 58·56		59·21	38·12	−21·09,		11 04 38·09
	11	B.J. 424.......		"	12 00·05		00·82	39·67	....		11 39·70
	12	B.J. 425.......		"	13 59·21		59·71	38·59	−21·12		13 38·59
	13	39 H. Cephei..	L.C.	"	27 51·00		42·67	21·22	−21·45		....
Apr. 21	14	B.A.C. 7504...	L.C.	N	9 17 39·52	·007	29·81	28·01	− 1·80	−1·79	....
	15	1 H. Draconis.		"	24 22·01	(·515)	26·11	24·45	− 1·66		....
	16	B.J. 358.......		"	26 52·49		53·30	51·61	....		9 26 51·51
	17	B.J. 360.......		"	28 44·79		45·30	43·53	− 1·77		28 43·51
	18	B.J. 368.......		"	41 38·08		39·14	37·36	....		44 37·35
	19	B.J. 374.......		"	52 12·72		13·30	11·55	− 1·75		52 11·51
	20	B.J. 383.......		"	10 11 42·72		43·33	41·55	− 1·78		10 11 41·54
	21	B.A.C. 3495...		"	16 48·03		54·46	52·98	− 1·48		....
	22	30 H. Camel..		"	20 16·70		21·57	19·49	− 2·08		....
	23	B.J. 390.......		"	22 43·31		43·82	42·05	− 1·77		22 42·03
	24	B.J. 394.......		"	24 54·87		55·82	54·17	....		24 54·03
	25	B.J. 398.......		"	29 24·87		25·85	24·15	....		29 24·06
	26	37 Leo. Min...		"	33 41·86		42·30	....			35 40·51
	27	B.J. 412.......		"	48 19·43		19 90	18·09	− 1·81		48 18·11
	28	47 Ursae Maj..		"	54 28·33		28·91	....			54 27·12
	29	B.J. 416.......		"	56 27·89		28·85	27·06	....		56 27·06
	30	B.J. 420.......		"	11 04 39·16		39·80	38·03	− 1·77		11 04 38·01
	31	B.J. 425.......		"	13 39·82		40·27	38·53	− 1·74		13 38·48
Apr. 22	32	1 H.Draconis..		N	9 24 23·95	−·129	26·20	24·31	− 1·89	−1·82	....
	33	B.J. 358.......		"	26 52·95	(·448)	53·31	51·58	....		9 26 51·49
	34	B.J. 360.......		"	28 45·09		45·27	43·51	− 1·76		28 43·45
	35	B.J. 374.......		"	52 13·08		13·30	11·53	− 1·77		52 11·48
	36	B.J. 383.......		"	10 11 43·13		43·37	41·53	− 1·84		10 11 41·55
	37	B.A.C. 3495...		"	16 51·03		54·60	52·78	− 1·82		....
	38	30 H. Camel..		"	20 18·67		21·36	19·34	− 2·02		....
	39	B.J. 390.......		"	22 43·66		43·84	42·04	− 1·80		22 42·02
	40	B.J. 394.......		"	24 55·48		55·92	54·15	....		24 54·10
	41	B.J. 398.......		"	29 25·40		25·86	24·12	....		29 24·04
	42	37 Leo. Min...		"	33 42·22		42·36	....			33 40·54
	43	B.J. 407.......		"	40 54·54		54·66	52·87	− 1·79		40 52·84
	44	B.J. 412.......		"	48 19·75		19·90	18·08	− 1·82		48 18·08
	45	47 Urs. Maj...		"	54 28·75		28·97	....			54 27·15
	46	B.J. 416.......		"	56 28·41		28·85	27·04	....		56 27·03
	47	B.J. 420.......		"	11 04 39·57		39·84	38·02	− 1·82		11 04 38·02
	48	B.J. 424.......		"	11 41·03		41·36	39·56	......		11 39·54

From April 14 Clamp East: from April 22 Clamp West. 1−13. Adopted clock-rate zero. 14−31. Adopted $\Delta T+m=-1{\cdot}789+{\cdot}0028$ (T−10h. 20m.) 32−48. Adopted $\Delta T+m=-1{\cdot}821+{\cdot}0028$ (T−10h. 20m.) 10. Observed facing north.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Apr. 22	1	B.J. 425.......		N	11 13 40·20	—·129	40·35	38·52	—1·83	—1·82	11 13 38·53
	2	39 H. Cephei..	L.C.	"	27 31·24	(·448)	25·72	22·96	—2·76		....
Apr. 25	3	30 H.Camel...		S	10 20 18·38	—·141	20·36	18·86	—1·50	—1·49	....
	4	B.J. 390.......		"	22 43·31	(·397)	43·46	41·99	—1·47		10 22 41·97
	5	B.J. 394.......		"	24 55·27		55·57	54·07	......		24 54·08
	6	B.J. 398.......		"	29 25·21		25·52	24·04	.....		29 24·03
	7	37 Leo. Min...		"	33 41·90		42·01		.		33 40·52
	8	B.J. 407.......		"	40 54·22		54·32	52·84	—1·48		40 52·83
	9	B.J. 412.......		"	48 19·39		19·52	18·04	—1·48		48 18·03
	10	47 Urs. Maj...		"	54 28·36		28·55		.		54 27·06
	11	B.J. 416.......		"	56 28·13		28·44	26·97	. .		56 26·95
	12	B.J. 420.......		"	11 04 39·22		39·39	37·97	—1·42		11 04 37·90
	13	B.J. 424.......		"	11 40·85		41·06	39·51	. .		11 39·57
	14	B.J. 425.......		"	13 39·90		40·02	38·48	—1·54		13 38·53
	15	39 H. Cephei..	L.C.	"	27 30·34		25·52	23·86	—1·66		....
	16	B.J. 441.......		"	41 21·22		21·41	19·94	.. . .		41 19·92
	17	Groom. 1830..		"	47 50·65		50·81	.	... .		47 49·32
	18	B.J. 447.......		"	49 09·46		09·73	08·26	.. ..		49 08·24
	19	B.J. 458.......		"	12 11 40·12		40·31	38·86	—1·45		12 11 38·82
	20	Bradley 1672..		"	15 04·29		12·15	10·46	—1·69		.. ..
Apr. 27	21	B.J. 441.......		S	11 41 21·02	—·162	21·21	19·92	. ...	—1·30	11 41 19·91
	22	Groom. 1830..		"	47 50·51	(·417)	50·66	.	..		47 49·36
	23	B.J. 447.......		"	49 09·25		09·51	08·23	. .		49 08·21
	24	1 Can. Ven....		"	12 10 19·26		19·51	...	.. ...	—1·29	12 10 18·22
	25	B.J. 458.......		"	11 39·94		40·11	38·84	—1·27		11 38·82
	26	Bradley 1672 .		"	15 03·64		11·47	09·54	—1·93		....
	27	B.J. 461.......		"	21 27·88		28·04	26·74	—1·30		21 26·75
	28	B.J. 467.......		"	25 49·04		49·37	48·01	... ..		25 48·08
	29	B.J. 470.......		"	29 31·10		31·29	30·04	—1·25		29 30·00
	30	9 Can. Ven....		"	34 29·36		29·54	..	.....		34 28·25
	31	32² H. Camel..		"	48 39·89		42·15	41·13	—1·02		....
	32	B.J. 485.......		"	51 52·11		52·26	50·94	—1·32		51·50·97
	33	43 H. Cephei..	L.C.	"	56 01·21		57·59	56·17	—1·42		....
	34	14 Can. Ven...		"	13 01 34·93		35·06	. .	......		13 01 33·77
	35	B.J. 491.......		"	05 58·27		58·43	57·16	—1·27		05 57·14
	36	19 Can. Ven...		"	11 32·25		32·43	....	....		11 31·14
	37	B.J. 494.......		"	13 33·47		33·64	32·41	—1·23		13 32·35
	38	23 Can. Ven..		"	16 20·04		20·22	......	....		16 18·93
	39	B.J. 497.......		"	20 21·80		22·07	20·85	......		20 20·78
	40	α Urs. Min...	L.C.	"	25 54·81		41·80	41·50	— ·30		....
Apr. 28	41	B.J. 352.......		N	9 15 36·07	—·141	36·23	34·99	—1·24	—1·18	9 15 35·05
	42	1 H.Draconis..		"	24 22·35	(·472)	24·69	23·47	—1·22		....
	43	B.J. 358.......		"	26 52·32		52·69	51·43	....		26 51·51
	44	B.J. 360.......		"	28 44·39		44·56	43·41	—1·15		28 43·38
	45	B.J. 368.......		"	44 37·81		38·33	37·15	......		44 37·15
	46	B.J. 374.......		"	52 12·37		12·60	11·43	—1·17		52 11·42
	47	B.J. 383.......		"	10 11 42·36		42·60	41·42	—1·18		10 11 41·42

Clamp West.

1, 2. Adopted $\Delta T+m=-1\cdot821+\cdot0028$ (T—10^h 20^m).

3—20. Adopted $\Delta T+m=-1\cdot490+\cdot0028$ (T—11^h 15^m).

21—40. Adopted $\Delta T+m=-1\cdot293+\cdot0028$ (T—12^h 45^m).

41—47. Adopted $\Delta T+m=-1\cdot180+\cdot0028$ (T—10^h 15^m).

12. Observed facing north.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Apr. 28	1	B.A.C. 3495...		N	10 16 48·98	−·141	52·68	51·51	−1·17	−1·18	....
	2	30 H. Camel..		"	20 17·03	(·472)	19·81	18·40	−1·41		....
	3	B.J. 390......		"	22 42·85		43·03	41·95	−1·08		10 22 41·85
	4	B.J. 394		"	24 54·65		55·10	54·00	......		24 53·92
	5	B.J. 398.......		"	29 24·53		25·01	23·97	....		29 23·83
	6	37 Leo. Min...		"	33 41·48		41·61	..	....		33 40·43
	7	B.J. 407.......		"	40 53·89		54·01	52·80	−1·21		40 52·83
	8	B.J. 412.......		"	48 19·03		19·19	18·00	−1·19		48 18·01
	9	47 Urs. Maj...		"	54 28·00		28·22	..	.....		54 27·04
	10	B.J. 416.......		"	56 27·63		28·09	26·91	......		56 26·91
	11	B.J. 420.......		"	11 04 38·81		39·08	37·93	−1·15		11 04 37·90
	12	B.J. 424.......		"	11 40·41		40·75	39·46	......		11 39·57
	13	B.J. 425.......		"	13 39·41		39·55	38·45	−1·10		13 38·37
	14	39 H.Cephei...	L.C.	"	27 32·58		26·83	24·80	−2·03		....
Apr. 30	15	B.J. 379.......		S	10 02 27·44	−·162	27·46	26·23	−1·23	−1·17	10 02 26·29
	16	B.J. 384.......		"	11 43·03	(·478)	43·09	41·92	−1·17		11 41·92
	17	B.J. 386.......		"	17 00·23		00·47	59·30	−1·17		16 59·30
	18	30 H. Camel..		"	20 16·82		19·30	18·14	−1·16		....
	19	B.J. 390.......		"	22 42·90		43·09	41·92	−1·17		22 41·92
	20	B.J. 394.......		"	24 54·77		55·15	53·95	.....		24 53·98
	21	37 Leo. Min...		"	33 41·48		41·63	......	......		33 40·46
	22	B.J. 405.......		"	38 33·44		33·50	32·34	−1·16		38 32·33
	23	B.J. 407.......		"	40 53·80		53·93	52·78	−1·15		40 52·76
	24	B.J. 412.......		"	48 18·99		19·15	17·98	−1·17		48 17·98
	25	54 Leonis......		"	50 46·57		46·64	.	......		50 45·47
	26	47 Urs. Maj...		"	54 27·89		28·13	.....	.....		54 26·96
	27	B.J. 416.......		"	56 27·56		27·95	26·86	......		56 26·78
	28	B.J. 420.......		"	11 04 38·76		39·04	37·90	−1·14		11 04 37·87
	29	B.J. 422.......		"	09 21·52		21·56	20·41	−1·15		09 20·39
	30	B.J. 424.......		"	11 40·30		40·58	39·43	....		11 39·41
	31	B.J. 425.......		"	13 39·40		39·55	38·43	−1·12		13 38·38
	32	B.J. 432.......		"	25 41·48		41·74	40·66	−1·08		25 40·57
	33	B.J. 441.......		"	41 20·76		21·02	19·88	......		41 19·85
	34	B.J. 444.......		"	44 30·42		30·42	29·26	−1·16		44 29·25
	35	31 Comae.....		"	12 47 21·50		21·60	......	......		12 47 20·43
	36	B.J. 485.......		"	51 51·93		52·13	50·93	−1·20		51 50·96
	37	43 H. Cephei..	L.C.	"	56 02·04		57·59	56·59	−1·00		....
	38	14 Can. Ven...		"	13 01 34·70		34·88	......	......		13 01 33·71
	39	B.J. 492.......		"	07 43·05		43·15	42·00	−1·15		07 41·98
	40	19 Can. Ven...		"	11 32·09		32·32	......	......		11 31·15
	41	B.J. 494.......		"	13 33·29		33·52	32·41	−1·11	−1·16	13 32·36
	42	23 Can. Ven...		"	16 19·87		20·10	......	......		16 18·94
	43	B.J. 497.......		"	20 21·61		21·97	20·84	......		20 20·81
	44	α Urs. Min....	L.C.	"	26 00·32		44·33	42·62	−1·71		....
	45	B.J. 502.......		"	30 49·55		49·74	48·57	−1·17		30 48·58
	46	25 Can. Ven...		"	33 30·61		30·80	......	......		33 29·64
	47	B.J. 507.......		"	42 01·73		01·74	00·55	−1·19		42 00·58
	48	B.J. 509.......		"	43 02·87		03·14	02·06	....		43 01·98

Clamp West. 1−14. Adopted $\Delta T+m=-1\cdot180+\cdot0028\ (T-10^h\ 15^m)$.
15−48. Adopted $\Delta T+m=-1\cdot169+\cdot0029\ (T-11^h\ 50^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
May 3	1	54 Leonis.....		N	10 50 46·32	−·139	46·41	....	.....	−0·98	10 50 45·43
	2	47 Urs. Maj...		"	54 27·68	(·515)	27·95	..	....		54 26·97
	3	B.J. 416.......		"	56 27·32		27·85	26·79	....		56 26·87
	4	B.J. 420.......		"	11 04 38·52		38·84	37·84	−1·00		11 04 37·86
	5	B.J. 422.......		"	09 21·28		21·34	20·37	− ·97		09 20·36
	6	B.J. 424.......		"	11 40·04		40·43	39·37	.....		11 39·45
	7	B.J. 425.......		"	13 39·20		39·37	38·39	− ·98		13 38·39
	8	39 H. Cephei..	L.C.	"	27 33·59		27·02	26·13	− ·89		.....
	9	Groom. 1830..		"	47 50·08		50·31	.....	....		47 49·33
	10	o Leonis.......		"	51 04·95		04·96	..	...		51 03·98
	11	1 Can. Ven....		"	12 10 18·60		19·07		..		12 10 18·09
	12	B.J. 458.......		"	11 39·43		39·69	38·79	− ·90		11 38·71
	13	Bradley 1672..		"	14 55·72		08·15	07·32	− ·83		...
	14	B.J. 461.......		"	21 27·42		27·66	26·69	− ·97		21 26·68
	15	15 Comae.....		"	22 29·47		29·59		....		22 28·61
	16	B.J. 470.......		"	29 30·68		30·95	29·99	− ·96		29 29·97
	17	23 Comae.....		"	30 24·31		24·39	...	..		30 23·41
	18	9 Can. Ven....		"	34 28·98		29·24	...	.....		34 28·26
May 5	19	B.J. 444.......		S	11 44 29·93	−·167	29·94	29·22	− ·72	−·74	11 44 29·20
	20	Groom. 1830..		"	47 49·67	(·538)	49·91	...	....		47 49·17
	21	o Leonis.......		"	51 04·63		04·65	...	.....		51 03·91
	22	1 Can. Ven....		"	12 10 18·25		18·65	.	.		12 10 17·91
	23	B.J. 458.......		"	11 39·19		39·47	38·77	− ·70		11 38·73
	24	Bradley 1672..		"	14 55·18		06·72	06·51	− ·21		.....
	25	12 Comae.....		"	18 00·92		01·03	.	.....		12 18 00·29
	26	B.J. 461.......		"	21 27·11		27·36	26·67	− ·69		21 26·62
	27	15 Comae.....		"	22 29·25		29·39	..	...		22 28·65
	28	B.J. 466.......		"	25 13·97		14·03	13·32	− ·71		25 13·29
	29	B.J. 470.......		"	29 30·38		30·67	29·97	− ·70		29 29·93
	30	23 Comae.....		"	30 24·00		24·08	.....	......		30 23·34
	31	9 Can. Ven....		"	34 28·69		28·97	....	......		34 28·23
	32	31 Comae.....		"	47 21·09		21·22	.....	......		47 20·48
	33	B.J. 483.......		"	50 07·01		07·47	06·88	...		50 06·73
	34	B.J. 485.......		"	51 51·39		51·63	50·89	− ·74		51 50·89
	35	43 H. Cephei..	L.C.	"	56 02·94		57·75	57·27	− ·48		......
	36	14 Can. Ven...		"	13 01 34·25		34·46	...	.. ..		13 01 33·72
	37	B.J. 491.......		"	05 57·57		57·81	57·13	− ·68		05 57·07
	38	B.J. 492.......		"	07 42·59		42·72	41·98	− ·74		07 41·98
	39	19 Can. Ven...		"	11 31·58		31·86	...	.. ..		11 31·12
	40	B.J. 494.......		"	13 32·83		33·11	32·38	− ·73		13 32·37
	41	23 Can. Ven...		"	16 19·33		19·60	......	...		16 18·86
	42	B.J. 497.......		"	20 21·03		21·47	20·79	......		20 20·73
	43	α Urs. Min....	L.C.	"	26 03·74		45·07	44·42	− ·65		....
	44	81 Urs. Maj...		"	30 42·59		43·04	....	......		30 42·30
	45	25 Can. Ven...		"	33 30·04		30·26	......	.....		33 29·52
	46	B.J. 507.......		"	43 01·24		01·27	00·56	− ·71		43 00·53
	47	B.J. 509.......		"	44 02·37		02·71	02·04	.....		44 01·97
	48	B.J. 513.......		"	50 26·16		26·20	25·43	− ·77		50 25·46
	49	9 H.Boötis....		"	14 04 22·41		22·74	......	.....		14 04 22·00

Clamp West. 1−18. Adopted $\Delta T+m=-\cdot982+\cdot0029\ (T-11^{h}\ 45^{m})$.

19−49 Adopted $\Delta T+m=-\cdot738+\cdot0030\ (T-13^{h}\ 05^{m})$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
May 5	1	B.J. 522.......		S	14 06 19·91	−·167	20·02	19·29	−·73	−·73	14 06 19·29
	2	B.J. 526.......		"	11 35·59	(·538)	35·64	31·83	−·81		11 34·91
	3	B.J. 527.......		"	13 00·32		00·61	59·97	....		12 59·88
	4	*f* Boötis.......		"	22 18·35		18·40	...	.....		22 17·67
	5	204 B. Boötis..		"	26 06·45		06·74	.	....		26 06·01
	6	B.J. 531.......		"	27 59·42		59·58	58·81	−·77		27 58·85
May 6	7	32² H. Camel.		N	12 48 37·50	−·160	40·66	40·23	−·43	−·70	....
	8	B.J. 485.......		"	51 51·45	(·487)	51·63	50·89	−·74		12 51 50·93
	9	43 H. Cephei..	L.C.	"	56 02·19		57·91	57·45	−·46		....
	10	14 Can. Ven...		"	13 01 34·25		34·41	...	....		13 01 33·71
	11	B.J. 491.......		"	05 57·66		57·84	57·14	−·70		05 57·14
	12	B.J. 492.......		"	07 42·50		42·58	41·98	−·60		07 41·88
	13	19 Can. Ven...		"	11 31·56		31·78		....		11 31·08
	14	B.J. 494.......		"	13 32·81		33·02	32·38	−·64		13 32·32
	15	B.J. 497.......		"	20 21·08		21·51	20·78	....		20 20·81
	16	α Urs. Min....	L.C.	"	26 00·26		44·86	44·93	·07		....
	17	B.J. 502.......		"	30 49·07		49·24	48·56	−·68		30 48·54
	18	25 Can. Ven...		"	33 30·12		30·29	....	......		33 29·59
	19	B.J. 507.......		"	43 01·26		01·62	00·56	−·70		43 00·56
	20	B.J. 509.......		"	44 02·31		02·63	02·04	......		44 01·93
	21	B.J. 513.......		"	50 26·14		26·15	25·43	−·72		50 25·45
	22	B.J. 526.......		"	14 11 35·56		35·58	34·84	−·74		14 11 34·88
	23	B.J. 527.......		"	13 00·41		00·69	59·97	....		12 59·99
	24	*f* Boötis.......		"	22 18·39		18·41	....	....		22 17·71
	25	204 B. Boötis..		"	26 06·54		06·76	....	....		26 06·06
	26	B.J. 534.......		"	27 59·38		59·49	58·81	−·68		27 58·79
	27	σ Boötis.......		"	30 48·03		48·13	.....	......		30 47·43
	28	B.J. 540.......		"	35 31·85		32·10	31·40	−·70		35 31·40
May 7	29	B.J. 422.......		S	11 09 21·03	−·174	21·08	20·33	−·75	−·76	11 09 20·32
	30	B.J. 424.......		"	11 39·72	(·526)	40·04	39·30	....		11 39·28
	31	B.J. 425.......		"	13 38·91		39·08	38·34	−·74		13 38·32
	32	B.J. 432.......		"	25 40·97		41·26	40·55	−·71		25 40·50
	33	B.J. 441.......		"	41 20·15		20·44	19·77	....		41 19·68
	34	B.J. 444.......		"	44 29·97		29·96	29·20	−·76		44 29·20
	35	Groom. 1830..		"	47 49·76		49·99	...	....		47 49·23
	36	B.J. 447.......		"	49 08·35		08·74	08·05	....		49 07·98
	37	*o* Leonis.......		"	51 04·67		04·67	.....	....		51 03·91
	38	1 Can. Ven.....		"	12 10 18·31		18·69	....	....	−·75	12 10 17·94
	39	B.J. 458.......		"	11 39·17		39·43	38·74	−·69		11 38·68
	40	Bradley 1672..		"	14 54·10		05·02	05·50	·48		....
	41	12 Comae.....		"	18 00·92		01·02	....	....		18 00·27
	42	B.J. 461.......		"	21 27·11		27·34	26·65	−·69		21 26·59
	43	B.J. 466.......		"	25 14·03		14·07	13·31	−·76		25 13·32
	44	B.J. 470.......		"	29 30·38		30·65	29·95	−·70		29 29·90
	45	9 Can. Ven....		"	31 28·77		29·03	.....	....		34 28·28
	46	31 Comae.....		"	47 20·99		21·10	.....	....		47 20·35
	47	B.J. 483.......		"	50 06·98		07·41	06·86	....		50 06·66
	48	B.J. 485.......		"	51 51·36		51·59	50·88	−·71		51 50·84

Clamp West. 1−6. Adopted $\Delta T+m=-\cdot 738+\cdot 0030$ (T−13ʰ 05ᵐ).
7−28. Adopted $\Delta T+m=-\cdot 700+\cdot 0030$ (T−13ʰ 45ᵐ).
29−48. Adopted $\Delta T+m=-\cdot 753+\cdot 0030$ (T−12ʰ 50ᵐ).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
May 7	1	43 H. Cephei..	L.C.	S	12 56 02·86	—·174	57·93	57·66	— ·27	—·75	....
	2	14 Can. Ven...		"	13 01 34·23	(·526)	34·42	....	....		13 01 33·67
	3	B.J. 491.......		"	05 57·62		57·85	57·12	— ·73		05 57·10
	4	B.J. 492.......		"	07 42·59		42·70	41·98	— ·72		07 41·95
	5	19 Can. Ven...		"	11 31·53		31·79	....	....		11 31·04
	6	B.J. 494.......		"	13 32·87		33·13	32·37	— ·76		13 32·38
	7	23 Can. Ven...		"	16 19·40		19·65	....	....		16 18·90
	8	B.J. 497.......		"	20 21·04		21·45	20·77	....		20 20·70
	9	α Urs. Min....	L.C.	"	26 03·53		45·82	45·53	— ·29		....
	10	B.J. 502.......		"	30 49·05		49·26	48·56	— ·70		30 48·51
	11	25 Can. Ven...		"	33 30·12		30·32	....	....		33 29·57
	12	B.J. 507.......		"	43 01·35		01·37	00·56	— ·81		43 00·62
	13	B.J. 509.......		"	44 02·40		02·71	02·03	....		44 01·96
	14	B.J. 513.......		"	50 26·21		26·24	25·43	— ·81		50 25·49
	15	B.J. 517.......		"	57 07·93		08·04	07·29	— ·75		57 07·29
	16	9 H. Boötis...		"	14 04 22·52		22·83	....	....		14 04 22·08
	17	B.J. 522.......		"	06 19·96		20·05	19·29	— ·76		06 19·30
	18	B.J. 526.......		"	11 35·62		35·66	34·85	— ·81		11 34·91
	19	B.J. 527.......		"	13 00·43		00·69	59·97	....		12 59·94
	20	f Bootis.......		"	22 18·50		18.54	....	....		22 17·79
	21	204 B. Boötis.		"	26 06·50		06·77	....	....		26 06·02
	22	B.J. 534.......		"	27 59·44		59·59	58·82	— ·77		27 58·84
May 10	23	37 Leo. Min...		N	10 33 40·83	—·162	40·95	....	....	—·65	10 33 40·30
	24	B.J. 405.......		"	38 32·80	(·490)	32·85	32·21	— ·64		38 32·20
	25	B.J. 407.......		"	40 53·19		53·29	52·64	— ·65		40 52·64
	26	B.J. 412.......		"	48 18·28		18·42	17·84	— ·58		48 17·77
	27	54 Leonis......		"	50 45·94		46·00	....	....		50 45·35
	28	47 Urs. Maj...		"	54 27·29		27·50	....	....		54 26·85
	29	B.J. 416.......		"	56 26·77		27·22	26·61	....		56 26·57
	30	B.J. 420.......		"	11 04 38·08		38·34	37·73	— ·61		11 04 37·69
	31	B.J. 422.......		"	09 20·90		20·92	20·30	— ·62		09 20·27
	32	B.J. 424.......		"	11 39·59		39·92	39·24	....		11 39·27
	33	B.J. 425.......		"	13 38·93		39·06	38·30	— ·76		13 38·41
	34	39 H. Cephei..	L.C.	"	27 36·34		30·65	28·53	—2·12		....
	35	B.J. 441.......		"	41 20·01		20·31	19·73	....		41 19·66
	36	B.J. 444.......		"	44 29·85		29·82	29·18	— ·64		44 29·17
	37	Groom. 1830..		"	47 49·62		19·80	....	....		47 49·15
	38	o Leonis......		"	51 04·63		04·61	....	....	—·64	51 03·97
	39	1 Can. Ven....		"	12 10 18·18		18·57	....	....		12 10 17·93
	40	B.J. 458.......		"	11 39·07		39·28	38·71	— ·57		11 38·64
	41	Bradley 1672..		"	14 54·23		05·12	03·75	—1·37		....
	42	B.J. 461.......		"	21 27·06		27·25	26·63	— ·62		21 26·61
	43	15 Comae......		"	22 29·17		29·26	....	....		22 28·62
	44	B.J. 470.......		"	29 30·36		30·58	29·93	— ·65		29 29·94
	45	23 Comae......		"	30 24·02		24·06	....	....		30 23·42
	46	9 Can. Ven....		"	34 28·65		28·86	....	....		34 28·22
	47	32^2 H. Camel..		"	48 36·78		39·95	39·79	— ·16		....
	48	B.J. 485.......		"	51 51·25		51·43	50·86	— ·57		51 50·79
	49	43 H. Cephei..	L.C.	"	56 01·86		57·56	58·33	·77		....

Clamp West. 1—22. Adopted $\Delta T+m = -\cdot753+\cdot0030\ (T-12^h\ 50^m)$.
23—49. Adopted $\Delta T+m = -\cdot644+\cdot0030\ (T-12^h\ 10^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
May 10	1	14 Can. Ven....		N	13 01 34·19	−·162	34·35	....	....	−·64	13 01 33·71
	2	B.J. 491.......		"	05 57·54	(·490)	57·73	57·11	−·62		05 57·69
	3	B.J. 492.......		"	07 42·56		42·64	41·97	−·67		07 42·00
	4	19 Can. Ven....		"	11 31·56		31·77	....	....		11 31·13
	5	B.J. 494.......		"	13 32·73		32·94	32·36	−·58		13 32·30
	6	23 Can. Ven....		"	16 19·32		19·52	....	....		16 18·88
	7	B.J. 497.......		"	20 20·98		21·40	20·75	....		20 20·76
	8	α Urs. Min....	L.C.	"	26 02·89		47·46	47·56	−·10		....
	9	25 Can. Ven....		"	33 30·06		30·23	....	....		33 29·59
	10	B.J. 507.......		"	43 01·27		01·27	00·57	−·70		43 00·63
	11	B.J. 509.......		"	44 02·34		02·67	02·02	....		44 02·03
May 11	12	B.J. 432.......		S	11 25 40·76	−·196	41·05	40·49	−·56	−·64	11 25 40·41
	13	39 H. Cephei..	L.C.	"	27 36·19	(·561)	29·42	28·88	−·54		....
	14	B.J. 441.......		"	41 19·99		20·29	19·71	....		41 19·65
	15	B.J. 444.......		"	44 29·80		29·78	29·17	−·61		44 29·14
	16	Groom. 1830..		"	47 49·54		49·76	....	....		47 49·12
	17	B.J. 447.......		"	49 08·13		08·53	07·97	....		49 07·89
	18	*o* Leonis.......		"	51 04·55		04·54	....	....		51 03·90
	19	1 Can. Ven....		"	12 10 18·21		18·60	....	....		12 10 17·96
	20	B.J. 458.......		"	11 39·04		39·30	38·70	−·60		11 38·66
	21	Bradley 1672..		"	14 52·14		03·47	03·18	−·29		....
	22	B.J. 461.......		"	21 27·03		27·26	26·61	−·65		21 26·62
	23	15 Comae.....		"	22 29·13		29·25	....	....		22 28·61
	24	B.J. 466.......		"	25 13·87		13·91	13·28	−·63		25 13·27
	25	B.J. 470.......		"	29 30·25		30·52	29·92	−·60		29 29·88
	26	23 Comae.....		"	30 23·90		23·96	....	....		30 23·32
	27	9 Can. Ven....		"	34 28·56		28·82	....	....		34 28·18
	28	31 Comae.....		"	47 20·86		20·97	....	....		47 20·33
	29	B.J. 485.......		"	51 51·31		51·54	50·85	−·69		51 50·90
	30	43 H. Cephei..	L.C.	"	56 03·89		58·78	58·55	−·23		....
	31	14 Can. Ven....		"	13 01 34·13		34·33	....	....		13 01 33·69
	32	15 Can. Ven....		"	05 35·75		35·98	....	....		05 35·34
	33	B.J. 491.......		"	05 57·48		57·71	57·10	−·61		05 57·07
	34	B.J. 492.......		"	07 42·47		42·58	41·96	−·62		07 41·94
	35	19 Can. Ven....		"	11 31·49		31·75	....	....		11 31·11
	36	B.J. 494.......		"	13 32·68		32·93	32·35	−·58		13 32·29
	37	23 Can. Ven....		"	16 19·31		19·56	....	....		16 18·92
	38	B.J. 497.......		"	20 20·89		21·31	20·73	....		20 20·67
	39	α Urs. Min....	L.C.	"	26 06·79		48·43	48·23	−·20		....
	40	B.J. 502.......		"	30 48·97		49·18	48·54	−·64		30 48·54
	41	25 Can. Ven....		"	33 29·99		30·19	....	....		33 29·55
	42	B.J. 507.......		"	43 01·16		01·17	00·57	−·60		43 00·53
	43	B.J. 509.......		"	44 02·20		02·50	02·01	....		44 01·86
	44	B.J. 513.......		"	50 26·09		26·11	25·44	−·67		50 25·47
	45	B.J. 517.......		"	57 07·79		07·90	07·30	−·60		57 07·26
	46	9 H. Boötis....		"	14 04 22·25		22·55	....	....	−·63	14 04 21·92
	47	B.J. 522.......		"	06 19·85		19·93	19·30	−·63		06 19·30
	48	B.J. 526.......		"	11 35·52		35·54	34·86	−·68		11 34·91
	49	*f* Boötis......		"	22 18·33		18·35	....	....		22 17·72

Clamp West. 1−11. Adopted $\Delta T+m = -\cdot644+\cdot0030\ (T-12^h\ 10^m)$.
12−49. Adopted $\Delta T+m = -\cdot637+\cdot0031\ (T-13^h\ 25^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
May 11	1	204 B.Boötis..		S	14 26 06·37	−·196	06·65			−·63	14 26 06·02
	2	B.J. 534......		"	27 59·29	(·561)	59·43	58·83	−·60		27 58·80
	3	σ Boötis......		"	30 47·93		48·06				30 47·43
	4	B.J. 540.......		"	35 31·74		32·05	31·42	−·63		35 31·42
	5	B.J. 543.......		"	36 53·24		53·21	52·54	−·67		36 52·58
	6	34 Boötis.....		"	39 30·29		30·39				39 29·76
	7	ε Boötis.......		"	41 05·64		05·74				41 05·11
	8	295 B.Boötis..		"	45 37·01		37·23				45 36·60
	9	ξ Boötis.......		"	47 16·34		16·36				47 15·73
	10	c Boötis		"	15 03 23·13		23·20				15 03 22·57
	11	Groom. 2283..		"	06 25·25		33·71	33·71	·00		
	12	η Cor. Bor....		"	19 31·49		31·62				19 30·99
	13	B.J. 568.......		"	21 07·78		07·99	07·33	−·66		21 07·36
	14	B.J. 572.......		"	24 09·34		09·46	08·82	−·64		24 08·83
	15	B.J. 573.......		"	27 44·14		44·40	43·79	−·61		27 43·77
	16	ν^2 Boötis......		"	28 36·06		36·32				28 35·69
May 12	17	47 Urs. Maj...		N	10 54 27·27	−·176	27·52			−·66	10 54 26·86
	18	B.J. 416.......		"	56 26·68	(·557)	27·21	26·56			56 26·55
	19	B.J. 420.......		"	11 04 38·03		38·34	37·69	−·65		11 04 37·68
	20	B.J. 422.......		"	09 20·88		20·91	20·28	−·63		09 20·25
	21	B.J. 424.......		"	11 39·42		39·80	39·20			11 39·14
	22	B.J. 425.......		"	13 38·72		38·88	38·27	−·61	−·65	13 38·23
	23	39 H. Cephei..	L.C	"	27 36·84		30·20	29·23	−·97		
	24	B.J. 441.......		"	41 19·97		20·32	19·69			41 19·67
	25	B.J. 444.......		"	44 29·83		29·81	29·16	−·65		44 29·16
	26	Groom. 1830..		"	47 49·57		49·78				47 49·13
	27	B.J. 447.......		"	49 08·15		08·62	07·95			49 07·97
	28	o Leonis......		"	51 04·56		04·55				51 03·90
	29	1 Can. Ven....		"	12 10 18·12		18·58				12 10 17·93
	30	B.J. 458.......		"	11 38·97		39·21	38·68	−·53		11 38·56
	31	Bradley 1672..		"	14 51·82		04·41	02·66	−1·75		
	32	12 Comae.....		"	18 00·85		00·94				18 00·29
	33	B.J. 461.......		"	21 27·03		27·26	26·60	−·66		21 26·61
	34	15 Comae.....		"	22 29·18		29·29				22 28·64
	35	B.J. 466.......		"	25 13·96		14·00	13·27	−·73		25 13·35
	36	B.J. 470.......		"	29 30·19		30·45	29·90	−·55		29 29·80
	37	23 Comae.....		"	30 23·92		23·97				30 23·32
	38	32² H.Camel .		"	48 36·07		39·74	39·52	−·22		
	39	B.J. 485.......		"	51 51·30		51·52	50·84	−·68		51 50·87
	40	43 H. Cephei..	L.C.	"	56 04·22		59·20	58·75	−·45		
	41	14 Can. Ven...		"	13 01 34·09		34·28				13 01 33·63
	42	B.J. 491.......		"	05 57·47		57·69	57·09	−·60		05 57·04
	43	B.J. 492.......		"	07 42·55		42·65	41·96	−·69		07 42·00
	44	19 Can. Ven...		"	11 31·44		31·69				11 31·04
	45	B.J. 494.......		"	13 32·87		33·11	32·34	−·77		13 32·46
	46	23 Can. Ven...		"	16 19·35		19·60				16 18·95
	47	B.J. 497.......		"	20 20·89		21·39	20·72			20 20·74
	48	α Urs. Min....	L.C.	"	26 06·61		48·59	48·89	·30		
	49	B.J. 502.......		"	30 48·97		49·18	48·54	−·64		30 48·53

Clamp West. 1−16. Adopted $\Delta T+m = -\cdot637 + \cdot0031\ (T-13^h\ 25^m)$.
17−49. Adopted $\Delta T+m = -\cdot651 + \cdot0031\ (T-12^h\ 30^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
May 12	1	25 Can. Ven...		N	13 33 29·99	−·176	30·19	......	......	−·65	13 33 29·54
	2	B.J. 507.......		"	43 01·14	(·557)	01·14	00·57	− ·57		43 00·49
	3	B.J. 509.......		"	44 02·23		02·61	02·00	......		44 01·96
	4	B.J. 513.......		"	50 26·07		26·08	25·44	− ·64		50 25·43
	5	B.J. 517.......		"	57 07·85		07·95	07·30	− ·65		57 07·30
May 15	6	B.J. 441.......		S	11 41 19·29	·000	19·85	19·64	......	−·28	11 41 19·57
	7	B.J. 444.......		"	44 29·25	(·523)	29·43	29·13	− ·30		44 29·15
	8	Groom. 1830..		"	47 48·90		49·34	......	......		47 49·06
	9	B.J. 447.......		"	49 07·40		08·09	07·89	......		49 07·81
	10	*o* Leonis.......		"	51 03·91		04·10	......	......		51 03·82
	11	1 Can. Ven....		"	12 10 17·43		18·11	......	......		12 10 17·83
	12	B.J. 458.......		"	11 38·39		38·88	38·65	− ·23		11 38·60
	13	Bradley 1672..		"	14 45·33		01·82	01·29	− ·53		....
	14	12 Comae.....		"	18 00·16		00·45	......	......		18 00·17
	15	B.J. 461.......		"	21 26·37		26·83	26·57	− ·26		21 26·55
	16	15 Comae.....		"	22 28·48		28·80	......	......		22 28·52
	17	B.J. 466.......		"	25 13·26		13·49	13·25	− ·24		25 13·21
	18	B.J. 470.......		"	29 29·64		30·14	29·87	− ·27		29 29·86
	19	9 Can. Ven....		"	34 27·92		28·41	......	......		34 28·13
	20	31 Comae.....		"	47 20·44		20·75	......	......		47 20·47
	21	B.J. 483.......		"	50 06·17		06·92	06·73	......		50 06·64
	22	B.J. 485.......		"	51 50·65		51·10	50·81	− ·29		51 50·82
	23	43 H. Cephei..	L.C.	"	56 06·30		59·08	59·32	·24		....
	24	14 Can. Ven...		"	13 01 33·57		33·98	......	......		13 01 33·70
	25	15 Can. Ven...		"	05 35·13		35·58	......	......		05 35·30
	26	B.J. 491.......		"	05 56·94		57·39	57·07	− ·32		05 57·11
	27	B.J. 492.......		"	07 41·86		42·17	41·94	− ·23		07 41·89
	28	19 Can. Ven...		"	11 30·88		31·37	......	......		11 31·09
	29	B.J. 494.......		"	13 32·12		32·60	32·32	− ·28		13 32·32
	30	23 Can. Ven...		"	16 18·67		19·15	......	......		16 18·87
	31	B.J. 497.......		"	20 20·14		20·86	20·68	......		20 20·58
	32	α Ursae Min...	L.C.	"	26 17·70		51·77	50·56	−1·21		....
	33	B.J. 502.......		"	30 48·36		48·79	48·52	− ·27		30 48·51
	34	25 Can. Ven...		"	33 29·39		29·81	......	......		33 29·53
	35	B.J. 507.......		"	43 00·63		00·84	00·56	− ·28		43 00·56
	36	B.J. 509.......		"	44 01·56		02·15	01·98	......		44 01·87
	37	B.J. 513.......		"	50 25·54		25·76	25·44	− ·32		50 25·48
	38	B.J. 517.......		"	57 07·19		07·50	07·29	− ·21		57 07·22
	39	9 H. Boötis...		"	14 04 21·73		22·27	......	......	−·27	14 04 22·00
	40	B.J. 522.......		"	06 19·28		19·56	19·30	− ·26		06 19·29
	41	B.J. 526.......		"	11 35·00		35·22	34·87	− ·35		11 34·95
	42	B.J. 527.......		"	12 59·60		00·12	59·95	......		12 59·85
	43	*f* Boötis......		"	22 17·77		17·99	......	......		22 17·72
	44	204 B. Boötis..		"	26 05·77		06·28	......	......		26 06·01
	45	B.J. 534.......		"	27 58·72		59·06	58·84	− ·22		27 58·79
	46	σ Boötis.......		"	30 47·39		47·72	......	......		30 47·45
	47	B. J. 540......		"	35 31·11		31·66	31·42	− ·24		35 31·39
	48	B. J. 543......		"	36 52·68		52·85	52·56	− ·29		36 52·58
	49	34 Boötis.....		"	39 29·69		29·99	......	......		39 29·72

Clamp West. 1−5. Adopted $\Delta T+m=-\cdot 652+\cdot 0031\ (T-12^h\ 30^m)$.
6−49. Adopted $\Delta T+m=-\cdot 276+\cdot 0031\ (T-13^h\ 40^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
May 15	1	ε Boötis.......		S	14 41 05·09	·000	05·39			−·27	14 41 05·12
	2	295 B.Boötis..		"	45 36·46	(·523)	36·90				45 36·63
	3	ξ Boötis......		"	47 15·69		15·90				47 15·63
	4	B.J. 551.......		"	51 59·91		00·09	59·86	−·23		51 59·82
	5	B.J. 555.......		"	58 35·15		35·63	35·38	−·25		58 35·36
	6	B.J. 557.......		"	15 00 37·03		37·33	37·06	−·27		15 00 37·06
	7	c Boötis......		"	03 22·54		22·82				03 22·55
	8	Groom. 2283..		"	06 20·79		33·00	33·29	·29		
	9	B.J. 563.......		"	11 54·18		54·56	54·31	−·25		11 54·29
	10	η Cor. Bor....		"	19 30·90		31·24				19 30·97
	11	B.J. 568......		"	21 07·17		07·60	07·35	−·25		21 07·33
	12	B.J. 572.......		"	24 08·77		09·09	08·85	−·24		24 08·82
	13	B.J. 573.......		"	27 43·59		44·08	43·82	−·26		27 43·81
	14	ν² Boötis......		"	28 35·43		35·92				28 35·65
	15	B.J. 578.......		"	30 54·38		54·68	54·34	−·34		30 54·41
	16	B.J. 580.......		"	34 37·42		37·90	37·69	−·21		34 37·63
	17	ζ Cor. Bor....		"	36 01·05		01·47				36 01·20
	18	ι Serpentis....		"	37 33·95		34·17				37 33·90
May 16	19	39 H. Cephei..	L.C.	N	11 27 39·94	·016	31·25	30·43	−·82	−·26	
	20	B.J. 441......		"	41 19·21	(·517)	19·82	19·62			11 41 19·56
	21	B.J. 444.......		"	44 29·23		29·38	29·12	−·26		44 29·12
	22	Groom. 1830..		"	47 48·93		49·36				47 49·10
	23	B.J. 447.......		"	49 07·43		08·18	07·87			49 07·92
	24	o Leonis......		"	51 03·91		04·07				51 03·81
	25	1 Can. Ven....		"	12 10 17·27		18·01				12 10 17·75
	26	B.J. 458.......		"	11 38·34		38·81	38·63	−·18		11 38·55
	27	Bradley 1672..		"	14 43·44		59·94	00·84	·90		
	28	12 Comae.....		"	18 00·19		00·47				18 00·21
	29	B.J. 461.......		"	21 26·28		26·72	26·55	−·17		21 26·46
	30	15 Comae.....		"	22 28·52		28·82				22 28·56
	31	B.J. 466.......		"	25 13·24		13·45	13·25	−·20		25 13·19
	32	B.J. 470.......		"	29 29·56		30·05	29·85	−·20		29 29·79
	33	23 Comae.....		"	30 23·32		23·55				30 23·29
	34	9 Can. Ven....		"	34 27·97		28·44			−·25	34 28·19
	35	32² H. Camel..		"	48 34·50		39·36	38·98	−·38		
	36	B.J. 485.......		"	51 50·69		51·12	50·80	−·32		51 50·87
	37	43 H. Cephei..	L.C.	"	56 05·69		59·13	59·49	·36		
	38	14 Can. Ven...		"	13 01 33·52		33·92				13 01 33·67
	39	B.J. 491.......		"	05 56·84		57·28	57·06	−·22		05 57·03
	40	B.J. 492.......		"	07 41·91		42·21	41·93	−·28		07 41·96
	41	19 Can. Ven...		"	11 30·85		31·32				11 31·07
	42	B.J. 494.......		"	13 32·02		32·48	32·31	−·17		13 32·23
	43	23 Can. Ven...		"	16 18·65		19·11				16 18·86
	44	B.J. 497.......		"	20 20·05		20·83	20·67			20 20·58
	45	α Urs. Min....	L.C.	"	26 14·53		50·92	51·09	·17		
	46	B.J. 502.......		"	30 48·39		48·81	48·52	−·29		30 48·56
	47	25 Can. Ven...		"	33 29·40		29·81				33 29·56
	48	B.J. 507.......		"	43 00·66		00·84	00·56	−·28		43 00·59
	49	B.J. 509.......		"	44 01·53		02·16	01·97			44 01·91

From May 15 Clamp West; from May 16 Clamp East.

1−18. Adopted $\Delta T+m=-\cdot 276+\cdot 0031$ (T−13^{h} 40^{m}).

19−49. Adopted $\Delta T+m=-\cdot 253+\cdot 0031$ (T−13^{h} 10^{m}).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
May 16	1	B.J. 513.......		N	13 50 25·53	·016	25·72	25·44	−·28	−·25	13 50 25·47
	2	B.J. 517.......		"	57 07·30	(·517)	07·59	07·29	−·30		57 07·34
	3	9 H.Bootis....		"	14 04 21·70		22·23	......	......		14 04 21·98
	4	B.J. 522.......		"	06 19·32		19·58	19·30	−·28		06 19·33
	5	B.J. 526.......		"	11 34·95		35·15	34·87	−·28		11 34·90
	6	B.J. 527.......		"	12 59·59		00·15	59·95	......		12 59·90
	7	*f* Boötis......		"	22 17·81		18·01	......	......		22 17·76
	8	204 B.Boötis..		"	26 05·73		06·22	......	......		26 05·97
	9	B.J. 534.......		"	27 58·68		59·01	58·84	−·17		27 58·76
	10	σ Boötis......		"	30 47·44		47·76	......	......		30 47·51
	11	B.J. 540.......		"	35 31·13		31·66	31·42	−·24		35 31·41
	12	B.J. 543.......		"	36 52·69		52·83	52·57	−·26		36 52·58
	13	34 Boötis.....		"	39 29·70		29·98	......	......		39 29·73
	14	ε Boötis......		"	41 05·10		05·39	......	......		41 05·14
	15	295 B.Boötis..		"	45 36·52		36·95	......	......		45 36·70
	16	ξ Boötis......		"	47 15·76		15·95	......	......		47 15·70
	17	B.J. 549.......		"	49 11·44		12·35	12·25	......		49 12·10
May 17	18	B.J. 456.......		S	12 11 00·05	−·003	00·78	00·70	......	−·15	12 11 00·63
	19	B.J. 461.......		"	21 26·18	(·498)	26·62	26·54	−·08		21 26·47
	20	B.J. 467.......		"	25 47·02		47·79	47·63	......		25 47·64
	21	B.J. 470.......		"	29 29·48		29·96	29·84	−·12		29 29·81
	22	9 Can. Ven....		"	34 27·82		28·29	......	......		34 28·14
	23	32² H. Camel.		"	48 34·84		39·12	38·84	−·28		....
	24	B.J. 485.......		"	51 50·53		50·96	50·79	−·17		51 50·81
	25	43 H. Cephei..	L.C.	"	56 06·27		59·92	59·67	−·25		....
	26	14 Can. Ven...		"	13 01 33·42		33·81	......	......		13 01 33·66
	27	B.J. 494.......		"	13 32·01		32·47	32·30	−·17		13 32·32
	28	23 Can. Ven...		"	16 18·51		18·97	......	......		16 18·82
	29	B.J. 497.......		"	20 20·12		20·79	20·65	......		20 20·64
	30	α Urs. Min....	L.C.	"	26 15·17		52·29	51·64	−·65		....
	31	81 Urs. Maj...		"	30 41·65		42·33	......	......		30 42·18
	32	25 Can. Ven...		"	33 29·29		29·69	......	......		33 29·54
	33	B.J. 509.......		"	44 01·55		02·10	01·96	......		44 01·95
	34	B.J. 527.......		"	14 12 59·61		00·10	59·95	......		14 12 59·95
	35	B.J. 531.......		"	22 09·94		10·54	10·45	......	−·14	22 10·40
	36	*g* Boötis......		"	25 31·89		32·45	......	......		25 32·31
	37	B.J. 535.......		"	28 28·88		29·31	29·20	−·11		28 29·17
	38	σ Boötis......		"	30 47·28		47·59	......	......		30 47·45
May 19	39	31 Comae.....		S	12 47 19·89	·004	20·20	......	......	·09	12 47 20·29
	40	B.J. 483.......		"	50 05·73	(·522)	06·48	06·66	......		50 06·57
	41	B.J. 485.......		"	51 50·26		50·72	50·78	·06		51 50·81
	42	43 H. Cephei..	L.C.	"	56 06·50		59·71	00·10	·39		....
	43	14 Can. Ven...		"	13 01 33·12		33·53	......	......		13 01 33·62
	44	15 Can. Ven...		"	05 34·73		35·19	......	......		05 35·28
	45	B.J. 491.......		"	05 56·44		56·90	57·04	·14		05 56·99
	46	B.J. 492.......		"	07 41·47		41·78	41·91	·13		07 41·87
	47	19 Can. Ven...		"	11 30·42		30·92	......	......		11 31·01
	48	B.J. 494.......		"	13 31·67		32·16	32·29	·13		13 32·25

Clamp East. 1−17. Adopted $\Delta T+m=-\cdot253+\cdot0031\ (T-13^h\ 10^m)$.
18−38. Adopted $\Delta T+m=-\cdot148+\cdot0032\ (T-13^h\ 25^m)$.
39−48. Adopted $\Delta T+m=\cdot099+\cdot0032\ (T-14^h\ 45^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent ΔT+m	Adopted ΔT+m	App. R.A. from Observation.
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
May 19	1	23 Can. Ven...		S	13 16 18·23	·004	18·72	....	....	·09	13 16 18·81
	2	B.J. 497.......		"	20 19·77	(·522)	20·49	20·63	.....		20 20·58
	3	α Urs. Min....	L.C.	"	26 15·91		51·49	52·92	1·43		......
	4	B.J. 502.......		"	30 48·04		48·48	48·50	·02	·10	30 48·58
	5	25 Can. Ven...		"	33 28·99		29·42		....		33 29·52
	6	B.J. 507.......		"	43 00·28		00·47	00·56	·09		43 00·57
	7	B.J. 509.......		"	44 01·13		01·72	01·95	.....		44 01·82
	8	B.J. 513.......		"	50 25·17		25·37	25·44	·07		50 25·47
	9	B.J. 517.......		"	57 06·85		07·16	07·29	·13		57 07·26
	10	9 H. Boötis...		"	14 04 21·39		21·94	....	..		14 04 22·04
	11	B.J. 522.......		"	06 18·92		19·20	19·30	·10		06 19·30
	12	B.J. 526.......		"	11 34·65		34·86	34·87	·01		11 34·96
	13	B.J. 527.......		"	12 59·24		59·76	59·94	.....		12 59·86
	14	f Boötis.		"	22 17·45		17·66	.	....		22 17·76
	15	204 B. Boötis..		"	26 05·41		05·93	.	....		26 06·03
	16	B.J. 534.......		"	27 58·38		58·72	58·84	·12		27 58·82
	17	σ Boötis......		"	30 47·03		47·36	......	..		30 47·46
	18	B.J. 540.......		"	35 30·65		31·21	31·42	·21		35 31·31
	19	B.J. 543.......		"	36 52·34		52·49	52·58	·09		36 52·59
	20	34 Boötis......		"	39 29·37		29·67	.....	.....		39 29·77
	21	ε Boötis.......		"	41 04·75		05·05	....	.....		41 05·15
	22	295 B. Boötis..		"	45 36·11		36·56	....	.....		45 36·66
	23	ξ Boötis.......		"	47 15·42		15·62	....	.....		47 15·72
	24	B.J. 551.......		"	51 59·63		59·79	59·89	·10		51 59·89
	25	B.J. 555.......		"	58 34·77		35·26	35·39	·13		58 35·36
	26	B.J. 557.......		"	15 00 36·68		36·98	37·08	·10		15 00 37·08
	27	c Boötis.......		"	03 22·23		22·51	......	......		03 22·61
	28	Groom. 2283..		"	06 20·52		31·87	32·96	1·09		......
	29	B.J. 578.......		"	30 54·15		54·45	54·37	− ·08		30 54·55
	30	B.J. 580.......		"	34 37·05		37·54	37·71	·17		34 37·64
	31	ζ Cor. Bor....		"	36 00·65		01·08	...	......		36 01·18
	32	ι Serpentis.....		"	37 33·63		33·84	...	....		37 33·94
	33	B.J. 581.......		"	38 59·10		59·39	59·53	·14		38 59·49
	34	B.J. 583.......		"	42 03·36		03·53	03·62	·09		42 03·63
	35	B.J. 584.......		"	44 42·65		42·84	42·93	·09		44 42·94
	36	χ Herculis....		"	49 35·29		35·81	....	......		49 35·91
	37	B.J. 591.......		"	52 19·00		19·17	19·35	·18		52 19·27
	38	B.J. 593.......		"	53 52·98		53·28	53·40	·12		53 53·38
	39	B.J. 595.......		"	55 40·98		41·70	41·84	......		55 41·80
	40	r Herculis.....		"	57 12·96		13·15	....	......		57 13·25
	41	B.J. 598.......		"	16 00 13·93		14·75	14·97	......		16 00 14·85
	42	κ Herculis.....		"	04 02·10		02·28	...	......		04 02·38
	43	τ Cor. Bor....		"	05 42·22		42·65	....	.....		05 42·75
	44	σ^2 Cor. Bor..		"	11 19·91		20·30	.....	......		11 20·40
	45	B.J. 609.......		"	17 58·27		58·47	58·59	·12		17 58·57
	46	23 Herculis....		"	19 30·47		30·83	...	.....		19 30·93
	47	B.J. 613.......		"	21 17·04		17·19	17·30	·11		21 17·29
	48	g Herculis.....		"	25 42·47		42·98	...	....		25 43·08
	49	B.J. 621.......		"	31 13·48		14·00	14·11	·11		31 14·10
	50	ζ Herculis.....		"	37 54·96		55·31	....	......	·11	37 55·42

Clamp East. Adopted $\Delta T+m = \cdot 099 + \cdot 0032\ (T - 14^h\ 45^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s	s.	s.	s.	s.	s.	h. m. s.
May 19	1	B.J. 626.......		S	16 39 49·89	·004	50·35	50·54	·19	·11	16 39 50·46
	2	B.J. 627.......		"	43 36·88	(·522)	37·64	37·96	....		43 37·75
May 21	3	1 Can. Ven....		N	12 10 16·80	·015	17·48	...	....	·25	12 10 17·73
	4	B.J. 458.......		"	11 37·82	(·482)	38·26	38·57	·31		11 38·51
	5	Bradley 1672..		"	14 41·58		56·95	58·07	1·12		....
	6	B.J. 461.......		"	21 25·79		26·21	26·49	·28		21 26·46
	7	15 Comae.....		"	22 27·97		28·26	...	....		22 28·51
	8	B.J. 467.......		"	25 46·47		47·29	47·54	....		25 47·54
	9	B.J. 470.......		"	29 29·05		29·50	29·79	·29		29 29·75
	10	23 Comae.....		"	30 22·83		23·05	...	....		30 23·30
	11	9 Can. Ven...		"	34 27·44		27·88	...	....		34 28·13
	12	32² H. Camel.		"	48 33·25		37·78	38·28	·50		....
	13	B.J. 483.......		"	50 05·59		06·34	06·62	....		50 06·59
	14	B.J. 485.......		"	51 50·09		50·50	50·76	·26		51 50·75
	15	43 H. Cephei..	L.C.	"	56 05·87		59·79	00·59	·80		....
	16	14 Can. Ven...		"	13 01 32·98		33·35	...	....		13 01 33·60
	17	15 Can. Ven...		"	05 34·58		34·99	...	....		05 35·24
	18	B.J. 491.......		"	05 56·36		56·77	57·02	·25		05 57·02
	19	B.J. 492.......		"	07 41·34		41·61	41·90	·29		07 41·86
	20	19 Can. Ven...		"	11 30·28		30·72	...	....		11 30·97
	21	B.J. 494.......		"	13 31·56		31·99	32·27	·28		13 32·24
	22	23 Can. Ven...		"	16 18·15		18·58	...	....		16 18·83
	23	B.J. 497.......		"	20 19·56		20·28	20·60	....		20 20·53
	24	α Urs. Min....	L.C.	"	26 15·06		53·20	54·46	1·26		....
	25	B.J. 502.......		"	30 47·88		48·27	48·49	·22		30 48·52
	26	25 Can. Ven...		"	33 28·88		29·26	...	....		33 29·51
	27	B.J. 507.......		"	43 00·11		00·27	00·55	·28		43 00·52
	28	B.J. 509.......		"	44 01·05		01·64	01·93	....	·26	44 01·90
	29	B.J. 513.......		"	50 25·01		25·18	25·44	·26		50 25·44
	30	B.J. 517.......		"	57 06·69		06·96	07·28	·32		57 07·22
	31	9 H. Boötis...		"	14 04 21·20		21·69	...	....		14 04 21·95
	32	B.J. 522.......		"	06 18·80		19·04	19·30	·26		06 19·30
	33	B.J. 526.......		"	11 34·46		34·64	34·87	·23		11 34·90
	34	B.J. 527.......		"	12 59·18		59·71	59·93	....		12 59·97
	35	f Boötis.......		"	22 17·34		17·52	...	....		22 17·78
	36	204 B. Boötis..		"	26 05·30		05·76	...	....		26 06·02
	37	B.J. 534.......		"	27 58·29		58·60	58·84	·24		27 58·86
	38	σ Boötis.......		"	30 46·92		47·22	...	....		30 47·48
	39	B.J. 540.......		"	35 30·67		31·17	31·41	·24		35 31·43
	40	B.J. 543.......		"	36 52·23		52·36	52·58	·22		36 52·62
	41	34 Boötis.....		"	39 29·24		29·50	...	....		39 29·76
	42	ε Bootis.......		"	41 04·65		04·91	...	....		41 05·17
	43	295 B. Boötis..		"	45 36·03		36·43	...	....		45 36·69
	44	ξ Boötis.......		"	47 15·37		15·55	...	....		47 15·81
	45	B.J. 549.......		"	49 11·07		11·91	12·23	....		49 12·17
May 26	46	B.J. 483.......		N	12 50 05·07	−·014	05·68	06·51	....	·81	12 50 06·49
	47	B.J. 485.......		"	51 49·56	(·414)	49·87	50·70	·83		51 50·68
	48	43 H. Cephei..	L.C.	"	56 05·82		00·58	01·92	1·34		....

From May 19 Clamp East; from May 26 Clamp West.
1,2. Adopted $\Delta T+m = \cdot 099 + \cdot 0032\ (T-14^h\ 45^m)$.
3−45. Adopted $\Delta T+m = \cdot 254 + \cdot 0032\ (T-13^h\ 25^m)$.
46−48. Adopted $\Delta T+m = \cdot 815 + \cdot 0033\ (T-14^h\ 45^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
May 26	1	14 Can. Ven...		N	13 01 32·44	−·014	32·73	.....	.....	·81	13 01 33·54
	2	15 Can. Ven...		"	05 34·03	(·414)	34·35	.....	.....		05 35·16
	3	B.J. 491.......		"	05 55·80		56·12	56·96	·84		05 56·93
	4	B.J. 494.......		"	13 31·04		31·38	32·22	·84		13 32·19
	5	23 Can. Ven...		"	16 17·63		17·97	.....	.....		16 18·78
	6	B.J. 507.......		"	42 59·58		59·71	00·53	·82		43 00·52
	7	B.J. 509.......		"	44 00·51		01·01	01·87	.....		44 01·82
	8	B.J. 513.......		"	50 24·41		24·55	25·42	·87		50 25·36
	9	B.J. 517.......		"	57 06·27		06·48	07·27	·79		57 07·29
	10	9 H. Boötis...		"	14 04 20·73		21·12	.....	.....		14 04 21·93
	11	B.J. 522.......		"	06 18·27		18·46	19·29	·83		06 19·27
	12	B.J. 526.......		"	11 33·82		33·97	34·86	·89		11 34·78
	13	B.J. 527.......		"	12 58·57		58·99	59·89	.....		12 59·80
	14	204 B. Boötis.		"	26 04·80		05·16	.....	.....		26 05·97
	15	B.J. 534		"	27 57·74		57·98	58·83	·85		27 58·79
	16	B.J. 535.......		"	28 28·09		28·40	29·18	·78		28 29·21
	17	σ Boötis......		"	30 46·45		46·68	.....	.....		30 47·49
	18	B.J. 540.......		"	35 30·12		30·51	31·39	·88		35 31·32
	19	B.J. 543.......		"	36 51·70		51·80	52·59	·79		36 52·61
	20	31 Boötis.....		"	39 28·75		28·95	.....	.....		39 29·76
	21	ϵ Boötis.......		"	41 04·03		04·24	.....	.....		41 05·05
	22	295 B. Boötis..		"	45 35.50		35·81	.....	.....	·82	45 36·63
	23	ξ Boötis.......		"	47 14 82		11·97	.....	.....		47 15·79
	24	B.J. 549.......		"	49 10 66		11·35	12·18	.....		49 12·17
	25	B.J. 555.......		"	58 34.18		34·52	35·39	·87		58 35·34
	26	B.J. 583.......		"	15 42 02 72		02·84	03·67	·83		15 42 03·66
	27	B.J. 584.......		"	44 42.06		42·20	42·98	·78		44 43·02
	28	χ Herculis....		"	49 34.75		35·11	....	.....		49 35·93
	29	B.J. 591.......		"	52 18.54		18·66	19·41	·75		52 19·48
	30	B.J. 593.......		"	53 52 49		52·69	53·45	·76		53 53·51
	31	B.J. 595.......		"	55 40 41		40·98	41·86	.....		55 41·80
	32	τ Herculis.....		"	57 12.37		12·51	....	.....		57 13·33
	33	B.J. 598.......		"	16 00 13.45		14·11	14·99	.....		16 00 14·93
	34	B.J. 614.......		"	22 28.40		28·98	29·84	.....		22 29·80
	35	B.J. 621.......		"	31 13 03		13·39	14·18	·79		31 14·21
	36	B.J. 626.......		"	39 49 42		49·74	50·61	·87		39 50·56
	37	B.J. 627.......		"	43 36.47		37·09	38·03	.....		43 37·91
	38	53 Herculis....		"	49 34 08		34·33	....	.....		49 35·15
	39	ϵ Urs. Min ...		"	55 15.12		18·13	19·19	1·06		....
May 27	40	σ Boötis......		S	14 30 46·39	−·011	46·65	.....	.....	·83	14 30 47·48
	41	B.J. 540.......		"	35 30·11	(·422)	30·55	31·38	·83		35 31·38
	42	B.J. 543.......		"	36 51·65		51·79	52·59	·80		36 52·62
	43	34 Boötis.....		"	39 28·67		28·91	.....	.....		39 29·74
	44	ϵ Boötis.......		"	41 04·06		04·30	.....	.....		41 05·13
	45	295 B. Boötis..		"	45 35·46		35·81	.....	.....		45 36·64
	46	ξ Boötis......		"	47 14·71		14·88	.....	.....		47 15·71
	47	B.J. 549.......		"	49 10·61		11·30	12·17	.....		49 12·13
	48	B.J. 551.......		"	51 58·92		59·06	59·90	·84		51 59·89
	49	B.J. 555.......		"	58 34·14		34·52	35·39	·87		58 35·35

Clamp West. 1−39. Adopted $\Delta T+m = \cdot815+\cdot0033\ (T-14^h\ 45^m)$.

40−49. Adopted $\Delta T+m = \cdot836+\cdot0033\ (T-15^h\ 55^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
May 27	1	*i* Boötis.......		S	15 00 50·46	−·011	50·88	....		·83	15 00 51·71
	2	ε Boötis.......		"	03 21·55	(·422)	21·77	....			03 22·60
	3	Groom. 2283..		"	06 20·24		29·79	31·19	1·40		....
	4	B.J. 563.......		"	11 53·18		53·48	54·34	·86		11 54·31
	5	η Cor. Bor....		"	19 29·91		30·18	....	....		19 31·01
	6	B.J. 568.......		"	21 06·18		06·52	07·39	·87		21 07·35
	7	B.J. 571.......		"	22 56·91		57·56	58·53	......		22 58·39
	8	B.J. 572.......		"	24 07·84		08·10	08·91	·81		24 08·93
	9	B.J. 573.......		"	27 42·60		42·99	43·86	·87		27 43·82
	10	ν^2 Boötis		"	28 34·42		34·81	....	......		28 35·64
	11	B.J. 576.......		"	29 18·72		19·00	19·88	·88		29 19·83
	12	B.J. 578.......		"	30 53·40		53·64	54·42	·78		30 54·47
	13	B.J. 580.......		"	34 36·52		36·90	37·74	·84		34 37·73
	14	ζ Cor. Bor....		"	36 00·10		00·44		.....		36 01·27
	15	ι Serpentis....		"	37 32·92		33·09	..	.....	·84	37 33·93
	16	B.J. 581.......		"	38 58·38		58·61	59·58	·97		38 59·45
	17	B.J. 583.......		"	42 02·63		02·77	03·68	·91		42 03·61
	18	B.J. 584.......		"	44 42·03		42·19	42·99	·80		44 43·03
	19	χ Herculis ...		"	49 34·75		35·16	....			49 36·00
	20	B.J. 591.......		"	52 18·43		18·57	19·42	·85		52 19·41
	21	B.J. 593.......		"	53 52·46		52·70	53·46	·76		53 53·54
	22	B.J. 595.......		"	55 40·47		41·01	41·86	......		55 41·85
	23	*r* Herculis. ...		"	57 12·32		12·48	....			57 13·32
	24	B.J. 598.......		"	16 00 13·49		14·13	14·99	....		16 00 14·97
	25	κ Herculis....		"	04 01·48		01·64	....			04 02·48
	26	B.J. 601.......		"	05 57·10		57·48	58·22	......		05 58·32
	27	Groom. 750...	L.C.	"	07 46·66		41·52	43·34	1·82		....
	28	B.J. 621.......		"	31 12·87		13·28	14·19	·91		31 14·12
	29	42 Herculis...		"	36 19·25		19·69	..	.....		36 20·53
	30	ζ Herculis.....		"	37 54·35		54·63	.	.....		37 55·47
	31	B.J. 626.......		"	39 49·43		49·79	50·62	·83		39 50·63
	32	B.J. 627.......		"	43 36·53		37·12	38·04	....		43 37·96
	33	B.J. 629		"	47 59·62		59·76	00·64	·88		48 00·60
	34	53 Herculis....		"	49 34·01		31·29	..	....		49 35·13
	35	ε Urs. Min....		"	55 15·12		18·04	19·18	1·14		....
	36	*d* Herculis....		"	58 17·61		17·91	..	....		58 18·75
	37	B.J. 635.......		"	17 01 12·95		13·08	13·90	·82		17 01 13·92
	38	B.J. 636.......		"	04 51·29		51·67	52·56	·89		04 52·51
	39	B.J. 640.......		"	10 33·34		33·48	34·24	·76		10 34·32
	40	B.J. 643.......		"	11 55·46		55·80	56·62	·82		11 56·64
	41	*e* Herculis.....		"	14 34·73		35·07	...	....		14 35·91
	42	*w* Herculis....		"	17 18·13		18·42	....			17 19·26
	43	ρ Herculis.....		"	20 35·34		35·68	....			20 36·52
	44	B.J. 650.......		"	24 22·03		22·45	23·26	....		24 23·29
	45	λ Herculis		"	27 06·68		06·91	....			27 07·75
	46	B.J. 653.......		"	28 24·80		25·30	26·23	....		28 26·14
	47	Groom. 944...	L.C.	"	32 51·79		46·82	47·60	·78		....
	48	B.J. 663.......		"	36 56·11		56·50	57·47	....		36 57·34

Clamp West. Adopted $\Delta T+m = \cdot 836 + \cdot 0033$ (T−15ʰ 55ᵐ).

26. Observed facing north.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
May 28	1	Bradley 1672		N	12 14 38·30	– ·002	52·58	53·75	1·17	·90	....
	2	B.J. 461		"	21 25·14	(·432)	25·49	26·40	·91		12 21 26·39
	3	15 Comae		"	22 27·32		27·56	....	....		22 28·46
	4	B.J. 467		"	25 45·72		46·44	47·36	....		25 47·34
	5	B.J. 470		"	29 28·38		28·77	29·69	·92		29 29·67
	6	23 Comae		"	30 22·15		22·35	....	....		30 23·25
	7	9 Can. Ven.		"	34 26·73		27·11	....	....		34 28·01
	8	32^2 H. Camel.		"	48 31·95		36·11	37·19	1·08		....
	9	B.J. 485		"	51 49·49		49·84	50·68	·84		51 50·74
	10	43 H. Cephei	L.C.	"	56 06·36		00·72	02·37	1·65		....
	11	14 Can. Ven.		"	13 01 32·29		32·61	....	....		13 01 33·51
	12	15 Can. Ven.		"	05 33·88		34·23	....	....		05 35·13
	13	B.J. 491		"	05 55·69		56·04	56·94	·90		05 56·94
	14	B.J. 492		"	07 40·70		40·93	41·85	·92		07 41·83
	15	19 Can. Ven.		"	11 29·63		30·01	....	....		11 30·91
	16	B.J. 494		"	13 30·87		31·24	32·20	·96		13 32·14
	17	B.J. 497		"	20 18·88		19·51	20·48	....		20 20·41
	18	α Urs. Min.	L.C.	"	26 17·11		56·87	00·21	3·34		....
	19	B.J. 502		"	30 47·18		47·51	48·43	·92		30 48·41
	20	25 Can. Ven.		"	33 28·24		28·56	....	....		33 29·46
	21	B.J. 507		"	42 59·45		59·60	00·53	·93		43 00·50
	22	B.J. 509		"	44 00·37		00·88	01·85	....		44 01·78
	23	9 H. Bootis		"	14 04 20·60		21·02	....	....		14 04 21·92
	24	B.J. 522		"	06 18·15		18·37	19·28	·91		06 19·27
	25	B.J. 526		"	11 33·83		34·00	34·85	·85		11 34·90
	26	B.J. 527		"	12 58·50		58·95	59·87	....		12 59·85
	27	B.J. 531		"	22 08·79		09·35	10·37	....		22 10·25
	28	204 B. Boötis		"	26 04·67		05·06	....	....		26 05·96
	29	B.J. 534		"	27 57·65		57·91	58·82	·91		27 58·81
	30	B.J. 535		"	28 27·89		28·24	29·17	·93	·91	28 29·15
	31	σ Boötis		"	30 46·30		46·55	....	....		30 17·46
	32	B.J. 540		"	35 30·03		30·46	31·38	·92		35 31·37
	33	B.J. 543		"	36 51·60		51·72	52·59	·87		36 52·63
	34	34 Boötis		"	39 28·69		28·92	....	....		39 29·83
	35	ε Boötis		"	41 04·00		04·24	....	....		41 05·15
	36	295 B. Boötis		"	45 35·41		35·75	....	....		45 36·66
	37	ξ Boötis		"	47 14·69		14·85	....	....		47 15·76
	38	B.J. 549		"	49 10·51		11·25	12·16	....		49 12·16
	39	B.J. 551		"	51 58·86		58·98	59·91	·93		51 59·89
	40	B.J. 555		"	58 34·05		34·42	35·39	·97		58 35·33
	41	B.J. 557		"	15 00 35·99		36·23	37·09	·86		15 00 37·14
	42	Groom. 2283		"	06 17·87		28·42	30·97	2·55		....
	43	B.J. 563		"	11 53·12		53·41	54·35	·94		11 54·32
	44	η Cor. Bor.		"	19 29·80		30·05	....	....		19 30·96
	45	B.J. 568		"	21 06·17		06·51	07·40	·89		21 07·42
	46	B.J. 571		"	22 56·74		57·47	58·53	....		22 58·38
	47	B.J. 573		"	27 42·58		42·96	43·87	·91		27 43·87
	48	ν^2 Boötis		"	28 34·49		34·87	....	....		28 35·78
	49	B.J. 576		"	29 18·73		19·00	19·88	·88		29 19·91
	50	B.J. 578		"	30 53·27		53·50	54·42	·92		30 54·41

Clamp West. Adopted $\Delta T+m = \cdot 904 + \cdot 0033\ (T - 14^h\ 10^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
May 28	1	B.J. 580.......		N	15 34 36·42	−·002	36·79	37·74	·95	·91	15 34 37·70
	2	ζ Cor. Bor....		"	36 00·05	(·432)	00·37	.....	.....		36 01·28
	3	ι Serpentis....		"	37 32·95		33·12	.....	.....		37 34·03
	4	B.J. 581.......		"	38 58·42		58·65	59·59	·94		38 59·56
	5	B.J. 583.......		"	42 02·59		02·72	03·69	·97		42 03·63
	6	B.J. 584.......		"	44 41·93		42·08	43·00	·92		48 42·99
	7	χ Herculis.....		"	49 34·69		35·09	.....	.....		49 36·00
	8	B.J. 591.......		"	52 18·34		18·48	19·43	·95		52 19·39
	9	B.J. 593.......		"	53 52·38		52·61	53·47	·86		53 53·52
	10	B.J. 595.......		"	55 40·37		40·99	41·87	.....		55 41·90
	11	r Herculis.....		"	57 12·31		12·46	.....	.....		57 13·37
June 3	12	32² H. Camel..		S	12 48 31·01	−·025	34·97	36·19	1·22	1·40	....
	13	B.J. 485.......		"	51 48·85	(·456)	49·22	50·60	1·38		12 51 50·62
	14	43 H. Cephei..	L.C.	"	56 07·94		01·97	03·87	1·90		....
	15	14 Can. Ven...		"	13 01 31·77		32·10	.....	.....		13 01 33·50
	16	15 Can. Ven...		"	05 33·28		33·65	.....	.....		05 35·05
	17	B.J. 491.......		"	05 55·10		55·47	56·87	1·40		05 56·87
	18	B.J. 492.......		"	07 40·13		40·38	41·80	1·42		07 41·78
	19	19 Can. Ven...		"	11 29·02		29·42	.....	.....		11 30·82
	20	B.J. 494.......		"	13 30·30		30·69	32·13	1·44		13 32·09
	21	23 Can. Ven...		"	16 16·84		17·23	.....	.....		16 18·63
	22	B.J. 497.......		"	20 18·29		18·87	20·36	.....		20 20·27
	23	α Urs. Min....	L.C.	"	26 26·07		04·65	04·99	·34		....
	24	B.J. 502.......		"	30 46·62		46·97	48·37	1·40		30 48·37
	25	25 Can. Ven...		"	33 27·61		27·95	.....	.....	1·41	33 29·36
	26	B.J. 507.......		"	42 58·94		59·10	00·49	1·39		43 00·51
	27	B.J. 509.......		"	43 59·82		00·29	01·76	.....		44 01·70
	28	B.J. 513.......		"	50 23·79		23·96	25·38	1·42		50 25·37
	29	B.J. 517.......		"	57 05·50		05·74	07·22	1·48		57 07·15
	30	9 H. Boötis...		"	14 04 19·99		20·44	.....	.....		14 04 21·85
	31	B.J. 522.......		"	06 17·57		17·80	19·25	1·45		06 19·21
	32	B.J. 526.......		"	11 33·29		33·46	34·83	1·37		11 34·87
	33	B.J. 527.......		"	12 57·94		58·35	59·81	.....		12 59·76
	34	B.J. 531.......		"	22 08·32		08·83	10·29	.....		22 10·24
	35	204 B. Boötis..		"	26 04·10		04·52	.....	.....		26 05·93
	36	B.J. 534.......		"	27 57·08		57·35	58·80	1·45		27 58·76
	37	σ Boötis.......		"	30 45·77		46·03	.....	.....		30 47·44
	38	B.J. 540.......		"	35 29·49		29·94	31·34	1·40		35 31·35
	39	B.J. 543.......		"	36 51·06		51·18	52·59	1·41		36 52·59
	40	34 Boötis.....		"	39 28·03		28·27	.....	.....		39 29·68
	41	ε Boötis.......		"	41 03·46		03·71	.....	.....		41 05·12
	42	295 B. Boötis..		"	45 34·86		35·22	.....	.....		45 36·63
	43	ξ Boötis.......		"	47 14·18		14·35	.....	.....		47 15·76
	44	B.J. 549.......		"	49 09·96		10·65	12·08	.....		49 12·06
	45	B.J. 551.......		"	51 58·38		58·51	59·91	1·40		51 59·92
	46	B.J. 555.......		"	58 33·53		33·92	35·37	1·45		58 35·33
	47	B.J. 557.......		"	15 00 35·43		35·68	37·09	1·41		15 00 37·09
	48	c Boötis......		"	03 20·96		21·18	.....	.....		03 22·59
	49	Groom. 2283..		"	06 16·72		26·76	29·71	2·95		....

Clamp West. 1−11. Adopted $\Delta T+m=\cdot 904+\cdot 0033$ (T−14ʰ 10ᵐ).
12−49. Adopted $\Delta T+m=1\cdot 408+\cdot 0034$ (T−14ʰ 25ᵐ).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
June 3	1	B.J. 563.......		S	15 11 52·61	−·025	52·92	54·34	1·42	1·41	15 11 54·33
	2	η Cor. Bor....		"	19 29·34	(·456)	29·61	.....	......		19 31·02
	3	B.J. 568.......		"	21 05·68		06·03	07·39	1·36		21 07·44
	4	B.J. 571.......		"	22 56·31		56·99	58·47	......		22 58·40
	5	B.J. 572.......		"	24 07·22		07·48	08·92	1·44		24 08·89
	6	B.J. 573.......		"	27 42·06		42·46	43·86	1·40		27 43·87
	7	ν^2 Boötis......		"	28 33·92		34·32	.....	......		28 35·73
	8	B.J. 576.......		"	29 18·16		18·44	19·89	1·45		29 19·85
	9	B.J. 578.......		"	30 52·83		53·07	54·43	1·36		30 54·48
	10	B.J. 580.......		"	34 35·88		36·27	37·75	1·48		34 37·68
	11	ζ Cor. Bor....		"	35 59·51		59·85	.....	......		36 01·26
	12	ι Serpentis....		"	37 32·42		32·59	.....	......		37 34·00
	13	B.J. 581.......		"	38 57·96		58·20	59·60	1·40		38 59·61
	14	B.J. 583.......		"	42 02·17		02·31	03·72	1·41		42 03·72
	15	B.J. 584.......		"	44 41·43		41·59	43·03	1·44		44 43·00
	16	χ Herculis....		"	49 34·08		34·50	....	......		49 35·91
	17	B.J. 591.......		"	52 17·87		18·01	19·46	1·45		52 19·42
	18	B.J. 593.......		"	53 51·88		52·12	53·49	1·37		53 53·53
	19	B.J. 595.......		"	55 39·83		40·40	41·86	......		55 41·81
	20	r Herculis.....		"	57 11·84		12·00	....	......		57 13·41
	21	B.J. 598.......		"	16 00 12·80		13·46	14·98	......		16 00 14·87
	22	κ Herculis.....		"	04 00·94		01·09	....	......		04 02·50
	23	τ Cor. Bor....		"	05 41·03		41·37	....	......		05 42·78
	24	Groom. 750...	L.C.	"	07 47·38		11·99	43·84	1·85		....
June 4	25	23 Can. Ven...		S	13 16 16·71	−·017	17·13	.....	......	1·45	13·16 18·58
	26	B.J. 497.......		"	20 18·19	(·480)	18·82	20·34	......		20 20·27
	27	α Urs. Min....	L.C.	"	26 25·06		02·08	05·99	3·91		....
	28	B.J. 502.......		"	30 46·54		46·92	48·36	1·44		30 48·37
	29	25 Can. Ven...		"	33 27·56		27·93	.....	......		33 29·38
	30	B.J. 507.......		"	42 58·90		59·07	00·49	1·42		43 00·52
	31	B.J. 509.......		"	43 59·71		00·22	01·75	......		44 01·67
	32	B.J. 513.......		"	50 23·76		23·91	25·38	1·44		50 25·39
	33	B.J. 517.......		"	57 05·50		05·77	07·21	1·44		57 07·22
	34	9 H. Boötis...		"	14 04 19·84		20·32	....	.....		14 04 21·77
	35	B.J. 522.......		"	06 17·51		17·75	19·25	1·50		06 19·20
	36	B.J. 526.......		"	11 33·28		33·47	34·83	1·36		11 34·92
	37	B.J. 527.......		"	12 57·88		58·32	59·80	......		12 59·77
	38	B.J. 531.......		"	22 08·20		08·76	10·28	......		22 10·21
	39	204 B. Boötis..		"	26 04·04		04·49	....	......		26 05·94
	40	B.J. 534.......		"	27 57·07		57·37	58·80	1·43		27 58·82
	41	σ Boötis......		"	30 45·69		45·98	....	....		30 47·43
	42	B.J. 540.......		"	35 29·36		29·85	31·33	1·48		35 31·30
	43	B.J. 543.......		"	36 51·04		51·18	52·58	1·40		36 52·63
	44	34 Boötis.....		"	39 28·07		28·33	.....	.....		39 29·78
	45	ϵ Boötis......		"	41 03·40		03·66	.....	......		41 05·11
	46	295 B. Boötis..		"	45 34·70		35·09	.....	......		45 36·54
	47	ξ Boötis......		"	47 14·05		14·24	.....	......		47 15·69
	48	B.J. 549.......		"	49 09·86		10·61	12·06	....		49 12·06
	49	B.J. 555.......		"	58 33·49		33·91	35·36	1·45		58 35·36

Clamp West. 1−24. Adopted $\Delta T+m=1{\cdot}408+{\cdot}0034\ (T-14^h\ 25^m)$.
25−49. Adopted $\Delta T+m=1{\cdot}454+{\cdot}0035\ (T-15^h\ 20^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T + m$	Adopted $\Delta T + m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
June 1	1	B.J. 557......		S	15 00 35·43	− ·017	35·69	37·08	1·39	1·45	15 00 37·14
	2	ι Bootis		"	03 20·99	(·480)	21·24	...	......		03·22·69
	3	Groom. 2283..		"	06 16·18		26·98	29·38	2·40		....
	4	B.J. 563.......		"	11 52·66		52·99	54·34	1·35		11 54·44
	5	η Cor. Bor....		"	19 29·21		29·50	...	...		19 30·95
	6	B.J. 568.......		"	21 05·41		05·79	07·39	1·60		21 07·24
	7	B.J. 571.......		"	22 56·27		57·01	58·46	......		22 58·46
	8	B.J. 572.......		"	24 07·21		07·49	08·92	1·43		24 08·94
	9	B.J. 573.......		"	27 41·94		42·37	43·86	1·49		27 43·82
	10	ν² Bootis......		"	28 33·81		34·24	...	...		28 35·69
	11	B.J. 578.......		"	30 52·69		52·95	54·44	1·49		30 54·40
	12	B.J. 580......		"	34 35·85		36·27	37·74	1·47		34 37·72
	13	ξ Cor. Bor....		"	36 59·47		59·84	...	...		37 01·29
	14	ι Serpentis.....		"	37 32·41		32·60	...		1·46	37 34·06
	15	B.J. 581......		"	38 57·88		58·13	59·61	1·48		38 59·59
	16	B.J. 583.......		"	42 02·09		02·24	03·72	1·48		42 03·70
	17	B.J. 584.......		"	44 41·35		41·53	43·03	1·50		41 42·99
	18	χ Herculis....		"	49 33·99		34·44	...	...		49 35·90
	19	B.J. 591.......		"	52 17·73		17·89	19·46	1·57		52 19·35
	20	B.J. 593.......		"	53 51·75		52·01	53·50	1·49		53 53·47
	21	B.J. 595.......		"	55 39·84		40·46	41·85	...		55 41·92
	22	τ Herculis....		"	57 11·73		11·91	...	...		57 13·37
	23	B.J. 598.......		"	16 00 12·73		13·45	14·98	...		16 00 14·91
	24	κ Herculis.....		"	04 00·88		01·05	...	...		04 02·51
	25	τ Cor. Bor		"	05 40·98		41·35	...	...		05 42·81
	26	Groom. 750...	L.C.	"	07 47·97		42·19	43·96	1·77		....
	27	σ² Cor. Bor...		"	11 18·58		18·92	...	...		11 20·38
	28	B.J. 609.......		"	17 57·12		57·31	58·74	1·43		17 58·77
	29	23 Herculis...		"	19 29·28		29·60	...	...		19 31·06
	30	B.J. 613.......		"	21 15·78		15·92	17·45	1·53		21 17·38
	31	g Herculis		"	25 41·35		41·79	...	...		25 43·25
	32	ε Urs. Min....		"	55 14·22		17·52	19·18	1·66		....
	33	d Herculis		"	58 17·15		17·48	...	...		58 18·94
	34	B.J. 635......		"	17 01 12·42		12·55	14·00	1·45		17 01 14·01
	35	B.J. 636.......		"	04 50·71		51·13	52·65	1·52		04 52·59
	36	B.J. 640......		"	10 32·78		32·92	34·34	1·42		10 34·38
	37	B.J. 643......		"	11 54·89		55·26	56·71	1·45		11 56·72
	38	u Herculis ...		"	14 00·21		00·53	...	...		14 01·99
	39	w Herculis....		"	17 17·58		17·90	...	...		17 19·36
	40	ρ Herculis. ...		"	20 34·83		35·21	...	...		20 36·67
June 7	41	B.J. 643.......		S	17 11 51·62	− ·021	51·97	56·74	1·77	1·71	17 11 56·68
	42	w Herculis.....		"	17 17·36	(·457)	17·66	...	...		17 19·37
	43	ρ Herculis.....		"	20 34·53		34·89	...	...		20 36·60
	44	B.J. 653......		"	28 21·06		24·58	26·37	...		28 26·29
	45	B.J. 663......		"	36 55·53		55·95	57·63	...		36 57·66
	46	B.J. 667.....		"	42 56·00		56·25	57·97	1·72		42 57·96
	47	87 Herculis....		"	45 10·03		10·26	...	...		45 11·97
	48	z Herculis		"	47 42·09		42·55	...	...		47 44·26
	49	168 H¹. Herc..		"	49 08·91		09·30	...	...		49 11·01

Clamp West. 1−40. Adopted $\Delta T + m = 1{\cdot}454 + {\cdot}0035\ (T - 15^{h}\ 20^{m})$.
41−49. Adopted $\Delta T + m = 1{\cdot}713 + {\cdot}0035\ (T - 18^{h}\ 10^{m})$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
June 7	1	B.J. 671		S	17 51 58·55	−·021	59·17	00·95	......	1·71	17 52 00·88
	2	B.J. 672		"	53 09·84	(·457)	10·20	11·91	1·71		53 11·91
	3	B.J. 676		"	54 31·03		31·54	33·29	...		54 33·25
	4	B.J. 684		"	18 12 50·67		51·09	52·79	1·70		18 12 52·80
	5	446 B. Herc.		"	18 23·31		23·52	....	.....		18 25·23
	6	B. J. 690		"	19 51·59		51·78	53·49	1·71		19 53·49
	7	μ Lyrae		"	21 15·69		16·08	...	.....		21 17·79
	8	B.J. 694		"	22 35·91		36·58	38·34	.....		22 38·29
	9	B.J. 699		"	33 53·26		53·64	55·34	1·70		33 55·35
	10	51 H. Cephei	L.C.	"	58 27·17		18·08	20·29	2·21	1·72	......
	11	B.J. 716		"	19 01 16·14		16·27	17·99	1·72		19 01 17·99
	12	B.J. 719		"	04 05·03		05·37	07·11	1·74		04 07·09
	13	λ Urs. Min.		"	11 23·55		48·26	51·25	2·99		...
	14	159 B. Lyrae		"	15 57·19		57·59	....	...		15 59·31
	15	b Aquilae		"	20 40·42		40·54	..			20 42·26
	16	21 B. Vulp		"	21 41·86		42·08	....	....		21 43·80
	17	4 Cygni		"	22 54·16		54·50	.....	...		22 56·22
	18	α Vulp.		"	24 57·22		57·44	....	...		24 59·16
	19	B.J. 733		"	27 25·89		26·40	28·10			27 28·12
	20	ε Sagittae		"	33 12·55		12·69				33 14·41
	21	14 Cygni		"	36 30·18		30·61				36 32·33
June 8	22	43 H. Cephei	L.C.	N	12 56 08·34	−·012	02·47	05·37	2·90	1·81	...
	23	14 Can. Ven.		"	13 01 31·30	(·459)	31·63		...		13 01 33·44
	24	15 Can. Ven.		"	05 32·91		33·27		...		05 35·08
	25	B.J. 491		"	05 54·61		54·97	56·81	1·84		05 56·78
	26	B.J. 492		"	07 39·71		39·95	41·75	1·80		07 41·76
	27	19 Can. Ven.		"	11 28·58		28·97	....			11 30·78
	28	B.J. 494		"	13 29·83		30·21	32·06	1·85		13 32·02
	29	23 Can. Ven.		"	16 16·41		16·79				16 18·60
	30	B.J. 497		"	20 17·79		18·44	20·26			20 20·25
	31	α Urs. Min.	L.C.	"	26 28·97		07·90	10·07	2·17		...
	32	B.J. 502		"	30 46·22		46·56	48·32	1·76		30 48·37
	33	25 Can. Ven.		"	33 27·23		27·56	...			33 29·37
	34	B.J. 507		"	42 58·48		58·63	00·46	1·83		43 00·44
	35	B.J. 509		"	43 59·38		59·90	01·68			44 01·71
	36	B.J. 513		"	50 23·38		23·54	25·35	1·81		50 25·35
	37	B.J. 517		"	57 05·10		05·33	07·19	1·86		57 07·14
	38	9 H. Boötis		"	14 04 19·60		20·03	..	...		14 04 21·84
	39	B.J. 522		"	06 17·16		17·37	19·22	1·85		06 19·18
	40	B.J. 526		"	11 32·87		33·04	34·81	1·77		11 34·85
	41	B.J. 527		"	12 57·45		57·91	59·76	...		12 59·72
	42	B.J. 531		"	22 07·82		08·39	10·23			22 10·20
	43	204 B. Boötis		"	26 03·78		04·19				26 06·00
	44	B.J. 534		"	27 56·71		56·98	58·77	1·79		27 58·79
	45	B.J. 535		"	28 26·96		27·32	29·10	1·78		28 29·13
	46	σ Boötis		"	30 45·28		45·54				30 47·35
	47	B.J. 540		"	35 29·11		29·55	31·30	1·75		35 31·36
	48	B.J. 543		"	36 50·63		50·74	52·58	1·84		36 52·55
	49	34 Boötis		"	39 27·74		27·96	.....	.....		39 29·77

Clamp West. 1–21. Adopted $\Delta T+m=1{\cdot}713+{\cdot}0035\ (T-18^{h}\ 10^{m})$.
22–49. Adopted $\Delta T+m=1{\cdot}811+{\cdot}0035\ (T-14^{h}\ 30^{m})$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
June 8	1	ε Boötis.......		N	14 41 03·06	−·012	03·29	......	....	1·81	14 41 05·10
	2	295 B. Boötis..		"	45 34·46	(·459)	34·81	......	....		45 36·62
	3	ξ Boötis.......		"	47 13·82		13·98	......	....		47 15·79
	4	B.J. 549.......		"	49 09·44		10·21	12·00	....		49 12·02
	5	B.J. 551.......		"	51 57·98		58·10	59·91	1·81		51 59·91
	6	B.J. 555.......		"	58 33·07		33·46	35·34	1·88		58 35·27
	7	B.J. 557.......		"	15 00 35·04		35·27	37·08	1·81		15 00 37·08
	8	c Boötis.......		"	03 20·55		20·76	......	....		03 22·57
	9	Groom. 2283..		"	06 12·81		23·77	27·88	4·11		....
	10	B.J. 563.......		"	11 52·15		52·45	54·33	1·88		11 54·26
	11	η Cor. Bor.....		"	19 28·92		29·18	......	....		19 30·99
	12	B.J. 568.......		"	21 05·21		05·55	07·38	1·83		21 07·36
	13	B.J. 571.......		"	22 55·77		56·52	58·42	....		22 58·33
	14	B.J. 573.......		"	27 41·57		41·96	43·85	1·89		27 43·77
	15	ν^2 Boötis......		"	28 33·57		33·96	......	....		28 35·77
	16	B.J. 578.......		"	30 52·35		52·57	54·42	1·85		30 54·38
	17	B.J. 580.......		"	34 35·53		35·92	37·74	1·82		34 37·73
	18	ζ Cor. Bor....		"	35 59·18		59·51	......	....		36 01·32
	19	ι Serpentis....		"	37 32·06		32·23	......	....		37 34·04
	20	B.J. 581.......		"	38 57·60		57·82	59·61	1·79	1·82	38 59·64
	21	B.J. 583.......		"	42 01·86		01·99	03·74	1·75		42 03·81
	22	B.J. 584.......		"	44 41·01		41·19	43·05	1·86		44 43·01
	23	χ Herculis....		"	49 33·75		34·16	......	....		49 35·98
	24	B.J. 591.......		"	52 17·55		17·68	19·48	1·80		52 19·50
	25	B.J. 593.......		"	53 51·49		51·71	53·51	1·80		53 53·53
	26	B.J. 595.......		"	55 39·32		39·96	41·84	....		55 41·78
	27	r Herculis		"	57 11·51		11·66	......	....		57 13·48
	28	B.J. 598.......		"	16 00 12·32		13·06	14·96	....		16 00 14·88
	29	κ Herculis.....		"	04 00·60		00·74	......	....		04 02·56
	30	τ Cor. Bor....		"	05 40·64		40·97	......	....		05 42·79
	31	Groom. 750...	L.C.	"	07 47·71		42·41	44·54	2·13		....
June 9	32	23 Can. Ven...		S	13 16 16·25	−·021	16·66	......	....	1·94	13 16 18·60
	33	B.J. 497.......		"	20 17·65	(·462)	18·25	20·23	....		20 20·19
	34	α Urs. Min....	L.C.	"	26 30·57		08·65	11·01	2·36		....
	35	B.J. 502.......		"	30 46·03		46·40	48·31	1·91		30 48·34
	36	25 Can. Ven...		"	33 27·06		27·42	......	....		33 29·36
	37	B.J. 507.......		"	42 58·36		58·52	00·46	1·94		43 00·46
	38	B.J. 509.......		"	43 59·12		59·60	01·67	....		44 01·54
	39	B.J. 513.......		"	50 23·28		23·45	25·35	1·90		50 25·39
	40	B.J. 517.......		"	57 04·98		05·24	07·18	1·94		57 07·18
	41	9 H. Boötis...		"	14 04 19·38		19·83	......	....		14 04 21·77
	42	B.J. 522.......		"	06 17·04		17·27	19·22	1·95		06 19·21
	43	B.J. 526.......		"	11 32·77		32·95	34·81	1·86		11 34·89
	44	B.J. 527.......		"	12 57·37		57·80	59·75	....		12 59·74
	45	B.J. 531.......		"	22 07·67		08·20	10·22	....		22 10·14
	46	g Boötis		"	25 29·69		30·17	......	....		25 32·11
	47	B.J. 534.......		"	27 56·51		56·80	58·77	1·97		27 58·74
	48	σ Boötis		"	30 45·15		45·43	......	....		30 47·37
	49	B.J. 540.......		"	35 28·86		29·32	31·29	1·97		35 31·26

Clamp West. 1−31. Adopted $\Delta T+m=1{\cdot}811+{\cdot}0035\ (T-14^h\ 30^m)$.
32−49. Adopted $\Delta T+m=1{\cdot}942+{\cdot}0035\ (T-14^h\ 40^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
June 9	1	B.J. 543.......		S	14 36 50·45	−·021	50·59	52·58	1·99	1·94	14 36 52·53
	2	34 Boötis.....		"	39 27·51	(·462)	27·76	.....	......		39 29·70
	3	ε Boötis.......		"	41 02·87		03·12	.....	......		41 05·06
	4	295 B. Boötis..		"	45 34·31		34·69	.....	......		45 36·63
	5	ξ Boötis.......		"	47 13·60		13·77	.....	......		47 15·71
	6	B.J. 549.......		"	49 09·35		10·06	11·98	......		49 12·00
	7	B.J. 551.......		"	51 57·81		57·95	59·91	1·96		51 59·89
	8	B.J. 555.......		"	58 32·97		33·38	35·34	1·96		58 35·32
	9	i Boötis		"	15 00 49·28		49·73	.....	......		15 00 51·67
	10	c Boötis		"	03 20·39		20·62	.....	......		03 22·56
	11	Groom. 2283..		"	06 14·18		24·47	27·54	3·07		....
	12	B.J. 563.......		"	11 52·06		52·38	54·33	1·95		11 54·32
	13	η Cor. Bor....		"	19 28·80		29·08	.....	......		19 31·02
	14	B.J. 568.......		"	21 05·06		05·43	07·38	1·95		21 07·37
	15	B.J. 571.......		"	22 55·69		56·39	58·41	......		22 58·33
	16	B.J. 572.......		"	24 06·66		06·93	08·92	1·99		24 08·87
	17	B.J. 573.......		"	27 41·47		41·88	43·85	1·97		27 43·82
	18	ν^2 Boötis.....		"	28 33·34		33·76	....	......		28 35·70
	19	B.J. 578.......		"	30 52·25		52·50	54·44	1·94		30 54·44
	20	B.J. 580.......		"	34 35·41		35·82	37·74	1·92	1·95	34 37·77
	21	ζ Cor. Bor....		"	35 59·00		59·36	....	......		36 01·31
	22	ι Serpentis....		"	37 31·88		32·06	.....	......		37 34·01
	23	B.J. 581.......		"	38 57·40		57·64	59·61	1·97		38 59·59
	24	B.J. 583.......		"	42 01·66		01·80	03·74	1·94		42 03·75
	25	B.J. 584.......		"	44 40·95		41·11	43·05	1·94		44 43·06
	26	χ Herculis....		"	49 33·57		34·01	.....	......		49 35·96
	27	B.J. 591.......		"	52 17·37		17·51	19·48	1·97		52 19·46
	28	B.J. 593.......		"	53 51·27		51·52	53·51	1·99		53 53·47
	29	B.J. 595.......		"	55 39·30		39·89	41·84	....		55 41·84
	30	r Herculis		"	57 11·31		11·47	....	......		57 13·42
	31	B.J. 598.......		"	16 00 12·25		12·93	14·96	......		16 00 14·88
	32	κ Herculis.....		"	04 00·42		00·57	....	......		04 02·52
	33	B.J. 601.......		"	05 55·89		56·36	58·25	......		05 58·31
	34	Groom. 750...	L.C.	"	07 47·69		42·17	44·69	2·52		....
	35	σ^2 Cor. Bor...		"	11 18·27		18·59	....	......		11 20·54
	36	B.J. 608.......		"	17 02·00		02·43	04·39	......		17 01·38
June 10	37	B.J. 527.......		N	14 12 57·08	·003	57·60	59·73	......	2·14	14 12 59·74
	38	f Boötis		"	22 15·36	(·486)	15·53	.....	......		22 17·67
	39	204 B. Boötis..		"	26 03·26		03·71	....	......		26 05·85
	40	B.J. 534.......		"	27 56·33		56·62	58·76	2·14		27 58·76
	41	B.J. 535.......		"	28 26·54		26·94	29·09	2·15		28 29·08
	42	σ Boötis......		"	30 44·95		45·23	....	......		30 47·37
	43	B.J. 540.......		"	35 28·63		29·12	31·28	2·16		35 31·26
	44	B.J. 543.......		"	36 50·36		50·47	52·57	2·10		36 52·61
	45	34 Boötis.....		"	39 27·31		27·56	.....	......		39 29·70
	46	ε Boötis.......		"	41 02·74		02·99	.....	......		41 05·13
	47	295 B. Boötis .		"	45 34·04		34·13	.....	......		45 36·57
	48	ξ Boötis.......		"	47 13·39		13·56	.....	......		47 15·70
	49	B.J. 549.......		"	49 08·97		09·80	11·96	......		49 11·94

From June 9 Clamp West; from June 10 Clamp East.
1−36. Adopted $\Delta T+m=1{\cdot}942+{\cdot}0035$ ($T-14^h\ 40^m$).
37−49. Adopted $\Delta T+m=2{\cdot}146+{\cdot}0036$ ($T-15^h\ 10^m$).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
June 10	1	B.J. 551.......		N	14 51 57·62	·003	57·74	59·91	2·17	2·14	14 51 59·88
	2	B.J. 555.......		"	58 32·79	(·486)	33·22	35·33	2·11	2·15	58 35·37
	3	B.J. 557.......		"	15 00 34·68		34·93	37·07	2·14		15 00 37·08
	4	ψ Boötis		"	03 20·20		20·43	. .	....		03 22·58
	5	Groom. 2283..		"	06 13·37		24·60	27·21	2·61		....
	6	B.J. 563......		"	11 51·84		52·17	54·32	2·15		11 54·32
	7	B.J. 568.......		"	21 04·81		05·19	07·37	2·18		21 07·34
	8	B.J. 571.......		"	22 55·36		56·18	58·39	....		22 58·33
	9	B.J. 572.....		"	24 06·47		06·74	08·92	2·18		24 08·89
	10	B.J. 573......		"	27 41·25		41·68	43·84	2·16		27 43·83
	11	ν² Bootis......		"	28 33·21		33·65	. .	. .		28 35·80
	12	B.J. 576.......		"	29 17·48		17·78	19·89	2·11		29 19·93
	13	B.J. 578.......		"	30 52·00		52·25	54·41	2·19		30 54·40
	14	B.J. 580.......		"	34 35·17		35·60	37·73	2·13		34 37·75
	15	ζ Cor. Bor....		"	35 58·76		59·13	. .	. .		36 01·28
	16	ι Serpentis....		"	37 31·69		31·86		. .		37 34·01
	17	B.J. 581.......		"	38 57·20		57·44	59·61	2·17		38 59·59
	18	B.J. 583.......		"	42 01·37		01·50	03·74	2·24		42 03·65
	19	B.J. 584.......		"	44 40·72		40·88	43·05	2·17		44 43·03
	20	χ Herculis ...		"	49 33·30		33·76		.		49 35·91
	21	B.J. 591.......		"	52 17·17		17·31	19·48	2·17		52 19·46
	22	B.J. 593.......		"	53 51·13		51·38	53·51	2·13		53 53·53
	23	B.J. 595.......		"	55 38·88		39·58	41·83	......		55 41·73
	24	r Herculis.....		"	57 11·16		11·32	..	......		57 13·47
	25	B.J. 598.......		"	16 00 11·89		12·69	14·95	.....		16 00 14·84
	26	κ Herculis.....		"	04 00·22		00·37	.	......		04 02·52
	27	τ Cor. Bor....		"	05 40·25		40·62	..	.....		05 42·77
	28	Groom. 750...	L.C.	"	07 47·79	——	42·40	44·83	2·43	——	....
June 13	29	B.J. 497.......		N	13 20 17·22	·002	17·95	20·14	. .	2·25	13 20 20·20
	30	α Urs. Min....	L.C.	"	26 31·96	(·503)	09·75	14·42	4·67		....
	31	B.J. 502......		"	30 45·67	(·464)*	46·06	48·25	2·19		30 48·31
	32	B.J. 507.......		"	42 57·94		58·10	00·43	2·33		43 00·35
	33	B.J. 509......		"	43 58·77		59·36	01·60	......		44 01·61
	34	B.J. 513		"	50 22·91		23·08	25·32	2·24		50 25·33
	35	B.J. 517.......		"	57 04·62		04·89	07·15	2·26		57 07·14
	36	9 H. Boötis...		S	14 04 18·92		19·41	..	.....	2·28*	14 04 21·69
	37	B.J. 522.......		N	06 16·68		16·92	19·19	2·27		06 19·17
	38	B.J. 526.......		"	11 32·35		32·53	34·78	2·25		11 34·78
	39	B.J. 528.......		S	12 58·00		58·55	00·82	....		13 00·83
	40	B.J. 531.......		N	22 07·29		07·94	10·14	.....		22 10·19
	41	g Boötis.......		S	25 29·21		29·74		......		25 32·02
	42	B.J. 534.......		N	27 56·17		56·47	58·74	2·27		27 58·72
	43	B.J. 535.......		"	28 26·41		26·81	29·06	2·25		28 29·06
	44	σ Boötis		S	30 44·81		45·11	.....	......		30 47·39
	45	B.J. 540.......		N	35 28·42		28·92	31·24	2·32		35 31·17
	46	B.J. 543.......		"	36 50·22		50·34	52·56	2·22		36 52·59
	47	34 Bootis.....		"	39 27·14		27·40	......	......		39 29·65
	48	ϵ Bootis.......		"	41 02·61		02·87	......	......		41 05·12
	49	295 B. Boötis..		S	45 33·89		34·29	......	......		45 36·57

Clamp East.

For polar deviation and adopted $\Delta T+m$ the unmarked values are for observations by N, those marked * for observations by S.

1–28. Adopted $\Delta T+m=2{\cdot}146+{\cdot}0036$ ($T-15^h\ 10^m$).

29–49. Adopted $\Delta T+m$ for observations by $N=2{\cdot}253+{\cdot}0036$ ($T-15^h\ 10^m$); for observations by $S=2{\cdot}282+{\cdot}0036$ ($T-15^h\ 45^m$).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
June 13	1	ξ Boötis		N	14 47 13·28	·002	13·46	.....	......	2·25	14 47 15·71
	2	B.J. 549		"	49 08·85	(·503)	09·71	11·90	.....		49 11·96
	3	B.J. 551		"	51 57·49	(·464)*	57·61	59·90	2·29		51 59·86
	4	B.J. 555		S	58 32·62		33·05	35·31	2·26	2·28*	58 35·33
	5	B.J. 557		N	15 00 34·57		34·83	37·06	2·23		15 00 37·08
	6	Groom. 2283		S	06 13·31		23·43	26·34	2·91		.....
	7	B.J. 563		N	11 51·69		52·03	54·31	2·28		11 54·28
	8	η Cor. Bor.		"	19 28·45		28·75		.		19 31·00
	9	B.J. 568		S	21 04·69		05·08	07·36	2·28		21 07·36
	10	B.J. 571		"	22 55·26		55·99	58·34	.		22 58·27
	11	B.J. 572		N	24 06·38		06·66	08·91	2·25		24 08·91
	12	B.J. 573		"	27 41·18		41·62	43·82	2·20		27 43·87
	13	ν^2 Boötis		"	28 32·99		33·43				28 35·68
	14	B.J. 576		S	29 17·23		17·55	19·88	2·33		29 19·83
	15	B.J. 578		N	30 51·95		52·21	54·43	2·22		30 54·46
	16	B.J. 580		S	34 34·98		35·41	37·72	2·31		34 37·69
	17	ζ Cor. Bor.		N	35 58·63		59·01	..	..		36 01·26
	18	ι Serpentis		"	37 31·65		31·83	...	.		37 34·08
	19	B.J. 581		"	38 57·06		57·31	59·61	2·30		38 59·56
	20	B.J. 583		"	42 01·33		01·46	03·74	2·28		42 03·71
	21	B.J. 584		"	44 40·59		40·76	43·05	2·29	2·26	44 43·02
	22	χ Herculis		S	49 33·19		33·66	.		2·28*	49 35·94
	23	B.J. 591		N	52 17·11		17·25	19·49	2·24		52 19·51
	24	B.J. 593		"	53 50·96		51·22	53·51	2·29		53 53·48
	25	B.J. 595		S	55 38·90		39·52	41·80	.		55 41·80
	26	r Herculis		N	57 11·04		11·21	.			57 13·47
	27	B.J. 598		"	16 00 11·87		12·70	14·91			16 00 14·96
	28	κ Herculis		"	04 00·12		00·27	..			04 02·53
	29	τ Cor. Bor.		"	05 40·18		40·56	.			05 42·82
	30	Groom. 750	L.C.	S	07 47·93		42·55	45·21	2·66		..
	31	σ^2 Cor. Bor.		N	11 17·92		18·26				11 20·52
	32	B.J. 608		"	17 01·53		02·06	04·38	.		17 04·32
	33	ξ Cor. Bor.		"	18 34·81		35·11		..		18 37·37
	34	23 Herculis		S	19 28·46		28·79		..		19 31·07
	35	B.J. 613		N	21 15·06		15·18	17·50	2·32		21 17·44
	36	ϱ Herculis		"	25 40·54		40·99		..		25 43·25
	37	B.J. 621		S	31 11·46		11·93	14·27	2·34		31 14·21
	38	ζ Herculis		N	37 53·02		53·33				37 55·59
	39	B.J. 626		"	39 48·05		48·46	50·72	2·26		39 50·72
	40	B.J. 627		S	43 35·09		35·76	38·08		2·29*	43 38·05
	41	B.J. 629		N	47 58·56		58·69	00·81	2·12	2·26	48 00·95
	42	53 Herculis		"	49 32·60		32·91				49 35·17
	43	ε Urs. Min.		"	55 12·72		16·30	18·85	2·55		.....
June 15	44	α Urs. Min.	L.C.	S	13 26 33·25	·028	12·14	16·22	4·08	2·48	.....
	45	B.J. 502		"	30 45·39	(·431)	45·79	48·23	2·44		13 30 48·27
	46	B.J. 507		"	42 57·74		57·93	00·42	2·49		43 00·41
	47	B.J. 509		"	43 58·56		59·08	01·56	.		44 01·56
	48	B.J. 513		"	50 22·64		22·84	25·31	2·47	2·49	50 25·33
	49	B.J. 526		"	14 11 32·11		32·32	34·77	2·45		14 11 34·81

Clamp East.

1–43. For polar deviation and adopted $\Delta T+m$ the unmarked values are for observations by N, those marked * for observations by S.

1–43. Adopted $\Delta T+m$ for observations by N$=2{\cdot}253+{\cdot}0036$ (T-15^h 10^m); for observations by S$=2{\cdot}282+{\cdot}0036$ (T-15^h 45^m).

44–49. Adopted $\Delta T+m=2{\cdot}490+{\cdot}0036$ (T-15^h 10^m).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
June 15	1	B.J. 531.......		S	14 22 07·08	·028	07·65	10·11	....	2·49	14 22 10·14
	2	B.J. 534.......		"	27 55·91	(·431)	56·23	58·73	2·50		27 58·72
	3	B.J. 535.......		"	28 26·11		26·52	29·04	2·52		28 29·01
	4	B.J. 540.......		"	35 28·20		28·70	31·22	2·52		35 31·19
	5	B.J. 543.......		"	36 49·93		50·08	52·56	2·48		36 52·57
	6	34 Boötis......		"	39 26·91		27·18	....	....		39 29·67
	7	ε Boötis.......		"	41 02·25		02·54	....	....		41 05·03
	8	ξ Boötis.......		"	47 12·99		13·19	....	....		47 15·68
	9	B.J. 549.......		"	49 08·62		09·36	11·86	....		49 11·85
	10	B.J. 551.......		"	51 57·20		57·35	59·89	2·54		51 59·84
	11	B.J. 557.......		"	15 00 34·29		34·58	37·05	2·47		15 00 37·07
	12	B.J. 563.......		"	11 51·45		51·80	54·30	2·50		11 54·29
	13	η Cor. Bor....		"	19 28·17		28·48	....	....		19 30·97
	14	B.J. 572.......		"	24 06·08		06·38	08·90	2·52		24 08·87
	15	B.J. 573.......		"	27 40·80		41·24	43·81	2·57		27 43·73
	16	ν^2 Boötis......		"	28 32·70		33·15	....	....		28 35·64
	17	B.J. 578.......		"	30 51·70		51·97	54·43	2·46		30 54·46
	18	ζ Cor. Bor....		"	35 58·34		58·73	....	....		36 01·22
	19	ι Serpentis....		"	37 31·31		31·52	....	....		37 34·01
	20	B.J. 581.......		"	38 56·82		57·10	59·60	2·50		38 59·59
	21	B.J. 583.......		"	42 01·08		01·24	03·74	2·50		42 03·73
	22	B.J. 584.......		"	44 40·30		40·49	43·05	2·56		44 42·98
	23	B.J. 591.......		"	52 16·82		16·99	19·49	2·50		52 19·48
	24	B.J. 593.......		"	53 50·72		50·99	53·51	2·52		53 53·48
	25	r Herculis.....		"	57 10·71		10·90	....	....		57 13·39
	26	B.J. 598.......		"	16 00 11·62		12·33	14·89	....		16 00 14·82
	27	κ Herculis.....		"	03 59·91		00·09	....	....		04 02·58
	28	τ Cor. Bor....		"	05 39·91		40·30	....	....		05 42·79
	29	σ^2 Cor. Bor....		"	11 17·64		17·99	....	....		11 20·48
	30	B.J. 608.......		"	17 01·44		01·91	04·38	....		17 04·40
	31	ξ Cor. Bor.....		"	18 34·58		34·90	....	....		18 37·39
	32	B.J. 613.......		"	21 14·88		15·03	17·51	2·48		21 17·52
	33	B.J. 614.......		"	22 26·58		27·21	29·83	....		22 29·70
	34	g Herculis......		"	25 40·34		40·80	....	....		25 43·29
	35	ζ Herculis.....		"	37 52·76		53·10	....	....	2·50	37 55·60
	36	B.J. 626.......		"	39 47·84		48·26	50·73	2·47		39 50·76
	37	B.J. 629.......		"	47 58·24		58·40	00·82	2·42		48 00·90
	38	53 Herculis....		"	49 32·41		32·74	....	....		49 35·24
	39	ε Urs. Min.....		"	55 12·97		16·05	18·79	2·74		....
June 18	40	α Urs. Min....	L.C.	N	13 26 32·04	−·020	15·55	19·36	3·81	2·73	....
	41	25 Can. Ven...		"	33 26·26	(·373)	26·52	....	....		13 33 29·25
	42	B.J. 507.......		"	42 57·55	(·350)*	57.66	00.40	2.74		43 00·39
	43	B.J. 509.......		"	43 58·36		58·77	01·51	....		44 01·50
	44	B.J. 513.......		"	50 22·41		22·53	25·29	2·76	2·74	50 25·27
	45	B.J. 517.......		"	57 04·17		04·35	07·11	2·76		57 07·09
	46	9 H. Boötis...		S	14 04 18·50		18·85	....	....	2·77*	14 04 21·62
	47	B.J. 522.......		N	06 16·24		16·41	19·15	2·74		06 19·15
	48	B.J. 526.......		"	11 31·87		31·99	34·75	2·76		11 34·73
	49	B.J. 528.......		S	12 57·57		57·94	00·73	....		13 00·71

From June 15 Clamp East; from June 18 Clamp West.

1—39. Adopted $\Delta T+m=2{\cdot}490+{\cdot}0036$ $(T-15^h\ 10^m)$.

40—49. For polar deviation and adopted $\Delta T+m$ the unmarked values are for observations by N, those marked * for observations by S.

40—49. Adopted $\Delta T+m$ for observations by $N=2{\cdot}740+{\cdot}0037$ $(T-15^h\ 10^m)$; for observations by $S=2{\cdot}772+{\cdot}0037$ $(T-15^h\ 45^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit.	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent ΔT+m	Adopted ΔT+m	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
June 18	1	B.J. 531		N	14 22 06·90	−·020	07·35	10·05		2·74	14 22 10·09
	2	g Boötis		S	25 28·87	(·373)	29·22			2·77*	25 31·99
	3	B.J. 534		N	27 55·77	(·350)*	55·97	58·71	2·74		27 58·71
	4	B.J. 535		"	28 26·07		26·35	29·01	2·66		28 29·09
	5	σ Boötis		S	30 44·34		44·55				30 47·32
	6	B.J. 540		N	35 28·14		28·48	31·18	2·70		35 31·22
	7	B.J. 543		"	36 49·72		49·80	52·54	2·74		36 52·54
	8	34 Boötis		"	39 26·78		26·96				39 29·70
	9	ε Boötis		"	41 02·10		02·28				41 05·02
	10	295 B. Boötis		S	45 33·47		33·76				45 36·53
	11	ξ Boötis		N	47 12·80		12·92				47 15·66
	12	B.J. 549		"	49 08·48		09·09	11·80			49 11·83
	13	B.J. 551		"	51 56·99		57·08	59·88	2·80		51 59·82
	14	B.J. 555		S	58 32·19		32·50	35·27	2·77		58 35·27
	15	B.J. 557		N	15 00 34·09		34·27	37·03	2·76		15 00 37·01
	16	Groom. 2283		S	06 13·42		21·08	24·61	3·53		......
	17	B.J. 563		N	11 51·37		51·60	54·28	2·68		11 54·34
	18	η Cor. Bor		"	19 28·09		28·29				19 31·03
	19	B.J. 568		S	21 04·26		04·54	07·33	2·79		21 07·31
	20	B.J. 571		"	22 55·00		55·51	58·26			22 58·28
	21	B.J. 572		N	24 05·94		06·13	08·89	2·76		24 08·87
	22	B.J. 573		"	27 40·76		41·06	43·79	2·73		27 43·80
	23	ν² Boötis		"	28 32·64		32·95				28 35·69
	24	B.J. 576		S	29 16·86		17·09	19·86	2·77		29 19·86
	25	B.J. 578		N	30 51·51		51·69	54·42	2·73		30 54·43
	26	B.J. 580		S	34 34·57		34·88	37·69	2·81		34 37·65
	27	ζ Cor. Bor		N	35 58·30		58·56				36 01·30
	28	ι Serpentis		"	37 31·19		31·31				37 34·05
	29	B.J. 581		"	38 56·64		56·82	59·60	2·78		38 59·56
	30	B.J. 583		"	42 00·91		01·00	03·74	2·74		42 03·74
	31	B.J. 584		"	44 40·17		40·28	43·05	2·77		44 43·02
	32	χ Herculis		S	49 32·80		33·13				49 35·90
	33	B.J. 591		N	52 16·68		16·78	19·49	2·71		52 19·52
	34	B.J. 593		"	53 50·52		50·70	53·51	2·81		53 53·44
	35	B.J. 595		S	55 38·56		38·99	41·76			55 41·76
	36	r Herculis		N	57 10·51		10·62				57 13·36
	37	B.J. 598		"	16 00 11·41		12·00	14·86			16 00 14·74
	38	κ Herculis		"	03 59·64		59·75				04 02·49
	39	τ Cor. Bor		"	05 39·80		40·06				05 42·80
	40	Groom. 750	L.C.	S	07 46·83		42·67	45·91	3·24		......
	41	σ² Cor. Bor		N	11 17·48		17·71				11 20·45
	42	B.J. 608		"	17 01·28		01·65	04·37			17 04·39
	43	ξ Cor. Bor		"	18 34·44		34·64				18 37·38
	44	23 Herculis		S	19 28·17		28·40				19 31·17
	45	g Herculis		N	25 40·22		40·54				25 43·28
	46	B.J. 621		S	31 11·11		11·44	14·27	2·83		31 14·21
	47	42 Herculis		"	36 17·46		17·80			2·78*	36 20·58
	48	ζ Herculis		N	37 52·62		52·83			2·75	37 55·58
	49	B.J. 626		"	39 47·68		47·96	50·73	2·77		39 50·71
	50	B.J. 627		S	43 34·81		35·27	38·06			43 38·05

Clamp West.

For polar deviation and adopted $\Delta T+m$ the unmarked values are for observations by N, those marked * for observations by S.

Adopted $\Delta T+m$ for observations by N=2·740+·0037 (T−15^h 10^m); for observations by S=2·772 +·0037 (T−15^h 45^m).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent ΔT+m	Adopted ΔT+m	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
June 18	1	53 Herculis....		N	16 49 32·32	−·020	32·53	...	.....	2·75	16 49 35·28
	2	ε Urs. Min.....		"	55 13·13	(·373)	15·80	18·66	2·86		....
June 19	3	α Urs. Min....	L.C.	S	13 26 33·81	−·023	16·90	20·49	3·59	2·84	....
	4	B.J. 502.......		"	30 45·07	(·362)	45·35	18·18	2·83		13 30 48·19
	5	25 Can. Ven...		"	33 26·08	(·374)*	26·35	.....	.....		33 29·19
	6	B.J. 507.......		"	42 57·38		57·51	00·39	2·88		43 00·35
	7	B.J. 509.......		"	43 58·24		58·60	01·49	....		44 01·44
	8	B.J. 513.......		"	50 22·30		22·43	25·28	2·85		50 25·27
	9	B.J. 517.......		"	57 04·03		04·23	07·10	2·87		57 07·07
	10	9 H. Boötis...		N	14 01 18·51		18·85	.....	...	2·79*	14 04 21·64
	11	B.J. 522.......		S	06 16·10		16·28	19·14	2·86		06 19·12
	12	B.J. 526.......		"	11 31·74		31·88	34·74	2·86		11 34·72
	13	B.J. 528.......		N	12 57·51		57·95	00·72	.. ..		13 00·74
	14	B.J. 531.......		S	22 06·78		07·18	10·03	.. ....		22 10·02
	15	g Boötis......		N	25 28·84		29·26	.....	....		25 32·05
	16	B.J. 534.......		S	27 55·63		55·86	58·70	2·84		27 58·70
	17	B.J. 535.......		"	28 25·85		26·14	29·00	2·86		28 28·98
	18	σ Boötis.....		N	30 44·32		44·52	..	...		30 47·31
	19	B.J. 540.......		S	35 27·94		28·30	31·17	2·87		35 31·14
	20	B.J. 543.......		"	36 49·59		49·69	52·54	2·85		36 52·53
	21	34 Boötis....		"	39 26·60		26·79	.....	....		39 29·63
	22	ε Boötis.......		"	41 02·02		02·22	.....	....		41 05·06
	23	295 B. Boötis		N	45 33·43		33·59	.....	....		45 36·38
	24	ξ Boötis		S	47 12·72		12·86	.....	....		47 15·70
	25	B.J. 549.......		"	49 08·42		08·95	11·77	.. ...		49 11·79
	26	B.J. 551.......		"	51 56·94		57·04	59·88	2·84		51 59·88
	27	B.J. 555.......		N	58 32·13		32·42	35·26	2·81	2·80*	58 35·22
	28	B.J. 557.......		S	15 00 34·00		34·20	37·03	2·83	2·84	15 00 37·04
	29	Groom. 2283..		N	06 12·26		20·95	21·18	3·23		....
	30	B.J. 563.......		S	11 51·19		51·43	54·28	2·85		11 54·27
	31	η Cor. Bor....		"	19 27·92		28·14	.....	..		19 30·98
	32	B.J. 568.......		N	21 04·30		04·56	07·33	2·77		21 07·36
	33	B.J. 571.......		"	22 54·95		55·54	58·24	.. ..		22 58·34
	34	B.J. 572.......		S	24 05·83		06·04	08·89	2·85		24 08·88
	35	B.J. 573.......		"	27 40·59		40·90	43·79	2·89		27 43·74
	36	ν² Boötis......		"	28 32·48		32·80	.	...		28 35·64
	37	B.J. 576.......		N	29 16·85		17·06	19·86	2·80		29 19·86
	38	B.J. 578.......		S	30 51·42		51·61	54·42	2·81		30 54·45
	39	B.J. 580.......		N	34 34·50		34·79	37·69	2·90		34 37·59
	40	ξ Cor. Bor.....		S	35 58·08		58·35	.....	...		36 01·19
	41	ι Serpentis...		"	37 31·02		31·16	.....	...		37 34·00
	42	B.J. 581.......		"	38 56·57		56·76	59·60	2·84		38 59·60
	43	B.J. 583.......		"	42 00·78		00·89	03·74	2·85		42 03·73
	44	B.J. 584.......		"	44 40·07		40·20	43·05	2·85	2·85	44 43·05
	45	χ Herculis....		N	49 32·77		33·08	.....	.....	2·80*	49 35·88
	46	B.J. 591.......		S	52 16·57		16·68	19·49	2·81		52 19·53
	47	B.J. 593.......		"	53 50·50		50·69	53·51	2·82		53 53·54
	48	B.J. 595.......		N	55 38·49		38·99	11·75	....		55 41·79
	49	τ Herculis		S	57 10·48		10·61	.....	....		57 13·46

Clamp West.

1, 2. Adopted $\Delta T+m = 2{\cdot}740 + {\cdot}0037$ (T−15ʰ 10ᵐ).

3—49. For polar deviation and adopted $\Delta T+m$ the unmarked values are for observations by S, those marked * for observations by N.

3—49. Adopted $\Delta T+m$ for observations by S=2·813+·0037 (T−15ʰ 10ᵐ); for observations by N=2·798+·0037 (T−15ʰ 45ᵐ).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
June 19	1	B.J. 598.......		S	16 00 11·44	−·023	11·96	14·85	....	2·85	16 00 14·81
	2	κ Herculis.....		"	03 59·65	(·362)	59·77	.....	....		04 02·62
	3	τ Cor. Bor		"	05 39·69	(·374)*	39·96	....	......		05 42·81
	4	Groom. 750...	L.C.	N	07 47·18		43·05	46·10	3·05	2·80*	....
	5	σ² Cor. Bor....		S	11 17·39		17·64	....	......		11 20·49
	6	B.J. 608.......		"	17 01·22		01·53	04·37	....		17 04·38
	7	ξ Cor. Bor.....		"	18 31·29		34·52	....	......		18 37·37
	8	23 Herculis...		N	19 28·21		28·43	.....	......		19 31·23
	9	B.J. 613.......		S	21 14·60		14·70	17·52	2·82		21 17·55
	10	B.J. 614.......		"	22 26·45		26·89	29·81	... ..		22 29·74
	11	g Herculis		"	25 40·12		40·45	..	....		25 43·30
	12	B.J. 621.......		N	31 11·17		11·48	14·27	2·79		31 14·28
	13	42 Herculis....		"	36 17·51		17·91	...	....		36 20·71
	14	ζ Herculis.....		S	37 52·56		52·79	...	....		37 55·64
	15	B.J. 626.......		"	39 47·59		47·88	50·73	2·85		39 50·73
	16	B.J. 627.......		N	43 34·78		35·32	38·06	.....		43 38·12
	17	B.J. 629.......		S	47 57·86		57·97	00·84	2·87		48 00·82
	18	53 Herculis...		"	49 32·18		32·41	..	.....		49 35·26
	19	ε Urs. Min.....		"	55 13·24		15·64	18·59	2·95		.. ..
June 25	20	B.J. 531.......		S	14 22 06·53	−·020	07·01	9·91	.....	2·96	14 22 09·97
	21	5 Urs. Min....		"	27 41·83	(·417)	43·39	.....	.....		27 46·35
	22	σ Bootis......		"	30 44·01		44·29	.....	......		30 47·25
	23	B.D. 80·448...		"	36 05·98		08·19	...	......		36 11·15
	24	295 B. Boötis..		"	45 33·13		33·47	....	......		45 36·43
	25	B.J. 550.......		"	50 57·00		58·39	.....	......		51 01·35
	26	Groom. 2184..		"	55 09·95		11·86	....	.....		55 14·82
	27	Groom. 2283..	rn	"	15 06 08·65		18·51	21·56	3·05		.. ..
	28	B.J. 563.......		"	11 51·04		51·33	54·23	2·90		15 11 54·29
	29	11 Urs. Min...		"	17 09·23		10·43	.....	......		17 13·39
	30	B.J. 569.......		"	20 51·44		52·64	.....	......		20 55·60
	31	B.J. 571.......		"	22 54·46		55·09	58·11	....		22 58·05
	32	B.J. 573.......	r	"	27 40·43		40·74	43·73	2·99		27 43·70
	33	ν² Boötis......		"	28 32·27		32·65	.....	......		28 35·61
	34	B.J. 576.......		"	29 16·58		16·85	19·82	2·97		29 19·81
	35	θ Urs. Min....		"	34 01·49		06·26	..	.....		34 09·22
	36	B.J. 590.......		"	47 15·67		17·50	.....	......		47 20·46
	37	χ Herculis....	r	"	49 32·56		32·89	.....	......		49 35·85
	38	B.J. 595.......		"	55 38·22		38·75	41·66	....	2·97	55 41·72
	39	B.J. 598.......		"	16 00 11·02		11·64	14·74	....		16 00 14·61
	40	Groom. 750...	L.C.,rn	"	07 49·21		44·57	47·29	2·72		....
	41	B.J. 606.......		"	13 22·93		24·49	.....	......		13 27·46
	42	Groom. 2337..		"	16 01·78		03·09	.....	......		16 06·06
	43	B.J. 612.......	r	"	20 07·71		09·45	.....	......		20 12·42
	44	B.J. 614.......	r	"	22 26·20		26·82	29·74	....		22 29·79
	45	g Herculis		"	25 39·93		40·31	.....	......		25 43·28
	46	Groom. 2372..		"	30 44·46		46·49	.....	......		30 49·46
	47	B.D. 72·734...		"	32 50·68		51·93	.....	......		32 54·90
	48	B.J. 623.......		"	34 31·04		32·81	...	......		34 35·78
	49	B.J. 626.......		"	39 47·42		47·77	50·72	2·95		39 50·74

Clamp West.

1—19. For polar deviation and adopted $\Delta T+m$ the unmarked values are for observations by S, those marked * for observations by N.

1—19. Adopted $\Delta T+m$ for observations by S=2·843+·0037 (T−15ʰ 10ᵐ); for observations by N=2·798+·0037 (T−15ʰ 45ᵐ).

20—49. Adopted $\Delta T+m$=2·966+·0039 (T−16ʰ 10ᵐ).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent ΔT + m	Adopted ΔT + m	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.		s.	h. m. s.
June 25	1	B.D. 79·511...	r	S	16 43 59·97	−·020	02·23	......	....	2·97	16 44 05·20
	2	Groom. 2391..		"	47 06·75	(·417)	08·52	......	....		47 11·49
	3	ε Urs. Min.....	rn	"	55 12·33		15·35	18·14	2·79		....
	4	Groom. 2411..		"	58 03·91		05·20	......	....		58 08·17
	5	Groom. 2427..		"	17 04 30·05		31·53	......	....		17 04 34·50
	6	B.J. 643.......	r	"	11 53·48		53·74	56·83	3·09		11 56·71
	7	e Herculis.....		"	14 32·86		33·19	......	....		14 36 16
	8	w Herculis....		"	17 16·32		16·60	......	....		17 19·57
	9	ρ Herculis.....		"	20 33·51		33·84	......	....		20 36·81
	10	B.J. 650.......		"	24 20·03		20·44	23·46	....		24 23·41
	11	Groom. 2456..		"	26 27·34		29·60	......	....		26 32·57
	12	B.J. 653.......		"	28 22·97		23·45	26·42	....		28 26·42
	13	B.J. 655.......		"	30 23·25		23·78	26·85	....		30 26·75
	14	Groom. 944...	L.C.,rn	"	32 50·65		46·18	49·05	2·87		....
	15	B.J. 663.......	r	"	36 54·27		54·71	57·73	....		36 57·68
June 28	16	g Boötis......		S	14 25 27·90	·038	28·54	......	....	3·25	14 25 31·79
	17	5 Urs. Min....		"	27 40·71	(·510)	42·80	......	....		27 46·05
	18	σ Boötis......		"	30 43·64		44·01	......	....		30 47·26
	19	B.D. 80·448...		"	36 04·67		07·60	......	....		36 10·85
	20	295 B. Boötis..		"	45 32·64		33·12	......	....		45 36·37
	21	B.J. 549.......		"	49 07·40		08·30	11·55	....		49 11·55
	22	B.J. 550.......		"	50 56·07		57·94	......	....		51 01·19
	23	Groom. 2184..		"	55 08·76		11·31	......	....		55 14·56
	24	B.J. 555.......		"	58 31·35		31·88	35·15	3·27		58 35·13
	25	Groom. 2283..	nr	"	15 06 04·52		17·23	20·46	3·23		....
	26	B.J. 563.......		"	11 50·54		50·96	54·21	3·25		15 11 54·21
	27	11 Urs. Min...		"	17 08·44		10·05	......	....		17 13·30
	28	B.J. 569.......		"	20 50·51		52·12	......	....		20 55·37
	29	B.J. 571.......		"	22 53·83		54·72	58·05	....		22 57·97
	30	B.J. 573.......		"	27 39·86		40·39	43·71	3·32		27 43·64
	31	B.J. 576.......		"	29 16·13		16·53	19·80	3·27		29 19·78
	32	θ Urs. Min....		"	34 03·40		05·77	......	....		34 09·02
	33	B.J. 590.......		"	47 14·66		17·10	......	....		47 20·35
	34	χ Herculis....		"	49 32·01		32·57	......	....		49 35·82
	35	B.J. 595.......	r	"	55 37·49		38·33	41·61	....		55 41·58
	36	B.J. 598.......		"	16 00 10·50		11·37	14·69	....		16 00 14·62
	37	Groom. 750...	L.C.,nr	"	07 50·42		44·37	47·81	3·44		....
	38	B.J. 606.......	r	"	13 21·82		24·10	......	....		13 27·35
	39	Groom. 2337..		"	16 00·79		02·55	......	....		16 05·80
	40	B.J. 614.......		"	22 25·61		26·38	29·71	....		22 29·63
	41	g Herculis.....	r	"	25 39·54		40·03	......	....		25 43·28
	42	Groom. 2372..	r	"	30 43·02		45·96	......	....		30 49·21
	43	B.D. 72·734...		"	32 49·81		51·49	......	....		32 54·74
	44	B.J. 626.......		"	39 46·94		47·44	50·71	3·27	3·26	39 50·70
	45	B.D. 79·511...		"	42 58·96		01·33	......	....		43 04·59
	46	ε Urs. Min.....	nr	"	55 10·63		14·55	17·93	3·38		....
	47	Groom. 2411..		"	58 02·68		04·41	......	....		58 07·67
	48	Groom. 2427..		"	17 04 29·08		31·08	......	....		17 04 34·34
	49	B.J. 643.......		"	11 53·13		53·59	56·83	3·24		11 56·85

From June 25 Clamp West; from June 28 Clamp East.

1—15. Adopted $\Delta T + m = 2{\cdot}966 + {\cdot}0039\ (T - 16^h\ 10^m)$.

16—49. Adopted $\Delta T + m = 3{\cdot}253 + {\cdot}0039\ (T - 16^h\ 05^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date.	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
June 28	1	*e* Herculis....	r	S	17 14 32·39	·038	32·81			3·26	17 14 36·07
	2	*w* Herculis.....		"	17 15·86	(·510)	16·27				17 19·53
	3	*ρ* Herculis.....		"	20 33·00		33·47				20 36·73
	4	B.J. 650.......		"	24 19·48		20·08	23·46			24 23·34
	5	Groom. 2456..		"	26 26·19		29·19				26 32·45
	6	B.J. 653......		"	28 22·57		23·26	26·42			28 26·52
	7	B.J. 655.......		"	30 22·73		23·49	26·84			30 26·75
	8	B.J. 663......	r	"	36 53·81		54·44	57·74			36 57·70
June 29	9	B.J. 549.......		S	14 49 07·21	·035	08·17	11·52		3·34	14 49 11·51
	10	B.J. 550.......		"	50 55·80	(·546)	57·79				51 01·13
	11	Groom. 2184..		"	55 08·29		11·00				55 14·34
	12	B.J. 555.......		"	58 31·23		31·78	35·14	3·36		58 35·12
	13	Groom. 2283..	rn	"	15 06 03·07		16·57	20·08	3·51		…
	14	B.J. 563.......		"	11 50·42		50·86	54·20	3·34		15 11 54·20
	15	11 Urs. Min...		"	17 07·98		09·68				17 13·02
	16	*η* Cor. Bor....		"	19 27·16		27·55				19 30·89
	17	B.J. 569.......		"	20 50·25		51·97				20 55·31
	18	B.J. 571.......		"	22 53·66		54·61	58·02			22 57·95
	19	B.J. 573.......		"	27 39·78		40·34	43·70	3·36		27 43·68
	20	*ν*² Boötis......	r	"	28 31·71		32·21				28 35·55
	21	B.J. 576.......		"	29 16·04		16·45	19·79	3·34		29 19·79
	22	*θ* Urs. Min....		"	34 03·19		05·71				34 09·05
	23	B.J. 590.......		"	47 14·41		17·01				47 20·35
	24	*χ* Herculis....	r	"	49 31·97		32·49				49 35·83
	25	B.J. 595.......		"	55 37·43		38·24	41·60			55 41·58
	26	B.J. 598.......		"	16 00 10·32		11·25	14·67			16 00 14·59
	27	Groom. 750...	L.C.	"	07 50·85		44·67	48·00	3·33		…
	28	B.J. 606.......		"	13 21·83		24·06				13 27·40
	29	Groom. 2337..		"	16 00·55		02·43				16 05·77
	30	*ξ* Cor. Bor.....		"	18 33·60		34·00				18 37·34
	31	B.J. 612.......	r	"	20 06·49		08·88				20 12·22
	32	B.J. 614.......	r	"	22 25·42		26·32	29·70			22 29·66
	33	*g* Herculis....		"	25 39·30		39·88				25 43·22
	34	Groom. 2372..		"	30 42·88		45·75				30 49·09
	35	B.D. 72·734...		"	32 49·62		51·40				32 54·74
	36	B.J. 626.......		"	39 46·79		47·31	50·71	3·40	3·35	39 50·66
	37	B.D. 79·511...	r	"	42 58·66		01·75				42 05·10
	38	Groom. 2391..		"	47 05·39		07·91				47 11·26
	39	53 Herculis....		"	49 31·44		31·85				49 35·20
	40	*ϵ* Urs. Min.....	rn	"	55 10·36		14·53	17·87	3·34		…
	41	Groom. 2411..		"	58 02·62		04·46				58 07·81
	42	Groom. 2427..		"	17 04 28·75		30·87				17 04 34·22
	43	B.J. 643.......	r	"	11 53·04		53·47	56·83	3·36		11 56·82
	44	*e* Herculis		"	14 32·29		32·78				14 36·13
	45	*w* Herculis....		"	17 15·73		16·15				17 19·50
	46	*ρ* Herculis....		"	20 32·91		33·40				20 36·75
	47	B.J. 650.......	r	"	24 19·33		20·03	23·46			24 23·38
	48	Groom. 2456..		"	26 25·82		29·01				26 32·36
	49	B.J. 653.......		"	28 22·24		22·98	26·42			28 26·33

Clamp East. 1—8. Adopted $\Delta T+m=3\cdot253+\cdot0039$ (T-16^h 05^m).
9—49. Adopted $\Delta T+m=3\cdot343+\cdot0039$ (T-16^h 05^m).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
June 29	1	B.J. 655.......		S	17 30 22·55	·035	23·37	26·84	....	3·35	17 30 26·72
	2	Groom. 944...	L.C.,rn	"	32 52·28	(·546)	46·04	49·45	3·41		....
	3	B.J. 663......		"	36 53·78		54·37	57·74	....		36 57.72
July 4	4	χ Herculis ...		S	15 49 31·48	·042	32·11	....	....	3·62	15 49 35·73
	5	B.J. 591.......		"	52 15·56	(·576)	15·79	19·45	3·66		52 19·41
	6	B.J. 593.......		"	53 49·41		49·81	53·43	3·62		53 53·43
	7	B.J. 595.......		"	55 37·01		37·87	41·50	....		55 41·49
	8	r Herculis....		"	57 09·49		09·75	..	....		57 13·37
	9	B.J. 598.......		"	16 00 09·86		10·85	14·56	....		16 00 14·47
	10	κ Herculis....		"	03 58·67		58·92	.	....		04 02·54
	11	Groom. 750..	L.C.,nr	"	07 52·27		45·36	49·18	3·82		....
	12	σ^2 Cor. Bor...		"	11 16·27		16·74	...	....		11 20·36
	13	B.J. 608.......		"	16 59·88		00·52	04·23	....		17 04·14
	14	ξ Cor. Bor.....		"	18 33·23		33·66		....		18 37·28
	15	23 Herculis...		"	19 26·95		27·40		....		19 31·02
	16	B.J. 613......		"	21 13·65		13·85	17·51	3·66		21 17·47
	17	B.J. 614.......		"	22 25·01		25·89	29·61	....		22 29·51
	18	g Herculis....		"	25 38·98		39·59	....	....		25 43·21
	19	B.J. 621......		"	31 09·88		10·51	14·17	3·66		31 14·13
	20	ζ Herculis.....		"	37 51·48		51·92	....	....		37 55·54
	21	B.J. 626.......		"	39 46·44		47·00	50·67	3·67		39 50·62
	22	B.J. 627......		"	43 33·32		34·25	37·89	....		43 37·87
	23	B.J. 629.......		"	47 56·98		57·20	00·85	3·65		48 00·82
	24	53 Herculis....		"	49 31·15		31·59	....	....		49 35·21
	25	ε Urs. Min.....	nr	"	55 09·37		13·81	17·38	3·57	3·63	....
	26	d Herculis ...		"	58 14·88		15·35		....		58 18·98
	27	B.J. 635.......		"	17 01 10·43		10·62	14·17	3·55		17 01 14·25
	28	B.J. 640.......		"	10 30·76		30·97	34·53	3·56		10 34·60
	29	B.J. 643.......		"	11 52·67		53·19	56·81	3·62		11 56·82
	30	u Herculis....		"	13 58·01		58·46	....			14 02·09
	31	ω Herculis....		"	17 15·45		15·90	....			17 19·53
	32	ρ Herculis....		"	20 32·57		33·10	....			20 36·73
	33	B.J. 650.......		"	24 19·09		19·78	23·43	....		24 23·41
	34	λ Herculis.....		"	27 04·06		04·41	....			27 08·04
	35	B.J. 653.......		"	28 21·94		22·73	26·38	....		28 26·36
	36	Groom. 944 ..	L.C.,nr	"	32 53·52		46·85	50·18	3·33		....
	37	B.J. 663......		"	36 53·40		54·03	57·72	....		36 57·66
	38	B.J. 667.......		"	42 54·16		54·55	58·16	3·61		42 58·18
	39	87 Herculis....		"	45 08·25		08·60	....			45 12·23
	40	ε Herculis....		"	47 40·06		40·75	....			47 44·38
	41	168 H. Herc...		"	49 06·90		07·47	....			49 11·10
	42	89 Herculis....		"	51 45·36		45·71	....	....		51 49·34
	43	B.J. 672.......		"	53 07·92		08·45	12·12	3·67		53 12·08
	44	B.J. 676.......		"	54 28·96		29·73	33·42	....		54 33·36
	45	δ Urs. Min....	nr	"	18 01 21·83		32·08	35·78	3·70		....
July 5	46	B.J. 551.......		S	14 51 55·91	·032	56·12	59·77	3·65	3·65	14 51 59·77
	47	B.J. 555.......		"	58 30·83	(·597)	31·42	35·05	3·63		58 35·07
	48	B.J. 557.......		"	15 00 32·88		33·25	36·90	3·65	3·66	15 00 36·91

Clamp East.

1—3. Adopted $\Delta T+m=3{\cdot}343+{\cdot}0039$ (T$-16^h\ 05^m$).
4—45. Adopted $\Delta T+m=3{\cdot}625+{\cdot}0040$ (T$-16^h\ 50^m$).
46—48. Adopted $\Delta T+m=3{\cdot}661+{\cdot}0040$ (T$-16^h\ 30^m$).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
July 5	1	Groom. 2283..	rn	S	15 05 58·93	·032	13·57	17·06	3·49	3·66	....
	2	B.J. 563.......		"	11 49·99	(·597)	50·46	54·13	3·67		15 11 54·12
	3	η Cor. Bor ...		"	19 26·77		27·19	...	.....		19 30·85
	4	B.J. 568.......		"	21 02·95		03·49	07·16	3·67		21 07·15
	5	B.J. 571.......		"	22 53·10		54·12	57·87	....		22 57·78
	6	B.J. 572.......		"	24 04·69		05·09	08·76	3·67		24 08·75
	7	B.J. 573.......	r	"	27 39·41		39·95	43·61	3·66		27 43·61
	8	ν² Bootis		"	28 31·17		31·78	...	.....		28 35·44
	9	B.J. 578.......		"	30 50·31		50·67	54·31	3·64		30 54·33
	10	B.J. 580.......		"	34 33·24		33·83	37·52	3·69		34 37·49
	11	ζ Cor. Bor....		"	35 56·93		57·46	...	....		36 01·12
	12	ι Serpentis.....		"	37 30·03		30·30	.	....		37 33·96
	13	B.J. 581.......		"	38 55·49		55·85	59·50	3·65		38 59·51
	14	B.J. 583.......		"	41 59·81		00·03	03·68	3·65		42 03·69
	15	B.J. 584.......	r	"	44 39·08		39·29	42·98	3·69		44 42·95
	16	χ Herculis.....		"	49 31·47		32·10	...	....		49 35·76
	17	B.J. 591.......		"	52 15·57		15·79	19·44	3·65		52 19·45
	18	B.J. 593.......		"	53 49·43		49·79	53·43	3·64		53 53·45
	19	B.J. 595.......		"	55 36·89		37·76	41·48	....		55 41·42
	20	τ Herculis		"	57 09·48		09·74	...	......		57 13·40
	21	B.J. 598.......		"	16 00 09·78		10·78	14·54	....		16 00 14·44
	22	κ Herculis.....		"	03 58·61		58·84	.	....		04 02·50
	23	Groom. 750...	L.C.,rn	"	07 52·30		45·26	49·43	4·17		....
	24	σ² Cor Bor...		"	11 16·24		16·72	.	....		11 20·38
	25	B.J. 608.......		"	16 59·88		00·53	04·21	....		17 04·19
	26	ξ Cor. Bor...		"	18 33·16		33·59	....	....		18 37·25
	27	23 Herculis...		"	19 26·94		27·39	....	......		19 31·05
	28	B.J. 613.......		"	21 13·64		13·84	17·50	3·66		21 17·50
	29	B.J. 614.......		"	22 24·93		25·82	29·59	....		22 29·48
	30	g Herculis		"	25 38·89		39·51	....	....		25 43·17
	31	B.J. 621.......		"	31 09·82		10·45	14·16	3·71		31 14·11
	32	42 Herculis...		"	36 16·03		16·74	.....	......		36 20·40
	33	ζ Herculis		"	37 51·41		51·85	.....	......		37 55·51
	34	B.J. 626.......		"	39 46·45		47·01	50·67	3·66		39 50·67
	35	B.J. 627.......		"	43 33·20		34·14	37·87	....		43 37·80
	36	B.J. 629.......		"	47 56·98		57·19	00·85	3·66		48 00·85
	37	53 Herculis....		"	49 31·10		31·54	.	......		49 35·20
	38	ε Urs. Min....	rn	"	55 09·00		13·52	17·27	3·75		....
	39	d Herculis		"	58 14·85		15·32	...	....		58 18·98
	40	B.J. 635.......		"	17 01 10·29		10·48	14·17	3·69		17 01 14·14
	41	B.J. 636.......		"	04 48·38		48·97	52·70	3·73		04 52·63
	42	B.J. 640.......		"	10 30·67		30·88	34·53	3·65		10 34·54
	43	B.J. 643.......		"	11 52·59		53·12	56·80	3·68		11 56·78
	44	u Herculis		"	13 57·91		58·37	...	....		14 02·03
	45	ω Herculis		"	17 15·39		15·84	...	....		17 19·50
	46	ρ Herculis		"	20 32·52		33·05	...	....		20 36·71
	47	B.J. 650.......		"	24 18·96		19·65	23·42	......		24 23·31
	48	λ Herculis.....		"	27 04·02		04·37	....	....		27 08·03
	49	B.J. 653.......		"	28 21·80		22·60	26·38	....		28 26·26
	50	B.J. 656.......	r	"	30 43·53		43·66	47·35	3·69	3·67	30 47·33

Clamp East. 1-50. Adopted $\Delta T+m=3{\cdot}661+{\cdot}0040\ (T-16^h\ 30^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent ΔT+m	Adopted ΔT+m	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
July 5	1	Groom. 944...	L.C.,rn	S	17 32 53·64	·032	46·84	50·37	3·53	3·67	....
	2	B.J. 663.......		"	36 53·34	(·597)	53·98	57·72	....		17 36 57·65
	3	B.J. 667.......		"	42 54·12		54·50	58·16	3·66		42 58·17
	4	87 Herculis...	r	"	45 08·21		08·51	....	....		45 12·18
	5	z Herculis		"	47 39·97		40·66	....	....		47 44·33
	6	168 H. Herc...		"	49 06·86		07·44	....	....		49 11·11
	7	89 Herculis....		"	51 45·30		45·65	....	....		51 49·32
	8	B.J. 672.......		"	53 07·90		08·43	12·12	3·69		53 12·10
	9	B.J. 674.......		"	54 14·00		14·40	18·11	3·71		54 18·07
	10	δ Urs. Min	rn	"	18 01 21·07		31·51	35·59	4·08		....
	11	B.J. 681.......		"	03 59·90		00·30	03·96	3·66		18 04 03·97
July 6	12	B.J. 555.......		N	14 58 30·74	·038	31·34	35·03	3·69	3·72	14 58 35·06
	13	B.J. 557.......		"	15 00 32·83	(·623)	33·20	36·89	3·69		15 00 36·92
	14	Groom. 2283..	nr	"	05 57·55		12·95	16·53	3·58		....
	15	B.J. 563.......		"	11 49·91		50·38	54·12	3·74		11 54·10
	16	B.J. 568.......		"	21 02·92		03·45	07·15	3·70		21 07·17
	17	B.J. 571.......		"	22 52·93		54·06	57·84	....		22 57·78
	18	B.J. 572.......		"	24 04·68		05·08	08·75	3·67		24 08·80
	19	B.J. 573.......		"	27 39·28		39·88	43·60	3·72		27 43·60
	20	ν^2 Boötis.....	r	"	28 31·14		31·74	....	....		28 35·46
	21	B.J. 578.......		"	30 50·25		50·61	54·30	3·69		30 54·33
	22	B.J. 580.......		"	34 33·15		33·75	37·51	3·76		34 37·47
	23	ζ Cor. Bor....		"	35 56·81		57·33	....	....		36 01·05
	24	ι Serpentis.....		"	37 29·97		30·23	....	....		37 33·95
	25	B.J. 581.......		"	38 55·42		55·77	59·49	3·72		38 59·49
	26	B.J. 583.......		"	41 59·72		59·93	03·68	3·75		42 03·65
	27	B.J. 584.......	r	"	44 38·95		39·20	42·98	3·78		44 42·92
	28	χ Herculis....		"	49 31·38		32·01	....	....		49 35·73
	29	B.J. 591.......		"	52 15·49		15·71	19·43	3·72		52 19·43
	30	B.J. 593.......		"	53 49·28		49·64	53·42	3·78		53 53·36
	31	B.J. 595.......		"	55 36·79		37·75	41·46	....		55 41·47
	32	r Herculis		"	57 09·36		09·61	....	....		57 13·33
	33	B.J. 598.......		"	16 00 09·59		10·70	14·51	....	3·73	16 00 14·43
	34	κ Herculis		"	03 58·55		58·78	....	....		04 02·51
	35	τ Cor. Bor....		"	05 38·48		39·00	....	....		05 42·73
	36	Groom. 750...	L.C.	"	07 52·92		45·48	49·70	4·22		....
	37	σ^2 Cor. Bor...		"	11 16·18		16·65	....	....		11 20·38
	38	B.J. 608.......		"	16 59·69		00·41	04·20	....		17 04·14
	39	ξ Cor. Bor.....		"	18 33·05		33·47	....	....		18 37·20
	40	23 Herculis....		"	19 26·91		27·36	....	....		19 31·09
	41	B.J. 613.......		"	21 13·59		13·78	17·50	3·72		21 17·51
	42	B.J. 614.......		"	22 24·86		25·83	29·57	....		22 29·56
	43	g Herculis		"	25 38·77		39·39	....	....		25 43·12
	44	B.J. 618.......		"	26 18·83		19·12	22·86	3·74		26 22·85
	45	B.J. 621.......		"	31 09·73		10·36	14·15	3·79		31 14·09
	46	ζ Herculis.....		"	37 51·35		51·79	....	....		37 55·52
	47	B.J. 626.......		"	39 46·38		46·94	50·66	3·72		39 50·67
	48	B.J. 627.......		"	43 32·97		34·00	37·85	....		43 37·73
	49	B.J. 629.......		"	47 56·88		57·09	00·85	3·76		48 00·82

Clamp East. 1—11. Adopted $\Delta T+m=3·661+·0040$ (T−16h 30m).
12—49. Adopted $\Delta T+m=3·725+·0040$ (T−16h 00m).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
July 6	1	53 Herculis...		N	16 49 30·98	·038	31·42	.....	......	3·73	16 49 35·15
	2	ε Urs. Min.....		"	55 08·39	(·623)	13·14	17·16	4·02		....
	3	d Herculis		"	58 14·79		15·26	.....	......		58 18·99
	4	B.J. 635.......		"	17 01 10·24		10·41	14·17	3·76		17 01 14·14
	5	B.J. 636.......		"	04 48·31		48·91	52·69	3·78		04 52·64
July 11	6	11 Urs. Min...		N	15 17 06·67	·037	08·54	.....	......	4·25	15 17 12·79
	7	η Cor. Bor. ...		"	19 26·22	(·568)	26·61	.....	......		19 30·86
	8	B.J. 571.......		"	22 52·40		53·42	57·70	......		22 57·67
	9	B.J. 573.......	r	"	27 38·74		39·29	43·52	4·23		27 43·54
	10	ν² Boötis		"	28 30·61		31·17	....	......		28 35·42
	11	θ Urs. Min.....		"	34 01·08		03·82	.....	......		34 08·07
	12	ι Serpentis		"	37 29·39		29·63	....	......		37 33·88
	13	B.J. 581.......		"	38 54·88		55·20	59·45	4·25		38 59·45
	14	B.J. 583.......	r	"	41 59·21		59·40	03·64	4·24		42 03·65
	15	B.J. 584.......		"	44 38·43		38·66	42·94	4·28		44 42·91
	16	B.J. 590.......		"	47 12·23		15·06	.....	......		47 19·31
	17	χ Herculis....		"	49 30·79		31·37	.....	......		49 35·62
	18	B.J. 591.......		"	52 14·97		15·17	19·40	4·23		52 19·42
	19	B.J. 593.......		"	53 48·74		49·07	53·38	4·31		53 53·32
	20	B.J. 595.......		"	55 36·21		37·09	41·36	......		55 41·34
	21	r Herculis		"	57 08·79		09·02	.....	......		57 13·27
	22	B.J. 598.......		"	16 00 09·00		10·01	14·39	......		16 00 14·26
	23	Groom. 750...	L.C.	"	07 52·80		46·04	50·83	4·79	4·26	....
	24	σ² Cor. Bor...		"	11 15·67		16·11	...	......		11 20·37
	25	B.J. 606.......		"	13 20·05		22·47	...	......		13 26·73
	26	ξ Cor. Bor. ...		"	18 32·57		32·96	.....	......		18 37·22
	27	B.J. 612.......		"	20 04·90		07·29	...	......		20 11·55
	28	B.J. 614.......	r	"	22 24·31		25·20	29·47	......		22 29·46
	29	g Herculis		"	25 38·28		38·85	.....	......		25 43·11
	30	Groom. 2372..		"	30 41·03		44·15	.....	......		30 48·41
	31	B.D. 72·734...		"	32 48·13		50·08	.....	......		32 54·34
	32	B.J. 623.......		"	34 27·78		30·52	....	......		34 34·78
	33	ζ Herculis.....		"	37 50·83		51·23	...	......		37 55·49
	34	B.J. 626.......		"	39 45·84		46·35	50·62	4·27		39 50·61
	35	B.D. 79·511...	r	"	42 56·81		59·90	.....	......		43 04·16
	36	Groom. 2391..		"	47 03·66		06·40	.....	......		47 10·66
	37	53 Herculis....		"	49 30·54		30·94	.....	......		49 35·20
	38	ε Urs. Min.....		"	55 08·10		12·45	16·64	4·19		....
	39	Groom. 2411..		"	58 01·09		03·09	.....	......		58 07·35
	40	B.J. 635.......		"	17 01 09·73		09·89	14·16	4·27		17 01 14·15
	41	B.D. 75·612...		"	03 11·07		13·37	....	......		03 17·63
	42	B.J.. 640......		"	10 30·09		30·27	34·52	4·25		10 34·53
	43	B.J. 643.......		"	11 52·01		52·49	56·77	4·28		11 56·75
	44	e Herculis	r	"	14 31·36		31·84	.....	......		14 36·10
	45	ρ Herculis		"	20 32·10		32·58	.....	......		20 36·84
	46	B.J. 650.......		"	24 18·29		18·99	23·38	......		24 23·25
	47	Groom. 2456..		"	26 23·91		27·37	.....	......		26 31·63
	48	Groom. 944...	L.C.	"	32 54·32		47·80	51·38	3·58		....

Clamp East. 1—5. Adopted $\Delta T+m=3{\cdot}725+{\cdot}0040\ (T-16^h\ 00^m)$.
6—48. Adopted $\Delta T+m=4{\cdot}256+{\cdot}0041\ (T-16^h\ 20^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
July 13	1	B.J. 563		N	15 11 49·10	·034	49·58	54·03	4·45	4·49	15 11 54·07
	2	11 Urs. Min.		"	17 05·98	(·643)	08·07	...	...		17 12·56
	3	η Cor. Bor.		"	19 25·85		26·27	...	...		19 30·76
	4	B.J. 569		"	20 48·18		50·27		...		20 54·76
	5	B.J. 571		"	22 51·98		53·13	57·64			22 57·62
	6	B.J. 573		"	27 38·36		38·97	43·49	4·52		27 43·46
	7	ν² Bootis	r	"	28 30·25		30·87	...	...		28 35·36
	8	B.J. 576		"	29 14·76		15·20	19·64	4·44		29 19·69
	9	B.J. 578		"	30 19·39		49·76	54·23	4·47		30 54·25
	10	θ Urs. Min.		"	34 00·47		03·54	...	...		34 08·03
	11	ζ Cor. Bor.		"	35 56·03		56·56	...	...		36 01·05
	12	ι Serpentis		"	37 29·11		29·37	...	...		37 33·86
	13	B.J. 581		"	38 54·47		54·83	59·42	4·59		38 59·32
	14	B.J. 583		"	41 58·90		59·11	03·62	4·51		42 03·60
	15	B.J. 584	r	"	44 38·11		38·35	42·92	4·57		44 42·84
	16	B.J. 590		"	47 11·84		15·01	...	...		47 19·50
	17	χ Herculis		"	49 30·50		31·14	...	...		49 35·63
	18	B.J. 591		"	52 14·73		14·95	19·39	4·44		52 19·44
	19	B.J. 593		"	53 48·52		48·89	53·35	4·46		53 53·38
	20	B.J. 595		"	55 35·83		36·81	41·31	...		55 41·30
	21	*r* Herculis		"	57 08·69		08·93	...	...		57 13·42
	22	B.J. 598		"	16 00 08·54		09·67	14·34	...		16 00 14·16
	23	κ Herculis		"	03 57·74		57·97	...	...		04 02·46
	24	τ Cor. Bor.		"	05 37·65		38·18	...	...		05 42·67
	25	Groom. 750	L.C., nr	"	07 54·31		46·68	51·27	4·59		...
	26	σ² Cor. Bor.		"	11 15·34		15·83	...	...		11 20·32
	27	B.J. 606		"	13 19·19		21·90	...	...		13 26·39
	28	20 Urs. Min.		"	14 43·96		46·55	...	...		14 51·04
	29	ξ Cor. Bor.		"	18 32·28		32·71	...	...		18 37·20
	30	B.J. 612	r	"	20 04·06		06·74	...	...		20 11·23
	31	B.J. 614	r	"	22 23·84		24·83	29·43	...		22 29·32
	32	g Herculis	r	"	25 38·01		38·64	...	...		25 43·13
	33	Groom. 2372		"	30 40·02		43·52	...	...		30 48·01
	34	B.D. 72·734		"	32 47·48		49·66	...	...		32 54·15
	35	B.J. 623		"	34 27·00		30·07	...	...		34 34·56
	36	B.J. 626		"	39 45·52		46·09	50·59	4·50		39 50·58
	37	B.D. 79·511	r	"	42 55·90		59·37	...	...		43 03·86
	38	53 Herculis		"	49 30·28		30·72	...	...		49 35·21
	39	ε Urs. Min.	nr	"	55 07·16		12·03	16·45	4·42		...
	40	Groom. 2411		"	58 00·45		02·69	...	...		58 07·18
	41	B.J. 635		"	17 01 09·43		09·61	14·15	4·54		17 01 14·10
	42	B.D. 75·612		"	03 10·49		13·06	...	...		03 17·55
	43	Groom. 2427		"	04 26·65		29·23	...	...		04 33·72
	44	B.J. 643		"	11 51·78		52·31	56·76	4·45		11 56·80
	45	e Herculis	r	"	14 31·07		31·61	...	...	4·50	14 36·11
	46	w Herculis		"	17 14·54		15·00	...	...		17 19·50
	47	ρ Herculis		"	20 31·67		32·21	...	...		20 36·71
	48	B.J. 650		"	24 18·01		18·79	23·35	...		24 23·29
	49	Groom. 2456		"	26 23·25		27·13	...	...		26 31·63
	50	Groom. 944	L.C., nr	"	32 54·42		47·05	51·69	4·64		...

Clamp East. 1—50. Adopted $\Delta T+m=4\cdot492+\cdot0041\ (T-16^{h}\ 30^{m})$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
July 13	1	B.J. 663.......		N	17 36 52·49	·034	53·22	57·67	...	4·50	17 36 57·72
	2	B.D. 72·800...		"	38 48·22	(·643)	50·36	...	...		38 54·86
	3	B.J. 670.......		"	43 29·54		31·63	...	...		43 36·13
	4	87 Herculis..		"	45 07·43		07·78	...	...		45 12·28
	5	z Herculis....		"	47 39·02		39·81	...	...		47 44·31
	6	168 H. Herc...		"	49 06·05		06·64	.	.		49 11·14
	7	89 Herculis....		"	51 44·53		44·89		.		51 49·39
	8	B.J. 672......		"	53 07·02		07·56	12·10	4·54		53 12·06
	9	δ Urs. Min....	ur	"	18 01 17·96		29·22	34·21	...		....
July 16	10	53 Herculis....		S	16 49 29·98	·047	30·47	.	.	4·63	16 49 35·10
	11	ε Urs. Min.....	nr	"	55 06·42	(·650)	11·44	16·11	4·67		...
	12	d Herculis....		"	58 13·77		14·30		...		58 18·93
	13	B.J. 635.......		"	17 01 09·32		09·54	14·14	4·60		17 01 14·17
	14	B.J. 636.......		"	04 47·26		47·92	52·61	4·69		04 52·55
	15	B.J. 643.......		"	11 51·53		52·11	56·74	4·63		11 56·74
	16	u Herculis ...		"	14 56·87		57·38	.	.		15 02·01
	17	w Herculis		"	17 14·30		14·81	.	...		17 19·44
	18	ρ Herculis		"	20 31·46		32·04	..	.	4·64	20 36·68
	19	B.J. 650.......		"	24 17·82		18·59	23·32			24 23·23
	20	λ Herculis....		"	27 03·01		03·41	.	.		27 08·05
	21	B.J. 653......		"	28 20·66		21·55	26·26	.		28 26·19
	22	B.J. 656......		"	30 42·53		42·74	47·35	4·61		30 47·38
	23	Groom. 944..	L.C.,nr	"	32 55·25		47·65	52·23	4·58		....
	24	B.J. 663......		"	36 52·31		53·03	57·64	.		36 57·67
	25	B.J. 667......	r	"	42 53·12		53·49	58·14	4·65		42 58·13
	26	87 Herculis....		"	45 07·17		07·56	..	...		45 12·20
	27	z Herculis....		"	47 38·87		39·64	...	...		47 44·28
	28	168 H. Herc...		"	49 05·82		06·47	..	...		49 11·11
	29	89 Herculis....		"	51 44·34		44·74	...	.		51 49·38
	30	B.J. 672.......		"	53 06·86		07·44	12·09	4·65		53 12·08
	31	δ Urs. Min....	nr	"	18 01 17·44		29·03	33·63	4·60		....
	32	B.J. 681.......		"	03 58·86		59·30	03·96	4·66		18 04 03·94
	33	B.J. 684.......		"	12 47·66		48·34	52·99	4·65		12 52·98
	34	446 B. Herc...		"	18 20·54		20·90	.	.....		18 25·54
	35	B.J. 690.......		"	19 48·84		49·18	53·83	4·65		19 53·82
	36	μ Lyrae.......		"	21 12·77		13·40	.	...		21 18·04
	37	B.J. 694.......		"	22 32·56		33·68	38·46	.....		22 38·32
	38	B.J. 699.......	r	"	33 50·42		50·98	55·66	4·68		33 55·62
	39	B.J. 703.......		"	41 44·42		44·73	49·39	4·66		41 49·37
	40	111 Herculis...		"	42 59·96		00·24	....	......		43 04·88
	41	204 B. Drac...		"	44 39·27		40·17	....	......		44 44·81
	42	B.J. 705......		"	46 42·41		42·93	47·57	4·64		46 47·57
	43	B.J. 707.......		"	49 49·30		50·44	55·17	...		49 55·08
	44	B.J. 711.......		"	52 32·68		33·40	38·08	4·68		52 38·04
	45	B.J. 713.......		"	55 31·62		32·13	36·75	4·62		55 36·77
	46	51 H. Cephei..	L.C.,nr	"	58 30·40		17·25	21·95	4·70		....
	47	B.J. 719.......		"	19 04 02·36		02·92	07·58	4·66		19 04 07·56
	48	19 Lyrae......		"	08 15·85		16·33	...	....		08 20·97
	49	B.J. 725.......		"	13 32·80		33·00	37·65	4·65		13 37·64

Clamp East. 1—9. Adopted $\Delta T+m=4\cdot492+\cdot0041(T-16^h\ 30^m)$.
10—49. Adopted $\Delta T+m=4\cdot639+\cdot0042\ (T-18^h\ 15^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Obser-vation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
July 16	1	B.J. 726		S	19 14 58·22	·047	59·14	03·89		4·64	19 15 03·78
	2	159 B. Lyrae		"	15 54·47	(·650)	55·12				15 59·76
	3	*b* Aquilae		"	20 38·00		38·21				20 42·85
	4	21 B. Vulp.		"	21 39·36		39·74				21 44·38
	5	4 Cygni.		"	22 51·55		52·11				22 56·75
	6	α Vulp.	r	"	24 54·77		55·10				24 59·74
	7	B.J. 732		"	27 02·56		02·98	07·61	4·63		27 07·62
	8	8 Cygni		"	28 22·59		23·12				28 27·76
	9	ε Sagittae		"	33 10·13		10·39				33 15·03
	10	B.J. 738		"	33 58·55		59·36	04·06			34 04·00
	11	β Sagittae		"	36 57·59		57·86				37 02·50
July 19	12	B.J. 614		S	16 22 23·13	·040	24·05	29·29		5·24	16 22 29·29
	13	*g* Herculis		"	25 37·15	(·607)	37·79				25 43·03
	14	Groom. 2372	r	"	30 38·92		42·38				30 47·62
	15	B.D. 72·734		"	32 46·62		48·62				32 53·86
	16	B.J. 623		"	34 26·04		28·86				34 34·10
	17	B.J. 626		"	39 44·70		45·28	50·53	5·25		39 50·52
	18	B.D. 79·511		"	42 55·05		58·24				43 03·48
	19	Groom. 2391		"	47 01·91		04·73				47 09·97
	20	53 Herculis		"	49 29·43		29·89				49 35·13
	21	ε Urs. Min.	rn	"	55 05·93		10·58	15·69	5·11		....
	22	Groom. 2411		"	57 59·68		01·74				58 06·98
	23	B.D. 75·612		"	17 03 09·46		11·82				17 03 17·06
	24	Groom. 2427		"	04 25·73		28·10				04 33·34
	25	B.J. 643		"	11 50·91		51·45	56·72	5·27		11 56·69
	26	*e* Herculis	r	"	14 30·27		30·76				14 36·00
	27	*w* Herculis		"	17 13·73		14·20				17 19·44
	28	ρ Herculis		"	20 30·87		31·42				20 36·66
	29	B.J. 650	r	"	24 17·19		17·97	23·29			24 23·21
	30	Groom. 2456		"	26 22·22		25·79				26 31·03
	31	B.J. 653		"	28 20·12		20·91	26·22			28 26·18
	32	B.J. 655		"	30 20·38		21·29	26·61			30 26·53
	33	Groom. 944	L.C.,rn	"	32 54·72		47·71	52·88	5·17		....
	34	B.J. 663		"	36 51·68		52·31	57·62			36 57·58
	35	B.D. 72·800		"	38 47·33		49·29				38 54·53
	36	B.J. 670		"	43 28·60		30·53				43 35·77
	37	*z* Herculis		"	47 38·30		39·02				47 44·26
	38	168 H. Herc.		"	49 05·26		05·86				49 11·10
	39	B.J. 675		"	53 25·18		27·85				53 33·09
	40	B.D. 78·616		"	55 11·24		14·22				55 19·46
	41	ψ² Draconis		"	56 41·09		43·00			5.25	56 48·25
	42	δ Urs. Min.	rn	"	18 01 16·52		27·27	32·87	5·60		....
	43	40 Draconis		"	06 43·74		47·22				18 06 52·47
	44	B.J. 684		"	12 47·15		47·79	52·98	5·19		12 53·04
	45	B.J. 693		"	21 59·59		01·42				22 06·67
	46	B.J. 700		"	34 02·89		05·67				34 10·92
	47	Bradley 2382		"	44 08·19		09·96				44 15·21
	48	B.J. 705		"	46 41·83		42·31	47·58	5·27		46 47·56
	49	Groom. 2719		"	47 58·25		00·40				48 05·65

Clamp East. 1—11. Adopted $\Delta T+m=4\cdot639+\cdot0042$ ($T-18^h\ 15^m$).
12—49. Adopted $\Delta T+m=5\cdot246+\cdot0042$ ($T-18^h\ 10^m$).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
July 19	1	50 Draconis...		S	18 49 13·63	·040	15·99	....		5·25	18 49 21·24
	2	B.D. 79·604...		"	51 57·05	(·607)	00·48	....			52 05·73
	3	51 H. Cephei..	L.C.,rn	"	58 29·42		17·29	22·61	5·32		....
	4	B.J. 719.......		"	19 04 01·79		02·31	07·59	5·28		19 04 07·56
	5	B.D. 70·1073..		"	31 40·20		41·98	....			31 47·23
	6	B.D. 49·3059..		"	33 27·57		28·32	....			33 33·57
	7	B.J. 738.......		"	33 58·02		58·77	04·07	......		34 04·02
	8	14 Cygni......		"	36 27·01		27·66	....			36 32 91
	9	B.J. 740.......		"	40 58·21		58·76	04·04	5·28		41 04·01
	10	B.J. 742.......	r	"	42 06·10		06·74	12·03	5·29		42 11·99
	11	B.J. 747.......		"	48 25·36		27·07	....			48 32·32
	12	B.J. 750.......		"	53 14·54		15·35	20·63	......		53 20·60
	13	B.D. 69·1084..		"	58 51·68		53·39	....			58 58·64
July 26	14	B.J. 627.......		S	16 43 30·52	—·046	31·30	37·40	.....	6·04	16 43 37·34
	15	B.J. 629.......		"	47 54·51	(·582)	54·66	00·74	6·08		48 00·70
	16	53 Herculis....		"	49 28·64		28·98	....			49 35·02
	17	ε Urs. Min....	nr	"	55 04·80		08·83	14·78	5·95		......
	18	*d* Herculis		"	58 12·41		12·78	....			58 18·82
	19	B.J. 635.......	r	"	17 01 07·94		08·02	14·08	6·06		17 01 14·06
	20	B.J. 636.......		"	04 45·93		46·41	52·48	6·07		04 52·45
	21	B.J. 640.......		"	10 28·24		28·38	34·45	6·07		10 34·42
	22	B.J. 643.......		"	11 50·12		50·54	56·63	6·09		11 56·58
	23	*u* Herculis		"	13 55·49		55·85	....			14 01·89
	24	*w* Herculis		"	17 12·97		13·32	....			17 19·36
	25	ρ Herculis		"	20 30·09		30·51	....			20 36·55
	26	B.J. 650.......		"	24 16·55		17·10	23·17	....		24 23·14
	27	λ Herculis		"	27 01·63		01·90	....			27 07·94
	28	B.J. 653.......		"	28 19·31		19·97	26·09	....		28 26·01
	29	B.J. 656.......		"	30 41·16		41·28	47·30	6·02		30 47·32
	30	Groom. 944...	L.C.,nr	"	32 54·39		48·28	54·38	6·10		......
	31	B.J. 663.......		"	36 50·95		51·46	57·52	....		36 57·50
	32	B.J. 667.......		"	42 51·76		52·06	58·08	6·02		42 58·10
	33	87 Herculis....	r	"	45 05·87		06·09	....			45 12·13
	34	*z* Herculis		"	47 37·58		38·14	....			47 44·18
	35	168 H. Herc...		"	49 04·45		04·92	....			49 10·96
	36	89 Herculis....		"	51 43·00		43·27	....			51 49·31
	37	B.J. 672.......		"	53 05·56		05·98	12·01	6·03		53 12·02
	38	B.J. 676.......		"	54 26·44		27·07	33·20	......		54 33·11
	39	δ Urs. Min....	nr	"	18 01 15·37		24·76	31·12	6·36		....
	40	B.J. 681.......		"	03 57·57		57·88	03·92	6·04		18 04 03·92
	41	B.J. 684.......		"	12 46·38		46·88	52·93	6·05		12 52·92
	42	446 B. Herc...		"	18 19·27		19·51	....			18 25·55
	43	B.J. 690.......		"	19 47·56		47·78	53·82	6·04		19 53·82
	44	μ Lyrae	r	"	21 11·58		11·98	....			21 18·02
	45	B.J. 694.......		"	22 31·44		32·28	38·31	.....		22 38·32
	46	B.J. 699.......		"	33 49·12		49·57	55·62	6·05		33 55·61
	47	B.J. 703.......		"	41 43·13		43·34	49·39	6·05		41 49·38
	48	111 Herculis...		"	42 58·68		58·86	....			43 04·90
	49	204 B. Drac...		"	44 38·08		38·74	....			44 44·78

From July 19 Clamp East; from July 26 Clamp West.
1—13. Adopted $\Delta T+m=5{\cdot}246+{\cdot}0042$ ($T-18^h\ 10^m$).
14—49. Adopted $\Delta T+m=6{\cdot}044+{\cdot}0043$ ($T-18^h\ 35^m$).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
July 26	1	B.J. 705.......	......	S	18 46 41·13	—·046	41·49	17·56	6·07	6·04	18 46 47·53
	2	B.J. 707.......		"	49 48·19	(·582)	49·05	55·07	....	6·05	49 55·10
	3	B.J. 711.......		"	52 31·44		31·97	38·04	6·07		52 38·02
	4	B.J. 713... ...		"	55 30·40		30·75	36·75	6·00		55 36·80
	5	51 H. Cephei..	L.C.,nr	"	58 28·87		18·33	24·33	6·00		....
	6	B.J. 719.......		"	19 04 01·11		01·51	07·58	6·07		19 04 07·56
	7	19 Lyrae......		"	08 14·69		15·02	......	.....		08 21·07
	8	B.J. 725.......		"	13 31·52		31·63	37·69	6·06		13 37·68
	9	B.J. 726... ...		"	14 57·12		57·79	03·85	....		15 03·84
	10	159 B. Lyrae..		"	15 53·24		53·71	......	....		15 59·76
	11	*b* Aquilae ...		"	20 36·75		36·86	......	....		20 42·91
	12	21 B.Vulp...	r	"	21 38·21		38·42	......	....		21 44·47
	13	1 Cygni...		"	22 50·38		50·78	......	....		22 56·83
	14	α Vulp		"	24 53·46		53·72	......	....		24 59·77
	15	φ Aquilae		"	51 54·57		54·68	......	....		52 00·73
	16	B.J. 752.......		"	54 41·25		41·44	47·44	6·00		54 47·49
	17	15 Vulp.		"	57 19·48		19·77	......	.....		57 25·82
	18	b^2 Cygni		"	20 06 00·78		01·19	......	....		20 06 07·24
	19	20 Vulp.......		"	08 10·11		10·38	......	....		08 16·43
	20	30 Cygni......		"	10 24·01		24·54	......	....		10 30·59
	21	B.J. 760.......		"	12 51·91		52·16	58·19	6·03		12 58·21
	22	176 B. Cygni..		"	16 55·21		55·66	......	....		17 01·71
	23	B.J. 765.....		"	18 55·53		56·00	02·11	6·11		19 02·05
	24	40 Cygni.....	r	"	21 09·97		10·35	......	....		24 16·40
	25	41 Cygni....		"	25 38·88		39·20	......	....		25 45·25
July 28	26	40 Draconis...		N	18 06 42·88	—·060	45·92	......	....	6·12	18 06 52·04
	27	B.J. 684.......		"	12 46·29	(·580)	46 75	52·91	6·16		12 52·87
	28	146 B. Herc...		"	18 19·16		19·36	......	......		18 25·48
	29	B.J. 690.......		"	19 47·52		47·70	53·81	6·11		19 53·82
	30	B.J. 691.......		"	22 31·41		32·27	38·28	......		22 38·39
	31	B.J. 699.......		"	33 49·11		49·50	55·61	6·11		33 55·62
	32	111 Herculis...		"	42 58·59		58·73	......	....	6·13	43 04·86
	33	204 B. Drac...		"	44 37·99		38·67	......	....		44 44·80
	34	B.J. 705.......		"	46 41·05		41·37	47·55	6·18		46 47·50
	35	B.J. 707.......		"	49 47·96		48·81	55·04	......		49 54·97
	36	B.J. 711.......		"	52 31·41		31·89	38·03	6·14		52 38·02
	37	B.J. 713.......		"	55 30·27		30·58	36·75	6·17		55 36·71
	38	51 H. Cephei.	L.C.	"	58 29·04		18·80	24·77	5·97		....
	39	B.J. 719......		"	19 01 01·03		01·38	07·58	6·20		19 04 07·51
	40	λ Urs. Min ...		"	11 07·28		38·51	44·26	5·75		....
	41	B.J. 726.......		"	14 56·98		57·67	03·84	......		15 03·80
	42	21 B. Vulp....		"	21 38·13		38·35	......	....		21 44·48
	43	4 Cygni.......		"	22 50·37		50·72	......	....		22 56·85
	44	α Vulp	r	"	24 53·45		53·67	......	....		24 59·80
	45	B.J. 732.......		"	27 01·38		01·63	07·66	6·03		27 07·76
	46	8 Cygni......		"	28 21·40		21·73	......	....		28 27·86
	47	B.D. 49·3059..		"	33 26·90		27·50	......	....		33 33·63
	48	B.J. 738.......		"	33 57·26		57·86	04·06	....		34 03·99
	49	14 Cygni......		"	36 26·38		26·84	......	....		36 32·97
	50	10 Vulp.......		"	39 54·15		54·38	......	....		40 00·51

Clamp West. 1—25. Adopted $\Delta T+m=6{\cdot}044+{\cdot}0043\ (T-18^h\ 35^m)$.
26—50. Adopted $\Delta T+m=6{\cdot}128+{\cdot}0044\ (T-19^h\ 15^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
July 28	1	B.J. 740.......		N	19 40 57·51	—·060	57·88	04·07	6·19	6·13	19 41 04·01
	2	B.J. 742.......		"	42 05·33	(·580)	05·83	12·04	6·21		42 11·96
	3	ζ Sagittae.....		"	44 54·93		55·08	...	.....		45 01·21
	4	φ Aquilae.....		"	51 54·46		54·54	.	......		52 00·67
	5	B.J. 750.......		"	53 13·80		14·46	20·64	....		53 20·59
	6	B.J. 752.....		"	54 41·22		41·37	47·46	6·09		54 47·50
	7	15 Vulp.		"	57 19·44		19·68	.	.		57 25·81
	8	Groom. 1119	L.C.	"	20 08 20·89		54·61	00·86	6·25		..
	9	B.J. 760.....		"	12 51·89		52·11	58·20	6·09		20 12 58·24
July 30	10	B.J. 703.....		N	18 41 42·87	—·034	43·07	49·38	6·31	6·37	18 41 49·44
	11	111 Herculis...		"	42 58·39	(·601)	58·57	. .	...		43 04·94
	12	204 B. Drac...		"	44 37·71		58·45	.	.		44 44·82
	13	B.J. 707.......		"	49 47·72		48·68	55·01			49 55·05
	14	B.J. 711.......		"	52 31·03		31·57	38·02	6·45		52 37·94
	15	B.J. 713.....		"	55 30·03		30·38	36·74	6·36		55 36·75
	16	51 H. Cephei.	L.C.,nr	"	58 28·78		17·60	25·30	7·70		..
	17	B.J. 719.......		"	19 04 00·82		01·23	07·58	6·35		19 04 07·60
	18	b Aquilae ...		"	20 36·41		36·52	...	. .		20 42·89
	19	21 B. Vulp....		"	21 37·82		38·08	...	...		21 44·45
	20	4 Cygni.....		"	22 50·08		50·49	..	..		22 56·86
	21	a Vulp.		"	24 53·19		53·45		...		24 59·82
	22	B.J. 732.....		"	27 01·01		01·30	07·66	6·36		27 07·67
	23	8 Cygni...		"	28 21·09		21·47	.	.....		28 27·84
	24	B.D. 49·3059.		"	33 26·53		27·19		....		33 33·56
	25	B.J. 738.......		"	33 57·08		57·74	04·05	....		34 04·11
	26	β Sagittae.....		"	36 56·03		56·20	.....	....		37 02·57
	27	10 Vulp.......		"	39 53·94		54·20	...	......		40 00·57
	28	B.J. 740.......		"	40 57·28		57·71	04·06	6·35		41 04·08
	29	B.J. 742......		"	42 05·13		05·69	12·03	6·34		42 12·06
	30	B.J. 743.......		"	43 18·11		18·29	24·67	6·38		43 24·66
	31	ζ Sagittae.....		"	44 54·58		54·76	....	.. .		45 01·13
	32	φ Aquilae.....		"	51 54·27		54·37	...	. . .		52 00·74
	33	B.J. 750.......		"	53 13·52		14·24	20·63	....		53 20·61
	34	B.J. 752.......		"	54 40·90		41·09	47·46	6·37		54 47·46
	35	15 Vulp.		"	57 19·16		19·44	.	... .		57 25·81
	36	Groom. 1119..	L.C.	"	20 08 24·14		55·44	01·44	6·00		.
	37	B.J. 760.......		"	12 51·56		51·82	58·21	6·39		20 12 58·19
	38	176 B. Cygni..		"	16 54·94		55·39	...	......		17 01·76
	39	B.J. 765.......		"	18 55·27		55·73	02·13	6·40		19 02·10
	40	40 Cygni......		"	24 09·65		10·08	....	.....		24 16·45
	41	41 Cygni......		"	25 38·54		38·86	...	...		25 45·23
	42	B.J. 768.......		"	28 50·57		50·66	57·03	6·37		28 57·03
	43	ζ Delphini.....		"	31 01·71		01·85	....	.. ..		31 08·22
	44	B.J. 771.......		"	33 15·40		15·53	21·94	6·41		33 21·90
	45	29 Vulp.......		"	34 25·72		25·93	. .	......		34 32·30
	46	B.J. 774.......		"	35 23·13		23·28	29·68	6·40		35 29·65
	47	B.J. 777.......		"	38 17·15		17·71	24·10	6·39		38 24·08
	48	B.J. 778.......		"	39 11·16		11·30	17·64	6·34		39 17·67
	49	B.J. 780.......		"	42 29·55		29·92	36·38	6·46	6·38	42 36·30

Clamp West. 1—9. Adopted $\Delta T+m=6{\cdot}128+{\cdot}0044\ (T-19^h\ 15^m)$.
10—49. Adopted $\Delta T+m=6{\cdot}371+{\cdot}0044\ (T-19^h\ 45^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
July 30	1	B.J. 784.......		N	20 43 49·56	—·034	49·97	56·36	6·39	6·38	20 43 56·35
	2	76 Draconis...		"	49 05·57	(·601)	09·83	16·27	6·44		....
	3	220 H[1] Drac...		"	51 37·60		40·97	47·56	6·59		....
Aug. 2	4	B.J. 684.......		S	18 12 45·71	—·040	46·28	52·85	6·57	6·57	18 12 52·85
	5	446 B. Herc...		"	18 18·62	(·639)	18·89	.....	....		18 25·46
	6	B.J. 690.......	r	"	19 47·02		47·23	53·79	6·56		19 53·80
	7	μ Lyrae......		"	21 10·93		11·44	.....	....		21 18·01
	8	B.J. 699.......	r	"	33 48·55		48·99	55·57	6·58		33 55·56
	9	B.J. 703.......		"	41 42·56		42·80	49·37	6·57		41 49·37
	10	111 Herculis...		"	42 58·10		58·31	.....	....		43 04·88
	11	204 B. Drac...		"	44 37·39		38·13	.....	....		44 44·70
	12	B.J. 705.......		"	46 40·54		40·95	47·52	6·57		46 47·52
	13	B.J. 707.......		"	49 47·48		48·44	54·95	....		49 55·01
	14	B.J. 711.......		"	52 30·79		31·38	37·99	6·61	6·58	52 37·96
	15	51 H. Cephei..	L.C.,rn	"	58 31·44		19·59	26·27	6·68		....
	16	B.J. 719.......		"	19 04 00·47		00·93	07·56	6·63		19 04 07·51
	17	λ Urs. Min....		"	10 57·73		33·54	40·39	6·85		....
	18	b Aquilae.....		"	20 36·12		36·25	.....	....		20 42·83
	19	21 B. Vulp....		"	21 37·51		37·79	.....	....		21 44·37
	20	4 Cygni.......		"	22 49·75		50·21	.....	....		22 56·79
	21	α Vulp.......	r	"	24 53·00		53·23	.....	....		24 59·81
	22	B.J. 733.......		"	27 21·31		22·06	28·61	....		27 28·64
	23	8 Cygni.......		"	28 20·76		21·18	.....	....		28 27·76
	24	ϵ Sagittae.....		"	33 08·36		08·55	.....	....		33 15·13
	25	B.J. 738.......		"	33 56·83		57·50	04·03	....		34 04·08
	26	β Sagittae.....		"	36 55·87		56·07	.....	....		37 02·65
	27	10 Vulp.......		"	39 53·67		53·97	.....	....		40 00·55
	28	B.J. 740.......		"	40 56·98		57·46	04·06	6·60		41 04·04
	29	B.J. 742.......		"	42 04·78		05·40	12·02	6·62		42 11·98
	30	B.J. 743.......		"	43 17·90		18·11	24·67	6·56		43 24·69
	31	ζ Sagittae.....	r	"	44 54·45		54·62	.....	....		45 01·20
	32	ϕ Aquilae.....		"	51 54·03		54·16	.....	....		52 00·74
	33	B.J. 752.......		"	54 40·65		40·87	47·47	6·60		54 47·45
	34	15 Vulp.......		"	57 18·91		19·23	.....	....		57 25·81
Aug. 7	35	B. J. 650.......	r	S	17 24 15·11	—·040	15·79	22·94	....	7·14	17 24 22·93
	36	Groom. 2456..		"	26 18·54	(·621)	21·86	.....	....		26 29·00
	37	B.J. 653.......		"	28 17·87		18·58	25·83	....		28 25·72
	38	B.J. 655.......		"	30 18·16		18·95	26·18	....		30 26·09
	39	Groom. 944...	L.C.,rn	"	32 57·15		50·50	57·38	6·88		....
	40	B.J. 663.......		"	36 49·54		50·11	57·31	....		36 57·25
	41	B.D. 72·800...	r	"	38 44·39		46·34	.....	....		38 53·48
	42	B.J. 670.......		"	43 25·95		27·71	.....	....		43 34·85
	43	z Herculis....		"	47 36·19		36·80	.....	....		47 43·94
	44	168 H. Herc...		"	49 03·19		03·70	.....	....		49 10·84
	45	B.J. 675.......		"	53 22·36		24·84	.....	....		53 31·98
	46	B.D. 78·616...		"	55 08·28		11·05	.....	....		55 18·19
	47	ψ^2 Draconis...		"	56 38·45		40·19	.....	....		56 47·33
	48	δ Urs. Min....	rn	"	18 01 09·97		20·13	27·42	7·29		....

Clamp West. 1—3. Adopted $\Delta T+m=6{\cdot}371+{\cdot}0044\ (T-19^h\ 45^m)$.

4—34. Adopted $\Delta T+m=6{\cdot}576+{\cdot}0044\ (T-19^h\ 05^m)$.

35—48. Adopted $\Delta T+m=7{\cdot}144+{\cdot}0015\ (T-19^h\ 15^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Aug. 7	1	40 Draconis...		S	18 06 40·62	–·040	43·87	......	......	7·14	18 06 51·01
	2	B.J. 684.......		"	12 45·09	(·621)	45·64	52·79	7·15		12 52·78
	3	B.J. 695.......		"	22 34·92		36·74	......	......		22 43·88
	4	B.J. 700.......		"	34 00·12		02·69	......	......		34 09·83
	5	Bradley 2382..		"	44 05·87		07·49	......	......		44 14·63
	6	Groom. 2719..		"	47 55·86		57·84	......	......		48 04·98
	7	50 Draconis...		"	49 11·08		13·26	......	......		49 20·40
	8	B.D. 79·604...		"	51 54·11		57·31	......	......		52 04·45
	9	51 H. Cephei..	L.C.,rn	"	58 32·00		20·52	27·99	7·47		......
	10	B.J. 719.......		"	19 03 59·88		00·32	07·53	7·21		19 04 07·46
	11	λ Urs. Min....	rn	"	10 55·09		29·85	36·11	6·26		......
	12	B.J. 729.......		"	17 11·78		13·67	......	......		17 20·81
	13	4 Cygni......		"	22 49·19		49·63	......	......		22 56·77
	14	B.D. 76·734...		"	24 40·77		43·13	......	......		24 50·27
	15	B.J. 734.......		"	27 03·73		06·79	......	......		27 13·93
	16	B.D. 70·1073..		"	31 38·17		39·79	......	......	7·15	31 46·94
	17	B.J. 738.......		"	33 56·26		56·91	04·00	......		34 04·06
	18	14 Cygni......		"	36 25·24		25·80	......	......		36 32·95
	19	B.J. 740.......		"	40 56·44		56·90	04·04	7·14		41 04·05
	20	B.J. 742.......		"	42 01·23		04·83	12·00	7·17		42 11·98
	21	B.J. 747.......		"	48 23·30		24·86	......	......		48 32·01
	22	B.D. 69·1084..		"	58 49·82		51·38	......	......		58 58·53
	23	b^2 Cygni......		"	20 05 59·65		00·10	......	......		20 06 07·25
	24	B.J. 759.......		"	11 50·72		53·29	......	......		12 00·44
	25	176 B.Cygni...		"	16 54·09		54·58	......	......		17 01·73
	26	B.J. 765.......		"	18 54·49		55·00	02·14	7·14		19 02·15
	27	40 Cygni......	r	"	24 08·91		09·33	......	......		24 16·48
	28	41 Cygni......		"	25 37·75		38·10	......	......		25 45·25
	29	ω^1 Cygni......		"	27 10·83		11·45	......	......		27 18·60
	30	Groom. 3211..		"	30 18·90		20·67	......	......		30 27·82
	31	B.J. 770.......		"	32 37·07		39·14	......	......		32 46·29
Aug. 8	32	87 Herculis...		N	17 45 04·53	–·043	04·79	......	......	7·20	17 45 11·99
	33	z Herculis.....		"	47 36·18	(·619)	36·82	......	......		47 44·02
	34	168 H. Herc..		"	49 03·18		03·65	......	......		49 10·85
	35	89 Herculis....		"	51 41·65		41·91	......	......		51 49·11
	36	B.D. 78·616...		"	55 08·26		11·12	......	......		55 18·32
	37	ψ^2 Draconis...		"	56 38·40		40·21	......	......		56 47·41
	38	δ Urs. Min....	nr	"	18 01 09·58		19·66	27·14	7·48		......
	39	40 Draconis...		"	06 40·15		43·50	......	......		18 06 50·70
	40	B.J. 684.......		"	12 45·03		45·54	52·77	7·23		12 52·74
	41	446 B. Herc...		"	18 17·98		18·22	......	......		18 25·42
	42	B.J. 690.......		"	19 46·30		46·52	53·75	7·23		19 53·72
	43	μ Lyrae......		"	21 10·18		10·64	......	......		21 17·84
	44	B.J. 694.......		"	22 29·80		30·75	......	......		22 37·95
	45	B.J. 700.......		"	34 00·13		02·79	......	......		34 09·99
	46	B.J. 703......		"	41 41·90		42·10	49·34	7·24		41 49·30
	47	Bradley 2382..		"	44 05·69		07·36	......	......		44 14·56
	48	B.J. 705.......		"	46 39·89		40·26	47·48	7·22		46 47·46
	49	Groom. 2719..		"	47 55·70		57·74	......	......		48 04·94

Clamp West. 1—31. Adopted $\Delta T+m=7\cdot144+\cdot0045$ ($T-19^h\ 15^m$).
32—49. Adopted $\Delta T+m=7\cdot206+\cdot0045$ ($T-19^h\ 05^m$).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Aug. 8	1	50 Draconis...		N	18 49 11·09	—·013	13·35	......	......	7·20	18 49 20·55
	2	B.D. 79·604...		"	51 54·21	(·619)	57·52	......	......	7·21	52 04·73
	3	B.J. 714.......		"	55 24·33		26·04	......	......		55 33·25
	4	51 H. Cephei..	L.C.,nr	"	58 31·74		20·37	28·30	7·93		....
	5	B.J. 719.......		"	19 03 59·87		00·28	07·52	7·24		19 04 07·49
	6	λ Urs. Min....		"	10 52·74		27·22	35·38	8·16		....
	7	B.J. 726......		"	14 55·75		56·52	03·73	......		15 03·73
	8	B.J. 729.......		"	17 11·64		13·59	......	......		17 20·80
	9	21 B. Vulp....		"	21 36·91		37·16	......	......		21 44·37
	10	4 Cygni....		"	22 49·12		49·53	......	......		22 56·74
	11	B.D. 76·734...		"	24 40·50		42·94	......	......		24 50·15
	12	B.J. 734......		"	27 03·44		06·60	......	......		27 13·81
	13	8 Cygni......		"	28 20·15		20·53	......	......		28 27·77
	14	B.D. 70·1073..		"	31 37·94		39·62	......	......		31 46·84
	15	B.D. 49·3059..		"	33 25·69		26·36	......	......		33 33·53
	16	B.J. 738.....		"	33 56·14		56·81	03·99	......		34 04·02
	17	14 Cygni.....		"	36 25·23		25·75	......	......		36 32·96
	18	10 Vulp.......		"	39 53·02		53·28	......	......		40 00·49
	19	B.J. 742.......		"	42 04·26		04·83	12·00	7·17		42 12·04
	20	B.J. 747.......		"	48 23·47		25·08	......	......		48 32·29
	21	φ Aquilae.....		"	51 53·52		53·61	......	......		52 00·82
	22	B.J. 750.......		"	53 12·61		13·35	20·58	......		53 20·56
	23	B.J. 752.......		"	54 40·10		40·29	47·48	7·19		54 47·50
	24	15 Vulp.......		"	57 18·25		18·53	......	......		57 25·74
Aug. 11	25	B.J. 700.......		S	18 33 59·23	—·041	01·91	......	......	7·73	18 34 09·64
	26	Bradley 2382..		"	44 05·12	(·646)	06·81	......	......		41 14·54
	27	B.J. 705......		"	46 39·25		39·67	47·44	7·77		46 47·40
	28	Groom. 2719..		"	47 54·92		56·99	......	......		48 04·72
	29	50 Draconis...		"	49 10·32		12·59	......	......		49 20·32
	30	51 H. Cephei..	L.C.,nr	"	58 32·87		20·90	29·18	8·28		....
	31	B.J. 719.......		"	19 03 59·26		59·72	07·49	7·77		19 04 07·45
	32	λ Urs. Min ...	nr	"	10 50·16		26·33	33·13	6·80		....
	33	B.J. 729.......		"	17 10·96		12·92	......	......		17 20·65
	34	4 Cygni.......		"	22 48·56		49·02	......	......		22 56·75
	35	B.D. 76·734..		"	24 39·82		42·28	......	......		24 50·01
	36	B.J. 731.......		"	27 02·87		06·07	......	......		27 13·80
	37	B.D. 70·1073..		"	31 37·53		39·23	......	......		31 46·96
	38	B.D. 49·3059..		"	33 25·20		25·88	......	......		33 33·61
	39	B.J. 738.......	r	"	33 55·50		56·25	03·95	......		34 03·98
	40	14 Cygni......	r	"	36 24·71		25·22	......	......		36 32·95
	41	B.J. 740.......		"	40 55·79		56·27	04·01	7·74		41 04·00
	42	B.J. 742.......		"	42 03·59		04·22	11·97	7·75	7·74	42 11·96
	43	B.D. 69·1084..		"	58 49·16		50·78	......	......		58 58·52
	44	69 Draconis...		"	20 02 02·58		05·01	......	......		20 02 12·75
	45	Groom. 1119..	L.C.,nr	"	08 30·02		59·33	07·46	8·13		....
	46	176 B. Cygni..		"	16 53·45		53·95	......	......		17 01·69
	47	B.J. 765.......	r	"	18 53·93		54·39	02·13	7·74		19 02·13
	48	40 Cygni......		"	24 08·18		08·67	......	......		24 16·45
	49	41 Cygni......		"	25 37·15		37·51	......	......		25 45·21

Clamp West. 1—24. Adopted $\Delta T+m=7{\cdot}206+{\cdot}0045\ (T-19^h\ 05^m)$.
25—49. Adopted $\Delta T+m=7{\cdot}737+{\cdot}0065\ (T-20^h\ 00^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T + m$	Adopted $\Delta T + m$	App. R.A. from Observation
					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
1910 Aug. 11	1	ω¹ Cygni		S	20 27 10·24	−·041	10·89	....	....	7·74	20 27 18·63
	2	Groom. 3241		"	30 18·14	(·646)	19·99	.....	..		30 27·73
	3	B.J. 770		"	32 36·19		38·35	...			32 46·09
	4	76 Draconis	nr	"	49 03·47		08·01	15·91	7·90		....
	5	220 H¹. Drac		"	51 35·98		39·45	47·32	7·87		....
	6	B.J. 788		"	53 43·05		43·59	51·33	7·74		53 51·33
	7	Bradley 2748		"	55 42·63		44·94				55 52·68
	8	B.J. 792		"	21 01 33·35		33·94	41·74	7·80		21 01 41·68
	9	B.J. 793		"	02 45·98		46·47	54·21	7·74		02 54·21
	10	Groom. 3409		"	05 45·24		46·97	....	....		05 54·71
	11	B.J. 798		"	09 21·73		25·73	33·44			09 33·47
	12	B.J. 799		"	11 05·93		06·42	14·15	7·73		11 14·16
	13	σ Cygni		"	13 46·79		47·29	.....	...		13 55·03
	14	Bradley 2796		"	16 35·91		38·41	...	..	7·75	16 46·16
Aug. 12	15	Groom. 2411		N	16 57 55·80	−·042	57·80			7·84	16 58 05·64
	16	B.J. 635		"	17 01 05·93	(·630)	06·05	13·90	7·85		17 01 13·89
	17	B.D. 75·612		"	03 05·57		07·87	....	....		03 15·71
	18	Groom. 2427		"	04 21·61		23·92		....		04 31·76
	19	B.J. 640		"	10 26·28		26·41	34·27	7·86		10 34·25
	20	B.J. 643		"	11 48·06		48·49	56·36	7·87		11 56·33
	21	e Herculis		"	14 27·40		27·84	....	.....		14 35·68
	22	w Herculis		"	17 10·91		11·30	...	..		17 19·14
	23	ρ Herculis		"	20 28·05		28·49				20 36·33
	24	B.J. 650		"	24 14·33		14·98	22·82	..		24 22·82
	25	Groom. 2456		"	26 17·31		20·80		..		26 28·64
	26	B.J. 653		"	28 17·05		17·81	25·70			28 25·65
	27	B.J. 655		"	30 17·20		18·05	26·03			30 25·89
	28	Groom. 944	L.C.,nr	"	32 57·43		50·70	58·62	7·92		......
	29	B.J. 663		"	36 48·74		49·34	57·21	..		36 57·18
	30	B.D. 72·800		"	38 43·58		45·48				38 53·32
	31	B.J. 670		"	43 24·88		26·74		...		43 34·58
	32	87 Herculis		"	45 03·84		04·11		..		45 11·95
	33	z Herculis		"	47 35·36		36·01	....			47 43·85
	34	168 H. Herc		"	49 02·49		02·97	......			49 10·81
	35	89 Herculis		"	51 40·98		41·26	.. ...			51 49·10
	36	B.J. 675		"	53 20·93		23·54	......	...		53 31·38
	37	B.D. 78·616		"	55 07·06		09·98				55 17·82
	38	δ Urs. Min.	nr	"	18 01 07·58		17·86	25·90	8·04		
	39	40 Draconis		"	06 39·43		42·55	....		7·85	18 06 50·40
	40	B.J. 684		"	12 41·33		41·85	52·70	7·85		12 52·70
	41	146 B. Herc		"	18 17·36		17·60				18 25·45
	42	B.J. 690		"	19 45·61		45·83	53·70	7·87		19 53·68
	43	B.J. 695		"	22 33·84		35·76		..		22 43·61
	44	B.J. 699		"	33 47·16		47·61	55·45	7·81		33 55·46
	45	B.J. 703		"	41 41·29		41·49	49·31	7·82		41 49·34
	46	111 Herculis		"	42 56·77		56·95	....	......		43 04·80
	47	Bradley 2382		"	44 04·93		06·64		......		44 14·49
	48	B.J. 705		"	46 39·26		39·61	47·43	7·79		46 47·49
	49	Groom. 2719		"	47 54·58		56·67	.....	....		48 04·52

Clamp West. 1—14. Adopted $\Delta T+m=7{\cdot}737+{\cdot}0065$ ($T-20^h\ 00^m$).
15—49. Adopted $\Delta T+m=7{\cdot}818+{\cdot}0069$ ($T-18^h\ 30^m$).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent ΔT + m	Adopted ΔT + m	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Aug. 12	1	B.D. 79·604...		N	18 51 53·03	−·042	56·39	......	......	7·85	18 52 04·24
	2	B.J. 714.......		"	55 23·22	(·630)	24·98	......	......		55 32·83
	3	51 H. Cephei..	L.C.,nr	"	58 32·56		20·95	29·51	8·56		....
	4	B.J. 719......		"	19 03 59·18		59·60	07·48	7·88		19 04 07·45
	5	λ Urs. Min....		"	10 46·90		22·05	32·28	10·23		....
	6	B.J. 726.......		"	14 54·95		55·73	03·65	......		15 03·58
	7	B.J. 729.......		"	17 10·74		12·72	......	......		17 20·57
	8	*b* Aquilae		"	20 34·95		35·06	......	......		20 42·91
	9	21 B. Vulp ...		"	21 36·28		36·54	......	......		21 44·39
	10	4 Cygni.......		"	22 48·47		48·89	......	......		22 56·74
	11	B.D. 76·734...		"	24 39·58		42·06	......	......		24 49·91
	12	B.J. 734.......		"	27 02·54		05·77	......	......		27 13·62
	13	8 Cygni.......		"	28 19·32		19·71	......	......		28 27·56
	14	B.D. 70·1073..		"	31 37·06		38·78	......	......	7·86	31 46·64
	15	B.D. 49·3059..		"	33 24·90		25·59	......	......		33 33·45
	16	B.J. 738.......		"	33 55·40		56·09	03·93	......		34 03·95
	17	14 Cygni......		"	36 24·50		25·03	......	......		36 32·89
	18	10 Vulp.......		"	39 52·35		52·62	......	......		40 00·48
	19	B.J. 740.......		"	40 55·65		56·09	04·01	7·92		41 03·95
	20	B.J. 742.......		"	42 03·45		04·03	11·96	7·93		42 11·89
	21	B.J. 743.......		"	43 16·60		16·78	24·66	7·88		43 24·64
	22	ζ Sagittae.....		"	44 53·07		53·25	......	......		45 01·11
	23	B.J. 747.......		"	48 22·43		24·07	......	......		48 31·93
	24	φ Aquilae		"	51 52·79		52·90	......	......		52 00·76
	25	B.J. 750.......		"	53 11·86		12·61	20·53	......		53 20·47
	26	B.J. 752.......		"	54 39·48		39·67	47·47	7·80		54 47·53
	27	15 Vulp..		"	57 17·64		17·93	......	......		57 25·79
	28	B.D. 69·1084..		"	58 48·94		50·59	......	......		58 58·45
	29	Groom. 1119..	L.C.,nr	"	20 08 28·98		59·21	07·95	8·74		....
Aug. 19	30	B.J. 643.......		N	17 11 46·45	·035	47·02	56·23	9·21	9·19	17 11 56·21
	31	*e* Herculis		"	14 25·76	(·694)	26·34	......	......		14 35·53
	32	*w* Herculis		"	17 09·31		09·80	......	......		17 18·99
	33	ρ Herculis	r	"	20 26·43		27·01	......	......		20 36·20
	34	B.J. 650.......		"	24 12·63		13·47	22·65	......		24 22·66
	35	Groom. 2456..		"	26 14·42		18·60	......	......		26 27·79
	36	B.J. 653.......		"	28 15·37		16·33	25·50	......		28 25·52
	37	B.J. 657.......		"	30 20·85		21·92	31·22	......		30 31·11
	38	Groom. 944...	L.C.,nr	"	32 59·13		51·15	00·68	9·53		....
	39	B.J. 663.......		"	36 47·07		47·85	57·05	......		36 57·04
	40	B.D. 72·800...		"	38 41·58		43·88	......	......		38 53·07
	41	B.J. 670.......		"	43 22·62		24·88	......	......		43 34·07
	42	87 Herculis....		"	45 02·32		02·69	......	......		45 11·88
	43	*z* Herculis		"	47 33·59		34·44	......	......		47 43·63
	44	168 H. Herc...		"	49 00·84		01·47	......	......		49 10·66
	45	89 Herculis....		"	51 39·42		39·80	......	......		51 48·99
	46	B.J. 675.......		"	53 18·56		21·69	......	......		53 30·88
	47	B.D. 78·616...		"	55 04·24		07·73	......	......		55 16·92
	48	ψ² Draconis...		"	56 35·15		37·39	......	......		56 46·58
	49	δ Urs. Min....	nr	"	18 01 02·02		14·18	23·25	9·07		....

From Aug 12 Clamp West; from Aug. 19 Clamp East.

1—29. Adopted $\Delta T+m=7·848+·0069$ ($T-18^h\ 30^m$).

30—49. Adopted $\Delta T+m=9·204+·0094$ ($T-19^h\ 00^m$).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Aug. 19	1	B.J. 681.......		N	18 03 54·03	·035	54·45	03·66	9·21	9·20	18 04 03·65
	2	40 Draconis...		"	06 36·51	(·694)	40·61	......	......		06 49·81
	3	B.J. 684.......		"	12 42·61		43·29	52·57	9·28		12 52·49
	4	446 B. Herc...		"	18 15·77		16·11	......	......		18 25·31
	5	B.J. 690.......		"	19 44·11		44·43	53·62	9·19		19 53·63
	6	μ Lyrae.......		"	21 07·92		08·54	......	......		21 17·74
	7	B.J. 695.......		"	22 31·81		34·14	......	......		22 43·34
	8	B.J. 699.......		"	33 45·55		46·15	55·34	9·19		33 55·35
	9	111 Herculis...		"	42 55·30		55·56	......	......		43 04·76
	10	Bradley 2382..		"	44 03·08		05·16	......	......		44 14·36
	11	B.J. 705.......		"	46 37·66		38·17	47·35	9·18		46 47·37
	12	Groom. 2719..		"	47 52·52		55·04	......	......		48 04·24
	13	50 Draconis...		"	49 07·65		10·41	......	......		49 19·61
	14	B.J. 711.......		"	52 27·83		28·56	37·77	9·21		52 37·76
	15	B.J. 713.......		"	55 27·00		27·49	36·56	9·07		55 36·69
	16	51 H. Cephei..		"	58 35·97		22·18	32·35	10·17		....
	17	B.J. 719.......		"	19 03 57·60		58·16	07·40	9·24		19 04 07·36
	18	B.J. 725.......		"	13 28·22		28·39	37·64	9·25	9·21	13 37·60
	19	B.J. 726.......		"	14 53·29		54·28	03·52	......		15 03·49
	20	B.J. 729.......		"	17 08·52		10·92	......	......		17 20·13
	21	b Aquilae		"	20 33·47		33·65	......	......		20 42·86
	22	φ Aquilae. ...		"	51 51·38		51·55	......	......		52 00·76
	23	B.J. 750.......		"	53 10·24		11·20	20·45	......		53 20·41
	24	B.J. 752.......		"	54 37·91		38·18	47·45	9·27		54 47·39
	25	15 Vulp.......		"	57 16·15		16·55	......	......		57 25·76
	26	B.D. 69·1084..		"	58 46·82		48·83	......	......		58 58·04
	27	69 Draconis...		"	20 02 00·29		03·24	......	......		20 02 12·45
	28	B.J. 760.......		"	12 48·71		49·07	58·22	9·15	9·22	12 58·29
	29	176 B. Cygni..		"	16 51·87		52·48	......	......		17 01·70
	30	B.J. 765.......		"	18 52·31		52·94	02·09	9·15		19 02·16
	31	40 Cygni......		"	24 06·56		07·16	......	......		24 16·38
	32	41 Cygni......		"	25 35·63		36·07	......	......		25 45·29
	33	Groom. 3241..		"	30 16·21		18·48	......	......		30 27·70
	34	B.J. 770.......		"	32 34·02		36·66	......	......		32 45·88
	35	B.J. 774.......		"	35 20·27		20·49	29·76	9·27		35 29·71
	36	B.J. 777.......		"	38 14·12		14·87	24·10	9·23		38 24·09
	37	B.J. 780.......		"	42 26·60		27·12	36·42	9·30		42 36·34
	38	B.J. 784.......		"	43 46·60		47·16	56·39	9·23		43 56·38
	39	76 Draconis...		"	49 00·81		06·07	15·43	9·36		....
	40	220 H[1]. Drac..		"	51 33·34		37·52	47·01	9·49		....
Aug. 20	41	B.J. 690.......		S	18 19 43·90	·046	44·25	53·61	9·36	9·38	18 19 53·63
	42	μ Lyrae		"	21 07·69	(·700)	08·36	......	......		21 17·74
	43	B.J. 694.......		"	22 27·05		28·26	37·67	......		22 37·64
	44	B.J. 699.......	r	"	33 45·33		45·93	55·32	9·39		33 55·31
	45	B.J. 703.......		"	41 39·51		39·84	49·23	9·39		41 49·22
	46	111 Herculis...		"	42 55·05		55·35	......	......		43 04·73
	47	204 B. Drac...		"	44 34·00		34·96	......	......		44 44·34
	48	B.J. 705.......		"	46 37·31		37·86	47·34	9·48		46 47·24
	49	B.J. 707.......		"	49 43·79		45·02	54·51	......		49 54·40

Clamp East. 1—40. Adopted $\Delta T+m=9{\cdot}204+{\cdot}0094\ (T-19^{h}\ 00^{m})$.

41—49. Adopted $\Delta T+m=9{\cdot}394+{\cdot}0102\ (T-19^{h}\ 45^{m})$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Aug. 20	1	B.J. 711.......		S	18 52 27·58	·016	28·35	37·75	9·40	9·39	18 52 37·74
	2	B.J. 713.......		"	55 26·63	(·700)	27·17	36·55	9·38		55 36·56
	3	51 H. Cephei..	L.C.,nr	"	58 36·63		22·48	32·75	10·27		....
	4	B.J. 719.......		"	19 03 57·40		58·00	07·38	9·38		19 04 07·39
	5	19 Lyrae.....	r	"	08 11·07		11·52	....	.....		08 20·91
	6	B.J. 725.......		"	13 28·02		28·22	37·63	9·41		13 37·61
	7	B.J. 726.......		"	14 53·07		54·05	03·50	......		15 03·44
	8	159 B. Lyrae..		"	15 49·54		50·24	.....	......		15 59·63
	9	21 B. Vulp....		"	21 34·55		34·95	.....	......		21 44·34
	10	4 Cygni.......		"	22 46·66		47·26	.....	......		22 56·65
	11	α Vulp........		"	24 49·91		50·31	.....	......		24 59·70
	12	B.J. 732.......		"	26 57·74		58·19	07·56	9·37		27 07·58
	13	8 Cygni.......		"	28 17·76		18·33	.....	......		28 27·72
	14	ε Sagittae....		"	33 05·45		05·72	.....	......		33 15·11
	15	β Sagittae.....		"	36 52·87		53·16	.....	......		37 02·55
	16	10 Vulp.......		"	39 50·67		51·09	.....	......		40 00·48
	17	B.J. 740.......		"	40 53·93		54·55	03·93	9·38		41 03·94
	18	B.J. 742.......		"	42 01·63		02·43	11·87	9·44		42 11·82
	19	B.J. 743.......		"	43 15·00		15·30	24·62	9·32		43 24·69
	20	ζ Sagittae.....		"	44 51·41		51·72	.....	......		45 01·11
	21	φ Aquilae.....		"	51 51·17		51·37	.....	......	9·40	52 00·77
	22	B.J. 765.......		"	20 18 52·00		52·69	02·08	9·39		20 19 02·09
	23	40 Cygni......		"	24 06·34		06·98	.....	......		24 16·38
	24	41 Cygni......		"	25 35·40		35·89	.....	......		25 45·29
	25	ω¹ Cygni......		"	27 08·31		09·15	.....	......		27 18·55
	26	B.J. 768.......		"	28 47·51		47·70	57·09	9·39		28 57·10
	27	ζ Delphini.....		"	30 58·66		58·91	.....	......		31 08·31
	28	B.J. 771.......	r	"	33 12·39		12·59	22·00	9·41		33 21·99
	29	29 Vulp.......		"	34 22·61		22·95	.....	......		34 32·35
	30	B.J. 774.......		"	35 20·06		20·33	29·75	9·42		35 29·73
	31	B.J. 777.......		"	38 13·86		14·66	24·09	9·43		38 24·06
	32	B.J. 778.......		"	39 08·08		08·33	17·72	9·39		39 17·73
	33	B.J. 780.......		"	42 26·42		26·98	36·42	9·44		42 36·38
	34	B.J. 784.......	r	"	43 46·37		46·91	56·39	9·48		43 56·31
	35	76 Draconis...	nr	"	49 00·33		05·71	15·35	9·64		....
	36	220 H¹. Drac...	nr	"	51 33·17		37·45	46·96	9·51	9·41	....
	37	B.J. 788.......		"	53 41·21		41·91	51·33	9·42		53 51·32
	38	f¹ Cygni.......		"	56 38·00		38·80	.....	......		56 48·21
	39	B.J. 792.......		"	21 01 31·52		32·29	41·74	9·45		21 01 41·70
	40	B.J. 793.......		"	02 44·19		44·83	54·22	9·39		02 54·24
	41	B.J. 797.......		"	08 58·75		59·23	08·59	9·36		09 08·64
	42	B.J. 799.......		"	11 04·12		04·75	14·17	9·42		11 14·16
	43	υ Cygni.......		"	14 05·28		05·85	.....	......		14 05·26
	44	B.A.C. 7504...	nr	"	17 28·93		41·55	50·78	9·23		....
	45	69 Cygni......		"	21 58·57		59·17	.....	......		22 08·58
	46	B.J. 807.......		"	25 59·81		00·58	10·02	......		26 09·99
	47	72 Cygni......		"	30 58·16		58·80	.....	......		31 08·21
Aug. 26	48	δ Urs. Min....	nr	N	18 00 57·80	·047	09·89	20·71	10·82	10·95	....
	49	B.J. 681.......		"	03 52·19	(·679)	52·62	03·55	10·93		18 04 03·57

Clamp East. 1—47. Adopted $\Delta T+m=9{\cdot}394+{\cdot}0102\ (T-19^h\ 45^m)$.
48, 49. Adopted $\Delta T+m=10{\cdot}965+{\cdot}0120\ (T-19^h\ 00^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Aug. 26	1	40 Draconis...		N	18 06 33·92	·047	37·99	...	.....	10·95	18 06 48·94
	2	B.J. 684.......		"	12 40·87	(·679)	41·56	52·42	10·86	10·96	12 52·52
	3	446 B. Herc...		"	18 14·00		14·34	...	...		18 25·30
	4	B.J. 690.......		"	19 42·26		42·58	53·52	10·94		19 53·54
	5	μ Lyrae......		"	21 06·04		06·67	.	....		21 17·63
	6	B.J. 694.......		"	22 25·24		26·45	37·47	.		22 37·41
	7	B.J. 699.......		"	33 43·64		44·25	55·21	10·96		33 55·21
	8	B.J. 703.......		"	41 37·91		38·21	49·15	10·94		41 49·17
	9	111 Herculis...		"	42 53·50		53·77	...	.....		43 04·73
	10	204 B. Drac...		"	44 32·19		33·17	.	....		44 44·13
	11	B.J. 705.......		"	46 35·74		36·25	47·25	11·00		46 47·21
	12	B.J. 707.......		"	49 41·99		43·22	54·32	.. .		49 54·18
	13	B.J. 711.......		"	52 25·86		26·58	37·63	11·05		52 37·54
	14	B.J. 713.......		"	55 25·02		25·51	36·46	10·95		55 36·47
	15	51 H. Cephei..	L.C.,nr	"	58 38·04		24·32	35·07	10·75		..
	16	B.J. 719......		"	19 03 55·76		56·32	07·29	10·97	10·97	19 04 07·29
	17	19 Lyrae......		"	08 09·32		09·79	.	.		08 20·76
	18	B.J. 725......		"	13 26·33		26·51	37·58	11·07		13 37·48
	19	B.J. 726.......		"	14 51·27		52·26	03·36	...		15 03·23
	20	b Aquilae.....		"	20 31·69		31·87	..	..		20 42·84
	21	21 B. Vulp....		"	21 32·97		33·33	....	.		21 44·30
	22	4 Cygni......		"	22 45·03		45·59	..	. ..		22 56·56
	23	a Vulp......		"	24 48·24		48·60	.. .	.		24 59·57
	24	B.J. 732.......		"	26 56·11		56·53	07·49	10·96		27 07·50
	25	8 Cygni... ..		"	28 16·11		16·63	..	. .		28 27·60
	26	B.D. 49·3059..		"	33 21·36		22·25	.	.		33 33·22
	27	B.J. 738......		"	33 51·79		52·68	03·70	.....	.	34 03·65
	28	14 Cygni......		"	36 21·03		21·72	...	......		36 32·69
	29	10 Vulp.......		"	39 49·11		49·49	...	....		40 00·46
	30	B.J. 740.......		"	40 52·29		52·88	03·86	10·98		41 03·85
	31	B.J. 742.......		"	42 00·03		00·78	11·78	11·00		42 11·75
	32	B.J. 743.......		"	43 13·29		13·56	24·58	11·02		43 24·53
	33	ζ Sagittae.....		"	44 49·81		50·09	....	......		45 01·06
	34	ϕ Aquilae.....		"	51 49·56		49·74	...	.....	10·98	52 00·72
	35	B.J. 750.......		"	53 08·32		09·28	20·32	......		53 20·26
	36	B.J. 752.......		"	54 36·12		36·41	47·40	10·99		54 47·39
	37	15 Vulp.......		"	57 14·34		14·75	...	......		57 25·73
Aug. 29	38	ψ^2 Draconis...		N	17 56 31·84	·044	34·16	...	....	11·84	17 56 46·00
	39	δ Urs. Min....	nr	"	18 00 54·83	(·711)	07 44	19·41	11·99		...
	40	B.J. 681.......		"	03 51·21		51·65	03·50	11·85		18 04 03·49
	41	40 Draconis...		"	06 32·27		36·51	...	..		06 48·35
	42	B.J. 684.......		"	12 39·77		40·49	52·36	11·87		12 52·33
	43	446 B. Herc...		"	18 12·98		13·34	...	....		18 25·18
	44	B.J. 690.......		"	19 41·34		41·67	53·48	11·81		19 53·51
	45	μ Lyrae......		"	21 05·07		05·71	.....	....		21 17·55
	46	B.J. 693.......		"	21 50·49		52·71	......	......		22 04·55
	47	B.J. 695.......		"	22 28·14		30·55	...	......		22 42·39
	48	B.J. 699.......	r	"	33 42·67		43·30	55·15	11·85		33 55·14
	49	B.J. 703.......		"	41 36·95		37·26	49·11	11·85	11·85	41 49·11

Clamp East. 1—37. Adopted $\Delta T+m=10{\cdot}965+{\cdot}0120\ (T-19^{h}\ 00^{m})$.
38—49. Adopted $\Delta T+m=11{\cdot}856+{\cdot}0131\ (T-19^{h}\ 30^{m})$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Aug. 29	1	111 Herculis...		N	18 42 52·54	·044	52·81	.....	....	11·85	18 43 04·66
	2	Bradley 2382..		"	43 59·53	(·711)	01·68	.....	....		44 13·53
	3	B.J. 705.......		"	46 34·76		35·29	47·20	11·91		46 47·14
	4	Groom. 2719..		"	47 49·09		51·70	.....	....		48 03·55
	5	50 Draconis...		"	49 04·31		07·18	.....	....		49 19·03
	6	B.J. 711.......		"	52 24·92		25·67	37·57	11·90		52 37·52
	7	B.J. 713.......		"	55 24·06		24·57	36·42	11·85		55 36·42
	8	51 H. Cephei..	L.C.,nr	"	58 38·17		23·84	36·47	12·63		....
	9	B.J. 719.......		"	19 03 54·79		55·37	07·24	11·87		19 04 07·22
	10	λ Urs. Min....		"	10 18·74		01·77	13·80	12·03		....
	11	B.J. 726.......		"	14 50·30		51·33	03·29	....		15 03·18
	12	B.J. 729.......		"	17 05·21		07·69	.....	....		17 19·54
	13	*b* Aquilae......		"	20 30·78		30·97	.....	....		20 42·82
	14	21 B. Vulp ...		"	21 32·02		32·40	.....	....		21 44·27
	15	4 Cygni.......		"	22 44·12		44·70	.....	....		22 56·55
	16	B.D. 76·734...		"	24 33·83		36·93	.....	....		24 48·78
	17	B.J. 734.......		"	26 56·15		00·15	.....	....	11·86	27 12·01
	18	8 Cygni... ...		"	28 15·20		15·74	.....	....		28 27·60
	19	B.D. 70·1073..		"	31 31·96		34·12	.....	....		31 45·98
	20	B.D. 49·3059..		"	33 20·34		21·26	.....	....		33 33·12
	21	B.J. 738..... .		"	33 50·86		51·78	03·64	....		34 03·64
	22	14 Cygni......		"	36 20·06		20·78	.....	....		36 32·64
	23	10 Vulp.......		"	39 48·16		48·55	.....	....		40 00·41
	24	B.J. 740.......		"	40 51·42		52·02	03·82	11·80		41 03·88
	25	B.J. 742.......		"	41 59·04		59·82	11·73	11·91		42 11·68
	26	B.J. 743.......		"	43 12·40		12·67	24·56	11·89		43 24·53
	27	ζ Sagittae.....		"	44 48·86		49·14	.....	....		45 01·00
	28	B.J. 747.......		"	48 17·46		19·54	.....	....		48 31·40
	29	φ Aquilae.....		"	51 48·68		48·86	.....	....		52 00·72
	30	B.J. 750.......		"	53 07·38		08·38	20·26	....		53 20·24
	31	B.J. 752.......		"	54 35·28		35·57	47·38	11·81		54 47·43
	32	15 Vulp........		"	57 13·43		13·85	.....	....		57 25·71
	33	B.D. 69·1084..		"	58 43·85		45·93	.....	....		58 57·79
	34	Groom. 1119..	L.C.,nr	"	20 08 46·71		10·03	20·71	10·68		....
	35	176 B. Cygni..		"	16 49·07		49·71	.....	....	11·87	20 17 01·58
	36	B.J. 765.......		"	18 49·45		50·11	01·99	11·88		19 01·98
	37	40 Cygni......		"	24 03·79		04·41	.....	....		24 16·28
	38	41 Cygni......		"	25 32·92		33·38	.....	....		25 45·25
	39	ω^1 Cygni......		"	27 05·69		06·57	.....	....		27 18·44
	40	B.J. 768.......		"	28 45·00		45·18	57·06	11·88		28 57·05
	41	Groom. 3241..		"	30 12·91		15·26	.....	....		30 27·13
	42	B.J. 770.......		"	32 30·79		33·52	.....	....		32 45·39
	43	74 Draconis...		"	34 29·83		34·43	.....	....		34 46·30
	44	B.J. 777.......		"	38 11·37		12·15	24·01	11·86		38 24·02
	45	B.J. 780.......		"	42 23·91		24·45	36·38	11·93		42 36·32
	46	B.J. 784.......		"	43 43·96		44·54	56·34	11·80		43 56·41
	47	76 Draconis...	nr	"	48 57·35		02·80	14·70	11·90		....
	48	220 H[1].Drac...		"	51 29·98		34·31	.....	....		51 46·18
	49	B.J. 788.......		"	53 38·63		39·30	51·28	11·98		53 51·17
	50	Bradley 2748..		"	55 37·12		40·04	.....	....		55 51·91

Clamp East. 1—50. Adopted $\Delta T+m=11\cdot856+\cdot0131\ (T-19^h\ 30^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Aug. 31	1	B.J. 757		N	20 10 36·63	·043	37·45	49·93		12·41	20 10 49·86
	2	B.J. 760		"	12 45·35	(·710)	45·72	58·14	12·42		12 58·13
	3	176 B. Cygni		"	16 48·49		49·12			—	17 01·53
	4	B.J. 765		"	18 48·91		49·57	01·97	12·40	12·42	19 01·99
	5	40 Cygni		"	24 03·28		03·90				24 16·32
	6	41 Cygni		"	25 32·37		32·83				25 45·25
	7	ω^1 Cygni		"	27 05·11		05·99				27 18·41
	8	B.J. 768		"	28 44·41		44·58	57·05	12·47		28 57·00
	9	ζ Delphini		"	30 55·60		55·82				31 08·24
	10	B.J. 770		"	32 30·52		33·24				32 45·66
	11	74 Draconis		"	34 29·17		33·75				34 46·17
	12	B.J. 777		"	38 10·77		11·55	23·99	12·44		38 23·97
	13	B.J. 778		"	39 05·10		05·32	17·69	12·37		39 17·74
	14	B.J. 780		"	42 23·37		23·91	36·36	12·45		42 36·33
	15	B.J. 784		"	43 43·30		43·88	56·32	12·44		43 56·30
	16	76 Draconis	nr	"	48 56·59		02·02	14·48	12·46		......
	17	B.J. 788		"	53 38·10		38·77	51·26	12·49		53 51·19
	18	Bradley 2748		"	55 36·68		39·58			—	55 52·00
	19	B.J. 792		"	21 01 28·47		29·21	41·67	12·46	12·43	21 01 41·64
	20	B.J. 793		"	02 41·16		41·78	54·18	12·40		02 54·21
	21	f^2 Cygni		"	03 19·09		19·93				03 32·36
	22	Groom. 3409		"	05 39·69		41·88				05 54·31
	23	B.J. 798		"	09 19·51		20·81	33·29			09 33·24
	24	B.J. 799		"	11 01·10		01·71	14·13	12·42		11 14·14
	25	σ Cygni		"	13 41·99		42·62				13 55·05
	26	B.A.C. 7504	nr	"	17 23·57		36·31	49·20	12·89		......
	27	69 Cygni		"	21 55·55		56·13				22 08·56
	28	1 H. Draconis	L.C., nr	"	24 09·55		04·73	17·27	12·54		......
	29	B.J. 809		"	27 18·70		20·79				27 33·22
	30	ρ Cygni		"	30 24·72		25·51				30 37·94
	31	B.J. 811		"	33 09·67		10·33	22·75	12·42		33 22·76
	32	B.J. 813		"	35 58·84		00·02	12·62			36 12·45
	33	B.J. 817		"	40 24·96		27·13				40 39·56
	34	78 Draconis		"	41 47·16		49·45				42 01·88
	35	B.J. 821		"	43 17·11		18·00	30·45		—	43 30·43
	36	14 Pegasi		"	45 41·23		41·68			12.44	45 54·12
	37	B.J. 823		"	48 47·44		47·83	00·32	12·49		49 00·27
	38	Bradley 2868		"	49 53·96		55·08				50 07·52
	39	79 Draconis		"	51 32·78		35·27				51 47·71
	40	Bradley 2897		"	56 48·45		51·16				57 03·60
	41	B.J. 831		"	22 02 38·79		39·17	51·59	12·42		22 02 51·61
	42	B.J. 833		"	05 03·64		04·15	16·66	12·51		05 16·59
	43	B.J. 835		"	05 48·76		49·27	01·69	12·42		06 01·71
	44	B.J. 836		"	07 32·80		34·00	46·46			07 46·44
	45	1 H. Lacertae		"	09 50·18		50·82				10 03·26
	46	B.A.C. 3495	L.C., nr	"	16 31·51	—	23·94	36·60	12·66	—	...
Sept. 1	47	B.J. 693		S	18 21 49·34	·056	51·56			12·81	18 22 04·37
	48	B.J. 700		"	33 51·54	(·723)	54·91			—	34 07·72
	49	Bradley 2382		"	43 58·30		00·46			12·82	44 13·28

Clamp East. 1—46. Adopted $\Delta T+m=12{\cdot}427+{\cdot}0138\ (T-21^h\ 10^m)$.
47—49. Adopted $\Delta T+m=12{\cdot}836+{\cdot}0142\ (T-20^h\ 10^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Sept. 1	1	B.J. 705		S	18 46 33·72	·056	31·30	47·14	12·84	12·82	18 46 47·12
	2	Groom. 2719		"	47 47·72	(·723)	50·33	......	......		48 03·15
	3	50 Draconis		"	49 02·96		05·83	......	......		49 18·65
	4	B.D. 79·604		"	51 44·92		49·09	......	......		52 01·91
	5	B.J. 714		"	55 16·92		19·14	......	......		55 31·96
	6	51 H. Cephei	L.C., rn	"	58 39·59		24·79	37·97	13·18		......
	7	B.J. 719		"	19 03 53·75		54·38	07·19	12·81		19 04 07·20
	8	λ Urs. Min	rn	"	10 12·39		56·78	09·81	13·03		......
	9	B.J. 726		"	14 49·31		50·34	03·21	......		15 03·16
	10	B.J. 729		"	17 04·02		06·51	......	......		17 19·33
	11	4 Cygni		"	22 43·04		43·67	......	......		22 56·49
	12	B.D. 76·734		"	24 32·53		35·62	......	......	12·83	24 48·45
	13	B.J. 734		"	26 54·90		58·91	......	......		27 11·74
	14	8 Cygni		"	28 14·10		14·69	......	......		28 27·52
	15	B.D. 70·1073		"	31 30·71		32·87	......	......		31 45·70
	16	B.D. 49·3059	r	"	33 19·27		20·26	......	......		33 33·09
	17	B.J. 738		"	33 49·77		50·69	03·57	......		34 03·52
	18	14 Cygni		"	36 19·04		19·75	......	......		36 32·58
	19	B.J. 740		"	40 50·27		50·93	03·77	12·84		41 03·76
	20	B.J. 742		"	41 57·98		58·82	11·67	12·85		42 11·65
	21	B.J. 759		"	20 11 42·99		46·35	......	......	12·84	20 11 59·19
	22	176 B. Cygni		"	16 47·97		48·67	......	......		17 01·51
	23	B.J. 765	r	"	18 48·47		49·13	01·95	12·82		19 01·97
	24	40 Cygni		"	24 02·74		03·42	......	......		24 16·26
	25	41 Cygni		"	25 31·82		32·34	......	......		25 45·18
	26	ω^1 Cygni		"	27 04·70		05·58	......	......		27 18·42
	27	Groom. 3241		"	30 11·85		14·19	......	......		30 27·03
	28	B.J. 770		"	32 29·65		32·38	......	......		32 45·22
	29	74 Draconis	rn	"	34 28·50		33·24	......	......		34 46·08
	30	B.J. 777		"	38 10·30		11·14	23·97	12·83		38 23·98
	31	B.J. 780	r	"	42 22·98		23·50	36·35	12·85		42 36·34
	32	B.J. 784		"	43 42·78		43·41	56·31	12·90		43 56·25
	33	76 Draconis	rn	"	48 55·80		01·43	14·37	12·94	12·85	......
	34	220 H^1. Drac	rn	"	51 28·62		33·09	46·21	13·12		......
	35	B.J. 788		"	53 37·67		38·40	51·25	12·85		53 51·25
	36	Bradley 2748		"	55 36·07		38·98	......	......		55 51·83
	37	B.J. 792		"	21 01 27·95		28·76	41·66	12·90		21 01 41·61
	38	f^2 Cygni		"	03 18·60		19·44	......	......		03 32·29
	39	Groom. 3409		"	05 39·19		41·39	......	......		05 54·24
	40	B.J. 795		"	07 06·28		09·73	......	......		07 22·58
	41	B.J. 798		"	09 19·07		20·38	33·27	......		09 33·23
	42	B.J. 799		"	11 00·61		01·28	14·13	12·85		11 14·13
	43	σ Cygni		"	13 41·46		42·16	......	......		13 55·01
	44	Bradley 2796		"	16 29·51		32·66	......	......		16 45·51
	45	69 Cygni		"	21 55·06		55·69	......	......		22 08·54
	46	1 H. Draconis	L.C., rn	"	24 09·08		04·09	17·37	13·28		......
	47	B.J. 807		"	25 56·27		57·07	09·98	......		26 09·92
	48	B.J. 809		"	27 18·19		20·28	......	......		27 33·13
	49	ρ Cygni		"	30 24·32		25·17	......	......	12·86	30 38·03
	50	B.J. 811		"	33 09·11		09·83	22·74	12·91		33 22·69

Clamp East. 1—50. Adopted $\Delta T+m=12{\cdot}836+{\cdot}0142\ (T-20^h\ 10^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Sept. 1	1	B.J. 813.......		S	21 35 58·54	·056	59·71	12·61	......	12·86	21 36 12·57
	2	B.J. 817.......		"	40 24·59	(·723)	26·77	.....	....		40 39·63
	3	78 Draconis...	r	"	41 46·49		48·94	...	......		42 01·80
	4	B.J. 821.......		"	43 16·69		17·58	30·44	......		43 30·44
	5	Bradley 2868..		"	49 53·52		54·64	...	......		50 07·50
	6	79 Draconis...		"	51 32·06		34·57	...	......		51 47·43
	7	Bradley 2897..	r	"	56 47·69		50·58	...	......		57 03·44
Sept. 2	8	B.J. 703.......		N	18 41 35·63	·041	35·95	49·05	13·10	13·08	18 41 49·03
	9	111 Herculis...		"	42 51·17	(·758)	51·46	....	....		43 04·54
	10	Bradley 2382..		"	43 57·92		00·20	...	......		44 13·28
	11	B.J. 705.......		"	46 33·47		34·02	47·12	13·10		46 47·10
	12	Groom. 2719..		"	47 47·49		50·26	.	.....		48 03·34
	13	50 Draconis...		"	49 02·63		05·67	.	.. .		49 18·75
	14	B.D. 79·604...		"	51 44·47		48·89	.	. . ..		52 01·97
	15	B.J. 714.......		"	55 16·57		18·90	...	.. . ..		55 31·98
	16	51 H. Cephei..	L.C.,nr	"	58 39·67		24·44	38·44	14·00		....
	17	B.J. 719.......		"	19 03 53·39		54·00	07·17	13·17		19 01 07·08
	18	λ Urs. Min.....		"	10 08·02		53·60	08·56	14·96	13·09	....
	19	B.J. 726.......		"	14 49·04		50·13	03·18	....		15 03·22
	20	*b* Aquilae.		"	20 29·44		29·64	..	. . .		20 42·73
	21	21 B. Vulp....		"	21 30·69		31·09	..	.		21 44·18
	22	4 Cygni.......		"	22 42·76		43·37	.	. ..		22 56·46
	23	α Vulp........		"	24 46·04		46·14	..	...		24 59·53
	24	B.J. 732.......		"	26 53·91		54·36	07·40	13·04		27 07·45
	25	8 Cygni.......		"	28 13·82		14·39	.	.....		28 27·48
	26	B.D. 49·3059..		"	33 19·01		19·98	. .	......		33 33·07
	27	B.J. 738.......		"	33 49·47		50·44	03·55	......		34 03·53
	28	14 Cygni......		"	36 18·75		19·51	...	. ..		36 32·60
	29	10 Vulp.......		"	39 46·85		47·26				40 00·35
	30	B.J. 740.......		"	40 50·01		50·65	03·76	13·11		41 03·74
	31	B.J. 742.......		"	41 57·69		58·51	11·65	13·14		42 11·60
	32	B.J. 743.......		"	43 11·21		11·50	24·51	13·01		43 24·59
	33	ζ Sagittae.....		"	44 47·62		47·92	. .	.. . ..		45 01·01
	34	φ Aquilae		"	51 47·41		47·60	..	... .	13·10	52 00·70
	35	B.J. 750.......		"	53 06·04		07·09	20·17	... ..		54 20·19
	36	B.J. 752.......		"	54 33·97		34·28	47·34	13·06		54 47·38
	37	15 Vulp.......		"	57 12·08		12·52	.	.....		57 25·62
	38	b^2 Cygni......		"	20 05 53·35		53·97	..	.		20 06 07·07
	39	20 Vulp.......		"	08 02·78		03·20	...	. ...		08 16·30
	40	B.J. 757.......		"	10 35·92		36·79	49·90	.		10 49·89
	41	B.J. 760.......		"	12 44·65		45·04	58·12	13·08		12 58·14
	42	176 B. Cygni..		"	16 47·64		48·31	.	...		17 01·41
	43	B.J. 765.......		"	18 48·17		48·87	01·94	13·07		19 01·97
	44	40 Cygni......		"	24 02·56		03·22	....	......		24 16·32
	45	41 Cygni......		"	25 31·53		32·02	....	....		25 45·12
	46	ω^1 Cygni......		"	27 04·34		05·27	....	.....		27 18·37
	47	B.J. 768.......		"	28 43·82		44·00	57·04	13·04		28 57·10
	48	ζ Delphini....		"	30 55·01		55·25	....	......	13·11	31 08·36
	49	B.J. 771.......		"	33 08·66		08·89	21·95	13·06		33 22·00

Clamp East. 1—7. Adopted $\Delta T+m=12{\cdot}836+{\cdot}0142$ (T$-20^h\ 10^m$).
8—49. Adopted $\Delta T+m=13{\cdot}098+{\cdot}0145$ (T$-20^h\ 00^m$).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Sept. 2	1	29 Vulp.......		N	20 34 18·95	·041	19·28	......	......	13·11	20 34 32·39
	2	B.J. 774.......		"	35 16·40	(·758)	16·65	29·70	13·05		35 29·76
	3	B.J. 777.......		"	38 09·97		10·79	23·96	13·17		38 23·90
	4	B.J. 778.......		"	39 04·32		04·56	17·67	13·11		39 17·67
	5	B.J. 780.......		"	42 22·59		23·15	36·34	13·19		42 36·26
	6	B.J. 781.......		"	43 42·56		43·17	56·30	13·13		43 56·28
	7	76 Draconis...	nr	"	48 55·31		01·09	14·27	13·18		....
	8	220 H[1].Drac...		"	51 28·29		32·88	......	......		51 45·99
	9	B.J. 788.......		"	53 37·35		38·06	51·24	13·18		53 51·17
	10	f^1 Cygni......		"	56 34·04		34·93	......	......		56 48·04
	11	B.J. 792.......		"	21 01 27·69		28·47	41·65	13·18		21 01 41·58
	12	B.J. 793.......		"	02 40·42		41·08	54·16	13·08		02 54·19
	13	B.J. 799.......		"	11 00·30		00·94	14·12	13·18	13·12	11 14·06
	14	σ Cygni.......		"	13 41·23		41·90	......	......		13 55·02
	15	B.J. 804.......		"	17 44·31		44·62	57·74	13·12		17 57·74
	16	69 Cygni......		"	21 54·74		55·35	......	......		22 08·47
	17	1 H. Draconis	L.C.,nr	"	24 09·46		04·33	17·46	13·13		....
	18	B.J. 807.......		"	25 55·97		56·83	09·97	......		26 09·95
Sept. 7	19	B.J. 891.......		S	23 33 29·71	·053	30·46	45·68	15·22	15·16	23 33 45·62
	20	κ Andromedae		"	35 44·87	(·691)	45·64	......	......		36 00·80
	21	ψ Andromedae		"	41 20·83		21·59	......	......		41 36·75
	22	B.J. 898.......		"	47 41·39		41·70	56·89	15·19		47 56·86
	23	B.J. 899.......		"	49 39·43		40·55	55·76	......		49 55·71
	24	ψ Pegasi......		"	52 57·09		57·49	......	......		53 12·65
	25	Bradley 1672..	L.C.,nr	"	0 14 08·76		46·77	01·45	14·68	15·17	....
	26	B.J. 18		"	31 50·92		51·47	06·68	15·21		0 32 06·64
	27	B.J. 19........		"	33 34·54		35·01	50·21	15·20		33 50·18
	28	B.J. 21........		"	35 10·10		11·19	26·42	......		35 26·36
	29	B.J. 25........		"	39 28·86		29·67	44·91	......		39 44·84
	30	B.J. 27........		"	42 20·72		21·10	36·30	15·20		42 36·27
	31	η Cass........		"	43 25·74		26·88	......	......		43 42·05
	32	ν Andromedae		"	44 37·32		38·02	......	......		44 53·19
	33	32[2] H. Camel.	L.C.,nr	"	48 12·08		05·61	20·86	15·25		....
	34	B.J. 33........		"	51 31·85		32·49	47·69	15·20		51 47·66
	35	h Piscium.....		"	52 44·43		44·89	......	......		53 00·06
	36	43 H. Cephei..	nr	"	56 03·41		13·34	28·74	15·40	15·18	....
	37	72 Piscium....		"	1 00 07·07		07·32	......	......		1 00 22·50
	38	μ Cass........		"	03 03·41		04·44	......	......		03 19·62
	39	B.J. 42........		"	04 28·01		28·59	43·76	15·17		04 43·77
	40	χ Piscium.....		"	06 23·65		23·99	......	......		06 39·17
	41	B.J. 45........		"	14 17·71		18·15	33·32	15·17		14 33·33
	42	l Piscium.....		"	15 55·28		55·74	......	......		16 10·92
	43	B.J. 48........		"	19 41·56		42·81	58·12	......		19 57·99
	44	ω Andromedae		"	22 02·48		03·28	......	......		22 18·46
	45	α Urs. Min....	nr.	"	26 47·04		22·78	37·27	14·49		....
	46	B.J. 57........		"	37 47·24		48·12	03·37	......		38 03·30
	47	2 Persei.......		"	46 12·00		12·89	......	......	15·19	46 28·08
	48	B.J. 66........		"	49 26·64		26·98	42·15	15·17		49 42·17
	49	B.J. 73........		"	58 08·64		09·37	24·57	15·20		59 24·56

Clamp East. 1—18. Adopted $\Delta T+m=13\cdot098+\cdot0145$ (T-20^{h} 00^{m}).
19—49. Adopted $\Delta T+m=15\cdot179+\cdot0125$ (T-1^{h} 15^{m}).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

DATE.	Reference No.	OBJECT	NOTES	Observer	Time of Observed Transit	COLL. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Sept. 7	1	B.J. 74........		S	2 01 52·45	·053	52·83	08·01	15·18	15·19	2 02 08·20
	2	B.J. 75........		"	03 57·58	(·691)	58·16	13·32	15·16		04 13·35
	3	B.J. 77........		"	07 23·23		24·12	39·33	....		07 39·31
	4	B.J. 79........		"	11 44·15		44·71	59·84	15·13		11 59·90
	5	ξ Arietis......		"	19 46·16		46·35	.....	....		20 01·54
	6	27 Arietis... .		"	25 41·30		41·59	.....	....		25 56·78
	7	B.J. 89...... .		"	33 28·72		29·08	44·26	15·18	15·20	33 44·28
	8	B.J. 93.......		"	37 49·19		50·03	05·20	.....		38 05·23
	9	39 Arietis... .		"	42 19·16		19·63	...	.....		42 34·83
	10	B.J. 99...... .		"	43 53·70		54·77	09·99	...		44 09·97
	11	σ Arietis.		"	46 17·78		18·03	....	....		46 33·23
	12	B.J. 103.......		"	47 38·47		39·43	54·62	.....		47 54·63
	13	ϵ Arietis		"	53 50·19		50·53	....	.....		54 05·73
	14	B.J. 108..... .		"	58 02·46		03·44	18·68	.....		58 18·64
	15	B.J. 109.....		"	59 10·57		11·22	26·44	15·22		59 26·42
	16	B.J. 112..... .		"	3 02 20.38		21·23	36·35	.		3 02 36·43
	17	Groom. 2283.	L.C.,nr	"	05 44·15		27·77	43·27	15·50		.....
	18	ζ Arietis.. .		"	09 29·95		30·29	.....	....		09 45·49
	19	τ^1 Arietis. .		"	15 48·00		48·34	.....	.....		16 03·54
Sept. 8	20	α Vulp . .		S	19 24 43·62	·055	44·03	.....	....	15·41	19 24 59·44
	21	B.J. 732.......		"	26 51·45	(·702)	51·91	07·31	15·40		27 07·32
	22	8 Cygni... ...		"	28 11·42		12·00	....	...		28 27·41
	23	B.J. 760.......		"	20 12 42·16		42·57	58·05	15·48	15·42	20 12 57·99
	24	176 B. Cygni..		"	16 45·35		46·03	....	....		17 01 45
	25	B.J. 765.......		"	18 45·74		46·44	01·86	15·42.		19 01·86
	26	40 Cygni.... .	r	"	24 00·18		00·78	.....	.....		24 16·20
	27	41 Cygni.....		"	25 29·21		29·71	...	....		25 45·13
	28	ω^1 Cygni		"	27 02·00		02·85	.....	....		27 18·27
	29	B.J. 768......		"	28 41·37		41·57	57·00	15·43		28 56·99
	30	ζ Delphini.....	r	"	30 52·60		52·81	....	...		31 08·23
	31	B.J. 771.......		"	33 06·21		06·47	21·91	15·44		34 21·89
	32	29 Vulp.......		"	34 16·45		16·80	...	.. .		34 32·22
	33	B.J. 774.......		"	35 13·96		14·24	29·66	15·42		35 29·66
	34	B.J. 777.......		"	38 07·61		08·43	23·88	15·45		38 23·85
	35	B.J. 780.......		"	42 20·29		20·86	36·28	15·42		42 36·28
	36	B.J. 784.......	r	"	43 40·25		40·81	56·24	15·43		43 56·23
	37	76 Draconis...	rn	"	48 52·76		58·23	13·72	15·49		....
	38	220 1H^1.Drac...	rn	"	51 25·81		30·15	45·67	15·52		....
	39	B.J. 788.......		"	53 35·03		35·74	51·17	15·43		53 51·16
	40	f^1 Cygni......		"	56 31·78		32·59	....	.. .		56 48·01
	41	B.J. 792.......		"	21 01 25·38		26·16	41·59	15·43	15·43	21 01 41·59
	42	f^2 Cygni......		"	03 15·98		16·79	....	.....		03 32·22
	43	B.J. 798..... .		"	09 16·43		17·70	33·15	...		09 33·13
	44	B.J. 799.......		"	10 58·01		58·65	14·08	15·43		11 14·08
	45	v Cygni.......		"	13 59·16		59·74	....	....		14 15·17
	46	B.A.C. 7504...	rn	"	17 19·47		32·30	47·70	15·40		....
	47	69 Cygni......		"	21 52·49		53·10	....	.....		22 08·53
	48	1 H. Draconis	L.C.,rn	"	24 07·14		02·30	17·91	15·61		....
	49	ρ Cygni......		"	30 21·70		22·53	.....	....		30 37·96

Clamp East. 1—19. Adopted $\Delta T+m=15·179+·0125$ (T−1^h 15^m).
20—49. Adopted $\Delta T+m=15·421+·0125$ (T−20^h 40^m).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
1910 Sept. 8	1	B.J. 811.......		S	21 33 06·58	·055	07·28	22·71	15·43	15·43	21 33 22·71
	2	B.J. 813.......		"	35 55·83	(·702)	56·97	12·53	....		36 12·40
	3	B.J. 816.......		"	40 20·60		21·02	36·44	15·42		40 36·45
	4	B.J. 821.......		"	43 14·08		14·94	30·40	....		43 30·37
	5	14 Pegasi.....		"	45 38·11		38·60	....	....		45 54·03
	6	B.J. 823.......	r	"	48 44·52		44·90	00·31	15·41	15·44	49 00·34
	7	Bradley 2868..		"	49 50·93		52·02	....	....		50 07·46
	8	13 Cephei.....		"	51 37·52		38·63	....	....		51 54·07
	9	B.J. 826.......		"	56 28·98		29·22	44·67	15·45		56 44·66
Sept. 9	10	50 Draconis...		N	18 48 59·46	·051	02·46	....	....	15·83	18 49 18·29
	11	B.J. 712.......		"	55 13·44	(·737)	15·75	....	....		55 31·58
	12	51 H. Cephei..	L.C.,nr	"	58 40·11		25·12	41·49	16·37		....
	13	B.J. 719.......		"	19 03 50·57		51·18	07·03	15·84		19 04 07·02
	14	λ Urs. Min....		"	09 58·53		43·48	00·32	16·84		....
	15	B.J. 726.......		"	14 46·14		47·22	02·98	....		15 03·05
	16	B.J. 729.......		"	17 00·49		03·09	....	....		17 18·92
	17	*b* Aquilae.....		"	20 26·61		26·81	....	....		20 42·64
	18	21 B. Vulp....		"	21 27·89		28·29	....	....		21 44·12
	19	4 Cygni.......		"	22 39·94		40·55	....	....		22 56·38
	20	B.D. 76·734...		"	24 28·80		32·03	....	....		24 47·86
	21	B.J. 734.......		"	26 50·97		55·14	....	....		27 10·97
	22	8 Cygni.......		"	28 10·98		11·54	....	....	15·84	28 27·38
	23	B.D. 70·1073..		"	31 27·22		29·48	....	....		31 45·32
	24	B.D. 49·3059..		"	33 16·18		17·15	....	....		33 32·99
	25	B.J. 738.......		"	33 46·60		47·57	03·38	....		34 03·41
	26	14 Cygni......		"	36 15·82		16·58	....	....		36 32·42
	27	10 Vulp.......		"	39 44·02		44·43	....	....		40 00·27
	28	B.J. 740.......		"	40 47·11		47·74	03·64	15·90		41 03·58
	29	B.J. 742.......		"	41 54·87		55·69	11·51	15·82		42 11·53
	30	B.J. 743.......		"	43 08·28		08·57	24·43	15·86		43 24·41
	31	ζ Sagittae....		"	44 44·71		45·01	....	....		45 00·85
	32	B.J. 747.......		"	48 12·74		14·91	....	....		48 30·75
	33	B.J. 750.......		"	52 03·20		04·24	20·01	....		52 20·08
	34	B.J. 752.......		"	54 31·09		31·40	47·26	15·86		54 47·24
	35	15 Vulp.......		"	57 09·31		09·75	....	....		57 25·59
	36	B.D. 69·1084..		"	58 39·30		41·47	....	....		58 57·31
	37	69 Draconis...		"	20 01 52·04		55·23	....	....		20 02 11·07
	38	Groom. 1119..	L.C.,nr	"	08 51·95		13·56	30·89	17·33		....
	39	176 B. Cygni..		"	16 44·86		45·53	....	....	15·85	17 01·38
	40	B.J. 765.......		"	18 45·34		46·03	01·84	15·81		19 01·88
	41	41 Cygni......		"	25 28·73		29·22	....	....		25 45·07
	42	ω¹ Cygni.....		"	27 01·51		02·43	....	....		27 18·28
	43	Groom. 3241..		"	30 08·41		10·86	....	....		30 26·71
	44	B.J. 770.......		"	32 26·05		28·90	....	....		32 44·75
	45	74 Draconis...		"	34 24·82		29·62	....	....		34 45·47
	46	B.J. 777.......		"	38 07·11		07·93	23·86	15·93		38 23·78
	47	B.J. 778.......		"	39 01·56		01·80	17·63	15·83		39 17·65
	48	B.J. 780.......		"	42 19·86		20·42	36·27	15·85		42 36·27
	49	B.J. 784.......		"	43 39·74		40·35	56·23	15·88		43 56·20

Clamp East. 1—9. Adopted $\Delta T+m=15{\cdot}421+{\cdot}0125\ (T-20^h\ 40^m)$.
10—49. Adopted $\Delta T+m=15{\cdot}846+{\cdot}0125\ (T-20^h\ 20^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Sept. 9	1	76 Draconis...		N	20 48 51·93	·051	57·62	13·62	16·00	15·85	....
	2	220 H[1]. Drac..		"	51 24·91	(·737)	29·44	......	......		20 51 45·29
	3	B.J. 788.......		"	53 34·53		35·24	51·16	15·92		53 51·09
	4	Bradley 2748..		"	55 32·66		35·71	...	...		55 51·56
	5	B.J. 793.......		"	21 02 37·64		38·29	54·10	15·81		21 02 54·14
	6	f^2 Cygni.....		"	03 15·50		16·38	...	......	15·86	03 32·24
	7	Groom. 3409.		"	05 35·87		38·16	...	...		05 54·02
	8	B.J. 797.......		"	08 52·18		52·66	08·51	15·85		09 08·52
	9	B.J. 799.......		"	10 57·59		58·23	14·06	15·83		11 14·09
	10	σ Cygni......		"	13 38·46		39·13		......		13 54·99
	11	B.J. 804.......		"	17 41·54		41·85	57·71	15·86		17 57·71
	12	69 Cygni......		"	21 51·98		52·59		.....		22 08·45
	13	1 H. Draconis	L.C.,nr	"	24 07·28		02·23	17·99	15·76		...
	14	B.J. 807.......		"	25 53·16		54·01	09·91	......		26 09·87
	15	B.J. 809.......		"	27 14·92		17·10	...	......		27 32·96
	16	ρ Cygni.......		"	30 21·19		22·01		.....		30 37·87
	17	B.J. 811.......		"	33 06·12		06·82	22·70	15·88		33 22·68
	18	B.J. 813.......		"	35 55·18		56·42	12·51	......		36 12·28
	19	B.J. 817......		"	40 21·04		23·31	...	......		40 39·17
	20	78 Draconis...		"	41 43·36		45·77	.	.....		42 01·63
	21	B.J. 821.......		"	43 13·51		14·44	30·39	....		43 30·30
	22	14 Pegasi.....		"	45 37·63		38·11	...	......		45 53·97
Sept. 10	23	B.D. 69·1084.		S	19 58 39·05	·056	41·20	.....	......	16·01	19 58 57·21
	24	69 Draconis..		"	20 01 51·85	(·745)	55·00	..	.....		20 02 11·01
	25	b^2 Cygni.....		"	05 50·23		50·89	.	....		06 06·90
	26	30 Cygni.....		"	10 13·26		14·11	.	....		10 30·12
	27	B.J. 759......		"	11 39·13		12·59	..	......		11 58·60
	28	176 B. Cygni..		"	16 44·68		45·39		.....	16·02	17 01·41
	29	B.J. 765.......	r	"	18 45·10		45·78	01·82	16·04		19 01·80
	30	40 Cygni......		"	23 59·43		00·13	..	......		24 16·15
	31	41 Cygni......		"	25 28·50		29·03	....	.....		25 45·05
	32	ω^1 Cygni......		"	27 01·31		02·22	..	...		27 18·24
	33	Groom. 3241..		"	30 08·16		10·57	.	....		30 26·59
	34	B.J. 770.......		"	32 25·93		28·74	.	...		32 44·76
	35	74 Draconis...		"	34 24·29		29·03		.		34 45·05
	36	B.J. 777.......		"	38 06·93		07·79	23·84	16·05		38 23·81
	37	B.J. 782.......		"	42 51·87		53·08	09·23	....		43 09·10
	38	76 Draconis...	nr	"	48 51·61		57·40	13·51	16·11		......
	39	220 H[1]. Drac..	nr	"	51 24·81		29·41	45·49	16·08		..
	40	B.J. 788.......		"	53 34·34		35·09	51·14	16·05		53 51·11
	41	Bradley 2748..		"	55 32·44		35·44	..	....		55 51·46
	42	B.J. 792......		"	21 01 24·62		25·45	41·56	16·11		21 01 41·47
	43	B.J. 793......		"	02 37·33		38·03	54·09	16·06	16·03	02 54·06
	44	Groom. 3409..		"	05 35·71		37·98		......		05 51·01
	45	B.J. 795.......		"	07 02·62		06·17	.	....		07 22·20
	46	B.J. 798.......		"	09 15·71		17·05	33·11	...		09 33·08
	47	B.J. 799.......		"	10 57·32		58·00	14·05	16·05		11 14·03
	48	σ Cygni.......		"	13 38·20		38·91		...		13 54·94
	49	B.A.C. 7504...	nr	"	17 17·01		30·58	47·30	16·72		....

Clamp East. 1—22. Adopted $\Delta T+m=15{\cdot}846+{\cdot}0125\ (T-20^h\,20^m)$.
23—49. Adopted $\Delta T+m=16{\cdot}033+{\cdot}0125\ (T-21^h\,40^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Sept. 10	1	69 Cygni		S	21 21 51·81	·056	52·45			16·03	21 22 08·48
	2	1 H. Draconis	L.C.,nr	"	24 07·10	(·745)	01·95	18·09	16·14		....
	3	B.J. 807		"	25 53·00		53·82	09·90			26 09·85
	4	B.J. 809		"	27 14·80		16·95				27 32·98
	5	72 Cygni		"	30 51·43		52·13				31 08·16
	6	B.J. 811		"	33 05·89		06·63	22·69	16·06		33 22·66
	7	B.J. 813		"	35 55·24		56·45	12·50			36 12·48
	8	B.J. 817	r	"	40 21·07		23·45				40 39·48
	9	78 Draconis		"	41 43·31		45·68				42 01·71
	10	B.J. 821		"	43 13·42		14·34	30·38			43 30·37
	11	Bradley 2868		"	49 50·33		51·48			16·04	50 07·52
	12	79 Draconis		"	51 28·86		31·44				51 47·48
	13	Bradley 2897		"	56 44·59		47·39				57 03·43
	14	B.J. 833	r	"	22 05 00·08		00·60	16·65	16·05		22 05 16·64
	15	B.J. 835		"	05 45·04		45·62	01·69	16·07		06 01·66
	16	B.J. 837		"	07 49·74		52·11				08 08·15
	17	1 H. Lacertae		"	09 46·49		47·21				10 03·25
	18	Bradley 2942		"	11 00·11		02·61				11 18·65
	19	B.A.C. 3495	L.C.,nr	"	16 28·85		20·77	37·26	16·49		....
	20	30 H. Camel	L.C.,nr	"	19 57·67		51·56	07·68	16·12		....
	21	B.D. 70·1240		"	23 26·28		28·46				23 44·50
	22	28 Cephei	r	"	25 46·92		50·88				26 06·92
	23	B.J. 848		"	27 20·45		21·39	37·42			27 37·43
	24	29 Cephei		"	28 50·44		54·18				29 10·22
	25	226 B. Cephei		"	30 26·77		29·81				30 45·85
	26	B.J. 851		"	33 17·92		20·49				33 36·53
	27	Groom. 3857		"	35 02·47		05·33				35 21·37
	28	B.J. 858	r	"	39 50·29		51·00	06·98	15·98	16·05	40 07·05
	29	B.J. 869		"	57 32·32		33·10	49·17	16·07		57 49·15
	30	5 Andromedae		"	23 03 25·67		26·58				23 03 42·63
	31	B.J. 874	r	"	04 47·19		50·23				05 06·28
	32	B.J. 875		"	08 42·41		43·60	59·66			08 59·65
	33	Bradley 3085		"	11 10·23		12·89				11 28·94
	34	Groom. 4033		"	13 53·76		56·60				14 12·65
	35	1 H. Cass		"	25 37·94		39·20			16·06	25 55·26
Sept. 13	36	*b* Aquilae		S	19 20 26·74	·059	26·98			15·66	19 20 42·64
	37	21 B. Vulp		"	21 27·93	(·752)	28·37				21 44·03
	38	4 Cygni		"	22 39·96		40·62				22 56·28
	39	B.D. 76·734		"	24 28·55		31·78				24 47·44
	40	B.J. 734		"	26 50·69		54·86				27 10·52
	41	B.D. 70·1073		"	31 27·40		29·66				31 45·32
	42	B.D. 49·3059		"	33 16·27		17·22				33 32·88
	43	B.J. 738		"	33 46·76		47·71	03·27			34 03·37
	44	14 Cygni		"	36 15·89		16·70				36 32·36
	45	10 Vulp		"	39 44·10		44·55				40 00·21
	46	B.J. 740		"	40 47·26		47·94	03·56	15·62		41 03·60
	47	B.J. 743	r	"	43 08·43		08·72	24·37	15·65		43 24·38
	48	ζ Sagittae		"	44 44·81		45·15				45 00·81
	49	φ Aquilae		"	51 44·59		44·82				52 00·48

Clamp East. 1—35. Adopted $\Delta T+m=16{\cdot}033+{\cdot}0125\ (T-21^{h}\ 40^{m})$.
36—49. Adopted $\Delta T+m=15{\cdot}647-{\cdot}0068\ (T-21^{h}\ 10^{m})$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Sept. 13	1	B.J. 752		S	19 54 31·21	·059	31·55	47·20	15·65	15·66	19 54 47·21
	2	15 Vulp		"	57 09·36	(·752)	09·84	...	...		57 25·50
	3	B.D. 69·1084		"	58 39·27		41·44	...	...		58 57·10
	4	69 Draconis		"	20 01 51·85		55·04	...	...	15·65	20 02 10·69
	5	b^2 Cygni		"	05 50·62		51·29	...	...		06 06·94
	6	20 Vulp		"	08 00·00		00·46	...	...		08 16·11
	7	ρ Aquilae		"	09 52·89		53·17	...	...		10 08·82
	8	B.J. 759		"	11 39·22		42·73	...	...		11 58·38
	9	B.J. 765		"	18 45·39		46·13	01·77	15·64		19 01·78
	10	40 Cygni		"	23 59·73		00·43	...	...		24 16·08
	11	41 Cygni		"	25 28·90		29·44	...	...		25 45·09
	12	ω^1 Cygni		"	27 01·60		02·52	...	...		27 18·17
	13	B.J. 768		"	28 41·10		41·32	56·95	15·63		28 56·97
	14	Groom. 3241		"	30 08·28		10·73	...	...		30 26·38
	15	B.J. 770		"	32 26·00		28·85	...	...		32 44·50
	16	29 Vulp.		"	34 16·20		16·58	...	...		34 32·23
	17	B.J. 778		"	39 01·65		01·93	17·58	15·65		39 17·58
	18	B.J. 780	r	"	42 19·95		20·50	36·22	15·72		42 36·15
	19	B.J. 784		"	43 39·89		40·55	56·17	15·62		43 56·20
	20	76 Draconis	rn	"	48 51·58		57·44	13·13	15·69		...
	21	220 H[1]. Drac	rn	"	51 24·75		29·40	45·21	15·81		...
	22	B.J. 788		"	53 34·72		35·48	51·10	15·62		53 51·13
	23	Bradley 2748		"	55 32·66		35·70	...	...		55 51·35
	24	B.J. 792		"	21 01 25·03		25·86	41·51	15·65		21 01 41·51
	25	f^2 Cygni		"	03 15·63		16·50	...	...		03 32·15
	26	Groom. 3409		"	05 36·02		38·32	...	...		05 53·97
	27	B.J. 795		"	07 02·77		06·37	...	...		07 22·02
	28	B.J. 799		"	10 57·67		58·36	14·02	15·66		11 14·01
	29	σ Cygni		"	13 38·58		39·30	...	...		13 54·95
	30	Bradley 2796		"	16 25·91		29·21	...	...		16 44·86
	31	B.J. 804		"	17 41·65		41·99	57·69	15·70		17 57·64
	32	69 Cygni		"	21 52·16		52·82	...	...		22 08·47
	33	1 H.Draconis	L.C.,rn	"	24 07·86		02·64	18·42	15·78		...
	34	B.J. 807		"	25 53·40		54·24	09·86	...		26 09·89
	35	72 Cygni		"	30 51·81		52·51	...	...	15·64	31 08·15
	36	B.J. 817	r	"	40 21·26		23·53	...	...		40 39·17
	37	78 Draconis		"	41 43·62		46·02	...	...		42 01·66
	38	B.J. 821		"	43 13·83		14·75	30·35	...		43 30·39
	39	14 Pegasi		"	45 37·83		38·36	...	...		45 54·00
	40	B.J. 823		"	48 44·16		44·61	00·29	15·68		49 00·25
	41	Bradley 2868		"	49 50·68		51·86	...	...		50 07·50
	42	13 Cephei		"	51 37·24		38·43	...	...		51 54·07
	43	B.J. 826		"	56 28·73		28·98	44·66	15·68		56 44·62
	44	16 Cephei		"	57 43·10		45·62	...	...		58 01·26
	45	B.J. 831		"	22 02 35·50		35·94	51·58	15·64		22 02 51·58
	46	B.J. 833	r	"	05 00·45		00·98	16·64	15.66		05 16·62
	47	28 Pegasi		"	06 01·24		01·61	...	...		06 17·25
	48	B.J. 837		"	07 50·01		52·41	...	...		08 08·05
	49	1 H.Lacertae		"	09 46·84		47·57	...	...		10 03·21
	50	Bradley 2942		"	11 00·40		02·95	...	...		11 18·59

Clamp East. 1—50. Adopted $\Delta T+m=15\cdot647-\cdot0068\ (T-21^h\ 10^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.		s.	h. m. s.
Sept. 13	1	B.A.C. 3495...	L.C.,rn	S	22 16 29·93	·059	21·73	37·57	15·84	15·64	....
	2	30 H. Camel..	L.C.,rn	"	19 58·39	(·752)	52·19	07·90	15·71		....
	3	B.D. 70·1240..		"	23 26·53		28·74				22 23 44·33
	4	28 Cephei.....		"	25 47·43		51·21				26 06·85
	5	B.J. 848.......		"	27 20·82		21·77	37·40			27 37·41
	6	29 Cephei.....	r	"	28 50·42		54·44				29 10·08
	7	B.J. 851.......		"	33 18·27		20·87				33 36·51
	8	Groom. 3857..		"	35 02·64		05·55				35 21·19
	9	B.J. 855.......		"	36 45·02		45·24	00·87	15·63		37 00·88
	10	B.J. 857.......		"	38 33·14		33·67	49·33	15·66		38 49·31
Sept. 14	11	*b* Aquilae.....		N	19 20 26·93	·035	27·11			15·55	19 20 42·66
	12	21 B. Vulp....	r	"	21 28·10	(·735)	28·48				21 44·03
	13	4 Cygni.......		"	22 40·12		40·71				22 56·26
	14	α Vulp........		"	24 43·47		43·85				24 59·40
	15	B.J. 732.......		"	26 51·30		51·73	07·21	15·48		27 07·28
	16	8 Cygni.......		"	28 11·20		11·74				28 27·29
	17	B.D. 70·1073..		"	31 27·41		29·61				31 45·16
	18	B.D. 49·3059..		"	33 16·40		17·33				33 32·88
	19	B.J. 738.......		"	33 46·79		47·72	03·24			34 03·27
	20	β Sagittae.....		"	36 46·49		46·75				37 02·30
	21	10 Vulp.......		"	39 44·26		44·65				40 00·20
	22	B.J. 740.......		"	40 47·43		48·04	03·54	15·50		41 03·59
	23	ζ Sagittae....		"	44 45·01		45·29				45 00·84
	24	B.J. 747.......		"	48 12·76		14·87				48 30·42
	25	φ Aquilae.....		"	51 44·81		44·99				52 00·54
	26	B.J. 750.......		"	53 03·27		04·28	19·87			53 19·83
	27	B.J. 752.......		"	54 31·35		31·64	47·19	15·55		54 47·19
	28	15 Vulp.......		"	57 09·52		09·94				57 25·49
	29	B.D. 69.1084..		"	58 39·19		41·31				58 56·86
	30	69 Draconis...		"	20 01 52·07		55·19				20 02 10·74
	31	Groom. 1119..	L.C.,nr	"	08 55·25		17·83	36·44	18·61		....
	32	176 B. Cygni..		"	16 45·19		45·84				17 01·39
	33	B.J. 765.......	r	"	18 45·56		46·23	01·76	15·53	15·54	19 01·77
	34	40 Cygni......		"	23 59·84		00·47				24 16·01
	35	41 Cygni......		"	25 29·03		29·50				25 45·04
	36	ω¹ Cygni......		"	27 01·68		02·58				27 18·12
	37	B.J. 768.......		"	28 41·26		41·43	56·94	15·51		28 56·97
	38	ζ Delphini....	r	"	30 52·46		52·68				31 08·22
	39	B.J. 771.......		"	33 06·11		06·32	21·85	15·53		33 21·86
	40	29 Vulp.......		"	34 16·35		16·67				34 32·21
	41	B.J. 774.......		"	35 13·84		14·08	29·60	15·52		35 29·62
	42	B.J. 777.......		"	38 07·41		08·21	23·77	15·56		38 23·75
	43	B.J. 778.......		"	39 01·77		01·99	17·57	15·58		39 17·53
	44	B.J. 780.......		"	42 20·05		20·59	36·20	15·61		42 36·13
	45	B.J. 784.......	r	"	43 40·02		40·61	56·16	15·55		43 56·15
	46	76 Draconis..	nr	"	48 51·70		57·26	13·00	15·74		....
	47	220 H¹. Drac..		"	51 24·85		29·26				51 44·80
	48	B.J. 788.......		"	53 34·76		35·44	51·09	15·65		53 50·98
	49	*f*¹ Cygni......		"	56 31·51		32·36				56 47·90

Clamp East. 1—10. Adopted $\Delta T+m=15{\cdot}647-{\cdot}0068\ (T-21^h\ 10^m)$.
11—49. Adopted $\Delta T+m=15{\cdot}542-{\cdot}0068\ (T-20^h\ 45^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE.—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T + m$	Adopted $\Delta T + m$	App. R.A. from Observation
					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
1910 Sept. 14	1	B.J. 792.......		N	21 01 25·10	·035	25·86	41·50	15·64	15·54	21 01 41·40
	2	B.J. 793.......		"	02 37·90	(·735)	38·53	54·04	15·51		02 54·07
	3	Groom. 3409..		"	05 36·01		38·26	...	...		05 53·80
	4	B.J. 795.......		"	07 02·76		06·28		.....		07 21·82
	5	B.J. 798.......		"	09 16·00		17·33	33·01	..		09 32·87
	6	σ Cygni.......		"	13 38·68		39·33	.....	...		13 54·87
	7	B.J. 804.......		"	17 41·82		42·11	57·68	15·57		17 57·65
	8	69 Cygni......		"	21 52·29		52·88	.....	.....		22 08·42
	9	1 H.Draconis..	L.C.,nr	"	24 07·92		02·99	18·54	15·55		....
	10	B.J. 807.......		"	25 53·45		54·27	09·85	....		26 09·81
	11	ρ Cygni.......		"	30 21·54		22·34		...		30 37·88
	12	B.J. 811.......		"	33 06·40		07·07	22·65	15·58		33 22·61
	13	B.J. 813.......		"	35 55·56		56·77	12·43	..		36 12·31
	14	B.J. 817.......		"	40 21·41		23·62				40 39·16
	15	78 Draconis...	r	"	41 43·52		45·87	...	..		42 01·41
	16	B.J. 821.......		"	43 13·90		14·81	30·34	...		43 30·35
	17	14 Pegasi.....		"	45 38·03		38·49				45 54·03
	18	B.J. 823.......		"	48 44·36		44·75	00·28	15·53	15·53	49·00·28
	19	Bradley 2868..		"	49 50·71		51·86	.			50 07·39
	20	13 Cephei.....	r	"	51 37·30		38·47		...		51 54·00
	21	B.J. 826.......		"	56 28·94		29·14	44·66	15·52		56 44·67
	22	16 Cephei.....		"	57 43·14		45·61				58 01·14
	23	B.J. 831.......		"	22 02 35·64		36·02	51·57	15·55		22 02 51·55
	24	B.J. 833.......	r	"	05 00·57		01·09	16·64	15·55		05 16·62
	25	B.J. 835.......		"	05 45·60		46·12	01·67	15·55		06 01·65
	26	B.J. 837.......		"	07 50·19		52·54	...	...		08 08·07
	27	1 H.Lacertae..		"	09 46·98		47·63	...	.		10 03·16
	28	Bradley 2942..		"	11 00·44		02·92	.			11 18·45
	29	B.A.C. 3495...	L.C.,nr	"	16 29·85		22·09	37·70	15·61		...
	30	30 H. Camel..	L.C.	"	19 58·55		52·69	08·00	15·31		......
Sept. 15	31	10 Vulp.......		S	19 39 44·34	.048	44·78	.	.	15·35	19 40 00·13
	32	B.J. 740.......		"	40 47·50	(·746)	48·17	03·53	15·36		41 03·52
	33	B.J. 742.......		"	41 55·18		56·04	11·37	15·33		42 11·39
	34	B.J. 743.......		"	43 08·71		09·03	24·34	15·31		43 24·38
	35	ζ Sagittae....	r	"	44 45·21		45·48	..	..		45 00·83
	36	φ Aquilae.....		"	51 44·96		45·18	..	...		52 00·53
	37	B.J. 750.......		"	53 03·50		04·51	19·85	....	15·34	53 19·85
	38	B.J. 752.......		"	54 31·54		31·87	47·17	15·30		54 47·21
	39	15 Vulp. ...		"	57 09·68		10·15	.	.....		57 25·49
	40	B.D. 69·1084..		"	58 39·50		41·62	......	......		58 56·96
	41	69 Draconis...		"	20 01 52·07		55·19	...	.....		20 02 10·53
	42	b^2 Cygni......		"	05 50·87		51·52	..	.....		06 06·86
	43	20 Vulp.......		"	08 00·35		00·80	......	......		08 16·14
	44	ρ Aquilae.....		"	09 53·16		53·43	.....	....		10 08·77
	45	B.J. 759.......		"	11 39·37		42·80	...	.		11 58·14
	46	B.J. 760.......		"	12 42·15		42·57	57·96	15·39		12 57·91
	47	B.J. 765.......	r	"	18 45·72		46·39	01·74	15·35		19 01·73
	48	40 Cygni......	r	"	24 00·11		00·74	....	... ..		24 16·08
	49	41 Cygni......		"	25 29·15		29·67	......	.....		25 45·01

Clamp East. 1—30. Adopted $\Delta T+m=15·542-·0068$ (T-20^h 45^m).
31—49. Adopted $\Delta T+m=15·335-·0068$ (T-21^h 20^m).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Sept. 15	1	ω¹ Cygni.....		S	20 27 01.91	·048	02·80	.....	......	15·34	20 27 18·14
	2	B.J. 768.......		"	28 41·39	(·746)	41·60	56·93	15·33		28 56·94
	3	ζ Delphini.....		"	30 52·56		52·82	......	......		31 08·16
	4	B.J. 770.......		"	32 26·45		29·24	......	......		32 44·58
	5	B.J. 774.......		"	35 13·98		14·26	29·59	15·33		35 29·60
	6	B.J. 778.......		"	39 01·94		02·20	17·56	15·36		39 17·54
	7	B.J. 782.......		"	42 52·52		53·73	09·10	......		43 09·07
	8	76 Draconis...	nr	"	48 51·68		57·42	12·86	15·44		....
	9	220 H¹. Drac..	nr	"	51 25·04		29.60	45·03	15·43		....
	10	B.J. 788.......		"	53 34·96		35·70	51·07	15·37		53 51·04
	11	Bradley 2748..		"	55 32·95		35.92	......	......		55 51·26
	12	Groom. 3409..		"	21 05 36·24		38·48	......	......		21 05 53 82
	13	B.J. 795.......		"	07 03·02		06·54	......	......		07 21·88
	14	B.J. 798.......		"	09 16·23		17·56	32·99	......		09 32·90
	15	B.J. 799.......		"	10 58·00		58·67	14·00	15·33		11 14·01
	16	υ Cygni.......		"	13 59·20		59·80	......	......		14 15·14
	17	B.A.C. 7504..	nr	"	17 16·98		30.45	45·93	15·48		....
	18	69 Cygni......		"	21 52·47		53·10	......	......	15·33	22 08·43
	19	1 H. Draconis	L.C.,nr	"	24 08·08		02·98	18·66	15·68		....
	20	B.J. 809.......		"	27 15·34		17·47	......	......		27 32·80
	21	B.J. 811.......		"	33 06·58		07·31	22·65	15·34		33 22·64
	22	B.J. 813.......		"	35 55·89		57·09	12·42	......		36 12·42
	23	B.J. 817.......	r	"	40 21·52		23·89	......	......		40 39·22
	24	78 Draconis...		"	41 43·86		46·20	......	......		42 01·53
	25	B.J. 821.......		"	43 14·10		15·00	30·33	......		43 30·33
	26	14 Pegasi.....		"	45 38·13		38·65	......	......		45 53·98
	27	B.J. 823.......		"	48 44·51		44·95	00·28	15·33		49 00·28
	28	Bradley 2868..		"	49 50.94		52·09	......	......		50 07·42
	29	13 Cephei.....		"	51 37·47		38·63	......	......		51 53·96
	30	B.J. 826.......		"	56 29·03		29·27	44·66	15·39		56 44·60
	31	16 Cephei.....	r	"	57 43·23		45·85	......	......		58 01·18
	32	B.J. 831.......		"	22 02 35·84		36·26	51·57	15·31		22 02 51·59
	33	B.J. 833.......		"	05 00 69		01·26	16·64	15·38		05 16·59
	34	28 Pegasi.....		"	06 01·54		01·89	......	......		06 17·22
	35	B.J. 837.......		"	07 50·29		52·63	......	......		08 07·96
	36	1 H.Lacertae..		"	09 47·11		47.82	......	......		10 03·15
	37	Bradley 2942..		"	11 00·59		03·08	......	......		11 18·41
	38	B.A.C. 3495...	L.C.,nr	"	16 30·58		22·56	37·83	15·27		....
	39	30 H. Camel..	L.C.,nr	"	19 58·77		52·71	08·11	15·40.		....
	40	B.D. 70·1240..		"	23 26·80		28·95	......	......		23 44·28
	41	28 Cephei.....		"	25 47·68		51·37	......	......		26 06·70
	42	B.J. 848.......		"	27 21·08		22·00	37·40	......		27 37·33
	43	29 Cephei.....	r	"	28 50·66		54·60	......	......		29 09·93
	44	B.J. 851.......		"	33 18·51		21·05	......	......		33 36·38
	45	Groom. 3857..		"	35 02.91		05·75	......	......		35 21·08
	46	B.J. 855.......		"	36 45·30		45·50	00·88	15·38		37 00·83
	47	B.J. 857.......		"	38 33·46		33·98	49·33	15·35		38 49·31
	48	B.J. 858.......		"	39 50·84		51·60	06·98	15·38		40 06.93
	49	B.J. 859.......		"	41 58·41		58·81	14·13	15·32		42 14·14
	50	B.J. 862.......	r	"	45 26·22		26·59	41.94	15·35		45 41·92

Clamp East. 1—50. Adopted $\Delta T+m=15{\cdot}335-{\cdot}0068\ (T-21^{h}\ 20^{m})$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Sept. 15	1	52 Pegasi.....		S	22 54 28·61	·048	28·83			15.32	22 54 44·15
	2	B.J. 869.......	r	"	57 33·15	(·746)	33·86	49·18	15·32		57 49·18
	3	B.J. 870.......		"	59 11·28		11·75	27·04	15·29		59 27·07
	4	5 Andromedae		"	23 03 26·33		27·22				23 03 42·54
	5	B.J. 874.......		"	04 47·91		50·75				05 06·07
	6	B.J. 875.......		"	08 43·14		44·32	59·67			08 59·64
Sept. 16	7	λ Urs. Min....		N	19 09 56·96	−·038	36·73	50·32	13·59	15·17	
	8	B.J. 726.......		"	14 46·69	(·704)	47·57	02·76			19 15 02·74
	9	*b* Aquilae.....		"	20 27·21		27·34				20 42·51
	10	21 B. Vulp.....	r	"	21 28·51		28·80				21 43·97
	11	4 Cygni.......		"	22 40·56		41·03				22 56·20
	12	α Vulp........		"	24 43·81		44·10				24 59·27
	13	B.J. 733.......		"	27 11·67		12·51	27·69			27 27·68
	14	8 Cygni.......		"	28 11·64		12·08				28 27·25
	15	B.D. 49·3059..	r	"	33 16·82		17·61				33 32·78
	16	B.J. 738.......		"	33 47·25		48·04	03·19			34 03·21
	17	β Sagittae....		"	36 46·88		47·08				37 02·25
	18	10 Vulp.......		"	39 44·66		44·97				40 00·14
	19	B.J. 740.......		"	40 47·89		48·39	03·51	15·12		41 03·56
	20	B.J. 742.......		"	41 55·48		56·13	11·35	15·22		42 11·30
	21	B.J. 743.......	r	"	43 08·97		09·18	24·33	15·15		43 24·35
	22	ζ Sagittae.....		"	44 45·39		45·61				45 00·78
	23	φ Aquilae.....		"	51 45·17		45·29				52 00·46
	24	B.J. 750.......		"	53 03·83		04·69	19·82			53 19·86
	25	B.J. 752.......		"	54 31·85		32·08	47·16	15·08	15·16	54 47·24
	26	b^2 Cygni......		"	20 05 51·18		51·66				20 06 06·82
	27	20 Vulp.......		"	08 00·65		00·97				08 16·13
	28	B.J. 757.......		"	10 33·82		34·51	49·63			10 49·67
	29	B.J. 760.......		"	12 42·38		42·67	57·95	15·28		12 57·83
	30	176 B. Cygni..		"	16 45·65		46·18				17 01·34
	31	B.J. 765.......	r	"	18 45·93		46·48	01·72	15·24		19 01·64
	32	40 Cygni......		"	24 00·43		00·95				24 16·11
	33	41 Cygni......		"	25 29·47		29·85				25 45·01
	34	ω^1 Cygni......		"	27 02·27		03·02				27 18·18
	35	B.J. 768.......		"	28 41·66		41·77	56·92	15·15		28 56·93
	36	ζ Delphini.....	r	"	30 52·82		52·98				31 08·14
	37	B.J. 771.......		"	33 06·45		06·61	21·83	15·22		33 21·77
	38	29 Vulp.......		"	34 16·80		17·04				34 32·20
	39	B.J. 774.......		"	35 14·26		14·44	29·58	15·14		35 29·60
	40	B.J. 777.......		"	38 07·85		08·50	23·73	15·23		38 23·66
	41	B.J. 778.......		"	39 02·21		02·37	17·55	15·18		39 17·53
	42	B.J. 780.......	r	"	42 20·52		20·95	36·18	15·23		42 36·11
	43	B.J. 784.......		"	43 40·53		41·00	56·13	15·13		43 56·16
	44	76 Draconis...	nr	"	48 52·60		57·59	12·73	15·14		
	45	220 H[1].Drac...		"	51 26·09		30·04				51 45·20
	46	B.J. 788.......		"	53 35·30		35·87	51·06	15·19		53 51·03
	47	f^1 Cygni......		"	56 32·02		32·73				56 47·89
	48	B.J. 792.......		"	21 01 25·65		26·27	41·47	15·20		21 01 41·43
	49	B.J. 793.......		"	02 38·34		38·86	54·02	15·16		02 54·02

From Sept. 15 Clamp East; from Sept. 16 Clamp West.
1—6. Adopted $\Delta T+m=15{\cdot}335-{\cdot}0068\ (T-21^h\ 20^m)$.
7—49. Adopted $\Delta T+m=15{\cdot}158-{\cdot}0068\ (T-20^h\ 55^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Sept. 16	1	B.J. 797......		N	21 08 52·95	−·038	53·32	08·45	15·13	15·16	21 09 08·48
	2	B.J. 799......		"	10 58·32	(·704)	58·82	13·99	15·17		11 13·98
	3	σ Cygni......		"	13 39·24		39·77	...	......		13 54·93
	4	B.J. 804......		"	17 42·31		42·53	57·67	15·14		17 57·69
	5	69 Cygni......		"	21 52·94		53·41		......	15·15	22 08·56
	6	1 H. Draconis	L.C.,rn	"	24 07·91		03·45	18·78	15·33		....
	7	72 Cygni......		"	30 52·47		52·99	...	......		31 08·14
	8	B.J. 811......		"	33 06·92		07·47	22·64	15·17		33 22·62
	9	B.J. 813......		"	35 56·25		57·28	12·40	......		36 12·43
	10	B.J. 816......	r	"	40 21·02		21·32	36·40	15·08		40 36·47
	11	B.J. 821......		"	43 14·35		15·11	30·32	......		43 30·26
	12	14 Pegasi......		"	45 38·47		38·84	...	......		45 53·99
	13	B.J. 823......		"	48 44·84		45·15	00·27	15·12		49 00·30
	14	Bradley 2868..		"	49 51·24		52·22		......		50 07·37
	15	13 Cephei......		"	51 37·85		38·84		......		51 53·99
	16	B.J. 826......		"	56 29·35		29·49	44·65	15·16		56 44·64
	17	B.J. 831......		"	22 02 36·18		36·47	51·57	15·10		22 02 51·62
	18	B.J. 833......	r	"	05 00·96		01·37	16·63	15·26		05 16·52
	19	B.J. 835......		"	05 46·15		46·56	01·66	15·10		06 01·71
	20	B.J. 836......		"	07 30·22		31·27	46·34	......		07 46·42
	21	1 H.Lacertae..		"	09 47·49		48·03	...	......		10 03·18
	22	B.A.C. 3495...	L.C.,nr	"	16 29·66		22·66	37·98	15·32		....
	23	30 H. Camel..	L.C.,nr	"	19 58·95		53·64	08·21	14·57		....
Sept. 17	24	B.D. 76·734...		S	19 24 29·41	−·048	32·16	...	......	15·16	19 24 47·32
	25	B.J. 734......		"	26 51·53	(·723)	55·10	...	......		27 10·26
	26	S Cygni......		"	28 11·65		12·12	...	......		28 27·28
	27	B.D. 70·1073..		"	31 28·00		29·89	...	......		31 45·05
	28	B.D. 49·3059..		"	33 16·85		17·61	...	......		33 32·77
	29	B.J. 738......	r	"	33 47·14		47·97	03·16	......		34 03·13
	30	β Sagittae......		"	36 46·82		47·03	...	......		37 02·19
	31	10 Vulp......		"	39 44·64		44·97	...	......		40 00·13
	32	B.J. 740......		"	40 47·83		48·36	03·49	15·13		41 03·52
	33	B.J. 742......		"	41 55·43		56·12	11·32	15·20		42 11·28
	34	B.J. 743......	r	"	43 08·98		09·16	24·32	15·16		43 24·32
	35	ζ Sagittae......		"	44 45·37		45·61	...	......		45 00·77
	36	φ Aquilae......		"	51 45·21		45·34	...	......	15·15	52 00·49
	37	B.J. 750......		"	53 03·86		04·68	19·79	......		53 19·83
	38	B.J. 752......		"	54 31·74		31·98	47·15	15·17		54 47·13
	39	15 Vulp......		"	57 09·95		10·31	...	......		57 25·46
	40	B.D. 69·1084..		"	58 39·96		41·77	...	......		58 56·92
	41	69 Draconis...		"	20 01 52·67		55·38	...	......		20 02 10·53
	42	b^2 Cygni......		"	05 51·16		51·67	...	......		06 06·82
	43	20 Vulp......		"	08 00·65		00·98	...	......		08 16·13
	44	ρ Aquilae......		"	09 53·41		53·60	...	......		10 08·75
	45	B.J. 759......		"	11 39·91		42·90	...	......		11 58·05
	46	B.J. 765......		"	18 45·97		46·56	01·70	15·14		19 01·71
	47	40 Cygni......		"	20 00·42		00·97	...	......		20 16·12
	48	41 Cygni......		"	25 29·43		29·83	...	......		25 44·98

Clamp West. 1−23. Adopted $\Delta T+m=15{\cdot}158-{\cdot}0068$ (T−20ʰ 55ᵐ).
24−48. Adopted $\Delta T+m=15{\cdot}149-{\cdot}0068$ (T−20ʰ 40ᵐ).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Sept. 17	1	ω¹ Cygni......		S	20 27 02·28	−·048	03·00	...	...	15·15	20 27 18·15
	2	B.J. 768.......		"	28 41·63	(·723)	41·76	56·91	15·15		28 56·91
	3	ζ Delphini.....		"	30 52·79		52·97	..	.....		31 08·12
	4	B.J. 770.......		"	32 26·89		29·30	...	....		32 44·45
	5	29 Vulp.......		"	34 16·73		16·99	.	..		34 32·14
	6	B.J. 774.......		"	35 14·21		14·40	29·57	15·17		35 29·55
	7	B.J. 778......		"	39 02·19		02·37	17·54	15·17		39 17·52
	8	B.J. 782.......		"	42 52·94		53·94	09·05	.		43 09·09
	9	76 Draconis...	rn	"	48 52·45		57·50	12·61	15·11		... ...
	10	220 H¹. Drac...	rn	"	51 25·65		29·65	44·85	15·20		... ...
	11	B.J. 788......		"	53 35·31		35·90	51·05	15·15		53 51·05
	12	f¹ Cygni.....		"	56 32·10		32·78	.			56 47·93
	13	B.J. 792.......		"	21 01 25·58		26·24	41·45	15·21		21 01 41·39
	14	f² Cygni......		"	03 16·29		16·97	.	.		03 32·12
	15	Groom. 3409		"	05 36·63		38·56	..	...		05 53·71
	16	B.J. 795.......		"	07 03·65		06·72	....	.....		07 21·87
	17	B.J. 797.......		"	08 52·90		53·29	08·44	15·15		09 08·44
	18	B.J. 799.......		"	10 58·31		58·85	13·97	15·12		11 14·00
	19	υ Cygni......		"	13 59·48		59·96	.			14 15·11
	20	69 Cygni......		"	21 52·84		53·35	.		15·14	22 08·49
	21	72 Cygni......		"	30 52·46		53·01		..		31 08·15
	22	B.J. 811.......		"	33 06·88		07·47	22·63	15·16		33 22·61
	23	B.J. 813.......		"	35 56·21		57·20	12·38	.		36 12·34
	24	B.J. 816.......	r	"	40 20·97		21·24	36·40	15·16		40 36·38
Sept. 19	25	α Vulp........		N	19 24 44·38	−·040	44·66		..	14·61	19 24 59·27
	26	B.J. 732.......		"	26 52·15	(·678)	52·48	07·12	14·64		27 07·09
	27	8 Cygni... ...		"	28 12·13		12·55	..			28 27·16
	28	B.D. 49·3059..		"	33 17·24		18·00	..	.		33 32·61
	29	B.J. 738.......	r	"	33 47·71		48·47	03·10			34 03·08
	30	14 Cygni......		"	36 17·01		17·58	.	..	14·60	36 32·18
	31	10 Vulp.		"	39 45·25		45·55		..		40 00·15
	32	B.J. 740.......		"	40 48·35		48·83	03·44	14·61		41 03·43
	33	B.J. 742.......		"	41 55·96		56·59	11·27	14·68		42 11·19
	34	B.J. 743.......		"	43 09·53		09·72	24·28	14·56		43 24·32
	35	ζ Sagittae.....	r	"	44 45 91		46·11	..			45 00·71
	36	φ Aquilae....		"	51 45·83		45·95	.	.		52 00·55
	37	B.J. 750.......		"	53 04·32		05·13	19·73	..		53 19·73
	38	B.J. 752.......		"	54 32·30		32·51	47·11	14·60		54 47·11
	39	15 Vulp.......		"	57 10·52		10·84				57 25·44
	40	Groom. 1119..	L.C.,rn	"	20 08 58·48		26·22	42·05	15·83		.
	41	176 B. Cygni..		"	16 46·17		46·68	..			20 17 01·28
	42	B.J. 765.......		"	18 46·55		47·08	01·66	14·58		19 01·68
	43	40 Cygni......		"	24 00·94		01·44	...			24 16·04
	44	41 Cygni......		"	25 30·04		30·39	.	...		25 44·99
	45	ω¹ Cygni......		"	27 02·72		03·44	....	...		27 18·04
	46	B.J. 768.......		"	28 42·15		42·26	56·88	14·62		28 56·86
	47	ζ Delphini.....		"	30 53·38		53·54	....	...		31 08·14
	48	B.J. 771.......	r	"	33 07·04		07·19	21·79	14·60		33 21·79
	49	29 Vulp.......		"	34 17·36		17·59	....	..		34 32·19

Clamp West. 1—24. Adopted $\Delta T+m=15{\cdot}149-{\cdot}0068$ (T−20ʰ 40ᵐ).
25—49. Adopted $\Delta T+m=14{\cdot}597-{\cdot}0068$ (T−20ʰ 45ᵐ).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
					h. m. s.	s.	s.	s.	.	s.	h. m. s.
1910											
Sept. 19	1	B.J. 774.......		N	20 35 14·75	– ·040	14·92	29·54	14·62	14·60	20 35 29·52
	2	B.J. 777.......		"	38 08·40	(·678)	09·03	23·67	14·64		38 23·63
	3	B.J. 778.......		"	39 02·79		02·95	17·52	14·57		39 17·55
	4	B.J. 780.......		"	42 21·10		21·51	36·13	14·62		42 36·11
	5	B.J. 784.......	r	"	43 41·02		41·47	56·08	14·61		43 56·07
	6	76 Draconis...	rn	"	48 52·87		57·65	12·37	14·72		....
	7	220 H[1]. Drac..		"	51 26·04		29·83	....	......		51 44·43
	8	B.J. 788.......		"	53 35·82		36·36	51·01	14·65		53 50·96
	9	f^1 Cygni......		"	56 32·49		33·17	....	.....		56 47·77
	10	B.J. 792.......		"	21 01 26·20		26·79	41·42	14·63		21 01 41·39
	11	B.J. 793.......		"	02 38·90		39·40	53·98	14·58	14·59	02 53·99
	12	B.J. 798.......		"	09 17·17		18·26	32·89	....		09 32·85
	13	B.J. 799.......		"	10 58·89		59·37	13·94	14·57		11 13·96
	14	ε Cygni.......		"	14 00·10		00·53	....	......		14 15·12
	15	B.J. 804.......		"	17 42·85		43·06	57·64	14·58		17 57·65
	16	69 Cygni......	r	"	21 53·33		53·78	....	......		22 08·37
	17	1 H. Draconis..	L.C.,nr	"	24 08·91		04·64	19·10	14·46		....
	18	B.J. 807.......		"	25 54·55		55·23	09·78	......		26 09·82
	19	72 Cygni......		"	30 52·99		53·49	....	......		31 08·08
	20	B.J. 811.......		"	33 07·50		08·03	22·60	14·57		33 22·62
	21	B.J. 813.......		"	35 56·68		57·66	12·34	....		36 12·25
	22	B.J. 816.......		"	40 21·47		21·76	36·38	14·62		40 36·35
	23	B.J. 821.......		"	43 15·05		15·78	30·28	....		43 30·37
	24	14 Pegasi.....		"	45 39·02		39·38	....	....		45 53·97
	25	B.J. 823.......	r	"	48 45·35		45·65	00·25	14·60		49 00·24
	26	Bradley 2868..		"	49 51·86		52·80	....	....		50 07·39
	27	13 Cephei.....	r	"	51 38·37		39·32	....	....		51 53·91
	28	B.J. 826.......		"	56 29·94		30·08	44·64	14·56		56 44·67
	29	B.J. 831.......		"	22 01 36·64		36·92	51·55	14·63		22 01 51·51
	30	B.J. 833.......		"	05 01·58		01·97	16·61	14·64		05 16·56
	31	B.J. 835.......	r	"	05 46·68		47·07	01·64	14·57		06 01·66
	32	B.J. 836.......		"	07 30·70		31·71	46·29	......		07 46·30
	33	1 H. Lacertae..		"	09 47·98		48·50	....	....		10 03·09
	34	B.A.C. 3495...	L.C.,rn	"	16 30·28		23·58	38·34	14·76		....
Sept. 21	35	B.J. 768.......		N	20 28 42·42	– ·048	42·52	56·85	14·33	14·34	20 28 56·86
	36	ζ Delphini.....	r	"	30 53·62	(·666)	53·76	....	......		31 08·10
	37	B.J. 771.......		"	33 07·35		07·49	21·76	14·27		33 21·83
	38	29 Vulp.......		"	34 17·57		17·78	....	......		34 32·12
	39	B.J. 774.......		"	35 15·04		15·20	29·51	14·31		35 29·54
	40	B.J. 777.......		"	38 08·71		09·32	23·63	14·31		38 23·66
	41	B.J. 778.......		"	39 03·05		03·19	17·49	14·30		39 17·53
	42	B.J. 780.......	r	"	42 21·33		21·73	36·10	14·37		42 36·07
	43	B.J. 784.......		"	43 41·30		41·74	56·05	14·31		43 56·08
	44	76 Draconis...	nr	"	48 53·07		57·70	12·14	14·44	14·33	....
	45	220 H[1]. Drac..		"	51 26·69		30·36	....	....		51 44·69
	46	B.J. 788.......		"	53 36·19		36·70	50·98	14·28		53 51·03
	47	f^1 Cygni......		"	56 32·94		33·60	....	....		56 47·93
	48	Groom. 3409..		"	21 05 37·39		39·22	....	....		21 05 53·55
	49	B.J. 798.......		"	09 17·48		18·54	32·84	....		09 32·87

Clamp West. 1—34. Adopted $\Delta T+m=14·597-·0068$ ($T-20^h\ 45^m$).
35—49. Adopted $\Delta T+m=14·327-·0068$ ($T-21^h\ 55^m$).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
1910 Sept. 21	1	B.J. 799.......		N	21 10 59·11	— ·048	59·57	13·91	14·34	14·33	21 11 13·90
	2	σ Cygni.......		"	13 40·02	(·666)	40·51	....	....		13 54·84
	3	Bradley 2796..		"	16 27·48		30·13	....	....		16 44·46
	4	B.J. 804.......		"	17 43·08		43·27	57·62	14·35		17 57·60
	5	69 Cygni......	r	"	21 53·66		54·10	....	....		22 08·43
	6	1 H. Draconis.	L.C.,nr	"	24 08·86		04·73	19·31	14·58		....
	7	B.J. 807.......		"	25 54·75		55·41	09·75	....		26 09·74
	8	B.J. 809.......		"	27 16·52		18·25	....	....		27 32·58
	9	ρ Cygni.......		"	30 22·94		23·55	....	....		30 37·88
	10	B.J. 811.......		"	33 07·79		08·29	22·57	14·28		33 22·62
	11	B.J. 813.......		"	35 56·99		57·94	12·30	....		36 12·27
	12	B.J. 817.......	r	"	40 22·87		24·68	....	....		40 39·01
	13	78 Draconis...		"	41 45·17		47·09	....	....		42 01·42
	14	B.J. 821.......		"	43 15·24		15·94	30·25	....		43 30·27
	15	14 Pegasi.....		"	45 39·29		39·63	....	....		45 53·96
	16	B.J. 823.......		"	48 45·64		45·92	00·24	14·32		49 00·25
	17	Bradley 2868..	r	"	49 52·09		53·00	....	....		50 07·33
	18	13 Cephei.....		"	51 38·68		39·59	....	....		51 53·92
	19	B.J. 826.......		"	56 30·17		30·29	44·63	14·34		56 44·62
	20	B.J. 831.......		"	22 02 36·93		37·20	51·54	14·34		22 02 51·53
	21	B.J. 833.......	r	"	05 01·81		02·19	16·60	14·41		05 16·52
	22	B.J. 835.......		"	05 46·87		47·25	01·63	14·38		06 01·58
	23	1 H. Lacertae		"	09 48·31		48·81	....	....		10 03·14
	24	Bradley 2942..		"	11 01·83		03·87	....	....		11 18·20
	25	B.A.C. 3495...	L.C.	"	16 30·69		24·19	38·54	14·35	14·32	....
	26	30 H. Camel..	L.C.,nr	"	19 59·66		54·76	08·63	13·87		....
	27	B.D. 70.1240...		"	23 27·98		29·73	....	....		22 23 44·05
	28	B.J. 847.......		"	25 36·74		37·73	52·19	....		25 52·05
	29	B.J. 848.......		"	27 22·22		22·94	37·35	....		27 37·26
	30	29 Cephei.....		"	28 52·21		55·30	....	....		29 09·62
	31	B.J. 851.......		"	33 19·67		21·75	....	....		33 36·07
	32	B.J. 852.......		"	35 00·75		01·23	15·67	14·44		35 15·55
	33	B.J. 855.......		"	36 46·49		46·58	00·87	14·29		37 00·90
	34	B.J. 857.......		"	38 34·65		34·99	49·32	14·33		38 49·31
	35	B.J. 858.......		"	39 52·05		52·58	06·96	14·38		40 06·90
	36	B.J. 859.......	r	"	41 59·56		59·81	14·12	14·31		42 14·13
	37	B.J. 862.......		"	45 27·33		27·59	41·93	14·34		45 41·91
	38	52 Pegasi.....	r	"	54 29·71		29·81	....	....		54 44·13
	39	B.J. 869.......	r	"	57 34·20		34·74	49·17	14·43		57 49·06
	40	B.J. 870.......		"	59 12·38		12·69	27·05	14·36		59 27·01
	41	B.J. 871.......		"	23 00 04·65		04·79	19·11	14·32		23 00 19·11
	42	5 Andromedae		"	03 27·52		28·21	....	....		03 42·53
	43	B.J. 874.......		"	04 49·20		51·54	....	....		05 05·86
	44	B.J. 875.......		"	08 44·31		45·24	59·66	....		08 59·56
	45	Bradley 3085..		"	11 12·21		14·37	....	....		11 28·69
	46	Groom. 4033..		"	13 55·73		58·05	....	....		14 12·37
	47	B.J. 880.......		"	15 58·81		59·06	13·35	14·29		16 13·38
	48	B.J. 881.......		"	20 41·11		41·35	55·67	14·32		20 55·67
	49	39 H. Cephei..	nr	"	27 35·56		47·02	00·72	13·70		....

Clamp West. 1—49. Adopted $\Delta T+m=14{\cdot}327-{\cdot}0068\ (T-21^{h}\ 55^{m})$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Sept. 22	1	β Sagittae....		S	19 36 17·82	— ·053	18·01			14·12	19 37 02·16
	2	10 Vulp.......		"	39 45·57	(·751)	45·91				40 00·03
	3	B.J. 740......		"	40 48·74		49·28	03·38	14·10		41 03·40
	4	B.J. 742.......		"	41 56·35		57·06	11·20	14·14		42 11·18
	5	B.J. 743.......		"	43 09·89		10·12	24·23	14·11		43 24·24
	6	ζ Sagittae.....	r	"	44 46·38		46·58				45 00·70
	7	φ Aquilae.....		"	51 46·16		46·30				52 00·42
	8	B.J. 750.......		"	53 04·68		05·53	19·64			53 19·65
	9	B.J. 752.......		"	54 32·73		32·97	47·07	14·10		54 47·09
	10	15 Vulp.		"	57 10·93		11·30				57 25·42
	11	Groom. 1119..	L.C.,nr	"	20 09 05·41		29·97	15·09	15·12		....
	12	B.J. 765.......		"	18 46·85		47·45	01·60	14·15		20 19 01·57
	13	40 Cygni......	r	"	24 01·35		01·85				24 15·97
	14	41 Cygni......		"	25 30·37		30·79				25 44·91
	15	ω[1] Cygni......		"	27 03·11		03·86				27 17·98
	16	B.J. 768.......		"	28 42·56		42·69	56·84	14·15		28 56·81
	17	ζ Delphini.....		"	30 53·73		53·92				31 08·04
	18	B.J. 771.......	r	"	33 07·51		07·64	21·75	14·11		33 21·76
	19	29 Vulp.		"	34 17·72		17·99				34 32·11
	20	B.J. 774.......		"	35 15·17		15·37	29·50	14·13		35 29·49
	21	B.J. 777.......		"	38 08·75		09·46	23·61	14·15		38 23·58
	22	B.J. 778.......		"	39 03·16		03·35	17·48	14·13		39 17·47
	23	B.J. 780.......		"	42 21·47		21·94	36·09	14·15		42 36·06
	24	B.J. 784.......	r	"	43 41·46		41·92	56·04	14·12		43 56·04
	25	76 Draconis...	nr	"	48 52·62		57·83	12·02	14·19		....
	26	220 H[1].Drac..	nr	"	51 26·09		30·23	44·32	14·09		....
	27	B.J. 788.......		"	53 36·21		36·83	50·96	14·13	14·11	53 50·94
	28	f^1 Cygni		"	56 32·98		33·69				56 47·80
	29	B.J. 792.......		"	21 01 26·52		27·20	41·36	14·16		21 01 41·31
	30	f^2 Cygni......		"	03 17·20		17·91				03 32·02
	31	B.J. 797.......		"	08 53·82		54·23	08·37	14·14		09 08·34
	32	B.J. 799.......		"	10 59·24		59·79	13·90	14·11		11 13·90
	33	σ Cygni.......		"	13 40·15		40·73				13 54·84
	34	B.J. 804.......		"	17 43·23		43·47	57·61	14·14		17 57·58
	35	69 Cygni......	r	"	21 53·85		54·31				22 08·42
	36	1 H. Draconis	L.C.,nr	"	24 09·92		05·24	19·41	14·17		....
	37	B.J. 807.......		"	25 54·93		55·61	09·74			26 09·72
	38	ρ Cygni.......		"	30 22·93		23·65				30 37·76
	39	B.J. 811.......		"	33 07·85		08·45	22·56	14·11		33 22·56
	40	B.J. 813.......		"	35 57·13		58·16	12·28			36 12·27
	41	B.J. 816.......		"	40 21·93		22·26	36·35	14·09		40 36·37
	42	B.J. 821.......		"	43 15·39		16·14	30·23			43 30·25
	43	14 Pegasi.....		"	45 39·43		39·84				45 53·95
	44	B.J. 823.......	r	"	48 45·84		46·13	00·23	14·10		49 00·24
	45	Bradley 2868..		"	49 52·24		53·22				50 07·33
	46	13 Cephei.....	r	"	51 38·70		39·78				51 53·89
	47	B.J. 826.......		"	56 30·31		30·47	44·62	14·15		56 44·58
	48	B.J. 831......		"	22 02 37·08		37·41	51·54	14·13		22 02 51·52
	49	B.J. 833.......		"	05 01·99		02·44	16·59	14·15		05 16·55
	50	B.J. 835.......	r	"	05 47·21		47·61	01·62	14·01		06 01·72

Clamp West. 1—50. Adopted $\Delta T+m=14{\cdot}112-{\cdot}006S\ (T-21^h\ 20^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Sept. 22	1	B.J. 836		S	22 07 31·09	—·053	32·15	46·24		14·11	22 07 46·26
	2	1 H.Lacertae		"	09 48·49	(·751)	49·08				10 03·19
	3	B.A.C. 3495	L.C.,nr	"	16 32·02		24·67	38·63	13·96		...
	4	30 H. Camel	L.C.,nr	"	20 00·20		54·64	08·70	14·06		...
	5	38 Pegasi		"	25 42·52		42·97			14·10	25 57·07
	6	B.J. 848		"	27 22·44		23·22	37·34			27 37·32
	7	52 Pegasi		"	54 29·92		30·06				54 44·16
	8	B.J. 869		"	57 34·42		35·07	49·17	14·10		57 49·17
	9	B.J. 871		"	23 00 04·82		05·01	19·11	14·10		23 00 19·11
Sept. 26	10	*b* Aquilae		N	19 20 28·79	—·043	28·91			13·51	19 20 42·42
	11	21 B. Vulp		"	21 29·99	(·697)	30·28				21 43·79
	12	4 Cygni		"	22 42·01		42·48				22 55·99
	13	α Vulp		"	24 45·35		45·64				24 59·15
	14	B.J. 732		"	26 53·14		53·47	06·98	13·51		27 06·98
	15	8 Cygni		"	28 13·08		13·51				28 27·02
	16	B.D. 70·1073		"	31 28·92		30·82				31 44·33
	17	B.D. 49·3059		"	33 18·20		18·97				33 32·48
	18	B.J. 738	r	"	33 48·57		49·34	02·90			34 02·85
	19	β Sagittae		"	36 48·37		48·56				37 02·07
	20	10 Vulp		"	39 46·19		46·48				39 59·99
	21	B.J. 740		"	40 49·28		49·76	03·29	13·53		41 03·27
	22	B.J. 742		"	41 56·92		57·57	11·10	13·53		42 11·08
	23	B.J. 743		"	43 10·46		10·66	24·16	13·50		43 24·17
	24	ζ Sagittae		"	44 46·93		47·14				45 00·65
	25	B.J. 747		"	48 14·54		16·37				48 29·88
	26	φ Aquilae		"	51 46·74		46·85				52 00·36
	27	B.J. 750		"	53 05·19		06·03	19·52			53 19·54
	28	15 Vulp		"	57 11·40		11·72				57 25·23
	29	B.D. 69·1084		"	58 41·04		42·87				58 56·38
	30	69 Draconis		"	20 01 53·46		56·19				20 02 09·70
	31	*b*² Cygni		"	05 52·64		53·11				06 06·62
	32	20 Vulp		"	08 02·14		02·44				08 15·95
	33	30 Cygni		"	10 15·67		16·35				10 29·86
	34	B.J. 759		"	11 40·26		43·26				11 56·77
	35	176 B. Cygni		"	16 47·08		47·59				17 01·10
	36	B.J. 765		"	18 47·45		47·99	01·52	13·53	13·50	19 01·49
	37	40 Cygni	r	"	24 01·83		02·33				24 15·83
	38	41 Cygni		"	25 30·99		31·35				25 44·85
	39	ω¹ Cygni		"	27 03·57		04·31				27 17·81
	40	B.J. 768		"	28 43·13		43·23	56·79	13·56		28 56·73
	41	Groom. 3241		"	30 10·12		12·20				30 25·70
	42	B.J. 770		"	32 27·74		30·17				32 43·67
	43	29 Vulp		"	34 18·25		18·49				34 31·99
	44	B.J. 774		"	35 15·79		15·96	29·45	13·49		35 29·46
	45	B.J. 777		"	38 09·39		10·04	23·53	13·49		38 23·54
	46	B.J. 778		"	39 03·75		03·90	17·43	13·53		39 17·40
	47	B.J. 780		"	42 22·07		22·50	36·02	13·52		42 36·00
	48	B.J. 784	r	"	43 42·09		42·56	55·97	13·41		43 56·06
	49	76 Draconis		"	48 52·82		57·72	11·43	13·71		...

Clamp West. 1—9. Adopted $\Delta T+m=14{\cdot}112-{\cdot}0068$ (T$-21^h\ 20^m$).
10—49. Adopted $\Delta T+m=13{\cdot}502-{\cdot}0068$ (T$-20^h\ 45^m$).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Sept. 26	1	B.J. 788......		N	20 53 36·85	−·043	37·40	50·89	13·49	13·50	20 53 50·90
	2	Bradley 2718..		"	55 34·43	(·697)	37·02	....	.....		55 50·52
	3	B.J. 792.......		"	21 01 27·15		27·76	41·29	13·53		21 01 41·26
	4	B.J. 793.......		"	02 39·83		40·33	53·87	13·54		02 53·83
	5	f^2 Cygni.......		"	03 17·68		18·37	.....	....		03 31·87
	6	Groom. 3409..		"	05 37·86		39·80	....	...		05 53·30
	7	B.J. 795.......		"	07 04·56		07·65	.....	.....		07 21·15
	8	B.J. 797.......		"	08 54·12		54·78	08·32	13·54		09 08·28
	9	B.J. 799.......		"	10 59·82		00·32	13·84	13·52		11 13·82
	10	σ Cygni.......		"	13 40·72		41·23	.....	.....		13 54·73
	11	B.A.C. 7504...		"	17 17·43		29·02	42·93	13·91		....
	12	1 H. Draconis	L.C.	"	24 10·45		06·07	19·93	13·86		....
	13	B.J. 807.......		"	25 55·53		56·23	09·67	.....		26 09·73
	14	72 Cygni......		"	30 53·95		54·45	..	....		31 07·95
	15	B.J. 811.......		"	33 08·18		09·02	22·51	13·49		33 22·52
	16	B.J. 813.......		"	35 57·65		58·65	12·20	......		36 12·15
	17	B.J. 817.......		"	40 23·50		25·42	.....	......		40 38·92
	18	78 Draconis...	r	"	41 45·54		47·57	.....	.....		42 01·07
	19	B.J. 821.......		"	43 15·96		16·70	30·17	....		43 30·20
	20	14 Pegasi.....		"	45 40·10		40·46	.....	....		45 53·96
	21	B.J. 823.......		"	48 46·37		46·66	00·20	13·54	13·49	49 00·15
	22	Bradley 2868..		"	49 52·79		53·75	.....	....		50 07·24
	23	13 Cephei.....	r	"	51 39·33		40·30	.....	....		51 53·79
	24	B.J. 826.......		"	56 30·97		31·10	44·60	13·50		56 44·59
	25	16 Cephei.....		"	57 45·17		47·32	.....	.....		58 00·81
	26	B.J. 831.......		"	22 02 37·70		37·99	51·51	13·52		22 02 51·48
	27	B.J. 833.......		"	05 02·64		03·05	16·56	13·51		05 16·54
	28	B.J. 835.......	r	"	05 47·70		48·11	01·60	13·49		06 01·60
	29	B.J. 836.......		"	07 31·64		32·67	46·17	....		07 46·16
	30	1 H. Lacertae		"	09 49·07		49·59	.....	....		10 03·08
	31	Bradley 2942..		"	11 02·45		01·60	.....	....		11 18·09
	32	B.A.C. 3495...	L.C.,nr	"	16 32·24		25·36	39·18	13·82		....
	33	30 H. Camel..	L.C.,nr	"	20 00·93		55·72	09·09	13·37		....
Sept. 27	34	B.J. 817.......	r	S	21 40 23·27	−·043	25·29	.....	....	13·49	21 40 38·78
	35	78 Draconis...		"	41 45·57	(·708)	47·57	.....	....		42 01·06
	36	B.J. 821.......		"	43 15·92		16·64	30·16	....		43 30·13
	37	Bradley 2868..		"	49 52·77		53·70	.....	....		50 07·19
	38	79 Draconis...		"	51 31·05		33·23	.....	....		51 46·72
	39	Bradley 2897..	r	"	56 46·60		49·13	.....	....		57 02·62
	40	16 Cephei.....		"	57 45·10		47·20	.....	....		58 00·69
	41	B.J. 833.......	r	"	22 05 02·66		03·01	16·55	13·51		22 05 16·53
	42	B.J. 835.......		"	05 47·60		48·04	01·59	13·55		06 01·53
	43	B.J. 837.......		"	07 51·87		53·87	.....	....		08 07·36
	44	1 H. Lacertae		"	09 49·06		49·62	.....	....		10 03·11
	45	Bradley 2942..		"	11 02·42		04·53	.....	....		11 18·02
	46	B.A.C. 3495...	L.C.,rn	"	16 33·22		26·22	39·36	13·14		....
	47	30 H. Camel..	L.C.,rn	"	20 01·29		55·99	09·23	13·24		....
	48	B.D. 70·1240..		"	23 28·50		30·32	.....	....		23 43·81
	49	28 Cephei.....	r	"	25 49·16		52·57	.....	....		26 06·06

Clamp West. 1—33. Adopted $\Delta T+m = 13{\cdot}502 - {\cdot}0068\ (T - 20^h\ 45^m)$.
34—49. Adopted clock-rate zero.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent ΔT + m	Adopted ΔT + m	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Sept. 27	1	B.J. 848		S	22 27 23·04	−·043	23·79	37·30		13·49	22 27 37·28
	2	29 Cephei		"	28 52·75	(·708)	55·94				29 09·43
	3	226 B. Cephei		"	30 29·04		31·62				30 45·11
	4	B.J. 851		"	33 20·32		22·48				33 35·97
	5	Groom. 3857		"	35 04·78		07·21				35 20·70
	6	B.J. 858	r	"	39 52·87		53·41	06·93	13·52		40 06·90
	7	B.J. 869		"	57 34·96		35·58	49·16	13·58		57 49·07
	8	5 Andromedae		"	23 03 28·31		29·03				23 03 42·52
	9	B.J. 874		"	04 49·93		52·36				05 05·85
	10	B.J. 875		"	08 45·19		46·16	59·64			08 59·65
	11	Bradley 3085		"	11 12·96		15·20				11 28·69
	12	Groom. 4033	r	"	13 56·37		58·95				14 12·44
	13	39 H. Cephei	rn	"	27 35·24		47·56	00·35	12·79		...
	14	Bradley 3217		"	0 04 09·95		13·40				0 04 26·89
	15	B.J. 4		"	05 27·00		27·63	41·09			05 41·12
	16	B.J. 8		"	10 55·35		58·07				11 11·56
	17	σ Andromedae		"	13 26·02		26·52				13 40·01
	18	ρ Andromedae	r	"	16 11·41		11·89				16 25·38
	19	Bradley 34		"	24 56·36		59·09				25 12·58
	20	B.J. 17		"	31 45·74		46·60	00·11			32 00·09
	21	B.J. 20		"	34 19·55		19·96	33·40	13·44		34 33·45
	22	B.J. 21		"	35 12·38		13·33	26·74			35 26·82
	23	B.J. 24		"	39 30·44		32·80				39 46·29
	24	23 Cass		"	41 33·49		35·82				41 49·31
	25	η Cass		"	43 27·99		28·98				43 42·47
	26	ν Andromedae		"	44 39·51		40·10				44 53·59
	27	32² H. Camel.	L.C., rn	"	48 12·16		06·09	19·71	13·62		...
	28	B.J. 33		"	51 34·02		34·55	48·00	13·45		51 48·04
	29	43 H. Cephei	rn	"	56 08·14		17·40	31·05	13·65		...
	30	Bradley 109		"	1 01 18·98		22·53				1 01 36·02
	31	B.J. 41		"	04 17·46		20·90				04 34·39
	32	Bradley 137		"	08 20·53		24·06				08 37·55
	33	Bradley 155		"	12 37·59		40·45				12 53·94
	34	Bradley 166		"	16 38·64		41·80				16 55·29
	35	B.J. 48		"	19 43·96		45·06	58·64			19 58·55
	36	α Urs. Min.	rn	"	27 02·23		35·75	48·48	12·73		...
	37	B.J. 52		"	32 16·53		17·23	30·73			32 30·72
	38	42 Cass		"	35 45·16		46·96				36 00·45
	39	B.J. 57		"	37 49·61		50·36	03·86			38 03·85
	40	2 Persei	r	"	46 14·35		15·19				46 28·68
Sept. 28	41	69 Draconis		N	20 01 53·42	−·042	56·37			13·47	20 02 09·84
	42	b² Cygni		"	05 52·63	(·752)	53·15				06 06·62
	43	20 Vulp		"	08 02·17		02·51				08 15·98
	44	30 Cygni		"	10 15·62		16·37				10 29·84
	45	B.J. 757		"	10 35·13		35·88	49·34			10 49·35
	46	B.J. 759		"	11 40·29		43·55				11 57·02
	47	176 B. Cygni		"	16 47·08		47·64				17 01·11
	48	B.J. 765		"	18 47·32		47·90	01·48	13·58		19 01·37
	49	40 Cygni	r	"	24 01·81		02·35				24 15·82

Clamp West. Adopted clock-rate zero.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date.	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T + m$	Adopted $\Delta T + m$	App. R.A. from Observation
					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
1910 Sept. 28	1	41 Cygni......		N	20 25 30·98	−·042	31·38	...	...	13·47	20 25 44·85
	2	ω¹ Cygni......		"	27 03·61	(·752)	04·41	...	...		27 17·88
	3	B.J. 768.......		"	28 43·18		43·30	56·76	13·46		28 56·77
	4	Groom. 3241..		"	30 10·01		12·26	...	...		30 25·73
	5	B.J. 770.......		"	32 27·68		30·31	...	...		32 43·78
	6	29 Vulp.......		"	34 18·27		18·53	...	...		34 32·00
	7	B.J. 774.......		"	35 15·79		15·97	29·42	13·45		35 29·44
	8	B.J. 777.......		"	38 09·34		10·04	23·48	13·44		38 23·51
	9	B.J. 778.......		"	39 03·76		03·93	17·40	13·47		39 17·40
	10	B.J. 780.......	r	"	42 21·98		22·44	35·99	13·55		42 35·91
	11	220 H¹. Drac..		"	51 26·05		30·26	...	...		51 43·73
	12	B.J. 788.......		"	53 36·73		37·33	50·85	13·52		53 50·80
	13	Bradley 2748..		"	55 34·16		36·98	...	...		55 50·45
	14	f¹ Cygni.......		"	56 33·49		34·25	...	...		56 47·72
	15	B.J. 792.......		"	21 01 27·10		27·76	41·25	13·49		21 01 41·23
	16	B.J. 793.......		"	02 39·82		40·36	53·84	13·48		02 53·83
	17	f² Cygni		"	03 17·59		18·35	...	...		03 31·82
	18	Groom. 3409..		"	05 37·70		39·80	...	...		05 53·27
	19	B.J. 795.......		"	07 04·13		07·47	...	...		07 20·94
	20	B.J. 798.......		"	09 17·91		19·13	32·64	...		09 32·60
	21	B.J. 799.......		"	10 59·84		00·38	13·81	13·43		11 13·85
	22	σ Cygni... ...		"	13 40·59		41·15	...	...		13 54·62
	23	B.A.C. 7504. .		"	17 15·69		28·24	42·21	13·97		...
	24	69 Cygni...	r	"	21 54·27		54·78	...	...		22 08·25
	25	1 H.Draconis..	L.C.,nr	"	24 11·26		06·49	20·14	13·65		...
	26	B.J. 807.......		"	25 55·40		56·16	09·64	...		26 09·63
	27	B.J. 809.......		"	27 16·90		18·89	...	...		27 32·36
	28	B.J. 811.......		"	33 08·46		09·04	22·48	13·44		33 22·51
	29	B.J. 813.......		"	35 57·56		58·65	12·15	...		36 12·12
	30	B.J. 816.....	r	"	40 22·46		22·78	36·29	13·51		40 36·25
	31	B.J. 821.......		"	43 15·82		16·63	30·14	...		43 30·10
	32	14 Pegasi.....		"	45 40·06		40·45	...	...		45 53·92
	33	B.J. 823.....		"	48 46·40		46·73	00·18	13·45		49 00·20
	34	Bradley 2868..	r	"	49 52·65		53·70	...	...		50 07·17
	35	13 Cephei..		"	51 39·27		40·33	...	...		51 53·80
	36	Bradley 2897..	r	"	56 46·64		49·25	...	...		57 02·72
	37	16 Cephei.....		"	57 44·99		47·31	...	...		58 00·78
	38	B.J. 831.......		"	22 02 37·72		38·04	51·50	13·46		22 02 51·51
	39	B.J. 833.......	r	"	05 02·56		03·00	16·54	13·54		05 16·47
	40	B.J. 835.......		"	05 47·66		48·10	01·58	13·48		06 01·57
	41	B.J. 837.......		"	07 51·95		54·15	...	...		08 07·62
	42	1 H.Lacertae..		"	09 49·19		49·76	...	...		10 03·23
	43	B.A.C. 3495.	L.C.,rn	"	16 33·36		25·88	39·54	13·66		...
	44	30 H. Camel.	L.C.,rn	"	20 01·59		55·93	09·37	13·44		...
	45	B.D. 70·1240..		"	23 28·50		30·52	...	...		23 43·99
	46	B.J. 847.......		"	25 37·42		38·55	52·10	...		25 52·02
	47	B.J. 848.......		"	27 22·97		23·81	37·28	...		27 37·28
	48	29 Cephei.....		"	28 52·39		55·92	...	...		29 09·39
	49	226 B.Cephei..		"	30 28·99		31·84	...	...		30 45·31
	50	B.J. 851.......		"	33 20·26		22·65	...	...		34 36·12

Clamp West. Adopted clock-rate zero.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected Σ	R. A. of Known Stars	Apparent ΔT + m	Adopted ΔT + m	App. R.A. from Observation
					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
1910 Sept. 28	1	B.J. 852.......		N	22 35 01·58	−·042	02·13	15·63	13·50	13·47	22 35 15·60
	2	B.J. 855.......	r	"	36 47·23	(·752)	47·35	00·85	13·50		37 00·82
	3	B.J. 857.......		"	38 35·39		35·78	49·29	13·51		38 49·25
	4	B.J. 858.......	r	"	39 52·83		53·44	06·92	13·48		40 06·91
	5	B.J. 859.......	r	"	42 00·39		00·68	14·10	13·42		42 14·15
	6	B.J. 862.......		"	45 28·13		28·44	41·91	13·47		45 41·91
	7	52 Pegasi....		"	54 30·50		30·63	......	...		54 44·10
	8	B.J. 869.......		"	57 35·02		35·65	49·15	13·50		57 49·12
	9	B.J. 870.......		"	59 13·29		13·64	27·03	13·39		59 27·11
Sept. 29	10	φ Aquilae.....		S	19 51 46·68	−·044	46·83	...	...	13·49	19 52 00·32
	11	B.J. 750.......		"	53 05·08	(·743)	05·94	19·43	...		53 19·43
	12	B.J. 752.......		"	54 33·21		33·46	46·95	13·49		54 46·95
	13	15 Vulp.......		"	57 11·38		11·76	......	...		57 25·25
	14	B.D. 69·1084..		"	58 40·74		42·63	......	...		58 56·12
	15	b^2 Cygni......		"	20 05 52·54		53·07	......	...		20 06 06·56
	16	20 Vulp.......		"	08 02·07		02·42	...	...		08 15·91
	17	ρ Aquilae.....		"	09 54·88		55·08	..			10 08·57
	18	B.J. 759.......		"	11 40·18		43·32	..	...		11 56·81
	19	176 B. Cygni..		"	16 46·98		47·56	...	...		17 01·05
	20	B.J. 765......	r	"	18 47·40		47·94	01·46	13·52		19 01·43
	21	40 Cygni.....		"	24 01·73		02·30	...	..		24 15·79
	22	41 Cygni......		"	25 30·89		31·31	......	...		25 44·80
	23	ω^1 Cygni.......		"	27 03·54		04·30	...	...		27 17·79
	24	B.J. 768.......		"	28 43·16		43·30	56·75	13·45		28 56·79
	25	Groom. 3241..		"	30 09·79		11·93	...	...		30 25·42
	26	B.J. 770.......		"	32 27·43		29.93	...	...		32 43·42
	27	74 Draconis...	nr	"	34 24·92		29·33	...			34 42·82
	28	B.J. 777.......		"	38 09·27		09·99	23·46	13·47		38 23·48
	29	B.J. 778.......		"	39 03·72		03·91	17·38	13·47		39 17·40
	30	B.J. 780.......	r	"	42 22·03		22·46	35·97	13·51		42 35·95
	31	B.J. 784.......		"	43 41·89		42·41	55.91	13·50		43 55·90
	32	76 Draconis...	nr	"	48 52·05		57·27	10·95	13·68		...
	33	220 H[1].Drac..	nr	"	51 25·63		29·78	43·55	13·77		
	34	B.J. 788......		"	53 36·71		37·33	50·83	13·50		53 50·82
	35	Bradley 2748..		"	55 33·98		36·66	......	......		55 50·15
	36	B.J. 792.......		"	21 01 27·01		27·70	41·23	13·53		21 01 41·19
	37	f^2 Cygni......		"	03 17·65		18·36	....	......		03 31·85
	38	Groom. 3409..		"	05 37·67		39·67	...	....		05 53·16
	39	B.J. 795.......		"	07 03·98		07·15	......	......		07 20·64
	40	B.J. 798.......		"	09 17·97		19·12	32·61	...		09 32·61
	41	B.J. 799.......	r	"	10 59·83		00·32	13·79	13·47		11 13·81
	42	Bradley 2796..		"	16 27·59		30·49	..	......		16 43·98
	43	69 Cygni.. ...		"	21 54·25		54·77	..	..		22 08·26
	44	1 H.Draconis..	L.C.,nr	"	24 11·53		06·01	20·38	14·37		
	45	B.J. 807.......		"	25 55·40		56·08	09·62	.....		26 09·57
	46	Groom. 3511..		"	27 15·27		19·24	...	....		27 32·73
	47	ρ Cygni.......		"	30 23·45		24·18	...	....		30 37·67
	48	B.J. 811.......		"	33 08·35		08·95	22·46	13·51		33 22·44
	49	B.J. 813.......		"	35 57·50		58·53	12·12	....		36 12·02

Clamp West. Adopted clock-rate zero.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
					h. m.	s.	s.	s.	s.	s.	h. m. s.
1910											
Sept. 29	1	B.J. 817.......		S	21 40 23·13	−·044	25·11	.....	....	13·49	21 40 38·60
	2	78 Draconis...	r	"	41 45·06	(·743)	47·30	.....	....		42 00·79
	3	B.J. 821.......		"	43 15·80		16·56	30·12	....		43 30·05
	4	14 Pegasi.....		"	45 39·95		40·36	.....	....		45 53·85
	5	B.J. 823.......		"	48 46·32		46·67	00·17	13·50		49 00·16
	6	Bradley 2868..	r	"	49 52·59		53·65	.....	....		50 07·14
	7	13 Cephei.....		"	51 39·18		40·18	.....	....		51 53·67
	8	Bradley 2897..		"	56 46·47		48·96	.....	....		57 02·45
	9	16 Cephei	r	"	57 44·66		47·02	.....	....		58 00·51
	10	B.J. 831.......		"	22 02 37·68		38·01	51·49	13·48		22 02 51·50
	11	B.J. 833.......		"	05 02·57		03·03	16·53	13·50		05 16·52
	12	28 Pegasi.....		"	06 03·42		03·68	.....	....		06 17·17
	13	B.J. 837.......		"	07 51·87		53·96	.....	....		08 07·45
	14	1 H.Lacertae..		"	09 49·00		49·59	.....	....		10 03·08
	15	Bradley 2942..		"	11 02·18		04·40	.....	....		11 17·89
	16	B.A.C. 3495...	L.C.,nr	"	16 33·82		26·46	39·70	13·24		....
	17	30 H.Camel...	L.C.,nr	"	20 01.92		56·35	09·50	13·15		....
	18	B.D. 70·1240..		"	23 28·53		30·44	.....	....		23 43.93
	19	28 Cephei.....		"	25 49·04		52·37	.....	....		26 05·86
	20	B.J. 848.......		"	27 22·92		23·70	37·27	....		27 37·19
	21	29 Cephei.....	r	"	28 52·19		55·77	.....	....		29 09·26
	22	B.J. 851.......		"	33 20·17		22·44	.....	....		33 35·93
	23	Groom. 3857..		"	35 04·63		07·19	.....	....		35 20·68
	24	52 Pegasi.....		"	54 30·50		30·65	.....	....		54 44·14
	25	B.J. 869.......	r	"	57 35·01		35·60	49·14	13·54		57 49·09
	26	B.J. 870.......		"	59 13·15		13·53	27·03	13·50		59 27·02
	27	B.J. 871.......		"	23 00 05·40		05·59	19·10	13·51		23 00 19·08
	28	5 Andromedae		"	03 28·25		29·01	.....	....		03 42·50
	29	B.J. 874.......	r	"	04 49·48		52·21	.....	....		05 05·70
	30	B.J. 875.......		"	08 45·05		46·07	59·62	....		08 59·56
	31	Bradley 3085..		"	11 12·86		15·22	.....	....		11 28·71
	32	B.J. 880.......		"	15 59·51		59.82	13·36	13·54		16 13·31
	33	B.J. 881.......	r	"	20 41·94		42·19	55·68	13·49		20 55·68
	34	B.J. 885.......		"	24 25·04		25·20	38·69	13·49		24 38·69
	35	39 H. Cephei..	nr	"	27 34·21		47·13	00·06	12·93		....
	36	B.J. 890.......		"	32 57·82		58·49	12·01	......		33 11·98
	37	Groom. 4119..		"	35 06·33		08·85	.....	....		35 22·34
	38	ψ Andromedae		"	41 22·73		23·40	.....	....		41 36·89
Sept. 30	39	λ Urs. Min....		N	19 09 33·29	−·034	15·40	30·06	14·66	13·45	....
	40	*b* Aquilae.....		"	20 28·75	(·740)	28·89	.....	....		19 20 42·34
	41	21 B.Vulp. ...	r	"	21 29·94		30·26	.....	....		21 43·71
	42	4 Cygni.......		"	22 41·95		42·46	.....	....		22 55·91
	43	α Vulp........		"	24 45·26		45·58	.....	....		24 59·03
	44	B.J. 733.......		"	27 12·85		13·73	27·25	....		27 27·18
	45	8 Cygni.......		"	28 13·01		13·48	.....	....		28 26·93
	46	B.D. 49·3059..	r	"	33 18·11		18·94	.....	....		33 32·39
	47	B.J. 738.......		"	33 48·54		49·37	02·78	....		34 02·82
	48	14 Cygni......		"	36 17·84		18·48	.....	....		36 31·93
	49	10 Vulp.......		"	39 46·14		46·47	.....	....		39 59.92

Clamp West. Adopted clock-rate zero.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date.	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T + m$	Adopted $\Delta T + m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Sept. 30	1	B.J. 740.......		N	19 40 49·24	−·034	49·77	03·20	13·43	13·45	19 41 03·22
	2	B.J. 742.......		"	41 56·80	(·740)	57·50	10·99	13·49		42 10·95
	3	B.J. 743.......		"	43 10·42		10·64	24·09	13·45		43 24·09
	4	ζ Sagittae ..	r	"	44 46·90		47·13	....	....		45 00·58
	5	φ Aquilae ...		"	51 46·68		46·81	....	....		52 00·26
	6	B.J. 750......		"	53 05·03		05·94	19·40	....		53 19·39
	7	B.J. 752.....		"	54 33·23		33·47	46·93	13·46		54 46·92
	8	15 Vulp.......		"	57 11·41		11·77	....	....		57 25·22
	9	Groom. 1119.	L.C.	"	20 09 16·61		40·76	55·27	14·51		....
	10	176 B.Cygni...		"	16 47·01		47·57	....	....		20 17 01·02
	11	B.J. 765.....		"	18 47·40		47·98	01·44	13·46		19 01·43
	12	40 Cygni.....	r	"	24 01·76		02·30	....	....		24 15·75
	13	41 Cygni.....		"	25 30·90		31·30	....	....		25 44·75
	14	ω^1 Cygni.....		"	27 03·57		04·37	....	....		27 17·82
	15	B.J. 768.......		"	28 43·17		43·29	56·73	13·44		28 56·74
	16	ζ Delphini....		"	30 54·36		54·53	....	....		31 07·98
	17	B.J. 771......	r	"	33 08·01		08·18	21·64	13·46		33 21·63
	18	29 Vulp......		"	34 18·26		18·52	....	....		34 31·97
	19	B.J. 774.....		"	35 15·79		15·98	29·39	13·41		35 29·43
	20	B.J. 777......		"	38 09·18		09·88	23·44	13·56		38 23·33
	21	B.J. 778.......		"	39 03·78		03·95	17·37	13·42		39 17·40
	22	B.J. 780.......		"	42 21·97		22·44	35·95	13·51		42 35·89
	23	B.J. 784.......	r	"	43 41·92		42·43	55·89	13·46		43 55·88
	24	76 Draconis...		"	48 51·98		57·25	10·79	13·54		....
	25	220 H^1. Drac..		"	51 25·59		29·77	....	....		51 43·22
	26	B.J. 788......		"	53 36·74		37·34	50·81	13·47		53 50·79
	27	f^1 Cygni		"	56 33·42		34·18	....	....		56 47·63
	28	B.J. 792.....		"	21 01 26·98		27·64	41·21	13·57		21 01 41·09
	29	B.J. 793.....		"	02 39·85		40·39	53·80	13·41		02 53·84
	30	f^2 Cygni		"	03 17·57		18·33	....	....		03 31·78
	31	B.J. 798.....		"	09 17·89		19·11	32·57	....		09 32·56
	32	B.J. 799.......		"	10 59·79		00·33	13·77	13·44		11 13·78
	33	ν Cygni......		"	14 01·01		01·49	....	....		14 14·94
	34	B.J. 804.......		"	17 43·83		44·07	57·52	13·45		17 57·52
	35	69 Cygni.....		"	21 54·32		54·83	....	....		22 08·28
	36	B.J. 807.......		"	25 55·46		56·22	09·60	....		26 09·67
	37	ρ Cygni.......		"	30 23·47		24·18	....	....		30 37·63
	38	B.J. 811.....		"	33 08·43		09·01	22·45	13·44		33 22·46
	39	B.J. 813.....		"	35 57·53		58·62	12·10	....		36 12·07
	40	B.J. 816......	r	"	40 22·49		22·82	36·27	13·45		40 36·27
	41	B.J. 821.......		"	43 15·84		16·65	30·10	....		43 30·10
	42	14 Pegasi.....		"	45 40·05		40·44	....	....		45 53·89
	43	B.J. 823.....		"	48 46·39		46·72	00·15	13·43		49 00·17
	44	Bradley 2868..		"	49 52·56		53·60	....	....		50 07·05
	45	13 Cephei.....	r	"	51 39·19		40·24	....	....		51 53·69
	46	B.J. 826.......		"	56 31·00		31·15	44·56	13·41		56 44·60
	47	B.J. 831.......		"	22 02 37·67		37·99	51·48	13·49		22 02 51·44
	48	B.J. 833.......		"	05 02·61		03·05	16·51	13·46		05 16·50
	49	B.J. 835.......	r	"	05 47·66		48·10	01·55	13·45		06 01·55
	50	B.J. 836.......		"	07 31·56		32·68	46·09	....		07 46·13

Clamp West. Adopted clock-rate zero.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s	h. m. s.
Sept. 30	1	1 H.Lacertae..		N	22 09 49·01	−·034	49·58	.....	....	13·45	22 10 03·03
	2	B.A.C. 3495...	L.C.	"	16 33·71	(·740)	26·26	39·88	13·62		....
	3	B.J. 844.......		"	19 49·13		50·02	03·44	....		20 03·47
	4	B.J. 847.......		"	25 37·46		38·59	52·06	....		25 52·04
	5	B.J. 848.......		"	27 22·96		23·78	37·25	....		27 37·23
	6	B.J. 852.......		"	35 01·59		02·14	15·61	13·47		35 15·59
	7	B.J. 855.......		"	36 47·31		47·42	00·84	13·42		37 00·87
	8	B.J. 857.......		"	38 35·37		35·76	49·28	13·52		38 49·21
	9	B.J. 858.......		"	39 52·86		53·47	06·90	13·43		40 06 92
	10	B.J. 859.......		"	42 00·36		00·66	14·09	13·43		42 14·11
	11	B.J. 862.......	r	"	45 28·09		28·40	41·90	13·50		45 41·85
Oct. 3	12	B.J. 780.......		N	20 42 21·67	−·045	22·14	35·89	13·75	13·75	20 42 35·89
	13	B.J. 804.....		"	21 17 43·47	(·764)	43·71	57·49	13·78		21 17 57·46
	14	1 H.Draconis..	L.C.	"	24 11·74		06·91	20·90	13·99	13·76	....
	15	B.J. 831......		"	22 02 37·39		37·70	51·45	13·75		22 02 51·46
	16	B.J. 833.......	r	"	05 02·18		02·63	16·48	13·85		05 16·39
	17	B.J. 835.......		"	05 47·27		47·72	01·52	13·80		06 01·48
	18	B.J. 836.......		"	07 31·18		32·32	46·03	....		07 46·08
	19	1 H.Lacertae..		"	09 48·63		49·21	.....	....		10 02·97
	20	B.A.C. 3495...	L.C.	"	16 34·33		26·75	40·34	13·59		....
	21	30 H.Camel...	L.C.	"	20 02·32		56·58	09·97	13·39		....
	22	B.J. 847......		"	25 37·09		38·24	52·01	....		25 52·00
	23	B.J. 848.......		"	27 22·58		23·42	37·21	....		27 37·18
	24	B.J. 852.......		"	35 01·23		01·79	15·58	13·79		35 15·55
	25	B.J. 857.......		"	38 35·04		35·44	49·26	13·82		38 49·20
	26	B.J. 858.....		"	39 52·61		53·23	06·87	13·64		40 06·99
	27	B.J. 859.......		"	42 00·08		00·38	14·07	13·69		42 14·14
	28	B.J. 862.......		"	45 27·77		28·07	41·88	13·81		45 41·83
	29	B.J. 869.......		"	57 34·75		35·39	49·12	13·73		57 49·15
	30	B.J. 870.......		"	59 12·91		13·27	27·02	13·75		59 27·03
	31	B.J. 875......		"	23 08 44·73		45·82	59·58	....		23 08 59·58
	32	B.J. 880.......		"	15 59·27		59·57	13·35	13·78		16 13·33
	33	B.J. 881.......		"	20 41·61		41·90	55·67	13·77		20 55·66
	34	39 H.Cephei...		"	27 33·04		46·33	59·58	13·25	13·77	....
	35	B.J. 890.......		"	32 57·44		58·17	12·00	....		33 11·94
Oct. 7	36	Groom. 1119..	L.C..nr	N	20 09 23·65	−·046	49·80	03·35	13·55	14·48	....
	37	176 B.Cygni...		"	16 45·84	(·713)	46·37	.....	....		20 17 00·85
	38	B.J. 765.......	r	"	18 46·21		46·76	01·27	14·51		19 01·24
	39	40 Cygni......		"	24 00·62		01·13	.....	....	14·49	24 15·62
	40	41 Cygni......		"	25 29·81		30·18	.....	....		25 44·67
	41	ω^1 Cygni		"	27 02·35		03·10	.....	....		27 17·59
	42	B.J. 768.......		"	28 42·06		42·17	56·63	14·46		28 56·66
	43	ζ Delphini....	r	"	30 53·22		53.38	.....	....		31 07·87
	44	B.J. 771.......		"	33 06·94		07·09	21·54	14·45		33 21·58
	45	29 Vulp.......		"	34 17·10		17·34	.....	....		34 31·83
	46	B.J. 774.......		"	35 14·57		14·74	29·29	14·55		35 29·23
	47	B.J. 777.......		"	38 08·09		08·74	23·27	14·53		38 23·23
	48	B.J. 778.....		"	39 02·67		02·83	17·26	14·43		39 17·32

Clamp West. 1–11. Adopted clock-rate zero.
12–35. Adopted $\Delta T+m=13{\cdot}758+{\cdot}0050$ (T-22^h 00^m).
36–48. Adopted $\Delta T+m=14{\cdot}505+{\cdot}0136$ (T-21^h 50^m).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Oct. 7	1	B.J. 780......	r	N	20 42 20·86	– ·046	21·30	35·82	14·52	14·49	20 42 35·79
	2	B.J. 784.....		“	43 40·76	(·713)	41·23	55·75	14·52		43 55·72
	3	76 Draconis...		“	48 50·23		55·23	09·80	14·57		
	4	220 H¹ Drac...	nr	“	51 24·05		28·02	. . .	. . .		51 42·51
	5	B.J. 788......		“	53 35·63		36·19	50·66	14·47		53 50·68
	6	f^1 Cygni.....		“	56 32·22		32·93	. . .	. . .		56 47·42
	7	B.J. 792.......		“	21 01 25·84		26·46	41·06	14·60		21 01 40·95
	8	B.J. 793.....		“	02 38·64		39·15	53·67	14·52		02 53·64
	9	f^2 Cygni ...		“	03 16·43		17·14	. . .	. . . . . .		03 31·63
	10	B.J. 798......		“	09 16·68		17·82	32·34	. . .	14·50	09 32·32
	11	B.J. 799.....		“	10 58·61		59·11	13·65	14·54		11 13·61
	12	σ Cygni.......		“	13 39·49		40·02	. . .	. . .		13 54·52
	13	B.A.C. 7504..	nr	“	17 12·53		24·36	39·42	15·06		. . .
	14	69 Cygni...	r	“	21 53·20		53·67	. . .	. . .		22 08·17
	15	1 H. Draconis..	L.C., rn	“	24 11·48		07·00	21·40	14·40		
	16	B.J. 807.......		“	25 54·25		54·93	09·46	. . . .		26 09·43
	17	ρ Cygni.......		“	30 22·26		22·92	. . .			30 37·42
	18	B.J. 811.......		“	33 07·26		07·81	22·34	14·53		33 22·31
	19	B.J. 813.....		“	35 56·34		57·37	11·91			36 11·87
	20	B.J. 816.....		“	40 21·34		21·64	36·19	14·55		40 36·14
	21	B.J. 821......		“	43 14·68		15·44	29·96	. . .		43 29·94
	22	14 Pegasi.....		“	45 38·91		39·28		. . .		45 53·78
	23	B.J. 823......	r	“	48 45·24		45·54	00·08	14·54		49 00·04
	24	Bradley 2868..	r	“	49 51·52		52·50	. . .			50 07·00
	25	13 Cephei...		“	51 38·11		39·10	. . .		14·51	51 53·61
	26	B.J. 826.....		“	56 29·84		29·97	44·50	14·53		56 44·48
	27	B.J. 831.....		“	22 02 36·55		36·84	51·41	14·57		22 02 51·35
	28	B.J. 833.......	r	“	05 01·57		01·99	16·44	14·45		05 16·50
	29	B.J. 835.......		“	05 46·59		47·01	01·48	14·47		06 01·52
	30	B.J. 836......		“	07 30·38		31·44	45·94	. . .		07 45·95
	31	1 H. Lacertae..		“	09 47·86		48·39	. . .	. . .		10 02·90
	32	B.A.C. 3495...	L.C., rn	“	16 33·31		26·29	41·00	14·71		. . .
	33	30 H. Camel..	L.C., rn	“	20 01·11		55·79	10·41	14·62		
	34	B.J. 847......		“	25 36·27		37·34	51·93	. . .		25 51·85
	35	B.J. 848......		“	27 21·71		22·49	37·16	. . .		27 37·00
	36	B.J. 852......		“	35 00·48		01·00	15·55	14·55	14·52	35 15·52
	37	B.J. 855......		“	36 46·22		46·32	00·80	14·48		37 00·84
	38	B.J. 857.....		“	38 34·33		34·70	49·23	14·53		38 49·22
	39	B.J. 858.......		“	39 51·61		52·19	06·84	14·65		40 06·71
	40	B.J. 859.......		“	41 59·25		59·53	14·05	14·52		42 14·05
	41	B.J. 862......	r	“	45 27·04		27·32	41·86	14·54		45 41·84
	42	52 Pegasi....	r	“	54 29·52		29·63	. . .			54 44·15
	43	B.J. 869.....	r	“	57 33·98		34·57	49·09	14·52		57 49·09
	44	B.J. 870.....		“	59 12·22		12·55	27·00	14·45		59 27·07
	45	B.J. 871.......		“	23 00 04·42		04·58	19·08	14·50		23 00 19·10
	46	5 Andromedae		“	03 27·11		27·86		. . . .		03 42·38
	47	B.J. 875......		“	08 44·02		45·03	59·55	. . .		08 59·55
	48	B.J. 881.......		“	20 40·94		41·21	55·67	14·46	14·53	20 55·74
	49	B.J. 885.......		“	24 24·08		24·21	38·68	14·47		24 38·74
	50	39 H. Cephei..	rn	“	27 33·15		45·51	59·20	13·69		. . . .

Clamp West. 1—50. Adopted $\Delta T+m=14{\cdot}505+{\cdot}0136\ (T-21^{h}\ 50^{m})$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent ΔT + m	Adopted ΔT + m	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Oct. 10	1	Groom. 1119..	L.C.,nr	N	20 09 26·15	−·048	53·33	07·36	14·03	15·29	....
	2	176 B.Cygni...		"	16 44·96	(·705)	45·48	.....	.....	15·30	20 17 00·78
	3	B.J. 765.......		"	18 45·37		45·91	01·20	15·29		19 01 21
	4	40 Cygni......	r	"	23 59·73		00·24	.....	.....		24 15·54
	5	41 Cygni.....		"	25 28·92		29·28	.....	.....		25 44·58
	6	ω^1 Cygni.....		"	27 01·45		02·19	.....	.....		27 17·49
	7	Groom. 3241..		"	30 07·31		09·39	.....	.....		30 24·69
	8	B.J. 770.......		"	32 24·71		27·15	.....	.....		32 42·45
	9	29 Vulp.......		"	34 16·30		16·53	.....	.....		34 31·83
	10	B.J. 774.....		"	35 13·72		13·89	29·24	15·35		35 29·19
	11	B.J. 777.....		"	38 07·15		07·80	23·20	15·40		38 23·10
	12	B.J. 778.......		"	39 01·73		01·88	17·22	15·34		39 17·18
	13	B.J. 780.......		"	42 19·96		20·38	35·76	15·38		42 35·68
	14	B.J. 784.....	r	"	43 39·92		40·38	55·69	15·31		43 55·68
	15	76 Draconis...		"	48 48·81		53·73	09·29	15·56		....
	16	220 H[1]. Drac..	r	"	51 22·69		26·59	.....	.....		51 41·89
	17	B.J. 788.......		"	53 34·72		35·27	50·60	15·33		53 50·57
	18	Bradley 2748..		"	55 31·32		33·92	.....	.....	15·31	55 49·23
	19	f^1 Cygni......		"	56 31·33		32·03	.....	.....		56 47·34
	20	B.J. 792.......		"	21 01 25·01		25·62	40·99	15·37		21 01 40·93
	21	B.J. 793.......		"	02 37·77		38·28	53·61	15·33		02 53·59
	22	f^2 Cygni......		"	03 15·51		16·21	.....	.....		03 31·52
	23	Groom. 3409..		"	05 35·20		37·15	.....	.....		05 52·46
	24	B.J. 795.......		"	07 01·39		04·48	.....	.....		07 19·79
	25	B.J. 798.......		"	09 15·67		16·80	32·23	.....		09 32·11
	26	B.J. 799.......	r	"	10 57·77		58·26	13·60	15·34		11 13·57
	27	v Cygni....		"	13 58·98		59·42	.....	.....		14 14·73
	28	Bradley 2796..		"	16 24·85		27·67	.....	.....		16 42·98
	29	69 Cygni.......		"	21 52·38		52·84	.....	.....		22 08·15
	30	1 H.Draconis..	L.C.,nr	"	24 10·80		06·39	21·86	15·47		....
	31	B.J. 807.......		"	25 53·36		54·03	09·39	.....		26 09·34
	32	B.J. 809.......		"	27 14·58		16·42	.....	.....		27 31·73
	33	72 Cygni......		"	30 51·90		52·41	.....	.....		31 07·72
	34	B.J. 811.......		"	33 06·40		06·93	22·28	15·35		33 22·24
	35	B.J. 813.......		"	35 55·53		56·54	11·82	.....		36 11·85
	36	B.J. 817......	r	"	40 20·92		22·85	.....	.....	15·32	40 38·17
	37	78 Draconis...		"	41 43·02		45·06	.....	.....		42 00·38
	38	B.J. 821.......		"	43 13·80		14·54	29·90	.....		43 29·86
	39	14 Pegasi.....		"	45 38·07		38·43	.....	.....		45 53·75
	40	B.J. 823.......		"	48 44·45		44·75	00·03	15·28		49 00·07
	41	Bradley 2868..		"	49 50·65		51·62	.....	.....		50 06·94
	42	13 Cephei.....	r	"	51 37·12		38·09	.....	.....		51 53·41
	43	Bradley 2897..		"	56 44·10		46·52	.....	.....		57 01·84
	44	16 Cephei.....	r	"	57 42·58		44·73	.....	.....		58 00·05
	45	B.J. 831.......		"	22 02 35·82		36·10	51·37	15·27		22 02 51·42
	46	B.J. 833.......		"	05 00·69		01·09	16·39	15·30		05 16·41
	47	B.J. 835.......	r	"	05 45·69		46·09	01·42	15·33		06 01·41
	48	B.J. 836.......		"	07 29·48		30·51	45·87	.....		07 45·83
	49	1 H.Lacertae..		"	09 47·07		47·60	.....	.....		10 02·92
	50	Bradley 2942..		"	10 59·86		02·03	.....	.....		11 17·35

Clamp West. 1—50. Adopted $\Delta T+m=15{\cdot}318+{\cdot}0140\ (T-21^{h}\ 50^{m})$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Oct. 10	1	B.A.C. 3495…	L.C.,rn	N	22 16 33·11	—·048	26·20	41·46	15·26	15·32	....
	2	30 H.Camel…	L.C.,rn	"	20 00·48	(·705)	55·25	10·81	15·56	5·33	....
	3	B. D. 70·1240..		"	23 26·32		28·18	....	....		22 23 43·51
	4	B.J. 847.......		"	25 35·45		36·50	51·87	....		25 51·83
	5	B.J. 848.......		"	27 20·92		21·68	37·10	....		27 37·01
	6	29 Cephei.....		"	28 49·92		53·19	....	....		29 08·52
	7	226 B.Cephei.		"	30 26·42		29·06	....	....		30 44·39
	8	B.J. 851.......		"	33 17·87		20·08	....	....		33 35·41
	9	B.J. 852.......		"	34 59·65		00·16	15·51	15·35		35 15·49
	10	B.J. 855.......	r	"	36 45·39		45·49	00·78	15·29		37 00·82
	11	B.J. 857.......		"	38 33·53		33·89	49·20	15·31		38 49·22
	12	B.J. 858.......	r	"	39 50·86		51·42	06·80	15·38		40 06·75
	13	B.J. 859.......	r	"	41 58·43		58·69	14·02	15·33		42 14·02
	14	B.J. 862.......		"	45 26·21		26·49	41·84	15·35		45 41·82
	15	52 Pegasi......		"	54 28·67		28·78	....	....		54 44·11
	16	B.J. 869.......		"	57 33·14		33·71	49·05	15·34		57 49·04
	17	B.J. 870.......		"	59 11·36		11·69	26·98	15·29		23 00 27·02
	18	B.J. 874.......	r	"	23 04 47·42		49·91	....	....	15·34	05 05·25
	19	B.J. 875.......		"	08 43·10		44·09	59·50	....		08 59·43
	20	Groom. 4033..		"	13 54·16		56·61	....	....		14 11·95
	21	B.J. 880.......	r	"	15 57·78		58·04	13·32	15·28		16 13·38
	22	B.J. 881.......		"	20 40·08		40·34	55·65	15·31		20 55·68
	23	39 H. Cephei..	rn	"	27 31·74		43·92	58·76	14·84		....
Oct. 11	24	20 Vulp........		S	20 07 59·76	—·049	00·09	....	....	15·58	20 08 15·67
	25	ρ Aquilae.....		"	09 52·59	(·723)	52·78	....	....		10 08·36
	26	B.J. 759.......		"	11 37·09		40·07	....	....		11 55·65
	27	176 B. Cygni..		"	16 44·65		45·21	....	....		17 00·79
	28	40 Cygni.......	r	"	23 59·47		59·96	....	....	15·59	24 15·55
	29	41 Cygni.......		"	25 28·56		28·96	....	....		25 44·55
	30	ω^1 Cygni.......		"	27 01·20		01·92	....	....		27 17·51
	31	B.J. 768.......		"	28 40·86		40·99	56·57	15·58		28 56·58
	32	ζ Delphini.....	r	"	30 52·05		52·18	....	....		31 07·77
	33	B.J. 770.......		"	32 24·50		26·91	....	....		32 42·50
	34	74 Draconis...	rn	"	34 21·49		25·74	....	....		34 41·33
	35	B.J. 777.......		"	38 06·90		07·59	23·17	15·58		38 23·18
	36	B.J. 778.......		"	39 01·42		01·60	17·20	15·60		39 17·19
	37	B.J. 780.......		"	42 19·66		20·12	35·74	15·62		42 35·71
	38	B.J. 784.......	r	"	43 39·62		40·07	55·67	15·60		43 55·66
	39	76 Draconis...	rn	"	48 48·32		53·35	09·12	15·77		....
	40	220 H[1]. Drac..	rn	"	51 22·49		26·49	42·09	15·60		....
	41	B.J. 788.......		"	53 34·40		34·99	50·58	15·59		53 50·58
	42	Bradley 2748..		"	55 31·10		33·68	....	....		55 49·27
	43	B.J. 792.......		"	21 01 24·72		25·38	40·97	15·59		21 01 40·97
	44	f^2 Cygni.......		"	03 15·27		15·95	....	....	15·60	03 31·55
	45	Groom. 3409..		"	05 34·93		36·85	....	....		05 52·45
	46	B.J. 795.......		"	07 01·09		04·15	....	....		07 19·75
	47	B.J. 798.......		"	09 15·43		16·54	32·20	....		09 32·14
	48	B.J. 799.......		"	10 57·45		57·99	13·58	15·59		11 13·59

Clamp West. 1—23. Adopted $\Delta T+m=15{\cdot}318+{\cdot}0140$ (T-21^h 50^m).

24—48. Adopted $\Delta T+m=15{\cdot}598+{\cdot}0141$ (T-21^h 15^m).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Oct. 11	1	Bradley 2796..		S	21 16 24·54	−·049	27·33			15·60	21 16 42·93
	2	69 Cygni......	r	"	21 52·05	(·723)	52·50				22 08·10
	3	1 H.Draconis..	L.C.,rn	"	24 10·78		06·27	22·03	15·76		...
	4	B.J. 807.......		"	25 53·13		53·78	09·37			26 09·38
	5	B.J. 811.......		"	33 06·06		06·64	22·26	15·62		33 22·24
	6	B.J. 817.......		"	40 20·57		22·47				40 38·07
	7	78 Draconis...	r	"	41 42·55		44·71				42 00·31
	8	B.J. 821.......		"	43 13·50		14·23	29·87			43 29·83
	9	14 Pegasi.....		"	45 37·71		38·10			15·61	45 53·71
	10	B.J. 823.......		"	48 44·04		44·37	00·02	15·65		48 59·98
	11	79 Draconis...		"	51 28·22		30·42				51 46·03
	12	B.J. 826.......		"	56 28·71		28·87	44·46	15·59		56 44·48
	13	16 Cephei.....		"	57 42·31		44·44				58 00·05
	14	B.J. 831.......		"	22 02 35·40		35·71	51·36	15·65		22 02 51·32
	15	B.J. 833.......		"	05 00·26		00·70	16·38	15·68		05 16·31
	16	28 Pegasi.....		"	06 01·20		01·46				06 17·07
	17	B.J. 837.......		"	07 49·37		51·39				08 07·00
	18	Bradley 2942..		"	10 59·47		01·61				11 17·22
Oct. 12	19	40 Cygni......		N	20 23 58·72	·068	59·44			16·03	20 24 15·47
	20	41 Cygni......		"	25 28·00	(·792)	28·54				25 44·57
	21	ω[1] Cygni.. ...		"	27 00·54		01·55				27 17·58
	22	Groom. 3241..		"	30 06·10		08·78				30 24·81
	23	B.J. 770.......		"	32 23·44		26·55				32 42·58
	24	B.J. 774.......		"	35 12·86		13·15	29·21	16·06		35 29·18
	25	B.J. 777.......		"	38 06·16		07·05	23·14	16·09		38 23·08
	26	B.J. 778.......		"	39 00·85		01·13	17·19	16·06		39 17·16
	27	B.J. 780.......		"	42 19·09		19·71	35·72	16·01		42 35·74
	28	B.J. 784.......	r	"	43 39·04		39·71	55·65	15·94		43 55·74
	29	76 Draconis...	nr	"	48 46·38		52·59	08·94	16·35		...
	30	220 H[1]. Drac..	nr	"	51 20·89		25·83				51 41·86
	31	Bradley 2748..		"	55 29·65		32·98			16·04	55 49·02
	32	B.J. 792.......		"	21 01 24·01		24·86	40·95	16·09		21 01 40·90
	33	B.J. 793.......		"	02 36·86		37·58	53·57	15·99		02 53·62
	34	B.J. 795.......		"	06 59·72		03·65				07 19·69
	35	B.J. 798.......		"	09 14·60		16·09	32·16			09 32·13
	36	B.J. 799.......		"	10 56·80		57·50	13·56	16·06		11 13·54
	37	v Cygni.		"	13 58·01		58·65				14 14·69
	38	B.A.C. 7504...	nr	"	17 06·70		21·29	37·53	16·24		...
	39	69 Cygni......	r	"	21 51·35		52·02				22 08·06
	40	1 H.Draconis..	L.C.,nr	"	24 11·41		05·86	22·20	16·34		...
	41	72 Cygni......		"	30 50·97		51·69				31 07·73
	42	B.J. 811.......		"	33 05·39		06·15	22·24	16·09		33 22·19
	43	B.J. 813.......		"	35 54·31		55·66	11·76		16·05	36 11·71
	44	B.J. 817.......		"	40 19·39		21·88				40 37·93
	45	78 Draconis...	r	"	41 41·52		44·14				42 00·19
	46	B.J. 821.......		"	43 12·78		13·80	29·85			43 29·85
	47	14 Pegasi.....		"	45 37·05		37·58				45 53·63
	48	B.J. 823.......		"	48 43·41		43·87	00·01	16·14		48 59·92
	49	Bradley 2868..		"	49 49·46		50·75				50 06·80

From Oct. 11 Clamp West; from Oct. 12 Clamp East.
1—18. Adopted $\Delta T+m=15{\cdot}598+{\cdot}0141$ $(T-21^{h}\ 15^{m})$.
19—49. Adopted $\Delta T+m=16{\cdot}046+{\cdot}0142$ $(T-21^{h}\ 40^{m})$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent ΔT+m	Adopted ΔT+m	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Oct. 12	1	13 Cephei....	r	N	21 51 35·99	·068	37·30	....	....	16·05	21 51 53·35
	2	Bradley 2897..		"	56 42·49	(·792)	45 59	....	....		57 01·64
	3	16 Cephei.....		"	57 41·15		43·91	....	....		57 59·96
	4	B.J. 831.......		"	22 02 34·82		35·26	51·35	16·09		22 02 51·31
	5	B.J. 833.......		"	04 59·70		00·30	16·37	16·07		05 16·35
	6	B.J. 835.......	r	"	05 44·85		45·45	01·41	15·96		06 01·50
	7	B.J. 837.......		"	07 48·21		50·83	....	....		08 06·88
	8	1 H.Lacertae..		"	09 46·04		46·78	....	....		10 02·83
	9	Bradley 2912..		"	10 58·53		01·30	....	....		11 17·35
	10	B.A.C. 3495...	L.C.,nr	"	16 34·14		25·43	41·88	16·45		....
	11	30 H.Camel...	L.C.,nr	"	20 01·78		55·19	41·14	15·95	16·06	....
	12	B.D. 70·1240..		"	23 25·11		27·52	....	....		23 43·58
	13	28 Cephei.....		"	25 44·55		48·68	....	....		26 04·74
	14	B.J. 848.......		"	27 19·94		20·99	37·07	16·08		27 37·05
	15	29 Cephei.....	r	"	28 48·28		52·43	....	....		29 08·49
	16	B.J. 851.......		"	33 16·49		19·33	....	....		33 35·39
	17	B.J. 852.......		"	34 58·62		59·34	15·49	16·15		35 15·40
	18	B.J. 855.......		"	36 44·51		44·71	00·76	16·05		37 00·77
	19	B.J. 858.......		"	39 49·90		50·70	06·78	16·08		40 06·76
	20	B.J. 859.......		"	41 57·55		57·96	14·01	16·05		42 14·02
t. 17	21	29 Vulp.......		N	20 34 13·49	·041	13·82	....	....	17·88	20 34 31·70
	22	B.J. 774.......		"	35 11·01	(·770)	11·27	29·13	17·86		35 29·15
	23	B.J. 777.......		"	38 04·26		05·09	23·01	17·92	17·89	38 22·98
	24	B.J. 778.......		"	38 59·07		59·31	17·11	17·80		39 17·20
	25	B.J. 780.......	r	"	42 17·18		17·75	35·62	17·87		42 35·64
	26	B.J. 784.......		"	43 37·00		37·62	55·54	17·92		43 55·51
	27	76 Draconis...	nr	"	48 44·31		50·18	08·13	17·95		....
	28	220 H[1].Drac...	nr	"	51 18·61		23·27	....	....		51 41·16
	29	B.J. 788.......		"	53 31·80		32·52	50·44	17·92		53 50·41
	30	Bradley 2748..		"	55 27·64		30·78	....	....		55 48·67
	31	f^1 Cygni......		"	56 28·45		29·35	....	....		56 47·24
	32	B.J. 792.......		"	21 01 22·10		22·89	40·83	17·94		21 01 40·78
	33	B.J. 793.......		"	02 34·95		35·62	53·47	17·85		02 53·51
	34	f^2 Cygni......		"	03 12·53		13·43	....	....		03 31·32
	35	Groom. 3409..		"	05 31·74		34·10	....	....		05 51·99
	36	B.J. 795.......		"	06 57·43		01·14	....	....		07 19·03
	37	B.J. 798.......		"	09 12·55		13·95	31·98	....		09 31·84
	38	B.J. 799.......	r	"	10 54·91		55·56	13·46	17·90		11 13·45
	39	v Cygni......		"	13 56·14		56·72	....	....		14 14·61
	40	B.A.C. 7504...	nr	"	16 04·14		17·90	35·65	17·75		....
	41	1 H.Draconis..	L.C.,nr	"	24 09·98		04·78	22·97	18·19	17·90	....
	42	B.J. 807.......		"	25 50·45		51·32	09·23	....		26 09·22
	43	B.J. 809.......		"	27 11·22		13·46	....	....		27 31·36
	44	72 Cygni......		"	30 49·09		49·76	....	....		31 07·66
	45	B.J. 811.......		"	33 03·46		04·17	22·14	17·97		33 22·07
	46	B.J. 813.......		"	35 52·41		53·68	11·61	....		36 11·58
	47	B.J. 817.......		"	40 17·54		19·88	....	....		40 37·78
	48	78 Draconis...		"	41 39·52		42·00	....	....		41 59·90
	49	B.J. 821.......		"	43 10·87		11·83	29·73	....		43 29·73

Clamp East. 1—20. Adopted $\Delta T+m=16\cdot046+\cdot0142$ (T-21^h 40^m).
21—49. Adopted $\Delta T+m=17\cdot908+\cdot0147$ (T—22^h 10^m).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Oct. 17	1	14 Pegasi.....		N	21 45 35·25	·041	35·74	.....	....	17·90	21 45 53·64
	2	B.J. 823.......		"	48 41·56	(·770)	41·98	59·94	17·96		48 59·88
	3	79 Draconis...		"	51 24·96		27·65	.....	....		51 45·55
	4	Bradley 2897..	r	"	56 40·61		43·53	.....	....		57 01·43
	5	16 Cephei.....		"	57 39·05		41·65	.....	....		57 59·55
	6	B.J. 831.......		"	22 02 32·99		33·39	51·29	17·90	17·91	22 02 51·30
	7	B.J. 833.......	r	"	04 57·79		58·33	16·30	17·97		05 16·24
	8	B.J. 835.......		"	05 42·89		43·43	01·34	17·91		06 01·34
	9	B.J. 837.......		"	07 46·30		48·78	.....	....		08 06·69
	10	1 H.Lacertae..		"	09 44·19		44·88	.....	....		10 02·79
	11	B.A.C. 3495...	L.C.,nr	"	16 33·47		25·28	42·93	17·65		....
	12	30 H.Camel...	L.C.,nr	"	20 00·28		54·09	11·92	17·83		....
	13	B.D. 70·1240..		"	23 23·04		25·31	...	....		23 43·22
	14	B.J. 847.......		"	25 32·51		33·82	51·70	....		25 51·73
	15	B.J. 848.......		"	27 18·06		19·04	36·98	....		27 36·95
	16	29 Cephei.....		"	28 46·17		50·07	.....	....		29 07·98
	17	226 B.Cephei..		"	30 22·98		26·15	.....	....		30 44·06
	18	B.J. 851.......		"	33 14·48		17·15	.....	....		33 35·06
	19	B.J. 852.......		"	34 56·83		57·51	15·43	17·92		35 15·42
	20	B.J. 855.......	r	"	36 42·66		42·83	00·73	17·90		37 00·74
	21	B.J. 857.......		"	38 30·73		31·22	49·13	17·91		38 49·13
	22	B.J. 858.......	r	"	39 48·01		48·75	06·72	17·97	17·92	40 06·67
	23	B.J. 859.......	r	"	41 55·73		56·10	13·97	17·87		42 14·02
	24	B.J. 862.......		"	45 23·46		23·86	41·78	17·92		45 41·78
	25	52 Pegasi.....		"	54 25·95		26·14	.....	....		54 44·06
	26	B.J. 869.......		"	57 30·19		30·94	48·98	18·04		57 48·86
	27	B.J. 870.......		"	59 08·53		08·98	26·93	17·95		59 26·90
	28	5 Andromedae		"	23 03 23·42		24·37	.....	....		23 03 42·29
	29	B.J. 874.......		"	04 44·20		47·19	.....	....		05 05·11
	30	B.J. 875.......		"	08 40·10		41·35	59·41	....		08 59·27
	31	Bradley 3085..		"	11 07·40		10·16	.....	....		11 28·08
	32	Bradley 3086..		"	11 51·92		54·19	.....	....		12 12·11
	33	Groom. 4033..		"	13 50·83		53·79	.....	....		14 11·71
	34	B.J. 880......	r	"	15 54·96		55·33	13·29	17·96		16 13·25
	35	B.J. 881.......		"	20 37·32		37·68	55·61	17·93	17·93	20 55·61
	36	B.J. 885.......		"	24 20·52		20·73	38·65	17·92		24 38·66
	37	39 H. Cephei..	nr	"	27 24·85		39·23	57·27	18·04		....
	38	Bradley 3140..		"	30 47·29		49·66	.....	....		31 07·59
	39	B.J. 890.......		"	32 53·08		53·94	11·92	....		33 11·87
	40	Groom. 4119..		"	35 00·92		03·88	.....	....		35 21·81
	41	ψ Andromedae		"	41 17·94		18·80	.....	....		41 36·73
	42	B.J. 898.......		"	47 38·86		39·16	57·04	17·88		47 57·09
	43	B.J. 899.......		"	49 36·49		37·76	55·81	....		49 55·69
	44	ψ Pegasi......		"	52 54·43		54·83	.....	....		53 12·76
Oct. 18	45	σ Cygni.......		S	21 13 35·31	·048	36·04	.....	....	18·23	21 13 54·27
	46	Bradley 2796..		"	16 20·72	(·772)	24·05	.....	....		16 42·28
	47	B.J. 804.......		"	17 38·74		39·08	57·27	18·19		17 57·31
	48	69 Cygni......		"	21 49·06		49·71	.....	....		22 07·94
	49	1 H.Draconis..	L.C.,nr	"	24 10·20		04·93	23·13	18·20		....

Clamp East. 1—44. Adopted $\Delta T+m=17{\cdot}908+{\cdot}0147\ (T-22^h\ 10^m)$.
45—49. Adopted $\Delta T+m=18{\cdot}258+{\cdot}0149\ (T-23^h\ 05^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent ΔT+m	Adopted ΔT+m	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Oct. 18	1	Groom. 3511..		S	21 27 07·77	·048	12·30	....	....	18·23	21 27 30·53
	2	ρ Cygni.......		"	30 18·16	(·772)	19·05	....	....		30 37·28
	3	B.J. 811.......		"	33 03·13		03·88	22·12	18·24	18·24	33 22·12
	4	B.J. 813.......		"	35 52·03		53·27	11·58	....		36 11·51
	5	B.J. 817.......		"	40 17·09		19·38	....	....		40 37·62
	6	78 Draconis...	r	"	41 39·07		41·64	....	....		41 59·88
	7	B.J. 821.......		"	43 10·47		11·40	29·71	....		43 29·64
	8	14 Pegasi.....		"	45 34·83		35·35	....	....		45 53·59
	9	B.J. 823.......		"	48 41·21		41·66	59·92	18·26		48 59·90
	10	Bradley 2868..		"	49 47·17		48·35	....	....		50 06·59
	11	79 Draconis...		"	51 24·66		27·30	....	....		51 45·54
	12	B.J. 826.......		"	56 25·93		26·18	44·38	18·20		56 44·42
	13	16 Cephei.....		"	57 38·78		41·34	....	....		57 59·58
	14	B.J. 831.......		"	22 02 32·61		33·05	51·27	18·22		22 02 51·29
	15	B.J. 833.......		"	04 57·41		57·99	16·28	18·29		05 16·23
	16	28 Pegasi.....		"	05 58·37		58·73	....	....		06 16·97
	17	B.J. 837..		"	07 45·93		48·35	....	....		08 06·59
	18	1 H.Lacertae..		"	09 43·82		44·55	....	....		10 02·79
	19	Bradley 2942..		"	10 56·11		58·68	....	....		11 16·92
	20	B.A.C. 3495...	L.C.,nr	"	16 33·30		25·01	43·10	18·09	18·25	....
	21	30 H.Camel...	L.C.,nr	"	20 00·00		53·73	12·05	18·32		....
	22	B.D. 70·1240..		"	23 22·69		24·91	....	....		23 43·16
	23	38 Pegasi.....		"	25 37·99		38·57	....	....		25 56·82
	24	B.J. 848.......		"	27 17·71		18·66	36·96	....		27 36·91
	25	29 Cephei.....		"	28 45.90		49·72	....	....		29 07·97
	26	226 B. Cephei		"	30 22·58		25·69	....	....		30 43·94
	27	B.J. 851.......		"	33 14·24		16·87	....	....		33 35·12
	28	Groom. 3857..		"	34 58·43		01·36	....	....		35 19·61
	29	B.J. 855.......		"	36 42·26		42·47	00·72	18·25		37 00·72
	30	B.J. 857.......		"	38 30·33		30·86	49·11	18·25		38 49·11
	31	B.J. 858.......		"	39 47·61		48·39	06·70	18·31		40 06·64
	32	B.J. 859.......	r	"	41 55·32		55·68	13·96	18·28		42 13·93
	33	B.J. 862.......		"	45 23·07		23·50	41·77	18·27		45 41·75
	34	52 Pegasi.....	r	"	54 25·56		25·73	....	....	18·26	54 43·99
	35	B.J. 869.......	r	"	57 29·94		30·67	48·96	18·29		57 48·93
	36	B.J. 871.......		"	23 00 00·48		00·75	19·01	18·26		23 00 19·01
	37	5 Andromedae		"	03 23·06		23·98	....	....		03 42·24
	38	B.J. 874.......		"	04 43·80		46·73	....	....		05 04·99
	39	B.J. 875.......		"	08 39·82		41·04	59·39	....		08 59·30
	40	Bradley 3085..		"	11 07·02		09·74	....	....		11 28·00
	41	Groom. 4033..	r	"	13 50·31		53·40	....	....		14 11·66
	42	B.J. 880.......		"	15 54·60		55·01	13·28	18·27		16 13·27
	43	B.J. 881.......	r	"	20 37·01		37·36	55·61	18·25		20 55·62
	44	B.J. 885.......		"	24 20·15		20·39	38·64	18·25		24 38·65
	45	39 H.Cephei...	nr	"	27 25·33		39·88	57·11	17·23		....
	46	B.J. 890.......		"	32 52·77		53·61	11·91	....		33 11·87
	47	Groom. 4119..		"	35 00·64		03·55	....	....	18·27	35 21·82
	48	ψ Andromedae	r	"	41 17·65		18·56	....	....		41 36·83
	49	Groom. 4154..		"	47 43·51		46·48	....	....		48 04·75
	50	Groom. 4163..		"	50 09·30		12·05	....	....		50 30·32

Clamp East. 1—50. Adopted $\Delta T+m = 18{\cdot}258 + {\cdot}0149\ (T - 23^{h}\ 05^{m})$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Oct. 18	1	ψ Pegasi....		S	23 52 54·08	·048	54·52	......	......	18·27	23 53 12·79
	2	Bradley 3217..		"	0 01 03·98	(·772)	08·12	......	......		0 04 26·39
	3	B.J. 7.........		"	08 20·05		20·32	38·65	18·33		08 38·59
	4	B.J. 8.........		"	10 49·78		53·06	......	......		11 11·33
	5	σ Andromedae	r	"	13 21·11		21·71	......	......		13 39·98
	6	ρ Andromedae		"	16 06·33		07·02	......	......	18·28	16 25·30
	7	Bradley 34....		"	24 50·71		54·01	......	......		25 12·29
	8	B.J. 17........		"	31 40·74		41·83	00·20	......		32 00·11
	9	B.J. 21........		"	35 07·27		08·47	26·84	......		35 26·75
	10	B.J. 24........		"	39 24·98		27·84	......	......		39 46·12
	11	23 Cass........	r	"	41 28·08		31·08	......	......		41 49·36
	12	ν Andromedae		"	44 34·61		35·37	......	......		44 53·65
	13	32² H.Camel..	L.C.,nr	"	48 08·92		01·74	19·83	18·09		....
	14	B.J. 33........		"	51 29·11		29·81	48·15	18·34		51 48·09
	15	h Piscium.....		"	52 41·72		42·22	......	......		53 00·50
	16	43 H.Cephei...	nr	"	56 01·98		12·96	31·42	18·46	18·29	....
Oct. 19	17	B.J. 768.......		N	20 28 37·67	·036	37·84	56·44	18·60	18·60	20 28 56·44
	18	ζ Delphini....		"	30 48·86	(·751)	49·09	......	......		31 07·69
	19	B.J. 771.......	r	"	33 02·59		02·81	21·34	18·53		33 21·41
	20	29 Vulp.......		"	34 12·78		13·11	......	......		34 31·71
	21	B.J. 774.......		"	35 10·31		10·55	29·09	18·54		35 29·15
	22	B.J. 777.......		"	38 03·51		04·32	22·96	18·64		38 22·92
	23	B.J. 778.......		"	38 58·25		58·48	17·08	18·60		39 17·08
	24	B.J. 780.......		"	42 16·38		16·93	35·58	18·65		42 35·53
	25	B.J. 784.......	r	"	43 36·28		36·88	55·50	18·62		43 55·48
	26	76 Draconis....	nr	"	48 43·28		48·97	07·82	18·85	18·61	....
	27	220 H¹.Drac....	nr	"	51 17·69		22·20	......	......		51 40·81
	28	B.J. 788.......		"	53 31·04		31·74	50·40	18·66		53 50·35
	29	Bradley 2748..		"	55 26·80		29·84	......	......		55 48·45
	30	f¹ Cygni.......		"	56 27·69		28·56	......	......		56 47·17
	31	B.J. 792.......		"	21 01 21·31		22·08	40·79	18·71		21 01 40·69
	32	B.J. 793.......		"	02 34·21		34·85	53·43	18·58		02 53·46
	33	f² Cygni.......		"	03 11·80		12·67	......	......		03 31·28
	34	Groom. 3409..		"	05 30·94		33·23	......	......		05 51·84
	35	B.J. 795.......		"	06 56·59		00·18	......	......		07 18·79
	36	B.J. 798.......		"	09 11·83		13·18	31·90	......		09 31·79
	37	υ Cygni.......		"	13 55·35		55·92	......	......		14 14·53
	38	Bradley 2796..		"	16 20·23		23·52	......	......		16 42·13
	39	B.J. 804.......		"	17 38·36		38·66	57·25	18·59		17 57·27
	40	69 Cygni......		"	21 48·69		49·29	......	......		22 07·90
	41	1 H.Draconis..	L.C.,nr	"	24 09·60		04·55	23·27	18·72		....
	42	B.J. 807......		"	25 49·74		50·58	09·18	......	18·62	26 09·20
	43	72 Cygni......		"	30 48·32		48·96	......	......		31 07·58
	44	B.J. 811.......		"	33 02·78		03·46	22·10	18·64		33 22·08
	45	B.J. 813.......		"	35 51·66		52·89	11·55	......		36 11·51
	46	B.J. 817.......		"	40 16·61		18·88	......	......		40 37·50
	47	78 Draconis....	r	"	41 38·76		41·16	......	......		42 59·78
	48	B.J. 821.......		"	43 10·12		11·04	29·69	......		43 29·66
	49	14 Pegasi.....		"	45 34·50		34·97	......	......		45 53·59

Clamp East. 1—16. Adopted $\Delta T+m=18{\cdot}258+{\cdot}0149\ (T-23^{h}\ 05^{m})$.
17—49. Adopted $\Delta T+m=18{\cdot}620+{\cdot}0150\ (T-21^{h}\ 45^{m})$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Oct. 19	1	B.J. 823.......		N	21 48 40·85	·036	41·25	59·91	18·66	18·62	21 48 59·87
	2	Bradley 2868..		"	49 46·82	(·751)	47·99	.....	....		50 06·61
	3	13 Cephei.....	r	"	51 33·39		34·58	.....	....		51 53·20
	4	Bradley 2897..		"	56 39·66		42·49	.....	....		57 01·11
	5	16 Cephei.....	r	"	57 38·37		40·89	.....	....		57 59·51
	6	B.J. 831.......		"	22 02 32·19		32·58	51·26	18·68		22 02 51·20
	7	B.J. 833.......		"	04 57·10		57·63	16·27	18·64		05 16·25
	8	B.J. 835.......	r	"	05 42·17		42·70	01·31	18·61	18·63	06 01·33
	9	B.J. 837.......		"	07 45·44		47·84	.....	....		08 06·47
	10	1 H.Lacertae..		"	09 43·45		44·12	.....	....		10 02·75
	11	Bradley 2942..		"	10 55·70		58·24	.....	....		11 16·87
	12	B.A.C. 3495...	L.C.,nr	"	16 32·43		24·50	43·28	18·78		....
	13	30 H.Camel...	L.C.,nr	"	19 59·56		53·56	12·18	18·62		....
	14	B.D. 70·1240..		"	23 22·19		24·39	.....	....		23 43·02
	15	B.J. 847.......		"	25 31·67		32·94	51·65	....		25 51·57
	16	B.J. 848.......		"	27 17·28		18·23	36·94	....		27 36·86
	17	29 Cephei.....		"	28 45·35		49·14	.....	....		29 07·77
	18	226 B.Cephei..		"	30 22·31		25·39	.....	....		30 44·02
	19	B.J. 851.......		"	33 13·56		16·15	.....	....		33 34·78
	20	B.J. 852.......		"	34 56·03		56·68	15·40	18·72		35 15·31
	21	B.J. 855.......		"	36 41·92		42·09	00·71	18·62		37 00·72
	22	B.J. 857.......		"	38 29·99		30·46	49·10	18·64		38 49·09
	23	B.J. 858.......		"	39 47·28		47·99	06·68	18·69		40 06·62
	24	B.J. 859.......		"	41 54·97		55·33	13·95	18·62		42 13·96
	25	B.J. 862.......	r	"	45 22·78		23·16	41·76	18·60	18·64	45 41·80
	26	52 Pegasi.....	r	"	54 25·23		25·41	.....	....		54 44·05
	27	B.J. 869.......	r	"	57 29·54		30·27	48·95	18·68		57 48·91
	28	B.J. 870.......		"	59 07·87		08·30	26·91	18·61		59 26·94
	29	B.J. 875.......		"	23 08 39·44		40·65	59·37	....		23 08 59·29
	30	39 H.Cephei...	nr	"	27 24·66		38·61	56·96	18·35	18·65	....
Oct. 20	31	69 Cygni.. ...		S	21 21 48·16	·055	48·82	.....	....	19·03	21 22 07·85
	32	1 H.Draconis..	L.C.,rn	"	24 09·72	(·772)	04·40	23·41	19·01		....
	33	Groom. 3511..		"	27 06·83		11·40	.....	....		27 30·43
	34	72 Cygni......		"	30 47·81		48·53	.....	....		31 07·56
	35	B.J. 811.......		"	33 02·29		03·05	22·08	19·03		33 22·08
	36	B.J. 813.......		"	35 51·19		52·44	11·52	....		36 11·47
	37	B.J. 817.......		"	40 16·24		18·56	.....	....		40 37·59
	38	78 Draconis...	r	"	41 38·13		40·73	.....	....		41 59·76
	39	14 Pegasi.....		"	45 34·00		34·53	.....	....		45 53·56
	40	B.J. 823.......		"	48 40·32		40·78	59·89	19·11		48 59·81
	41	Bradley 2868..		"	49 46·32		47·51	.....	....		50 06·54
	42	79 Draconis...		"	51 23·73		26·39	.....	....	19·04	51 45·43
	43	Bradley 2897..		"	56 39·29		42·18	.....	....		57 01·22
	44	16 Cephei.....	r	"	57 37·68		40·41	.....	....		57 59·45
	45	B.J. 831.......		"	22 02 31·75		32·19	51·24	19·05		22 02 51·23
	46	B.J. 833.......		"	04 56·57		57·16	16·25	19·09		05 16·20
	47	B.J. 835.......	r	"	05 41·69		42·22	01·29	19·07		06 01·26
	48	B.J. 837.......		"	07 44·92		47·37	.....	....		08 06·41
	49	1 H.Lacertae..		"	09 42·94		43·68	.....	....		10 02·72

Clamp East. 1—30. Adopted $\Delta T+m=18{\cdot}620+{\cdot}0150\ (T-21^{h}\ 45^{m})$.
31—49. Adopted $\Delta T+m=19{\cdot}055+{\cdot}0151\ (T-23^{h}\ 10^{m})$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Oct. 20	1	Bradley 2942..		S	22 10 55·22	·055	57·81	.....	....	19·04	22 11 16·85
	2	B.A.C. 3495...	L.C.,rn	"	16 32·69	(·772)	24·33	43·46	19·13		....
	3	30 H.Camel...	L.C.,rn	"	19 59·50		53·18	12·32	19·14		....
	4	52 Pegasi.....		"	54 24·75		24·97	....	....	19·05	54 44·02
	5	B.J. 869......		"	57 29·05		29·85	48·94	19·09		57 48·90
	6	B.J. 871.......		"	59 59·69		59·97	18·99	19·02		23 00 19·02
	7	5 Andromedae		"	23 03 22·28		23·21	.....	....		03 42·26
	8	B.J. 874.......		"	04 42·99		45·95	.....	....		05 05·00
	9	B.J. 875... ...		"	08 39·03		40·26	59·35	....		08 59·31
	10	Bradley 3085..		"	11 06·22		08·96	.....	....	19·06	11 28·02
	11	Groom. 4033..	r	"	13 49·39		52·50	.....	....		14 11·56
	12	B.J. 880.......		"	15 53·81		54·23	13·26	19·03		16 13·29
	13	B.J. 881.......		"	20 36·15		36·56	55·59	19·03		20 55·62
	14	B.J. 885.......		"	24 19·31		19·55	38·63	19·08		24 38·61
	15	39 H. Cephei..	rn	"	27 23·85		38·52	56·80	18·28		....
	16	Bradley 3140..		"	30 46·24		48·59	.....	....		31 07·65
	17	B.J. 890.......	r	"	32 51·86		52·77	11·89	....		33 11·83
	18	Groom. 4119..		"	34 59·85		02·79	.....	....		35 21·85
	19	ψ Andromedae		"	41 16.90		17·74	.....	....		41 36·80
	20	Groom. 4154..		"	47 42·71		45·70	.....	....		48 04·76
	21	Groom. 4163..		"	50 08·38		11·15	.....	....	19.07	50 30·22
	22	ψ Pegasi......		"	52 53·32		53·76	.....	....		53 12·83
	23	Bradley 3217..		"	0 04 03·04		07·22	.....	....		0 04 26·29
	24	B.J. 4.........		"	05 21·18		22·02	41·08	....		05 41·09
	25	B.J. 7.........		"	08 19·30		19·58	38·64	19·06		08 38·65
	26	B.J. 8.........		"	10 48·97		52·28	.....	....		11 11·35
	27	σ Andromedae		"	13 20·30		20·96	.....	....		13 40·03
	28	ρ Andromedae	r	"	16 05·70		06·34	.....	....		16 25·41
	29	Bradley 34....		"	24 49·99		53·32	.....	....		25 12·39·
	30	B.J. 17........		"	31 39·99		41·09	00·09	....	19·08	32 00·17
	31	B.J. 20........		"	34 13·88		14·43	33·51	19·08		34 33·51
	32	B.J. 21........		"	35 06·41		07·62	26·83	....		35 26·70
	33	B.J. 24........		"	39 24·32		27·21	.....	....		39 46·29
	34	B.D. 71·37....		"	41 58·34		00·83	.....	....		42 19·91
	35	η Cassiopeiae..	r	"	43 22·22		23·57	.....	....		43 42·65
	36	ν Andromedae		"	44 33·83		34·60	.....	....		44 53·68
	37	B.J. 33........		"	51 28·38		29·09	48·16	19·07		51 48·17
	38	h Piscium.....		"	52 40·95		41·46	.....	....		53 00·54
	39	43 H. Cephei..	rn	"	56 00·70		11·77	31·44	19·67		....
Oct. 21	40	13 Cephei.....		S	21 51 32·52	·062	33·77	.....	....	19·40	21 51 53·17
	41	Bradley 2897..	r	"	56 38·58	(·793)	41·75	.....	....		57 01·15
	42	16 Cephei.....		"	57 37·36		40·02	.....	....		57 59·42
	43	B.J. 831.......		"	22 02 31·35		31·80	51·23	19·43	19·41	22 02 51·21
	44	B.J. 833.......	r	"	04 56·24		56·80	16·24	19·44		05 16·21
	45	28 Pegasi.....		"	05 57·17		57·55	.....	....		06 16·96
	46	B.J. 837.......		"	07 44·58		47·12	.....	....		08 06·53
	47	1 H.Lacertae..		"	09 42·57		43·34	.....	....		10 02·75
	48	Bradley 2942..		"	10 54·70		57·39	.....	....		11 16·80
	49	B.A.C. 3495...	L.C.,nr	"	16 32·73		24·06	43·65	19·59		....

Clamp East.

1—39. Adopted $\Delta T+m=19{\cdot}055+{\cdot}0151\ (T-23^{h}\ 10^{m})$.
40—49. Adopted $\Delta T+m=19{\cdot}426+{\cdot}0152\ (T-23^{h}\ 25^{m})$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Oct. 21	1	30 H.Camel	L.C.,nr	S	22 19 59·63	·062	53·08	12·47	19·39	19·41	....
	2	B.D. 70·1240		"	23 21·35	(·793)	23·67				22 23 43·08
	3	38 Pegasi		"	25 36·81		37·42				25 56·83
	4	B.J. 848		"	27 16·40		17·41	36·90			27 36·82
	5	226 B. Cephei		"	30 21·22		24·48				30 43·89
	6	Groom. 3857		"	34 57·06		00·13				35 19·54
	7	B.J. 855	r	"	36 41·08		41·25	00·69	19·41		37 00·66
	8	B.J. 858	r	"	39 46·45		47·21	06·65	19·44		40 06·62
	9	B.J. 859	r	"	41 54·14		54·52	13 92	19·40	19·42	42 13·94
	10	B.J. 862		"	45 21·87		22·32	41·74	19·42		45 41·74
	11	52 Pegasi		"	54 24·32		24·56				54 43·98
	12	B.J. 869		"	57 28·65		29·48	48·92	19·44		57 48·90
	13	B.J. 870		"	59 06·97		07·48	26·89	19·41		59 26·90
	14	5 Andromedae		"	23 03 21·82		22·79				23 03 42·21
	15	B.J. 874	r	"	04 42·30		45·54				05 01·96
	16	B.J. 875		"	08 38·50		39·78	59·33			08 59·20
	17	Bradley 3085		"	11 05·60		08·44				11 27·86
	18	Groom. 4033		"	13 48·99		52·04				14 11·46
	19	B.J. 880	r	"	15 53·45		53·83	13·26	19·43		16 13·25
	20	B.J. 881		"	20 35·74		36·16	55·59	19·43		20 55·58
	21	B.J. 885		"	24 18·94		19·19	38·62	19·43	19·43	24 38·62
	22	1 H. Cass		"	25 34·05		35·40				25 54·83
	23	15Andromedae		"	29 55·41		56·19				30 15·62
	24	B.J. 890		"	32 51·52		52·40	11·88			33 11·83
	25	κ Andromedae		"	35 40·51		41·40				36 00·83
	26	ψ Andromedae	r	"	41 16·39		17·34				41 36·77
	27	Groom. 4154		"	47 42·07		45·17				48 04·60
	28	Groom. 4163		"	50 07·87		10·74				50 30·17
	29	ψ Pegasi		"	52 52·94		53·39				53 12·82
	30	Bradley 3217		"	0 04 02·49		06·82			19·44	0 04 26·26
	31	B.J. 4		"	05 20·74		21·61	41·07			05 41·05
	32	B.J. 7		"	08 18·92		19·21	38·64	19·43		08 38·65
	33	B.J. 8		"	10 48·45		51·88				11 11·32
	34	σ Andromeda	r	"	13 19·99		20·62				13 40·06
	35	ρ Andromedae		"	16 05·18		05·90				16 25·34
	36	Bradley 34		"	24 49·48		52·93				25 12·37
	37	B.J. 17		"	31 39·50		40·64	00·18			32 00·08
	38	B.J. 19		"	33 30·57		31·11	50·56	19·45		33 50·55
	39	B.J. 21	r	"	35 06·07		07·41	26·82			35 26·85
	40	B.J. 25		"	39 24·89		25·83	45·33			39 45·27
	41	23 Cass		"	41 26·91		29·86			19·45	41 49·31
	42	η Cass		"	43 21·83		23·15				43 42·60
	43	ν Andromedae		"	44 33·44		34·24				44 53·69
	44	32² H. Camel	L.C.,nr	"	48 07·83		00·32	19·98	19·66		....
	45	B.J. 33		"	51 27·98		28·71	48·16	19·45		51 48·16
	46	*h* Piscium		"	52 40·55		41·08				53 00·53
	47	43 H. Cephei	nr	"	56 00·26		11·72	31·43	19·71		....
Oct. 26	48	B.J. 768	....	N	20 28 34·66	·022	34·84	56·33	21·49	21·47	20 28 56·31
	49	ζ Delphini	....	"	30 45·87	(·818)	46·10				31 07·57

Clamp East. 1—47. Adopted $\Delta T+m=19\cdot426+\cdot0152$ $(T-23^h\ 25^m)$.
48—49. Adopted $\Delta T+m=21\cdot488+\cdot0158$ $(T-21^h\ 35^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Oct. 26	1	29 Vulp.......		N	20 34 09·80	·022	10·13	.....	......	21·47	20 34 31·60
	2	B.J. 774.......		"	35 07·30	(·818)	07·55	28·98	21·43		35 29·02
	3	B.J. 777.......		"	38 00·46		01·32	22·78	21·46		38 22·79
	4	B.J. 778.......		"	38 55·30		55·53	16·97	21·44		39 17·00
	5	B.J. 780.......	r	"	42 13·37		13·95	35·44	21·49		42 35·42
	6	B.J. 784.......		"	43 33·18		33·81	55·36	21·55		43 55·28
	7	76 Draconis...		"	48 38·93		45·01	06·54	21·53	21·48	....
	8	220 H[1]. Drac..	nr	"	51 13·67		18·50	.....	......		51 39·98
	9	B.J. 788.......		"	53 27·90		28·64	50·24	21·60		53 50·12
	10	Bradley 2748..		"	55 23·30		26·54	....	....		55 48·02
	11	f^1 Cygni.......		"	56 24·59		25·51	....	....		56 46·99
	12	υ Cygni.......		"	21 13 52·29		52·88	.....	....		21 14 14·36
	13	B.J. 804.......		"	17 35·31		35·62	57·14	21·52		17 57·10
	14	69 Cygni......		"	21 45·64		46·27	.....	......		22 07·75
	15	1 H.Draconis..	L.C.	"	24 08·25		02·84	24·48	21·64	21·49	....
	16	B.J. 807.......		"	25 46·63		47·52	09·01	......		26 09·01
	17	B.J. 809.......		"	27 06·91		09·23	.....	....		27 30·72
	18	ρ Cygni.......		"	30 14·70		15·57	.....	......		30 37·06
	19	B.J. 811.......		"	32 59·73		00·46	21·96	21·50		33 21·95
	20	B.J. 813.......		"	35 48·42		49·72	11·32	......		36 11·21
	21	B.J. 816.......	r	"	40 13·99		14·40	35·91	21·51		40 35·89
	22	B.J. 821.......		"	43 07·02		08·00	29·52	....		43 29·49
	23	14 Pegasi.....		"	45 31·42		31·92	.....	....		45 53·41
	24	B.J. 831.......		"	22 02 29·27		29·68	51·16	21·48	21·50	22 02 51·18
	25	B.J. 833.......	r	"	04 54·06		54·61	16·16	21·55		05 16·11
	26	B.J. 835.......		"	05 39·16		39·71	01·20	21·49		06 01·21
	27	B.J. 836.......		"	07 22·60		23·93	45·42	....		07 45·43
	28	1 H.Lacertae..		"	09 40·45		41·15	.....	....		10 02·65
	29	B.A.C. 3495...	L.C.,nr	"	16 31·81		23·30	44·86	21·56		....
	30	30 H.Camel...	L.C.,nr	"	19 58·47		52·04	13·39	21·35		....
	31	B.J. 847.......		"	25 28·60		29·96	51·46	....		25 51·46
	32	B.J. 848.......		"	27 14·27		15·28	36·80	....		27 36·78
	33	B.J. 852.......		"	34 53·13		53·81	15·29	21·48		35 15·31
	34	B.J. 855.......	r	"	36 39·00		39·17	00·64	21·47		37 00·67
Nov. 2	35	B.J. 836.......		N	22 07 19·64	·018	20·90	45·20	....	24·38	22 07 45·28
	36	1 H.Lacertae..		"	09 37·52	(·769)	38·18	.....	....		10 02·56
	37	Bradley 2942..		"	10 49·31		51·84	.....	....		11 16·22
	38	B.A.C. 3495...	L.C.,nr	"	16 29·45		21·52	46·43	24·91		....
	39	30 H.Camel...	L.C.,nr	"	19 56·00		50·00	14·57	24·57		....
	40	B.D. 70·1240..		"	23 15·96		18·15	.....	....		23 42·53
	41	B.J. 847.......		"	25 25·67		26·94	51·25	....		25 51·32
	42	B.J. 848.......		"	27 11·31		12·26	36·64	....	24·39	27 36·65
	43	29 Cephei.....		"	28 38·84		42·63	.....	....		29 07·02
	44	226 B.Cephei..		"	30 15·70		18·77	.....	....		30 43·16
	45	B.J. 851.......		"	33 07·34		09·93	.....	....		33 34·32
	46	B.J. 852.......		"	34 50·18		50·83	15·17	24·34		35 15·22
	47	B.J. 855.......		"	36 36·07		36·22	00·56	24·34		37 00·61
	48	B.J. 857.......		"	38 24·14		24·60	48·92	24·32		38 48·99
	49	B.J. 858.......		"	39 41·31		42·02	06·46	24·44		40 06·41

Clamp East.

1—34. Adopted $\Delta T+m = 21{\cdot}488 + {\cdot}0158\ (T - 21^h\ 35^m)$.
35—49. Adopted $\Delta T+m = 24{\cdot}408 + {\cdot}0165\ (T - 23^h\ 50^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T + m$	Adopted $\Delta T + m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Nov. 2	1	B.J. 859		N	22 41 49·09	·018	49·44	13·78	24·34	24·39	22 42 13·83
	2	B.J. 862	r	"	45 16·81	(·769)	17·18	41·60	24·42		45 41·57
	3	B.J. 869	r	"	57 23·62		24·34	48·75	24·41		57 48·73
	4	B.J. 870		"	59 01·97		02·39	26·75	24·36		59 26·78
	5	B.J. 871		"	59 54·31		54·52	18·87	24·35		23 00 18·91
	6	5 Andromedae		"	23 03 16·73		17·64	.....	......	24·40	03 42·04
	7	B.J. 874		"	04 36·85		39·75		.....		05 04·15
	8	B.J. 875		"	08 33·41		34·62	59·08			08 59·02
	9	Bradley 3085		"	11 00·10		02·78				11 27·18
	10	Groom. 4033	r	"	13 43·51		46·39				14 10·79
	11	B.J. 880		"	15 48·37		48·72	13·15	24·43		16 13·12
	12	B.J. 881	r	"	20 30·69		31·03	55·49	24·46		20 55·43
	13	B.J. 885		"	24 13·96		14·14	38·54	24·40		24 38·54
	14	39 H.Cephei	nr	"	27 15·36		29·33	53·51	24·18		....
	15	Bradley 3140.		"	30 40·35		42·64				31 07·04
	16	B.J. 890		"	32 46·43		47·25	11·73	......		33 11·65
	17	κ Andromedae		"	35 35·48		36·25				36 00·65
	18	ψ Andromedae		"	41 11·40		12·22			24·41	41 36·63
	19	Groom. 4154		"	47 36·75		39·69				48 04·10
	20	Groom. 4163		"	50 02·62		05·33				50 29·74
	21	ψ Pegasi		"	52 47·94		48·31				53 12·72
	22	B.J. 1		"	0 03 21·70		22·14	46·55	24·41		0 03 46·55
	23	B.J. 2		"	03 59·26		00·56	25·07			04 24·97
	24	B.J. 4		"	05 15·66		16·47	40·98			05 40·88
	25	B.J. 7		"	08 13·94		14·15	38·60	24·45		08 38·56
	26	B.J. 8		"	10 43·15		46·39				11 10·80
	27	Bradley 1672	L.C.	"	14 05·63		42·33	06·79	24·46		....
	28	Bradley 34		"	24 44·16		47·42			24·42	25 11·84
	29	B.J. 18		"	31 42·01		42·54	07·00	24·46		32 06·96
	30	B.J. 19		"	33 25·63		26·07	50·54	24·47		33 50·49
	31	B.J. 20		"	34 08·59		09·06	33·49	24·43		34 33·48
	32	B.J. 21		"	35 01·11		02·30	26·75	......		35 26·72
	33	B.J. 24		"	39 18·76		21·58				39 46·00
	34	23 Cass	r	"	41 21·87		24·66				41 49·08
	35	η Cass		"	43 16·87		18·11				43 42·53
	36	ν Andromedae		"	44 28·59		29·28				44 53·70
	37	32² H. Camel.	L.C.,nr	"	48 03·43		56·56	20·78	24·22		... ...
	38	B.J. 33		"	51 23·04		23·67	48·16	24·49		51 48·09
	39	h Piscium		"	52 35·67		36·11			24·43	53 00·54
	40	43 H.Cephei	nr	"	55 54·99		05·53	30·60	25·07		....
	41	72 Piscium		"	59 58·35		58·56				1 00 22·99
	42	μ Cass		"	1 01 54·57		55·69				02 20·12
	43	B.J. 42		"	04 19·29		19·86	44·32	24·46		04 44·29
	44	B.J. 43		"	06 20·00		20·46	44·94	24·48		06 44·89
	45	Bradley 151		"	09 20·81		23·12				09 47·55
Nov. 4	46	5 Andromedae		N	23 03 15·95	·049	16·81			25·12	23 03 41·93
	47	B.J. 874		"	04 36·07	(·686)	38·79				05 03·91
	48	B.J. 875		"	08 32·64		33·77	59·04			08 58·89
	49	Bradley 3086		"	11 44·04		46·10				12 11·22

Clamp East.

1—45. Adopted $\Delta T+m=24{\cdot}408+{\cdot}0165\ (T-23^h\ 50^m)$.

46—49. Adopted $\Delta T+m=25{\cdot}129+{\cdot}0168\ (T-23^h\ 40^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Nov. 4	1	o Cephei......		N	23 14 30·65	·049	32·44	......	......	25·12	23 14 57·56
	2	B.J. 880.......		"	15 47·65	(·686)	48·00	13·13	25·13		16 13·12
	3	B.J. 881.......	r	"	20 30·00		30·34	55·47	25·13		20 55·46
	4	B.J. 885.......		"	24 13·19		13·38	38·52	25·14		24 38·50
	5	39 H. Cephei..	nr	"	27 14·75		27·78	53·03	25·25	25·13	....
	6	Bradley 3140..		"	30 39·53		41·68	......	......		31 06·81
	7	B.J. 890.......		"	32 45·69		46·48	11·71	......		33 11·61
	8	B.J. 891.......		"	33 19·57		20·27	45·50	25·23		33 45·40
	9	B.J. 893.......		"	35 13·25		16·45	......	......		35 41·58
	10	ψ Andromedae	r	"	41 10·67		11·46	......	......		41 36·59
	11	B.J. 895.......	r	"	43 11·84		13·60	......	......		43 38·73
	12	B.J. 898.......		"	47 31·58		31·86	56·94	25·08		47 56·99
	13	B.J. 899.......		"	49 29·14		30·29	55·55	......		49 55·42
	14	ψ Pegasi......		"	52 47·24		47·62	......	......		53 12·75
	15	B.J. 1.........		"	0 03 20·96		21·40	46·54	25·14	25·14	0 03 46·54
	16	B.J. 7.........		"	08 13·28		13·51	38·59	25·08		08 38·65
	17	σ Andromedae		"	13 14·21		14·78	......	......		13 39·92
	18	ρ Andromedae	r	"	15 59·50		00·10	......	......		16 25·24
Nov. 8	19	B.J. 851.......		S	22 33 04·35	·055	06·97	......	......	26·88	22 33 33·85
	20	B.J. 853.......		"	35 00·33	(·765)	01·91	......	......		35 28·79
	21	B.J. 855.......		"	36 33·38		33·59	00·49	26·90		37 00·47
	22	B.J. 857.......		"	38 21·41		21·94	48·84	26·90		38 48·82
	23	B.J. 858.......	r	"	39 38·72		39·44	06·35	26·91		40 06·32
	24	B.J. 859.......		"	41 46·39		46·81	13·71	26·90		42 13·69
	25	B.J. 863.......		"	46 01·31		03·08	......	......		46 29·96
	26	52 Pegasi......	r	"	54 16·73		16·91	......	......		54 43·79
	27	B.J. 869.......		"	57 20·88		21·68	48·65	26·97	26·89	57 48·57
	28	B.J. 871.......		"	59 51·66		51·94	18·81	26·87		23 00 18·83
	29	B.J. 874.......	r	"	23 04 33·86		36·98	......	......		05 03·87
	30	B.J. 875.......		"	08 30·73		31·95	58·94	......		08 58·84
	31	Bradley 3085..		"	10 57·34		00·05	......	......		11 26·94
	32	o Cephei.......		"	14 28·64		30·58	......	......		14 57·47
	33	B.J. 880.......	r	"	15 45·83		46·19	13·09	26·90		16 13·08
	34	B.J. 881.......		"	20 28·12		28·53	55·43	26·90		20 55·42
	35	B.J. 885.......		"	24 11·37		11·61	38·49	26·88		24 38·50
	36	39 H. Cephei..	nr	"	27 10·86		25·40	51·78	26·38		....
	37	B.J. 890.......	r	"	32 43·80		44·71	11·65	......	26·90	33 11·61
	38	Groom. 4119..		"	34 51·02		53·93	......	......		35 20·83
	39	B.J. 895.......		"	43 09·86		11·77	......	......		43 38·67
	40	B.J. 898.......		"	47 29·64		29·98	56·91	26·93		47 56·88
	41	B.J. 899.......		"	49 27·27		28·51	55·48	......		49 55·41
	42	ψ Pegasi......		"	52 45·37		45·81	......	......		53 12·71
	43	Bradley 3217..		"	0 03 54·22		58·36	......	......		0 04 25·26
	44	B.J. 7.........		"	08 11·35		11·63	38·57	26·94	26·91	08 38·54
	45	B.J. 8.........		"	10 40·41		43·69	......	......		11 10·60
	46	σ Andromedae		"	13 12·29		12·95	......	......		13 39·86
	47	ρ Andromedae	r	"	15 57·71		58·35	......	......		16 25·26
	48	Bradley 34....		"	24 41·52		44·82	......	......		25 11·73
	49	B.J. 16........		"	27 27·30		28·84	......	......		27 55·75

Clamp East

1—18. Adopted $\Delta T+m=25{\cdot}129+{\cdot}0168\ (T-23^h\ 40^m)$.

19—49. Adopted $\Delta T+m=26{\cdot}909+{\cdot}0172\ (T-0^h\ 20^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent ΔT + m	Adopted ΔT + m	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Nov. 8	1	B.J. 17........		S	0 31 32·03	·055	33·12	00·05	......	26·91	0 32 00·03
	2	B.J. 19........		"	33 23·07	(·765)	23·58	50·53	26·95		33 50·49
	3	B.J. 21........		"	35 58·57		59·77	26·69	......		36 26·68
	4	B.J. 24........	r	"	39 15·76		18·79	......	......		39 45·70
	5	23 Cass.......		"	41 19·22		22·05	......	......	26·92	41 48·97
	6	η Cass........	r	"	43 14·23		15·57	......	......		43 42·49
	7	B.J. 29........	r	"	44 50·21		51·93	......	......		45 18·85
	8	32² H.Camel.	L.C.,nr	"	48 01·46		54·28	21·34	27·06		....
	9	B.J. 32........		"	50 51·23		52·64	......	......		51 19·56
	10	h Piscium.....		"	52 33·12		33·62	......	......		53 00·54
	11	43 H.Cephei...	nr	"	55 51·70		02·68	30·00	27·32		....
	12	72 Piscium....		"	59 55·80		56·08	......	......		1 00 23·00
	13	μ Cass........		"	1 01 52·18		53·31	......	......		02 20·23
	14	B.J. 41........		"	04 03·17		07·31	......	......		04 34·23
	15	χ Piscium.....		"	06 12·38		12·74	......	......		06 39·66
	16	Bradley 137...	r	"	08 06·15		10·63	......	......		08 37·55
	17	Bradley 155...		"	12 23·65		27·10	......	......		12 54·02
	18	Bradley 166...		"	15 24·75		28·55	......	......		15 55·47
	19	ξ Andromedae		"	16 37·52		38·40	......	......	26·93	17 05·33
	20	B.J. 46........		"	19 09·23		11·17	......	......		19 38·10
	21	α Urs. Min....	nr	"	26 43·75		23·41	51·05	27·64		....
	22	υ Andromedae		"	31 06·02		06·80	......	......		31 33·73
	23	τ Andromedae		"	34 51·26		52·01	......	......		35 18·94
	24	B.J. 57........		"	37 36·34		37·32	04·30	......		38 04·25
	25	2 Persei.......	r	"	46 00·99		02·05	......	......		46 28·98
	26	γ Arietis.....		"	48 11·08		11·42	......	......		48 38·35
	27	B.J. 66........		"	49 15·68		16·04	42·96	26·92		49 42·97
	28	λ Arietis......	r	"	52 30·38		30·74	......	......	26·94	52 57·68
	29	48 Cass.......		"	54 08·84		11·08	......	......		54 38·02
	30	B.J. 70........		"	55 19·99		22·43	......	......		55 49·37
	31	Groom. 424....	rn	"	57 53·33		58·38	......	......		58 25·32
	32	B.J. 74........		"	2 01 41·59		42·01	08·92	26·91		2 02 08·95
	33	Bradley 282...		"	04 38·77		41·46	......	......		05 08·40
Nov. 9	34	14 Pegasi.....		N	21 45 25·61	·041	26·13	......	......	27·15	21 45 53·28
	35	B.J. 823.......		"	48 31·96	(·822)	32·40	59·58	27·18		48 59·55
	36	Bradley 2868..	r	"	50 37·63		38·92	......	......		51 06·07
	37	13 Cephei.....		"	51 24·08		25·38	......	......		51 52·53
	38	Bradley 2897..		"	56 29·49		32·59	......	......		56 59·74
	39	16 Cephei.....	r	"	57 28·33		31·10	......	......		57 58·25
	40	B.J. 833.......	r	"	22 04 48·15		48·73	15·92	27·19	27·16	22 05 15·89
	41	B.J. 835.......		"	05 33·12		33·70	00·96	27·26		06 00·86
	42	B.J. 837.......		"	07 35·46		38·09	......	......		08 05·25
	43	1 H.Lacertae..		"	09 34·49		35·22	......	......		10 02·38
	44	B.A.C. 3495...	L.C.,rn	"	16 29·53		20·79	48·19	27·40		....
	45	30 H.Camel...	L.C.,rn	"	19 55·62		49·01	15·92	26·91		....
	46	B.D. 70·1240..		"	23 12·36		14·77	......	......		23 41·93
	47	B.J. 847.......		"	25 22·43		23·82	51·04	......		25 50·98
	48	B.J. 848.......		"	27 08·24		09·28	36·47	......		27 36·44
	49	226 B.Cephei..		"	30 11·88		15·26	......	......		30 42·42

Clamp East. 1—33. Adopted $\Delta T+m=26{\cdot}909+{\cdot}0172\ (T-0^h\ 20^m)$.
34—49. Adopted $\Delta T+m=27{\cdot}177+{\cdot}0173\ (T-23^h\ 20^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Nov. 9	1	B.J. 851.......		N	22 33 03·85	·041	06·69	.....	.....	27·16	22 33 33·85
	2	B.J. 852.......		"	34 47·18	(·822)	47·90	15·05	27·15		35 15·06
	3	B.J. 855.......	r	"	36 33·12		33·30	00·48	27·18		37 00·46
	4	B.J. 857.......		"	38 21·17		21·69	48·82	27·13		38 48·85
	5	B.J. 858.......	r	"	39 38·32		39·10	06·33	27·23	27·17	40 06·27
	6	B.J. 859.......	r	"	41 46·18		46·57	13·69	27·12		42 13·74
	7	B.J. 862.......		"	45 13·93		14·35	41·51	27·16		45 41·52
	8	52 Pegasi.....		"	54 16·46		16·66	.....	.....		54 43·83
	9	B.J. 869.......		"	57 20·55		21·35	48·63	27·28		57 48·52
	10	B.J. 870.......		"	58 58·99		59·47	26·67	27·20		59 26·64
	11	B.J. 871.......		"	59 51·43		51·68	18·79	27·11		23 00 18·85
	12	5 Andromedae		"	23 03 13·68		14·69	...	....		03 41·86
	13	B.J. 874.......	r	"	04 33·44		36·62		....		05 03·79
	14	B.J. 875.......		"	08 30·29		31·62	58·92	....		08 58·79
	15	Bradley 3085..		"	10 56·80		59·74	.....	....		11 26·91
	16	Bradley 3086..		"	11 41·61		44·03	.....	....		12 11·20
	17	Groom. 4033..		"	13 40·16		43·31	.....	....	27·18	14 10·49
	18	B.J. 880.......	r	"	15 45·51		45·90	13·07	27·17		16 13·08
	19	B.J. 881.......		"	20 27·82		28·21	55·42	27·21		20 55·39
	20	B.J. 885.......		"	24 11·09		11·31	38·48	27·17		24 38·49
	21	39 H.Cephei...	rn	"	27 09·61		24·93	51·42	26·49		....
	22	15 Androm....		"	29 47·47		48·21	.....	....		30 15·39
	23	B.J. 890.......		"	32 43·51		44·43	11·63	....		33 11·61
	24	B.J. 891.......		"	33 17·47		18·29	45·43	27·14		33 45·47
	25	κ Andromedae		"	35 32·52		33·37	.....	....		36 00·55
	26	ψ Andromedae	r	"	41 08·54		09·46	.....	....		41 36·64
	27	B.J. 895.......		"	43 09·37		11·43	.....	....		43 38·61
	28	Groom. 4154..		"	47 33·43		36·65	.....	....		48 03·83
	29	Groom. 4163..		"	49 59·36		02·34	.....	....	27·19	50 29·53
	30	ψ Pegasi......		"	52 45·10		45·53	.....	....		53 12·72
	31	B.J. 1.........		"	0 03 18·76		19·26	46·50	27·24		0 03 46·45
	32	B.J. 2.........		"	03 56·34		57·77	24·94	....		04 24·96
	33	B.J. 4.........		"	05 12·81		13·72	40·91	....		05 40·91
	34	B.J. 7.........		"	08 11·12		11·37	38·56	27·19		08 38·56
	35	B.J. 8.........		"	10 39·94		43·50	.....	....		11 10·69
	36	σ Andromedae	r	"	13 12·14		12·80	.....	....		13 39·99
	37	ρ Andromedae		"	15 57·38		58·07	.....	....		16 25·26
	38	Bradley 34....		"	24 40·91		44·49	.....	....	27·20	25 11·69
	39	B.J. 16........	r	"	27 26·92		28·59	.....	....		27 55·79
	40	B.J. 17........		"	31 31·60		32·78	00·04	....		31 59·98
	41	B.J. 19........		"	33 22·82		23·32	50·51	27·19		33 50·52
	42	B.J. 20........		"	34 05·73		06·26	33·46	27·20		34 33·46
	43	B.J. 21........		"	34 58·22		59·52	26·68	....		35 26·72
	44	B.J. 24........	r	"	39 15·46		18·56	.....	....		39 45·76
	45	23 Cass.......		"	41 18·77		21·83	.....	....		41 49·03
	46	B.J. 27........		"	42 09·14		09·55	36·67	27·12		42 36·75
	47	η Cass.........		"	43 13·95		15·31	.....	....		43 42·51
	48	ν Andromedae		"	44 25·70		26·47	.....	....		44 53·67
	49	32² H.Camel..	L.C.,rn	"	48 02·11		54·53	21·46	26·93		....
	50	B.J. 33........		"	51 20·22		20·92	48·13	27·21		51 48·12

Clamp East. 1—50. Adopted $\Delta T+m=27\cdot177+\cdot0173$ (T-23^h 20^m).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Nov. 9	1	*h* Piscium.....		N	0 52 32·87	·041	33·36	...	....	27·20	0 53 00·56
	2	43 H.Cephei...	rn	"	55 51·08	(·822)	02·64	29·85	27·21		....
Nov. 20	3	38 Pegasi.....		S	22 25 56·98	−·038	57·42	...	....	−1·10	22 25 56·32
	4	B.J. 848.......		"	27 36·53	(·709)	37·28	36·19	....		27 36·18
	5	29 Cephei.....		"	29 02·82		06·04		......		29 04·94
	6	226 B.Cephei..		"	30 40·07		42·67	...	....		30 41·57
	7	B.J. 851.......		"	33 31·95		34·13	...	....		33 33·03
	8	Groom. 3857..		"	35 16·07		18·52	...	......		35 17·42
	9	B.J. 855......	r	"	37 01·43		01·52	00·35	−1·17		37 00·42
	10	B.J. 857.......		"	38 49·37		49·76	48·65	−1·11		38 48·66
	11	B.J. 858.......		"	40 06·58		07·19	06·12	−1·07		40 06·09
	12	B.J. 859.......		"	42 14·33		14·63	13·54	−1·09		42 13·53
	13	B.J. 863.......		"	46 29·12		30·56	...	.....		46 29·46
	14	52 Pegasi.....		"	54 44·63		41·77	...	.....		54 43·67
	15	B.J. 869......	r	"	57 48·90		49·47	48·43	−1·04		57 48·37
	16	B.J. 871.......		"	23 00 19·55		19·73	18·67	−1·06		23 00 18·63
	17	5 Andromedae		"	03 42·02		42·74	...	.....		03 41·64
	18	B.J. 874.......	r	"	05 01·49		04·12	...	....		05 03·02
	19	B.J. 875.......		"	08 58·71		59·69	58·63	....		08 58·59
	20	Bradley 3085..		"	11 25·17		27·43	...	....		11 26·33
	21	Groom. 4033..		"	14 08·40		10·83	...	.....		14 09·73
	22	B.J. 880.......	r	"	16 13·80		14·05	12·95	−1·10		16 12·95
	23	B.J. 882.......		"	20 51·92		53·13	...	....		20 52·03
	24	B.J. 885.......		"	24 39·33		39·49	38·36	−1·13		24 38·39
	25	39 H.Cephei...	rn	"	27 36·47		48·93	47·84	−1·09		....
	26	B.J. 890.......	r	"	33 11·83		12·55	11·45	....		33 11·45
	27	κ Andromedae		"	36 00·85		01·52	...	....		36 00·42
	28	ψ Andromedae		"	41 36·87		37·52	...	.....		41 36·42
	29	B.J. 895.......		"	43 37·82		39·38	...	......		43 38·28
	30	Groom. 4154..		"	48 01·82		04·30	...	......		48 03·20
	31	Groom. 4163..		"	50 27·77		30·06	...	......		50 28·96
	32	ψ Pegasi......		"	53 13·36		13·69	...	....	−1·11	53 12·58
	33	Bradley 3217..		"	0 04 21·84		25·32	...	....		0 04 24·21
	34	B.J. 7.........		"	08 39·41		39·59	38·48	−1·11		08 38·48
	35	σ Andromedae	r	"	13 40·47		40·92	...	....		13 39·81
	36	ρ Andromedae		"	16 25·72		26·26	...	.....		16 25·15
Nov. 27	37	B.A.C. 3495...	L.C.,nr	S	22 17 01·05	−·041	54.30	52·95	−1·35	−1·49	....
	38	30 H.Camel...	L.C.,nr,	"	20 26·08	(·684)	20·97	19·55	−1·42		....
	39	Groom. 4033..		"	23 14 08·52		10·85	...	....		23 14 09·36
	40	B.J. 880.......		"	16 14·06		14·34	12·86	−1·48		16 12·85
	41	B.J. 882.......		"	20 52·03		53·18	...	....		20 51·69
	42	B.J. 885.......		"	24 39·69		39·84	38·29	−1·55		24 38·35
	43	1 H.Cass......		"	25 54·56		55·55	...	....		25 54·06
	44	15Andromedae		"	30 16·14		16·69	...	....		30 15·20
	45	B.J. 890.......		"	33 12·22		12·84	11·32	....		33 11·35
	46	ψ Andromedae	r	"	41 37·05		37·73	...	....		41 36·24
	47	B.J. 895.......		"	43 37·97		39·47	...	....		43 37·98
	48	Groom. 4154..		"	48 01·91		04·29	...	....	−1·50	48 02·79

From Nov. 9 Clamp East; from Nov. 20 Clamp West.

1—2. Adopted $\Delta T+m=27\cdot177+\cdot0173$ (T−23^h 20^m).

3—36. Adopted $\Delta T+m=-1\cdot104-\cdot0022$ (T−23^h 25^m).

37—48. Adopted $\Delta T+m=-1\cdot496-\cdot0022$ (T−0^h 15^m).

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Nov. 27	1	Groom. 4163..	r	S	23 50 27·69	−·041	30·04			−1·50	23 50 28·54
	2	ψ Pegasi......		"	53 13·72	(·684)	14·02				53 12·52
	3	Bradley 3217..		"	0 04 21·97		25·30				0 04 23·80
	4	B.J. 4.........		"	05 41·50		42·12	40·65			05 40·62
	5	B.J. 7.........		"	08 39·75		39·93	38·42	−1·51		08 38·43
	6	B.J. 8..........		"	11 08·39		11·02				11 09·52
	7	σ Andromedae	r	"	13 40·84		41·27				13 39·77
	8	ρ Andromedae		"	16 26·01		26·56				16 25·06
	9	Bradley 34....		"	25 09·65		12·29				25 10·79
	10	B.J. 16........	r	"	27 55·55		56·84				27 55·34
	11	B.J. 17........		"	32 00·41		01·23	59·78			31 59·73
	12	B.J. 20........		"	34 34·42		34·81	33·34	−1·47		34 33·31
	13	B.J. 25........		"	39 45·83		46·49	45·04			39 44·99
	14	B.D. 71·37....		"	42 18·76		20·72				42 19·22
	15	η Cass........		"	43 42·79		43·75				43 42·25
	16	ν Andromedae		"	44 54·37		54·94				44 53·44
	17	32² H.Camel..	L.C.,nr	"	48 31·10		25·25	23·86	−1·39		....
	18	B.J. 32........		"	51 19·61		20·70				51 19·20
	19	h Piscium.....		"	53 01·55		01·91				53 00·41
	20	43 H.Cephei...	nr	"	56 19·01		27·99	26·92	−1·07		....
	21	72 Piscium....		"	1 00 24·25		24·43				1 00 22·93
	22	μ Cass........		"	02 20·72		21·58				02 20·08
	23	B.J. 41........	r	"	04 31·20		34·78				04 33·28
	24	χ Piscium		"	06 40·84		41·09				06 39·59
	25	Bradley 151...		"	09 46·78		48·64				09 47·14
	26	Bradley 155...		"	12 52·12		54·89				12 53·39
	27	B.J. 45........		"	14 35·00		35·33	33·87	−1·46		14 33·83
	28	l Piscium.....		"	16 12·63		12·99				16 11·49
	29	B.J. 46........		"	19 37·79		39·31				19 37·81
	30	ω Andromedae		"	22 19·93		20·59				22 19·09
	31	α Urs. Min....	nr	"	27 11·46		44·10	42·22	−1·88		....
	32	υ Andromedae		"	31 34·69		35·27				31 33·77
	33	τ Andromedae	r	"	35 19·98		20·47				35 18·97
	34	B.J. 57........	r	"	38 04·85		05·65	04·23			38 04·15
	35	2 Persei.......		"	46 29·81		30·55				46 29·05
	36	B.J. 63........		"	47 58·99		00·23				47 58·73
Dec. 5	37	B.J. 7.........		N	0 08 39·07	−·073	39·21	38·35	−0·86	−0·90	0 08 38·31
	38	Bradley 1672..	L.C.	"	14 45·07	(·751)	24·19	23·92	−0·27		....
	39	Bradley 34....		"	25 08·52		11·40			−0·89	25 10·51
	40	B.J. 16........		"	27 54·81		56·11				27 55·22
	41	B.J. 18........		"	32 07·15		07·56	06·74	−0·82		32 06·67
	42	B.J. 19........		"	33 50·89		51·23	50·29	−0·94		33 50·34
	43	B.J. 20........		"	34 33·66		34·03	33·26	−0·77		34 33·14
	44	B.J. 24........		"	39 43·25		45·74			−0·88	39 44·86
	45	23 Cass.......	r	"	41 46·35		48·81				41 47·93
	46	η Cass........		"	43 41.93		42·98				43 42·10
	47	ν Andromedae		"	44 53·65		54·21				44 53·33
	48	32² H.Camel..	L.C.,nr	"	48 32·19		26·02	25·22	−0·80		....
	49	B.J. 33........		"	51 48·37		48·87	47·93	−0·94		51 47·99

Clamp West.

1—36. Adopted $\Delta T+m=-1{\cdot}496-{\cdot}0022\ (T-0^h\ 15^m)$.
37—49. Adopted $\Delta T+m=-0{\cdot}855+{\cdot}0300\ (T-1^h\ 35^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent ΔT + m	Adopted ΔT + m	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Dec. 5	1	*h* Piscium.....		N	0 53 00.90	−·073	01·24	....	......	−0·88	0 53 00·36
	2	43 H.Cephei...	nr	"	56 16·72	(·751)	26·17	25·34	−0·83	−0·87	....
	3	72 Piscium....		"	1 00 23·58		23·72	....	....		1 00 22·85
	4	*μ* Cass........		"	02 19·90		20·83	....	.....		02 19·96
	5	B.J. 42........		"	04 44·55		45·00	44·15	−0·85		04 44·13
	6	B.J. 43........		"	06 45·30		45·66	44·82	−0·84		06 44·79
	7	Bradley 137...		"	08 33·71		37·42	.....	......		08 36·55
	8	Bradley 151...		"	09 45·84		47·86	....	.....		09 46·99
	9	B.J. 45........		"	14 34·36		34·67	33·82	−0·85		14 33·80
	10	*l* Piscium.....		"	16 12·00		12·34	....	....	−0·86	16 11·48
	11	*ξ* Andromedae		"	17 05·33		05·98	...	......		17 05·12
	12	B.J. 48........		"	19 58·38		59·54	58·63	−0·86		19 58·68
	13	*ω* Andromedae		"	22 19·35		20·00	..	.....		22 19·14
	14	*α* Urs. Min....		"	27 02·77		37·11	37·33	0·22		....
	15	*υ* Andromedae		"	31 34·03		34·59	.....	.....		31 33·73
	16	B.J. 55........		"	35 43·33		44·98	......	....	−0·85	35 44·13
	17	B.J. 57........		"	38 04·27		05·06	04·16	....		38 04·21
	18	2 Persei.......	r	"	46 29·15		29·95	.....	....		46 29·10
	19	B.J. 64........		"	48 00·41		00·76	59·96	−0·80		47 59·91
	20	B.J. 66........		"	49 43·58		43·80	42·95	−0·85		49 42·95
	21	48 Cass.......		"	54 37·07		39·00	.....	....		54 38·15
	22	B.J. 70........		"	55 48·03		50·13	..	....	−0·84	55 49·29
	23	B.J. 73........		"	58 25·83		26·42	25·57	−0·85		58 25·58
	24	B.J. 75........		"	2 04 14·75		15·19	14·34	−0·85		2 04 14·35
	25	15 Arietis.....		"	05 41·93		42·13		....		05 41·29
	26	B.J. 77........		"	07 40·83		41·64	40·55	......		07 40·80
	27	B.J. 79........		"	12 01·37		01·79	00·93	−0·86		12 00·95
	28	B.J. 81........		"	13 10·76		10·96	10·16	−0·80		13 10·12
	29	*ι* Cass.........		"	21 42·62		44·23	..	......	−0·83	21 43·40
	30	B.J. 87........		"	29 32·50		34·67	...	.....		29 33·84
	31	B.J. 89........		"	33 46·06		46·30	45·46	−0·84		33 45·47
	32	B.J. 92........		"	37 08·96		10·61	..	.....	−0·82	37 09·79
	33	B.J. 93........		"	38 07·03		07·79	06·80	.. ...		38 06·97
	34	39 Arietis.....		"	42 36·74		37·08	..	......		42 36·26
	35	B.J. 100.......		"	44 44·96		45·27	44·42	−0·85		44 44·45
	36	*σ* Arietis......		"	46 35·32		35·46	..	....		46 34·64
	37	B.J. 103.......		"	47 56·55		57·42	56·44	......		47 56·60
	38	B.J. 108.......		"	58 20·71		21·60	20·68	....	−0·81	58 20·79
	39	B.J. 109.......		"	59 28·45		28·96	28·09	−0·87		59 28·15
Dec. 8	40	B.J. 902.......		S	23 54 42·34	·074	42·55	43·63	1·08	1·12	23 54 43·67
	41	B.J. 13........		"	0 25 28·11	(·782)	28·29	29·28	0·99	1·14	0 25 29·43
	42	B.J. 17........		"	31 57·27		58·42	59·56	....		31 59·56
	43	B.J. 24........		"	39 40·23		43·29	......			39 44·43
	44	32[2] H.Camel..	L.C.,nr	"	48 32·43		24·58	25·78	1·20	1·15	....
	45	43 H.Cephei...	nr	"	56 11·50		23·37	24·55	1·18		....
	46	Bradley 155...		"	1 12 47·83		51·55	....	....	1·16	1 12 52·71
	47	Bradley 166...		"	15 48·83		52·91	....	....		15 54·07
	48	*ξ* Andromedae		"	17 03·03		03·95	....	....		17 05·11
	49	B.J. 48........		"	19 55·95		57·42	58·57	....		19 58·58

Clamp West. 1—39. Adopted $\Delta T + m = -0{\cdot}855 + {\cdot}0300\ (T - 1^h\ 35^m)$.
40—49. Adopted $\Delta T + m = 1{\cdot}165 + {\cdot}0300\ (T - 1^h\ 25^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Dec. 8	1	ω Andromedae		S	1 22 16·89	·074	17·81	....	....	1·16	1 22 18·97
	2	α Urs. Min....	nr	"	26 50·37	(·782)	33·48	34·76	1·28	1·17	....
	3	π Piscium....		"	32 20·96		21·24	....	....		32 22·41
	4	42 Cass.......		"	35 56·93		59·28	....	....		36 00·45
	5	B.J. 57........		"	38 01·97		03·00	04·12	....		38 04·17
	6	2 Persei.......	r	"	46 26·65		27·76	....	....	1·18	46 28·94
	7	B.J. 64........		"	47 58·22		58·78	59·94	1·16		47 59·96
	8	B.J. 66........		"	49 41·36		41·77	42·94	1·17		49 42·95
	9	Bradley 246...		"	53 49·88		53·70	....	....		53 54·88
	10	Groom. 422...		"	55 12·43		15·28	....	....		55 16·46
	11	B.J. 74........		"	2 02 07·33		07·79	08·93	1·14		2 02 08·97
	12	15 Arietis.....		"	05 39·64		40·03	....	....	1·19	05 41·22
	13	B.J. 76........		"	07 26·00		27·92	....	....		07 29·11
	14	B.J. 79........		"	11 59·13		59·78	00 91	1·13		12 00·97
	15	B.J. 81........		"	13 08·56		08·95	10·15	1·20		13 10·14
	16	ξ Arietis......		"	20 01·14		01·40	....	....		20 02·59
	17	27 Arietis.....		"	25 56·37		56·73	....	....	1·20	25 57·93
	18	B.J. 87........		"	29 29·50		32·18	....	....		29 33·38
	19	B.J. 93........		"	38 04·65		05·63	06·79	....		38 06·83
	20	39 Arietis.....		"	42 34·55		35·10	....	....		42 36·30
	21	B.J. 99........		"	44 09·41		10·65	11·82	....		44 11·85
	22	σ Arietis......		"	46 33·08		33·40	....	....	1·21	46 34·61
	23	B.J. 103.......		"	47 54·15		55·26	56·43	....		47 56·47
	24	B.J. 109.......		"	59 26·12		26·88	28·09	1·21		59 28·09
Dec. 9	25	B.J. 16........		N	0 27 51·65	·022	53·30	....	....	1·80	0 27 55·10
	26	B.J. 17........		"	31 56·62	(·829)	57·79	59·54	....		31 59·59
	27	B.J. 19........		"	33 47·90		48·40	50·25	1·85		33 50·20
	28	B.J. 21........		"	35 22·91		24·20	26·13	....		35 26·00
	29	B.J. 25........		"	39 42·19		43·14	44·85	....	1·81	39 44·95
	30	B.D. 71·37....		"	42 14·26		16·95	....	....		42 18·76
	31	η Cass..... ...		"	43 38·80		40·14	....	....		43 41·95
	32	ν Andromedae		"	44 50·72		51·47	....	....		44 53·28
	33	32² H.Camel...	L.C.,nr	"	48 31·27		23·47	25·97	2·50		....
	34	B.J. 32........		"	51 15·68		17·19	....	....		...51 19·00
	35	h Piscium.....		"	52 58·00		58·49	....	....		52 00·30
	36	43 H.Cephei...	nr	"	56 09·99		21·79	24·30	2·51		....
	37	μ Cass........		"	1 02 16·79		18·00	....	....	1·82	1 02 19·82
	38	B.J. 41........		"	04 26·18		30·72	....	....		04 32·54
	39	B.J. 43........		"	06 42·39		42·90	44·78	1·88		06 44·72
	40	Bradley 137...		"	08 28·97		33·62	....	....		08 35·44
	41	Bradley 151...		"	09 42·11		44·67	....	....		09 46·49
	42	B.J. 45........		"	14 31·50		31·95	33·79	1·84		14 33·77
	43	l Piscium......		"	16 09·21		09·70	....	....		16 11·52
	44	ξ Andromedae		"	17 02·44		03·31	....	....		17 05·13
	45	B.J. 48........		"	19 55·31		56·80	58·55	....	1·83	19 58·63
	46	ω Andromedae		"	22 16·41		17·28	....	....		22 19·11
	47	α Urs. Min....		"	26 48·76		31·64	33·91	2·27		....
	48	B.J. 51........		"	31 18·20		20·95	....	....		31 22·78
	49	B.J. 55........		"	35 40·07		42·16	....	....		35 43·99

Clamp West.

1—24. Adopted $\Delta T+m=1{\cdot}165+{\cdot}0300$ $(T-1^h\ 25^m)$.
25—49. Adopted $\Delta T+m=1{\cdot}838+{\cdot}0300$ $(T-1^h\ 45^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Dec. 9	1	B.J. 57........	r	N	1 38 01·23	·022	02·26	04·10	.....	1·83	1 38 04·09
	2	2 Persei.......		"	46 26·00	(·829)	27·04	...	.....	1·84	46 28·88
	3	B.J. 63........		"	47 55·09		56·80				47 58·64
	4	B.J. 66........		"	49 40·73		41·08	42·93	1·85		49 42·92
	5	48 Cass........		"	54 33·50		35·94	...	.....		54 37·78
	6	B.J. 70........		"	55 44·33		46·99	...	.....		55 48·83
	7	B.J. 73........		"	58 22·93		23·72	25·54	1·82		58 25·56
	8	B.J. 74........		"	2 02 06·70		07·10	08·92	1·82	1·85	2 02 08·95
	9	B.J. 75........	r	"	04 11·81		12·42	14·32	1·90		04 14·27
	10	15 Arietis.....	r	"	05 38·99		39·32	...	.....		05 41·17
	11	B.J. 77........		"	07 37·61		38·66	40·51	....		07 40·51
	12	B.J. 79........		"	11 58·49		59·08	00·91	1·83		12 00·93
	13	B.J. 81........		"	13 07·94		08·27	10·15	1·88		13 10·12
	14	ι Cass.........	r	"	21 39·14		41·18	...	.....	1·86	21 43·04
	15	27 Arietis.....		"	25 55·75		56·05	...	.....		25 57·91
	16	B.J. 87........		"	29 28·83		31·56	...	.....		29 33·42
	17	B.J. 89........		"	33 43·22		43·59	45·45	1·86		33 45·45
	18	B.J. 92........		"	37 05·86		07·94	.....	.....		37 09·80
	19	B.J. 93........		"	38 04·04		05·03	06·78	...		38 06·89
	20	39 Arietis.....		"	42 33·90		34·40	...	.....	1·87	42 36·27
	21	B.J. 99........		"	44 08·75		10·01	11·81	.....		44 11·88
	22	σ Arietis......		"	46 32·52		32·78	...	.....		46 34·65
	23	B.J. 103.......		"	47 53·54		54·66	56·42	.....		47 56·53
	24	B.J. 108.......		"	58 17·63		18·78	20·67	..		58 20·65
	25	B.J. 109.......		"	59 25·64		26·34	28·09	1·75	1·88	59 28·22
Dec. 10	26	B.J. 895.......		S	23 43 32·68	·043	34·78	...	...	2·60	23 43 37·38
	27	Groom. 4163..	r	"	50 22·04	(·843)	25·25	.....	.....		50 27·85
	28	ψ Pegasi......		"	53 09·29		09·77	.....	.....		53 12·37
	29	B.J. 1.........		"	0 03 43·02		43·57	46·17	2·60	2·61	0 03 46·18
	30	B.J. 4.........		"	05 36·94		37·84	40·42	.....		05 40·45
	31	B.J. 8.........		"	11 02·51		06·16	....	.....		11 08·77
	32	σ Andromedae		"	13 36·24		36·95	.....	.....		13 39·56
	33	ρ Andromedae	r	"	16 21·61		22·29	.....	.....		16 24·90
	34	Bradley 34....		"	25 03·76		07·43	.....	.....	2·62	25 10·05
	35	B.J. 17........		"	31 55·76		56·94	59·52	....		31 59·56
	36	B.J. 20........		"	34 30·01		30·60	33·20	2·60		34 33·22
	37	B.J. 25........		"	39 41·37	—·048	42·20	44·83	....		39 44·82
	38	B.D. 71·37....		"	42 13·44	(·843)	15·87	.....	.....	2·63	42 18·50
	39	ν Andromedae		"	44 49·96		50·65	.....	.....		44 53·28
	40	32² H.Camel..	L.C.,rn	"	48 31·01		23·75	26·16	2·41		...
	41	h Piscium.....		"	52 57·24		57·68	...	...		53 00·31
	42	43 H.Cephei..	rn	"	56 09·99		21·03	24·06	3·03		...
	43	Bradley 109...		"	1 01 26·96		31·22	.....	.....	2·64	1 01 33·86
	44	χ Piscium.....		"	06 36·51		36·81	.....	.....		06 39·45
	45	Bradley 137...	r	"	08 28·25		32·72	.....	.....		08 35·36
	46	ω Andromedae		"	22 15·54		16·35	.....	.....	2·65	22 19·00
	47	α Urs. Min....	rn	"	26 51·16		31·26	33·11	1·85		....
	48	π Piscium.....		"	32 19·59		19·76	.....	.....		32 22·41
	49	τ Andromedae		"	35 15·51		16·20	.....	.....		35 18·85
	50	B.J. 57........	r	"	38 00·49		01·47	04·09	....		38 04·12

Clamp West.

1—25. Adopted $\Delta T+m=1{\cdot}838+{\cdot}0300\ (T-1^h\ 45^m)$.

26—50. Adopted $\Delta T+m=2{\cdot}650+{\cdot}0300\ (T-1^h\ 30^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R.A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Dec. 10	1	2 Persei		S	1 46 25·44	−·048	26·36			2·66	1 46 29·02
	2	B.J. 61		"	47 56·81	(·843)	57·26	59·93	2·67		47 59·92
	3	48 Cass		"	54 32·72		34·92				54 37·58
	4	47 Cass		"	56 01·82		08·18				56 10·84
	5	Bradley 282		"	2 05 02·62		05·28			2·67	2 05 07·95
	6	B.J. 76		"	07 24·62		26·37				07 29·04
	7	B.J. 79		"	11 57·70		58·24	00·90	2·66		12 00·91
	8	B.J. 81		"	13 07·15		07·44	10·14	2·70		13 10·11
	9	ξ Arietis		"	19 59·78		59·92				20 02·59
	10	27 Arietis	r	"	25 54·97		55·17			2·68	25 57·85
	11	B.J. 87		"	29 28·26		30·72				29 33·40
	12	Bradley 344	rn	"	34 47·16		52·32				34 55·00
	13	B.J. 92		"	37 05·06		06·93				37 09·61
	14	B.J. 94		"	38 10·32		10·74	13·42	2·68		38 13·42
	15	39 Arietis		"	42 33·08		33·52			2·69	42 36·21
	16	B.J. 99		"	44 07·95		09·06	11·81			44 11·75
	17	σ Arietis		"	46 31·65		31·86				46 34·55
	18	B.J. 103		"	47 52·77		53·76	56·42			47 56·45
	19	B.J. 105		"	54 07·79		11·86				54 14·55
	20	Bradley 396	rn	"	57 44·91		50·10				57 52·79
	21	B.J. 109		"	59 24·77		25·42	28·09	2·67		59 28·11
	22	Bradley 417		"	3 02 11·46		14·20			2·70	3 02 16·90
	23	Groom. 2283	L.C.,rn	"	05 39·17		20·85	24·38	3·53		…
	24	τ Arietis		"	16 02·14		02·45				16 05·15
	25	B.J. 120		"	17 54·37		55·26	57·88			17 57·96
	26	Bradley 459		"	21 00·62		02·96			2·71	21 05·67
Dec. 12	27	B.J. 27		N	0 42 31·91	−·020	32·24	36·43	4·19	4·17	0 42 36·41
	28	η Cass		"	43 36·62	(·767)	37·79				43 41·96
	29	ν Andromedae		"	44 48·49		49·13				44 53·30
	30	32² H.Camel.	L.C.,rn	"	48 28·96		22·13	26·54	4·41		…
	31	B.J. 33		"	51 42·99		43·57	47·84	4·27		51 47·74
	32	h Piscium		"	52 55·75		56·15			4·18	53 00·33
	33	43 H.Cephei	rn	"	56 08·75		19·15	23·62	4·47		…
	34	Bradley 109		"	1 01 25·58		29·71				1 01 33·89
	35	B.J. 42		"	04 39·38		39·90	44·07	4·17		04 44·08
	36	χ Piscium		"	06 35·06		35·33				06 39·51
	37	Bradley 137		"	08 27·43		31·52				08 35·70
	38	Bradley 151		"	09 39·91		42·15				09 46·33
	39	B.J. 45		"	14 29·17		29·54	33·76	4·22	4·19	14 33·73
	40	Bradley 166		"	15 45·90		49·57				15 53·76
	41	B.J. 46		"	19 31·32		33·16				19 37·35
	42	ω Andromedae		"	22 14·00		14·75				22 18·94
	43	α Urs. Min.		"	26 46·89		24·68	31·63	6·95		…
	44	υ Andromedae		"	31 28·75		29·40				31 33·59
	45	τ Andromedae	r	"	35 13·99		14·61			4·20	35 18·81
	46	B.J. 57		"	37 58·96		59·86	04·06			38 04·06
	47	2 Persei	r	"	46 23·71		24·62				46 28·82
	48	B.J. 63		"	47 52·78		54·27				47 58·47
	49	B.J. 66		"	49 38·47		38·74	42·91	4·17		49 42·94

Clamp West.

1–26. Adopted $\Delta T+m=2{\cdot}650+{\cdot}0300\ (T-1^h\ 30^m)$.
27–49. Adopted $\Delta T+m=4{\cdot}204+{\cdot}0300\ (T-1^h\ 50^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Continued

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T + m$	Adopted $\Delta T + m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Dec. 12	1	λ Arietis......		N	1 52 53·14	− ·020	53·46			4·21	1 52 57·67
	2	Bradley 246...		"	53 46·92	(·767)	50·35				53 54·56
	3	B.J. 70........		"	55 42·20		44·53				55 48·74
	4	B.J. 73........		"	58 20·60		21·27	25·52	4·25		58 25·48
	5	B.J. 74........		"	2 02 04·40		04·72	08·91	4·19		2 02 08·93
	6	B.J. 75........		"	04 09·60		10·12	14·30	4·18		04 14·33
	7	15 Arietis.....		"	05 36·79		37·05				05 41·26
	8	B.J. 77........		"	07 35·43		36·35	40·48			07 40·56
	9	B.J. 79........	r	"	11 56·17		56·67	00·89	4·22		12 00·88
	10	B.J. 81........	r	"	13 05·65		05·91	10·14	4·23	4·22	13 10·13
	11	ι Cass..........		"	21 37·09		38·87				21 43·09
	12	27 Arietis.....		"	25 53·50		53·74				25 57·96
	13	B.J. 87........		"	29 26·69		29·09				29 33·31
	14	B.J. 89........		"	33 40·97		41·27	45·45	4·18	4·23	33 45·50
	15	B.J. 92........	r	"	37 03·44		05·26				37 09·49
	16	B.J. 93........		"	38 01·69		02·54	06·77			38 06·77
	17	39 Arietis.....		"	42 31·65		32·06				42 36·29
	18	B.J. 100.......		"	44 39·82		40·20	44·41	4·21		44 44·43
	19	σ Arietis......		"	46 30·12		30·32				46 34·55
	20	B.J. 103.......		"	47 51·20		52·18	56·41			47 56·41
	21	B.J. 105.......		"	54 06·25		10·20			4·24	54 14·44
	22	B.J. 108.......		"	58 15·45		16·44	20·65			58 20·68
	23	B.J. 109.......		"	59 23·26		23·85	28·09	4·24		59 28·09
	24	B.J. 111.......		"	3 02 17·48		18·12	22·37	4·25		3 02 22·36
	25	Groom. 2283..	L.C.,nr	"	05 36·36		19·15	24·80	5·65		....
Dec. 21	26	α Urs. Min....		N	1 26 47·08	− ·022	25·08	23·94	−1·14	−1·39	....
	27	υ Andromedae	r	"	31 34·38	(·773)	35·03				1 31 33·64
	28	B.J. 52........		"	32 31·44		32·28	30·76			32 30·89
	29	τ Andromedae		"	35 19·51		20·14				35 18·75
	30	B.J. 57........	r	"	38 04·44		05·34	03·92		−1·38	38 03·96
	31	2 Persei.......		"	46 29·25		30·16				46 28·78
	32	B.J. 64........		"	48 00·90		01·32	59·84	−1·48		47 59·94
	33	B.J. 66........		"	49 44·03		44·31	42·85	−1·46		49 42·93
	34	λ Arietis......		"	52 58·68		59·00				52 57·62
	35	B.J. 70........		"	55 47·45		49·79				55 48·41
	36	B.J. 73........		"	58 26·18		26·86	25·43	−1·43		58 25·48
	37	B.J. 74........		"	2 02 09·90		10·22	08·85	−1·37		2 02 08·84
	38	B.J. 75........	r	"	04 15·05		15·56	14·23	−1·33		04 14·18
	39	15 Arietis.....	r	"	05 42·28		42·54				05 41·16
	40	B.J. 76........		"	07 28·44		30·16				07 28·78
	41	B.J. 79........		"	12 01·75		02·24	00·83	−1·41		12 00·86
	42	B.J. 81........		"	13 11·18		11·44	10·09	−1·35		13 10·06
	43	ξ Arietis......		"	20 03·80		03·94				20 02·56
	44	ι Cass	r	"	21 42·45		44·24				21 42·86
	45	27 Arietis.....		"	25 59·07		59·30				25 57·92
	46	B.J. 87........		"	29 31·95		34·36				29 32·98
	47	B.J. 89........		"	33 46·52		46·82	45·41	−1·41		33 45·44
	48	B.J. 92........		"	37 08·89		10·72				37 09·34
	49	B.J. 94........		"	38 14·38		14·77	13·37	−1·40		38 13·39
	50	39 Arietis.....		"	42 37·23		37·65				42 36·27

Clamp West. 1—25. Adopted $\Delta T+m=4{\cdot}204+{\cdot}0300\ (T-1^h\ 50^m)$.
26—50. Adopted $\Delta T+m=-1{\cdot}376+{\cdot}0075\ (T-2^h\ 50^m)$.

TABLE III.

REDUCTION OF TRANSITS OBSERVED WITH THE MERIDIAN CIRCLE—Concluded

Date	Reference No.	Object	Notes	Observer	Time of Observed Transit	Coll. (Polar Dev.)	Sec. of Transit Corrected	R. A. of Known Stars	Apparent $\Delta T+m$	Adopted $\Delta T+m$	App. R.A. from Observation
1910					h. m. s.	s.	s.	s.	s.	s.	h. m. s.
Dec. 21	1	B.J. 100.......		N	2 44 45·42	−·022	45·80	44·37	−1·43	−1·38	2 44 44·42
	2	σ Arietis......		"	46 35·72	(·773)	35·91	......	......		46 34·53
	3	B.J. 103.......		"	47 56·84		57·82	56·34	....		47 56·44
	4	B.J. 105.......		"	54 11·16		15·13	......	....		54 13·75
	5	B.J. 108.......		"	58 21·01		22·01	20·59	....	−1·37	58 20·64
	6	B.J. 109.......		"	59 28·86		29·46	28·06	−1·40		59 28·09
	7	B.J. 111.......		"	3 02 23·04		23·69	22·34	−1·35		3 02 22·32
	8	Groom. 2283..	L.C.	"	05 45·38		28·07	26·82	−1·25		....
	9	B.J. 122.......		"	21 51·49		52·78	51·45	....		21 51·41
	10	B.J. 124.......		"	24 18·32		19·14	17·78	....		24 17·77
	11	s Tauri........		"	25 33·79		33·94	......	....		25 32·57
	12	B.J. 129.......		"	34 25·57		27·06	......	....		34 25·69
	13	11 Tauri......		"	35 28·29		28·64	......	....		35 27·27
	14	B.J. 131.......		"	36 35·65		36·46	35·15	....		36 35·09
	15	B.J. 132.......		"	38 44·90		45·37	44·18	−1·19		38 44·00
	16	B.J. 136.......		"	39 36·37		36·70	35·40	−1·30		39 35·33
	17	B.J. 139.......	r	"	42 12·65		12·98	11·63	−1·35		42 11·61
	18	B.J. 144.......		"	48 32·99		33·46	32·23	−1·23		48 32·09
	19	B.J. 145.......		"	49 32·80		34·15	......	....		49 32·78
	20	B.J. 147.......		"	51 53·56		54·18	52·86	−1·32		51 52·81
	21	B.J. 148.......		"	53 12·23		12·76	11·41	−1·35		53 11·39
	22	B.J. 150.......		"	55 46·37		46·54	45·08	−1·46		55 45·17

Clamp West. 1—22. Adopted $\Delta T+m = -1·376 + ·0075\ (T - 2^h\ 50^m)$.

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0

Date	Clamp	Observer	Mean R.A. 1910·0
B. J. 296 Dec. 33° 38′			
			h m s
Mar. 18	W	N	7 41 42·37
	Δ_1		−·003
	Δ_2		−·003
Mean R.A.			7 41 42·364
B. J. 314 Dec. 43° 29′			
Mar. 18	W	N	8 16 40·66
	Δ_1		−·002
	Δ_2		−·005
Mean R.A.			8 16 40·653
B. J. 320 Dec. 38° 20′			
Mar. 17	W	S	8 27 04·13
18	W	N	04·16
Mean			04·145
	Δ_1		−·005
	Δ_2		−·002
Mean R.A.			8 27 04·138
B. J. 323 Dec. 53° 02′			
Mar. 17	W	S	8 32 37·85
18	W	N	37·94
Mean			37·895
	Δ_1		−·003
	Δ_2		−·005
Mean R.A.			8 32 37·887
B. J. 335 Dec. 48° 24′			
Mar. 17	W	S	8 53 03·04
	Δ_1		−·003
	Δ_2		−·001
Mean R.A.			8 53 03.036

Date	Clamp	Observer	Mean R.A. 1910·0
B. J. 339 Dec. 42° 08′			
			h m s
Mar. 17	W	S	8 54 48·14
18	W	N	48·02
Mean			48·080
	Δ_1		·004
	Δ_2		−·002
Mean R.A.			8 54 48·082
B. J. 341 Dec. 47° 31′			
Mar. 17	W	S	8 57 29·17
18	W	N	29·15
Mean			29·160
	Δ_1		−·004
	Δ_2		−·003
Mean R.A.			8 57 29·153
B. A. C. 3097 Dec. 38° 49′			
Mar. 17	W	S	9 00 48·51
18	W	N	48·52
Mean			48·515
	Δ_1		·000
	Δ_2		−·002
Mean R.A.			9 00 48·513
B. J. 346 Dec. 43° 35′			
Mar. 17	W	S	9 07 55·30
18	W	N	55·38
Mean			55·340
	Δ_1		−·004
	Δ_2		−·003
Mean R.A.			9 07 55·333

Date	Clamp	Observer	Mean R.A. 1910·0
B. J. 349 Dec. 37° 11′			
			h m s
Mar. 17	W	S	9 13 14·87
18	W	N	14·90
Mean			14·885
	Δ_1		·000
	Δ_2		−·002
Mean R.A.			9 13 14·883
B. J. 352 Dec. 34° 46′			
Apr. 28	W	N	9 15 34·61
	Δ_1		·004
	Δ_2		−·003
Mean R.A.			9 15 34·611
B. J. 358 Dec. 52° 05′			
Mar. 17	W	S	9 26 50·64
18	W	N	50·72
Apr. 2	W	S	50·59
10	E	S	50·70
11	E	N	50·69
14	E	S	50·68
21	E	N	50·59
22	W	N	50·60
28	W	N	50·77
Mean			50·664
	Δ_1		−·004
	Δ_2		−·001
Mean R.A.			9 26 50·659
B. J. 360 Dec. 36° 48′			
Mar. 17	W	S	9 28 42·88
Apr. 2	W	S	42·81
10	E	S	42·86
11	E	N	42·83
14	E	S	42·80
21	E	N	42·83
22	W	N	42·79
28	W	N	42·82
Mean			42·828
	Δ_1		−·004
	Δ_2		·000
Mean R.A.			9 28 42·824

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B. J. 368
Dec. 59° 28′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Mar. 17	W	S	9 44 35·94
18	W	N	35.91
Apr. 2	W	S	35·90
3	E	S	35·99
10	E	S	36·00
11	E	N	35·95
14	E	S	35·93
21	E	N	35·97
28	W	N	35·98
Mean			35·952
Δ_1			·001
Δ_2			·001
Mean R.A.			9 44 35·954

B. J. 374
Dec. 41° 29′

Date	Clamp	Observer	Mean R.A. 1910·0
Mar. 17	W	S	9 52 10·58
18	W	N	10.61
Apr. 2	W	S	10.60
3	E	S	10.63
10	E	S	10.63
11	E	N	10.63
14	E	S	10·55
21	E	N	10·59
22	W	N	10·58
28	W	N	10·62
Mean			10·602
Δ_1			−·001
Δ_2			·000
Mean R.A.			9 52 10·601

B. J. 379
Dec. 17° 12′

Date	Clamp	Observer	Mean R.A. 1910·0
Apr. 30	W	S	10 02 25·73
Δ_1			·001
Δ_2			·003
Mean R.A.			10 02 25·734

B.J. 383
Dec. 43° 22′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Mar. 17	W	S	10 11 40·44
18	W	N	40·39
26	W	S	40·45
Apr. 2	W	S	40·51
3	E	S	40·43
10	E	S	40·41
11	E	N	40·41
13	E	S	40·45
14	E	S	40·49
21	E	N	40·43
22	W	N	40·46
28	W	N	40.44
Mean			40·445
Δ_1			−·002
Δ_2			·000
Mean R.A.			10 11 40·443

B. J. 384
Dec. 23° 52′

Date	Clamp	Observer	Mean R.A. 1910·0
Apr. 30	W	S	10 11 41·24
Δ_1			−·001
Δ_2			·002
Mean R.A.			10 11 41·241

B. J. 386
Dec. 41° 57′

Date	Clamp	Observer	Mean R.A. 1910·0
Mar. 18	W	N	10 16 58·31
26	W	S	58·36
Apr. 30	W	S	58·33
Mean			58·333
Δ_1			·003
Δ_2			−·001
Mean R.A.			10 16 58·335

B. J. 390
Dec. 37° 10′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Mar. 18	W	N	10 22 40·98
Apr. 3	E	S	40·95
10	E	S	41·00
11	E	N	40·95
13	E	S	41·01
21	E	N	40·98
22	W	N	40·98
25	W	S	40·98
28	W	N	40·90
30	W	S	41·00
Mean			40·973
Δ_1			−·002
Δ_2			·000
Mean R.A.			10 22 40·971

B. J. 394
Dec. 56° 27′

Date	Clamp	Observer	Mean R.A. 1910·0
Mar. 17	W	S	10 24 52·52
18	W	N	52·41
26	W	S	52·40
Apr. 3	E	S	52·42
10	E	S	52·52
11	E	N	52·51
13	E	S	52·47
21	E	N	52·36
22	W	N	52·45
25	W	S	52·51
28	W	N	52·42
30	W	S	52·53
Mean			52·460
Δ_1			−·003
Δ_2			·000
Mean R.A.			10 24 52·457

B. J. 398
Dec. 57° 33′

Date	Clamp	Observer	Mean R.A. 1910·0
Mar. 17	W	S	10 29 22·30
18	W	N	22·32
26	W	S	22·27
Apr. 2	W	S	22·28

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B. J. 398 (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Apr. 3	E	S	10 29 22·28
10	E	S	22·33
11	E	N	22·40
13	E	S	22·29
14	E	S	22·32
21	E	N	22·27
22	W	N	22·28
25	W	S	22·35
28	W	N	22·22
Mean			22·301
Δ_1			·003
Δ_2			·000
Mean R.A.			10 29 22·304

37 Leonis Minoris Dec. 32° 27′

Date	Clamp	Observer	Mean R.A. 1910·0
Mar. 26	W	S	10 33 39·52
Apr. 2	W	S	39·56
3	E	S	39·53
10	E	S	39·54
13	E	S	39·53
14	E	S	39·56
21	E	N	39·48
22	W	N	39·52
25	W	S	39·54
28	W	N	39·49
30	W	S	39·54
May 10	W	N	39·52
Mean			39·528
Δ_1			·000
Δ_2			·000
Mean R.A.			10 33 39·528

B. J. 405 Dec. 23° 40′

Date	Clamp	Observer	Mean R.A. 1910·0
Apr. 30	W	S	10 38 31·50
May 10	W	N	31·50
Mean			31·500
Δ_1			−·001
Δ_2			·000
Mean R.A.			10 38 31·499

B. J. 407 Dec. 31° 09′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Mar. 26	W	S	10 40 51·82
Apr. 3	E	S	51·81
10	E	S	51·81
11	E	N	51·85
13	E	S	51·77
14	E	S	51·79
22	W	N	51·80
25	W	S	51·82
28	W	N	51·86
30	W	S	51·81
May 10	W	N	51·83
Mean			51·815
Δ_1			·004
Δ_2			·000
Mean R.A.			10 40 51·819

B. J. 412 Dec. 34° 42′

Date	Clamp	Observer	Mean R.A. 1910·0
Mar. 26	W	S	10 48 16·91
Apr. 3	E	S	16·96
10	E	S	16·86
11	E	N	16·91
13	E	S	16·91
14	E	S	16·92
21	E	N	16·95
22	W	N	16·93
25	W	S	16·92
28	W	N	16·94
30	W	S	16·93
May 10	W	N	16·86
Mean			16·917
Δ_1			·004
Δ_2			·000
Mean R.A.			10 48 16·921

54 Leonis Dec. 25° 14′

Date	Clamp	Observer	Mean R.A. 1910·0
Apr. 30	W	S	10 50 44·56
May 3	W	N	44·56
10	W	N	44·56
Mean			44·560
Δ_1			−·005
Δ_2			−·001
Mean R.A.			10 50 44·554

47 Ursae Majoris Dec. 40° 55′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Mar. 26	W	S	10 54 25·83
Apr. 3	E	S	25·74
11	E	N	25·78
13	E	S	25·74
21	E	N	25·78
22	W	N	25·82
25	W	S	25·78
28	W	N	25·80
30	W	S	25·75
May 3	W	N	25·81
10	W	N	25·79
12	W	N	25·84
Mean			25·788
Δ_2			−·001
Mean R.A.			10 54 25·787

B. J. 416 Dec. 56° 52′

Date	Clamp	Observer	Mean R.A. 1910·0
Mar. 17	W	S	10 56 24·99
26	W	S	24·95
Apr. 3	E	S	25·04
10	E	S	25·07
11	E	N	25·08
13	E	S	25·05
14	E	S	25·04
21	E	N	25·08
22	W	N	25·07
25	W	S	25·06
28	W	N	25·08
30	W	S	25·00
May 3	W	N	25·16
10	W	N	25·04
12	W	N	25·07
Mean			25·052
Δ_1			−·003
Δ_2			−·001
Mean R.A.			10 56 25·048

B. J. 420 Dec. 44° 59′

Date	Clamp	Observer	Mean R.A. 1910·0
Mar. 26	W	S	11 04 36·42
Apr. 2	W	S	36·41
3	E	S	36·45
10	E	S	36·43

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B. J. 420 (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Apr. 11	E	N	11 04 36·53
13	E	S	36·49
14	E	S	36·47
21	E	N	36·48
22	W	N	36·50
25	W	S	36·43
28	W	N	36·47
30	W	S	36·47
May 3	W	N	36·52
10	W	N	36·46
12	W	N	36·49
Mean			36·468
Δ_1			·004
Δ_2			·000
Mean R.A.			11 04 36·472

B. J. 422 Dec. 21° 01′

Date	Clamp	Observer	Mean R.A. 1910·0
Apr. 30	W	S	11 09 19·42
May 3	W	N	19·43
7	W	S	19·43
10	W	N	19·41
12	W	N	19·41
Mean			19·420
Δ_1			–·005
Δ_2			·000
Mean R.A.			11 09 19·415

B. J. 424 Dec. 49° 58′

Date	Clamp	Observer	Mean R.A. 1910·0
Mar. 26	W	S	11 11 37·87
Apr. 2	W	S	37·80
3	E	S	37·77
10	E	S	37·85
11	E	N	37·93
14	E	S	37·86
22	W	N	37·81
25	W	S	37·89
28	W	N	37·91
30	W	S	37·81
May 3	W	N	37·91
7	W	S	37·81
10	W	N	37·86
12	W	N	37·77

B. J. 424 (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Mean			11 11 37·849
Δ_1			·003
Δ_2			–·001
Mean R.A.			11 11 37·851

B. J. 425 Dec. 33° 35′

Date	Clamp	Observer	Mean R.A. 1910·0
Mar. 26	W	S	11 13 37·31
Apr. 2	W	S	37·23
11	E	N	37·20
14	E	S	37·25
21	E	N	37·20
22	W	N	37·26
25	W	S	37·30
28	W	N	37·17
30	W	S	37·20
May 3	W	N	37·25
7	W	S	37·23
10	W	N	37·36
12	W	N	37·21
Mean			37·244
Δ_1			·003
Δ_2			–·001
Mean R.A.			11 13 37·246

B. J. 432 Dec. 43° 10′

Date	Clamp	Observer	Mean R.A. 1910·0
Apr. 30	W	S	11 25 39·08
May 7	W	S	39·12
11	W	S	39·09
Mean			39·097
Δ_1			·003
Δ_2			–·001
Mean R.A.			11 25 39·099

B. J. 441 Dec. 48° 17′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Mar. 26	W	S	11 41 18·07
Apr. 2	W	S	18·02
25	W	S	18·13
27	W	S	18·14
30	W	S	18·12
May 7	W	S	18·06
10	W	N	18·08
11	W	S	18.09
12	W	N	18·13
15	W	S	18·08
16	E	N	18·09
Mean			18·092
Δ_1			–·001
Δ_2			–·002
Mean R.A.			11 41 18·089

B.J. 444 Dec. 15° 05′

Date	Clamp	Observer	Mean R.A. 1910·0
Apr. 30	W	S	11 44 28·20
May 5	W	S	28·19
7	W	S	28·21
10	W	N	28·20
11	W	S	28·18
12	W	N	28·21
15	W	S	28·23
16	E	N	28·21
Mean			28·204
Δ_1			–·004
Δ_2			·001
Mean R.A.			11 44 28·201

Groombridge 1830 Dec. 38° 22′

Date	Clamp	Observer	Mean R.A. 1910·0
Apr. 2	W	S	11 47 47·64
12	E	N	47·76
25	W	S	47·70
27	W	S	47·76
May 3	W	N	47·78
5	W	S	47·65
7	W	S	47·73

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

Groombridge 1830 (continued)

Date	Clamp	Observer	Mean R.A. 1910·0 h m s
May 10	W	N	11 47 47·68
11	W	S	47·66
12	W	N	47·69
15	W	S	47·66
16	E	N	47·71
Mean			47·702
Δ_1			·003
Δ_2			−·001
Mean R.A.			11 47 47·704

B.J. 447
Dec. 54°12′

Date	Clamp	Observer	Mean R.A. 1910·0
Mar 26	W	S	11 49 06·00
Apr. 12	E	N	06·09
25	W	S	06·09
27	W	S	06·09
May 7	W	S	06·04
11	W	S	06·03
12	W	N	06·13
15	W	S	06·03
16	E	N	06·16
Mean			06·073
Δ_1			·003
Δ_2			−·002
Mean R.A.			11 49 06·074

***o* Leonis**
Dec. 16° 09′

Date	Clamp	Observer	Mean R.A. 1910·0
May 3	W	N	11 51 02·90
5	W	S	02·85
7	W	S	02·86
10	W	N	02·94
11	W	S	02·88
12	W	N	02·89
15	W	S	02·84
16	E	N	02·84
Mean			02·875
Δ_2			·001
Mean R.A.			11 51 02·876

1 Canum Venaticorum
Dec. 53° 56′

Date	Clamp	Observer	Mean R.A. 1910·0 h m s
Mar. 26	W	S	12 10 15·96
Apr. 27	W	S	16·01
May 3	W	N	15·96
5	W	S	15·81
7	W	S	15·88
10	W	N	15·91
11	W	S	15·96
12	W	N	15·95
15	W	S	15·91
16	E	N	15·85
21	E	N	15·92
Mean			15·920
Δ_2			−·003
Mean R.A.			12 10 15·917

B.J. 456
Dec. 57° 32′

Date	Clamp	Observer	Mean R.A. 1910·0
Apr. 8	E	N	12 10 58·61
12	E	N	58·43
May 17	E	S	58·55
Mean			58·530
Δ_1			·002
Δ_2			·005
Mean R.A.			12 10 58·537

B.J. 458
Dec. 41° 10′

Date	Clamp	Observer	Mean R.A. 1910·0
Mar. 26	W	S	12 11 37·12
Apr. 25	W	S	37·12
27	W	S	37·14
May 3	W	N	37·08
5	W	S	37·12
7	W	S	37·10
10	W	N	37·09
11	W	S	37·12
12	W	N	37·04
15	W	S	37·11
16	E	N	37·08
21	E	N	37·10
Mean			37·102
Δ_1			·002
Δ_2			−·001
Mean R.A.			12 11 37·103

12 Comae
Dec. 26° 21′

Date	Clamp	Observer	Mean R.A. 1910·0 h m s
May 5	W	S	12 17 58·98
7	W	S	58·97
12	W	N	59·03
15	W	S	58·93
16	E	N	58·98
Mean			58·978
Δ_1			·000
Δ_2			·000
Mean R.A.			12 17 58·978

B.J. 461
Dec. 39° 31′

Date	Clamp	Observer	Mean R.A. 1910·0
Mar. 26	W	S	12 21 25·04
Apr. 8	E	N	25·06
12	E	N	25·04
27	W	S	25·08
May 3	W	N	25·06
5	W	S	25·02
7	W	S	25·01
10	W	N	25·05
11	W	S	25·08
12	W	N	25·08
15	W	S	25·05
16	E	N	24·98
17	E	S	25·00
21	E	N	25·04
28	W	N	25·06
Mean			25·043
Δ_1			−·004
Δ_2			−·001
Mean R.A.			12 21 25·038

15 Comae
Dec. 28° 46′

Date	Clamp	Observer	Mean R.A. 1910·0
May 3	W	N	12 22 27·22
5	W	S	27·28
10	W	N	27·28
11	W	S	27·28
12	W	N	27·32
15	W	S	27·23
16	E	N	27·28
21	E	N	27·27
28	W	N	27·29
Mean			27·272
Δ_2			−·001
Mean R.A.			12 22 27·271

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 466 Dec. 21° 24′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 5	W	S	12 25 12·02
7	W	S	12·06
11	W	S	12·04
12	W	N	12·13
15	W	S	12·01
16	E	N	11·99
	Mean		12·042
	Δ1		·002
	Δ2		·001
Mean R.A.			12 25 12·045

B.J. 467 Dec. 58° 54′

Date	Clamp	Observer	Mean R.A. 1910·0
Mar. 26	W	S	12 25 45·45
Apr. 2	W	S	45·39
8	E	N	45·39
12	E	N	45·37
27	W	S	45·43
May 17	E	S	45·37
21	E	N	45·36
28	W	N	45·34
	Mean		45·388
	Δ1		−·004
	Δ2		·000
Mean R. A.			12 25 45·384

B.J. 470 Dec. 41° 51′

Date	Clamp	Observer	Mean R.A. 1910·0
Mar. 26	W	S	12 29 28·19
Apr. 2	W	S	28·25
8	E	N	28·21
12	E	N	28·28
27	W	S	28·25
May 3	W	N	28·27
5	W	S	28·25
7	W	S	28·24
10	W	N	28·30
11	W	S	28·25
12	W	N	28·19
15	W	S	28·28
16	E	N	28·23

B. J. 470 (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 17	E	S	12 29 28·26
21	E	N	28·25
28	W	N	28·27
	Mean		28·248
	Δ1		·003
	Δ2		−·001
Mean R.A.			12 29 28·250

23 Comae Dec. 23° 07′

Date	Clamp	Observer	Mean R.A. 1910·0
May 3	W	N	12 30 22·09
5	W	S	22·03
10	W	N	22·14
11	W	S	22·05
12	W	N	22·06
16	E	N	22·05
21	E	N	22·10
28	W	N	22·11
	Mean		22·079
	Δ1		·000
	Δ2		−·001
Mean R.A.			12 30 22·078

9 Canum Venaticorum Dec. 41° 22′

Date	Clamp	Observer	Mean R.A. 1910·0
Apr. 12	E	N	12 34 26·49
27	W	S	26·47
May 3	W	N	26·53
5	W	S	26·51
7	W	S	26·58
10	W	N	26·54
11	W	S	26·52
15	W	S	26·51
16	E	N	26·59
17	E	S	26·55
21	E	N	26·59
28	W	N	26·56
	Mean		26·537
	Δ2		−·001
Mean R.A.			12 34 26·536

31 Comae Dec. 28° 02′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Apr. 30	W	S	12 47 18·95
May 5	W	S	19·03
7	W	S	18·91
11	W	S	18·91
15	W	S	19·08
19	E	S	18·92
	Mean		18·967
	Δ1		−·002
	Δ2		·002
Mean R.A.			12 47 18·967

B. J. 483 Dec. 56° 27′

Date	Clamp	Observer	Mean R.A. 1910·0
Apr. 2	W	S	12 50 04·32
May 5	W	S	04·24
7	W	S	04·19
15	W	S	04·30
19	E	S	04·30
21	E	N	04·36
26	W	N	04·37
	Mean		04·297
	Δ1		·002
	Δ2		−·001
Mean R.A.			12 50 04·298

B. J. 485 Dec. 38° 48′

Date	Clamp	Observer	Mean R.A. 1910·0
Apr. 8	E	N	12 51 49·20
12	E	N	49·20
27	W	S	49·22
30	W	S	49·22
May 5	W	S	49·19
6	W	N	49·23
7	W	S	49·15
10	W	N	49·12
11	W	S	49·24
12	W	N	49·22
15	W	S	49·20
16	E	N	49·26
17	E	S	49·21
19	E	S	49·22

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B. J. 485 (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 21	E	N	12 51 49·18
26	W	N	49·17
28	W	N	49·25
June 3	W	S	49·21
Mean			49·205
Δ₁			·000
Δ₂			–·001
Mean R.A.			12 51 49·204

14 Canum Venaticorum, Dec. 36° 17′

Date	Clamp	Observer	Mean R.A. 1910·0
Apr. 12	E	N	13 01 32·07
27	W	S	32·06
30	W	S	32·00
May 5	W	S	32·04
6	W	N	32·03
7	W	S	32·00
10	W	N	32·05
11	W	S	32·04
12	W	N	31·99
15	W	S	32·08
16	E	N	32·06
17	E	S	32·06
19	E	S	32·03
21	E	N	32·03
26	W	N	32·02
28	W	N	32·01
June 3	W	S	32·07
8	W	N	32·07
Mean			32·039
Δ₂			·000
Mean R.A.			13 01 32·039

15 Canum Venaticorum, Dec. 39° 01′

Date	Clamp	Observer	Mean R.A. 1910·0
May 11	W	S	13 05 33·61
15	W	S	33·60
19	E	S	33·61
21	E	N	33·59
26	W	N	33·57
28	W	N	33·56
June 3	W	S	33·55
8	W	N	33·64
Mean			33·591
Δ₂			–·001
Mean R.A.			13 05 33·590

B. J. 491, Dec. 38° 59′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Apr. 12	E	N	13 05 55·37
27	W	S	55·35
May 5	W	S	55·31
6	W	N	55·37
7	W	S	55·35
10	W	N	55·35
11	W	S	55·34
12	W	N	55·32
15	W	S	55·41
16	E	N	55·34
19	E	S	55·32
21	E	N	55·37
26	W	N	55·34
28	W	N	55·37
June 3	W	S	55·37
8	W	N	55·34
Mean			55·351
Δ₁			–·003
Δ₂			–·001
Mean R.A.			13 05 55·347

B. J. 492, Dec. 28° 20′

Date	Clamp	Observer	Mean R.A. 1910·0
Apr. 30	W	S	13 07 40·46
May 5	W	S	40·48
6	W	N	40·38
7	W	S	40·45
10	W	N	40·51
11	W	S	40·46
12	W	N	40·52
15	W	S	40·43
16	E	N	40·51
19	E	S	40·44
21	E	N	40·44
28	W	N	40·46
June 3	W	S	40·46
8	W	N	40·49
Mean			40·464
Δ₁			–·001
Δ₂			·000
Mean R.A.			13 07 40·463

19 Canum Venaticorum, Dec. 41° 20′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Apr. 8	E	N	13 11 29·17
12	E	N	29·24
27	W	S	29·26
30	W	S	29·27
May 5	W	S	29·27
6	W	N	29·23
7	W	S	29·20
10	W	N	29·30
11	W	S	29·29
12	W	N	29·23
15	W	S	29·30
16	E	N	29·29
19	E	S	29·25
21	E	N	29·23
28	W	N	29·25
June 3	W	S	29·24
8	W	N	29·26
Mean			29·252
Δ₂			–·001
Mean R.A.			13 11 29·251

B. J. 494, Dec. 41° 03′

Date	Clamp	Observer	Mean R.A. 1910·0
Apr. 8	E	N	13 13 30·54
12	E	N	30·50
27	W	S	30·48
30	W	S	30·49
May 5	W	S	30·53
6	W	N	30·48
7	W	S	30·55
10	W	N	30·48
11	W	S	30·48
12	W	N	30·66
15	W	S	30·54
16	E	N	30·46
17	E	S	30·56
19	E	S	30·50
21	E	N	30·51
26	W	N	30·51
28	W	N	30·48
June 3	W	S	30·50
8	W	N	30·50
Mean			30·513
Δ₁			–·005
Δ₂			–·001
Mean R.A.			13 13 30·507

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

23 Canum Venaticorum
Dec. 40° 37′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Apr. 8	E	N	13 16 17·01
12	E	N	17·05
27	W	S	17·06
30	W	S	17·07
May 5	W	S	17·01
7	W	S	17·06
10	W	N	17·05
11	W	S	17·10
12	W	N	17·14
15	W	S	17·08
16	E	N	17·08
17	E	S	17·05
19	E	S	17·05
21	E	N	17·09
26	W	N	17·09
June 3	W	S	17·03
4	W	S	16·99
8	W	N	17·06
9	W	S	17·07
Mean			17·060
Δ₂			·000
Mean R.A.			13 16 17·060

B. J. 497
Dec. 55° 24′

Date	Clamp	Observer	Mean R.A. 1910·0
Apr. 8	E	N	13 20 18·23
12	E	N	18·20
27	W	S	18·17
30	W	S	18·21
May 5	W	S	18·18
6	W	N	18·27
7	W	S	18·17
10	W	N	18·25
11	W	S	18·18
12	W	N	18·26
15	W	S	18·14
16	E	N	18·15
17	E	S	18·23
19	E	S	18·19
21	E	N	18·17
28	W	N	18·17
June 3	W	S	18·15
4	W	S	18·17
8	W	N	18·23
9	W	S	18·20
13	E	N	18·30

B. J. 497
(continued)

			h m s
Mean			13 20 18·201
Δ₁			·003
Δ₂			−·002
Mean R.A.			13 20 18·202

81 Ursae Majoris
Dec. 55° 49′

Date	Clamp	Observer	Mean R.A. 1910·0
May 5	W	S	13 30 39·69
17	E	S	39·70
Mean			39·695
Δ₂			·003
Mean R.A.			13 30 39·698

B. J. 502
Dec. 37° 39′

Date	Clamp	Observer	Mean R.A. 1910·0
Apr. 30	W	S	13 30 46·77
May 6	W	N	46·74
7	W	S	46·71
11	W	S	46·76
12	W	N	46·75
15	W	S	46·75
16	E	N	46·80
19	E	S	46·84
21	E	N	46·79
28	W	N	46·74
June 3	W	S	46·76
4	W	S	46·77
8	W	N	46·81
9	W	S	46·79
13	E	N	46·82
15	E	S	46·80
19	W	S	46·77
Mean			46·775
Δ₁			·003
Δ₂			·000
Mean R.A.			13 30 46·778

25 Canum Venaticorum
Dec. 36° 45′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Apr. 8	E	N	13 33 27·78
12	E	N	27·90
30	W	S	27·85
May 5	W	S	27·74
6	W	N	27·81
7	W	S	27·79
10	W	N	27·81
11	W	S	27·78
12	W	N	27·77
15	W	S	27·78
16	E	N	27·81
17	E	S	27·80
19	E	S	27·79
21	E	N	27·79
28	W	N	27·80
June 3	W	S	27·75
4	W	S	27·78
8	W	N	27·81
9	W	S	27·81
18	W	N	27·82
19	W	S	27·77
Mean			27·797
Δ₁			·000
Δ₂			·000
Mean R.A.			13 33 27·797

B.J. 507
Dec. 17° 54′

Date	Clamp	Observer	Mean R.A. 1910·0
Apr. 30	W	S	13 42 59·15
May 5	W	S	59·09
6	W	N	59·12
7	W	S	59·18
10	W	N	59·18
11	W	S	59·08
12	W	N	59·04
15	W	S	59·12
16	E	N	59·15
19	E	S	59·13
21	E	N	59·09
26	W	N	59·11
28	W	N	59·09
June 3	W	S	59·14
4	W	S	59·15
8	W	N	59·10
9	W	S	59·12

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B. J. 507 (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
June 13	E	N	13 42 59·04
15	E	S	59·11
18	W	N	59·11
19	W	S	59·08
Mean			59·113
Δ₁			−·001
Δ₂			·001
Mean R.A.			13 42 59·113

B.J. 509 Dec. 49° 46′

Date	Clamp	Observer	Mean R.A. 1910·0
Apr. 8	E	N	13 43 59·74
30	W	S	59·68
May 5	W	S	59·69
6	W	N	59·65
7	W	S	59·69
10	W	N	59·77
11	W	S	59·61
12	W	N	59·72
15	W	S	59·65
16	E	N	59·70
17	E	S	59·75
19	E	S	59·63
21	E	N	59·73
26	W	N	59·71
28	W	N	59·69
June 3	W	S	59·70
4	W	S	59·68
8	W	N	59·79
9	W	S	59·63
13	E	N	59·77
15	E	S	59·76
18	W	N	59·75
19	W	S	59·71
Mean			59·704
Δ₁			−·003
Δ₂			−·001
Mean R.A.			13 43 59·700

B.J. 513 Dec. 18° 51′

Date	Clamp	Observer	Mean R.A. 1910·0
May 5	W	S	13 50 24·00
6	W	N	23·99
7	W	S	24·03
11	W	S	24·00

B.J. 513 (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 12	W	N	13 50 23·96
15	W	S	24·01
16	E	N	24·00
19	E	S	24·00
21	E	N	23·97
26	W	N	23·91
June 3	W	S	23·96
4	W	S	23·98
8	W	N	23·97
9	W	S	24·01
13	E	N	23·98
15	E	S	23·99
18	W	N	23·95
19	W	S	23·96
Mean			23·982
Δ₁			−·004
Δ₂			·001
Mean R.A.			13 50 23·979

B.J. 517 Dec. 27° 49′

Date	Clamp	Observer	Mean R.A. 1910·0
May 7	W	S	13 57 05·66
11	W	S	05·62
12	W	N	05·66
15	W	S	05·59
16	E	N	05·71
19	E	S	05·63
21	E	N	05·60
26	W	N	05·68
June 3	W	S	05·59
4	W	S	05·67
8	W	N	05·61
9	W	S	05·66
13	E	N	05·65
18	W	N	05·64
19	W	S	05·63
Mean			05·640
Δ₁			·004
Δ₂			·000
Mean R.A.			13 57 05·644

9 H. Boötis Dec. 44° 17′

Date	Clamp	Observer	Mean R.A. 1910·0
May 5	W	S	14 04 19·92
7	W	S	20·00
11	W	S	19·84
15	W	S	19·94

9 H. Boötis (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 16	E	N	14 04 19·92
19	E	S	19·99
21	E	N	19·91
26	W	N	19·93
28	W	N	19·94
June 3	W	S	19·93
4	W	S	19·86
8	W	N	19·97
9	W	S	19·91
13	E	S	19·89
18	W	S	19·88
19	W	N	19·91
Mean			19·921
Δ₂			−·001
Mean R.A.			14 04 19·920

B.J. 522 Dec. 25° 31′

Date	Clamp	Observer	Mean R.A. 1910·0
May 5	W	S	14 06 17·69
7	W	S	17·70
11	W	S	17·69
15	W	S	17·68
16	E	N	17·72
19	E	S	17·69
21	E	N	17·69
26	W	N	17·67
28	W	N	17·68
June 3	W	S	17·65
4	W	S	17·64
8	W	N	17·65
9	W	S	17·68
13	E	N	17·67
18	W	N	17·69
19	W	S	17·67
Mean			17·679
Δ₁			·004
Δ₂			·000
Mean R.A.			14 06 17·683

B.J. 526 Dec. 19° 39′

Date	Clamp	Observer	Mean R.A. 1910·0
May 5	W	S	14 11 33·44
6	W	N	33·40
7	W	S	33·42
11	W	S	33·41

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 526 (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 15	W	S	14 11 33·44
16	E	N	33·39
19	E	S	33·45
21	E	N	33·39
26	W	N	33·28
28	W	N	33·41
June 3	W	S	33·40
4	W	S	33·45
8	W	N	33·40
9	W	S	33·44
13	E	N	33·36
15	E	S	33·40
18	W	N	33·34
19	W	S	33·31
Mean			33·398
Δ_1			−·003
Δ_2			·001
Mean R.A.			14 11 33·396

B.J. 527
Dec. 46° 30′

Date	Clamp	Observer	Mean R.A. 1910·0
Apr. 8	E	N	14 12 57·77
May 5	W	S	57·70
6	W	N	57·81
7	W	S	57·76
15	W	S	57·69
16	E	N	57·74
17	E	S	57·79
19	E	S	57·71
21	E	N	57·83
26	W	N	57·70
28	W	N	57·77
June 3	W	S	57·74
4	W	S	57·76
8	W	N	57·75
9	W	S	57·78
10	E	N	57·80
Mean			57·756
Δ_1			·003
Δ_2			−·001
Mean R.A.			14 12 57·758

B.J. 528
Dec. 51° 47′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
June 13	E	S	14 12 58·76
18	W	S	58·73
19	W	N	58·77
Mean			58·753
Δ_1			−·003
Δ_2			·000
Mean R.A.			14 12 58·750

B.J. 531
Dec. 52° 16′

Date	Clamp	Observer	Mean R.A. 1910·0
May 17	E	S	14 22 07·95
28	W	N	07·88
June 3	W	S	07·95
4	W	S	07·93
8	W	N	07·97
9	W	S	07·92
13	E	N	08·05
15	E	S	08·03
18	W	N	08·04
19	W	S	07·99
25	W	S	08·06
Mean			07·979
Δ_1			·003
Δ_2			−·001
Mean R.A.			14 22 07·981

***f* Boötis**
Dec. 19° 38′

Date	Clamp	Observer	Mean R.A. 1910·0
May 5	W	S	14 22 16·13
6	W	N	16·17
7	W	S	16·24
11	W	S	16·16
15	W	S	16·15
16	E	N	16·19
19	E	S	16·18
21	E	N	16·20
June 10	E	N	16·15
Mean			16·174
Δ_1			·002
Δ_2			·000
Mean R.A.			14 22 16·176

***g* Boötis**
Dec. 50° 15′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 17	E	S	14 25 29·95
June 9	W	S	29·95
13	E	S	29·93
15	W	S	29·98
19	W	N	30·05
28	E	S	29·96
Mean			29·970
Δ_2			·002
Mean R.A.			14 25 29·972

204 B.Boötis
Dec. 42° 12′

Date	Clamp	Observer	Mean R.A. 1910·0
May 5	W	S	14 26 03·98
6	W	N	04·03
7	W	S	03·98
11	W	S	03·97
15	W	S	03·97
16	E	N	03·93
19	E	S	03·99
21	E	N	03·99
26	W	N	03·96
28	W	N	03·96
June 3	W	S	03·97
4	W	S	03·99
8	W	N	04·08
10	E	N	03·95
Mean			03·982
Δ_2			−·001
Mean R.A.			14 26 03·981

5 Ursae Minoris
Dec. 76° 06′

Date	Clamp	Observer	Mean R.A. 1910·0
June 25	W	S	14 27 42·26
28	E	S	42·17
Mean			42·215
Δ_1			·000
Δ_2			·007
Mean R.A.			14 27 42·222

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 534
Dec. 30° 46′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 5	W	S	14 27 57·13
6	W	N	57·07
7	W	S	57·11
11	W	S	57·06
15	W	S	57·04
16	E	N	57·01
19	E	S	57·07
21	E	N	57·11
26	W	N	57·05
28	W	N	57·08
June 3	W	S	57·05
4	W	S	57·11
8	W	N	57·11
9	W	S	57·06
10	E	N	57·09
13	E	N	57·07
15	E	S	57·08
18	W	N	57·09
19	W	S	57·09
Mean			57·078
Δ_1			·002
Δ_2			·000
Mean R.A.			14 27 57·080

B.J. 535
Dec. 38° 42′

Date	Clamp	Observer	Mean R.A. 1910·0
May 17	E	S	14 28 27·24
26	W	N	27·30
28	W	N	27·25
June 8	W	N	27·30
10	E	N	27·26
13	E	N	27·27
15	E	S	27·24
18	W	N	27·35
19	W	S	27·25
Mean			27·273
Δ_1			—·003
Δ_2			—·001
Mean R.A.			14 28 27·269

σ Boötis
Dec. 30° 08′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 6	W	N	14 30 45·71
11	W	S	45·69
15	W	S	45·70
16	E	N	45·76
17	E	S	45 70
19	E	S	45·70
21	E	N	45·72
26	W	N	45·74
27	W	S	45·73
28	W	N	45·72
June 3	W	S	45·72
4	W	S	45·72
8	W	N	45·65
9	W	S	45·68
10	E	N	45·69
13	E	S	45·73
18	W	S	45·69
19	W	N	45·69
25	W	S	45·68
28	E	S	45·72
Mean			45·707
Δ_1			·004
Δ_2			·000
Mean R.A.			14 30 45·711

B.J. 540
Dec. 44° 48′

Date	Clamp	Observer	Mean R.A. 1910·0
May 6	W	N	14 35 29·28
11	W	S	29·28
15	W	S	29·25
16	E	N	29·27
19	E	S	29·17
21	E	N	29·30
26	W	N	29·21
27	W	S	29·28
28	W	N	29·27
June 3	W	S	29·29
4	W	S	29·25
8	W	N	29·34
9	W	S	29·25
10	E	N	29·26
13	E	N	29·21
15	E	S	29·25
18	W	N	29·32
19	W	S	29·25

B.J. 540
(continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Mean			14 35 29·263
Δ_1			—·002
Δ_2			—·001
Mean R.A.			14 35 29·260

B.D. 80·448
Dec. 80° 03′

Date	Clamp	Observer	Mean R.A. 1910·0
June 25	W	S	14 36 05·55
28	E	S	05·55
Mean			05·550
Δ_2			·009
Mean R.A.			14 36 05·559

B.J. 543
Dec. 14° 07′

Date	Clamp	Observer	Mean R.A. 1910·0
May 11	W	S	14 36 51·07
15	W	S	51·05
16	E	N	51·04
19	E	S	51·04
21	E	N	51·07
26	W	N	51·05
27	W	S	51·06
28	W	N	51·07
June 3	W	S	51·03
4	W	S	51·08
8	W	N	51·00
9	W	S	50·98
10	E	N	51·07
13	E	N	51·06
15	E	S	51·04
18	W	N	51·03
19	W	S	51·02
Mean			51·045
Δ_1			·000
Δ_2			·000
Mean R.A.			14 36 51·045

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

34 Boötis
Dec. 26° 55′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 11	W	S	14 39 28·08
15	W	S	28·02
16	E	N	28·03
19	E	S	28·06
21	E	N	28·05
26	W	N	28·05
27	W	S	28·03
28	W	N	28·12
June 3	W	S	27·99
4	W	S	28·09
8	W	N	28·10
9	W	S	28·03
10	E	N	28·04
13	E	N	28·00
15	E	S	28·03
18	W	N	28·08
19	W	S	28·01
Mean			28·048
Δ_2			·000
Mean R.A.			14 39 28·048

295 B.Boötis
Dec. 38° 11′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 11	W	S	14 45 34·66
15	W	S	34·68
16	E	N	34·75
19	E	S	34·70
21	E	N	34·73
26	W	N	34·68
27	W	S	34·69
28	W	N	34·72
June 3	W	S	34·71
4	W	S	34·63
8	W	N	34·73
9	W	S	34·74
10	E	N	34·69
13	E	S	34·72
18	W	S	34·72
19	W	N	34·58
25	W	S	34·70
28	E	S	34·67
Mean			34·694
Δ_2			·000
Mean R.A.			14 45 34·694

B.J. 549
Dec. 59° 40′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 16	E	N	14 49 09·09
21	E	N	09·18
26	W	N	09·23
27	W	S	09·20
28	W	N	09·24
June 3	W	S	09·22
4	W	S	09·24
8	W	N	09·26
9	W	S	09·26
10	E	N	09·22
13	E	N	09·30
15	E	S	09·23
18	W	N	09·27
19	W	S	09·26
28	E	S	09·24
29	E	S	09·23
Mean			09·229
Δ_1			−·001
Δ_2			−·001
Mean R.A.			14 49 09·227

ε Boötis
Dec. 27° 27′

Date	Clamp	Observer	Mean R.A. 1910·0
May 11	W	S	14 41 03·42
15	W	S	03·41
16	E	N	03·43
19	E	S	03·43
21	E	N	03·45
26	W	N	03·33
27	W	S	03·41
28	W	N	03·43
June 3	W	S	03·41
4	W	S	03·41
8	W	N	03·41
9	W	S	03·37
10	E	N	03·45
13	E	N	03·45
15	E	S	03·38
18	W	N	03·38
19	W	S	03·13
Mean			03·412
Δ_1			·003
Δ_2			·000
Mean R.A.			14 41 03·415

ξ Boötis
Dec. 19° 28′

Date	Clamp	Observer	Mean R.A. 1910·0
May 11	W	S	14 47 14·14
15	W	S	14·03
16	E	N	14·10
19	E	S	14·10
21	E	N	14·19
26	W	N	14·16
27	W	S	14·08
28	W	N	14·12
June 3	W	S	14·13
4	W	S	14·06
8	W	N	14·17
9	W	S	14·09
10	E	N	14·09
13	E	N	14·11
15	E	S	14·09
18	W	N	14·08
19	W	S	14·12
Mean			14·109
Δ_2			·000
Mean R.A.			14 47 14·109

B.J. 550
Dec. 74° 31′

Date	Clamp	Observer	Mean R.A. 1910·0
June 25	W	S	14 50 57·35
28	E	S	57·37
29	E	S	57·37
Mean			57·363
Δ_1			−·003
Δ_2			·011
Mean R.A.			14 50 57·371

B.J. 551
Dec. 14° 49′

Date	Clamp	Observer	Mean R.A. 1910·0
May 15	W	S	14 51 58·28
19	E	S	58·32
27	W	S	58·31
28	W	N	58·30
June 3	W	S	58·33
8	W	N	58·32
9	W	S	58·30
10	E	N	58·29
13	E	N	58·28

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 551 (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
June 15	E	S	14 51 58·27
18	W	N	58·26
19	W	S	58·32
July 5	E	S	58·32

Mean 58·300
Δ_1 −·005
Δ_2 ·001
Mean R.A. 14 51 58·296

Groombridge 2184
Dec. 78° 32′

Date	Clamp	Observer	Mean R.A. 1910·0
June 25	W	S	14 55 09·59
28	E	S	09·58
29	E	S	09·44

Mean 09·537
Δ_2 ·016
Mean R.A. 14 55 09·553

B.J. 555
Dec. 40° 45′

Date	Clamp	Observer	Mean R.A. 1910·0
May 15	W	S	14 58 33·33
19	E	S	33·32
26	W	N	33·30
27	W	S	33·31
28	W	N	33·29
June 3	W	S	33·31
4	W	S	33·35
8	W	N	33·28
9	W	S	33·33
10	E	N	33·39
13	E	S	33·37
18	W	S	33·35
19	W	N	33·31
28	E	S	33·33
29	E	S	33·33
July 5	E	S	33·37
6	E	N	33·38

Mean 33·332
Δ_1 ·003
Δ_2 ·000
Mean R.A. 14 58 33·335

B.J. 557
Dec. 27° 18′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 15	W	S	15 00 35·34
19	E	S	35·34
28	W	N	35·39
June 3	W	S	35·34
4	W	S	35·40
8	W	N	35·34
10	E	N	35·35
13	E	N	35·36
15	E	S	35·36
18	W	N	35·32
19	W	S	35·35
July 5	E	S	35·35
6	E	N	35·37

Mean 35·355
Δ_1 ·001
Δ_2 ·000
Mean R.A. 15 00 35·356

***i* Boötis**
Dec. 48° 00′

Date	Clamp	Observer	Mean R.A. 1910·0
May 27	W	S	15 00 49·42
June 9	W	S	49·46

Mean 49·440
Δ_2 −·001
Mean R.A. 15 00 49·439

***c* Boötis**
Dec. 25° 13′

Date	Clamp	Observer	Mean R.A. 1910·0
May 11	W	S	15 03 20·89
15	W	S	20·85
19	E	S	20·88
27	W	S	20·86
June 3	W	S	20·84
4	W	S	20·95
8	W	N	20·83
9	W	S	20·82
10	E	N	20·84

Mean 20·862
Δ_1 ·003
Δ_2 ·001
Mean R.A. 15 03 20·866

B.J. 563
Dec. 33° 39′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 15	W	S	15 11 52·44
27	W	S	52·43
28	W	N	52·43
June 3	W	S	52·45
4	W	S	52·56
8	W	N	52·39
9	W	S	52·45
10	E	N	52·46
13	E	N	52·43
15	E	S	52·45
18	W	N	52·52
19	W	S	52·45
25	W	S	52·52
28	E	S	52·46
29	E	S	52·46
July 5	E	S	52·45
6	E	N	52·44
13	E	N	52·50

Mean 52·461
Δ_1 ·000
Δ_2 ·000
Mean R.A. 15 11 52·461

11 Ursae Minoris
Dec. 72° 09′

Date	Clamp	Observer	Mean R.A. 1910·0
June 25	W	S	15 17 09·60
28	E	S	09·65
29	E	S	09·41
July 11	E	N	09·83
13	E	N	09·72

Mean 09·642
Δ_2 ·009
Mean R.A. 15 17 09·651

η Coronae Borealis
Dec. 30° 37′

Date	Clamp	Observer	Mean R.A. 1910·0
May 11	W	S	15 19 29·22
15	W	S	29·17
27	W	S	29·16
28	W	N	29·11

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

η Coronae Borealis (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
June 3	W	S	15 19 29·16
4	W	S	29·10
8	W	N	29·14
9	W	S	29·17
13	E	N	29·17
15	E	S	29·15
18	W	N	29·22
19	W	S	29·17
29	E	S	29·15
July 5	E	S	29·17
11	E	N	29·25
13	E	N	29·18

Mean 29·168
Δ_1 ·000
Δ_2 ·000

Mean R.A. 15 19 29·168

B.J. 569
Dec. 72° 09′

Date	Clamp	Observer	Mean R.A. 1910·0
June 25	W	S	15 20 51·78
28	E	S	51·68
29	E	S	51·66
July 13	E	N	51·88

Mean 51·750
Δ_1 ·001
Δ_2 ·010

Mean R.A. 15 20 51·761

B.J. 568
Dec. 37° 42′

Date	Clamp	Observer	Mean R.A. 1910·0
May 11	W	S	15 21 05·44
15	W	S	05·39
27	W	S	05·37
28	W	N	05·43
June 3	W	S	05·46
4	W	S	05·26
8	W	N	05·39
9	W	S	05·40
10	E	N	05·38
13	E	S	05·41

B.J. 568
(continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
June 18	W	S	15 21 05·39
19	W	N	05·44
July 5	E	S	05·40
6	E	N	05·43

Mean 05·399
Δ_1 ·000
Δ_2 ·000

Mean R.A. 15 21 05·399

B.J. 571
Dec. 59° 17′

Date	Clamp	Observer	Mean R.A. 1910·0
May 27	W	S	15 22 55·42
28	W	N	55·41
June 3	W	S	55·49
4	W	S	55·56
8	W	N	55·47
9	W	S	55·48
10	E	N	55·50
13	E	S	55·49
18	W	S	55·58
19	W	N	55·66
25	W	S	55·50
28	E	S	55·48
29	E	S	55·49
July 5	E	S	55·47
6	E	N	55·50
11	E	N	55·53
13	E	N	55·54

Mean 55·504
Δ_1 −·002
Δ_2 ·000

Mean R.A. 15 22 55·502

B.J. 572
Dec. 29° 25′

Date	Clamp	Observer	Mean R.A. 1910·0
May 11	W	S	15 24 07·10
15	W	S	07·06
27	W	S	07·11
June 3	W	S	07·06

B.J. 572
(continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
June 4	W	S	15 24 07·11
9	W	S	07·04
10	E	N	07·06
13	E	N	07·09
15	E	S	07·06
18	W	N	07·07
19	W	S	07·08
July 5	E	S	07·08
6	E	N	07·14

Mean 07·082
Δ_1 ·003
Δ_2 ·001

Mean R.A. 15 24 07·086

B.J. 573
Dec. 41° 08′

Date	Clamp	Observer	Mean R.A. 1910·0
May 11	W	S	15 27 41·76
15	W	S	41·77
27	W	S	41·74
28	W	N	41·78
June 3	W	S	41·79
4	W	S	41·74
8	W	N	41·70
9	W	S	41·75
10	E	N	41·77
13	E	N	41·83
15	E	S	41·70
18	W	N	41·79
19	W	S	41·73
25	W	S	41·75r
28	E	S	41·71
29	E	S	41·76
July 5	E	S	41·78r
6	E	N	41·78
11	E	N	41·80r
13	E	N	41·75

Mean 41·759
Δ_1 −·003
Δ_2 ·000

Mean R.A. 15 27 41·756

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

ν² Boötis
Dec. 41° 12′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 11	W	S	15 28 33·67
15	W	S	33·60
27	W	S	33·55
28	W	N	33·68
June 3	W	S	33·64
4	W	S	33·60
8	W	N	33·69
9	W	S	33·62
10	E	N	33·73
13	E	N	33·63
15	E	S	33·60
18	W	N	33·67
19	W	S	33·62
25	W	S	33·65
29	E	S	33·63r
July 5	E	S	33·60
6	E	N	33·63r
11	E	N	33·67
13	E	N	33·64r

Mean 33·638
Δ_2 ·000

Mean R.A. 15 28 33·638

B.J. 576
Dec. 31° 40′

Date	Clamp	Observer	Mean R.A. 1910·0
May 27	W	S	15 29 17·96
28	W	N	18·04
June 3	W	S	17·97
10	E	N	18·05
13	E	S	17·96
18	W	S	18·01
19	W	N	18·01
25	W	S	18·00
28	E	S	17·99
29	E	S	18·01
July 13	E	N	18·06

Mean 18·005
Δ_1 —·005
Δ_2 ·000

Mean R.A. 15 29 18·000

B.J. 578
Dec. 27° 01′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 15	W	S	15 30 52·69
19	E	S	52·80
27	W	S	52·67
28	W	N	52·61
June 3	W	S	52·67
4	W	S	52·58
8	W	N	52·58
9	W	S	52·62
10	E	N	52·58
13	E	N	52·65
15	E	S	52·65
18	W	N	52·63
19	W	S	52·65
July 5	E	S	52·64
6	E	N	52·65
13	E	N	52·64

Mean 52·644
Δ_1 —·001
Δ_2 ·000

Mean R.A. 15 30 52·643

θ Ursae Minoris
Dec. 77° 39′

Date	Clamp	Observer	Mean R.A. 1910·0
June 25	W	S	15 34 03·88
28	E	S	03·88
29	E	S	03·98
July 11	E	N	03·96
13	E	N	04·09

Mean 03·958
Δ_2 ·014

Mean R.A. 15 34 03·972

B.J. 580
Dec. 40° 39′

Date	Clamp	Observer	Mean R.A. 1910·0
May 15	W	S	15 34 35·60
19	E	S	35·59
27	W	S	35·65
28	W	N	35·62

B.J. 580
(continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
June 3	W	S	15 34 35·59
4	W	S	35·64
8	W	N	35·65
9	W	S	35·69
10	E	N	35·68
13	E	S	35·63
18	W	S	35·62
19	W	N	35·56
July 5	E	S	35·63
6	E	N	35·62

Mean 35·626
Δ_1 ·002
Δ_2 ·000

Mean R.A. 15 34 35·628

ζ Coronae Borealis
Dec. 36° 56′

Date	Clamp	Observer	Mean R.A. 1910·0
May 15	W	S	15 35 59·28
19	E	S	59·23
27	W	S	59·29
28	W	N	59·30
June 3	W	S	59·27
4	W	S	59·30
8	W	N	59·33
9	W	S	59·32
10	E	N	59·29
13	E	N	59·29
15	E	S	59·25
18	W	N	59·35
19	W	S	59·24
July 5	E	S	59·22
6	E	N	59·26
13	E	N	59·35

Mean 59·286
Δ_1 —·005
Δ_2 ·000

Mean R.A. 15 35 59·281

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

ι Serpentis
Dec. 19° 58′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 15	W	S	15 37 32·27
19	E	S	32·28
27	W	S	32·22
28	W	N	32·31
June 3	W	S	32·26
4	W	S	32·31
8	W	N	32·28
9	W	S	32·25
10	E	N	32·25
13	E	N	32·32
15	E	S	32·26
18	W	N	32·30
19	W	S	32·25
July 5	E	S	32·28
6	E	N	32·28
11	E	N	32·25
13	E	N	32·25

Mean 32·272
Δ_2 ·000
Mean R.A. 15 37 32·272

B.J. 581
Dec. 26° 35′

Date	Clamp	Observer	Mean R.A. 1910·0
May 19	E	S	15 38 57·75
27	W	S	57·66
28	W	N	57·76
June 3	W	S	57·80
4	W	S	57·77
8	W	N	57·82
9	W	S	57·77
10	E	N	57·77
13	E	N	57·74
15	E	S	57·78
18	W	N	57·75
19	W	S	57·79
July 4	E	S	57·80
6	E	N	57·79
11	E	N	57·79
13	E	N	57·69

Mean 57·764
Δ_1 −·005
Δ_2 ·000
Mean R.A. 15 38 57·759

B.J. 583
Dec. 15° 42′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 19	E	S	15 42 02·01
26	W	N	01·99
27	W	S	01·93
28	W	N	01·94
June 3	W	S	02·00
4	W	S	01·98
8	W	N	02·07
9	W	S	02·01
10	E	N	01·91
13	E	N	01·97
15	E	S	01·99
18	W	N	02·00
19	W	S	01·99
July 5	E	S	02·01
6	E	N	01·97
11	E	N	02·01r
13	E	N	01·98

Mean 01·986
Δ_1 ·002
Δ_2 ·000
Mean R.A. 15 42 01·988

B.J. 584
Dec. 18° 25′

Date	Clamp	Observer	Mean R.A. 1910·0
May 19	E	S	15 44 41·30
26	W	N	41·33
27	W	S	41·33
28	W	N	41·28
June 3	W	S	41·26
4	W	S	41·25
8	W	N	41·25
9	W	S	41·30
10	E	N	41·27
13	E	N	41·26
15	E	S	41·22
18	W	N	41·26
19	W	S	41·29
July 5	E	S	41·26r
6	E	N	41·23r
11	E	N	41·26
13	E	N	41·21r

Mean 41·268
Δ_1 −·002
Δ_2 ·000
Mean R.A. 15 44 41·266

B.J. 590
Dec. 78° 04′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
June 25	W	S	15 47 14·82
28	E	S	14·91
29	E	S	14·98
July 11	E	N	14·91
13	E	N	15·28

Mean 14·980
Δ_1 ·000
Δ_2 ·015
Mean R.A. 15 47 14·995

χ Herculis
Dec. 42° 42′

Date	Clamp	Observer	Mean R.A. 1910·0
May 19	E	S	15 49 33·78
26	W	N	33·76
27	W	S	33·83
28	W	N	33·83
June 3	W	S	33·73
4	W	S	33·72
8	W	N	33·80
9	W	S	33·78
10	E	N	33·73
13	E	S	33·78
18	W	S	33·76
19	W	N	33·74
25	W	S	33·76r
28	E	S	33·75
29	E	S	33·77r
July 4	E	S	33·74
5	E	S	33·78
6	E	N	33·76
11	E	N	33·73
13	E	N	33·77

Mean 33·765
Δ_1 ·000
Δ_2 ·000
Mean R.A. 15 49 33·765

B.J. 591
Dec. 15° 57′

Date	Clamp	Observer	Mean R.A. 1910·0
May 19	E	S	15 52 17·63
26	W	N	17·78
27	W	S	17·70
28	W	N	17·67

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 591 (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
June 3	W	S	15 52 17·67
4	W	S	17·60
8	W	N	17·73
9	W	S	17·69
10	E	N	17·69
13	E	N	17·73
15	E	S	17·70
18	W	N	17·74
19	W	S	17·75
July 4	E	S	17·67
5	E	S	17·72
6	E	N	17·71
11	E	N	17·73
13	E	N	17·76
Mean			17·704
Δ_1			·000
Δ_2			·000
Mean R.A.			15 52 17·704

B.J. 593 Dec. 27° 08′

Date	Clamp	Observer	Mean R.A. 1910·0
May 19	E	S	15 53 51·63
26	W	N	51·71
27	W	S	51·73
28	W	N	51·70
June 3	W	S	51·69
4	W	S	51·62
8	W	N	51·67
9	W	S	51·61
10	E	N	51·67
13	E	N	51·62
15	E	S	51·62
18	W	N	51·58
19	W	S	51·68
July 4	E	S	51·65
5	E	S	51·67
6	E	N	51·59
11	E	N	51·59
13	E	N	51·68
Mean			51·651
Δ_1			−·003
Δ_2			·000
Mean R.A.			15 53 51·648

B.J. 595 Dec. 55° 00′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 19	E	S	15 55 39·16
26	W	N	39·14
27	W	S	39·19
28	W	N	39·23
June 3	W	S	39·15
4	W	S	39·27
8	W	N	39·14
9	W	S	39·20
10	E	N	39·10
13	E	S	39·20
18	W	S	39·20
19	W	N	39·24
25	W	S	39·26
28	E	S	39·17r
29	E	S	39·18
July 4	E	S	39·19
5	E	S	39·14
6	E	N	39·21
11	E	N	39·18
13	E	N	39·19
Mean			39·187
Δ_1			−·005
Δ_2			·001
Mean R.A.			15 55 39·183

τ Herculis Dec. 18° 04′

Date	Clamp	Observer	Mean R.A. 1910·0
May 19	E	S	15 57 11·61
26	W	N	11·63
27	W	S	11·61
28	W	N	11·65
June 3	W	S	11·66
4	W	S	11·61
8	W	N	11·70
9	W	S	11·64
10	E	N	11·69
13	E	N	11·69
15	E	S	11·60
18	W	N	11·57
19	W	S	11·67
July 4	E	S	11·62
5	E	S	11·66
6	E	N	11·59
11	E	N	11·57
13	E	N	11·73
Mean			11·639
Δ_2			·000
Mean R.A.			15 57 11·639

B.J. 598 Dec. 58° 48′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 19	E	S	16 00 11·95
26	W	N	12·01
27	W	S	12·05
June 3	W	S	11·96
4	W	S	12·00
8	W	N	11·99
9	W	S	11·99
10	E	N	11·96
13	E	N	12·12
15	E	S	12·00
18	W	N	11·95
19	W	S	12·03
25	W	S	11·94
28	E	S	12·00
29	E	S	11·99
July 4	E	S	11·98
5	E	S	11·97
6	E	N	11·99
11	E	N	11·94
13	E	N	11·89
Mean			11·986
Δ_1			·003
Δ_2			·001
Mean R.A.			16 00 11·990

κ Herculis Dec. 17° 17′

Date	Clamp	Observer	Mean R.A. 1910·0
May 19	E	S	16 04 00·74
27	W	S	00·77
June 3	W	S	00·74
4	W	S	00·74
8	W	N	00·77
9	W	S	00·73
10	E	N	00·73
13	E	N	00·73
15	E	S	00·78
18	W	N	00·68
19	W	S	00·81
July 4	E	S	00·78
5	E	S	00·74
6	E	N	00·75
13	E	N	00·75
Mean			00·749
Δ_1			·002
Δ_2			·000
Mean R.A.			16 04 00·751

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

τ Coronae Borealis
Dec. 36° 43′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 19	E	S	16 05 40·82
June 3	W	S	40·76
4	W	S	40·78
8	W	N	40·75
10	E	N	40·73
13	E	N	40·78
15	E	S	40·76
18	W	N	40·77
19	W	S	40·78
July 6	E	N	40·82
13	E	N	40·84
Mean			40·781
Δ_2			·000
Mean R.A.			16 05 40·781

B.J. 601
Dec. 45° 10′

Date	Clamp	Observer	Mean R.A. 1910·0
May 27	W	S	16 05 56·11
June 9	W	S	56·07
Mean			56·090
Δ_1			—·002
Δ_2			—·001
Mean R.A.			16 05 56·087

σ² Coronae Borealis
Dec. 34° 05′

Date	Clamp	Observer	Mean R.A. 1910·0
May 19	E	S	16 11 18·55
June 4	W	S	18·42
9	W	S	18·56
13	E	N	18·54
15	E	S	18·50
18	W	N	18·47
19	W	S	18·51
July 4	E	S	18·46
5	E	S	18·49
6	E	N	18·50
11	E	N	18·53
13	E	N	18·50
Mean			18·503
Δ_1			—·002
Δ_2			·001
Mean R.A.			16 11 18·502

B.J. 606
Dec. 76° 06′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
June 25	W	S	16 13 22·36
28	E	S	22·39
29	E	S	22·50
July 11	E	N	22·57
13	E	N	22·37
Mean			22·438
Δ_1			—·004
Δ_2			·013
Mean R.A.			16 13 22·447

20 Ursae Minoris
Dec. 75° 26′

Date	Clamp	Observer	Mean R.A. 1910·0
July 13	E	N	16 14 47·14
Δ_2			·012
Mean R.A.			16 14 47·152

Groombridge 2337
Dec. 73° 37′

Date	Clamp	Observer	Mean R.A. 1910·0
June 25	W	S	16 16 01·61
28	E	S	01·46
29	E	S	01·47
Mean			01·513
Δ_2			·011
Mean R.A.			16 16 01·524

B.J. 608
Dec. 46° 32′

Date	Clamp	Observer	Mean R.A. 1910·0
June 9	W	S	16 17 02·08
13	E	N	02·03
15	E	S	02·11
18	W	N	02·11
19	W	S	02·10
July 4	E	S	02·00
5	E	S	02·07
6	E	N	02·03
Mean			02·066
Δ_1			·000
Δ_2			·001
Mean R.A.			16 17 02·067

B.J. 609
Dec. 19° 22′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 19	E	S	16 17 56·92
June 4	W	S	56·97
Mean			56·945
Δ_1			·004
Δ_2			·002
Mean R.A.			16 17 56·951

ξ Coronae Borealis
Dec. 31° 06′

Date	Clamp	Observer	Mean R.A. 1910·0
June 13	E	N	16 18 35·42
15	E	S	35·43
18	W	N	35·42
19	W	S	35·41
29	E	S	35·40
July 4	E	S	35·38
5	E	S	35·35
6	E	N	35·31
11	E	N	35·37
13	E	N	35·37
Mean			35·386
Δ_2			·001
Mean R.A.			16 18 35·387

23 Herculis
Dec. 32° 33′

Date	Clamp	Observer	Mean R.A. 1910·0
May 19	E	S	16 19 29·11
June 4	W	S	29·11
13	E	S	29·10
18	W	S	29·19
19	W	N	29·25
July 4	E	S	29·10
5	E	S	29·13
6	E	N	29·18
Mean			29·146
Δ_2			·001
Mean R.A.			16 19 29·147

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 612
Dec. 75° 58′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
June 25	W	S	16 20 07·35r
29	E	S	07·33r
July 11	E	N	07·38
13	E	N	07·20r
Mean			07·315
Δ_1			— ·003
Δ_2			·009
Mean R.A.			16 20 07·321

B.J. 613
Dec. 14° 14′

Date	Clamp	Observer	Mean R.A. 1910·0
May 19	E	S	16 21 15·69
June 4	W	S	15·63
13	E	N	15·64
15	E	S	15·71
19	W	S	15·73
July 4	E	S	15·66
5	E	S	15·70
6	E	N	15·71
Mean			15·684
Δ_1			— ·005
Δ_2			·000
Mean R.A.			16 21 15·679

B.J. 614
Dec. 55° 25′

Date	Clamp	Observer	Mean R.A. 1910·0
May 26	W	N	16 22 27·13
June 15	E	S	27·04
19	W	S	27·10
25	W	S	27·22r
28	E	S	27·09
29	E	S	27·13r
July 4	E	S	27·07
5	E	S	27·06
6	E	N	27·16
11	E	N	27·16r
13	E	N	27·06r
19	E	S	27·17
Mean			27·116
Δ_1			— ·001
Δ_2			·003
Mean R.A.			16 22 27·118

g Herculis
Dec. 42° 05′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 19	E	S	16 25 41·04
June 4	W	S	41·09
13	E	N	41·07
15	E	S	41·12
18	W	N	41·11
19	W	S	41·13
25	W	S	41·14
28	E	S	41·16r
29	E	S	41·10
July 4	E	S	41·14
5	E	S	41·11
6	E	N	41·07
11	E	N	41·11
13	E	N	41·16r
19	E	S	41·13
Mean			41·112
Δ_2			·002
Mean R.A.			16 25 41·114

B.J. 618
Dec. 21° 41′

Date	Clamp	Observer	Mean R.A. 1910·0
July 6	E	N	16 26 21·01
Δ_1			·003
Δ_2			— ·002
Mean R.A.			16 26 21·011

Groombridge 2372
Dec. 79° 09′

Date	Clamp	Observer	Mean R.A. 1910·0
June 25	W	S	16 30 43·03
28	E	S	42·96r
29	E	S	42·90
July 11	E	N	43·14
13	E	N	42·92
19	E	S	43·07r
Mean			43·003
Δ_2			·019
Mean R.A.			16 30 43·022

B.J. 621
Dec. 42° 37′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 19	E	S	16 31 12·06
26	W	N	12·10
27	W	S	12·00
June 13	E	S	12·01
18	W	S	12·01
19	W	N	12·08
July 4	E	S	12·03
5	E	S	12·02
6	E	N	12·01
Mean			12·036
Δ_1			·003
Δ_2			·001
Mean R.A.			16 31 12·040

B.D. 72·734
Dec. 72° 48′

Date	Clamp	Observer	Mean R.A. 1910·0
June 25	W	S	16 32 50·56
28	E	S	50·50
29	E	S	50·53
July 11	E	N	50·67
13	E	N	50·58
19	E	S	50·61
Mean			50·575
Δ_2			·011
Mean R.A.			16 32 50·586

B.J. 623
Dec. 77° 38′

Date	Clamp	Observer	Mean R.A. 1910·0
June 25	W	S	16 34 30·06
July 11	E	N	30·04
13	E	N	29·97
19	E	S	29·97
Mean			30·010
Δ_1			— ·004
Δ_2			·010
Mean R.A.			16 34 30·016

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

Date	Clamp	Observer	Mean R.A. 1910·0
42 Herculis Dec. 49° 06′			
			h m s
May 27	W	S	16 36 18·19
June 18	W	S	18·19
19	W	N	18·32
July 5	E	S	18·15
Mean			18·213
Δ_2			—·001
Mean R.A.			16 36 18·212
ζ Herculis Dec. 31° 46′			
May 19	E	S	16 37 53·65
27	W	S	53·61
June 13	E	N	53·63
15	E	S	53·63
18	W	N	53·60
19	W	S	53·66
July 4	E	S	53·60
5	E	S	53·57
6	E	N	53·58
11	E	N	53·59
Mean			53·612
Δ_1			—·001
Δ_2			·001
Mean R.A.			16 37 53·612
B.J. 626 Dec. 39° 06′			
May 19	E	S	16 39 48·53
26	W	N	48·56
27	W	S	48·62
June 13	E	N	48·61
15	E	S	48·64
18	W	N	48·59
19	W	S	48·61
25	W	S	48·63
28	E	S	48·60
29	E	S	48·56
July 4	E	S	48·56
5	E	S	48·61
6	E	N	48·62
11	E	N	48·60
13	E	N	48·60
19	E	S	48·60

Date	Clamp	Observer	Mean R.A. 1910·0
B.J. 626 (continued)			
			h m s
Mean			16 39 48·596
Δ_1			·001
Δ_2			·001
Mean R.A.			16 39 48·598
B.D. 79·511 Dec. 79° 05′			
June 25	W	S	16 42 58·75r
28	E	S	58·92
29	E	S	58·87r
July 11	E	N	58·80r
13	E	N	58·67r
19	E	S	58·80
Mean			58·802
Δ_2			·019
Mean R.A.			16 42 58·821
B.J. 627 Dec. 56° 57′			
May 19	E	S	16 43 35·10
26	W	N	35·19
27	W	S	35·23
June 13	E	S	35·28
18	W	S	35·30
19	W	N	35·37
July 4	E	S	35·29
5	E	S	35·24
6	E	N	35·19
26	W	S	35·25
Mean			35·244
Δ_1			·003
Δ_2			·001
Mean R.A.			16 43 35·248
Groombridge 2391 Dec. 77° 40′			
June 25	W	S	16 47 05·69
29	E	S	05·63
July 11	E	N	05·77
19	E	S	05·67

Date	Clamp	Observer	Mean R.A. 1910·0
Groombridge 2391 (continued)			
			h m s
Mean			16 47 05·690
Δ_2			·014
Mean R.A.			16 47 05·704
B. J. 629 Dec. 15° 07′			
May 27	W	S	16 47 58·93
June 13	E	N	59·11
15	E	S	59·05
19	W	S	58·95
July 4	E	S	58·94
5	E	S	58·97
6	E	N	58·94
26	W	S	58·93
Mean			58·977
Δ_1			—·003
Δ_2			·001
Mean R.A.			16 47 58·975
53 Herculis Dec. 31° 51′			
May 26	W	N	16 49 33·31
27	W	S	33·27
June 13	E	N	33·18
15	E	S	33·24
18	W	N	33·27
19	W	S	33·25
29	E	S	33·18
July 4	E	S	33·21
5	E	S	33·21
6	E	N	33·16
11	E	N	33·24
13	E	N	33·27
16	E	S	33·19
19	E	S	33·24
26	W	S	33·21
Mean			33·229
Δ_2			·001
Mean R.A.			16 49 33·230

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

Groombridge 2411
Dec. 73° 16′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
June 25	W	S	16 58 03·68
28	E	S	03·26
29	E	S	03·43
July 11	E	N	03·45
13	E	N	03·38
19	E	S	03·47
Aug. 12	W	N	03·67
Mean			03·477
Δ_2			·007
Mean R.A.			16 58 03·484

d Herculis
Dec. 33° 42′

Date	Clamp	Observer	Mean R.A. 1910·0
May 27	W	S	16 58 16·88
June 4	W	S	16·98
July 4	E	S	16·95
5	E	S	16·95
6	E	N	16·97
16	E	S	16·98
26	W	S	16·97
Mean			16·954
Δ_1			·002
Δ_2			·002
Mean R.A.			16 58 16·958

B.J. 635
Dec. 12° 52′

Date	Clamp	Observer	Mean R.A. 1910·0
May 27	W	S	17 01 12·26
June 4	W	S	12·25
July 4	E	S	12·32
5	E	S	12·21
6	E	N	12·21
11	E	N	12·23
13	E	N	12·19
16	E	S	12·27
26	W	S	12·22r
Aug. 12	W	N	12·23
Mean			12·239
Δ_1			·003
Δ_2			·000
Mean R.A.			17 01 12·242

B.D. 75·612
Dec. 75° 21′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
July 11	E	N	17 03 13·28
13	E	N	13·31
19	E	S	13·16
Aug. 12	W	N	13·58
Mean			13·333
Δ_2			·005
Mean R.A.			17 03 13·338

Groombridge 2427
Dec. 75° 25′

Date	Clamp	Observer	Mean R.A. 1910·0
June 25	W	S	17 04 29·45
28	E	S	29·38
29	E	S	29·29
July 13	E	N	29·46
19	E	S	29·42
Aug. 12	W	N	29·61
Mean			29·435
Δ_2			·008
Mean R.A.			17 04 29·443

B.J. 636
Dec. 40° 38′

Date	Clamp	Observer	Mean R.A. 1910·0
May 27	W	S	17 04 50·51
June 4	W	S	50·50
July 5	E	S	50·49
6	E	N	50·51
16	E	S	50·50
26	W	S	50·53
Mean			50·507
Δ_1			−·002
Δ_2			·001
Mean R.A.			17 04 50·506

B.J. 640
Dec. 14° 30′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 27	W	S	17 10 32·66
June 4	W	S	32·62
July 4	E	S	32·65
5	E	S	32·59
11	E	N	32·59
26	W	S	32·55
Aug. 12	W	N	32·56
Mean			32·603
Δ_1			·004
Δ_2			·001
Mean R.A.			17 10 32·608

B.J. 643
Dec. 36° 55′

Date	Clamp	Observer	Mean R.A. 1910·0
May 27	W	S	17 11 54·74
June 4	W	S	54·73
7	W	S	54·66
25	W	S	54·60r
28	E	S	54·74
29	E	S	54·71r
July 4	E	S	54·73
5	E	S	54·70
11	E	N	54·70
13	E	N	54·76
16	E	S	54·72
19	E	S	54·69
26	W	S	54·67
Aug. 12	W	N	54·69
19	E	N	54·70
Mean			54·703
Δ_1			−·001
Δ_2			·001
Mean R.A.			17 11 54·703

u Herculis
Dec. 33° 12′

Date	Clamp	Observer	Mean R.A. 1910·0
June 4	W	S	17 13 60·06
July 4	E	S	60·03
5	E	S	59·97
16	E	S	60·01
26	W	S	59·98
Mean			60·010
Δ_2			·002
Mean R.A.			17 14 00·012

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

ε Herculis
Dec. 37° 23′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
May 27	W	S	17 14 34·00
June 25	W	S	34·04
28	E	S	33·94r
29	E	S	34·00
July 11	E	N	34·02r
13	E	N	34·01r
19	E	S	33·98r
Aug. 12	W	N	34·02
19	E	N	34·01
Mean			34·006
Δ_2			·001
Mean R.A.			17 14 34·007

ω Herculis
Dec. 32° 35′

Date	Clamp	Observer	Mean R.A. 1910·0
May 27	W	S	17 17 17·44
June 4	W	S	17·44
7	W	S	17·42
25	W	S	17·51
28	E	S	17·46
29	E	S	17·43
July 4	E	S	17·47
5	E	S	17·44
13	E	N	17·47
16	E	S	17·43
19	E	S	17·45
26	W	S	17·45
Aug. 12	W	N	17·47
19	E	N	17·44
Mean			17·451
Δ_1			−·004
Δ_2			·001
Mean R.A.			17 17 17·448

ρ Herculis
Dec. 37° 14′

Date	Clamp	Observer	Mean R.A. 1910·0
May 27	W	S	17 20 34·63
June 4	W	S	34·68
7	W	S	34·58
25	W	S	34·69

ρ Herculis.
(continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
June 28	E	S	17 20 34·60
29	E	S	34·62
July 4	E	S	34·62
5	E	S	34·60
11	E	N	34·76
13	E	N	34·64
16	E	S	34·63
19	E	S	34·63
26	W	S	34·60
Aug. 12	W	N	34·64
19	E	N	34·65r
Mean			34·638
Δ_2			·001
Mean R.A.			17 20 34·639

B.J. 650
Dec. 48° 20′

Date	Clamp	Observer	Mean R.A. 1910·0
May 27	W	S	17 24 21·11
June 25	W	S	21·03
28	E	S	20·96
29	E	S	21·00r
July 4	E	S	21·06
5	E	S	20·97
11	E	N	20·95
13	E	N	21·02
16	E	S	20·99
19	E	S	21·00r
26	W	S	21·05
Aug. 7	W	S	21·07r
12	W	N	21·08
19	E	N	21·09
Mean			21·027
Δ_1			·003
Δ_2			·002
Mean R.A.			17 24 21·032

Groombridge 2456
Dec. 80° 13′

Date	Clamp	Observer	Mean R.A. 1910·0
June 25	W	S	17 26 25·41
28	E	S	25·41
29	E	S	25·37

Groombridge 2456
(continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
July 11	E	N	17 26 25·41
13	E	N	25·57
19	E	S	25·45
Aug. 7	W	S	25·41
12	W	N	25·66
19	E	N	25·69
Mean			25·487
Δ_2			·010
Mean R.A.			17 26 25·497

λ Herculis
Dec. 26° 11′

Date	Clamp	Observer	Mean R.A. 1910·0
May 27	W	S	17 27 06·04
July 4	E	S	06·02
5	E	S	06·01
16	E	S	06·06
26	W	S	06·01
Mean			06·028
Δ_1			·004
Δ_2			·002
Mean R.A.			17 27 06·034

B.J. 653
Dec. 52° 22′

Date	Clamp	Observer	Mean R.A. 1910·0
May 27	W	S	17 28 23·83
June 7	W	S	23·84
25	W	S	23·92
28	E	S	24·02
29	E	S	23·83
July 4	E	S	23·90
5	E	S	23·80
16	E	S	23·85
19	E	S	23·88
26	W	S	23·84
Aug. 7	W	S	23·81
12	W	N	23·87
19	E	N	23·94
Mean			23·872
Δ_1			−·002
Δ_2			·002
Mean R.A.			17 28 23·872

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 655
Dec. 55° 15′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
June 25	W	S	17 30 24·11
28	E	S	24·12
29	E	S	24·09
July 19	E	S	24·13
Aug. 7	W	S	24·12
12	W	N	24·07
Mean			24·107
Δ_1			−·005
Δ_2			·002
Mean R.A.			17 30 24·104

B.J. 657
Dec. 55° 14′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 19	E	N	17 30 29·500
Δ_1			−·002
Δ_2			·002
Mean R.A.			17 30 29·500

B.J. 656
Dec. 12° 37′

Date	Clamp	Observer	Mean R.A. 1910·0
July 5	E	S	17 30 45·35r
16	E	S	45·40
26	W	S	45·39
Mean			45·380
Δ_1			−·004
Δ_2			·002
Mean R.A.			17 30 45·378

B.J. 663
Dec. 46° 03′

Date	Clamp	Observer	Mean R.A. 1910·0
May 27	W	S	17 36 55·30
June 7	W	S	55·46
25	W	S	55·38r
28	E	S	55·39r
29	E	S	55·41

B.J. 663
(continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
July 4	E	S	17 36 55·37
5	E	S	55·36
13	E	N	55·48
16	E	S	55·46
19	E	S	55·39
26	W	S	55·41
Aug. 7	W	S	55·37
12	W	N	55·40
19	E	N	55·42
Mean			55·400
Δ_1			−·004
Δ_2			·002
Mean R.A.			17 36 55·398

B.D. 72·800
Dec. 72° 30′

Date	Clamp	Observer	Mean R.A. 1910·0
July 13	E	N	17 38 51·00
19	E	S	50·89
Aug. 7	W	S	50·84r
12	W	N	50·99
19	E	N	51·20
Mean			50·984
Δ_2			·002
Mean R.A.			17 38 50·986

B.J. 667
Dec. 27° 46′

Date	Clamp	Observer	Mean R.A. 1910·0
June 7	W	S	17 42 56·11
July 4	E	S	56·14
5	E	S	56·13
16	E	S	56·11r
26	W	S	56·14
Mean			56·126
Δ_1			−·001
Δ_2			·002
Mean R.A.			17 42 56·127

B.J. 670
Dec. 72° 12′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
July 13	E	N	17 43 32·30
19	E	S	32·15
Aug. 7	W	S	32·19
12	W	N	32·23
19	E	N	32·17
Mean			32·208
Δ_1			·004
Δ_2			·002
Mean R.A.			17 43 32·214

87 Herculis
Dec. 25° 39′

Date	Clamp	Observer	Mean R.A. 1910·0
June 7	W	S	17 45 10·14
July 4	E	S	10·19
5	E	S	10·14r
13	E	N	10·24
16	E	S	10·16
26	W	S	10·15r
Aug. 8	W	N	10·13
12	W	N	10·15
19	E	N	10·17
Mean			10·163
Δ_2			·000
Mean R.A.			17 45 10·163

z Herculis
Dec. 48° 25′

Date	Clamp	Observer	Mean R.A. 1910·0
June 7	W	S	17 47 42·01
July 4	E	S	42·02
5	E	S	41·97
13	E	N	41·99
16	E	S	41·99
19	E	S	41·99
26	W	S	42·01
Aug. 7	W	S	41·99
8	W	N	42·09
12	W	N	42·01
19	E	N	41·95
Mean			42·002
Δ_2			·001
Mean R.A.			17 47 42·003

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

168 H¹. Herculis, Dec. 40° 00′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
June 7	W	S	17 49 08·98
July 4	E	S	08·91
5	E	S	08·92
13	E	N	08·97
16	E	S	08·96
19	E	S	08·96
26	W	S	08·89
Aug. 7	W	S	08·94
8	W	N	08·96
12	W	N	09·00
19	E	N	08·98
Mean			08·952
Δ₂			·001
Mean R.A.			17 49 08·953

89 Herculis, Dec. 26° 04′

Date	Clamp	Observer	Mean R.A. 1910·0
July 4	E	S	17 51 47·29
5	E	S	47·27
13	E	N	47·34
16	E	S	47·33
26	W	S	47·31
Aug. 8	W	N	47·23
12	W	N	47·28
19	E	N	47·27
Mean			47·290
Δ₁			−·004
Δ₂			·000
Mean R.A.			17 51 47·286

B.J. 671, Dec. 56° 53′

Date	Clamp	Observer	Mean R.A. 1910·0
June 7	W	S	17 51 58·270
Δ₁			·003
Δ₂			−·003
Mean R.A.			17 51 58·270

B.J. 672, Dec. 37° 16′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
June 7	W	S	17 53 09·97
July 4	E	S	09·93
5	E	S	09·95
13	E	N	09·93
16	E	S	09·96
26	W	S	09·98
Mean			09·953
Δ₁			·001
Δ₂			·002
Mean R.A.			17 53 09·956

B.J. 675, Dec. 76° 59′

Date	Clamp	Observer	Mean R.A. 1910·0
July 19	E	S	17 53 28·49
Aug. 7	W	S	28·69
12	W	N	28·52
19	E	N	28·63
Mean			28·583
Δ₁			·000
Δ₂			·000
Mean R.A.			17 53 28·583

B.J. 674, Dec. 29° 15′

Date	Clamp	Observer	Mean R.A. 1910·0
July 5	E	S	17 54 16·000
Δ₁			−·005
Δ₂			·003
Mean R.A.			17 54 15·998

B.J. 676, Dec. 51° 30′

Date	Clamp	Observer	Mean R.A. 1910·0
June 7	W	S	17 54 30·92
July 4	E	S	30·90
26.	W	S	30·87
Mean			30·897
Δ₁			−·003
Δ₂			·002
Mean R.A.			17 54 30·896

B.D. 78·616, Dec. 78° 19′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
July 19	E	S	17 55 14·44
Aug. 7	W	S	14·64
8	W	N	14·85
12	W	N	14·74
19	E	N	14·53
Mean			14·640
Δ₂			−·006
Mean R.A.			17 55 14·634

ψ² Draconis, Dec. 72° 01′

Date	Clamp	Observer	Mean R.A. 1910·0
July 19	E	S	17 56 44·61
Aug. 7	W	S	44·58
8	W	N	44·71
19	E	N	44·55
29	E	N	44·65
Mean			44·620
Δ₂			·002
Mean R.A.			17 56 44·622

B.J. 681, Dec. 28° 45′

Date	Clamp	Observer	Mean R.A. 1910·0
July 5	E	S	18 04 01·90
16	E	S	01·87
26	W	S	01·89
Aug. 19	E	N	01·88
26	E	N	01·91
29	E	N	01·88
Mean			01·888
Δ₁			·001
Δ₂			·000
Mean R.A.			18 04 01·889

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

Date	Clamp	Observer	Mean R.A. 1910·0
40 Draconis Dec. 79° 59′			
			h m s
July 19	E	S	18 06 46·72
28	W	N	47·00
Aug. 7	W	S	46·92
8	W	N	46·71
12	W	N	46·85
19	E	N	47·05
26	E	N	47·04
29	E	N	46·84
Mean			46·891
Δ_2			-·004
Mean R.A.			18 06 46·887
B.J. 684 Dec. 42° 08′			
June 7	W	S	18 12 50·80
July 16	E	S	50·78
19	E	S	50·85
26	W	S	50·78
28	W	N	50·75
Aug. 2	W	S	50·79
7	W	S	50·78
8	W	N	50·76
12	W	N	50·79
19	E	N	50·71
26	E	N	50·89
29	E	N	50·76
Mean			50·787
Δ_1			-·004
Δ_2			·000
Mean R.A.			18 12 50·783
446 B. Herculis Dec. 23° 14′			
June 7	W	S	18 18 23·49
July 16	E	S	23·46
26	W	S	23·49
28	W	N	23·43
Aug. 2	W	S	23·44
8	W	N	23·44
12	W	N	23·52
19	E	N	23·46
26	E	N	23·55
29	E	N	23·47
446 B. Herculis (continued)			
			h m s
Mean			18 18 23·475
Δ_2			·000
Mean R.A.			18 18 23·475
B.J. 690 Dec. 21° 44′			
June 7	W	S	18 19 51·75
July 16	E	S	51·74
26	W	S	51·75
28	W	N	51·76
Aug. 2	W	S	51·76r
8	W	N	51·72
12	W	N	51·73
19	E	N	51·76
20	E	S	51·77
26	E	N	51·77
29	E	N	51·78
Mean			51·754
Δ_1			·003
Δ_2			·000
Mean R.A.			18 19 51·757
μ Lyrae Dec. 39° 27′			
June 7	W	S	18 21 15·87
July 16	E	S	15·84
26	W	S	15·88r
Aug. 2	W	S	15·94
8	W	N	15·83
19	E	N	15·91
20	E	S	15·93
26	E	N	15·94
29	E	N	15·92
Mean			15·896
Δ_2			·000
Mean R.A.			18 21 15·896
B.J. 693 Dec. 71° 17′			
			h m s
July 19	E	S	18 22 03·06
Aug. 29	E	N	02·93
Sept.	E	S	02·95
Mean			02·980
Δ_1			-·001
Δ_2			·015
Mean R.A.			18 22 02·994
B.J. 694 Dec. 58° 45′			
June 7	W	S	18 22 35·74
July 16	E	S	35·65
26	W	S	35·80
28	W	N	35·90
Aug. 8	W	N	35·71
20	E	S	35·76
26	E	N	35·73
Mean			35·756
Δ_1			-·004
Δ_2			·000
Mean R.A.			18 22 35·752
B.J. 695 Dec. 72° 42′			
Aug. 7	W	S	18 22 40·81
12	W	N	40·82
19	E	N	40·96
29	E	N	40·68
Mean			40·818
Δ_1			-·004
Δ_2			-·003
Mean R.A.			18 22 40·811

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 699
Dec. 38° 42′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
June 7	W	S	18 33 53·47
July 16	E	S	53·42r
26	W	S	53·45
28	W	N	53·47
Aug. 2	W	S	53·45r
12	W	N	53·47
19	E	N	53·47
20	E	S	53·45r
26	E	N	53·46
29	E	N	53·45r
Mean			53·456
Δ_1			·004
Δ_2			·000
Mean R.A.			18 33 53·460

B.J. 700
Dec. 77° 29′

Date	Clamp	Observer	Mean R.A. 1910·0
July 19	E	S	18 34 06·02
Aug. 7	W	S	06·05
8	W	N	06·28
11	W	S	06·17
Sept. 1	E	S	06·13
Mean			06·130
Δ_1			·004
Δ_2			·000
Mean R.A.			18 34 06·134

B.J. 703
Dec. 20° 28′

Date	Clamp	Observer	Mean R.A. 1910·0
July 16	E	S	18 41 47·27
26	W	S	47·28
30	W	N	47·35
Aug. 2	W	S	47·29
8	W	N	47·25
12	W	N	47·32
20	E	S	47·28
26	E	N	47·31
29	E	N	47·29
Sept. 2	E	N	47·27
Mean			47·291
Δ_1			·002
Δ_2			·000
Mean R.A.			18 41 47·293

111 Herculis
Dec. 18° 05′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
July 16	E	S	18 43 02·77
26	W	S	02·79
28	W	N	02·75
30	W	N	02·84
Aug. 2	W	S	02·79
12	W	N	02·76
19	E	N	02·79
20	E	S	02·77
26	E	N	02·84
29	E	N	02·81
Sept. 2	E	N	02·75
Mean			02·787
Δ_2			·000
Mean R.A.			18 43 02·787

Bradley 2382
Dec. 70° 42′

Date	Clamp	Observer	Mean R.A. 1910·0
July 19	E	S	18 44 11·64
Aug. 7	W	S	11·67
8	W	N	11·64
11	W	S	11·76
12	W	N	11·76
19	E	N	11·97
29	E	N	11·70
Sept. 1	E	S	11·63
2	E	N	11·70
Mean			11·719
Δ_2			·001
Mean R.A.			18 44 11·720

204 B. Draconis
Dec. 52° 53′

Date	Clamp	Observer	Mean R.A. 1910·0
July 16	E	S	18 44 42·33
26	W	S	42·38
28	W	N	42·42
30	W	N	42·47
Aug. 2	W	S	42·39
20	E	S	42·39
26	E	N	42·33
Mean			42·387
Δ_2			·000
Mean R.A.			18 44 42·387

B.J. 705
Dec. 33° 15′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
July 16	E	S	18 46 45·42
19	E	S	45·40
26	W	S	45·39
28	W	N	45·37
Aug. 2	W	S	45·42
8	W	N	45·40
11	W	S	45·38
12	W	N	45·48
19	E	N	45·44
20	E	S	45·32
26	E	N	45·38
29	E	N	45·36
Sept. 1	E	S	45·40
2	E	N	45·40
Mean			45·397
Δ_1			·000
Δ_2			·000
Mean R.A.			18 46 45·397

Groombridge 2719
Dec. 73° 59′

Date	Clamp	Observer	Mean R.A. 1910·0
July 19	E	S	18 48 01·57
Aug. 7	W	S	01·66
8	W	N	01·66
11	W	S	01·62
12	W	N	01·48
19	E	N	01·61
29	E	N	01·60
Sept. 1	E	S	01·43
2	E	N	01·69
Mean			01·591
Δ_2			·001
Mean R.A.			18 48 01·592

50 Draconis
Dec. 75° 20′

Date	Clamp	Observer	Mean R.A. 1910·0
July 19	E	S	18 49 16·89
Aug. 7	W	S	16·90
8	W	N	17·10
11	W	S	17·06
19	E	N	16·86

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

50 Draconis (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Aug. 29	E	N	18 49 17·02
Sept. 1	E	S	16·89
2	E	N	17·07
9	E	N	17·20
Mean			16·999
Δ1			−·002
Δ2			·005
Mean R.A.			18 49 17·002

B.J. 707
Dec. 59° 17′

Date	Clamp	Observer	Mean R.A. 1910·0
July 16	E	S	18 49 52·36
26	W	S	52·48
28	W	N	52·38
30	W	N	52·49
Aug. 2	W	S	52·51
20	E	S	52·34
26	E	N	52·31
Mean			52·410
Δ1			·000
Δ2			·000
Mean R.A.			18 49 52·410

B.D. 79·604
Dec. 79° 50′

Date	Clamp	Observer	Mean R.A. 1910·0
July 19	E	S	18 51 59·91
Aug. 7	W	S	59·89
8	W	N	60·25
12	W	N	60·14
Sept. 1	E	S	59·93
2	E	N	60·12
Mean			60·040
Δ2			·000
Mean R.A.			18 52 00·040

B.J. 711
Dec. 43° 50′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
July 16	E	S	18 52 35·76
26	W	S	35·78
28	W	N	35·79
30	W	N	35·72
Aug. 2	W	S	35·77
19	E	N	35·79
20	E	S	35·79
26	E	N	35·71
29	E	N	35·75
Mean			35·762
Δ1			·002
Δ2			·000
Mean R.A.			18 52 35·764

B.J. 714
Dec. 71° 11′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 8	W	N	18 55 30·22
12	W	N	29·99
Sept. 1	E	S	30·19
2	E	N	30·27
9	E	N	30·31
Mean			30·196
Δ1			−·001
Δ2			·000
Mean R.A.			18 55 30·195

B.J. 713
Dec. 32° 34′

Date	Clamp	Observer	Mean R.A. 1910·0
July 16	E	S	18 55 34·62
26	W	S	34·65
28	W	N	34·56
30	W	N	34·61
Aug. 19	E	N	34·73
20	E	S	34·61
26	E	N	34·61
29	E	N	34·60
Mean			34·624
Δ1			−·003
Δ2			·000
Mean R.A.			18 55 34·621

B.J. 716
Dec. 13° 44′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
June 7	W	S	19 01 16·400
Δ1			·002
Δ2			·003
Mean R.A.			19 01 16·405

B.J. 719
Dec. 35° 58′

Date	Clamp	Observer	Mean R.A. 1910·0
June 7	W	S	19 04 05·38
July 16	E	S	05·38
19	E	S	05·37
26	W	S	05·38
28	W	N	05·33
30	W	N	05·42
Aug. 2	W	S	05·35
7	W	S	05·33
8	W	N	05·37
11	W	S	05·36
12	W	N	05·37
19	E	N	05·36
20	E	S	05·41
26	E	N	05·40
29	E	N	05·38
Sept. 1	E	S	05·41
2	E	N	05·31
9	E	N	05·39
Mean			05·372
Δ1			·003
Δ2			·000
Mean R.A.			19 04 05·375

19 Lyrae
Dec. 31° 08′

Date	Clamp	Observer	Mean R.A. 1910·0
July 16	E	S	19 08 18·82
26	W	S	18·91
Aug. 20	E	S	18·91 r
26	E	N	18·84
Mean			18·870
Δ2			·001
Mean R.A.			19 08 18·871

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 725
Dec. 11° 26′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
July 16	E	S	19 13 35·51
26	W	S	35·51
Aug. 19	E	N	35·48
20	E	S	35·50
26	E	N	35·42
Mean			35·484
Δ_1			·000
Δ_2			·000
Mean R.A.			19 13 35·484

B.J. 726
Dec. 53° 12′

Date	Clamp	Observer	Mean R.A. 1910·0
July 16	E	S	19 15 01·29
26	W	S	01·39
28	W	N	01·36
Aug. 8	W	N	01·40
12	W	N	01·33
19	E	N	01·37
20	E	S	01·34
26	E	N	01·27
29	E	N	01·29
Sept. 1	E	S	01·35
2	E	N	01·44
9	E	N	01·47
16	W	N	01·38
Mean			01·360
Δ_1			·004
Δ_2			·000
Mean R.A.			19 15 01·364

159 B.Lyrae
Dec. 40° 12′

Date	Clamp	Observer	Mean R.A. 1910·0
June 7	W	S	19 15 57·60
July 16	E	S	57·53
26	W	S	57·53
Aug. 20	E	S	57·60
Mean			57·565
Δ_2			·002
Mean R.A.			19 15 57·567

B.J. 729
Dec. 73° 11′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Aug. 7	W	S	19 17 17·43
8	W	N	17·46
11	W	S	17·45
12	W	N	17·42
19	E	N	17·32
29	E	N	17·31
Sept. 1	E	S	17·30
9	E	N	17·43
Mean			17·390
Δ_1			·002
Δ_2			−·001
Mean R.A.			19 17 17·391

b Aquilae
Dec. 11° 45′

Date	Clamp	Observer	Mean R.A. 1910·0
June 7	W	S	19 20 40·71
July 16	E	S	40·69
26	W	S	40·70
30	W	N	40·67
Aug. 2	W	S	40·61
12	W	N	40·71
19	E	N	40·69
26	E	N	40·73
29	E	N	40·75
Sept. 2	E	N	40·70
9	E	N	40·70
13	E	S	40·76
14	E	N	40·79
16	W	N	40·67
26	W	N	40·74
30	W	N	40·73
Mean			40·709
Δ_1			·000
Δ_2			−·001
Mean R.A.			19 20 40·708

21 B.Vulpeculae
Dec. 24° 45′

Date	Clamp	Observer	Mean R.A. 1910·0
June 7	W	S	19 21 42·25
July 16	E	S	42·26
26	W	S	42·31r
28	W	N	42·31
30	W	N	42·28

21 B.Vulpeculae
(continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Aug. 2	W	S	19 21 42·21
8	W	N	42·22
12	W	N	42·27
20	E	S	42·28
26	E	N	42·30
29	E	N	42·31
Sept. 2	E	N	42·27
9	E	N	42·32
13	E	S	42·30
14	E	N	42·31r
16	W	N	42·29r
26	W	N	42·29
30	W	N	42·29r
Mean			42·282
Δ_2			−·001
Mean R.A.			19 21 42·281

4 Cygni
Dec. 36° 08′

Date	Clamp	Observer	Mean R.A. 1910·0
June 7	W	S	19 22 54·59
July 16	E	S	54·57
26	W	S	54·62
28	W	N	54·64
30	W	N	54·66
Aug. 2	W	S	54·60
7	W	S	54·61
8	W	N	54·58
11	W	S	54·62
12	W	N	54·62
20	E	S	54·61
26	E	N	54·60
29	E	N	54·63
Sept. 1	E	S	54·62
2	E	N	54·61
9	E	N	54·66
13	E	S	54·64
14	E	N	54·64
16	W	N	54·62
26	W	N	54·62
30	W	N	54·64
Mean			54·619
Δ_2			·000
Mean R.A.			19 22 54·619

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.D. 76·734
Dec. 76° 23′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Aug. 7	W	S	19 24 46·35
8	W	N	46·27
11	W	S	46·31
12	W	N	46·26
29	E	N	46·25
Sept. 1	E	S	46·16
9	E	N	46·24
13	E	S	46·18
17	W	S	46·41
Mean			46·270
Δ_2			–·001
Mean R.A.			19 24 46·269

α Vulpeculae
Dec. 24° 29′

Date	Clamp	Observer	Mean R.A. 1910·0
June 7	W	S	19 24 57·63
July 16	E	S	57·63r
26	W	S	57·62
28	W	N	57·64
30	W	N	57·66
Aug. 2	W	S	57·66r
20	E	S	57·64
26	E	N	57·57
Sept. 2	E	N	57·62
8	E	S	57·61
14	E	N	57·68
16	W	N	57·58
19	W	N	57·63
26	W	N	57·64
30	W	N	57·60
Mean			57·627
Δ_1			–·004
Δ_2			·000
Mean R.A.			19 24 57·623

B.J. 732
Dec. 27° 46′

Date	Clamp	Observer	Mean R.A. 1910·0
July 16	E	S	19 27 05·50
28	W	N	05·59
30	W	N	05·50
Aug. 20	E	S	05·51
26	E	N	05·50

B.J. 732
(continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 2	E	N	19 27 05·54
8	E	S	05·50
14	E	N	05·56
19	W	N	05·46
26	W	N	05·49
Mean			05·515
Δ_1			·002
Δ_2			–·001
Mean R.A.			19 27 05·516

B.J. 734
Dec. 79° 25′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 7	W	S	19 27 09·21
8	W	N	09·15
11	W	S	09·36
12	W	N	09·26
29	E	N	09·11
Sept. 1	E	S	09·16
9	E	N	09·25
13	E	S	09·27
17	W	S	09·47
Mean			09·249
Δ_1			·003
Δ_2			–·002
Mean R.A.			19 27 09·250

B.J. 733
Dec. 51° 32′

Date	Clamp	Observer	Mean R.A. 1910·0
June 7	W	S	19 27 26·26
Aug. 2	W	S	26·27
Sept. 16	W	N	26·23
30	W	N	26·17
Mean			26·233
Δ_1			–·005
Δ_2			–·004
Mean R.A.			19 27 26·224

8 Cygni
Dec. 34° 16′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
July 16	E	S	19 28 25·60
28	W	N	25·66
30	W	N	25·64
Aug. 2	W	S	25·57
8	W	N	25·57
12	W	N	25·42
20	E	S	25·66
26	E	N	25·61
29	E	N	25·65
Sept. 1	E	S	25·62
2	E	N	25·59
8	E	S	25·62
9	E	N	25·61
14	E	N	25·62
16	W	N	25·62
17	W	S	25·67
19	W	N	25·59
26	W	N	25·60
30	W	N	25·60
Mean			25·606
Δ_2			–·001
Mean R.A.			19 28 25·605

B.D. 70·1073
Dec. 70° 48′

Date	Clamp	Observer	Mean R.A. 1910·0
July 19	E	S	19 31 43·65
Aug. 7	W	S	43·75
8	W	N	43·67
11	W	S	43·91
12	W	N	43·62
29	E	N	43·70
Sept. 1	E	S	43·58
9	E	N	43·65
13	E	S	43·89
14	E	N	43·79
17	W	S	43·87
26	W	N	43·74
Mean			43·735
Δ_2			·000
Mean R.A.			19 31 43·735

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

ε Sagittae
Dec. 16° 16′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
June 7	W	S	19 33 12·92
July 16	E	S	12·91
Aug. 2	W	S	12·94
20	E	S	12·97
Mean			12·935
Δ₂			·002
Mean R.A.			19 33 12·937

B.D. 49·3059
Dec. 50° 02′

Date	Clamp	Observer	Mean R.A. 1910·0
July 19	E	S	19 33 31·17
28	W	N	31·25
30	W	N	31·19
Aug. 8	W	N	31·26
11	W	S	31·34
12	W	N	31·20
26	E	N	31·19
29	E	N	31·15
Sept. 1	E	S	31·19r
2	E	N	31·19
9	E	N	31·28
13	E	S	31·29
14	E	N	31·31
16	W	N	31·27r
17	W	S	31·29
19	W	N	31·19
26	W	N	31·26
30	W	N	31·29r
Mean			31·239
Δ₂			–·001
Mean R.A.			19 33 31·238

B.J. 738
Dec. 50° 01′

Date	Clamp	Observer	Mean R.A. 1910·0
July 16	E	S	19 34 01·62
19	E	S	01·63
28	W	N	01·61
30	W	N	01·74
Aug. 2	W	S	01·73
7	W	S	01·74
8	W	N	01·71

B.J. 738
(continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Aug. 11	W	S	19 34 01·71r
12	W	N	01·70
26	E	N	01·63
29	E	N	01·68
Sept. 1	E	S	01·63
2	E	N	01·66
9	E	N	01·71
13	E	S	01·78
14	E	N	01·71
16	W	N	01·70
17	W	S	01·65r
19	W	N	01·66r
26	W	N	01·63r
30	W	N	01·72
Mean			01·683
Δ₁			–·005
Δ₂			–·001
Mean R.A.			19 34 01·677

14 Cygni
Dec. 42° 37′

Date	Clamp	Observer	Mean R.A. 1910·0
June 7	W	S	19 36 30·70
July 19	E	S	30·65
28	W	N	30·70
Aug. 7	W	S	30·72
8	W	N	30·73
11	W	S	30·75r
12	W	N	30·70
26	E	N	30·67
29	E	N	30·67
Sept. 1	E	S	30·67r
2	E	N	30·71
9	E	N	30·67
13	E	S	30·70
19	W	N	30·65
30	W	N	30·68
Mean			30·691
Δ₂			–·001
Mean R.A.			19 36 30·690

β Sagittae
Dec. 17° 16′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
July 16	E	S	19 37 00·39
30	W	N	00·38
Aug. 2	W	S	00·46
20	E	S	00·42
Sept. 14	E	N	00·45
16	W	N	00·43
17	W	S	00·38
22	W	S	00·43
26	W	N	00·40
Mean			00·416
Δ₁			–·004
Δ₂			·001
Mean R.A.			19 37 00·413

10 Vulpeculae
Dec. 25° 33′

Date	Clamp	Observer	Mean R.A. 1910·0
July 28	W	N	19 39 58·33
30	W	N	58·39
Aug. 2	W	S	58·37
8	W	N	58·31
12	W	N	58·32
20	E	S	58·37
26	E	N	58·40
29	E	N	58·39
Sept. 2	E	N	58·38
9	E	N	58·39
13	E	S	58·39
14	E	N	58·40
15	E	S	58·34
16	W	N	58·37
17	W	S	58·37
19	W	N	58·43
22	W	S	58·36
26	W	N	58·40
30	W	N	58·41
Mean			58·375
Δ₂			–·001
Mean R.A.			19 39 58·374

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 740
Dec. 37° 08′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
July 19	E	S	19 41 01·80
28	W	N	01·77
30	W	N	01·85
Aug. 2	W	S	01·81
7	W	S	01·84
11	W	S	01·82
12	W	N	01·77
20	E	S	01·84
26	E	N	01·82
29	E	N	01·89
Sept. 1	E	S	01·82
2	E	N	01·81
9	E	N	01·77
13	E	S	01·87
14	E	N	01·88
15	E	S	01·82
16	W	N	01·88
17	W	S	01·86
19	W	N	01·82
22	W	S	01·85
26	W	N	01·81
30	W	N	01·85

Mean 01·830
Δ_1 ·003
Δ_2 ·000

Mean R.A. 19 41 01·833

B.J. 742
Dec. 44° 55′

Date	Clamp	Observer	Mean R.A. 1910·0
July 19	E	S	19 42 09·70r
28	W	N	09·66
30	W	N	09·77
Aug. 2	W	S	09·70
7	W	S	09·72
8	W	N	09·78
11	W	S	09·73
12	W	N	09·67
20	E	S	09·69
26	E	N	09·71
29	E	N	09·69
Sept. 1	E	S	09·72
2	E	N	09·69
9	E	N	09·76
15	E	S	09·76
16	W	N	09·69
17	W	S	09·70

B.J. 742
(continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 19	W	N	19 42 09·66
22	W	S	09·72
26	W	N	09·72
30	W	N	09·70

Mean 09·711
Δ_1 −·004
Δ_2 −·001

Mean R.A. 19 42 09·706

B.J. 743
Dec. 18° 19′

Date	Clamp	Observer	Mean R.A. 1910·0
July 30	W	N	19 43 22·47
Aug. 2	W	S	22·50
12	W	N	22·46
20	E	S	22·55
26	E	N	22·43
29	E	N	22·45
Sept. 2	E	N	22·56
9	E	N	22·46
13	E	S	22·49r
15	E	S	22·52
16	W	N	22·50r
17	W	S	22·48r
19	W	S	22·52
22	W	S	22·49
26	W	N	22·49
30	W	N	22·48

Mean 22·491
Δ_1 ·000
Δ_2 ·000

Mean R.A. 19 43 22·491

ζ Sagittae
Dec. 18° 55′

Date	Clamp	Observer	Mean R.A. 1910·0
July 28	W	N	19 44 59·02
30	W	N	58·94
Aug. 2	W	S	59·01r
12	W	N	58·92
20	E	S	58·96
26	E	N	58·95
29	E	N	58·92

ζ Sagittae
(continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 2	E	N	19 44 58·97
9	E	N	58·90
13	E	S	58·92
14	E	N	58·96
15	E	S	58·97r
16	W	N	58·93
17	W	S	58·93
19	W	N	58·91r
22	W	S	58·94r
26	W	N	58·96
30	W	N	58·96r

Mean 58·948
Δ_2 −·001

Mean R.A. 19 44 58·947

B.J. 747
Dec. 70° 02′

Date	Clamp	Observer	Mean R.A. 1910·0
July 19	E	S	19 48 28·86
Aug. 7	W	S	28·83
8	W	N	29·14
12	W	N	28·90
29	E	N	29·00
Sept. 9	E	N	28·89
14	E	N	28·84
26	W	N	29·01

Mean 28·934
Δ_1 ·002
Δ_2 −·003

Mean R.A. 19 48 28·933

φ Aquilae
Dec. 11° 11′

Date	Clamp	Observer	Mean R.A. 1910·0
July 26	W	S	19 51 58·52
28	W	N	58·45
30	W	N	58·51
Aug. 2	W	S	58·50
8	W	N	58·57
12	W	N	58·52
19	E	N	58·54

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

φ Aquilae (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Aug. 20	E	S	19 51 58·55
26	E	N	58·54
29	E	N	58·56
Sept. 2	E	N	58·58
13	E	S	58·48
14	E	N	58·55
15	E	S	58·56
16	W	N	58·50
17	W	S	58·54
19	W	N	58·63
22	W	S	58·55
26	W	N	58·55
29	W	S	58·56
30	W	N	58·51
Mean			58·537
Δ_2			·000
Mean R.A.			19 51 58·537

B.J. 750
Dec. 52° 12′

Date	Clamp	Observer	Mean R.A. 1910·0
July 19	E	S	19 53 18·17
28	W	N	18·15
30	W	N	18·18
Aug. 8	W	N	18·18
12	W	N	18·14
19	E	N	18·16
26	E	N	18·14
29	E	N	18·18
Sept. 2	E	N	18·22
9	E	N	18·27
14	E	N	18·16
15	E	S	18·20
16	W	N	18·24
17	W	S	18·24
19	W	N	18·20
22	W	S	18·21
26	W	N	18·22
29	W	S	18·20
30	W	N	18·19
Mean			18·192
Δ_1			·000
Δ_2			−·002
Mean R.A.			19 53 18·190

B.J. 752
Dec. 19° 15′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
July 26	W	S	19 54 45·32
28	W	N	45·31
30	W	N	45·27
Aug. 2	W	S	45·25
8	W	N	45·29
12	W	N	45·33
19	E	N	45·21
26	E	N	45·26
29	E	N	45·32
Sept. 2	E	N	45·31
9	E	N	45·25
13	E	S	45·28
14	E	N	45·27
15	E	S	45·31
16	W	N	45·35
17	W	S	45·25
19	W	N	45·27
22	W	S	45·29
29	W	S	45·27
30	W	N	45·26
Mean			45·283
Δ_1			−·005
Δ_2			·000
Mean R.A.			19 54 45·278

15 Vulpeculae
Dec. 27° 30′

Date	Clamp	Observer	Mean R.A. 1910·0
July 26	W	S	19 57 23·65
28	W	N	23·62
30	W	N	23·62
Aug. 2	W	S	23·61
8	W	N	23·53
12	W	N	23·60
19	E	N	23·60
26	E	N	23·63
29	E	N	23·64
Sept. 2	E	N	23·59
9	E	N	23·65
13	E	S	23·62
14	E	N	23·63
15	E	S	23·64
17	W	S	23·64
19	W	N	23·66
22	W	S	23·69
26	W	N	23·57
29	W	S	23·65
30	W	N	23·64

15 Vulpeculae (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Mean			19 57 23·624
Δ_2			−·001
Mean R.A.			19 57 23·623

B.D. 69·1084
Dec. 70° 07′

Date	Clamp	Observer	Mean R.A. 1910·0
July 19	E	S	19 58 55·20
Aug. 7	W	S	55·32
11	W	S	55·41
12	W	N	55·37
19	E	N	55·17
29	E	N	55·31
Sept. 9	E	N	55·35
10	E	S	55·30
13	E	S	55·35
14	E	N	55·16
15	E	S	55·32
17	W	S	55·39
26	W	N	55·39
29	W	S	55·31
Mean			55·311
Δ_2			·002
Mean R.A.			19 58 55·313

69 Draconis
Dec. 76° 14′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 11	W	S	20 02 08·84
19	E	N	08·90
Sept. 9	E	N	08·88
10	E	S	08·90
13	E	S	08·81
14	E	N	08·94
15	E	S	08·81
17	W	S	08·97
26	W	N	08·92
28	W	N	09·23
Mean			08·920
Δ_2			·004
Mean R.A.			20 02 08·924

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

b^2 Cygni — Dec. 36° 34′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
July 26	W	S	20 06 05·03
Aug. 7	W	S	05·01
Sept. 2	E	N	05·04
10	E	S	04·99
13	E	S	05·08
15	E	S	05·04
16	W	N	05·02
17	W	S	05·03
26	W	N	05·01
28	W	N	05·05
29	W	S	05·01
Mean			05·028
Δ_2			·000
Mean R.A.			20 06 05·028

20 Vulpeculae — Dec. 26° 13′

Date	Clamp	Observer	Mean R.A. 1910·0
July 26	W	S	20 08 14·25
Sept. 2	E	N	14·22
13	E	S	14·17
15	E	S	14·23
16	W	N	14·23
17	W	S	14·24
26	W	N	14·22
28	W	N	14·28
29	W	S	14·23
Oct. 11	W	S	14·21
Mean			14·228
Δ_2			·000
Mean R.A.			20 08 14·228

ρ Aquilae — Dec. 14° 55′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 13	E	S	20 10 06·78
15	E	S	06·75
17	W	S	06·75
29	W	S	06·76
Oct. 11	W	S	06·74
Mean			06·756
Δ_2			·002
Mean R.A.			20 10 06·758

30 Cygni — Dec. 46° 33′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
July 26	W	S	20 10 28·26
Sept. 10	E	S	28·22
26	W	N	28·33
28	W	N	28·36
Mean			28·292
Δ_2			−·001
Mean R.A.			20 10 28·291

B.J. 757 — Dec. 46° 28′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 31	E	N	20 10 47·79
Sept. 2	E	N	47·85
16	W	N	47·90
28	W	N	47·87
Mean			47·853
Δ_1			−·004
Δ_2			−·002
Mean R.A.			20 10 47·847

B.J. 759 — Dec. 77° 26′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 7	W	S	20 11 56·08
Sept. 1	E	S	56·18
10	E	S	56·27
13	E	S	56·30
15	E	S	56·23
17	W	S	56·31
26	W	N	55·87
28	W	N	56·32
29	W	S	56·21
Oct. 11	W	S	56·28
Mean			56·205
Δ_1			−·004
Δ_2			·000
Mean R.A.			20 11 56·201

B.J. 760 — Dec. 24° 24′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
July 26	W	S	20 12 56·04
28	W	N	56·06
30	W	N	56·00
Aug. 19	E	N	56·09
31	E	N	56·01
Sept. 2	E	N	56·04
8	E	S	55·96
15	E	S	55·97
16	W	N	55·90
Mean			56·008
Δ_1			−·005
Δ_2			−·001
Mean R.A.			20 12 56·002

176 B.Cygni — Dec. 39° 07′

Date	Clamp	Observer	Mean R.A. 1910·0
July 26	W	S	20 16 59·48
30	W	N	59·51
Aug. 7	W	S	59·47
11	W	S	59·44
19	E	N	59·48
29	E	N	59·46
31	E	N	59·43
Sept. 1	E	S	59·43
2	E	N	59·34
8	E	S	59·46
9	E	N	59·41
10	E	S	59·46
14	E	N	59·50
16	W	N	59·49
19	W	N	59·49
26	W	N	59·45
28	W	N	59·51
29	W	S	59·47
30	W	N	59·46
Oct. 7	W	N	59·45
10	W	N	59·45
11	W	S	59·48
Mean			59·460
Δ_2			−·001
Mean R.A.			20 16 59·459

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 765
Dec. 39° 58′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
July 26	W	S	20 18 59·81
30	W	N	59·84
Aug. 7	W	S	59·88
11	W	S	59·87r
19	E	N	59·94
20	E	S	59·88
29	E	N	59·86
31	E	N	59·89
Sept. 1	E	S	59·89r
2	E	N	59·90
8	E	S	59·87
9	E	N	59·91
10	E	S	59·85r
13	E	S	59·88
14	E	N	59·88r
15	E	S	59·86r
16	W	N	59·79r
17	W	S	59·88
19	W	N	59·89
22	W	S	59·84
26	W	N	59·84
28	W	N	59·76
29	W	S	59·84r
30	W	N	59·86
Oct. 7	W	N	59·84r
10	W	N	59·88

Mean	59·863
Δ_1	·002
Δ_2	·000
Mean R.A.	20 18 59·865

40 Cygni
Dec. 38° 09′

Date	Clamp	Observer	Mean R.A. 1910·0
July 26	W	S	20 24 14·18r
30	W	N	14·21
Aug. 7	W	S	14·21r
11	W	S	14·15
19	E	N	14·15
20	E	S	14·16
29	E	N	14·14
31	E	N	14·20
Sept. 1	E	S	14·15
2	E	N	14·22
8	E	S	14·18r

40 Cygni
(continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 10	E	S	20 24 14·16
13	E	S	14·14
14	E	N	14·09
15	E	S	14·17r
16	W	N	14·22
17	W	S	14·24
19	W	N	14·20
22	W	S	14·19r
26	W	N	14·13r
28	W	N	14·16r
29	W	S	14·15
30	W	N	14·13r
Oct. 7	W	N	14·16
10	W	N	14·14r
11	W	S	14·18r
12	E	N	14·12

Mean	14·168
Δ_2	·000
Mean R.A.	20 24 14·168

41 Cygni
Dec. 30° 04′

Date	Clamp	Observer	Mean R.A. 1910·0
July 26	W	S	20 25 43·08
30	W	N	43·04
Aug. 7	W	S	43·02
11	W	S	43·02
19	E	N	43·07
20	E	S	43·08
29	E	N	43·09
31	E	N	43·11
Sept. 1	E	S	43·05
2	E	N	43·00
8	E	S	43·07
9	E	N	43·03
10	E	S	43·02
13	E	S	43·10
14	E	N	43·07
15	E	S	43·05
16	W	N	43·07
17	W	S	43·05
19	W	N	43·09
22	W	S	43·07
26	W	N	43·08
28	W	N	43·11
29	W	S	43·08
30	W	N	43·05

41 Cygni
(continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Oct. 7	W	N	20 25 43·10
10	W	N	43·07
11	W	S	43·06
12	E	N	43·10

Mean	43·065
Δ_1	−·003
Δ_2	·000
Mean R.A.	20 25 43·062

ω^1 Cygni
Dec. 48° 39′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 7	W	S	20 27 16·23
11	W	S	16·28
20	E	S	16·25
29	E	N	16·25
31	E	N	16·25
Sept. 1	E	S	16·28
2	E	N	16·24
8	E	S	16·25
9	E	N	16·28
10	E	S	16·26
13	E	S	16·25
14	E	N	16·22
15	E	S	16·26
16	W	N	16·32
17	W	S	16·31
19	W	N	16·24
22	W	S	16·26
26	W	N	16·18
28	W	N	16·31
29	W	S	16·24
30	W	N	16·30
Oct. 7	W	N	16·27
10	W	N	16·25
11	W	S	16·30
12	E	N	16·40

Mean	16·267
Δ_2	·000
Mean R.A.	20 27 16·267

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 768
Dec. 11° 00′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
July 30	W	N	20 28 54·80
Aug. 20	E	S	54·81
29	E	N	54·79
31	E	N	54·75
Sept. 2	E	N	54·86
8	E	S	54·79
13	E	S	54·82
14	E	N	54·83
15	E	S	54·81
16	W	N	54·81
17	W	S	54·80
19	W	N	54·78
21	W	N	54·81
22	W	S	54·77
26	W	N	54·74
28	W	N	54·81
29	W	S	54·84
30	W	N	54·81
Oct. 7	W	N	54·83
11	W	S	54·81
19	E	N	54·80
26	E	N	54·78
Mean			54·802
Δ_1			·000
Δ_2			·000
Mean R.A.			20 28 54·802

Groombridge 3241
Dec. 72° 14′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 7	W	S	20 30 24·33
11	W	S	24·32
19	E	N	24·48
29	E	N	24·26
Sept. 1	E	S	24·30
9	E	N	24·35
10	E	S	24·28
13	E	S	24·23
26	W	N	24·31
28	W	N	24·47
29	W	S	24·22
Oct. 10	W	N	24·25
12	E	N	24·51
Mean			24·332
Δ_1			−·004
Δ_2			·001
Mean R.A.			20 30 24·329

ζ Delphini
Dec. 14° 22′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
July 30	W	N	20 31 06·00
Aug. 20	E	S	06·03
31	E	N	06·00
Sept. 2	E	N	06·14
8	E	S	06·05r
14	E	N	06·10r
15	E	S	06·05
16	W	N	06·04r
17	W	S	06·03
19	W	N	06·08
21	W	N	06·07r
22	W	S	06·02
30	W	N	06·07
Oct. 7	W	N	06·06r
11	W	S	06·03r
19	E	N	06·08
26	E	N	06·08
Mean			06·055
Δ_2			−·001
Mean R.A.			20 31 06·054

B.J. 770
Dec. 74° 39′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 7	W	S	20 32 42·44
11	W	S	42·34
19	E	N	42·36
29	E	N	42·28
31	E	N	42·65
Sept. 1	E	S	42·27
9	E	N	42·23
10	E	S	42·30
13	E	S	42·23
15	E	S	42·43
17	W	S	42·43
26	W	N	42·28
28	W	N	42·54
29	W	S	42·26
Oct. 10	W	N	42·16
11	W	S	42·29
12	E	N	42·46
Mean			42·350
Δ_1			·001
Δ_2			·001
Mean R.A.			20 32 42·352

B.J. 771
Dec. 14° 17′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
July 30	W	N	20 33 19·68
Aug. 20	E	S	19·71r
Sept. 2	E	N	19·77
8	E	S	19·70
14	E	N	19·73
16	W	N	19·66
19	W	N	19·72r
21	W	N	19·79
22	W	S	19·73r
30	W	N	19·71r
Oct. 7	W	N	19·76
19	E	N	19·79r
Mean			19·729
Δ_1			·001
Δ_2			−·001
Mean R.A.			20 33 19·729

29 Vulpeculae
Dec. 20° 53′

Date	Clamp	Observer	Mean R.A. 1910·0
July 30	W	N	20 34 30·10
Aug. 20	E	S	30·10
Sept. 2	E	N	30·20
8	E	S	30·08
13	E	S	30·14
14	E	N	30·13
16	W	N	30·14
17	W	S	30·09
19	W	N	30·17
21	W	N	30·13
22	W	S	30·13
26	W	N	30·07
28	W	N	30·11
30	W	N	30·11
Oct. 7	W	N	30·08
10	W	N	30·14
17	E	N	30·12
19	E	N	30·17
26	E	N	30·18
Mean			30·126
Δ_2			−·001
Mean R.A.			20 34 30·125

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

74 Draconis
Dec. 80° 47′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Aug. 29	E	N	20 34 42·03
31	E	N	42·08
Sept. 1	E	S	42·07rn
9	E	N	42·21
10	E	S	41·89
29	W	S	41·88nr
Oct. 11	W	S	42·01rn
Mean			42·024
Δ2			·014
Mean R.A.			20 34 42·038

B.J. 774
Dec. 15° 36′

Date	Clamp	Observer	Mean R.A. 1910·0
July 30	W	N	20 35 27·44
Aug. 19	E	N	27·42
20	E	S	27·45
Sept. 2	E	N	27·53
8	E	S	27·47
14	E	N	27·49
15	E	S	27·48
16	W	N	27·49
17	W	S	27·45
19	W	N	27·45
21	W	N	27·50
22	W	S	27·46
26	W	N	27·48
28	W	N	27·49
30	W	N	27·51
Oct. 7	W	N	27·41
10	W	N	27·42
12	E	N	27·44
17	E	N	27·49
19	E	N	27·53
26	E	N	27·51
Mean			27·472
Δ1			−·001
Δ2			−·001
Mean R.A.			20 35 27·470

B.J. 777
Dec. 44° 57′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
July 30	W	N	20 38 21·78
Aug. 19	E	N	21·79
20	E	S	21·77
29	E	N	21·81
31	E	N	21·78
Sept. 1	E	S	21·81
2	E	N	21·74
8	E	S	21·77
9	E	N	21·72
10	E	S	21·77
14	E	N	21·78
16	W	N	21·73
19	W	N	21·76
21	W	N	21·83
22	W	S	21·77
26	W	N	21·81
28	W	N	21·83
29	W	S	21·82
30	W	N	21·69
Oct. 7	W	N	21·76
10	W	N	21·70
11	W	S	21·81
12	E	N	21·74
17	E	N	21·77
19	E	N	21·76
26	E	N	21·81
Mean			21·773
Δ1			·004
Δ2			−·001
Mean R.A.			20 38 21·776

B.J. 778
Dec. 14° 45′

Date	Clamp	Observer	Mean R.A. 1910·0
July 30	W	N	20 39 15·46
Aug. 20	E	S	15·44
31	E	N	15·48
Sept. 2	E	N	15·43
9	E	N	15·45
13	E	S	15·43
14	E	N	15·39
15	E	S	15·41
16	W	N	15·41
17	W	S	15·41
19	W	N	15·46
21	W	N	15·47
22	W	S	15·42

B.J. 778
(continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 26	W	N	20 39 15·40
28	W	N	15·43
29	W	S	15·45
30	W	N	15·46
Oct. 7	W	N	15·49
10	W	N	15·39
11	W	S	15·42
12	E	N	15·40
17	E	N	15·52
19	E	N	15·43
26	E	N	15·46
Mean			15·438
Δ1			·004
Δ2			−·001
Mean R.A.			20 39 15·441

B.J. 780
Dec. 33° 38′

Date	Clamp	Observer	Mean R.A. 1910·0
July 30	W	N	20 42 34·08
Aug. 19	E	N	34·08
20	E	S	34·12
29	E	N	34·10
31	E	N	34·13
Sept. 1	E	S	34·15r
2	E	N	34·08
8	E	S	34·16
9	E	N	34·16
13	E	S	34·09r
14	E	N	34·09
16	W	N	34·09r
19	W	N	34·14
21	W	N	34·13r
22	W	S	34·13
26	W	N	34·14
28	W	N	34·08r
29	W	S	34·14r
30	W	N	34·10
Oct. 3	W	N	34·16
7	W	N	34·13r
10	W	N	34·08
11	W	S	34·13
12	E	N	34·18
17	E	N	34·18r
19	E	N	34·11
26	E	N	34·14r
Mean			34·122
Δ1			−·004
Δ2			−·001
Mean R.A.			20 42 34·117

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 782
Dec. 57° 15′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 10	E	S	20 43 06·99
15	E	S	07·09
17	W	S	07·16

Mean 07·080
Δ_1 −·003
Δ_2 ·005

Mean R.A. 20 43 07·082

B.J. 784
Dec. 36° 10′

Date	Clamp	Observer	Mean R.A. 1910·0
July 30	W	N	20 43 54·13
Aug. 19	E	N	54·13
20	E	S	54·06r
29	E	N	54·21
31	E	N	54·12
Sept. 1	E	S	54·08
2	E	N	54·12
8	E	S	54·13r
9	E	N	54·11
13	E	S	54·17
14	E	N	54·13r
16	W	N	54·17
19	W	N	54·13r
21	W	N	54·17
22	W	S	54·14r
26	W	N	54·23r
29	W	S	54·13
30	W	N	54·13r
Oct. 7	W	N	54·11
10	W	N	54·13r
11	W	S	54·13r
12	E	N	54·23r
17	E	N	54·11
19	E	N	54·12r
26	E	N	54·06

Mean 54·135
Δ_1 ·000
Δ_2 −·001

Mean R.A. 20 43 54·134

220 H[1]. Draconis
Dec. 80° 13′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Aug. 29	E	N	20 51 41·84
Sept. 2	E	N	41·95
9	E	N	41·80
14	E	N	41·77
16	W	N	42·35
19	W	N	41·88
21	W	N	42·35
28	W	N	42·15
30	W	N	41·88
Oct. 7	W	N	42·00nr
10	W	N	41·76r
12	E	N	41·99nr
17	E	N	41·93nr
19	E	N	41·85nr
26	E	N	41·96nr

Mean 41·964
Δ_1 −·005
Δ_2 −·007

Mean R.A. 20 51 41·952

B.J. 788
Dec. 40° 49′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 11	W	S	20 53 49·04
20	E	S	49·03
29	E	N	48·93
31	E	N	48·97
Sept. 1	E	S	49·04
2	E	N	48·97
8	E	S	49·03
9	E	N	48·97
10	E	S	49·01
13	E	S	49·07
14	E	N	48·93
15	E	S	49·01
16	W	N	49·01
17	W	S	49·04
19	W	N	48·99
21	W	N	49·09
22	W	S	49·02
26	W	N	49·05
28	W	N	48·99
29	W	S	49·03
30	W	N	49·02
Oct. 7	W	N	49·06
10	W	N	49·01

B.J. 788
(continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Oct. 11	W	S	20 53 49·04
17	E	N	49·01
19	E	N	48·99
26	E	N	48·92

Mean 49·010
Δ_1 −·003
Δ_2 ·000

Mean R.A. 20 53 49·007

Bradley 2748
Dec. 75° 35′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 11	W	S	20 55 48·71
29	E	N	48·46
31	E	N	48·64
Sept. 1	E	S	48·52
9	E	N	48·65
10	E	S	48·61
13	E	S	48·67
15	E	S	48·70
26	W	N	48·70
28	W	N	48·78
29	W	S	48·55
Oct. 10	W	N	48·50
11	W	S	48·63
12	E	N	48·46
17	E	N	48·53
19	E	N	48·49
26	E	N	48·68

Mean 48·605
Δ_2 ·004

Mean R.A. 20 55 48·609

***f*[1] Cygni**
Dec. 47° 10′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 20	E	S	20 56 45·86
Sept. 2	E	N	45·80
8	E	S	45·84
14	E	N	45·83
16	W	N	45·86

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

f^1 Cygni (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 17	W	S	20 56 45·91
19	W	N	45·79
21	W	N	45·99
22	W	S	45·88
28	W	N	45·93
30	W	N	45·88
Oct. 7	W	N	45·84
10	W	N	45·83
17	E	N	45·92
19	E	N	45·90
26	E	N	45·91
Mean			45·873
Δ_2			−·001
Mean R.A.			20 56 45·872

B.J. 792
Dec. 43° 31′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 11	W	S	21 01 39·35
20	E	S	39·37
31	E	N	39·38
Sept. 1	E	S	39·36
2	E	N	39·34
8	E	S	39·41
10	E	S	39·32
13	E	S	39·41
14	E	N	39·31
16	W	N	39·37
17	W	S	39·35
19	W	N	39·38
22	W	S	39·36
26	W	N	39·38
28	W	N	39·39
29	W	S	39·37
30	W	N	39·29
Oct. 7	W	N	39·30
10	W	N	39·35
11	W	S	39·41
12	E	N	39·36
17	E	N	39·36
19	E	N	39·31
Mean			39·358
Δ_1			·000
Δ_2			·000
Mean R.A.			21 01 39·358

B.J. 793
Dec. 38° 18′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Aug. 11	W	S	21 02 51·72
20	E	S	51·74
31	E	N	51·75
Sept. 2	E	N	51·75
9	E	N	51·76
10	E	S	51·69
14	E	N	51·75
16	W	N	51·72
19	W	N	51·73
26	W	N	51·68
28	W	N	51·71
30	W	N	51·76
Oct. 7	W	N	51·69
10	W	N	51·70
12	E	N	51·77
17	E	N	51·76
19	E	N	51·75
Mean			51·731
Δ_1			−·005
Δ_2			−·001
Mean R.A.			21 02 51·725

f^2 Cygni
Dec. 47° 17′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 31	E	N	21 03 30·07
Sept. 1	E	S	30·01
8	E	S	30·02
9	E	N	30·06
13	E	S	30·03
17	W	S	30·06
22	W	S	30·06
26	W	N	29·99
28	W	N	29·98
29	W	S	30·03
30	W	N	29·98
Oct. 7	W	N	30·00
10	W	N	29·96
11	W	S	30·02
17	E	N	29·94
19	E	N	29·95
Mean			30·010
Δ_2			−·001
Mean R.A.			21 03 30·009

Groombridge 3409
Dec. 71° 01′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Aug. 11	W	S	21 05 51·35
31	E	N	51·32
Sept. 1	E	S	51·28
9	E	N	51·33
10	E	S	51·36
13	E	S	51·44
14	E	N	51·31
15	E	S	51·37
17	W	S	51·34
21	W	N	51·38
26	W	N	51·37
28	W	N	51·45
29	W	S	51·39
Oct. 10	W	N	51·32
11	W	S	51·37
17	E	N	51·29
19	E	N	51·26
Mean			51·349
Δ_2			·000
Mean R.A.			21 05 51·349

B.J. 795
Dec. 77° 46′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 1	E	S	21 07 18·81
10	E	S	18·93
13	E	S	18·95
14	E	N	18·81
15	E	S	18·94
17	W	S	19·06
26	W	N	19·03
28	W	N	18·99
29	W	S	18·78
Oct. 10	W	N	18·93
11	W	S	18·98
12	E	N	19·02
17	E	N	18·85
19	E	N	18·81
Mean			18·921
Δ_1			·001
Δ_2			·003
Mean R.A.			21 07 18·925

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

Date	Clamp	Observer	Mean R.A. 1910·0
B.J. 797 Dec. 29° 51′			
			h m s
Aug. 20	E	S	21 09 06·36
Sept. 9	E	N	06·32
16	W	N	06·34
17	W	S	06·31
22	W	S	06·28
26	W	N	06·27
Mean			06·313
Δ_1			·000
Δ_2			·000
Mean R.A.			21 09 06·313
B.J. 798 Dec. 59° 37′			
Aug. 11	W	S	21 09 30·82
31	E	N	30·74
Sept. 1	E	S	30·75
8	E	S	30·77
10	E	S	30·76
14	E	N	30·65
15	E	S	30·70
19	W	N	30·75
21	W	N	30·82
28	W	N	30·75
29	W	S	30·79
30	W	N	30·78
Oct. 7	W	N	30·77
10	W	N	30·67
11	W	S	30·73
12	E	N	30·76
17	E	N	30·65
19	E	N	30·68
Mean			30·741
Δ_1			·004
Δ_2			−·001
Mean R.A.			21 09 30·744
B.J. 799 Dec. 37° 40′			
Aug. 11	W	S	21 11 11·87
20	E	S	11·85
31	E	N	11·87
Sept. 1	E	S	11·86

Date	Clamp	Observer	Mean R.A. 1910·0
B.J. 799 (continued)			
			h m s
Sept. 2	E	N	21 11 11·80
8	E	S	11·86
9	E	N	11·89
10	E	S	11·84
13	E	S	11·85
15	E	S	11·87
16	W	N	11·85
17	W	S	11·89
19	W	N	11·88
21	W	N	11·85
22	W	S	11·86
26	W	N	11·84
28	W	N	11·90
29	W	S	11·88r
30	W	N	11·87
Oct. 7	W	N	11·82
10	W	N	11·83r
11	W	S	11·87
12	E	N	11·84
19	E	N	11·85r
Mean			11·858
Δ_1			·003
Δ_2			·000
Mean R.A.			21 11 11·861
σ Cygni Dec. 39° 01′			
Aug. 11	W	S	21 13 52·74
31	E	N	52·78
Sept. 1	E	S	52·75
2	E	N	52·77
9	E	N	52·79
10	E	S	52·75
13	E	S	52·80
14	E	N	52·73
16	W	N	52·81
21	W	N	52·79
22	W	S	52·81
26	W	N	52·76
28	W	N	52·68
Oct. 7	W	N	52·74
18	E	S	52·71
Mean			52·761
Δ_1			−·002
Δ_2			·000
Mean R.A.			21 13 52·759

Date	Clamp	Observer	Mean R.A. 1910·0
υ Cygni Dec. 34° 31′			
			h m s
Aug. 20	E	S	21 14 12·96
Sept. 8	E	S	12·95
15	E	S	12·99
17	W	S	12·98
19	W	N	13·02
30	W	N	12·99
Oct. 10	W	N	12·95
12	E	N	12·95
17	E	N	12·96
19	E	N	12·92
26	E	N	12·89
Mean			12·960
Δ_2			·000
Mean R.A.			21 14 12·960
Bradley 2796 Dec. 76° 38′			
Aug. 11	W	S	21 16 41·94
Sept. 1	E	S	41·84
13	E	S	41·77
21	W	N	41·86
29	W	S	41·95
Oct. 10	W	N	41·83
11	W	S	41·86
18	E	S	41·82
19	E	N	41·76
Mean			41·848
Δ_2			·000
Mean R.A.			21 16 41·848
B.J. 804 Dec. 19° 25′			
Sept. 2	E	N	21 17 55·43
9	E	N	55·43
13	E	S	55·38
14	E	N	55·40
16	W	N	55·45
19	W	N	55·44
21	W	N	55·41
22	W	S	55·40
30	W	N	55·43

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 804 (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Oct. 3	W	N	21 17 55·40
18	E	S	55·47
19	E	N	55·45
26	E	N	55·40
Mean			55·422
Δ_1			·004
Δ_2			−·001
Mean R.A.			21 17 55·425

69 Cygni Dec. 36° 17′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 20	E	S	21 22 06·27
31	E	N	06·27
Sept. 1	E	S	06·25
2	E	N	06·19
8	E	S	06·28
9	E	N	06·21
10	E	S	06·25
13	E	S	06·27
14	E	N	06·23
15	E	S	06·25
16	W	N	06·39
17	W	S	06·33
19	W	N	06·24r
21	W	N	06·33r
22	W	S	06·33r
28	W	N	06·24
29	W	S	06·27
30	W	N	06·30
Oct. 7	W	N	06·30r
10	W	N	06·34
11	W	S	06·31r
12	E	N	06·29r
18	E	S	06·28
19	E	N	06·26
20	E	S	06·23
26	E	N	06·25
Mean			06·275
Δ_2			·000
Mean R.A.			21 22 06·275

B.J. 807 Dec. 46° 09′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Aug. 20	E	S	21 26 07·61
Sept. 1	E	S	07·58
2	E	N	07·62
9	E	N	07·60
10	E	S	07·59
13	E	S	07·67
14	E	N	07·60
19	W	N	07·68
21	W	N	07·63
22	W	S	07·62
26	W	N	07·70
28	W	N	07·63
29	W	S	07·59
30	W	N	07·71
Oct. 7	W	N	07·61
10	W	N	07·59
11	W	S	07·65
17	E	N	07·63
19	E	N	07·66
26	E	N	07·64
Mean			07·631
Δ_1			·000
Δ_2			−·001
Mean R.A.			21 26 07·630

B.J. 809 Dec. 70° 10′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 31	E	N	21 27 30·15
Sept. 1	E	S	30·09
9	E	N	30·12
10	E	S	30·17
15	E	S	30·15
21	W	N	30·16
28	W	N	30·24
Oct. 10	W	N	30·21
17	E	N	30·21
26	E	N	30·11
Mean			30·161
Δ_1			−·001
Δ_2			·003
Mean R.A.			21 27 30·163

Groombridge 3511 Dec. 80° 08′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 29	W	S	21 27 30·24
Oct. 18	E	S	30·12
20	E	S	30·27
Mean			30·210
Δ_2			·018
Mean R.A.			21 27 30·228

ρ Cygni Dec. 45° 12′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 31	E	N	21 30 35·59
Sept. 1	E	S	35·69
8	E	S	35·66
9	E	N	35·58
14	E	N	35·65
21	W	N	35·74
22	W	S	35·64
29	W	S	35·66
30	W	N	35·64
Oct. 7	W	N	35·57
18	E	S	35·67
26	E	N	35·63
Mean			35·643
Δ_2			·000
Mean R.A.			21 30 35·643

72 Cygni Dec. 38° 08′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 20	E	S	21 31 05·89
Sept. 10	E	S	05·90
13	E	S	05·92
16	W	N	05·93
17	W	S	05·95
19	W	N	05·91
26	W	N	05·87
Oct. 10	W	N	05·87
12	E	N	05·90
17	E	N	05·94
19	E	N	05·90
20	E	S	05·89
Mean			05·906
Δ_2			·000
Mean R.A.			21 31 05·906

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 811
Dec. 40° 01′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Aug. 31	E	N	21 33 20·44
Sept. 1	E	S	20·38
8	E	S	20·43
9	E	N	20·41
10	E	S	20·40
14	E	N	20·39
15	E	S	20·42
16	W	N	20·41
17	W	S	20·41
19	W	N	20·45
21	W	N	20·48
22	W	S	20·43
26	W	N	20·42
28	W	N	20·46
29	W	S	20·41
30	W	N	20·44
Oct. 7	W	N	20·40
10	W	N	20·39
11	W	S	20·41
12	E	N	20·38
17	E	N	20·36
18	E	S	20·43
19	E	N	20·41
20	E	S	20·43
26	E	N	20·42

Mean 20·416
Δ_1 −·004
Δ_2 ·000

Mean R.A. 21 33 20·412

B.J. 813
Dec. 57° 05′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 31	E	N	21 36 09·90
Sept. 1	E	S	10·03
8	E	S	09·94
9	E	N	09·84
10	E	S	10·05
14	E	N	09·95
15	E	S	10·07
16	W	N	10·10
17	W	S	10·03
19	W	N	09·98
21	W	N	10·04
22	W	S	10·06
26	W	N	10·02
28	W	N	10·04
29	W	S	09·97
30	W	N	10·04

B.J. 813
(continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Oct. 7	W	N	21 36 10·03
10	W	N	10·10
12	E	N	10·02
17	E	N	10·04
18	E	S	10·00
19	E	N	10·03
20	E	S	10·02
26	E	N	09·96

Mean 10·011
Δ_1 ·004
Δ_2 ·000

Mean R.A. 21 36 10·015

B.J. 816
Dec. 25° 14′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 8	E	S	21 40 34·14
16	W	N	34·20 r
17	W	S	34·11 r
19	W	N	34·10
22	W	S	34·15
28	W	N	34·09 r
30	W	N	34·13 r
Oct 7	W	N	34·08
26	E	N	34·11 r

Mean 34·123
Δ_1 −·002
Δ_2 ·000

Mean R.A. 21 40 34·121

B.J. 817
Dec. 70° 54′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 31	E	N	21 40 36·34
Sept. 1	E	S	36·43
9	E	N	36·15
10	E	S	36·49 r
13	E	S	36·27 r
14	E	N	36·29
15	E	S	36·38 r
21	W	N	36·39 r
26	W	N	36·49
27	W	S	36·39 r
29	W	S	36·31

B.J. 817
(continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Oct. 10	W	N	21 40 36·41 r
11	W	S	36·36
12	E	N	36·28
17	E	N	36·39 r
18	E	S	36·29
19	E	N	36·23
20	E	S	36·38

Mean 36·349
Δ_1 ·004
Δ_2 ·004

Mean R.A. 21 40 36·357

78 Draconis
Dec. 71° 54′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 31	E	N	21 41 58·57
Sept. 1	E	S	58·51 r
9	E	N	58·53
10	E	S	58·64
13	E	S	58·60
14	E	N	58·47 r
15	E	S	58·62
21	W	N	58·74
26	W	N	58·60 r
27	W	S	58·63
29	W	S	58·46 r
Oct. 10	W	N	58·61
11	W	S	58·60 r
12	E	N	58·53 r
17	E	N	58·53
18	E	S	58·57 r
19	E	N	58·53 r
20	E	S	58·57 r

Mean 58·578
Δ_2 ·004

Mean R.A. 21 41 58·582

B.J. 821
Dec. 48° 54′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 31	E	N	21 43 28·01
Sept. 1	E	S	28·03
8	E	S	28·00
9	E	N	27·94

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 821 (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 10	E	S	21 43 28·02
13	E	S	28·07
14	E	N	28·04
15	E	S	28·03
16	W	N	27·97
19	W	N	28·12
21	W	N	28·05
22	W	S	28·05
26	W	N	28·06
27	W	S	28·00
28	W	N	27·99
29	W	S	27·96
30	W	N	28·03
Oct. 7	W	N	28·01
10	W	N	27·99
11	W	S	27·99
12	E	N	28·03
17	E	N	28·03
18	E	S	27·96
19	E	N	28·00
26	E	N	28·00
Mean			28·015
Δ_1			−·002
Δ_2			·000
Mean R.A.			21 43 28·013

14 Pegasi Dec. 29° 45′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 31	E	N	21 45 51·78
Sept. 8	E	S	51·71
9	E	N	51·65
13	E	S	51·71
14	E	N	51·74
15	E	S	51·70
16	W	N	51·72
19	W	N	51·72
21	W	N	51·73
22	W	S	51·73
26	W	N	51·77
28	W	N	51·76
29	W	S	51·70
30	W	N	51·75
Oct. 7	W	N	51·72
10	W	N	51·74
11	W	S	51·71
12	E	N	51·65
17	E	N	51·73
18	E	S	51·70

14 Pegasi (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Oct. 19	E	N	21 45 51·72
20	E	S	51·70
26	E	N	51·65
Nov. 9	E	N	51·76
Mean			51·719
Δ_2			−·001
Mean R.A.			21 45 51·718

B.J. 823 Dec. 25° 30′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 31	E	N	21 48 57·93
Sept. 8	E	S	58·01r
13	E	S	57·94
14	E	N	57·98
15	E	S	57·98
16	W	N	58·01
19	W	N	57·97r
21	W	N	57·99
22	W	S	57·99r
26	W	N	57·93
28	W	N	58·00
29	W	S	57·97
30	W	N	58·00
Oct. 7	W	N	57·94r
10	W	N	58·02
11	W	S	57·94
12	E	N	57·89
17	E	N	57·92
18	E	S	57·96
19	E	N	57·94
20	E	S	57·90
Nov. 9	E	N	57·95
Mean			57·962
Δ_1			−·005
Δ_2			−·001
Mean R.A.			21 48 57·956

Bradley 2868 Dec. 55° 47′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 31	E	N	21 50 04·96
Sept. 1	E	S	04·95
8	E	S	04·97
10	E	S	05·05

Bradley 2868 (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 13	E	S	21 50 05·07
14	E	N	04·97
15	E	S	05·01
16	W	N	04·97
19	W	N	05·04
21	W	N	05·02r
22	W	S	05·03
26	W	N	05·02
27	W	S	04·99
28	W	N	04·99r
29	W	S	04·98r
30	W	N	04·91
Oct. 7	W	N	05·03r
10	W	N	05·05
12	E	N	04·96
18	E	S	04·92
19	E	N	04·97
20	E	S	04·92
Nov. 9	E	N	05·06r
Mean			04·993
Δ_2			·000
Mean R.A.			21 50 04·993

79 Draconis Dec. 73° 17′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 31	E	N	21 51 44·19
Sept. 1	E	S	43·93
10	E	S	44·19
27	W	S	44·07
Oct. 11	W	S	44·13
17	E	N	44·02
18	E	S	44·05
20	E	S	44·07
Mean			44·081
Δ_1			·000
Δ_2			·011
Mean R.A.			21 51 44·092

13 Cephei Dec. 56° 11′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 8	E	S	21 51 51·56
13	E	S	51·62
14	E	N	51·56r
15	E	S	51·53

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

13 Cephei (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 16	W	N	21 51 51·57
19	W	N	51·54r
21	W	N	51·59
22	W	S	51·57r
26	W	N	51·55r
28	W	N	51·60
29	W	S	51·49
30	W	N	51·53r
Oct. 7	W	N	51·62
10	W	N	51·50r
12	E	N	51·49r
19	E	N	51·54r
21	E	S	51·57
Nov. 9	E	N	51·51

Mean 51·552
Δ_2 −·002

Mean R.A. 21 51 51·550

B.J. 826
Dec. 12° 41′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 8	E	S	21 56 42·24
13	E	S	42·21
14	E	N	42·26
15	E	S	42·19
16	W	N	42·24
19	W	N	42·28
21	W	N	42·24
22	W	S	42·21
26	W	N	42·24
30	W	N	42·29
Oct. 7	W	N	42·23
11	W	S	42·27
18	E	S	42·29

Mean 42·245
Δ_1 ·002
Δ_2 ·000

Mean R.A. 21 56 42·247

Bradley 2897
Dec. 74° 34′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Aug. 31	E	N	21 56 59·88
Sept. 1	E	S	59·74r
10	E	S	59·95
27	W	S	59·80r
28	W	N	59·96r
29	W	S	59·74
Oct. 10	W	N	59·75
12	E	N	59·68
17	E	N	59·79r
19	E	N	59·61
20	E	S	59·78
21	E	S	59·78r
Nov. 9	E	N	59·78

Mean 59·788
Δ_2 ·006

Mean R.A. 21 56 59·794

16 Cephei
Dec. 72° 45′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 13	E	S	21 57 58·06
14	E	N	57·96
15	E	S	58·03r
26	W	N	58·06
27	W	S	57·98
28	W	N	58·12
29	W	S	57·90r
Oct. 10	W	N	57·98r
11	W	S	58·03
12	E	N	58·00
17	E	N	57·87
18	E	S	57·96
19	E	N	57·95r
20	E	S	57·95r
21	E	S	57·98
Nov. 9	E	N	58·06r

Mean 57·993
Δ_2 ·004

Mean R.A. 21 57 57·997

B.J. 831
Dec. 24° 54′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Aug. 31	E	N	22 02 49·23
Sept. 13	E	S	49·21
14	E	N	49·19
15	E	S	49·23
16	W	N	49·26
19	W	N	49·17
21	W	N	49·20
22	W	S	49·19
26	W	N	49·18
28	W	N	49·22
29	W	S	49·22
30	W	N	49·17
Oct. 3	W	N	49·22
7	W	N	49·15
10	W	N	49·26
11	W	S	49·17
12	E	N	49·17
17	E	N	49·22
18	E	S	49·23
19	E	N	49·15
20	E	S	49·20
21	E	S	49·19
26	E	N	49·23

Mean 49·203
Δ_1 ·003
Δ_2 −·001

Mean R.A. 22 02 49·205

B.J. 833
Dec. 32° 44′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 31	E	N	22 05 14·23
Sept. 10	E	S	14·29r
13	E	S	14·28r
14	E	N	14·28r
15	E	S	14·25
16	W	N	14·19r
19	W	N	14·25
21	W	N	14·22r
22	W	S	14·26
26	W	N	14·28
27	W	S	14·28r
28	W	N	14·23r
29	W	S	14·29
30	W	N	14·29

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 833 (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Oct. 3	W	N	22 05 14·21r
7	W	N	14·36r
10	W	N	14·32
11	W	S	14·23
12	E	N	14·28
17	E	N	14·24r
18	E	S	14·25
19	E	N	14·28
20	E	S	14·25
21	E	S	14·27r
26	E	N	14·25r
Nov. 9	E	N	14·27r

Mean 14·263
Δ1 −·003
Δ2 −·001

Mean R.A. 22 05 14·259

B.J. 835 Dec. 32° 44′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 31	E	N	22 05 59·35
Sept. 10	E	S	59·30
14	E	N	59·31
16	W	N	59·38
19	W	N	59·35r
21	W	N	59·28
22	W	S	59·43r
26	W	N	59·33r
27	W	S	59·27
28	W	N	59·32
30	W	N	59·33r
Oct. 3	W	N	59·29
7	W	N	59·37
10	W	N	59·32r
12	E	N	59·42r
17	E	N	59·33
19	E	N	59·35r
20	E	S	59·30r
26	E	N	59·34
Nov. 9	E	N	59·23

Mean 59·330
Δ1 ·004
Δ2 −·001

Mean R.A. 22 05 59·333

28 Pegasi Dec. 20° 32′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 13	E	S	22 06 14·87
15	E	S	14·85
29	W	S	14·88
Oct. 11	W	S	14·90
18	E	S	14·88
21	E	S	14·91

Mean 14·882
Δ2 ·002

Mean R.A. 22 06 14·884

B.J. 836 Dec. 57° 45′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 31	E	N	22 07 43·78
Sept. 16	W	N	43·88
19	W	N	43·81
22	W	S	43·82
26	W	N	43·79
30	W	N	43·84
Oct. 3	W	N	43·85
7	W	N	43·81
10	W	N	43·76
26	E	N	43·81
Nov. 2	E	N	43·88

Mean 43·821
Δ1 −·003
Δ2 −·005

Mean R.A. 22 07 43·813

B.J. 837 Dec. 71° 54′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 10	E	S	22 08 04·86
13	E	S	04·83
14	E	N	04·88
15	E	S	04·79
27	W	S	04·57
28	W	N	04·87
29	W	S	04·74
Oct. 11	W	S	04·83
12	E	N	04·76
17	E	N	04·81

B.J. 837 (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Oct. 18	E	S	22 08 04·77
19	E	N	04·71
20	E	S	04·70
21	E	S	04·88
Nov. 9	E	N	04·74

Mean 04·783
Δ1 −·005
Δ2 ·007

Mean R.A. 22 08 04·785

1 H.Lacertae Dec. 39° 16′

Date	Clamp	Observer	Mean R.A. 1910·0
Aug. 31	E	N	22 10 00·87
Sept. 10	E	S	00·86
13	E	S	00·84
14	E	N	00·79
15	E	S	00·78
16	W	N	00·82
19	W	N	00·75
21	W	N	00·82
22	W	S	00·88
26	W	N	00·80
27	W	S	00·84
28	W	N	00·98
29	W	S	00·84
30	W	N	00·80
Oct. 3	W	N	00·78
7	W	N	00·75
10	W	N	00·82
12	E	N	00·76
17	E	N	00·79
18	E	S	00·81
19	E	N	00·79
20	E	S	00·78
21	E	S	00·82
26	E	N	00·81
Nov. 2	E	N	00·85
9	E	N	00·81

Mean 00·816
Δ2 ·000

Mean R.A. 22 10 00·816

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

Bradley 2942
Dec. 72° 52′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 10	E	S	22 11 15·22
13	E	S	15·23
14	E	N	15·12
15	E	S	15·10
21	W	N	15·07
26	W	N	15·13
27	W	S	15·10
29	W	S	15·06
Oct. 10	W	N	15·03
11	W	S	14·95
12	E	N	15·13
18	E	S	15·02
19	E	N	15·03
20	E	S	15·07
21	E	S	16·08
Nov. 2	E	N	15·24
Mean			15·099
Δ_2			·004
Mean R.A.			22 11 15·103

B.J. 844
Dec. 51° 47′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 30	W	N	22 20 01·140
Δ_1			·002
Δ_2			–·007
Mean R.A.			22 20 01·135

B.D. 70·1240
Dec. 70° 19′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 10	E	S	22 23 41·22
13	E	S	41·14
15	E	S	41·07
21	W	N	40·98
27	W	S	40·89
28	W	N	41·10
29	W	S	41·08

B.D. 70·1240
(continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Oct. 10	W	N	22 23 41·05
12	E	N	41·21
17	E	N	41·05
18	E	S	41·04
19	E	N	40·95
21	E	S	41·10
Nov. 2	E	N	41·16
9	E	N	40·94
Mean			41·065
Δ_2			·004
Mean R.A.			22 23 41·069

B.J. 847
Dec. 57° 57′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 21	W	N	22 25 49·47
28	W	N	49·53
30	W	N	49·59
Oct. 3	W	N	49·60
7	W	N	49·53
10	W	N	49·57
17	E	N	49·64
19	E	N	49·53
26	E	N	49·61
Nov. 2	E	N	49·68
9	E	N	49·55
Mean			49·573
Δ_1			·003
Δ_2			–·004
Mean R.A.			22 25 49·572

38 Pegasi
Dec. 32° 07′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 22	W	S	22 25 54·70
Oct. 18	E	S	54·69
21	E	S	54·74
Nov. 20	W	S	54·70
Mean			54·708
Δ_2			·002
Mean R.A.			22 25 54·710

28 Cephei
Dec. 78° 20′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 10	E	S	22 26 02·42r
13	E	S	02·44
15	E	S	02·35
27	W	S	02·23r
29	W	S	02·15
Oct. 12	E	N	01·87
Mean			02·243
Δ_2			·013
Mean R.A.			22 26 02·256

B.J. 848
Dec. 49° 49′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 10	E	S	22 27 34·89
13	E	S	34·89
15	E	S	34·81
21	W	N	34·79
22	W	S	34·86
27	W	S	34·86
28	W	N	34·88
29	W	S	34·80
30	W	N	34·86
Oct. 3	W	N	34·85
7	W	N	34·72
10	W	N	34·79
12	E	N	34·86
17	E	N	34·85
18	E	S	34·83
19	E	N	34·80
21	E	S	34·80
26	E	N	34·86
Nov. 2	E	N	34·89
9	E	N	34·85
20	W	S	34·87
Mean			34·839
Δ_1			–·002
Δ_2			·000
Mean R.A.			22 27 34·837

29 Cephei
Dec. 78° 22′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 10	E	S	22 29 05·67
13	E	S	05·62r
15	E	S	05·53r
21	W	N	05·45

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

29 Cephei (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 27	W	S	22 29 05·52
28	W	N	05·54
29	W	S	05·47r
Oct. 10	W	N	05·41
12	E	N	05·53r
17	E	N	05·38
18	E	S	05·45
19	E	N	05·34
Nov. 2	E	N	05·80
20	W	S	05·51
Mean			05·516
Δ_2			·003
Mean R.A.			22 29 05·519

226 B.Cephei
Dec. 75° 46′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 10	E	S	22 30 41·85
27	W	S	41·60
28	W	N	41·85
Oct. 10	W	N	41·51
17	E	N	41·58
18	E	S	41·53
19	E	N	41·67
21	E	S	41·67
Nov. 2	E	N	41·78
9	E	N	41·58
20	W	S	41·63
Mean			41·659
Δ_1			·004
Δ_2			·004
Mean R.A.			22 30 41·667

B.J. 851
Dec. 73° 11′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 10	E	S	22 33 32·86
13	E	S	32·88
15	E	S	32·78
21	W	N	32·61
27	W	S	32·68
28	W	N	32·87
29	W	S	32·71

B.J. 851 (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Oct. 10	W	N	22 33 32·63
12	E	N	32·70
17	E	N	32·60
18	E	S	32·72
19	E	N	32·43
Nov. 2	E	N	32·76
8	E	S	32·67
9	E	N	32·73
20	W	S	32·65
Mean			32·705
Δ_1			−·005
Δ_2			·004
Mean R.A.			22 33 32·704

B.J. 852
Dec. 38° 35′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 21	W	N	22 35 13·13
28	W	N	13·22
30	W	N	13·23
Oct. 3	W	N	13·22
7	W	N	13·22
10	W	N	13·23
12	E	N	13·16
17	E	N	13·24
19	E	N	13·16
26	E	N	13·27
Nov. 2	E	N	13·30
9	E	N	13·26
Mean			13·220
Δ_1			·003
Δ_2			−·002
Mean R.A.			22 35 13·221

Groombridge 3857
Dec. 74° 54′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 10	E	S	22 35 17·46
13	E	S	17·33
15	E	S	17·26
27	W	S	17·22
29	W	S	17·28
Oct. 18	E	S	17·12
21	E	S	17·23
Nov. 20	W	S	17·21

Groombridge 3857 (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Mean			22 35 17·264
Δ_2			·010
Mean R.A.			22 35 17·274

B.J. 853
Dec. 63° 07′

Date	Clamp	Observer	Mean R.A. 1910·0
Nov. 8	E	S	22 35 27·100
Δ_1			−·005
Δ_2			·012
Mean R.A.			22 35 27·107

B.J. 855
Dec. 10° 22′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 13	E	S	22 36 58·39
15	E	S	58·33
21	W	N	58·41
28	W	N	58·35r
30	W	N	58·41
Oct. 7	W	N	58·42
10	W	N	58·42r
12	E	N	58·39
17	E	N	58·39r
18	E	S	58·38
19	E	N	58·39
21	E	S	58·35r
26	E	N	58·41r
Nov. 2	E	N	58·43
8	E	S	58·36
9	E	N	58·36r
20	W	S	58·45r
Mean			58·391
Δ_1			−·004
Δ_2			−·001
Mean R.A.			22 36 58·386

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 857 — Dec. 29° 45′

Date	Clamp	Observer	Mean R.A. 1910·0 (h m s)
Sept. 13	E	S	22 38 46·88
15	E	S	46·88
21	W	N	46·89
28	W	N	46·86
30	W	N	46·83
Oct. 3	W	N	46·84
7	W	N	46·89
10	W	N	46·92
17	E	N	46·90
18	E	S	46·90
19	E	N	46·89
Nov. 2	E	N	46·97
8	E	S	46·88
9	E	N	46·93
20	W	S	46·91
Mean			46·891
Δ_1			−·003
Δ_2			·000
Mean R.A.			22 38 46·888

B.J. 858 — Dec. 41° 21′

Date	Clamp	Observer	Mean R.A. 1910·0 (h m s)
Sept. 10	E	S	22 40 04·58r
15	E	S	04·46
21	W	N	04·45
27	W	S	04·48r
28	W	N	04·50r
30	W	N	04·53
Oct. 3	W	N	04·63
7	W	N	04·38
10	W	N	04·46r
12	E	N	04·49
17	E	N	04·46r
18	E	S	04·45
19	E	N	04·45
21	E	S	04·48r
Nov. 2	E	N	04·46
8	E	S	04·48r
9	E	N	04·45r
20	W	S	04·48
Mean			04·482
Δ_1			−·002
Δ_2			−·001
Mean R.A.			22 40 04·479

B.J. 859 — Dec. 23° 06′

Date	Clamp	Observer	Mean R.A. 1910·0 (h m s)
Sept. 15	E	S	22 42 11·69
21	W	N	11·69r
28	W	N	11·73r
30	W	N	11·70
Oct. 3	W	N	11·75
7	W	N	11·68
10	W	N	11·68r
12	E	N	11·69
17	E	N	11·73r
18	E	S	11·65r
19	E	N	11·69
21	E	S	11·70r
Nov. 2	E	N	11·73
8	E	S	11·66
9	E	N	11·73
20	W	S	11·67
Mean			11·698
Δ_1			·001
Δ_2			−·001
Mean R.A.			22 42 11·698

B.J. 862 — Dec. 24° 08′

Date	Clamp	Observer	Mean R.A. 1910·0 (h m s)
Sept. 15	E	S	22 45 39·46r
21	W	N	39·46
28	W	N	39·48
30	W	N	39·43r
Oct. 3	W	N	39·43
7	W	N	39·46r
10	W	N	39·46
17	E	N	39·48
18	E	S	39·46
19	E	N	39·52r
21	E	S	39·48
Nov. 2	E	N	39·45r
9	E	N	39·49
Mean			39·466
Δ_1			−·002
Δ_2			−·001
Mean R.A.			22 45 39·463

B.J. 863 — Dec. 65° 44′

Date	Clamp	Observer	Mean R.A. 1910·0 (h m s)
Nov. 8	E	S	22 46 28·34
20	W	S	28·35
Mean			28·345
Δ_1			−·005
Δ_2			·004
Mean R.A.			22 46 28·344

52 Pegasi — Dec. 11° 15′

Date	Clamp	Observer	Mean R.A. 1910·0 (h m s)
Sept. 15	E	S	22 54 41·64
21	W	N	41·61r
22	W	S	41·64
28	W	N	41·59
29	W	S	41·63
Oct. 7	W	N	41·67r
10	W	N	41·65
17	E	N	41·64
18	E	S	41·58r
19	E	N	41·65r
20	E	S	41·63
21	E	S	41·60
Nov. 8	E	S	41·58r
9	E	N	41·64
20	W	S	41·60
Mean			41·623
Δ_2			·000
Mean R.A.			22 54 41·623

B.J. 869 — Dec. 41° 51′

Date	Clamp	Observer	Mean R.A. 1910·0 (h m s)
Sept. 10	E	S	22 57 46·63
15	E	S	46·65r
21	W	N	46·54r
22	W	S	46·65
27	W	S	46·56
28	W	N	46·62
29	W	S	46·60r

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 869 (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Oct. 3	W	N	22 57 46·68
7	W	N	46·65r
10	W	N	46·64
17	E	N	46·53
18	E	S	46·62r
19	E	N	46·61r
20	E	S	46·61
21	E	S	46·63
Nov. 2	E	N	46·63r
8	E	S	46·57
9	E	N	46·54
20	W	S	46·59r

Mean 46·608
Δ_1 ·003
Δ_2 ·000

Mean R.A. 22 57 46·611

B.J. 870
Dec. 27° 36′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 15	E	S	22 59 24·60
21	W	N	24·53
28	W	N	24·65
29	W	S	24·56
Oct. 3	W	N	24·58
7	W	N	24·64
10	W	N	24·61
17	E	N	24·54
19	E	N	24·60
21	E	S	24·58
Nov. 2	E	N	24·60
9	E	N	24·54

Mean 24·586
Δ_1 –·005
Δ_2 –·001

Mean R.A. 22 59 24·580

B.J. 871
Dec. 14° 43′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 21	W	N	23 00 16·60
22	W	S	16·60
29	W	S	16·58
Oct. 7	W	N	16·62

B.J. 871 (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Oct. 18	E	S	23 00 16·60
20	E	S	16·63
Nov. 2	E	N	16·64
8	E	S	16·62
9	E	N	16·66
20	W	S	16·56

Mean 16·611
Δ_1 ·000
Δ_2 ·000

Mean R.A. 23 00 16·611

5 Andromedae
Dec. 48° 48′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 10	E	S	23 03 40·01
15	E	S	39·91
21	W	N	39·91
27	W	S	39·92
29	W	S	39·92
Oct. 7	W	N	39·85
17	E	N	39·88
18	E	S	39·85
20	E	S	39·90
21	E	S	39·87
Nov. 2	E	N	39·90
4	E	N	39·83
9	E	N	39·86
20	W	S	39·87

Mean 39·891
Δ_2 ·001

Mean R.A. 23 03 39·892

B.J. 874
Dec. 74° 54′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 10	E	S	23 05 02·13r
15	E	S	01·94
21	W	N	01·82
27	W	S	01·92
29	W	S	01·83r
Oct. 10	W	N	01·74r
17	E	N	01·88

B.J. 874 (continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Oct. 18	E	S	23 05 01·81
20	E	S	01·92
21	E	S	01·93r
Nov. 2	E	N	01·79
4	E	N	01·67
8	E	S	01·88r
9	E	N	01·87r
20	W	S	01·86r

Mean 01·866
Δ_1 –·005
Δ_2 ·007

Mean R.A. 23 05 01·868

B.J. 875
Dec. 56° 40′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 10	E	S	23 08 56·67
15	E	S	56·65
21	W	N	56·58
27	W	S	56·69
29	W	S	56·62
Oct. 3	W	N	56·68
7	W	N	56·68
10	W	N	56·61
17	E	N	56·54
18	E	S	56·59
19	E	N	56·60
20	E	S	56·64
21	E	S	56·55
Nov. 2	E	N	56·62
4	E	N	56·53
8	E	S	56·58
9	E	N	56·55
20	W	S	56·64

Mean 56·612
Δ_1 –·003
Δ_2 ·002

Mean R.A. 23 08 56·611

Bradley 3085
Dec. 73° 44′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 10	E	S	23 11 24·93
21	W	N	24·75
27	W	S	24·83

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

Date	Clamp	Observer	Mean R.A. 1910·0
Bradley 3085 (continued)			
			h m s
Sept. 29	W	S	23 11 24·90
Oct. 17	E	N	24·82
18	E	S	24·78
20	E	S	24·89
21	E	S	24·78
Nov. 2	E	N	24·68
8	E	S	24·77
9	E	N	24·80
20	W	S	24·90
Mean			24·819
Δ_2			·007
Mean R.A.			23 11 24·826
Bradley 3086 Dec. 70° 24′			
Oct. 17	E	N	23 12 09·08
Nov. 4	E	N	08·89
9	E	N	09·10
Mean			09·023
Δ_2			·007
Mean R.A.			23 12 09·030
Groombridge 4033 Dec. 74° 48′			
Sept. 10	E	S	23 14 08·44
21	W	N	08·23
27	W	S	08·39r
Oct. 10	W	N	08·26
17	E	N	08·28
18	E	S	08·28r
20	E	S	08·27r
21	E	S	08·22
Nov. 2	E	N	08·17r
9	E	N	08·29
20	W	S	08·26
27	W	S	08·38
Mean			08·289
Δ_2			·004
Mean R.A.			23 14 08·293

Date	Clamp	Observer	Mean R.A. 1910·0
***o* Cephei Dec. 67° 37′**			
			h m s
Nov. 4	E	N	23 14 55·22
8	E	S	55·28
Mean			55·250
Δ_1			·003
Δ_2			·010
Mean R.A.			23 14 55·263
B.J. 880 Dec. 23° 15′			
Sept. 21	W	N	23 16 10·87
29	W	S	10·79
Oct. 3	W	N	10·82
10	W	N	10·90r
17	E	N	10·80r
18	E	S	10·83
20	E	S	10·87
21	E	S	10·83r
Nov. 2	E	N	10·81
4	E	N	10·83
8	E	S	10·83r
9	E	N	10·85r
20	W	S	10·81r
27	W	S	10·83
Mean			10·836
Δ_1			−·002
Δ_2			·000
Mean R.A.			23 16 10·834
B.J. 882 Dec. 61° 47′			
Nov. 20	W	S	23 20 50·18
27	W	S	50·07
Mean			50·125
Δ_1			−·004
Δ_2			−·004
Mean R.A.			23 20 50·117

Date	Clamp	Observer	Mean R.A. 1910·0
B.J. 881 Dec. 22° 55′			
			h m s
Sept. 21	W	N	23 20 53·14
29	W	S	53·14r
Oct. 3	W	N	53·13
7	W	N	53·21
10	W	N	53·17
17	E	N	53·14
18	E	S	53·15r
20	E	S	53·17
21	E	S	53·13
Nov. 2	E	N	53·08r
4	E	N	53·13r
8	E	S	53·13
9	E	N	53·11
Mean			53·141
Δ_1			−·001
Δ_2			·000
Mean R.A.			23 20 53·140
B.J. 885 Dec. 12° 16′			
Sept. 29	W	S	23 24 36·12
Oct. 7	W	N	36·18
17	E	N	36·13
18	E	S	36·13
20	E	S	36·10
21	E	S	36·12
Nov. 2	E	N	36·12
4	E	N	36·10
8	E	S	36·13
9	E	N	36·13
20	W	S	36·15
27	W	S	36·18
Mean			36·132
Δ_1			−·005
Δ_2			·000
Mean R.A.			23 24 36·127

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

1 H. Cassiopeiae
Dec. 58° 03′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 10	E	S	23 25 52·36
Oct. 21	E	S	52·16
Nov. 27	W	S	52·29
Mean			52·270
Δ_2			·005
Mean R.A.			23 25 52·275

15 Andromedae
Dec. 39° 44′

Date	Clamp	Observer	Mean R.A. 1910·0
Oct. 21	E	S	23 30 13·12
Nov. 9	E	N	13·11
27	W	S	13·19
Mean			13·140
Δ_2			·001
Mean R.A.			23 30 13·141

Bradley 3140
Dec. 71° 09′

Date	Clamp	Observer	Mean R.A. 1910·0
Oct. 17	E	N	23 31 04·18
20	E	S	04·33
Nov. 2	E	N	04·18
4	E	N	04·03
Mean			04·180
Δ_2			·011
Mean R.A.			23 31 04·191

B.J. 890
Dec. 45° 58′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 29	W	S	23 33 09·27
Oct. 3	W	N	09·24
17	E	N	09·25
18	E	S	09·26
20	E	S	09·24r
21	E	S	09·25
Nov. 2	E	N	09·22
4	E	N	09·20
8	E	S	09·26r
9	E	N	09·28
20	W	S	09·30r
27	W	S	09·33
Mean			09·258
Δ_1			·004
Δ_2			·001
Mean R.A.			23 33 09·263

B.J. 891
Dec. 42° 46′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	23 33 43·06
Nov. 4	E	N	43·02
9	E	N	43·16
Mean			43·080
Δ_1			−·002
Δ_2			·001
Mean R.A.			23 33 43·079

Groombridge 4119
Dec. 74° 48′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 29	W	S	23 35 18·03
Oct. 17	E	N	17·92
18	E	S	17·97
20	E	S	18·08
Nov. 8	E	S	17·94
Mean			17·988
Δ_2			·014
Mean R.A.			23 35 18·002

B.J. 893
Dec. 77° 08′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Nov. 4	E	N	23 35 38·270
Δ_1			−·002
Δ_2			·013
Mean R.A.			23 35 38·281

κ Andromedae
Dec. 43° 50′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	23 35 58·22
Oct. 21	E	S	58·26
Nov. 2	E	N	58·22
9	E	N	58·22
20	W	S	58·26
Mean			58·236
Δ_1			−·005
Δ_2			·002
Mean R.A.			23 35 58·233

ψ Andromedae
Dec. 45° 55′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	23 41 34·13
29	W	S	34·15
Oct. 17	E	N	34·06
18	E	S	34·17r
20	E	S	34·16
21	E	S	34·14r
Nov. 2	E	N	34·14
4	E	N	34·12r
9	E	N	34·25r
20	W	S	34·20
27	W	S	34·14r
Mean			34·151
Δ_1			·004
Δ_2			·002
Mean R.A.			23 41 34·157

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 895
Dec. 67° 18′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Nov. 4	E	N	23 43 35·87r
8	E	S	35·94
9	E	N	35·91
20	W	S	35·99
27	W	S	35·96
Dec. 10	W	S	35·95
	Mean		35·937
	Δ_1		−·005
	Δ_2		·001
Mean R.A.			23 43 35·933

B.J. 898
Dec. 18° 37′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	23 47 54·42
Oct. 17	E	N	54·50
Nov. 4	E	N	54·50
8	E	S	54·42
	Mean		54·460
	Δ_1		−·001
	Δ_2		−·001
Mean R.A.			23 47 54·458

Groombridge 4154
Dec. 75° 03′

Date	Clamp	Observer	Mean R.A. 1910·0
Oct. 18	E	S	23 48 00·59
20	E	S	00·67
21	E	S	00·54
Nov. 2	E	N	00·53
9	E	N	00·61
20	W	S	00·62
27	W	S	00·66
	Mean		00·603
	Δ_2		·010
Mean R.A.			23 48 00·613

B.J. 899
Dec. 57° 00′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 7	E	S	23 49 52·82
Oct. 17	E	N	52·75
Nov. 4	E	N	52·74
8	E	S	52·80
	Mean		52·778
	Δ_1		·002
	Δ_2		·006
Mean R.A.			23 49 52·786

Groombridge 4163
Dec. 73° 55′

Date	Clamp	Observer	Mean R.A. 1910·0
Oct. 18	E	S	23 50 26·29
20	E	S	26·25
21	E	S	26·23
Nov. 2	E	N	26·24
9	E	N	26·34
20	W	S	26·35
27	W	S	26·33r
Dec. 10	W	S	26·49r
	Mean		26·315
	Δ_1		−·005
	Δ_2		·007
Mean R.A.			23 50 26·317

ψ Pegasi
Dec. 24° 38′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	23 53 10·20
Oct. 17	E	N	10·15
18	E	S	10·18
20	E	S	10·23
21	E	S	10·23
Nov. 2	E	N	10·19
4	E	N	10·24
8	E	S	10·23
9	E	N	10·25
20	W	S	10·21
27	W	S	10·22
Dec. 10	W	S	10·23
	Mean		10·213
	Δ_2		·001
Mean R.A.			23 53 10·214

B.J. 1
Dec. 28° 36′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Nov. 2	E	N	0 03 43·96
4	E	N	43·96
9	E	N	43·91
Dec. 10	W	S	43·97
	Mean		43·950
	Δ_1		−·002
	Δ_2		−·001
Mean R.A.			0 03 43·947

Bradley 3217
Dec. 79° 13′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 27	W	S	0 04 20·91
Oct. 18	E	S	20·81
20	E	S	20·80
21	E	S	20·81
Nov. 8	E	S	20·78
20	W	S	20·65
27	W	S	20·84
	Mean		20·800
	Δ_2		·013
Mean R.A.			0 04 20·813

B.J. 2
Dec. 58° 39′

Date	Clamp	Observer	Mean R.A. 1910·0
Nov. 2	E	N	0 04 21·98
9	E	N	22·10
	Mean		22·040
	Δ_1		·004
	Δ_2		·003
Mean R.A.			0 04 22·047

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 4
Dec. 45° 34′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 27	W	S	0 05 38·31
Oct. 20	E	S	38·29
21	E	S	38·26
Nov. 2	E	N	38·18
9	E	N	38·28
27	W	S	38·25
Dec. 10	W	S	38·31
Mean			38·269
Δ_1			·002
Δ_2			·001
Mean R.A.			0 05 38·272

B.J. 7
Dec. 14° 41′

Date	Clamp	Observer	Mean R.A. 1910·0
Oct. 18	E	S	0 08 35·91
20	E	S	35·98
21	E	S	35·98
Nov. 2	E	N	35·93
4	E	N	36·03
8	E	S	35·94
9	E	N	35·97
20	W	S	35·97
27	W	S	35·98
Dec. 5	W	N	35·93
Mean			35·962
Δ_1			·003
Δ_2			·000
Mean R.A.			0 08 35·965

B.J. 8
Dec. 76° 27′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 27	W	S	0 11 06·39
Oct. 18	E	S	06·38
20	E	S	06·45
21	E	S	06·45
Nov. 2	E	N	06·36
8	E	S	06·43
9	E	N	06·57
27	W	S	06·48
Dec. 10	W	S	06·70

B.J. 8
(continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Mean			0 11 06·468
Δ_1			·002
Δ_2			·010
Mean R.A.			0 11 06·480

σ Andromedae
Dec. 36° 17′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 27	W	S	0 13 37·31
Oct. 18	E	S	37·24r
20	E	S	37·29
21	E	S	37·32r
Nov. 4	E	N	37·25
8	E	S	37·23
9	E	N	37·37r
20	W	S	37·29r
27	W	S	37·34r
Dec. 10	W	S	37·30
Mean			37·294
Δ_1			·000
Δ_2			·001
Mean R.A.			0 13 37·295

ρ Andromedae
Dec. 37° 28′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 27	W	S	0 16 22·65r
Oct. 18	E	S	22·52
20	E	S	22·64r
21	E	S	22·57
Nov. 4	E	N	22·54r
8	E	S	22·59r
9	E	N	22·60
20	W	S	22·60
27	W	S	22·59
Dec. 10	W	S	22·60r
Mean			22·590
Δ_2			·002
Mean R.A.			0 16 22·592

Bradley 34
Dec. 76° 31′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 27	W	S	0 25 07·23
Oct. 18	E	S	07·02
20	E	S	07·16
21	E	S	07·17
Nov. 2	E	N	06·99
8	E	S	07·12
9	E	N	07·13
27	W	S	07·22
Dec. 5	W	N	07·49
10	W	S	07·40
Mean			07·193
Δ_2			·007
Mean R.A.			0 25 07·200

B.J. 16
Dec. 62° 26′

Date	Clamp	Observer	Mean R.A. 1910·0
Nov. 8	E	S	0 27 52·45
9	E	N	52·51r
27	W	S	52·47r
Dec. 5	W	N	52·58
9	W	N	52·58
Mean			52·518
Δ_1			·004
Δ_2			−·002
Mean R.A.			0 27 52·520

B.J. 17
Dec. 53° 24′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 27	W	S	0 31 57·00
Oct. 18	E	S	56·93
20	E	S	57·00
21	E	S	56·92
Nov. 8	E	S	57·00
9	E	N	56·96
27	W	S	56·97
Dec. 8	W	S	57·02
9	W	N	57·07
10	W	S	57·06
Mean			56·993
Δ_1			−·001
Δ_2			·002
Mean R.A.			0 31 56·994

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LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 18
Dec. 33° 13′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 7	E	S	0 32 04·18
Nov. 2	E	N	04·18
Dec. 5	W	N	04·15
Mean			04·170
Δ_1			·004
Δ_2			·000
Mean R.A.			0 32 04·174

B.J. 19
Dec. 28° 49′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	0 33 47·76
Oct. 21	E	S	47·78
Nov. 2	E	N	47·74
8	E	S	47·75
9	E	N	47·80
Dec. 5	W	N	47·84
9	W	N	47·74
Mean			47·773
Δ_1			−·004
Δ_2			·000
Mean R.A.			0 33 47·769

B.J. 20
Dec. 30° 22′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 27	W	S	0 34 30·76
Oct. 20	E	S	30·71
Nov. 2	E	N	30·70
9	E	N	30·71
27	W	S	30·68
Dec. 5	W	N	30·59
10	W	S	30·73
Mean			30·697
Δ_1			−·003
Δ_2			·000
Mean R.A.			0 34 30·694

B.J. 21
Dec. 56° 03′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 7	E	S	0 35 23·48
27	W	S	23·62
Oct. 18	E	S	23·45
20	E	S	23·41
21	E	S	23·57r
Nov. 2	E	N	23·51
8	E	S	23·53
9	E	N	23·58
Dec. 9	W	N	23·41
Mean			23·507
Δ_1			−·002
Δ_2			·003
Mean R.A.			0 35 23·508

B.J. 24
Dec. 74° 30′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 27	W	S	0 39 41·31
Oct. 18	E	S	41·06
20	E	S	41·25
Nov. 2	E	N	41·20
8	E	S	41·07r
9	E	N	41·16r
Dec. 5	W	N	41·46
8	W	S	41·21
Mean			41·215
Δ_1			−·002
Δ_2			·006
Mean R.A.			0 39 41·219

B.J. 25
Dec. 47° 48′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	0 39 42·18
Oct. 21	E	S	42·19
Nov. 27	W	S	42·20
Dec. 9	W	N	42·35
10	W	S	42·24
Mean			42·232
Δ_1			·004
Δ_2			·001
Mean R.A.			0 39 42·237

23 Cassiopeiae
Dec. 74° 21′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 27	W	S	0 41 44·32
Oct. 18	E	S	44·27r
21	E	S	44·26
Nov. 2	E	N	44·24r
8	E	S	44·30
9	E	N	44·39
Dec. 5	W	N	44·46
Mean			44·320
Δ_2			·008
Mean R.A.			0 41 44·328

B.D. 71·37
Dec. 72° 11′

Date	Clamp	Observer	Mean R.A. 1910·0
Oct. 20	E	S	0 42 15·24
Nov. 27	W	S	15·53
Dec. 9	W	N	15·64
10	W	S	15·43
Mean			15·460
Δ_2			−·004
Mean R.A.			0 42 15·456

B.J. 27
Dec. 23° 47′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	0 42 33·88
Nov. 9	E	N	33·99
Dec. 12	W	N	33·89
Mean			33·920
Δ_1			·000
Δ_2			−·001
Mean R.A.			0 42 33·919

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

η Cassiopeiae
Dec. 57° 20′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 7	E	S	0 43 39·03
27	W	S	39·08
Oct. 20	E	S	39·12r
21	E	S	39·07
Nov. 2	E	N	39·06
8	E	S	39·08r
9	E	N	39·11
27	W	S	39·12
Dec. 5	W	N	39·13
9	W	N	39·08
12	W	N	39·16

Mean	39·095
Δ_1	·003
Δ_2	·000
Mean R.A.	0 43 39·098

ν Andromedae
Dec. 40° 35′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	0 44 50·66
27	W	S	50·76
Oct. 18	E	S	50·69
20	E	S	50·72
21	E	S	50·73
Nov. 2	E	N	50·75
9	E	N	50·75
27	W	S	50·67
Dec. 5	W	N	50·66
9	W	N	50·66
10	W	S	50·68
12	W	N	50·73

Mean	50·705
Δ_1	·000
Δ_2	·000
Mean R.A.	0 44 50·705

B.J. 29
Dec. 63° 45′

Date	Clamp	Observer	Mean R.A. 1910·0
Nov. 8	E	S	0 45 15·230r

Δ_1	–·004
Δ_2	·012
Mean R.A.	0 45 15·238

B.J. 32
Dec. 60° 14′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Nov. 8	E	S	0 51 16·05
27	W	S	16·00
Dec. 9	W	N	16·09

Mean	16·047
Δ_1	–·005
Δ_2	–·002
Mean R.A.	0 51 16·040

B.J. 33
Dec. 38° 01′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	0 51 45·16
27	W	S	45·23
Oct. 18	E	S	45·13
20	E	S	45·20
21	E	S	45·19
Nov. 2	E	N	45·12
9	E	N	45·18
Dec. 5	W	N	45·25
12	W	N	45·09

Mean	45·172
Δ_1	·004
Δ_2	·001
Mean R.A.	0 51 45·177

***h* Piscium**
Dec. 28° 30′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	0 52 57·65
Oct. 18	E	S	57·65
20	E	S	57·68
21	E	S	57·67
Nov. 2	E	N	57·68
8	E	S	57·69
9	E	N	57·71
27	W	S	57·66
Dec. 5	W	N	57·67
9	W	N	57·65
10	W	S	57·67
12	W	N	57·71

Mean	57·674
Δ_2	·000
Mean R.A.	0 52 57·674

72 Piscium
Dec. 14° 28′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 7	E	S	1 00 20·14
Nov. 2	E	N	20·15
8	E	S	20·16
27	W	S	20·16
Dec. 5	W	N	20·14

Mean	20·150
Δ_1	–·001
Δ_2	·000
Mean R.A.	1 00 20·149

Bradley 109
Dec. 79° 32′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 27	W	S	1 01 29·10
Dec. 10	W	S	29·14
12	W	N	29·35

Mean	29·197
Δ_2	–·023
Mean R.A.	1 01 29·174

μ Cassiopeiae
Dec. 54° 29′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	1 02 16·53
Nov. 2	E	N	16·36
8	E	S	16·49
27	W	S	16·53
Dec. 5	W	N	16·53
9	W	N	16·47

Mean	16·485
Δ_1	·004
Δ_2	·000
Mean R.A.	1 02 16·489

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 41
Dec. 79° 12′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 27	W	S	1 04 27·58
Nov. 8	E	S	27·44
27	W	S	27·47r
Dec. 9	W	N	27·64
Mean			27·533
Δ_1			·003
Δ_2			−·008
Mean R.A.			1 04 27·528

B.J. 42
Dec. 35° 09′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	1 04 41·33
Nov. 2	E	N	41·29
Dec. 5	W	N	41·30
12	W	N	41·33
Mean			41·313
Δ_1			−·002
Δ_2			−·001
Mean R.A.			1 04 41·310

χ Piscium
Dec. 20° 33′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	1 06 36·82
Nov. 8	E	S	36·78
27	W	S	36·78
Dec. 10	W	S	36·73
12	W	N	36·81
Mean			36·784
Δ_2			·001
Mean R.A.			1 06 36·785

B.J. 43
Dec. 29° 37′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Nov. 2	E	N	1 06 41·95
Dec. 5	W	N	41·97
9	W	N	41·94
Mean			41·953
Δ_1			−·001
Δ_2			−·002
Mean R.A.			1 06 41·950

Bradley 137
Dec. 79° 26′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 27	W	S	1 08 30·60
Nov. 8	E	S	30·54r
Dec. 5	W	N	31·08
9	W	N	30·30
10	W	S	30·31r
12	W	N	30·82
Mean			30·608
Δ_2			−·016
Mean R.A.			1 08 30·592

Bradley 151
Dec. 71° 16′

Date	Clamp	Observer	Mean R.A. 1910·0
Nov. 2	E	N	1 09 42·68
27	W	S	42·80
Dec. 5	W	N	42·94
9	W	N	42·61
12	W	N	42·59
Mean			42·724
Δ_2			−·011
Mean R.A.			1 09 42·713

Bradley 155
Dec. 77° 06′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 27	W	S	1 12 47·93
Nov. 8	E	S	47·82
27	W	S	47·91
Dec. 8	W	S	47·87
Mean			47·883
Δ_2			−·003
Mean R.A.			1 12 47·880

B.J. 45
Dec. 26° 47′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	1 14 30·98
Nov. 27	W	S	30·93
Dec. 5	W	N	30·95
9	W	N	30·95
12	W	N	30·94
Mean			30·950
Δ_1			−·001
Δ_2			·000
Mean R.A.			1 14 30·949

Bradley 166
Dec. 78° 15′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 27	W	S	1 15 48·82
Nov. 8	E	S	48·74
Dec. 8	W	S	48·82
12	W	N	48·81
Mean			48·798
Δ_2			−·008
Mean R.A.			1 15 48·790

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

l Piscium
Dec. 28° 16′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 7	E	S	1 16 08·55
Nov. 27	W	S	08·57
Dec. 5	W	N	08·61
9	W	N	08·68
Mean			08·603
Δ_2			·000
Mean R.A.			1 16 08·603

ξ Andromedae
Dec. 45° 03′

Date	Clamp	Observer	Mean R.A. 1910·0
Nov. 8	E	S	1 17 02·09
Dec. 5	W	N	02·06
8	W	S	02·09
9	W	N	02·12
Mean			02·090
Δ_2			-·001
Mean R.A.			1 17 02·089

B.J. 46
Dec. 67° 40′

Date	Clamp	Observer	Mean R.A. 1910·0
Nov. 8	E	S	1 19 33·59
27	W	S	33·62
Dec. 12	W	N	33·60
Mean			33·603
Δ_1			·002
Δ_2			-·002
Mean R.A.			1 19 33·603

B.J. 48
Dec. 59° 46′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	1 19 54·97
27	W	S	55·01
Dec. 5	W	N	55·15
8	W	S	55·11
9	W	N	55·18

B.J. 48
(continued)

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Mean			1 19 55·084
Δ_1			-·003
Δ_2			-·004
Mean R.A.			1 19 55·077

ω Andromedae
Dec. 44° 57′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	1 22 15·91
Nov. 27	W	S	15·89
Dec. 5	W	N	16·02
8	W	S	15·89
9	W	N	16·04
10	W	S	15·95
12	W	N	15·91
Mean			15·944
Δ_2			-·002
Mean R.A.			1 22 15·942

B.J. 51
Dec. 72° 35′

Date	Clamp	Observer	Mean R.A. 1910·0
Dec. 9	W	N	1 31 18·140
Δ_1			-·001
Δ_2			-·019
Mean R.A.			1 31 18·120

υ Andromedae
Dec. 40° 57′

Date	Clamp	Observer	Mean R.A. 1910·0
Nov. 8	E	S	1 31 30·49
27	W	S	30·58
Dec. 5	W	N	30·60
12	W	N	30·54
21	W	N	30·70r
Mean			30·582
Δ_1			·001
Δ_2			-·002
Mean R.A.			1 31 30·581

π Piscium
Dec. 11° 41′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Dec. 8	W	S	1 32 19·54
10	W	S	19·55
Mean			19·545
Δ_1			-·004
Δ_2			·003
Mean R.A.			1 32 19·544

B.J. 52
Dec. 48° 10′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 27	W	S	1 32 27·66
Dec. 21	W	N	27·80
Mean			27·730
Δ_1			·004
Δ_2			-·003
Mean R.A.			1 32 27·731

τ Andromedae
Dec. 40° 07′

Date	Clamp	Observer	Mean R.A. 1910·0
Nov. 8	E	S	1 35 15·68
27	W	S	15·75r
Dec. 10	W	S	15·73
12	W	N	15·71r
21	W	N	15·76
Mean			15·726
Δ_2			-·001
Mean R.A.			1 35 15·725

B.J. 55
Dec. 67° 35′

Date	Clamp	Observer	Mean R.A. 1910·0
Dec. 5	W	N	1 35 39·80
9	W	N	39·78
Mean			39·790
Δ_1			·000
Δ_2			-·014
Mean R.A.			1 35 39·776

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

42 Cassiopeiae
Dec. 70° 10′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 27	W	S	1 35 55·88
Dec. 8	W	S	55·94
Mean			55·910
Δ_2			–·007
Mean R.A.			1 35 55·903

B.J. 57
Dec. 50° 14′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	1 38 00·66
27	W	S	00·72
Nov. 8	E	S	00·68
27	W	S	00·65r
Dec. 5	W	N	00·78
8	W	S	00·78
9	W	N	00·72r
10	W	S	00·76r
12	W	N	00·73
21	W	N	00·77r
Mean			00·725
Δ_1			·001
Δ_2			–·002
Mean R.A.			1 38 00·724

2 Persei
Dec. 50° 21′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	1 46 25·46
27	W	S	25·53r
Nov. 8	E	S	25·34r
27	W	S	25·46
Dec. 5	W	N	25·57r
8	W	S	25·45r
9	W	N	25·40
10	W	S	25·56
12	W	N	25·38r
21	W	N	25·47
Mean			25·462
Δ_2			–·002
Mean R.A.			1 46 25·460

B.J. 63
Dec. 63° 14′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Nov. 27	W	S	1 47 54·41
Dec. 9	W	N	54·53
12	W	N	54·43
Mean			54·457
Δ_1			·001
Δ_2			–·009
Mean R.A.			1 47 54·449

B.J. 64
Dec. 29° 08′

Date	Clamp	Observer	Mean R.A. 1910·0
Dec. 5	W	N	1 47 56·79
8	W	S	56·86
10	W	S	56·83
21	W	N	56·94
Mean			56·855
Δ_1			–·004
Δ_2			·000
Mean R.A.			1 47 56·851

γ Arietis
Dec. 18° 51′

Date	Clamp	Observer	Mean R.A. 1910·0
Nov. 8	E	S	1 48 35·310
Δ_2			·001
Mean R.A.			1 48 35·311

B.J. 66
Dec. 20° 22′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	1 49 39·92
Nov. 8	E	S	39·91
Dec. 5	W	N	39·90
8	W	S	39·91
9	W	N	39·89
12	W	N	39·93
21	W	N	39·98
Mean			39·920
Δ_1			·004
Δ_2			·000
Mean R.A.			1 49 39·924

λ Arietis
Dec. 23° 09′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Nov. 8	E	S	1 52 54·58r
Dec. 12	W	N	54·62
21	W	N	54·63
Mean			54·610
Δ_2			–·001
Mean R.A.			1 52 54·609

Bradley 246
Dec. 77° 29′

Date	Clamp	Observer	Mean R.A. 1910·0
Dec. 8	W	S	1 53 48·26
12	W	N	48·16
Mean			48·210
Δ_2			–·021
Mean R.A.			1 53 48·189

48 Cassiopeiae
Dec. 70° 28′

Date	Clamp	Observer	Mean R.A. 1910·0
Nov. 8	E	S	1 54 32·54
Dec. 5	W	N	33·03
9	W	N	32·78
10	W	S	32·62
Mean			32·743
Δ_2			–·006
Mean R.A.			1 54 32·737

Groombridge 422
Dec. 73° 25′

Date	Clamp	Observer	Mean R.A. 1910·0
Dec. 8	W	S	1 55 10·910
Δ_2			–·009
Mean R.A.			1 55 10·901

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 70
Dec. 71° 59′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Nov. 8	E	S	1 55 43·58
Dec. 5	W	N	43·91
9	W	N	43·58
12	W	N	43·60
21	W	N	43·63

Mean	43·660
Δ_1	·004
Δ_2	–·011
Mean R.A.	1 55 43·653

47 Cassiopeiae
Dec. 76° 51′

Date	Clamp	Observer	Mean R.A. 1910·0
Dec. 10	W	S	1 56 04·460

Δ_2	–·013
Mean R.A.	1 56 04·447

Groombridge 424
Dec. 80° 52′

Date	Clamp	Observer	Mean R.A. 1910·0
Nov. 8	E	S	1 58 15·590r

Δ_2	·040
Mean R.A.	1 58 15·630

B.J. 73
Dec. 41° 54′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	1 58 22·14
Dec. 5	W	N	22·16
9	W	N	22·17
12	W	N	22·11
21	W	N	22·20

Mean	22·156
Δ_1	·002
Δ_2	–·002
Mean R.A.	1 58 22·156

B.J. 74
Dec. 23° 02′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 7	E	S	2 02 05·79
Nov. 8	E	S	05·81
Dec. 8	W	S	05·82
9	W	N	05·81
12	W	N	05·80
21	W	N	05·77

Mean	05·800
Δ_1	·004
Δ_2	·000
Mean R.A.	2 02 05·804

B.J. 75
Dec. 34° 34′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	2 04 11·04
Dec. 5	W	N	11·02
9	W	N	10·96r
12	W	N	11·04
21	W	N	10·96r

Mean	11·004
Δ_1	·001
Δ_2	–·002
Mean R.A.	2 04 11·003

Bradley 282
Dec. 73° 36′

Date	Clamp	Observer	Mean R.A. 1910·0
Nov. 8	E	S	2 05 02·03
Dec. 10	W	S	02·13

Mean	02·080
Δ_2	·006
Mean R.A.	2 05 02·086

15 Arietis
Dec. 19° 05′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Dec. 5	W	N	2 05 38·16
8	W	S	38·10
9	W	N	38·05r
12	W	N	38·16
21	W	N	38·11r

Mean	38·116
Δ_2	·000
Mean R.A.	2 05 38·116

B.J. 76
Dec. 66° 06′

Date	Clamp	Observer	Mean R.A. 1910·0
Dec. 8	W	S	2 07 24·35
10	W	S	24·32
21	W	N	24·34

Mean	24·337
Δ_1	·001
Δ_2	–·008
Mean R.A.	2 07 24·330

B.J. 77
Dec. 50° 39′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	2 07 36·71
Dec. 5	W	N	36·98
9	W	N	36·73
12	W	N	36·81

Mean	36·808
Δ_1	–·002
Δ_2	–·004
Mean R.A.	2 07 36·802

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 79
Dec. 33° 26′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 7	E	S	2 11 57·62
Dec. 5	W	N	57·58
8	W	S	57·62
9	W	N	57·58
10	W	S	57·57
12	W	N	57·55r
21	W	N	57·59
Mean			57·587
Δ_1			·004
Δ_2			–·001
Mean R.A.			2 11 57·590

B.J. 81
Dec. 19° 29′

Date	Clamp	Observer	Mean R.A. 1910·0
Dec. 5	W	N	2 13 06·95
8	W	S	06·98
9	W	N	06·96
10	W	S	06·96
12	W	N	06·98r
21	W	N	06·96
Mean			06·965
Δ_1			–·001
Δ_2			·000
Mean R.A.			2 13 06·964

ξ Arietis
Dec. 10° 12′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	2 19 59·43
Dec. 8	W	S	59·47
10	W	S	59·47
21	W	N	59·49
Mean			59·465
Δ_2			·002
Mean R.A.			2 19 59·467

ι Cassiopeiae
Dec. 67° 00′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Dec. 5	W	N	2 21 38·19
9	W	N	37·91r
12	W	N	38·01
21	W	N	38·00r
Mean			38·028
Δ_1			·003
Δ_2			–·014
Mean R.A.			2 21 38·017

27 Arietis
Dec. 17° 18′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	2 25 54·67
Dec. 8	W	S	54·71
9	W	N	54·70
10	W	S	54·64r
12	W	N	54·75
21	W	N	54·75
Mean			54·703
Δ_2			·001
Mean R.A.			2 25 54·704

B.J. 87
Dec. 72° 26′

Date	Clamp	Observer	Mean R.A. 1910·0
Dec. 5	W	N	2 29 27·49
8	W	S	27·10
9	W	N	27·16
10	W	S	27·17
12	W	N	27·13
21	W	N	27·09
Mean			27·190
Δ_1			·000
Δ_2			–·016
Mean R.A.			2 29 27·174

B.J. 89
Dec. 21° 34′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 7	E	S	2 33 42·18
Dec. 5	W	N	42·17
9	W	N	42·16
12	W	N	42·21
21	W	N	42·19
Mean			42·182
Δ_1			–·004
Δ_2			–·001
Mean R.A.			2 33 42·177

Bradley 344
Dec. 81° 04′

Date	Clamp	Observer	Mean R.A. 1910·0
Dec. 10	W	S	2 34 44·530rn
Δ_2			–·021
Mean R.A.			2 34 44·509

B.J. 92
Dec. 67° 27′

Date	Clamp	Observer	Mean R.A. 1910·0
Dec. 5	W	N	2 37 04·22
9	W	N	04·30
10	W	S	04·12
12	W	N	04·01r
21	W	N	04·08
Mean			04·152
Δ_1			–·002
Δ_2			–·012
Mean R.A.			2 37 04·138

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 93
Dec. 48° 51′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 7	E	S	2 38 02·78
Dec. 5	W	N	02·92
8	W	S	02·79
9	W	N	02·86
12	W	N	02·75
Mean			02·820
Δ₁			−·004
Δ₂			−·003
Mean R.A.			2 38 02·813

B.J. 94
Dec. 27° 19′

Date	Clamp	Observer	Mean R.A. 1910·0
Dec. 10	W	S	2 38 10·00
21	W	N	10·02
Mean			10·010
Δ₁			·000
Δ₂			·000
Mean R.A.			2 38 10·010

39 Arietis
Dec. 28° 52′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	2 42 32·70
Dec. 5	W	N	32·78
8	W	S	32·82
9	W	N	32·80
10	W	S	32·74
12	W	N	32·82
21	W	N	32·84
Mean			32·786
Δ₂			·000
Mean R.A.			2 42 32·786

B.J. 99
Dec. 55° 31′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 7	E	S	2 44 07·35
Dec. 8	W	S	07·40
9	W	N	07·44
10	W	S	07·31
Mean			07·375
Δ₁			·004
Δ₂			−·001
Mean R.A.			2 44 07·378

B.J. 100
Dec. 26° 53′

Date	Clamp	Observer	Mean R.A. 1910·0
Dec. 5	W	N	2 44 40·99
12	W	N	40·98
21	W	N	41·01
Mean			40·993
Δ₁			−·002
Δ₂			−·002
Mean R.A.			2 44 40·989

σ Arietis
Dec. 14° 43′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	2 46 31·20
Dec. 5	W	N	31·34
8	W	S	31·31
9	W	N	31·35
10	W	S	31·25
12	W	N	31·26
21	W	N	31·26
Mean			31·281
Δ₁			·003
Δ₂			·001
Mean R.A.			2 46 31·285

B.J. 103
Dec. 52° 24′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 7	E	S	2 47 52·14
Dec. 5	W	N	52·29
8	W	S	52·17
9	W	N	52·24
10	W	S	52·16
12	W	N	52·13
21	W	N	52·23
Mean			52·194
Δ₁			·003
Δ₂			−·003
Mean R.A.			2 47 52·194

ε Arietis (mean)
Dec. 20° 59′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	2 54 03·710
Δ₁			·000
Δ₂			·002
Mean R.A.			2 54 03·712

B.J. 105
Dec. 79° 04′

Date	Clamp	Observer	Mean R.A. 1910·0
Dec. 10	W	S	2 54 04·84
12	W	N	04·81
21	W	N	04·54
Mean			04·730
Δ₁			−·001
Δ₂			−·028
Mean R.A.			2 54 04·701

Bradley 396
Dec. 81° 07′

Date	Clamp	Observer	Mean R.A. 1910·0
Dec. 10	W	S	2 57 41·140m
Δ₂			−·021
Mean R.A.			2 57 41·119

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Continued.*

B.J. 108
Dec. 53° 09′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Sept. 7	E	S	2 58 16·17
Dec. 5	W	N	16·32
9	W	N	16·19
12	W	N	16·24
21	W	N	16·26
Mean			16·236
Δ1			-·003
Δ2			-·005
Mean R.A.			2 58 16·228

B.J. 109
Dec. 38° 30′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	2 59 24·24
Dec. 5	W	N	24·32
8	W	S	24·26
9	W	N	24·39
10	W	S	24·28
12	W	N	24·26
21	W	N	24·29
Mean			24·291
Δ1			·000
Δ2			-·001
Mean R.A.			2 59 24·290

Bradley 417
Dec. 74° 03′

Date	Clamp	Observer	Mean R.A. 1910·0
Dec. 10	W	S	3 02 09·360
Δ2			-·010
Mean R.A.			3 02 09·350

B.J. 111
Dec. 40° 37′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Dec. 12	W	N	3 02 18·46
21	W	N	18·45
Mean			18·455
Δ1			·004
Δ2			-·004
Mean R.A.			3 02 18·455

B.J. 112
Dec. 49° 16′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	3 02 33·980
Δ1			·001
Δ2			·006
Mean R.A.			3 02 33·987

ζ Arietis
Dec. 20° 43′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	3 09 43·540
Δ1			-·003
Δ2			·002
Mean R.A.			3 09 43·539

τ Arietis
Dec. 20° 49′

Date	Clamp	Observer	Mean R.A. 1910·0
Sept. 7	E	S	3 16 01·61
Dec. 10	W	S	01·64
Mean			01·625
Δ1			-·005
Δ2			·002
Mean R.A.			3 16 01·622

B.J. 120
Dec. 49° 32′

Date	Clamp	Observer	Mean R.A. 1910·0
			h m s
Dec. 10	W	S	3 17 53·530
Δ1			-·002
Δ2			-·002
Mean R.A.			3 17 53·526

Bradley 459
Dec. 71° 33′

Date	Clamp	Observer	Mean R.A. 1910·0
Dec. 10	W	S	3 20 58·460
Δ2			-·008
Mean R.A.			3 20 58·452

B.J. 122
Dec. 59° 38′

Date	Clamp	Observer	Mean R.A. 1910·0
Dec. 21	W	N	3 21 46·240
Δ1			·001
Δ2			-·009
Mean R.A.			3 21 46·232

B.J. 124
Dec. 47° 41′

Date	Clamp	Observer	Mean R.A. 1910·0
Dec. 21	W	N	3 24 13·390
Δ1			·004
Δ2			-·005
Mean R.A.			3 24 13·389

LEDGERS OF MEAN RIGHT ASCENSION, 1910·0—*Concluded.*

Date	Clamp	Observer	Mean R.A. 1910·0
s Tauri Dec. 11° 02′			
			h m s
Dec. 21	W	N	3 25 29·160
Δ₂			–·001
Mean R.A.			3 25 29·159
B.J. 129 Dec. 62° 56′			
Dec 21	W	N	3 34 19·960
Δ_1			·000
Δ_2			–·012
Mean R.A.			3 34 19·948
11 Tauri Dec. 25° 02′			
Dec. 21	W	N	3 35 23·560
Δ_1			·000
Δ_2			–·002
Mean R.A.			3 35 23·558
B.J. 131 Dec. 47° 30′			
Dec. 21	W	N	3 36 30·620
Δ_1			·001
Δ_2			–·005
Mean R.A.			3 36 30·616
B.J. 132 Dec. 32° 00′			
			h m s
Dec. 21	W	N	3 38 40·100
Δ_1			·003
Δ_2			–·003
Mean R.A.			3 38 40·100
B.J. 136 Dec. 23° 50′			
Dec. 21	W	N	3 39 31·630
Δ_1			–·001
Δ_2			–·002
Mean R.A.			3 39 31·627
B.J. 139 Dec. 23° 50′			
Dec. 21	W	N	3 42 07·890
Δ_1			·003
Δ_2			–·002
Mean R.A.			3 42 07·891
B.J. 144 Dec. 31° 37′			
Dec. 21	W	N	3 48 28·150
Δ_1			–·004
Δ_2			–·003
Mean R.A.			3 48 28·143
B.J. 145 Dec. 60° 51′			
			h m s
Dec. 21	W	N	3 49 27·110
Δ_1			·000
Δ_2			–·010
Mean R.A.			3 49 27·100
B.J. 147 Dec. 39° 45′			
Dec. 21	W	N	3 51 48·570
Δ_1			–·005
Δ_2			–·004
Mean R.A.			3 51 48·561
B.J. 148 Dec. 35° 32′			
Dec. 21	W	N	3 53 07·300
Δ_1			–·005
Δ_2			–·003
Mean R.A.			3 53 07·292
B.J. 150 Dec. 12° 14′			
Dec. 21	W	N	3 55 41·610
Δ_1			–·001
Δ_2			–·001
Mean R.A.			3 55 41·608

SESSIONAL PAPER No. 25a.

MEAN RIGHT ASCENSIONS OF STARS OBSERVED IN 1910

No.	Star	Mag.	Dec.	Mean R.A. 1910·0	Mean date 1910+	No. of Observations	O.−B.J.	O.−B.	O.−G.	O.−N.	Notes
			° ′	h m s							
1	B.J. 1	2·1	28 36	0 03 43·947	·87	4	......	......	......	......	
2	Bradley 3217	6·3	79 13	01 20·813*	·83	7	......	......	......	......	Comes 7m; close binary.
3	B.J. 2	2·2	58 39	01 22·017	·85	12	......	......	......	......	
4	B.J. 4	5·2	45 34	05 38·272†	·84	7	......	......	......	......	
5	B.J. 7	2·7	14 41	08 35·965	·85	10	−·008	−·013	−·011	−·024	
6	B.J. 8	6·5	76 27	0 11 06·480	·84	9	......	......	......	......	
7	σ Andromedae	4·5	36 17	13 37·295†	·84	10	......	......	......	−·065	
8	ρ Andromedae	5·4	37 28	16 22·592*	·84	10	......	......	......	......	
9	Bradley 34	6·4	76 31	25 07·200*	·85	10	......	......	......	......	
10	B.J. 16	4·2	62 26	27 52·520	·90	5	......	......	......	......	
11	B.J. 17	3·8	53 24	0 31 56·994	·86	10	−·025	−·020	−·036	−·100	
12	B.J. 18	4·2	33 13	32 01·174	·82	3	......	......	......	......	
13	B.J. 19	4·3	28 49	33 47·769†	·81	7	......	......	......	......	
14	B.J. 20	3·2	30 22	34 30·694	·86	7	......	......	......	......	
15	B.J. 21	2·2	56 03	35 23·508	·81	9	......	......	......	......	
16	B.J. 24	5·8	74 30	0 39 41·219	·81	8	......	......	......	......	
17	B.J. 25	4·7	47 48	39 42·237	·86	5	......	......	......	......	
18	23 Cassiopeiae	5·7	74 21	41 41·328*	·83	7	......	......	......	......	
19	B.D. 71·37	6·0	72 11	42 15·456*	·90	4	......	......	......	......	
20	B.J. 27	4·1	23 47	42 33·919	·83	3	......	......	......	......	
21	η Cassiopeiae	3·6	57 20	0 43 39·098†	·85	11	......	......	......	·195	Comes 7·6m, 5″ s. pr.; binary.
22	ν Andromedae	4·5	40 35	44 50·705†	·85	12	......	......	......	−·055	C. D. T.
23	B.J. 29	5·7	63 45	45 15·238	·85	1	......	......	......	......	
24	B.J. 32	2·0	60 14	51 16·040	·90	3	......	......	......	......	
25	B.J. 33	3·9	38 01	51 45·177	·82	9	......	......	......	......	

MEAN RIGHT ASCENSIONS OF STARS OBSERVED IN 1910 (continued)

No.	Star	Mag.	Dec.	Mean R.A. 1910·0	Mean date 1910+	No. of Observations	O.−B.J.	O.−B.	O.−G.	O.−N.	Notes
			° ′	h m s							
26	h Piscium..........	5·7	28 30	0 52 57·674*	·86	12	....	....	....	....	
27	72 Piscium..........	5·6	14 28	1 00 20·149†	·84	5	....	....	....	....	
28	Bradley 109..........	6·4	79 32	01 29·174*	·88	3	....	....	....	....	
29	μ Cassiopeiae......	5·3	54 29	02 16·489†	·86	6	....	....	....	....	
30	B.J. 41............	5·7	79 12	04 27·528	·86	4	....	....	....	....	
31	B.J. 42............	2·1	35 09	1 04 41·310	·85	4	....	....	....	....	
32	χ Piscium..........	4·7	20 33	06 36·785*	·87	5	....	....	....	....	
33	B.J. 43............	4·3	29 37	06 41·950†	·90	3	....	....	....	....	
34	Bradley 137........	6·5	79 26	08 30·592*	·89	6	....	....	....	....	
35	Bradley 151........	6·1	71 16	09 42·713*	·91	5	....	....	....	....	
36	Bradley 155........	6·4	77 06	1 12 47·880*	·86	4	....	....	....	....	
37	B.J. 45............	4·6	26 47	14 30·949	·88	5	....	....	....	....	
38	Bradley 166........	6·2	78 15	15 48·790*	·87	4	....	....	....	....	
39	l Piscium..........	5·3	28 16	16 08·603*	·86	4	....	....	....	....	
40	ξ Andromedae......	4·9	45 03	17 02·089*	·91	4	....	....	....	....	
41	B.J. 46............	5·0	67 40	1 19 33·603	·90	3	....	....	....	....	
42	B.J. 48............	2·7	59 46	19 55·077	·85	5	....	....	....	....	
43	ω Andromedae......	4·9	44 57	22 15·942*	·90	7	....	....	....	....	
44	B.J. 51............	5·5	72 35	31 18·120	·94	1	....	....	....	....	
45	υ Andromedae......	4·2	40 57	31 30·581†	·92	5	....	....	....	....	
46	π Piscium..........	5·6	11 41	1 32 19·544†	·94	2	....	....	....	....	
47	B.J. 52............	3·6	48 10	32 27·731	·86	2	....	....	....	....	
48	τ Andromedae......	5·3	40 07	35 15·725*	·92	5	....	....	....	....	
49	B.J. 55............	5·9	67 35	35 39·776	·93	2	....	....	....	....	
50	42 Cassiopeiae.....	5·4	70 10	35 55·903*	·84	2	....	....	....	....	

51	B.J. 57	4·1	50 14	1 38 00·724	·88	10	—·007	—·011	—·012	—·031	
52	2 Persei	5·6	50 21	46 25·460*	·88	10					
53	B.J. 63	3·3	63 14	47 54·449	·93	3					
54	B.J. 64	3·5	29 08	47 56·851	·94	4					
55	γ Arietis	4·7	18 51	48 35·311*	·85	1					Double, 9″; south star.
56	B.J. 66	2·7	20 22	1 49 39·924	·89	7					
57	λ Arietis	5·0	23 09	52 54·609*	·92	3					
58	Bradley 246	6·1	77 29	53 48·189*	·94	2					
59	48 Cassiopeiae	4·7	70 28	54 32·737*	·92	4					
60	Groombridge 422	6·4	73 25	55 10·901*	·94	1					Comes 8m, 5″.
61	B.J. 70	4·0	71 59	1 55 43·653	·93	5					
62	47 Cassiopeiae	5·4	76 51	56 04·447*	·94	1					
63	Groombridge 424	6·3	80 52	58 15·630*	·85	1					
64	B.J. 73	2·1	41 54	1 58 22·156	·89	5					Comes 6m, 10″.
65	B.J. 74	2·0	23 02	2 02 05·804	·89	6					
66	B.J. 75	3·0	34 34	2 04 11·003	·89	5					
67	Bradley 282	6·4	73 36	05 02·086*	·90	2					
68	15 Arietis	5·9	19 05	05 38·116*	·94	5					
69	B.J. 76	6·3	66 06	07 24·330	·95	3					
70	B.J. 77	5·7	50 39	07 36·802†	·87	4					
71	B.J. 79	4·2	33 26	2 11 57·590†	·91	7					
72	B.J. 81	5·7	19 29	13 06·964†	·94	6					
73	ξ Arietis	5·8	10 12	19 59·467*	·88	4					
74	ι Cassiopeiae	4·6	67 00	21 38·017†	·95	4					Triple, 7m, 2″, 8m, 8″.
75	27 Arietis	6·5	17 18	25 54·704*	·90	6					
76	B.J. 87	5·4	72 26	2 29 27·174	·94	6					
77	B.J. 89	5·6	21 34	33 42·177	·89	5					
78	Bradley 344	5·9	81 04	34 44·509*	·94	1					
79	B.J. 92	6·3	67 27	37 04·138	·95	5					
80	B.J. 93	4·1	48 51	38 02·813	·89	5					
81	B.J. 94	4·7	27 19	2 38 10·010	·96	2					
82	39 Arietis	4·8	28 52	42 32·786*	·91	7					
83	B.J. 99	3·8	55 31	44 07·378†	·88	4					
84	B.J. 100	3·6	26 53	44 40·989	·95	3					
85	σ Arietis	5·5	14 43	46 31·285†	·91	7					

MEAN RIGHT ASCENSIONS OF STARS OBSERVED IN 1910 (continued)

No.	Star	Mag.	Dec.	Mean R.A. 1910·0	Mean date 1910+	No. of Observations	O.−B.J.	O.−B.	O.−G.	O.−N.	Notes
			° ′	h m s							
86	B.J. 103	4·0	52 24	2 47 52·194	·91	7					
87	ϵ Arietis (mean)	4·6	20 59	54 03·712†	·68	1					Double, 5·2m, 5·6m, 1·2″.
88	B.J. 105	5·8	79 04	54 01·701	·95	3					Comes 9m, 5″.
89	Bradley 396	6·0	81 07	57 41·119*	·94	1					
90	B.J. 108	3·0	53 09	58 16·228	·89	5					
91	B.J. 109	3·8	38 30	2 59 21·290	·91	7					
92	Bradley 417	5·1	74 03	3 02 09·350*	·94	1					
93	B.J. 111	2·2	40 37	02 18·455	·96	2					
94	B.J. 112	4·1	49 16	02 33·987	·68	1					
95	ζ Arietis	5·0	20 43	09 43·539†	·68	1					
96	τ Arietis	5·2	20 49	3 16 01·622†	·81	2					
97	B.J. 120	1·9	49 32	17 53·526	·94	1					
98	Bradley 459	6·5	71 33	20 58·452*	·94	1					
99	B.J. 122	4·4	59 38	21 46·232	·97	1					Comes 9m, 3″.
100	B.J. 124	4·8	47 41	24 13·389	·97	1					
101	s Tauri	5·5	11 02	3 25 29·159*	·97	1					
102	B.J. 129	5·4	62 56	34 19·948	·97	1					
103	11 Tauri	6·7	25 02	35 23·558†	·97	1					
104	B.J. 131	3·0	47 30	36 30·616	·97	1					
105	B.J. 132	3·9	32 00	38 40·100	·97	1					Comes 8·5m, 1″.
106	B.J. 136	4·0	23 50	3 39 31·627†	·97	1					
107	B.J. 139	3·0	23 50	42 07·891	·97	1					
108	B.J. 144	2·9	31 37	48 28·143	·97	1					
109	B.J. 145	5·5	60 51	49 27·100	·97	1					Comes 8m, 2″ n.f.
110	B.J. 147	3·0	39 45	51 48·561	·97	1					Comes 8m, 9″ n.f.

111	B.J. 148	4·0	35 32	3 53 07·292	·97	1					
112	B.J. 150	3·5	12 14	3 55 41·608	·97	1					
113	B.J. 296	5·5	33 38	7 41 42·364	·21	1					
114	B.J. 314	4·4	43 29	8 16 40·653	·21	1					
115	B.J. 320	6·3	38 20	27 04·138	·21	2					
116	B.J. 323	6·3	53 02	8 32 37·887	·21	2					
117	B.J. 335	2·9	48 24	53 03·036	·21	1					
118	B.J. 339	3·9	42 08	54 48·082	·21	2					
119	B.J. 341	3·3	47 31	8 57 29·153	·21	2					
120	B.A.C. 3097	4·7	38 49	9 00 48·513†	·21	2					
121	B.J. 346	5·3	43 35	9 07 55·333	·21	2					
122	B.J. 349	3·9	37 11	13 11·883	·21	2					Comes 6·7m, 3″.
123	B.J. 352	3·2	34 46	15 31·611	·32	1					
124	B.J. 358	3·1	52 05	26 50·659	·27	9					
125	B.J. 360	4·6	36 48	28 42·824	·28	8					
126	B.J. 368	3·8	59 28	9 44 35·954	·27	9					
127	B.J. 374	5·2	41 29	9 52 10·601†	·27	10	— ·028	— ·011		·002	
128	B.J. 379	3·4	17 12	10 02 25·734	·33	1					
129	B.J. 383	3·4	43 22	11 40·443	·27	12	·005	·007	— ·018	— ·033	
130	B.J. 384	3·4	23 52	11 41·241	·33	1					
131	B.J. 386	3·0	41 57	10 16 58·335	·26	3					
132	B.J. 390	4·2	37 10	22 40·971	·29	10	— ·027	— ·015		— ·050	
133	B.J. 391	4·8	56 27	24 52·457	·28	12	— ·040	— ·033		— ·083	
134	B.J. 398	5·2	57 33	29 22·304	·27	13	— ·059	— ·057			
135	37 Leonis Minoris	4·8	32 27	33 39·528†	·29	12				·008	C.D.T.
136	B.J. 405	5·2	23 40	10 38 31·499†	·34	2					
137	B.J. 407	5·3	31 09	40 51·819	·29	11	— ·015	·008	— ·050	·005	
138	B.J. 412	3·9	34 42	48 16·921†	·29	12	— ·013	— ·009	·027	— ·005	
139	54 Leonis	4·5	25 14	50 14·554†	·34	3					Comes 6·3m, 6·4″ s.f.
140	47 Ursae Majoris	5·1	40 55	54 25·787*	·31	12					
141	B.J. 416	2·3	56 52	10 56 25·048	·30	15	— ·029	— ·037	— ·056	— ·056	
142	B.J. 420	3·0	44 59	11 04 36·472	·30	15	— ·032	— ·041	·000	— ·066	
143	B.J. 422	2·4	21 01	09 19·415	·35	5					
144	B.J. 424	6·1	49 58	11 37·851	·30	14	·018	·030			
145	B.J. 425	3·4	33 35	13 37·246	·31	13	— ·007	·000		— ·013	

MEAN RIGHT ASCENSIONS OF STARS OBSERVED IN 1910 (continued)

No.	Star	Mag.	Dec.	Mean R.A. 1910·0	Mean date 1910+	No. of Observations	O.−B.J.	O.−B.	O.−G.	O.−N.	Notes
			° ′	h m s							
146	B.J. 432	6·1	43 40	11 25 39·099	·34	3					
147	B.J. 441	3·8	48 17	41 18·089	·33	11	−·060	−·051	−·023	−·096	
148	B.J. 441	2·1	15 05	41 28·201	·35	8					
149	Groombridge 1830	6·5	38 22	47 47·701†	·33	12		·009		−·029	
150	B.J. 447	2·3	54 12	49 06·074	·33	9					
151	*o* Leonis	5·8	16 09	11 51 02·876*	·36	8					
152	1 Can. Venaticorum	6·2	53 56	12 10 15·917*	·31	11					
153	B.J. 456	3·4	57 32	10 58·537	·31	3					
154	B.J. 458	5·9	41 10	11 37·103†	·34	12	−·059			−·138	Comes 8m, 11·6″ s.pr.
155	12 Comae	4·8	26 21	17 58·978†	·36	5					Comes 9m, 7″.
156	B.J. 461	5·3	39 31	12 21 25·038	·34	15	−·028	−·012			
157	15 Comae	4·5	28 46	22 27·271*	·37	9					
158	B.J. 466	6·0	21 24	25 12·045	·36	6					Comes 10m, 2″.
159	B.J. 467	5·6	58 54	25 45·384	·31	8					
160	B.J. 470	4·3	41 51	29 28·250	·34	16	−·043	−·026		−·091	
161	23 Comae	4·9	23 07	12 30 22·078†	·36	8					
162	9 Can. Venaticorum	6·2	41 22	34 26·536*	·35	12					
163	31 Comae	5·1	28 02	47 18·967†	·35	6					
164	B.J. 483	1·7	56 27	50 01·298	·35	7					
165	B.J. 485	2·8	38 48	12 51 49·204	·36	18	·014	·004	·018	·023	Comes 5m, 19·8″ s.pr.
166	14 Can. Venaticorum	5·5	36 17	13 01 32·039*	·37	18					
167	15 Can. Venaticorum	6·5	39 01	05 33·590*	·39	8					
168	B.J. 491	6·1	38 59	05 55·347	·37	16	−·020	·007			Comes 10m, 1·4″.
169	B.J. 492	4·2	28 20	07 40·463	·37	14	−·016	−·009	−·045	−·037	
170	19 Can. Venaticorum	5·7	41 20	11 29·251*	·36	17					

171	B.J. 494	4·6	41	03	13 13	30·507†	·36	19	−·028	−·011	....	−·070	
172	23 Can. Venaticorum	5·7	40	37	16	17·060*	·37	19	....	....	....	....	
173	B.J. 497	2·2	55	24	20	18·202	·37	21	−·041	−·063	−·098	−·090	Comes 4m, 14″.
174	81 Ursae Majoris	5·4	55	49	30	39·698*	·36	2	....	....	....	....	
175	B.J. 502	4·9	37	39	30	46·778	·40	17	·015	·009	....	−·021	
176	25 Can. Venaticorum	5·1	36	45	13 33	27·797†	·38	21	....	....	·006	·027	C. D. T. 8m, 1″; binary.
177	B.J. 507	4·5	17	54	42	59·113	·40	21	−·006	−·004	−·021	−·002	
178	B.J. 509	1·8	49	46	43	59·700	·39	23	−·057	−·058	−·037	−·064	
179	B.J. 513	2·8	18	51	50	23·979	·40	18	·013	·010	·015	·008	
180	B.J. 517	6·3	27	49	13 57	05·644	·40	15	−·020	·005	....	−·034	
181	9 H. Boötis	5·4	44	17	14 04	19·920*	·40	16	....	....	....	....	
182	B.J. 522	4·9	25	31	06	17·683	·40	16	−·011	·010	−·006	−·021	
183	B.J. 526	1	19	39	11	33·396	·40	18	·039	·020	·050	·043	
184	B.J. 527	4·0	46	30	12	57·758	·38	16	−·035	−·020	....	−·065	
185	B.J. 528	4·6	51	47	12	58·750	·46	3	....	....	....	....	
186	B.J. 531	3·9	52	16	14 22	07·981	·44	11	−·022	−·007	....	−·045	
187	*f* Boötis	5·4	19	38	22	16·176†	·46	9	....	....	....	....	
188	*g* Boötis	5·7	50	15	25	29·972*	·45	6	....	....	....	....	
189	201 B. Boötis	5·7	42	12	26	03·981*	·39	14	....	....	....	....	
190	5 Ursae Minoris	4·4	76	06	27	42·222†	·49	2	....	....	....	....	
191	B.J. 534	3·7	30	46	14 27	57·080	·41	19	−·012	−·002	−·010	−·022	
192	B.J. 535	2·9	38	42	28	27·269	·43	9	....	....	....	....	
193	σ Boötis	4·5	30	08	30	45·711†	·42	20	....	....	....	−·033	
194	B.J. 540	5·5	44	48	35	29·260†	·41	18	−·018	·001	....	−·070	
195	B.D. 80.448	6·4	80	03	36	05·559*	·49	2	....	....	....	....	
196	B.J. 543	3·6	14	07	14 36	51·045	·42	17	·015	....	·040	·005	C.D.T. Close equal double.
197	34 Boötis	4·9	26	55	39	28·048*	·42	17	....	....	....	....	
198	ε Boötis	2·7	27	27	41	03·415†	·42	17	....	·012	·012	·022	Comes 5·1m, 2·8″ n.pr.
199	295 B. Boötis	6·4	38	11	45	34·694*	·42	18	....	....	....	....	
200	ξ Boötis	4·8	19	28	47	14·109*	·42	17	....	....	....	....	Comes 7m, 3″; binary.
201	B.J. 549	5·8	59	40	14 49	09·227	·43	16	−·012	·001	....	−·057	
202	B.J. 550	2·0	74	31	50	57·371	·49	3	....	....	....	....	
203	B.J. 551	6·0	14	49	51	58·296	·43	13	−·019	·000	....	·010	
204	Groombridge 2184	6·5	78	32	55	09·553*	·49	3	....	....	....	....	
205	B.J. 555	3·3	40	45	14 58	33·335	·44	17	−·018	−·007	·010	−·027	

MEAN RIGHT ASCENSIONS OF STARS OBSERVED IN 1910 (continued)

No.	Star	Mag.	Dec.	Mean R.A. 1910·0	Mean date 1910+	No. of Observations	O.−B.J.	O.−B.	O.−G.	O.−N.	Notes
			° ′	h m s							
206	B.J. 557	4·5	27 18	15 00 35·356	·44	13	·015	·019	·015	·014	
207	*i* Boötis	4·9	48 00	00 49·439*	·42	2	.....	.....	.....	.....	Comes 6m, 6″.
208	*c* Boötis	5·0	25 13	03 20·866†	·41	9	.....	.....	.....	.....	
209	B.J. 563	3·2	33 39	11 52·461	·45	18	·001	·002	·014	−·010	
210	11 Ursae Minoris	5·1	72 09	17 09·651*	·50	5	.....	.....	.....	.....	
211	η Cor. Borealis	5·0	30 37	15 19 29·168†	·45	16	.....	.....	−·028	−·002	C.D.T. Close equal binary.
212	B.J. 569	3·0	72 09	20 51·761	·50	4	.....	.....	.....	.....	
213	B.J. 568	4·1	37 42	21 05·399	·44	14	−·011	·001	.....	−·032	
214	B.J. 571	3·2	59 17	22 55·502	·46	17	−·056	−·045	−·077	−·158	
215	B.J. 572	3·7	29 25	24 07·086	·44	13	−·007	−·002	−·015	−·020	
216	B.J. 573	4·8	41 08	15 27 41·756	·45	20	−·021	−·002	.....	−·040	
217	ν² Boötis	5·0	41 12	28 33·638*	·45	19	.....	.....	.....	.....	
218	B.J. 576	4·1	31 40	29 18·000	·46	11	−·005	.....	.....	.....	
219	B.J. 578	2·2	27 01	30 52·643	·44	16	·024	·019	·019	·027	
220	θ Ursae Minoris	5·1	77 39	34 03·972*	·50	5	.....	.....	.....	.....	
221	B.J. 580	5·3	40 39	15 31 35·628	·44	14	−·034	−·013	.....	.....	
222	ζ Cor. Borealis	5·1	36 56	35 59·281†	·44	16	.....	.....	.....	−·054	Comes 6m, 6·2″ n.pr.
223	ι Serpentis	4·8	19 58	37 32·272*	·45	17	.....	.....	.....	.....	
224	B.J. 581	3·8	26 35	38 57·759	·45	16	−·026	.....	.....	.....	Comes 7m; close binary.
225	B.J. 583	3·4	15 42	42 01·988	·45	17	−·014	−·013	−·043	−·047	
226	B.J. 584	4·0	18 25	15 44 41·266	·45	17	−·022	−·016	.....	−·001	
227	B.J. 590	4·3	78 04	47 14·995	·50	5	.....	.....	.....	.....	
228	χ Herculis	4·5	42 42	49 33·765†	·46	20	.....	.....	.....	−·065	C.D.T.
229	B.J. 591	3·7	15 57	52 17·704†	·45	18	−·006	−·006	·011	−·015	
230	B.J. 593	4·0	27 08	53 51·648	·45	18	·001	·014	.....	·015	

231	B.J. 595	5·1	55 00	15 55 39·183	·46	20	—·012	—·005	......	......	
232	r Herculis	5·3	18 04	15 57 11·639*	·45	18	......	......	......	......	
233	B.J. 598	3·8	58 48	16 00 11·990	·46	20	—·083	—·078	......	—·137	
234	κ Herculis	5·3	17 17	04 00·751†	·46	15	......	......	......	·049	
235	τ Cor. Borealis	5·0	36 43	05 40·781*	·45	11	......	......	......	......	
236	B.J. 601	4·0	45 10	16 05 56·087†	·42	2	......	......	......	......	
237	σ² Cor. Borealis	5·8	34 05	11 18·502†	·47	12	......	......	......	·034	Comes 6·7m, 4·6″ s.pr.
238	B.J. 606	5·8	76 06	13 22·447	·50	5	......	......	......	......	
239	20 Ursae Minoris	6·4	75 26	14 47·152*	·53	1	......	......	......	......	
240	Groombridge 2337	6·3	73 37	16 01·524*	·49	3	......	......	......	......	
241	B.J. 608	3·6	46 32	16 17 02·067	·47	8	......	......	......	......	
242	B.J. 609	3·5	19 22	17 56·951	·40	2	......	......	......	......	
243	ξ Cor. Borealis	5·0	31 06	18 35·387*	·49	10	......	......	......	......	
244	23 Herculis	6·7	32 33	19 29·147*	·46	8	......	......	......	......	
245	B.J. 612	5·1	75 58	20 07·321†	·51	4	......	......	......	......	
246	B.J. 613	4·7	14 14	16 21 15·679†	·46	8	......	......	......	......	
247	B.J. 614	5·8	55 25	22 27·118	·49	12	—·051	—·035	......	......	
248	g Herculis	5·1	42 05	25 41·114*	·48	15	......	......	......	......	
249	B.J. 618	2·6	21 41	26 21·011	·51	1	......	......	......	......	
250	Groombridge 2372	5·8	79 09	30 43·022*	·51	6	......	......	......	......	
251	B.J. 621	4·1	42 37	16 31 12·040	·45	9	......	......	......	......	
252	B.D. 72·734	6·4	72 48	32 50·586*	·51	6	......	......	......	......	
253	B.J. 623	6·5	77 38	34 30·016	·52	4	......	......	......	......	
254	42 Herculis	5·1	49 06	36 18·212*	·46	4	......	......	......	......	
255	ζ Herculis	3·0	31 46	37 53·612†	·47	10	......	......	—·011	·023	Comes 6m, 1″; binary.
256	B.J. 626	3·3	39 06	16 39 48·598	·48	16	—·013	·001	·002	·004	
257	B.D. 79·511	6·4	79 05	42 58·821*	·51	6	......	......	......	......	
258	B.J. 627	4·9	56 57	43 35·218	·47	10	—·065	—·055	......	—·138	
259	Groombridge 2391	6·3	77 40	47 05·704*	·51	4	......	......	......	......	
260	B.J. 629	6·5	15 07	47 58·975	·48	8	......	......	......	......	
261	53 Herculis	5·7	31 51	16 49 33·230*	·49	15	......	......	......	......	
262	Groombridge 2411	6·5	73 16	58 03·484*	·52	7	......	......	......	......	
263	d Herculis	5·3	33 42	16 58 16·958†	·49	7	......	......	......	......	
264	B.J. 635	4·9	12 52	17 01 12·242	·51	10	—·001	—·006	......	......	
265	B.D. 75·612	6·9	75 21	03 13·338*	·55	4	......	......	......	......	

MEAN RIGHT ASCENSIONS OF STARS OBSERVED IN 1910 (continued)

No.	Star	Mag.	Dec.	Mean R.A. 1910·0	Mean date 1910+	No. of Observations	O.−B.J.	O.−B.	O.−G.	O.−N.	Notes
			° ′	h m s							
266	Groombridge 2427..	6·4	75 25	17 04 29·443*	·53	6	....	....	....	....	
267	B.J. 636............	6·4	40 38	04 50·506	·49	6	....	....	....	....	
268	B.J. 640............	3·0	14 30	10 32·608	·51	7	....	....	....	....	Comes 6m, 1·6″ s.f.
269	B.J. 643............	3·4	36 55	11 51·703	·51	15	−·016	−·016	·009	·006	
270	u Herculis..........	5·0	33 12	14 00·012*	·51	5	....	....	....	....	
271	e Herculis..........	4·8	37 23	17 14 34·007*	·52	9	....	....	....	....	
272	w Herculis..........	5·4	32 35	17 17·448†	·51	14	....	−·031	....	−·018	
273	ρ Herculis..........	4·4	37 14	20 34·639*	·51	15	....	....	....	....	Comes 5m, 4″.
274	B.J. 650............	6·0	48 20	24 21·032	·53	14	−·051	−·024	....	....	
275	Groombridge 2456..	5·8	80 13	26 25·497*	·55	9	....	....	....	....	
276	λ Herculis..........	4·5	26 11	17 27 06·034†	·50	5	....	....	....	....	
277	B.J. 653............	2·7	52 22	28 23·872	·52	13	−·046	−·048	−·070	−·041	
278	B.J. 655............	4·7	55 15	30 24·104	·54	6	....	....	....	....	
279	B.J. 657............	4·8	55 14	30 29·500	·63	1	....	....	....	....	
280	B.J. 656............	2·1	12 37	30 45·378	·54	3	....	....	....	....	
281	B.J. 663............	3·6	46 03	17 36 55·398	·52	14	−·028	−·041	−·007	−·074	
282	B.D. 72·800	6·0	72 30	38 50·986*	·58	5	....	....	....	....	
283	B.J. 667............	3·3	27 46	42 56·127	·51	5	....	....	....	....	
284	B.J. 670............	4·7	72 12	43 32·214	·58	5	....	....	....	....	
285	87 Herculis.........	5·3	25 39	45 10·163*	·55	9	....	....	....	....	
286	z Herculis..........	6·4	48 25	17 47 42·003*	·55	11	....	....	....	....	
287	168 H¹. Herculis....	6·1	40 00	49 08·953*	·55	11	....	....	....	....	
288	89 Herculis.........	5·5	26 04	51 47·286†	·56	8	....	....	....	....	
289	B.J. 671............	3·6	56 53	51 58·270	·43	1	....	....	....	....	
290	B.J. 672............	3·8	37 16	53 09·956	·51	6	....	....	....	....	

291	B.J. 675	5·1	76 59	17 53 28·583	·60	4	......	......	......	......	
292	B.J. 674	3·7	29 15	54 15·998†	·51	1	......	......	......	......	
293	B.J. 676	2·3	51 30	54 30·896	·50	3	......	......	......	......	
294	B.D. 78·616	6·3	78 19	55 14·634*	·60	5	......	......	......	......	
295	ψ^2 Draconis	5·7	72 01	17 56 44·622*	·61	5	......	......	......	......	
296	B.J. 681	3·8	28 45	18 04 01·889	·59	6	......	......	......	......	
297	40 Draconis	5·2	79 59	06 46·887*	·61	8	......	......	......	......	
298	B.J. 684	5·6	42 08	12 50·783†	·58	12	— ·003	·003	......	— ·010	
299	446 B. Herculis	5·6	23 14	18 23·475*	·59	10	......	......	......	......	
300	B.J. 690	3·9	21 44	19 51·757	·59	11	·004	·008	— ·022	·007	
301	μ Lyrae	5·4	39 27	18 21 15·896*	·59	9	......	......	......	......	
302	B.J. 693	4·3	71 17	22 02·994	·63	3	......	......	......	......	Comes 7m, 0·4″.
303	B.J. 694	5·1	58 45	22 35·752	·57	7	......	......	......	......	Comes 8m, 3″.
304	B.J. 695	3·6	72 42	22 40·811	·62	4	......	......	......	......	
305	B.J. 699	1	38 42	33 53·460	·59	10	— ·004	— ·018	·011	— ·015	
306	B.J. 700	6·1	77 29	18 34 06·134	·61	5	......	......	......	......	
307	B.J. 703	4·1	20 28	41 47·293	·61	10	·001	·012	— ·009	·034	
308	111 Herculis	4·4	18 05	43 02·787*	·61	11	......	......	......	......	
309	Bradley 2382	6·4	70 42	44 11·720*	·62	9	......	......	......	......	
310	204 B. Draconis	5·8	52 53	44 42·387*	·59	7	......	......	......	......	
311	B.J. 705	3·3	33 15	18 46 45·397	·61	14	— ·023	— ·023	— ·020	— ·019	
312	Groombridge 2719	5·4	73 59	48 01·592*	·62	9	......	......	......	......	
313	50 Draconis	5·4	75 20	49 17·002†	·63	9	......	......	......	......	
314	B.J. 707	4·6	59 17	49 52·410	·59	7	......	......	......	......	
315	B.D. 79·604	6·6	79 50	52 00·040*	·62	6	......	......	......	......	
316	B.J. 711	4·5	43 50	18 52 35·764	·60	9	......	......	......	......	
317	B.J. 714	5·0	71 11	55 30·195	·65	5	......	......	......	......	
318	B.J. 713	3·2	32 34	18 55 34·621	·60	8	......	......	......	......	
319	B.J. 716	3·0	13 44	19 01 16·405	·43	1	......	......	......	......	
320	B.J. 719	5·2	35 58	04 05·375†	·60	18	— ·028	— ·007	......	— ·056	
321	19 Lyrae	6·1	31 08	19 08 18·871*	·60	4	......	......	......	......	
322	B.J. 725	5·4	11 26	13 35·481	·60	5	......	......	......	......	
323	B.J. 726	3·8	53 12	15 01·364	·63	13	— ·010	— ·039	— ·113	— ·051	
324	159 B.Lyrae	6·6	40 12	15 57·567*	·51	4	......	......	......	......	
325	B.J. 729	4·5	73 11	17 17·391	·63	8	......	......	......	......	

MEAN RIGHT ASCENSIONS OF STARS OBSERVED IN 1910 (continued)

No.	Star	Mag.	Dec.	Mean R.A. 1910·0	Mean date 1910+	No. of Observations	O.−B.J.	O.−B	O.−G.	O.−N.	Notes
			° ′	h m s							
326	*b* Aquilae	5·3	11 45	19 20 40·708†	·64	16		−·019		−·012	C.D.T.
327	21 B.Vulpeculae	6·4	24 45	21 42·281*	·63	18					
328	4 Cygni	5·4	36 08	22 54·619*	·63	21					
329	B.D. 76·734	6·2	76 23	21 46·269*	·65	9					
330	α Vulpeculae	4·6	24 29	24 57·623†	·64	15		·011	·001	·017	
331	B.J. 732	3·0	27 46	19 27 05·516	·65	10	·024	·020	·005	·022	
332	B.J. 731	6·4	79 25	27 09·250	·65	9					
333	B.J. 733	3·9	51 32	27 26·224	·62	4					
334	8 Cygni	4·9	34 16	28 25·605*	·66	19					
335	B.D. 70·1073	6·2	70 48	31 43·735*	·65	12					
336	ε Sagittae	5·7	16 16	19 33 12·937*	·55	4					
337	B.D. 49·3059	6·3	50 02	33 31·238*	·66	18					
338	B.J. 738	4·5	50 01	34 01·677	·65	21	·002	·021		−·024	
339	14 Cygni	5·4	42 37	36 30·690*	·63	15					
340	β Sagittae	4·4	17 16	37 00·413†	·66	9					
341	10 Vulpeculae	5·6	25 33	19 39 58·374*	·67	19					
342	B.J. 740	5·2	37 08	41 01·833†	·66	22	·000			−·052	
343	B.J. 742	2·8	44 55	42 09·706	·65	21	−·030	−·028	−·014	−·059	Comes 8m, 1·6″ n.pr.
344	B.J. 743	3·8	18 19	43 22·491	·68	16	·011	·018	·023	·000	
345	ζ Sagittae	5·2	18 55	44 58·947*	·67	18					Comes 9m, 9″.
346	B.J. 747	3·8	70 02	19 48 28·933	·64	8					Comes 7·6m, 3·4″n.
347	φ Aquilae	5·4	11 11	51 58·537*	·67	21					
348	B.J. 750	5·0	52 12	53 18·490	·67	19	−·010	·003			Comes 8m, 3″.
349	B.J. 752	3·6	19 15	54 45·278	·66	20	·013	·015		·018	
350	15 Vulpeculae	4·9	27 30	57 23·623*	·67	20		·008			

351	B.D. 69·1084	6·4	70 07	19 58 55·313*	·67	14	....	....	....	....	
352	69 Draconis	6·3	76 14	20 02 08·924*	·69	10	....	....	....	....	
353	b^2 Cygni	5·2	36 34	06 05·028*	·69	11	....	....	....	....	
354	20 Vulpeculae	6·2	26 13	08 14·228*	·72	10	....	....	....	....	
355	ρ Aquilae	5·1	14 55	10 06·758*	·73	5	....	....	....	....	
356	30 Cygni	4·2	46 33	20 10 28·291*	·68	4	....	....	....	....	
357	B.J. 757	4·3	46 28	10 47·847	·70	4	....	....	....	....	
358	B.J. 759	4·3	77 26	11 56·201	·71	10	—·005	—·094	....	—·069	Comes 8m, 7·5″ s.f.
359	B.J. 760	5·7	24 24	12 56·002	·64	9	....	....	....	....	
360	176 B.Cygni	6·6	39 07	16 59·459*	·69	22	....	....	....	....	
361	B.J. 765	2·3	39 58	20 18 59·865	·69	26	—·007	—·012	·017	—·014	
362	40 Cygni	5·9	38 09	24 14·168*	·69	27	....	....	....	....	
363	41 Cygni	4·1	30 04	25 43·062†	·69	28	....	—·023	....	—·075	
364	ω^1 Cygni	5·6	48 39	27 16·267*	·70	25	....	....	....	....	
365	B.J. 768	3·9	11 00	28 54·802	·71	22	·002	—·002	·011	—·010	
366	Groombridge 3241	6·4	72 14	20 30 24·329†	·69	13	....	....	....	·143	
367	ζ Delphini	4·8	14 22	31 06·054*	·71	17	....	....	....	....	
368	B.J. 770	5·3	74 39	32 42·352	·70	17	—·039	—·064	—·114	....	
369	B.J. 771	3·5	14 17	33 19·729	·71	12	·008	·007	·005	—·028	Binary 4m, 5m, 0·5″.
370	29 Vulpeculae	5·0	20 53	34 30·125*	·72	19	....	....	....	....	
371	74 Draconis	6·3	80 47	20 34 42·038*	·70	7	....	....	....	....	
372	B.J. 774	3·7	15 36	35 27·470	·72	21	·001	·008	·019	—·010	
373	B.J. 777	1·3	44 57	38 21·776	·72	26	—·028	—·026	—·011	—·030	
374	B.J. 778	4·2	14 45	39 15·441†	·73	24	·007	·014	....	·002	
375	B.J. 780	2·4	33 38	42 31·117	·72	27	—·039	—·042	—·042	—·060	
376	B.J. 782	4·5	57 15	20 43 07·082	·70	3	....	....	....	....	
377	B.J. 784	4·6	36 10	43 54·134	·72	25	—·006	·011	....	....	Comes 7m, 0·7″.
378	220 11¹.Draconis	5·6	80 13	51 41·952†	·74	15	....	—·168	....	—·133	
379	B.J. 788	3·9	40 49	53 49·007	·72	27	—·030	—·006	....	—·034	
380	Bradley 2748	6·3	75 35	55 48·609*	·73	17	....	....	....	....	
381	f^1 Cygni	4·8	47 10	20 56 45·872*	·73	16	....	....	....	....	
382	B.J. 792	3·9	43 34	21 01 39·358†	·72	23	—·052	—·028	—·037	—·048	
383	B.J. 793	5·4	38 18	02 51·725	·72	17	·010	....	—·016	·056	
384	f^2 Cygni	4·9	47 17	03 30·009*	·73	16	....	....	....	....	
385	Groombridge 3409	6·2	71 04	05 51·349*	·72	17	....	....	....	....	

MEAN RIGHT ASCENSIONS OF STARS OBSERVED IN 1910 (continued)

No.	Star	Mag.	Dec.	Mean R.A. 1910·0	Mean date 1910+	No. of Observations	O.−B.J.	O.−B.	O.−G.	O.−N.	Notes
			° ′	h m s							
386	B.J. 795	6·0	77 46	21 07 18·925	·74	11	−·086	−·111	−·135	−·247	
387	B.J. 797	3·1	29 51	09 06·313	·70	6					
388	B.J 798	5·8	59 37	09 30·741	·73	18	−·050	−·032			Comes 7m, 1″.
389	B.J. 799	3·8	37 40	11 11·861†	·72	24	−·002		·007	−·017	Comes 7m, 0·8″ pr.; binary.
390	σ Cygni	1·3	39 01	13 52·759†	·71	15		−·022	−·065	−·059	
391	υ Cygni	4·6	34 31	21 14 12·960*	·74	11					
392	Bradley 2796	6·1	76 38	16 41·818*	·73	9					
393	B.J 804	4·2	19 25	17 55·425	·74	13	−·009	·005		−·021	
394	69 Cygni	6·2	36 17	22 06·275*	·73	26					
395	B.J. 807	5·4	46 09	26 07·630†	·73	20	−·010	·014		−·023	
396	B.J. 809	3·1	70 10	21 27 30·163	·73	10	−·036	−·039	−·050	−·063	
397	Groombridge 3511	6·3	80 08	27 30·228*	·78	3					
398	ρ Cygni	4·2	45 12	30 35·643*	·73	12					
399	72 Cygni	5·0	38 08	31 05·906*	·74	12					
400	B.J. 811	5·1	40 01	33 20·412	·74	25	−·011	·005		−·056	
401	B.J. 813	6·1	57 05	21 36 10·015	·74	21	−·059				Triple; 7m, 12″; 7m, 20″.
402	B.J. 816	4·1	25 14	40 31·121	·74	9					Close double, 0·1″.
403	B.J. 817	1·8	70 54	40 36·357†	·74	18	−·057	−·062		−·038	
404	78 Draconis	5·3	71 54	41 58·582*	·74	18					
405	B.J. 821	4·3	48 54	43 28·013	·74	25	−·015	·012		−·025	
406	11 Pegasi	5·4	29 45	21 45 51·718*	·75	24					
407	B.J. 823	5·2	25 30	48 57·956	·75	22	−·019	·000	−·016	−·028	
408	Bradley 2868	7·2	55 47	50 04·993*	·74	23					
409	79 Draconis	6·6	73 17	51 44·092†	·74	8					
410	13 Cephei	6·1	56 11	51 51·550*	·75	18					

411	B.J. 826	5·8	12 41	21 56 42·247†	·73	13	−·005	·014	……	−·013	
412	Bradley 2897	6·4	74 34	56 59·794*	·76	13	……	……	……	……	
413	16 Cephei	5·2	72 45	21 57 57·997*	·77	16	……	……	……	……	
414	B.J. 831	3·9	24 54	22 02 49·205†	·75	23	−·008	−·011	−·011	−·032	
415	B.J. 833	5·8	32 44	05 14·259	·75	26	−·038	……	……	……	
416	B.J. 835	4·3	32 44	22 05 59·333	·75	20	−·001	·013	……	−·026	
417	28 Pegasi	6·6	20 32	06 14·884*	·76	6	……	……	……	……	
418	B.J. 836	3·4	57 45	07 43·843	·75	11	·016	·020	−·005	−·007	
419	B.J. 837	4·8	71 54	08 04·785	·76	15	·000	−·013	−·031	·006	
420	1 H.Lacertae	4·6	39 16	10 00·816*	·76	26	……	……	……	……	
421	Bradley 2942	6·3	72 52	22 11 15·103*	·76	16	……	……	……	……	
422	B.J. 844	4·5	51 47	20 01·135	·75	1	……	……	……	……	
423	B.D. 70·1240	5·7	70 19	23 41·069*	·77	15	……	……	……	……	
424	B.J. 847	4·1	57 57	25 49·572	·78	11	−·011	−·021	……	……	
425	38 Pegasi	5·7	32 07	25 54·710*	·80	4	……	……	……	……	
426	28 Cephei	6·4	78 20	22 26 02·256*	·73	6	……	……	……	……	
427	B.J. 848	3·8	49 49	27 34·837	·77	21	−·041	−·033	……	−·088	
428	29 Cephei	5·6	78 22	29 05·549*	·77	14	……	……	……	……	
429	226 B.Cephei	5·7	75 46	30 41·667†	·79	11	……	−·082	……	−·107	
430	B.J. 851	5·2	73 11	33 32·701	·78	16	−·021	−·037	……	……	
431	B.J. 852	4·9	38 35	22 35 13·221	·78	12	−·032	−·011	……	−·061	
432	Groombridge 3857	5·9	74 51	35 17·274*	·76	8	……	……	……	……	
433	B.J. 853	5·3	63 07	35 27·107	·85	1	……	……	……	……	
434	B.J. 855	3·3	10 22	36 58·386	·79	17	·010	·011	·018	·000	
435	B.J. 857	2·9	29 45	38 46·888	·78	15	−·009	·002	−·015	−·015	
436	B.J. 858	5·4	41 21	22 40 04·479	·78	18	−·029	−·016	……	……	
437	B.J. 859	3·9	23 06	42 11·698	·78	16	·017	·018	……	·023	
438	B.J. 862	3·6	24 08	45 39·463†	·78	13	−·015	−·010	−·010	−·031	
439	B.J. 863	3·5	65 44	46 28·344	·87	2	……	……	……	……	
440	52 Pegasi	6·4	11 15	54 41·623*	·79	15	……	……	……	……	Comes 8m 1″.
441	B.J. 869	3·5	41 51	22 57 46·611	·78	19	−·042	−·030	……	−·025	
442	B.J. 870	2·4	27 36	22 59 24·580	·78	12	·015	·007	−·022	·007	
443	B.J. 871	2·4	14 43	23 00 16·611	·80	10	·011	·007	·014	·012	
444	5 Andromedae	5·8	48 48	03 39·892*	·79	14	……	……	……	……	
445	B.J. 874	4·5	74 54	05 01·868	·79	15	−·057	−·059	−·159	−·073	Comes 7m, 1″ n.f.

MEAN RIGHT ASCENSIONS OF STARS OBSERVED IN 1910 (concluded)

No.	Star	Mag.	Dec.	Mean R.A. 1910·0	Mean date 1910+	No. of Observations	O.−B.J.	O.−B.	O.−G.	O.−N.	Notes
			° ′	h m s							
446	B.J. 875	5·8	56 40	23 08 56·611	·79	18	−·066	−·051	......	−·139	
447	Bradley 3085	6·2	73 41	11 24·826*	·79	12	......	......	......	......	
448	Bradley 3086	5·8	70 21	12 09·030*	·83	3	......	......	......	......	
449	Groombridge 4033	6·5	74 48	14 08·293*	·80	12	......	......	......	......	
450	*o* Cephei	4·9	67 37	14 55·263†	·85	2	......	......	......	......	Comes 8m, 3″ s.pr.
451	B.J. 880	4·5	23 15	23 16 10·834	·81	14	−·001	−·012	·002	·008	
452	B.J. 882	5·5	61 17	20 50·117	·90	2	......	......	......	......	
453	B.J. 881	4·4	22 55	20 53·140†	·80	13	·001	·008	·050	·006	
454	B.J. 885	4·7	12 16	24 36·127	·82	12	·012	·018	......	·013	
455	1 11. Cassiopeiae	4·9	58 03	25 52·275*	·80	3	......	......	......	......	Multiple; 10m, 1″.
456	15 Andromedae	6·0	39 41	23 30 13·141*	·86	3	......	......	......	......	
457	Bradley 3140	5·9	71 09	31 01·191*	·82	4	......	......	......	......	
458	B.J. 890	3·8	45 58	33 09·263†	·82	12	−·011	−·016	......	−·071	
459	B.J. 891	4·1	42 46	33 43·079	·79	3	......	......	......	......	
460	Groombridge 4119	6·2	74 48	35 18·002*	·80	5	......	......	......	......	
461	B.J. 893	3·3	77 08	23 35 38·281	·84	1	......	......	......	......	
462	*κ* Andromedae	4·3	43 50	35 58·233	·81	5	......	......	......	......	
463	*ψ* Andromedae	5·1	45 55	41 31·157	·81	11	......	......	......	−·067	
464	B.J. 895	5·2	67 18	43 35·933	·88	6	......	......	......	......	
465	B.J. 898	5·4	18 37	47 54·458	·79	4	......	......	......	......	
466	Groombridge 4151	6·5	75 03	23 48 00·613*	·84	7	......	......	......	......	
467	B.J. 899	4·8	57 00	49 52·786†	·79	4	......	......	......	......	
468	Groombridge 4163	6·6	73 55	50 26·317	·85	8	......	......	......	......	
469	*ψ* Pegasi	4·8	24 38	53 10·214*	·83	12	......	......	......	......	

APPENDIX 4.

REPORT OF THE CHIEF ASTRONOMER, 1911

TABULAR STATEMENT OF LONGITUDE AND LATITUDE OBSERVATIONS

BY

J. MACARA.

CONTENTS

MAP.

APPENDIX 4.

TABULAR STATEMENT OF LONGITUDE AND LATITUDE OBSERVATIONS.

OTTAWA, CANADA,
1st April, 1911.

W. F. KING, LL.D., C.M.G.,
Chief Astronomer,
Department of the Interior,
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 1910; and, of four other stations, Erwood and Macdowall in Saskatchewan and Lloydminster and Stonyplain in Alberta, observed in 1909 by exchange of signals with the transit house, on Fort Osborne barracks ground, at Winnipeg. The longitude of the latter station was determined early in the summer of 1910, by telegraphic exchange of time with the Dominion Observatory.

This report also contains a statement, arranged in alphabetical order, giving the longitude and the latitude of the various astronomical stations established up to the present time. The small differences between the longitudes given herein and those previously published are due to the adjustment of the longitude triangles comprising Seattle, Vancouver, Boundary, Field, Winnipeg, Ottawa, Montreal and Harvard.

The accompanying map shows the positions of the stations.

I have the honour to be, sir,

Your obedient servant,

J. MACARA.

DIFFERENCE OF LONGITUDE BETWEEN ERWOOD, SASK., AND WINNIPEG, MAN.

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	v	
	m s	m s	s	s	m s	m s	m s	s	s
1909 Aug. 21	19 41·680	19 41·554	−43·127	−14·735	20 10·072	20 09·946	20 10·009	−·073	·063
" 22	42·532	42·395	−40·359	−12·856	10·035	09·898	09·962	−·026	·064
" 24	44·314	44·178	−35·501	−09·831	09·984	09·848	09·916	·020	·068
" 25	44·162	44·033	−34·074	−08·305	09·931	09·802	09·867	·069	·065
" 26	44·608	44·457	−32·145	−06·796	09·957	09·806	09·882	·054	·076
" 27	44·919	44·779	−30·503	−05·375	10·047	09·907	09·977	−·041	·070
" 28	46·261	46·139	−27·559	−03·912	09·911	09·786	09·849	·087	·063
" 29	48·180	48·037	−21·073	−02·173	10·080	09·937	10·008	−·072	·071

Observers {West, F. A. McDiarmid.
{East, W. C. Jaques.

	h	m	s
Mean difference of longitude		20	09·936
Longitude of Winnipeg	6	28	35·262
Longitude of Erwood	6	48	15·198

DIFFERENCE OF LONGITUDE BETWEEN MACDOWALL, SASK., AND WINNIPEG, MAN.

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.	v	
1909	m s	m s	m s	s	m s	m s	m s	s	s
Sept. 2......	36 51·999	36 54·902	+1 31·739	+04·387	35 27·647	35 27·550	35 27·599	−·019	·049
" 1......	36 59·591	36 59·530	+1 39·315	+07·368	27·641	27·583	27·613	−·033	·030
" 4	36 59·720	36 59·647	+1 39·581	+07·394	27·533	27·460	27·497	·083	·037
" 6......	37 03·794	37 03·713	+1 47·026	+10·879	27·647	27·566	27·606	−·026	·040
" 6......	37 03·835	37 03·756	+1 47·169	+10·952	27·618	27·539	27·579	·001	·040
" 7......	37 05·143	37 05·060	+1 49·905	+12·373	27·611	27·528	27·570	·010	·042
" 7......	37 05·217	37 05·135	+1 50·005	+12·423	27·635	27·553	27·594	−·011	·041

Observers {West, F. A. McDiarmid. East, W. C. Jaques.

	h	m	s
Mean difference of longitude....................		35	27·580
Longitude of Winnipeg..........................	6	28	35·262
Longitude of Macdowall.........................	7	04	02·842

DIFFERENCE OF LONGITUDE BETWEEN LLOYDMINSTER, ALTA., AND WINNIPEG, MAN.

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.	v	
1909	m s	m s	m s	s	m s	m s	m s	s	s
Sept. 9......	52 42·495	52 42·300	1 22·404	06·401	51 26·492	51 26·297	51 26·395	−·012	·098
" 13......	52 50·570	52 50·387	1 35·978	11·906	26·498	26·315	26·406	−·053	·091
" 16......	52 55·146	52 54·959	1 47·157	18·401	26·390	26·203	26·297	+·056	·094
" 20......	53 02·292	53 02·113	2 01·733	25·909	26·468	26·289	26·378	−·025	·089
" 23......	53 11·994	53 11·807	2 17·719	32·108	26·382	26·195	26·289	+·064	·094

Observers {West, F. A. McDiarmid. East, W. C. Jaques.

	h	m	s
Mean difference of longitude....................		51	26·353
Longitude of Winnipeg..........................	6	28	35·262
Longitude of Lloydminster......................	7	20	01·615

DIFFERENCE OF LONGITUDE BETWEEN STONYPLAIN, ALTA., AND WINNIPEG, MAN.

Date	Difference of Chronograph: Western Signals.	Difference of Chronograph: Eastern Signals.	Clock Correction: Western Station.	Clock Correction: Eastern Station.	Difference of Longitude: Western Signals.	Difference of Longitude: Eastern Signals.	Difference of Longitude: Mean.	v	Time of Transmission.
1909	h m s	h m s	m s	s	h m s	h m s	h m s	s	s
Sept. 27......	1 08 44·578	1 08 44·389	1 59·565	40·708	1 07 26·721	1 07 26·532	1 07 26·627	—·054	·095
" 28......	08 46·192	08 45·987	2 02·990	42·441	1 07 26·643	1 07 26·438	1 07 26·541	·032	·103
" 30......	08 45·562	08 45·389	2 06·549	46·677	1 07 26·690	1 07 26·517	1 07 26·603	—·030	·086
Oct. 2......	08 49·149	08 48·951	2 14·627	51·166	1 07 26·688	1 07 26·490	1 07 26·589	—·016	·099
" 3......	08 51·988	08 51·763	2 19·569	53·239	1 07 26·658	1 07 26·433	1 07 26·546	·027	·113
" 4......	08 53·756	08 53·563	2 23·154	55·024	1 07 26·626	1 07 26·433	1 07 26·530	·043	·097

Observers {West, F.A. McDiarmid.
East, W. C. Jaques.

	h	m	s
Mean difference of longitude....................	1	07	26·573
Longitude of Winnipeg..........................	6	28	35·262
Longitude of Stonyplain........................	7	36	01·835

DIFFERENCE OF LONGITUDE BETWEEN WINNIPEG, MAN., AND DOMINION OBSERVATORY, OTTAWA.

Date	Difference of Chronograph: Western Signals	Difference of Chronograph: Eastern Signals.	Clock Correction: Western Station.	Clock Correction: Eastern Station.	Difference of Longitude: Western Signals.	Difference of Longitude: Eastern Signals.	Difference of Longitude: Mean.	p	Time of Transmission.
1910	h m s	h m s	s	s	h m s	h m s	h m s		s
May 11......	1 25 20·415	1 25 20·308	−22·790	+ ·007	1 25 43·212	1 25 43·105	1 25 43·158	½	·053
" 16......	1 25 23·006	1 25 22·878	−20·011	+ ·115	1 25 43·432	1 25 43·004	1 25 43·068	½	·064
" 17......	1 25 24·919	1 25 24·789	−18·237	+ ·165	1 25 43·321	1 25 43·191	1 25 43·256	1	·065
" 18......	1 25 27·015	1 25 26·861	−16·039	+ ·301	1 25 43·355	1 25 43·201	1 25 43·278	½	·077
" 20......	1 25 32·510	1 25 32·389	−10·274	+ ·493	1 25 43·307	1 25 43·156	1 25 43·232	½	·075
" 21......	1 25 31·536	1 25 31·415	−08·261	+ ·545	1 25 43·342	1 25 43·221	1 25 43·281	1	·062
" 25......	1 25 41·112	1 25 41·027	−01·218	+1·014	1 25 43·374	1 25 43·259	1 25 43·316	½	·057
" 26......	1 25 42·215	1 25 42·085	−00·006	+1·128	1 25 43·349	1 25 43·219	1 25 43·284	1	·065
" 29......	1 25 45·166	1 25 45·049	+ 3·175	+1·310	1 25 43·304	1 25 43·181	1 25 43·243	½	·058
June 5	1 25 59·031	1 25 58·885	+17·649	+1·876	1 25 43·258	1 25 43·112	1 25 43·185	½	·073
" 6......	1 25 60·254	1 25 60·115	+18·940	+1·960	1 25 43·274	1 25 43·135	1 25 43·204	½	·069
" 7......	1 25 61·652	1 25 61·520	+20·344	+2·045	1 25 43·353	1 25 43·221	1 25 43·287	1	·066
" 8......	1 25 61·947	1 25 61·793	+20·850	+2·176	1 25 43·273	1 25 43·119	1 25 43·196	1	·077
" 9......	1 25 61·495	1 25 61·320	+20·363	+2·324	1 25 43·456	1 25 43·281	1 25 43·368	1	·087

Observers { West, F. A. McDiarmid.
East, D. B. Nugent
R. M. Stewart

	h m s
Mean difference of longitude....................	1 25 43·251
Longitude of Dominion Observatory	5 02 51·983
Correction to Winnipeg longitude due to solving of longitude net..........................	+ ·028
Longitude of Winnipeg..........................	6 28 35·262

DIFFERENCE OF LONGITUDE BETWEEN NORTH PORTAL, SASK., AND WINNIPEG, MAN.

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	v	
1910	m s	m s	s	s	m s	m s	m s	s	s
July 12.....	23 17·974	23 17·913	+59·895	−41·761	21 36·315	21 36·251	21 36·285	·119	·031
" 13.....	22 35·630	22 35·530	+60·669	+ 1·403	21 36·361	21 36·264	21 36·314	·090	·050
" 14.....	22 36·600	22 36·553	+62·069	+ 1·894	21 36·425	21 36·378	21 36·401	·003	·023
" 16.....	22 35·100	22 35·065	+62·060	+ 3·301	21 36·350	21 36·306	21 36·428	·076	·022
" 19.....	22 31·333	22 31·262	+63·791	+ 6·058	21 36·600	21 36·529	21 36·561	−·160	·035
" 20.....	22 34·517	22 34·452	+61·187	+ 6·237	21 36·567	21 36·502	21 36·531	−·130	·032

Observers { West, F. A. McDiarmid.
East, W. C. Jaques.

	h	m	s
Mean difference of longitude.....		21	36·404
Longitude of Winnipeg.....	6	28	35·262
Longitude of North Portal.....	6	50	11·666

DIFFERENCE OF LONGITUDE BETWEEN MORTLACH, SASK., AND WINNIPEG, MAN.

Date	Difference of Chronograph: Western Signals	Difference of Chronograph: Eastern Signals	Clock Correction: Western Station	Clock Correction: Eastern Station	Difference of Longitude: Western Signals	Difference of Longitude: Eastern Signals	Difference of Longitude: Mean	v	Time of Transmission
1910	h m s	h m s	s	s	h m s	h m s	h m s	s	s
July 23	0 36 13·731	0 36 13·672	+39·615	+6·687	0 35 40·773	0 35 40·714	0 35 40·744	·066	·030
" 24	0 36 12·518	0 36 12·458	+38·652	+7·003	0 35 40·868	0 35 40·809	0 35 40·839	−·029	·030
" 25	0 36 11·137	0 36 11·085	+37·610	+7·337	0 35 40·834	0 35 40·782	0 35 40·808	·002	·026
" 26	0 36 09·778	0 36 09·695	+36·929	+7·952	0 35 40·801	0 35 40·718	0 35 40·760	·050	·042
" 28	0 36 08·865	0 36 08·785	+36·731	+8·727	0 35 40·861	0 35 40·781	0 35 40·821	−·011	·040
" 29	0 36 09·138	0 36 09·055	+37·351	+9·140	0 35 40·927	0 35 40·844	0 35 40·885	−·075	·041

Observers {West, F. A. McDiarmid.
East, W. C. Jaques.

	h m s
Mean difference of longitude	0 35 40·810
Longitude of Winnipeg	6 28 35·262
Longitude of Mortlach	7 04 16·072

DIFFERENCE OF LONGITUDE BETWEEN WALSH, ALTA., AND WINNIPEG, MAN.

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.	v	
1910	h m s	h m s	s	s	h m s	h m s	h m s	s	s
Aug. 1......	0 52 02·888	0 52 02·743	+37·894	+ 9·391	0 51 34·385	0 51 34·240	0 51 34·312	−·022	·072
" 3......	0 52 01·172	0 52 01·058	+36·761	+10·019	0 51 34·430	0 51 34·316	0 51 34·373	−·083	·057
" 4......	0 52 00·173	0 52 00·046	+35·676	+ 9·894	0 51 34·391	0 51 34·264	0 51 34·327	−·037	·063
" 5......	0 51 59·202	0 51 59·061	+35·060	+10·177	0 51 34·319	0 51 34·178	0 51 34·249	·011	·071
" 6......	0 51 58·404	0 51 58·298	+34·293	+10·242	0 51 34·353	0 51 34·247	0 51 34·300	−·010	·053
" 7......	0 51 56·207	0 51 56·161	+32·212	+10·295	0 51 34·290	0 51 34·177	0 51 34·239	·051	·062
" 8......	0 51 54·933	0 51 51·810	+31·209	+10·621	0 51 34·345	0 51 34·222	0 51 34·283	·007	·061
" 9......	0 51 51·959	0 51 51·878	+28·935	+11·257	0 51 34·281	0 51 34·200	0 51 34·240	·050	·060

Observers {West, F. A. McDiarmid. / East, W. C. Jaques.

	h m s
Mean difference of longitude....................	0 51 34·290
Longitude of Winnipeg..........................	6 28 35·262
Longitude of Walsh.............................	7 20 09·552

DIFFERENCE OF LONGITUDE BETWEEN PINCHER, ALTA., AND WINNIPEG, MAN.

Date	Difference of Chronograph: Western Signals.	Difference of Chronograph: Eastern Signals.	Clock Correction: Western Station.	Clock Correction: Eastern Station.	Difference of Longitude: Western Signals.	Difference of Longitude: Eastern Signals.	Difference of Longitude: Mean	ε	Time of Transmission.
1910	h m s	h m s	s	s	h m s	h m s	h m s	s	s
Aug. 13......	1 06 16·136	1 06 15·919	−41·857	+14·078	1 07 12·071	1 07 11·881	1 07 11·977	·013	·093
" 16......	09·891	09·691	−44·945	+17·375	12·211	12·014	12·112	−·092	·098
" 17......	07·906	07·710	−45·029	+19·212	12·147	11·951	12·019	−·029	·098
" 18......	05·323	05·135	−45·620	+21·092	12·035	11·847	11·941	·079	·094

	h m s
Mean difference of longitude..........	1 07 12·020
Longitude of Winnipeg..........	6 28 35·262
Longitude of Pincher..........	7 35 47·282

Observers {West, F. A. McDiarmid.
{East, W. C. Jaques.

DIFFERENCE OF LONGITUDE BETWEEN COUTTS, ALTA., AND WINNIPEG, MAN.

Date	Difference of Chronograph		Clock Correction		Difference of Longitude			r	Time of Transmission.
	Western Signals.	Eastern Signals.	Western Station	Eastern Station	Western Signals.	Eastern Signals.	Mean.		
1910	h m s	h m s	s	s	h m s	h m s	h m s	s	s
Sept. 2......	0 58 15·769	0 58 15·555	−40·252	+19·254	0 59 15·275	0 59 15·061	0 59 15·168	−·037	·107
" 3......	0 58 16·327	0 58 16·110	−41·058	+17·899	0 59 15·284	0 59 15·066	0 59 15·175	−·044	·109
" 8......	0 58 19·110	0 58 18·883	−38·631	+17·443	0 59 15·184	0 59 14·957	0 59 15·071	·060	·114
" 9......	0 58 17·678	0 58 17·463	−39·700	+17·875	0 59 15·253	0 59 15·038	0 59 15·146	−·015	·108
" 11......	0 58 18·778	0 58 18·557	−37·113	+19·256	0 59 15·177	0 59 14·956	0 59 15·067	·061	·111
" 12......	0 58 19·106	0 58 18·873	−35·476	+20·692	0 59 15·274	0 59 15·041	0 59 15·157	−·026	·116

Observers {West, F. A. McDiarmid.
East, W. C. Jaques.

	h m s
Mean difference of longitude....................	0 59 15·131
Longitude of Winnipeg..........................	6 28 35·262
Longitude of Coutts............................	7 27 50·393

DIFFERENCE OF LONGITUDE BETWEEN EMERSON, MAN., AND WINNIPEG, MAN.

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.	v	
1910	h m s	h m s	s	s	h m s	h m s	h m s	s	s
Sept. 17......	0 00 41·923	0 00 42·005	−54·865	+1·874	0 00 14·816	0 00 14·734	0 00 14·775	−·018	·041
" 19......	41·857	41·944	−54·290	+2·422	14·855	14·768	14·811	−·054	·043
" 20......	42·344	42·440	−54·621	+2·442	14·719	14·623	14·671	·086	·048
" 23......	34·934	35·028	−44·921	+4·841	14·826	14·732	14·779	−·022	·047
" 26......	27·065	27·158	−34·660	+7·199	14·794	14·701	14·748	·009	·017

Observers {West. F. A. McDiarmid.
East, W. C. Jaques.

	h m s
Mean difference of longitude....................	0 00 14·757
Longitude of Winnipeg..........................	6 28 35·262
Longitude of Emerson..........................	6 28 50·019

DIFFERENCE OF LONGITUDE BETWEEN WINDSOR, 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.	v	
1910	h m s	h m s	s	s	h m s	h m s	h m s	s	s
Sept. 30......	0 29 47·063	0 29 46·976	+41·502	+13·984	0 29 19·545	0 29 19·458	0 29 19·502	−·003	·041
Oct. 1......	0 29 48·530	0 29 48·426	+43·099	+14·089	0 29 19·520	0 29 19·416	0 29 19·468	·031	·052
" 2......	0 29 48·170	0 29 48·079	+42·815	+14·192	0 29 19·547	0 29 19·456	0 29 19·501	·002	·045
" 3......	0 29 47·997	0 29 47·919	+42·705	+14·299	0 29 19·591	0 29 19·513	0 29 19·552	−·053	·039
" 4......	0 29 49·345	0 29 49·238	+44·153	+14·446	0 29 19·638	0 29 19·531	0 29 19·584	−·085	·053
" 7......	0 29 52·254	0 29 52·167	+47·707	+14·883	0 29 19·430	0 29 19·343	0 29 19·387	·119	·044

Observers {West, F. A. McDiarmid.
East, D. B. Nugent.

	h m s
Mean difference of longitude..................	0 29 19·499
Longitude of Dominion Observatory	5 02 51·983
Longitude of Windsor..........................	5 32 11·482

DIFFERENCE OF LONGITUDE BETWEEN SAULT STE. MARIE, 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	v	
1910	h m s	h m s	s	s	h m s	h m s	h m s	s	s
Oct. 6......	0 34 11·291	0 34 11·140	−00·950	+14·740	0 34 26·981	0 34 26·830	0 34 26·906	−·091	·076
" 7......	13·024	12·882	+01·074	+14·887	26·837	26·695	26·766	·019	·072
" 9......	15·006	14·858	+03·588	+15·461	26·879	26·731	26·805	·010	·071
" 10......	16·913	16·787	+05·793	+15·749	26·869	26·743	26·806	·009	·063
" 11......	17·889	17·736	+07·015	+16·022	26·866	26·713	26·790	·025	·077

Observers { West, W. C. Jaques.
East, R. M. Stewart.
D. B. Nugent.

	h m s
Mean difference of longitude....................	0 34 26·815
Longitude of Dominion Observatory............	5 02 51·983
Longitude of Sault Ste. Marie....................	5 37 18·798

SESSIONAL PAPER No. 25a

ASTRONOMICAL POSITIONS OF STATIONS.

OBSERVED, 1885 TO 1910.

Place.	Year.	Difference of Longitude.	Base.	Longitude.	Longitude.	Latitude.
		h m s		h m s	° ′ ″	° ′ ″
Bancroft..........	1909	0 08 34·317	Dom. Obs......	5 11 26·300	77 51 31·50	45 03 34·52
Barry Bay........	1907	0 07 50·531	" ...	5 10 42·517	77 40 37·76	45 29 17·11
Bathurst..........	1909	0 40 14·848	"	4 22 37·135	65 39 17·03	47 37 12·95
Beeton............	1904	0 16 17·528	Ottawa..........	5 19 07·550	79 16 53·25	44 01 17·70
Black Lake........	1908	0 17 27·431	Dom. Obs.........	4 45 24·552	71 21 08·28	46 02 14·59
Boiestown.........	1908	0 37 10·990	"	4 25 40·993	66 25 14·90	46 27 18·52
Boundary (Yukon)	1906	1 11 31·626	Vancouver. ...	9 24 00·030	141 00 00·45	64 40 51·42
Boundary (Waneta)	1908	0 18 49·289	Seattle.......	7 50 30·985	117 37 44·78	49 00 00·55
Calgary..........	1886	0 25 03·659	Kamloops.....	7 36 15·132	114 03 46·98	51 02 39·21
Campbellton......	1908	0 36 10·364	Dom. Obs.........	4 26 41·619	66 40 24·28	48 00 31·33
Canoe Lake.......	1900	0 12 04·914	Ottawa.	5 11 51·936	78 43 44·04	45 34 41·55
Chalk River.......	1900	0 06 58·506	"	5 09 48·528	77 27 07·92	46 00 52·32
Chapleau..........	1907	0 30 45·695	Dom. Obs.........	5 33 37·678	83 24 25·17	47 50 31·21
Charlottetown.....	1909	0 50 22·407	"	4 12 29·576	63 07 23·64	46 13 58·48
Cobourg...........	1904	....	....	....	....	43 57 51·40
Cochrane..........	1909	0 21 11·949	Dom. Obs.....	5 24 06·932	81 01 43·98	49 03 41·88
Coutts............	1910	0 59 15·131	Winnipeg..........	7 27 50·393	111 57 35·90	49 00 09·01
Covey Hill........	1903	....	....	...	.....	45 01 13·35
Dawson...........	1907	0 06 16·131	Boundary...	9 17 43·899	139 25 58·49	64 03 23·15
Digby.............	1909	0 39 50·801	Dom. Obs.........	4 23 01·182	65 45 17·73	44 37 13·58
Dom. Observatory	1905	0 00 01·961	Ottawa (Cliff St.)	5 02 51·983	75 42 59·75	......
Edmonton........	1888	1 05 27·965	Winnipeg (new Obs)	7 34 01·754	113 30 26·31	53 31 58·81
Edmundston......	1908	0 29 33·867	Dom. Obs.........	4 33 18·116	68 19 31·74	47 22 06·65
Emerson..........	1910	0 00 14·757	Winnipeg.........	6 28 50·019	97 12 30·29	49 00 04·34
Erwood...........	1909	0 20 09·936	"	6 48 45·198	102 11 17·97	52 51 37·69

ASTRONOMICAL POSITIONS OF STATIONS—*Continued.*

PLACE.	Year.	Difference of Longitude.	Base.	Longitude.	Longitude.	Latitude.
		h m s		h m s	° ′ ″	° ′ ″
Father Point......	1905	0 28 58·508	Dom. Obs........	4 33 53·475	68 28 22·12	48 31 05·14
Field..............	1886	0 15 18·953	Kamloops.........	7 45 59·864	116 29 57·96	51 23 38·58
Fort Frances......	1908	1 10 44·496	Dom. Obs........	6 13 36·479	93 24 07·18	48 36 48·59
Foster............	1908	0 12 52·932	"	4 49 59·051	72 29 45·76	45 17 14·63
Fredericton.......	1908	0 36 18·419	"	4 26 33·564	66 38 23·46	45 57 41·30
Gateway..........	1908	0 28 39·199	Seattle...........	7 40 41·075	115 10 16·13	48 59 58·45
Guelph............	1904	0 18 10·545	Ottawa...........	5 21 00·567	80 15 08·50	43 32 43·70
Haliburton........	1909	0 11 10·911	Dom. Obs.........	5 14 02·894	78 30 43·41	45 02 43·78
Halifax............	1908	0 48 27·314	"	4 14 24·669	63 36 10·03	44 40 07·52
Harriston.........	1904	0 20 39·252	Ottawa...........	5 23 29·274	80 52 19·11	43 54 52·40
Jackfish...........	1908	0 45 01·528	Dom. Obs.........	5 47 53·511	86 58 22·66	48 47 44·84
Kalmar...........	1887	0 08 40·476	Winnipeg (old Obs)	6 19 51·154	94 57 47·31	49 46 21·96
Kamloops.........	1886	1 32 47·157	Winnipeg (old Obs)	8 01 18·791	120 19 41·87	50 40 39·02
Kingston..........	1905	0 03 00·881	Dom. Obs.........	5 05 52·864	76 28 12·96	44 13 46·58
Labelle...........	1907	0 03 57·575	Dom. Obs.........	4 58 54·408	74 43 36·12	46 17 02·27
Lake Edward......	1907	0 13 45·875	"	4 49 06·108	72 16 31·62	47 39 34·25
Lindsay...........	1905	0 12 04·647	"	5 14 56·630	78 44 09·45	44 21 30·50
Liskeard..........	1906	0 15 53·001	"	5 18 44·984	79 41 14·76	47 30 33·58
Lloydminster......	1909	0 51 26·353	Winnipeg..........	7 20 01·615	110 00 24·23	53 17 08·49
Macdowall........	1909	0 35 27·580	Winnipeg..........	7 04 02·842	106 00 42·63	53 01 01·26
Madoc............	1905	0 07 01·794	Dom. Obs.........	5 09 53·777	77 28 26·66	44 30 15·70
Maniwaki.........	1906	0 01 02·581	"	5 03 54·564	75 58 38·46	46 22 28·40
Matheson.........	1908	0 18 59·665	"	5 21 51·648	80 27 54·72	48 32 07·23
Mattawa..........	1907	0 11 57·405	"	5 14 49·388	78 42 20·82	46 18 40·55

ASTRONOMICAL POSITIONS OF STATIONS—*Continued.*

Place	Year.	Difference of Longitude.	Base.	Longitude.	Longitude.	Latitude.
		h m s		h m s	° ′ ″	° ′ ″
Megantic	1908	0 19 19·926	Dom. Obs.	1 43 32·057	70 53 00·85	45 34 32·80
Michipicoten	1907					47 57 40·16
Midway	1901	0 17 19·354	Vancouver	7 55 09·050	118 47 15·75	49 00 40·50
Moncton	1908	0 43 42·254	Dom. Obs.	4 19 09·729	64 47 25·93	46 05 02·21
Mortlach	1910	0 35 40·810	Winnipeg	7 04 16·072	106 01 01·08	50 27 10·91
Mulgrave	1909	0 57 18·658	Dom. Obs.	4 05 33·325	61 23 19·87	45 36 18·84
Newcastle	1908	0 40 33·947	Dom. Obs.	4 22 18·036	65 34 30·54	47 00 11·37
Nipigon	1908	0 50 11·098	“	5 53 03·081	88 15 46·22	49 00 43·75
North Bay	1905	0 14 58·878	“	5 17 50·861	79 27 42·91	46 18 22·21
North Lake	1908	0 59 00·106	“	6 01 52·089	90 28 01·33	48 08 28·77
North Portal	1910	0 21 36·404	Winnipeg	6 50 11·666	102 32 54·99	48 59 59·37
Onion Lake	1888	0 51 26·833	Winnipeg (new Obs)	7 20 00·710	110 00 10·65	53 43 07·73
Orillia	1904	0 14 49·962	Ottawa	5 17 39·984	79 24 59·76	44 36 28·50
Ottawa	1896	0 08 31·388	Montreal	5 02 50·022	75 42 30·33	45 25 21·78
Owen Sound	1900	0 20 56·724	Ottawa	5 23 46·746	80 56 41·19	44 33 56·42
Pembroke	1907	0 05 34·875	Dom. Obs.	5 08 26·858	77 06 42·87	45 49 42·15
Percé	1908	0 45 59·383	“	4 16 52·600	64 13 09·00	48 30 52·05
Pickerel	1909	0 19 15·405	“	5 22 07·388	80 31 50·82	45 58 24·05
Pincher	1910	1 07 12·020	Winnipeg	7 35 47·282	113 56 49·23	49 31 22·60
Port Arthur	1887	0 31 40·192	Winnipeg (old Obs)	5 56 51·507	89 12 52·61	48 26 01·66
Port Moody	1885	0 10 05·108	Kamloops	8 11 26·659	122 51 39·89	49 16 29·55
Portneuf	1903	0 15 15·653	Ottawa	4 47 34·369	71 53 35·53	46 42 33·44
Port Stanley	1896	0 22 00·865	“	5 21 50·887	81 12 43·30	42 39 52·73
Rainy River	1908	1 15 23·871	Dom. Obs.	6 18 15·854	94 33 57·81	48 43 22·80
Rayside	1900	0 21 32·512	Ottawa	5 24 22·534	81 05 38·01	46 32 47·45
Renfrew	1905	0 03 51·729	Dom. Obs.	5 06 43·712	76 40 55·68	45 28 30·08

ASTRONOMICAL POSITIONS OF STATIONS—*Continued.*

Place	Year.	Difference of Longitude.	Base.	Longitude.	Longitude.	Latitude.
		h m s		h m s	° ′ ″	° ′ ″
Revelstoke........	1886	0 08 28·970	Kamloops (1886)..	7 52 49·847	118 12 27·70	51 00 11·25
Rivière-à-Pierre...	1907	0 14 08·284	Dom. Obs........	4 48 43·699	72 10 55·48	46 59 16·90
Rivière-du-Loup...	1908	0 21 45·836	"	4 38 06·147	69 31 32·20	47 49 23·48
Rivière Ouelle.....	1906	0 22 46·239	"	4 40 05·744	70 01 26·16	47 29 04·86
Roberval..........	1907	0 13 57·797	" .	4 48 54·186	72 13 32·79	48 31 03·68
Rose Point........	1900	0 17 19·911	Ottawa....	5 20 09·933	80 02 28·99	45 19 00·73
Sault Ste. Marie...	1910	0 34 26·815	Dom. Obs.........	5 37 18·798	84 19 41·97	46 30 31·37
Scotia Junction....	1907	0 14 18·831	"	5 17 10·814	79 17 42·21	45 30 46·75
Selkirk............	1907	0 08 13·294	Dawson...........	9 09 30·605	137 22 39·08	62 46 20·98
Sharbot Lake.....	1905	0 03 53·937	Dom. Obs........	5 06 45·920	76 41 28·80	44 46 29·07
Shippigan.........	1909	0 44 00·423	"	4 18 51·560	64 42 53·40	47 44 38·62
Sorel..............	1908	0 10 24·308	"	4 52 27·675	73 06 55·12	46 02 19·59
Sprague...........	1908	1 19 41·368	"	6 22 33·351	95 38 20·26	49 02 05·10
Ste. Anne-de-Bellevue........	1905	0 07 03·752	"	4 55 48·231	73 57 03·46	45 24 28·13
St. Catharines.....	1905	0 14 05·012	"	5 16 56·995	79 14 14·92	43 09 41·72
St. Hyacinthe.....	1908	0 11 07·658	"	4 51 44·325	72 56 04·87	45 37 15·28
St. Jerome........	1908	0 06 52·184	"	4 55 59·799	73 59 56·98	45 46 33·29
St. John...........	1908	0 38 35·985	"	4 24 15·998	66 03 59·97	45 16 35·04
Stonyplain........	1909	1 07 26·573	Winnipeg.........	7 36 01·835	114 00 27·53	53 31 47·27
Sutton............	1905	0 14 35·633	Dom. Obs.........	5 17 27·616	79 21 54·24	44 18 12·49
Sydney............	1909	1 02 04·431	"	4 00 47·552	60 11 53·28	46 08 27·86
Tadoussac.........	1905	0 24 00·532	Dom. Obs........	4 38 51·451	69 42 51·76	48 08 27·19
Tantalus..........	1907	0 12 35·313	Dawson....... ..	9 05 08·586	136 17 08·79	62 05 28·56
Three Rivers......	1902	0 12 41·407	Ottawa......... ..	4 50 08·615	72 32 09·22	46 20 37·09
Timagami.........	1905	0 16 17·318	Dom. Obs.........	5 19 09·301	79 47 19·51	47 03 47·91
Trenton..........	1905	0 07 26·720	"	5 10 18·703	77 34 40·54	44 05 52·53
Truro.............	1908	0 49 46·955	"	4 13 05·028	63 16 15·42	45 21 47·32

ASTRONOMICAL POSITIONS OF STATIONS—*Concluded.*

Place	Year.	Difference of Longitude.	Base.	Longitude.	Longitude.	Latitude.
		h m s		h m s	° ′ ″	° ′ ″
Vancouver........	1905	0 03 08·130	Seattle..........	8 12 28·401	123 07 06·06	49 17 46·07
Victoria...........	1885	0 04 06·991	"	8 13 26·111	123 21 36·66	48 25 31·38
Walsh.............	1910	0 51 34·290	Winnipeg........	7 20 09·552	110 02 23·28	49 57 06·79
Wapella...........	1887	0 19 21·505	Winnipeg (old Obs)	6 47 53·097	101 58 16·46	50 15 45·79
Whitby...........	1905	0 12 53·864	Dom. Obs........	5 15 45·847	78 56 27·70	43 52 43·34
Whitehorse........	1907	0 17 32·318	Dawson..........	9 00 11·581	135 02 53·71	60 43 17·17
White Pass........	1907	0 17 10·389	"	9 00 33·510	135 08 22·65	59 37 28·66
White River.......	1902	0 38 17·627	Ottawa..........	5 11 07·649	85 16 54·73	48 35 11·53
Wilno.............	1900	0 07 24·676	"	5 10 11·698	77 33 40·17	45 30 54·46
Windsor...........	1910	0 29 19·499	Dom. Obs.........	5 32 11·182	83 02 52·23	42 18 58·31
Winnipeg..........	1910	1 25 43·279	"	6 28 35·262	97 08 48·93	49 53 10·98
Woodstock (Ont.).	1903	0 20 14·841	Ottawa...........	5 23 04·863	80 46 12·94	43 08 07·62
Woodstock (N.B.).	1908	0 32 32·979	Dom. Obs.........	4 30 19·004	67 34 45·06	46 08 33·28
Yarmouth.........	1909	0 38 23·205	Dom. Obs.........	4 21 28·778	66 07 11·67	43 50 14·75

LOCAL POSITIONS OF ASTRONOMICAL STATIONS.

Bancroft.—The pier is 99.8 feet west and 220.8 feet north of the centre point of the crossing of Station street and the Central Ontario railway.

Barry Bay.—The pier is about 200 feet south of the Grand Trunk railway station-house and is 106.9 feet south and 1.1 feet east of the northeast corner of the Balmoral hotel.

Bathurst.—The pier is 54.1 feet west and 79.2 feet north of the southeast corner of King and Water streets, town of Bathurst.

Beeton.—The astronomical station is 100 feet west of the west side of Patterson street and 78 feet north of the north side of Main street. Patterson street is a road allowance between lots 10 and 11. Main street is a road allowance between concessions 7 and 8 in the township of Tecumseth.

Black Lake.—The pier is 111.1 feet east and 190.8 feet north of the northwest corner of Whitney avenue and the private way of the American Asbestos Company.

Boiestown.—The pier is 41.63 feet east and 90.87 feet north from the northeast corner of T. Lynch & Co.'s supply store.

Boundary (Yukon).—The astronomical station is on the south bank of the Yukon river and is 352 feet east of the "Ogilvie Line" and about 20 feet south from the shore of the Yukon river.

Boundary (Waneta).—The pier is 24.5 feet due east of monument No. 181 on the international boundary line.

Calgary.—The astronomical station is 1 chain 56 links south of the centre line of the main line of the Canadian Pacific railway, and 2 chains 49 links north of the northeast corner of town lot No. 11 in block 69. The meridian through the observatory passes 37½ links east of said northeast corner of lot 11.

Campbellton.—The pier is 18.27 feet east and 12.41 feet south of the southeast corner of the post office building.

Canoe Lake.—The astronomical station is 371 feet due south of the centre line of the Ottawa and Parry Sound railway, 526 feet due west from the division line between lots Nos. 20 and 21 in the 14th concession in the township of Peck.

Chalk River.—The astronomical station is on a slight knoll on the sandy expanse south of the Canadian Pacific railway track and distant 1885.7 feet on a course south 56° 15′ east from the original post on the north side of the road allowance between concessions 8 and 9 and between lots 1 and 2 in the township of Buchanan; it is also distant 457.6 feet due south from the centre line of the main line of the Canadian Pacific railway. It may be mentioned that the old or first Canadian Pacific railway station was considerably east (several miles) of the present one.

Chapleau.—The pier is 174.7 feet west and 432.3 feet south of the railway crossing sign-board of the Canadian Pacific railway. This crossing is about 300 feet west of the Canadian Pacific railway station-house.

Charlottetown.—The pier is situated off Water street 94.13 feet south and 19.73 feet west of the northwest corner of the stone verandah of Richard Grant's house.

LOCAL POSITIONS OF ASTRONOMICAL STATIONS—*Continued.*

Cobourg.—The astronomical station is situated 63 feet north of University avenue, 243 feet east of the east side of College street produced northerly, and 81 feet 6 inches due south of the centre of the dome of Faraday Hall.

Cochrane.—The pier is 24.8 feet west and 173.6 feet north of the southeast corner of Second street and Third avenue, town of Cochrane.

Coutts.—The pier is 5803.8 feet south and 3514.9 feet east of triangulation station "Tenant," of the International Boundary Survey.

Covey Hill.—The astronomical station is situated on township lot 34 in range 1 of the township of Havelock; owned by Mr. John Waddell. The station is marked by an iron bolt in the solid rock, two feet below the surface, over which a cairn of stones was erected. The azimuth to monument 681 on the international boundary is 135° 07′, and the distance 7716.1 feet. It is on the highest part of Covey Hill.

Dawson.—The pier is 168.3 feet east and 7.1 feet north of the southeast corner of the Administration Building.

Digby.—The pier is 7.03 feet south and 183.44 feet east of the stone foundation of the northeast corner of the entrance to the schoolroom of the Baptist church.

Dominion Observatory.—The meridian to which the longitudes are referred is that of the meridian circle in the transit annex.

Edmonton.—Here it was intended to occupy the Dominion Lands Survey latitude station (King) of 1877, but that being impracticable on account of excavation made there, the situation was established (observatory building) 70.2 feet southeast thereof, the azimuth being 120°.07. The 14th base line (Aldous, 1879) intersects the meridian of astronomical station (King, 1877) at 298.45 chains west of the northeast corner of township 52, range 24, west of the Fourth meridian (old system).

Edmundston.—The pier is 148.30 feet east and 12.04 feet north of the northeast corner of the Temiscouata railway station.

Emerson.—The pier is 1135.0 feet south and 43.5 feet east of the southeasterly corner of Morris and Second streets in the town of Emerson; also 411.3 feet due north of the international boundary line. The azimuth station is about one and one-half miles due south of the observatory; it is situated midway between Mr. Moise Pranteau's granary and implement house.

Erwood.—The pier is 729.5 feet north and 3035.1 feet west of iron post at northerly corner between sections 1 and 2, township 45, range 2, west of the 2nd meridian.

Father Point.—The astronomical station is on the property of J. McWilliams, immediately adjoining the lighthouse reserve. The centre of the pier is 125 feet 7 inches due south of the centre of the revolving light surmounting the lighthouse.

Field.—The astronomical station is situated on the north side of the Canadian Pacific railway track near and west of the Canadian Pacific railway hotel then building. It is distant 68 feet 8 inches from Canadian Pacific railway traverse station No. 93 in the year 1886.

LOCAL POSITIONS OF ASTRONOMICAL STATIONS—*Continued.*

Fort Frances.—The pier is 9.7 feet north and 189.2 feet east of the northeast corner of Fourth street and Cornwall avenue.

Foster.—The pier is 181.5 feet north and 480.3 feet west of the middle point of the crossing of the Bolton road and the Canadian Pacific railway main line (Foster crossing). The pier is about 80 feet north of the Canadian Pacific railway station-house.

Fredericton.—The pier is on the river front 52.15 feet north and 67.0 feet west of the northwest corner of Lamont's furniture warehouse at the corner of Regent and Campbell streets.

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.

Guelph.—The astronomical station is 150 feet west of Norfolk street and 85 feet north of Paisley street, Nelson crescent.

Haliburton.—The pier is 22.0 feet north and 32.9 feet west of the southwest corner of lot 3, block L, north side of Queen street, village of Haliburton.

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° 15′ from the meridian measured from the north through the west.

Harriston.—The astronomical station is 108 feet south of Queen street, and 148 feet east of Union street.

Jackfish.—The pier is 228.5 feet north and 82.9 feet west of the southwest corner of the Canadian Pacific railway station-house.

Kalmar.—The position of astronomical station is on the sloping hillside west of the railway station, since rebuilt, and on the north side of the Canadian Pacific railway due north 88 feet $5\frac{1}{2}$ inches from the centre line thereof.

Kamloops.—The astronomical station is on the intersection of the middle lines of Victoria avenue and Fifth street of the new townsite.

Kingston.—The observatory is situated on the Royal Military College grounds on Point Frederick, about 200 feet from Cataraqui bay. It is used in connection with the work of the college.

Labelle.—The pier is 1685 feet east and 82 feet south of the middle point of crossing of the Canadian Pacific railway and Berthiaume road. This crossing is about 470 feet east of the Canadian Pacific railway station-house.

Lake Edward.—The pier is 332.4 feet east and 40.6 feet north of the northeast corner of the Quebec and Lake St. John railway station-house.

LOCAL POSITIONS OF ASTRONOMICAL STATIONS—*Continued.*

Lindsay.—The astronomical station is on the right-of-way of the Canadian Pacific railway, 10.7 feet west and 172.8 feet north of the northwest corner of the Canadian Pacific railway station-house.

Liskeard.—The observatory pier is 25.5 feet south and 836.6 feet west of an iron post which is 145 feet S. 5° 20′ W. of the southwest corner of the Timiskaming and Northern Ontario railway station-house.

Lloydminster.—The pier is 378.0 feet west and 2155.1 feet north of the northeast corner of section 36, township 49, range 1, west of the 4th meridian.

Macdowall.—The pier is 2365.9 feet south and 1986.8 feet west of the northeast corner of section 13, township 46, range 1, west of the 3rd meridian.

Madoc.—The pier is 113 feet west and 123 feet north of the northwest corner of Durham and St. Lawrence streets.

Maniwaki.—The observatory pier is 112.8 feet south and 69.8 feet west of the southwest corner of the Canadian Pacific railway station-house.

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 Fifth avenue and Railway street.

Mattawa.—The pier is 119.6 feet west and 56.2 feet south of the southwest corner of the Canadian Pacific railway station-house.

Megantic.—The pier is 172.5 feet east and 72.6 feet north of the southwest corner of Maple avenue and McCauley street.

Michipicoten.—The pier is 45 feet north and 104 feet west of the northwest corner of the Algoma Inn.

Midway.—The astronomical station is situated about 100 feet south of the Canadian Pacific railway station (dwelling and ticket office) and 607½ feet in azimuth 255° 37′ from the point on the east side of Adams street, 15⅓ feet south of the south side of Eleventh street.

Moncton.—Reference point is the northwest corner of the Intercolonial railway blacksmith shop N. 52° 16′ E. from meridian through centre of pier. Distance 4.378 chains.

Mortlach.—The pier is 1114.7 feet south and 3583.2 feet west of the northeast corner of section 22, township 17, range 1, west of the 3rd meridian.

Mulgrave.—The pier is situated 10.51 feet north and 60.59 feet west of the northwest corner of Mr. Kawaga's house.

Newcastle.—The pier is 11.16 feet east and 90.66 feet south of the intersection of Station and Gene streets.

Nipigon.—The pier is 47.8 feet west and 82.4 feet north of the northwest corner of the Canadian Pacific railway station-house.

North Bay.—The astronomical station is situated on the property of the Canadian Pacific railway. The pier is 283.5 feet south and 109.5 feet west of the northwest corner of Main and Sherbrooke streets.

LOCAL POSITIONS OF ASTRONOMICAL STATIONS—*Continued.*

North Lake.—The pier is 272.5 feet east and 15.5 feet south of "frog" lying between the Port Arthur and Duluth railway main line and the southwest leg of the "Y".

North Portal.—The pier is 33.6 feet east and 0.7 feet north of the boundary monument situated on the international boundary line between the villages of Portal, N.D., and North Portal, Sask. The azimuth pier is due north of the observatory pier a distance of about one-half mile.

Onion Lake.—The astronomical station is situated 4 chains in azimuth 95°.81 from the point on survey line of Fourth meridian, 19.685 chains north of the southeast corner of township 55, and 3 feet south of the government telegraph line (the wire running over the observatory).

Orillia.—The astronomical station is 174½ feet south of Mississaga street, and 87½ feet east of Peter street.

Ottawa.—The observatory is at the northerly end of lot No. 7 on the north side of Cliff street, and at the edge of the perpendicular cliff overlooking the Ottawa river.

Owen Sound.—The astronomical station is distant southwesterly 215.96 feet on the course making an angle of 57° 33′ with the westerly side of Poulett street from the intersection of that side of Poulett street with the southerly side of Baker street.

Pembroke.—The pier is 98.2 feet north and 167.5 feet east of the intersection of the easterly limit of John street with the southerly limit of Wellington street.

Percé.—The pier is 84.63 feet west and 72.28 feet south of the southwest corner of Abraham Lenfesty's house.

Pickerel.—The pier is on a rocky knoll south of the Canadian Pacific railway main line and nearly opposite the station. The centre of the pier is 90.8 feet south and 60.1 feet east of the southeast corner of the Canadian Pacific railway station-house.

Pincher.—The pier is 555.0 feet south and 14.0 feet west of the northeast corner of section 34, township 6, range 30, west of the 4th meridian.

Port Arthur.—The pier is 77.6 feet north and 48.2 feet east of the northwest corner of Arthur street and South Water street.

Port Moody.—The astronomical station is 80 feet south of the centre line of the Canadian Pacific railway, 28 feet 10 inches southwest from a lot-stake marked L.18, and 25 feet 6 inches west from the centre of the plank road leading across the railway to the Elgin hotel.

Portneuf.—The astronomical station is 21,667.11 feet in azimuth 298° 40′ 54″.3 or N. 61° 19′ 05″.7 W. from monument No. 31 of the St. Lawrence River Survey.

Port Stanley.—The position of the astronomical station is on the property known formerly as a "Ship-yard" lying along the east side of Kettle creek, and to the west side of lots 1, 2 and 3 fronting on the west side of Main street.

LOCAL POSITIONS OF ASTRONOMICAL STATIONS—*Continued.*

Rainy River.—The pier is 111.2 feet north and 51.3 feet west of the southwest corner of Third street and Atwood avenue.

Rayside.—The astronomical station is situated on the farm of John Carrière, on lot 3, concession 1, township of Rayside, and distant 605.8 feet west from the division line between lots 2 and 3, and 141.4 feet north of the centre line of the Canadian Pacific railway.

Renfrew.—The astronomical station is situated north of the Canadian Pacific railway station, about 210 feet north of the main line. The pier is 75 feet north and 77.7 feet east of the southwest corner of Joe and Janet streets.

Revelstoke.—The astronomical station is 134 feet 10 inches to the north of the centre line of the Canadian Pacific railway, and 128 feet 8 inches on a course north 37° 29′ east from Canadian Pacific railway traverse station No. 1064 of the year 1886.

Rivière-à-Pierre.—The pier is 120.2 feet west and 39.3 feet north of the northwest corner of the Quebec and Lake St. John railway station-house.

Rivière-du-Loup.—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° 54′.

Rivière Ouelle.—The observatory pier is 48.7 feet south and 180.3 feet east of the first mooring post on the east side of the wharf. It is also about 70 feet from the Intercolonial railway crossing at the end of the wharf.

Roberval.—The pier is 138.2 feet north and 47.1 feet west of the middle point of crossing of the Quebec and Lake St. John railway and the Roberval road.

Rose Point.—The point of observation is on the north side of the railway track in the southeast corner of the garden of the Rose Point hotel, and 50 feet east of the road leading to the village of Parry Harbour. It is distant 196 feet at right angles to the township lot line running N. 20° 51′ 40″ W. (Beatty) at the point distant along the lot line 693 feet from the centre line of the Ottawa and Parry Sound railway.

Sault Ste. Marie.—The pier is 51.78 feet south of the southwest corner of Queen street and Bell avenue.

Scotia Junction.—The pier is about one-half mile east of the Grand Trunk railway station-house and is 249.4 feet north and 7.5 feet east of the sign-post at the Grand Trunk railway crossing.

Selkirk.—The pier is 32 feet east and 22.5 feet south of the northeast corner of the Government Telegraph office.

Sharbot Lake.—The astronomical station is on a hill north of the Canadian Pacific railway station. The pier is 385 feet north and 73.5 feet west of the west corner of the Canadian Pacific railway station-house.

Shippigan.—The pier is 309.3 feet south and 2643.1 feet west of the southwest corner of the shore end of the curb lying on the west side of Shippigan wharf. It is also 793.1 feet south and 1041.4 feet west of the main spire of the Roman Catholic church.

LOCAL POSITIONS OF ASTRONOMICAL STATIONS—*Continued.*

Sorel.—The pier is 194.9 feet west and 34.2 feet north of the southeast corner of Ray and Victoria streets.

Sprague.—The pier is 670.7 feet west and 1.4 feet north of the southwest corner of the Canadian Northern railway station-house.

Ste. Anne-de-Bellevue.—The astronomical station is about 300 feet south of the Canadian Pacific railway station. The pier is 1552.22 feet N. 12° 12′ 15″ E. from main triangulation station 5 on end of guard pier at the lower entrance of the new lock.

St. Catharines.—The astronomical station is situated on the property of the St. Catharines Gas Company at the corner of Phelps and Mill streets. The pier is 191.5 feet north and 94 feet east of the northeast corner of Phelps and Mill streets.

St. Hyacinthe.—The pier is 85 feet east and 546 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.

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.

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°.44 right from meridian at centre of pier to reference point. Distance 196.8 feet.

Stonyplain.—The pier is 4102.6 feet south and 1197.8 feet west of iron post at the northeast corner of section 36, township 52, range 1, west of the 5th meridian.

Sutton.—The astronomical station is situated on the right-of-way of the Grand Trunk railway. The pier is 65.7 feet south and 111.2 feet west of the southwest corner of the Grand Trunk railway station-house.

Sydney.—The pier is on the esplanade 49.24 feet south and 89.66 feet west of the northwest corner of the Sydney hotel.

Tadoussac.—The astronomical station is on the premises of the Richelieu and Ontario Navigation Company, to the rear of their hotel. The meridian through the centre of the pier passes one foot west of the flag-pole over the tower of the main or office entrance to the hotel, and the flag-pole is 211 feet south of the pier.

Tantalus.—The pier is 150.8 feet north and 32 feet west of the northwest corner of the Northwest Mounted Police barracks.

Three Rivers.—Astronomical station at Station No. IX. of the St. Lawrence River Hydrographic Survey.

Timagami.—The astronomical station is situated on the right-of-way of the Timiskaming and Northern Ontario railway. The pier is 316 feet south and 219.6 feet west of the southwest corner of the Timiskaming and Northern Ontario railway station-house.

LOCAL POSITIONS OF ASTRONOMICAL STATIONS—*Concluded.*

Trenton.—The astronomical station is on the right-of-way of the Central Ontario railway. The pier is 173 feet south and 83 feet east of the southeast corner of the Central Ontario railway station-house.

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 at the hinge end of Mr. Fraser's driveway gate.

Vancouver.—A permanent observatory was built on Brockton Point close to and southeast of the lighthouse.

Victoria.—The astronomical station is situated 7 feet 5 inches east of Broad street and 17 feet 6 inches south of View street, being in the northwest corner of the garden of the Driard hotel.

P.S.—Subsequently the hotel was extended to Broad street.

Walsh.—The pier is 1128.9 feet south and 2896.5 feet west of the wooden post marking the northeast corner of the southeast quarter of section 35, township 11, range 1, west of the 4th meridian.

Wapella.—The position of the astronomical station is on a knoll south of the Canadian Pacific railway and 5 chains 85 links southwesterly from the southwest corner of the railway station. It is definitely fixed by triangulation from the second meridian of the Dominion Lands survey.

Whitby.—The pier is 198 feet north and 159.3 feet east of the northeast corner of Brock and Colborne streets.

Whitehorse.—The pier is just behind the Government Telegraph office, and is 336.1 feet north and 379.7 feet west of the middle point of crossing of Main street and the White Pass and Yukon railway.

White Pass.—The pier is 111.1 feet north and 45.9 feet west of the bronze monument on the Canada-Alaska boundary line at summit of White Pass.

White River.—The astronomical station is on the sandy ridge south of the railway station, and distant 98½ feet due east of the centre line of the main track of the Canadian Pacific railway, from the point distant 183 feet north along the track from the "east switch," where the White River railway division begins.

Wilno.—The astronomical station is 766 feet due north of the centre line of the Ottawa and Parry Sound railway and 653 feet on a course N. 73° 38′ W. from the intersection of the lines separating the 4th and 5th concessions of the townships of Sherwood and Hagarty.

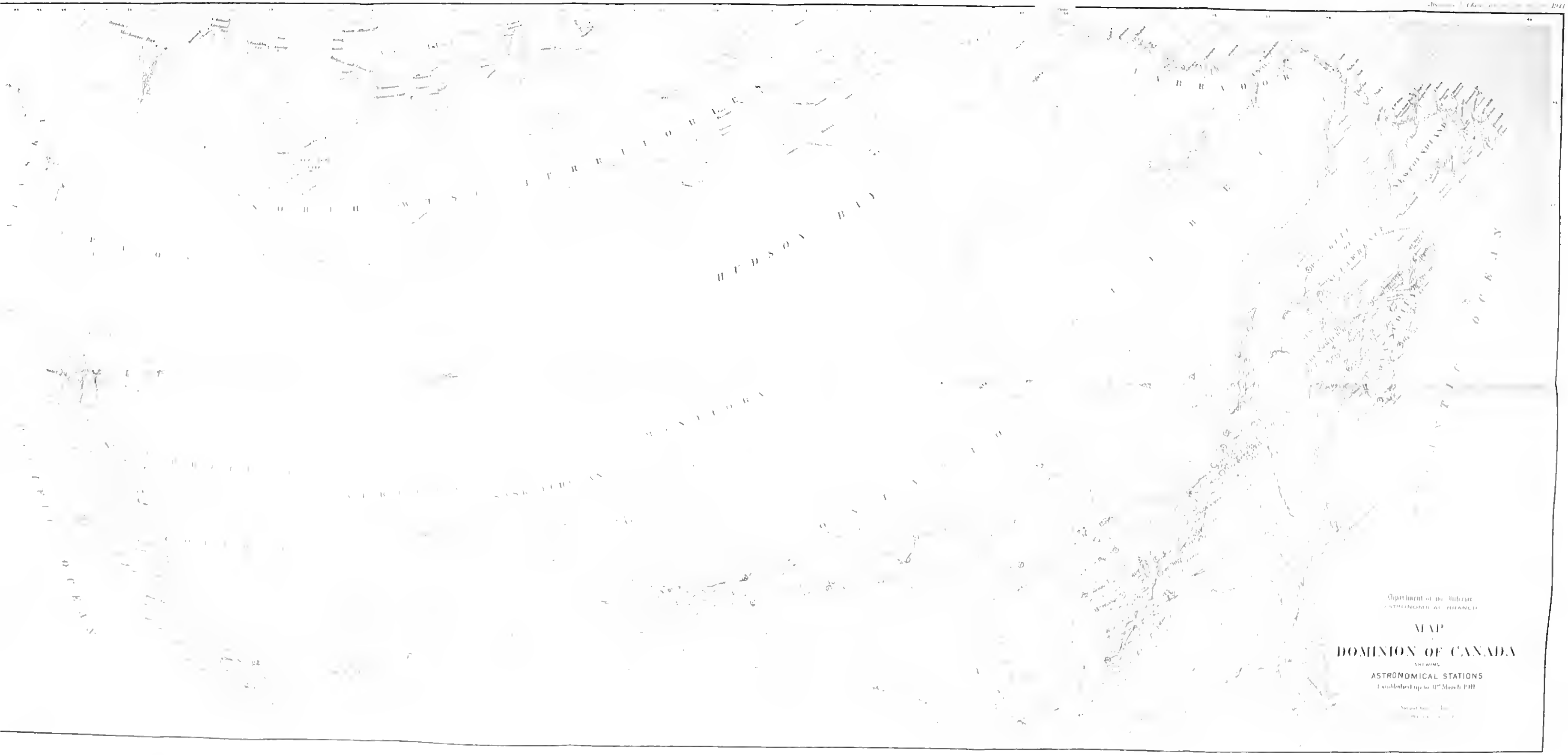
Windsor.—The pier is 33.3 feet east and 246.8 feet south of the southwest corner of Sandwich street west and Caron avenue in the city of Windsor.

Winnipeg.—The pier is on the Fort Osborne barracks ground near the southwest corner of the drill hall.

Woodstock, Ont.—The astronomical station is situated within the city limits of Woodstock, on land owned by the corporation on the north side of Admiral street, 21 feet west of the produced westerly limit of Givins street. It is marked by a concrete pier.

Woodstock, N.B.—The pier is 432.5 feet east and 100 feet south of the northeast corner of George and Main streets.

Yarmouth.—The pier is on Mr. Jacob Bingie's vacant lot, corner of Water and Townsend streets, 258.96 feet west and 64.78 feet north of the stone post at the southwest corner of Mr. James Lovett's property corner of Main and Townsend streets.



HUDSON BAY
MAP
DOMINION OF CANADA
ASTRONOMICAL STATIONS

APPENDIX 5.

REPORT OF THE CHIEF ASTRONOMER, 1911.

STATEMENT OF WORK PERFORMED IN THE PHOTOGRAPHIC DIVISION.

BY

J. D. WALLIS.

APPENDIX 5.

STATEMENT OF WORK DONE IN THE PHOTOGRAPHIC DIVISION.

Sizes	4¼" x 6½"	5" x 7"	8" x 10"	5" x 14"	11" x 14"	16" x 20"	20" x 24"	24" x 36"	30" x 40"	40" x 60"	9" x 36"	Total
Negatives.....	661	152	170	45	63	51	....	....	....	....	....	1445
Prints........	....	1586	198	193	580	217	45	23	51	27	383	3603
Total.....	661	1738	968	238	643	268	45	23	51	27	383	5048

J. D. WALLIS,
Photographer.

DEPARTMENT OF THE INTERIOR

ANNUAL REPORT

OF THE

TOPOGRAPHICAL SURVEYS BRANCH

1911 - 1912

PRINTED BY ORDER OF PARLIAMENT.

OTTAWA
PRINTED BY C. H. PARMELEE, PRINTER TO THE KING'S MOST
EXCELLENT MAJESTY
1913

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REPORT

OF THE

SURVEYOR GENERAL OF DOMINION LANDS

1911-1912

DEPARTMENT OF THE INTERIOR,
TOPOGRAPHICAL SURVEYS BRANCH,
OTTAWA, August 14, 1912.

The Deputy Minister of the Interior,
Ottawa.

SIR,—I have the honour to submit the following report of the Topographical Surveys Branch for the year ended March 31, 1912.

Surveys were continued throughout the year in the western provinces, and subdivision was extended northerly into the Peace River block. Seventy-six parties were employed but only seventy-three of these worked the whole season, three parties being engaged for a short time only. The surveyors working under contract numbered thirty-four and were engaged on subdivision and timber berth surveys while the forty-two employed by the day were engaged on subdivision, resurvey and miscellaneous work of various kinds.

The spring and early summer of 1911 was abnormally wet and was the cause of much delay as surveyors had much difficulty in reaching the scene of operations. The surveyors report that the continued wet weather affected the proper ripening of the grain and that some low grade wheat was produced by being cut before it was properly ripened in order to escape frost.

The following statement shows the average number of miles of survey for each party during the last four years:—

1908	366 miles.
1909	412 "
1910	279 "
1911	280 "

One hundred and sixty-six whole townships and eight fractional townships were completely subdivided while a partial subdivision was made of three hundred and thirty others, and a resurvey either partial or complete was made of two hundred and twenty-five others.

The distribution of these parties by provinces is shown in the following table:—

Parties.	In Manitoba.	In Saskatchewan.	In Alberta.	In British Columbia.	Partly in one province and partly in another.	Total.
Paid by the day	3	3	12	6	15	39
Under contract	3	16	13	—	2	34
Parties engaged for a short time only	1	—	—	1	1	3
Totals	7	19	25	7	18	76

SURVEY OF BLOCK OUTLINES.

Seven surveyors were employed in running base lines and initial meridians in Manitoba, Saskatchewan and Alberta while three others were similarly employed in the Peace River block.

Mr. T. H. Plunkett, D.L.S., completed the survey, levels and building of mounds along portions of the fifth meridian and the twenty-eighth and twenty-ninth base lines west of the fifth meridian. These lines were run in 1910 by Mr. A. W. Ponton, D.L.S., but the ground was so wet that mounds could not be built. Mr. Plunkett reports last season's rains as being the heaviest in twenty years, but he succeeded in getting the low-lying portions of the lines mounded before the heavy rains set in.

The twenty-second base line was run west from the fifth meridian one hundred and twenty miles by Mr. A. H. Hawkins, D.L.S. He lost twenty days through wet weather and reports rain on ninety days out of one hundred and fifty-eight. The base line runs through fairly level country which has been overrun by fire and could be cultivated without very much expense in clearing. No hills over one hundred feet high were encountered on the line.

Mr. G. H. Blanchet, D.L.S., ran the twenty-third base line from the fourth to the fifth meridian. Upon the completion of this work he moved directly to the nineteenth base line between the same meridians and began the production of this line west from range 5.

Latitude observations were taken on the principal meridian and on the fourth meridian by Mr. J. A. Fletcher, D.L.S. The correct survey of the initial meridians is of the utmost importance as it is from these the base lines, which govern the township subdivision, are run. The southern portions of the meridians were run a number of years ago when the degree of accuracy under which work at the present time is done, could not be obtained by surveyors with the equipment at their disposal. Latitude observations were, therefore, necessary to detect and correct errors which might have occurred in the original surveys. Observations were taken at two places on the principal meridian, on the north shore of lake Winnipeg in township 48 and on the south shore in township 35. On the fourth meridian observations were also taken at two places in township 89 at the crossing of Clearwater river and in township 62 on the south shore of Cold lake.

Part of the seventeenth base line west of the third meridian was run by Mr. A. Saint Cyr, D.L.S. He also made a restoration survey of part of the fourth meridian south to the sixteenth base as the end of the seventeenth base fell in Cold lake and closing had to be effected on the adjoining base line. The country crossed by the seventeenth base line is fairly well wooded east of the crossing of Beaver river, but west from the river it is low and swampy.

Mr. E. W. Robinson, D.L.S., surveyed a portion of the second meridian and ran a portion of the fifteenth base line westerly therefrom. Along the second meridian the land is low and swampy while muskegs are numerous. They have, however, a hardpan bottom and none of them are of the floating variety. Although the temperature was at 80° Fahr. frost was encountered when digging the pits as the dry mossy surface absorbs the heat and acts as a very efficient non-conductor. With cultivation and drainage, however, this disadvantage will doubtless disappear.

Mr. A. W. Ponton, D.L.S., surveyed the principal meridian from the thirteenth to the sixteenth base line. He reports the country through which the line runs to be low, wet and swampy, with occasional outcroppings of rock. The surface, though mostly covered with trees of small dimensions is composed of black vegetable muck unsuited to agriculture.

Portions of the fourth meridian and of the twenty-fourth base line westerly therefrom were run by Mr. J. B. McFarlane, D.L.S. The fourth meridian was produced north to township 103. From township 95 north the soil is nine-tenths sandy with jackpine and small muskegs. Fires sweep over this district about once every decade as the muskegs are not large enough to stop them. The country is not adapted to agriculture on account of the sandy nature of the soil, and rain, though fairly plentiful, falls generally in small drizzly showers.

SURVEYS IN THE PEACE RIVER BLOCK.

The Peace River block is a rectangular tract of land containing 3,500,000 acres. It is situated in British Columbia adjoining the Province of Alberta and was granted to the Dominion by the Province of British Columbia in exchange for land in the railway belt which had been disposed of by the province before the belt was placed under Dominion control. It was selected after an exploration by Messrs. J. A. Macdonell and J. A. Belleau in 1905-06, but the outlines had never been run to define its exact location. The survey of these outlines was a somewhat difficult undertaking.

During the past season four surveyors, Messrs. J. R. Akins, D.L.S., Geo. McMillan, D.L.S., O. Rolfson, D.L.S., and L. Brenot, D.L.S., were employed in outlining the block and running base lines across it.

Mr. Akins ran the north boundary and assisted Mr. Brenot to complete the west boundary. He experienced great difficulties in transportation as the snow was deep till late in the spring. Unless a surveyor is on the ground early he cannot accomplish much work, the summer season being short in these high latitudes.

Mr. McMillan ran the twenty-first base west across the block. He was assisted on the western portion by Mr. Brenot and on reaching the western boundary Mr McMillan ran the portion south to the southwest corner of the block while Mr. Brenot ran the portion north. Mr. McMillan had set out for the survey of the base line as early as February and he experienced some very cold weather, the thermometer registering as low as $-55°$ Fahr. but towards the end of March the weather moderated sufficiently to allow of the commencement of operations.

Mr. Rolfson ran the twenty-second base line across the block. He also experienced much difficulty in the transportation of supplies as the ice on Peace river west of Dunvegan was not strong enough to carry freighters owing to the swift current in the river. The country crossed by the base line is fairly well woooded although there are occasional open patches of scrubby prairie.

A report on the surveys in the Peace River district containing a description of the country, surveyors' reports on townships and general information has been published in pamphlet form.

INSPECTION OF CONTRACT SURVEYS.

Surveys which are executed under contract must pass a rigid examination before being accepted. Five inspection parties under Messrs. P. R. A. Belanger, D.L.S., C. F. Miles, D.L.S., E. W. Hubbell, D.L.S., L. E. Fontaine, D.L.S., and G. J. Lonergan, D.L.S., were employed on inspection work during the past season. They also performed small miscellaneous surveys which happened to be in the vicinity of their work. It may be worthy of note that it was necessary to send an inspector into the Peace River district for the first time, to examine contract surveys. This shows at what a rapid rate settlement is advancing. Some of the townships inspected lie over 300 miles from the nearest railway.

Mr. Belanger inspected contract surveys in Manitoba and made some subdivision and traverse surveys at Pointe du Bois on Winnipeg river. He also surveyed a small settlement at Fisher Bay, the lots of which are all occupied by half-breed fishermen.

The inspection of contracts in Saskatchewan was done by Messrs. Miles and Hubbell, in the northwestern and north central portions respectively. Mr. Miles also made several miscellaneous surveys in the vicinity of his inspection work and subdivided a portion of the Cold Lake Indian reserve which was transferred to this Department by the Department of Indian Affairs.

Messrs. Fontaine and Lonergan were empl yed on inspection work in western and northwestern Alberta respectively. Mr. Lonergan's work extended into the Peace River district as twenty-eight townships were subdivided there under contract last year.

BRITISH COLUMBIA SURVEYS.

Surveys in the railway belt were continued under Messrs. W. J. Deans, D.L.S., J. E. Ross, D.L.S., C. H. Taggart, D.L.S., A. Lighthall, D.L.S., and A. V. Chase, D.L.S.

Mr. Deans completed several miscellaneous surveys and traverses; he also surveyed a number of timber berths north of Vancouver.

Mr. Ross subdivided land in the district south of Kamloops, while Mr. Taggart was employed on miscellaneous surveys north of Kamloops.

Mr. Lighthall did some levelling at Woodhaven on Bedwell bay in order to determine if the slopes would permit of changing the courses of some of the roads. He was also engaged on subdivision survey, timber berth survey and delimitation of a portion of the railway belt.

The examination of vacant lands in the Kamloops district, for purposes of classification into fruit land, farming land, grazing land, timber land and worthless land was continued by Mr. Chase. He also performed some miscellaneous subdivision in the vicinity of Lytton.

TOWNSHIP SUBDIVISION SURVEYS.

Subdivision surveys which were carried on in five hundred and four townships were executed by surveyors working under contract and also by some surveyors working under daily pay in localities where contract rates would not apply.

Some miscellaneous subdivision at Le Pas in northern Manitoba was done by Mr. A. L. MacLennan, D.L.S. He also surveyed a booming site on Carrot river applied for by the Finger Lumber Co.

Messrs. W. A. Scott, D.L.S., and J. Francis, D.L.S., were engaged on miscellaneous subdivision and surveys of coal claims in southwestern Alberta.

Mr. C. M. Walker, D.L.S., made a survey of land required for power purposes on Elbow river and subdivided portions of townships in southwestern Alberta.

Subdivision of lands through which the Alberta Coal branch of the Grand Trunk Pacific railway runs and surveys of coal claims in the same vicinity were made by Mr. A. L. McNaughton, D.L.S.

CORRECTION, RESTORATION AND MISCELLANEOUS SURVEYS.

Mr. A. L. Cumming, D.L.S., retraced two townships in the Cypress hills in order to determine the true bearings of the lines and to renew the monuments, replacing the old wooden posts by iron posts. He also made several small miscellaneous surveys in southern Alberta.

Mr. P. B. Street, D.L.S., subdivided some lands in the foot-hills of the Rocky mountains in southwestern Alberta in order to enable the Department to dispose of some coal lands and mineral claims near Pincher Creek. He also made several miscellaneous surveys in this vicinity and traversed a portion of Icelandic river in eastern Manitoba.

A correction survey of several townships in central Alberta was done by Mr. H. Matheson, D.L.S. These townships were partly subdivided under contract in 1908, and owing to difficulties in securing supplies the contractor did not complete the subdivision. Although the contractor was requested to return and finish the work, it was never satisfactorily done and Mr. Matheson was instructed to complete it.

Mr. C. F. Aylsworth made a subdivision into lots of the land around Max lake in Turtle Mountain forest reserve and Fish lake in Moose Mountain forest reserve for summer resort purposes.

Mr. C. Rinfret, D.L.S., destroyed duplicate monuments in a number of townships subdivided in 1883 in the vicinity of Moosejaw. He also resurveyed some townships near Maple Creek and towards the close of the season performed a number of miscellaneous scattered surveys.

Messrs. G. A. Bennett, D.L.S., E. S. Martindale, D.L.S., and R. C. Purser, D.L.S., were engaged on miscellaneous scattered resurveys, correction surveys, traverses and investigation of reported errors in Manitoba, Saskatchewan and Alberta.

Settlement surveys were made by Mr. H. S. Day, D.L.S., along the Athabaska at Pelican, Grand Rapids, McMurray, McKay and Chipewyan.

Mr. P. A. Carson, D.L.S., made a stadia traverse of a portion of North Lillooet river.

Mr. A. W. Ashton, D.L.S., surveyed a cemetery site near Blairmore and also performed some miscellaneous surveys near Lytton.

An investigation of old surveys near Deloraine which was urgently required was made by Mr. T. S. Nash, D.L.S., of the office staff.

Messrs. W. T. Thompson, D.L.S., and H. K. Moberly, D.L.S., were employed on the survey of timber berths.

The easterly portion of the triangulation survey in the railway belt was retraced by Mr. M. P. Bridgland, D.L.S. He renewed the monument at station I on the fifth meridian, erected by Mr. W. S. Drewry, D.L.S., in 1890, and re-established all the stations westerly to the summit of the Rockies. He also connected the triangulation with the monuments of the Dominion Lands system, wherever possible, and, although he failed to locate the monuments on the sixth meridian, as they had been destroyed by fire and lumbering operations, he found the nearest existing monument two miles farther west and tied it to the triangulation. A thoroughly reliable tie has thus been established by means of the triangulation between the fifth and sixth meridians. Mr. Bridgland also investigated surveys west of Calgary.

Mr. J. N. Wallace, D.L.S., who is in charge of levelling operations ran lines northerly from Prince Albert and Lloydminster. This survey was necessary to connect the levels already taken along the third and fourth meridians and adjoining base lines with the elevations along the railway which are at present the only available source of information in the western provinces regarding sea-level. The line of levels run northerly from Prince Albert is thirty miles while that northerly from Lloydminster is eighty-three miles.

YUKON SURVEYS.

Mr. F. H. Kitto, D.L.S., a member of the Topographical Surveys staff at Ottawa, was sent to Dawson to take charge of the survey office of the Yukon Territory upon the resignation of the former director.

Under the direction of the Commissioner of the Yukon Territory, Mr. Kitto undertook the reorganization of that office, in addition to the routine work which consists of giving information to the public, making blue-prints, tracings and sketches, mounting maps, writing descriptions, correspondence, examining and filing of plans and field notes.

At the request of the Commissioner, group lots and placer claims were surveyed by Mr. Kitto, and the revenue derived therefrom was transferred to the revenue of the Yukon Territory.

Alterations were made in the layout of the office and the lighting overhauled and improved.

In addition to the routine and reorganization work of the office, Mr. Kitto carried on a triangulation survey from Dawson up Klondike river about thirty miles. He also spent eighteen days in the field looking up various locations of trails, base lines and lot posts, for the information of the Territorial and Gold Offices.

Mr. H. G. Dickson, D.L.S., completed his survey under contract of the Carmack's reference traverse from the Nordenskiold valley to Jarvis creek in the Kluane District.

The staff of the Dawson office consists of three draughtsmen.

PHOTO-TOPOGRAPHIC SURVEYS.

Mr. Arthur O. Wheeler, who was formerly topographer on the surveys staff and is now director of the Alpine Club of Canada, made a photo-topographic survey of Mount Robson and the mountains of the continental divide north of the Yellowhead pass on the Grand Trunk Pacific railway. This survey was undertaken for the Grand Trunk Pacific Railway Co., the British Columbia and Alberta Governments and the Alpine Club. Mr. Wheeler offered to place the results of the survey at the disposal of the Department of the Interior provided the Department would assist by the loan of surveying instruments, by furnishing, developing and printing the photographic plates and by preparing the map for photo-lithography. The map, which contains much valuable information, obtained at a trifling cost, on a region hitherto unexplored, accompanies this report.

STATEMENT OF MILEAGE SURVEYED.

The following is a comparison of the mileage surveyed each year since 1909:—

Nature of Survey.	April 1, 1909, to March 31, 1910.	April 1, 1910, to March 31, 1911.	April 1, 1911, to March 31, 1912.
	Miles.	Miles.	Miles.
Township outlines	2,089	2,376	2,041
Section lines	16,326	11,849	10,098
Traverse	2,413	2,758	2,577
Resurvey	3,876	906	2,317
Total for season	24,704	17,889	17,033
Number of parties	60	64	61
Average miles per party	412	279	280

The following tables show the mileage surveyed by the parties under daily pay and by the parties under contract:—

WORK OF PARTIES UNDER DAILY PAY.

Nature of Survey.	April 1, 1909, to March 31, 1910.	April 1, 1910, to March 31, 1911.	April 1, 1911, to March 31, 1912.
	Miles.	Miles.	Miles.
Township outlines	861	1,178	992
Section lines	1,066	1,487	823
Traverse	1,324	462	498
Resurvey	3,808	835	2,237
Total for season	7,059	3,962	4,550
Number of parties	34	30	29
Average miles per party	208	132	157

WORK OF PARTIES UNDER CONTRACT.

Nature of Survey.	April 1, 1909, to March 31, 1910.	April 1, 1910, to March 31, 1911.	April 1, 1911, to March 31, 1912.
	Miles.	Miles.	Miles.
Township outlines	1,228	1,198	1,049
Section lines	15,260	10,362	9,275
Traverse	1,089	2,296	2,079
Resurvey	68	71	80
Total for season	17,645	13,927	12,483
Number of parties	26	34	32
Average miles per party	679	410	390

Owing to the nature of their work, fifteen parties are not included in the statement of mileage for the year ended March 31, 1912.

COST OF SURVEYS.

The following statement shows the average cost per mile of surveys executed by surveyors under daily pay and by surveyors under contract:—

—	Surveyed under daily pay.	Surveyed under contract.
Total mileage surveyed	4,550	12,483
Total cost	$380,943	$334,304
Average cost per mile	$83.72	$26.78

RECIPROCITY AMONG SURVEYORS.

As the outcome of a conference of surveyors held in Melbourne in 1892, the examination of land surveyors in New Zealand and in the several States of Australia is conducted by a common examining board and the surveyors who are admitted have the right to practise their profession in all parts of Australia and New Zealand.

In 1900, a formal invitation was received from the New Zealand Institute of Surveyors to join in this arrangement on behalf of Canada. Some correspondence was also exchanged with the Surveyor General of New Zealand on the same subject. It was explained to them that the surveyors of each Canadian province had formed associations which were incorporated by the provincial legislatures, and that there was no reciprocity among these different bodies. There was little prospect of joining Australia and New Zealand in reciprocal arrangements before such arrangements were made between the several Canadian associations.

At the Colonial conference of 1907, a motion was submitted by the Governor of New Zealand for establishing reciprocity among land surveyors throughout the Empire. The motion was discussed and adopted after amendment. It states that it is desirable that reciprocity should be established and commends it to the favourable consideration of the several governments.

In order to be admitted as a Dominion Land Surveyor, it is necessary to pass a preliminary examination for admission as a pupil. After three years' service, the pupil is entitled to present himself for final examination for a commission as a Dominion Land Surveyor. At the time of the Colonial Conference (1907), the law authorized a land surveyor licensed in any part of the Empire to present himself for final examination as a Dominion Land Surveyor after one year's service, without having to pass the preliminary examination.

In 1908, the Dominion Lands Surveys Act was passed by Parliament. Advantage was taken of the occasion to introduce an amendment with a view to giving effect to the desire expressed by the Colonial Conference if satisfactory arrangements could be made. The amendment authorized the Board of Examiners if they considered it advisable to do so, to dispense with the final examination of land surveyors from any particular part of the Empire. This amendment was strongly objected to in the Senate on behalf of the Ontario and Quebec land surveyors. Not only was the amendment withdrawn, but the whole section was struck out. Land surveyors from elsewhere than Canada have no longer any special privileges under the present law.

Representations against the new law were made by the Surveyors' Institution of Great Britain, who brought the matter to the attention of the Colonial Office. At their instance, His Majesty's Government invited the Dominion, Commonwealth, State and Provincial Governments to a conference of the Surveyors General of the Colonies, to be held in London on October 24, 1910. The invitation was accepted by the Dominion Government, but declined by all the Provincial Governments in Canada. It was also declined by Newfoundland and by the Union of South Africa. The Commonwealth of Australia, the Australian States and New Zealand asked a postponement of the date of the conference, which was accordingly fixed for the 30th May, 1911.

The delegates at the conference were:—Right Hon. Sir George Reid, P.C., G.C.M.G., K.C., High Commissioner for Australia, representing the Commonwealth; A. A. Spowers, Surveyor General of Queensland, and E. A Counsel, Surveyor General of Tasmania, representing New Zealand and the Australian States, with the exception of South Australia; E. Deville, LL.D., representing the Dominion of Canada; Col. S. C. N. Grant, C.B., C.M.G., R.E., Director General of the Ordnance Survey, A. Siemens, President, and five other members of the Institution of Civil Engineers; W. Edgar Horne, M.P., President, and five other members of the Surveyors' Institution.

The proceedings were opened by Lord Lucas, Under Secretary of State for the Colonies. Colonel Sir Duncan Johnston, K.C.M.G., C.B.R.E., late Director General of the Ordnance Survey, was elected chairman, and Mr. A. Goddard, secretary to the Surveyors' Institution, undertook the duties of secretary.

In order that the position of Canada should not be misunderstood, the Surveyor General of Dominion Lands at the first meeting submitted the following statement:—

When the Canadian Confederation was formed, in 1867, there were two Licensing Boards for Land Surveyors: one in Toronto, for the Province of Ontario, and one in Quebec, for the Province of Quebec. The requirements of the two Boards were very much alike, *viz.*, a preliminary examination, three years' service as a pupil under articles, and a final examination. By the British North America Act, property and civil rights had been placed under the control of the Provinces: no one was allowed to make land surveys unless he was a Provincial Land Surveyor.

At that time, the North West Territories were bought by the Dominion Government from the Hudson's Bay Company. These lands being the property of the Dominion and outside of the Provinces, were not under Provincial control, but Provincial Land Surveyors were at first employed for their subdivision because no others were available. In 1872, the need of better control over the surveyors of Dominion lands led to legislation creating Dominion Land Surveyors and a Board of Examiners for their admission. All Provincial Land Surveyors in 1872 were made Dominion Land Surveyors by the new Act. For some years there was reciprocity between the three Boards, but as each one was acting independently, grave abuses arose, and the arrangement was discontinued.

Meanwhile, the Province of Manitoba had been formed out of a part of the Northwest Territories. The Ontario and Quebec Land Surveyors had each the exclusive right to make land surveys within their own Provinces; likewise the Dominion Land Surveyors had similar rights within Manitoba and the Northwest Territories. The other Provinces had no licensed surveyors and the practice of the profession was free.

After 1883, there was a period of dullness in the land business of Manitoba. In order to improve their prospects, the Dominion Land Surveyors of Manitoba formed an association, were incorporated by their legislature as Provincial Land Surveyors, and given the exclusive right to make land surveys within the Province. This was later resented by the Dominion Land Surveyors of the adjoining Territories, who were turned away at the boundaries of Manitoba, while those Manitoba Land Surveyors, who were also Dominion Land Surveyors, could freely practise within the Territories. As soon as the Provinces of Saskatchewan and Alberta were formed, their Dominion Land Surveyors retaliated by obtaining drastic legislation incorporating Land Surveyors Associations in each Province and excluding all other surveyors. This legislation practically abolished Dominion Land Surveyors as a profession, these two Provinces being the last ones where they could practice land surveying. At present, they can only act as employees of the Dominion Government. It follows that although the Surveyor General of Canada is a delegate to the Conference, he does not actually represent any branch of the surveying profession of Canada.

The first proposal of reciprocity was made to Canada at the time of the negotiations betweeen New Zealand and Australia, by Mr. Marchand, then Surveyor General of New Zealand. The Surveyor General of Canada replied that personally he was in favour of the proposal, but it was not until 1908 that an opportunity was found of giving effect to this suggestion. In that year the law respecting Dominion Land Surveyors was recast, and an amendment was introduced authorizing the Board of Examiners to enter into reciprocal arrangements with other parts of the Empire. This amendment was strongly objected to by the Ontario and Quebec surveyors: the opposition in Parliament was such that the Government withdrew not only the proposed amendment but also a previously existing clause granting certain privileges to surveyors from other parts of the Empire. In view of the strong objections of the Canadian

Surveyors to any proposals of reciprocity, and of the fact that it does not even exist amongst themselves, it seems that there is little prospect of the immediate adoption by them of the wider scheme of reciprocity throughout the Empire.

While recognizing the difficulties which stood in the way, the consensus of opinion among the delegates was that they had been called together for the purpose of preparing a scheme of reciprocity and that it was their duty to prepare such a scheme. The recommendations agreed upon contemplate uniform examinations, the syllabus of which was drafted by the Conference, similar terms of service everywhere and the creation of a Central Board to hear appeals against any of the local examining authorities. The Conference's report concludes as follows:

The free discussion which has taken place at the Conference does not permit the delegates to overlook the difficulties which undoubtedly exist in the way of a general agreement for reciprocity; and although they are conscious that the scheme they have formulated will not provide a complete answer to every objection which can be raised, they venture to submit it as offering a groundwork for a future agreement among the Dominion, Provinces or States who desire to enter into reciprocal arrangements.

Should any Government not find it practicable to accept in its entirety the scheme herein submitted, it may be that they will be able to adopt such parts of it as their circumstances permit. Even if a part only of the examinations for qualifying as surveyors should be accepted throughout the Empire, so that a candidate who had passed that part of the examination in any portion of the Empire would be excused having to undergo it again, in order to qualify as a surveyor in another portion of the Empire, a step forward would be made. In particular, the delegates wish to emphasize the importance they attach to the formation of the Central Board.

CORRESPONDENCE.

The correspondence of this Branch consisted of:—

Letters received	11,675
Letters sent	16,120

ACCOUNTS.

Number of accounts dealt with	1,024
Amount of accounts	$943,386
Number of cheques forwarded	3,068

OFFICE STAFF.

The office staff of the Topographical Surveys Branch at Ottawa consists of one hundred and twenty-seven employees, being an increase of one over the staff of last year.

Fifteen appointments were made, one employe was superannuated, nine resigned, while four were transferred to other Branches of the Department.

The appointments were:—Messrs. W. B. Armstrong, J. E. Spero, L. A. Nevins, J. F. McDonald, A. S. Thomas, H. C. Smith, G. N. Clarke, A. G. McLennan, G. H. Watt, G. A. Colquhoun, J. J. Freeland, W. H. Herbert, H. Parry, R. C. Ross and L. G. Smith. Mr. P. B. Symes was superannuated, Messrs. J. E. Umbach, R. C. McCully, C. P. Dubuc, C. M. Ross, A. H. Beaubien, H. Osmond, C. M. Hoar, J. Fredette and B. J. Roe resigned, while Mr. J. A. Belleau was transferred to the Lands Patents Branch, Mr. A. M. Grant to the Chief Astronomer's Branch, Mr. A. Tremblay to the Railway Lands Branch, and Mr. C. E. Marchand to the Geographer's Branch.

Mr. Symes, Chief Draughtsman, who, on account of continued ill-health, was superannuated after more than forty years of service, was connected with the Branch since its inception in 1873. He was a very valuable officer and had an intimate knowledge of the work, having materially assisted in the growth of the Branch from a small office in the Department of the Secretary of State to its present large dimensions. His unfailing courtesy and patience in his relations with the staff made his retirement a matter of general regret. The position of Chief Draughtsman, rendered vacant by his superannuation, was filled by the promotion of Mr. T. Shanks, B.A. Sc., D.L.S., formerly Assistant Chief Draughtsman. Mr. T. E. Brown, B.A., has been appointed to this latter position and the place formerly held by him, that of chief of the first section, was filled by the promotion of Mr. H. G. Barber.

CHIEF DRAUGHTSMAN'S OFFICE.

(T. Shanks, Chief Draughtsman.)

The progress of our work during the past year was seriously retarded by changes in the personnel and organization of the staff owing to transfers, resignations and absence from various causes.

There is possibly no other Branch in the Service which has suffered more than ours in the last few years from transfers and resignations. During the past year fourteen clerks left the office and the strength of the technical portion of the staff is no greater now than at the time of the reorganization in 1908, although the work has greatly increased. The activity in general engineering work throughout the Dominion has made it difficult to secure or retain properly qualified men and the salaries offered in this Branch of the Service are not sufficiently attractive to offset the advantages of a less restricted career outside where there are brighter prospects for more rapid promotion, greater variety of work and higher remuneration. The reorganization of 1908 and the consequent transfer of many temporary employes to the permanent staff has undoubtedly helped to make the tenure of office more continuous than before, but conditions are not likely to be satisfactory until provision is made for better salaries for technical men and improved facilities for more rapid promotion.

Attention has been repeatedly called to the serious handicap to efficient organization and the prompt despatch of business owing to the fact that our staff cannot be accommodated in one building or in offices convenient to the other Branches of the Department. The nature of our work necessitates frequent reference to the records of old surveys and as these are stored in a separate building the work is subject to awkward interruptions and delays. Moreover, it frequently happens that many of the record books and plans are retained in our offices for long periods, and with no adequate protection from fire. These valuable records comprise a complete history of Dominion land surveys, and as their loss would be irreparable provision should be made as soon as possible for their safe-keeping.

The average number of surveyors employed in the field each year for the past ten years has been sixty-four, about equally divided between contractors and day men The present tendency is towards an increase in the number of day men, and a corresponding falling off in contract work. One chief cause of this is the fact that as the country becomes settled the amount of work affecting old surveys increases. Errors come to light, monuments disappear, topographical features change, modifications of the old surveys are rendered necessary and the resurveys which result are too complicated to be done under contract. This change brings with it an increase in office work, as instructions to surveyors must be prepared in greater detail than for regular township subdivision, the examination of survey returns is more laborious and the preparation of the more involved plans requires greater skill in draughtsmanship than for the ordinary township plans, where much of the draughting and printing are done by mechanical means. The demand for original subdivision is still great, however, and it is estimated that about 180 townships will be surveyed under contract during 1912.

The primary object of our field work is to delimit the land for purposes of disposal and the plans of these surveys which are most urgently needed are those upon which entries may be granted and patents issued. But in addition to the work of marking out the boundaries of sections the surveyor collects much valuable information as to the character of the soil, the topography of the country, the extent of timber and prairie land and the natural resources of the district. An attempt has been made to compile this information in convenient form for reference but little progress has been made owing to the press of urgent routine work. Unless this information is up to date it loses much of its value and it is desirable that some arrangement shall be made to ensure early publication of data which, if one may judge from the inquiries received, are of great interest to the public.

FIRST SECTION—SURVEY INSTRUCTIONS AND GENERAL INFORMATION.

(H. G. Barber, Chief of Section.)

In this section instructions are prepared for surveyors engaged in field operations, and the returns of survey sent in by them are entered in the office registers. Preliminary plans are issued for all townships in which subdivision is done, except in the railway belt of British Columbia. This section also has charge of the preparation and issuing of the annual report of the Branch, and the answering of all requests for information from the general public or from other Branches of the Department.

During the year 161 drafts of instructions were issued involving the preparation of 1,905 sketches and 46 maps and tracings. These contained all necessary information regarding Dominion lands, Indian reserves and other surveys already made in the vicinity, as well as all available information as to the nature of the country, roads, trails and methods of transportation.

Preliminary plans were issued for 285 townships. Four copies of each are prepared, one copy being placed on file in this office, and one each being furnished to the Survey Records Branch, the Lands Patents Branch and the Land Agent in whose district the township lies.

The number of files received from the Correspondence Branch for use in the work of the office was 1,800, and the total number of draft letters and memoranda written was 4,930.

The Manual of Instructions for the Survey of Dominion Lands was again revised. It is now almost ready for printing and will be issued in the course of the coming year.

During the year a report on the Peace River district was prepared and issued for the information of intending settlers. It gives a description of the soil, climate and main topographical features and of the various roads and trails leading into the country, with information about the stopping-places, best means of transportation, etc. A map of the district accompanies the report.

Answering communications from settlers and others on various subjects and inquiries from other Branches of the Department forms an important part of the work. The number of communications dealt with during the year was 1,883, requiring the preparation of 3,599 sketches, 34 plans and tracings and 343 pages of field notes.

The office registers show that 1,142 progress sketches were received from the surveyors in the field, as well as 364 books of field notes for township surveys, 188 books and 330 plans for miscellaneous surveys, 235 timber reports, 86 statutory declarations of settlers and returns for 746 magnetic observations and for 29 timber berths. General reports on survey operations were received from thirty-eight surveyors.

Their examination being completed, 395 books of field notes of township surveys were placed on record together with 89 books and 137 plans of miscellaneous surveys and 86 statutory declarations of settlers.

Plans of 797 townships and 11 settlements or townsites were received from the lithographic office, entered in the registers and distributed, as well as 73 sectional maps and 106 miscellaneous plans.

The staff of this section consists of twenty-one permanent and three temporary employees, but of this number one is engaged the whole time in looking after the vault where numerous valuable records and sectional maps are kept, and the services of another employee are required to attend to requisitions for supplies for the whole Branch and the stationery for the office staff and the staff of surveyors in the field.

SECOND SECTION—EXAMINATION OF RETURNS OF SURVEYS IN MANITOBA, SASKATCHEWAN, ALBERTA AND YUKON TERRITORY.

(T. S. Nash, Chief of Section.)

The work performed in the second section consists of the examination of the returns of survey of all Dominion lands other than those in the railway belt in British Columbia, and the preparation of the required plans thereof.

As soon as a surveyor completes the survey of a township, or a portion thereof, he forwards a sketch showing the progress of the work in the field. These sketches are examined to see that correct methods are being employed and that accurate results are being obtained. They also form the basis for advances to contractors on progress accounts.

During the year 335 progress sketches from contractors, 440 from men employed by the day and 196 from inspectors of contract surveys were examined, making a total of 971 sketches. Plans of 348 townships were compiled, 209 of which were first edition plans. The total number of township plans compiled is much smaller than in previous years, as the practice of compiling reprints of old surveys where the stock of township plans is exhausted, was discontinued.

An examination was made of 224 subdivision surveys and 186 miscellaneous surveys. Compiled plans of 16 miscellaneous surveys and 24 timber berths were made. Four hundred and nineteen memoranda on the examination of survey returns were sent to surveyors and 355 replies were received and the necessary corrections made. The number of draft letters prepared was 1,350. Twenty-six contract accounts were prepared and closed as the work was shown by the inspector's report to be satisfactorily performed.

In the report of last year it was stated that the question of issuing maps of the surveys in the Yukon Territory would be taken up this year. This has been done; a style of plan has finally been adopted and the first one, which covers the district in the immediate vicinity of Dawson, has been printed, while two others will be printed shortly. The new plan, which covers approximately sixteen miles in latitude and twenty miles in longitude is printed on a scale of one mile to the inch, and shows, in addition to surveys all available geographic information. A new filing cabinet for the Yukon work has been procured and a great number of plans have been thoroughly cross-indexed and filed for ready reference in compiling Yukon surveys. During the year 64 group lot surveys were examined. The remaining part of the Carmack's reference traverse and the returns of survey of the road from Yukon Crossing to Whitehorse were also received and examined.

Requests for information from other Branches of the Department involved the writing of 220 memoranda, the preparation of 126 sketches and the calculation of 1,635 areas.

Two hundred and ninety-three plans of road diversions and 26 of timber berths were examined. The timber berths comprised 68 blocks and their boundaries totalled 569 miles, while the area is approximately 276 square miles. Twenty-four plans for these berths were prepared.

One hundred and eighty plans of right-of-way of railways were examined, the mileage of which is 3,114. As many of these plans were in duplicate and triplicate the gross mileage of plans examined was 5,892.

A large amount of work has been put upon the preparation of a topographical map of the valley of Fiddle creek, a tributary of Athabaska river in the Jasper Forest Park reserve, and in assisting the surveyor to complete his final returns of this survey.

The staff consists of twenty-six permanent and two temporary employees, but one of the permanent clerks is at present in charge of the office at Dawson, Yukon Territory.

THIRD SECTION—PREPARATION OF PLANS FOR REPRODUCTION.

(C. Engler, Chief of Section.)

The work of the third section consists in the preparation of copies of plans (which have been compiled in the second, fourth and sixth sections) for reproduction by photo-zincography or photo-lithography.

The appearance and accuracy of the printed copies of the various plans which are issued depend largely on the care given to the production of the fair or finished copies prepared in this section.

The efforts of both draughtsmen and stampers are directed to producing plans on which the information is shown accurately to scale, well arranged and of clean and neat appearance.

The various processes used in preparing fair copy plans have been described in previous reports.

The bulk of the work done in this section has necessarily been in connection with the issuing of township plans. Other plans prepared have been required for showing timber berths, orders in council, settlements or townsites, Yukon Territory group lots, Doukhobor villages and plans for the annual report.

Besides these, there are a number of plans and jobs forming a miscellaneous class in connection with the requirements of the Branch, difficult to classify, but forming an important factor in work of the section.

A statement showing the classification and number of jobs undertaken and completed is given in the report of the Chief Draughtsman.

The staff numbers thirteen, three previous members having been transferred to other Departments or offices, and two appointments having been made.

In addition, the services of an assistant printer are constantly required and three temporary employees were appointed, one of whom has lately been transferred to another Department.

FOURTH SECTION—SURVEYS IN THE RAILWAY BELT, BRITISH COLUMBIA.

(E. L. Rowan-Legg, Chief of Section.)

Instructions were prepared for surveys to be made in the railway belt and were accompanied by sketches and any other information which it was considered would be of assistance to the surveyors.

The greater part of the subdivision surveys which had to be shown on the township plans compiled during the year were those in which monuments were erected, as far as practicable, at legal subdivision corners and in the centre of legal subdivision boundaries along the surveyed lines, so that the lands might be disposed of in parcels of such sizes as may be desired.

On account, therefore, of the additional information required to be shown in connection with these surveys, quarter township plans were made on a scale of twenty chains to one inch. On these are shown the position and nature of all monuments, the distances between them, the bearings of the section or quarter section boundaries, the area of each legal subdivision or quarter section where monuments were placed at quarter section corners only, the section and legal subdivision numbers and provincial lots, Indian reserves, mineral claims, lakes, rivers, creeks and trails.

Field notes of the surveys of mineral claims, of miscellaneous surveys and of timber berths were examined. Plans of timber berths were made, and fair copies of them were forwarded to the Timber Branch.

A plan of the townsite of Field, in section 17, township 28, range 18, west of the fifth meridian, was compiled and printed, and also a second edition of the plan of the town of Lytton in section 6, township 15, range 26 and section 1, township 15, range 27, west of the sixth meridian.

In 1909, Mr. A. W. Johnson made a subdivision survey of villa lots at Woodhaven, in sections 23, 24 and 25, fractional township west of township 39, west of the coast meridian on Bedwell bay, north arm of Burrard inlet, a plan of which was compiled and printed.

This year a plan showing the block outlines of a proposed additional subdivision at Woodhaven was made for the guidance of the surveyor when the survey is being made.

The staff consists of seven permanent clerks, which is two fewer than the staff of the previous year.

FIFTH SECTION—MAPPING

(J. Smith, Chief of Section.)

The principal work of this section is the revision of sectional maps that have already been printed, and the completion of new sheets as they are required. Appendix No. 6 of this report shows the work done in this section during the year on sectional maps.

In addition to these maps, the following drawings were made:—A manuscript chart of the magnetic declination covering the southern part of Canada and the northern part of the United States, drawn on two sheets on a scale of one hundred miles to one inch to be photo-engraved on copper and printed on a scale of three hundred miles to one inch; a map of the Peace River district and one of the Peace River block on a scale of four miles to one inch; a map showing the topography along the fifteenth base line in the vicinity of the second meridian, drawn on a scale of four miles to one inch, to be photo-zincographed on a scale of six miles to one inch; a tracing of part of the Selkirk range on a scale of 1/80,000, to be photo-lithographed on a scale of 1/60,000.

Thirteen permanent employees constitute the staff of this section.

SIXTH SECTION—SCIENTIFIC AND TOPOGRAPHICAL WORK.

(G. Blanchard Dodge, Chief of Section.)

The work performed in general in this section consists of issuing instructions for and plotting returns of levels on meridians and base lines, checking and reducing magnetic observations, calculating astronomical field tables, testing and adjusting survey instruments, and preparing and issuing the pamphlets containing surveyors' township reports, &c.

The standard of accuracy of the levels on meridians and base lines was raised for 1911, and the difference of elevation between adjacent bench marks was required to be checked by a second independent line, the two lines to check between adjacent bench marks within 0.1 feet multiplied by the square root of the distance in miles.

All the level notes for 1910 have been checked, lists of bench marks prepared and profiles plotted. During the year 1,427 miles of level returns were received while 1,502 miles had been received previously. Level returns were examined and profiles plotted of 1,660 miles. All the lines on which levels have been run prior to March 31, 1912, are shown on a map which accompanies this report.

The number of magnetic declination returns received prior to March 31, 1912, was 2,841, of which 746 were received during the year. A statement of the results with a map showing the isogonic lines in that portion of western Canada covered by the Dominion Lands system of survey is published with this report.

The office computations of triangulation surveys in the railway belt, British Columbia, have been brought up to date, but further information is necessary before much use can be made of the present results. It is hoped that the returns for next season's surveys will supply this information.

All the returns of azimuth observations for the year 1910, received during 1911, have been examined and checked, and also the latitude observations of Mr. J. A. Fletcher, D.L.S., taken during 1911. The astronomical field tables for the year have been computed.

Compiling surveyors' reports on the townships subdivided requires the services of four of the staff. A report on the townships covered by the Fort Pitt sectional sheet has been compiled and sent to the printers for publication.

Information was obtained for a map to accompany the report of 'Descriptions of Surveyed Townships in the Peace River district,' and a rough copy of the map was made with the information added.

A surveys laboratory for testing instruments has lately been built, and it has already proved very useful. Although only a portion of the equipment has been installed, facilities will be provided for testing and adjusting surveying transits, levels, aneroid barometers, measuring tapes, etc., and for rating chronometers and watches.

The number of letters received during the year was 446 while the number of letters sent was 1,130 besides 498 memoranda. Seventy-nine letters of instructions to surveyors were prepared.

The staff of the section consists of fourteen permanent clerks and two temporary clerks.

PHOTOGRAPHIC OFFICE.

(J. Woodruff, Chief Photographer.)

The offices of the Chief Photographer have been moved to the rooms in the basement formerly occupied by the lithographic office. The rooms have been fitted with the necessary appliances and afford every facility for the work.

There has not been much change in the amount of work executed. Velox and blue printing have increased but other lines have decreased.

The staff of four assistants is the same as last year.

PHOTOGRAPHIC OFFICE.

(H. K. Carruthers, Process Photographer.)

With the removal of the Chief Photographer's offices to the basement, it has been possible to give increased accomodation to the Process Photographer.

The four dark rooms were made into two rooms, thus providing ample space for handling large zinc plates and glass negatives.

Sectional maps on a scale of three miles to one inch which before required two 18-in. x 20-in. negatives are now made on one 24-in. x 32-in. plate and printed direct on zinc for the press.

Three township plans are printed at one operation on zinc 32-in. x 49-in. and sent direct to the lithographic office ready for the press.

A new automatic mercury vapour lamp was installed. Five tubes are used in connection with a pneumatic printing frame 36-in. x 60-in., an automatic electric pump maintaining the vacuum.

A full set of machines for line and half-tone engraving was set up in the basement of the Imperial building. Twenty-one half-tone engravings were made to illustrate the Peace River report and almost a full set of line cuts for the Manual of Survey.

The staff was increased by the appointment of Mr. Leonard G. Smith as assistant process photographer, and now consists of four men. Mr. Smith has attended for six years the London County Council School of Photography, Engraving and Lithographing, and was six years on the staff of the Geographical Section of the War Office. He has proved a valuable addition to our staff.

In order to answer numerous enquiries concerning our copying camera, a description of the camera has been published in pamphlet form. It is annexed to this report as Appendix No. 51.

LITHOGRAPHIC OFFICE.

(A. Moody, Foreman.)

The lithographic office has been removed to the Imperial building on Queen street where it occupies the whole of the basement. This place was probably the best available in town; it affords splendid accommodation and no better quarters could be had unless a building was erected for that special purpose. The only disadvantage is that the place is a little damp in summer; it causes some trouble in registering coloured impressions.

A power paper-cutter was added to the equipment which now consists of a flat-bed power-press, a rotary offset power-press, three hand-presses for transferring, a zinc-plate graining machine and a power paper-cutter.

The work is for the greater part photo-zincographic printing. A few maps are printed on stone; others are engraved and transferred.

The staff of ten employes is the same as last year.

GEOGRAPHIC BOARD.

(A. H. Whitcher, Secretary.)

The Geographic Board has held a number of meetings and gave decisions on the geographic names submitted. The Chairman is Col. W. P. Anderson, Chief Engineer of Marine and Fisheries, and the report of the Board is published by his Department.

The Secretary is a member of the staff of this office.

BOARD OF EXAMINERS FOR DOMINION LAND SURVEYORS.

(F. D. Henderson, Secretary.)

The Board of Examiners for Dominion Land Surveyors held a special meeting for the examination of candidates from April 29, 1911, to May 18, 1911, during which examinations were held at Ottawa, Toronto, Regina and Vancouver. An adjourned meeting for the preparation of examination papers was held from October 2 to October 12, 1911. The regular annual meeting began on February 12, 1912, and lasted until March 23, 1912. During this meeting examinations were held at Ottawa, Montreal, Kingston, Toronto, Winnipeg, Calgary and Edmonton.

The total number of candidates for examination during the year was 268, as against 257 in 1910-11, and 362 in 1909-10. Of these 186 tried the full preliminary, 9 the limited preliminary, 71 the final, and 2 the examination for Dominion Topographical Surveyor.

Fifty-seven candidates were successful at the preliminary examination as follows:—

PRELIMINARY EXAMINATION.

Atkins, Cecil Ben., Revelstoke, B.C.
Bedard, Edward L., Courtright, Ont.
Britton, George Clayton, Whitby, Ont.
Burland, George Lewis, Ottawa, Ont.
Burrell, Eric, Yarmouth North, N.S.
Byron, Malcolm Ross, Ottawa, Ont.
Cameron, Charles Scott, Regina, Sask.
Campbell, John James, Galt, Ont.
Carlile, Reginald Clifford, Calgary, Alta.
Carty, Edward Godfrey, Ottawa, Ont.
Cavell, Edward, Toronto, Ont.
Clarke, Roger Fyfe, Hamilton, Ont.
Clouston, Noel Stewart, Winnipeg, Man.
Coursier, Eric Clarence, Revelstoke, B.C.
de Noblens, Gerard, Aldersyde, Alta.
Duffield, Hugh J., Calgary, Alta.
Ells, Sidney C., Ottawa, Ont.
Falconer, Fairbairn S., Shelburne, Ont.
Finnie, Oswald Stirling, Ottawa, Ont.
Fournier, Ovide Edouard, Ottawa, Ont.
Fraser, Jonathan William, Ottawa, Ont.
Gardner, Charles Turville, Walhachin, B.C.
Gardner, James David, Ottawa, Ont.
Grange, Edward Rochfort, Toronto, Ont.
Hardouin, Joseph, Calgary, Alta.
Heinonen, Henry J., Toronto, Ont.
Jordan, Edward Elliot, Ottawa, Ont.
King, John Albert Shirley, Ottawa, Ont.
Le Blanc, Pierre Maxime Henri, Ottawa, Ont.
Lowrie, Arthur Wellington Percy, Russell, Ont.
Malcolm, William Noel, Winnipeg, Man.
Miller, Albert Sherman, Brighton, Ont.
Milliken, John Bolton, Ottawa, Ont.
Moran, Patrick Joseph, Kingston, Ont.
Murdie, William Campbell, Winthrop, Ont.
MacTavish, William Higgins, Van Camp, Ont.
McCaw, Donald Arthur, Welland, Ont.
McDonald, Roderick C., Ripley, Ont.
McFaul, W. Lawrence, Owen Sound, Ont.
Nesham, Lionel Charles, Ottawa, Ont.
Nicklin, Harold Raymond, Millbank, Ont.
Noecker, Claude, Waterloo, Ont.
Oke, William Verner, Toronto, Ont.
Platt, Errol Beauchamp, Toronto, Ont.
Rhys, Howard Leonard, Ottawa, Ont.
Robertson, John Donald, Edmonton, Alta.
Ross, Othmar Wallace, Brantford, Ont.
Somers, Newton Lloyd, Rockford, Ont.
Spence, William A., Ottawa, Ont.
Spero, John Ethelbert, Ottawa, Ont.
Stidwill, Frank, Cornwall, Ont.
Tye, Howard Warner, Stratford, Ont.
von Gunten, Carl Frederick, Blenheim, Ont.
Walker, George Stuart, Renfrew, Ont.
Watson, Angus Robert, Beaverton, Ont.
Wrong, Frederick Hay, Windsor, Ont.
Young, Stewart, Owen Sound, Ont.

Forty-eight candidates were successful at the final examination as follows:—

FINAL EXAMINATION.

Berry, Edward Wilson, Seaforth, Ont.
Boulton, William James, Wallaceburg, Ont.
Brown, Edgar Carl, Regina, Sask.
Burd, James Henry, Weyburn, Sask.
Cline, Carl Gordon, Toronto, Ont.
Cond, Fritz Thomas Piercy, Vancouver, B.C.
Cote, J. Aurele, Ottawa, Ont.
Dann, Eyre Morton, Kamloops, B.C.
Dennis, Thomas Clinton, Ottawa, Ont.
Earle, Wallace Sinclair, Victoria, B.C.
Fawcett, Sidney Dawson, Ottawa, Ont.
Fletcher, James Allan, Fletcher, Ont.
Fraser, Donald John, Ottawa, Ont.
Matheson, Hugh, Ottawa, Ont.
Melhuish, Paul, Vancouver, B.C.
Menzies, John Whyte, Ottawa, Ont.
MacKay, Ernest George, Hamilton, Ont.
MacLeod, George Waters, Edmonton, Alta
McColl, Samuel Ebenezer, Winnipeg, Man
McEwen, Duncan Findlay, Edmonton, Alta.
Narraway, Athos Maxwell, Ottawa, Ont.
Neelands, Rupert A., Hamiota, Man.
Neville, Everett A., Ruthven, Ont.
Palmer, Philip Ebenezer, Dorchester, N.B.
Peckover, Horace Joseph, Toronto, Ont.
Robinson, William Andrew, Winnipeg, Man

Galletly, James Simpson, Brooklin, Ont.
Greene, Gerald Elliot Denbigh, Toronto, Ont.
Haggen, Rupert Williams, Revelstoke, B.C.
Hamilton, Charles Thomas, Vancouver, B.C.
Higgins, Connell J., Vancouver, B.C.
Hobbs, Wilfrid Ernest, Winnipeg, Man.
Hunter, A. Ernest, Wiarton, Ont.
Inkster, Oluff, Edmonton, Alta.
Jackson, John Edwin, Oxford Centre, Ont.
Jones, George Samuel, Ottawa, Ont.
Lindsay, James Herbert, Regina, Sask.
Loucks, Roy William Egbert, Saskatoon, Sask.
Roger, Alexander, Ottawa, Ont.
Stewart, Norman Charles, Nelson, B.C.
Stitt, Ormond Montgomery, Vancouver, B.C.
Stuart, Alexander Graham, Buckingham, Que.
Taggart, Charles Henry, Ottawa, Ont.
Tate, Harry William, Toronto, Ont.
Tipper, George Adrian, Brantford, Ont.
Tremblay, Albert Jacques, Edmonton, Alta.
Underwood, Joseph Edwin, Saskatoon, Sask.
Whyte, Harold Eustace, Victoria, B.C.
Wright, Alfred Esten, Prince Rupert, B.C.

As in former years, the time of the Board was largely taken up with the reading and valuation of the candidates' answers and with the preparation of sets of questions for the several examinations. The evidence as to the standing of final candidates, consisting of Provincial certificates in the case of Provincial Surveyors writing under section 21 of the Act, and of affidavits of service under articles in the case of others, had to be examined and passed upon.

The privilege of serving one year under articles instead of three years, as provided by Section 22 of the Act, was extended to graduates of the University of Liverpool holding the Degree of Bachelor of Engineering with Honours, and to graduates of the University of Dublin holding the Degree of B.A.I.

The forms of articles and of the transfer of articles (given in the Schedule of the Act as Forms B and D) are considered by the Board as unnecessarily long and involved. Considerable discussion took place with a view to preparing forms which would be shorter and easier to fill out.

When there are many candidates and when the examinations are held at places distant from Ottawa, it frequently happens that the results of the examinations are not known for a month or more after the candidates have finished writing. Thus the three weeks of grace allowed by the Rules of the Board is not enough to permit candidates who have passed the preliminary examination to come up for final examination one year or three years after as seems the intention of the Act. The Rules of the Board were, therefore, changed in this respect so as to allow any person who passes the preliminary examination and who becomes articled immediately on receiving notice thereof to write on the final examination in one year or in three years, as the case may be.

Oaths of office and allegiance and bonds for the sum of one thousand dollars each, as required by Section 25 of the Act, were received from, and commissions as Dominion Land Surveyors were issued to, fifty-one surveyors.

Subsidiary standards of length as required by Section 35 of the Act, were tested and issued to thirty-seven surveyors. One standard which had changed hands was retested. A list of surveyors who have been furnished with standard measures up to March 31, 1912, will be found in Appendix No. 10.

The correspondence of the Board was as follows:—

Letters received	1,824
Letters sent	880
Circular letters, pamphlets, and parcels sent	1,517

APPENDICES.

The following schedules and statements are appended:—

No. 1. Schedule of surveyors employed and work executed by them from April 1, 1911, to March 31, 1912.

No. 2. Schedule showing for each surveyor employed from April 1, 1911, to March 31, 1912, 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, 1911, to March 31, 1912.

No. 4. List of miscellaneous surveys in the Yukon Territory, returns of which have been received from April 1, 1911, to March 31, 1912.

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, 1911, to March 31, 1912.

No. 7. Statement of work executed in the photographic office from April 1, 1911, to March 31, 1912.

No. 8. Statement of work executed in the lithographic office from April 1, 1911, to March 31, 1912.

No. 9. List of employees of the Topographical Surveys Branch at Ottawa, giving the name, classification, duties of office and salary of each.

No. 10. List of Dominion Land Surveyors who have been supplied with standard measures.

No. 11 to 49. Reports of Surveyors employed.

No. 50. The Determination of the Magnetic Declination Dip and Total Force in Western Canada.

No. 51. The Copying Camera.

MAPS AND PROFILES.

The following maps and profiles accompany the report of the Topographical Surveys Branch in monograph form:—

Map showing surveys to March 31, 1912.
Map of Mt. Robson and vicinity.
Maps to accompany reports of surveyors.
Profiles of meridians and base lines.

I have the honour to be, Sir,

Your obedient servant,

E. DEVILLE,
Surveyor General.

TOPOGRAPHICAL SURVEYS BRANCH

SCHEDULES AND STATEMENTS.

APPENDIX No. 1.

SCHEDULE of Surveyors employed and work executed by them from April 1, 1911, to March 31, 1912.

Surveyor.	Address.	Description of Work.
Akins, J. R.	Ottawa, Ont.	Survey of the north boundary of the Peace River block, production of the twenty-third base line across ranges 10, 11 and 12, and parts of ranges 9 and 13; survey of the east outlines of townships 85, 86, 87 and 88, range 13, west of the sixth meridian.
Allison, C. B.	South Woodslee, Ont.	Contract No. 4 of 1911. Subdivision of townships 36 and 37, range 20, townships 34, 35 and 36, range 21, the southerly two-thirds of township 38, range 20, and the northerly third of township 33, range 21, west of the principal meridian.
Ashton, A. W.	Ottawa, Ont.	Survey of Blairmore cemetery in township 8, range 4, west of the fifth meridian. Miscellaneous surveys in townships 20 and 21, range 24, and at Lytton in township 15, range 27, west of the sixth meridian.
Aylen, J.	North Bay, Ont.	Contract No. 7 of 1911. Subdivision of township 46 and the north third of township 45, range 9, townships 46, 47, the north third of township 45 and the south two-thirds of township 48, range 10; survey of the north and south outlines of township 47, range 9, west of the second meridian.
Aylsworth, C. F.	Madoc, Ont.	Retracement in townships 13, 14 and 15, range 6, east of the principal meridian; survey of lots in Turtle Mountain and Moose Mountain forest reserves.
Baker, J. C.	Kingston, Ont.	Contract No. 15 of 1911. Subdivision of townships 56, 57, 58, 59 and 60, range 17, and township 57, range 18, west of the third meridian.
Belanger, P. R. A.	Ottawa, Ont.	Inspection of contracts Nos 2 and 3 of 1910. Contracts Nos. 3, 8 and part of contract No. 5 of 1911. Settlement survey at Fisher Bay in township 29, range 2, east of the principal meridian. Subdivision of parts of township 16, range 16, and townships 15 and 16, range 17, east of the principal meridian. Resurvey in township 33, range 8, and townships 31 and 32, range 9, west of the principal meridian.
Bennett, G. A.	Eden, Ont.	Subdivision in townships 13 and 14, range 29, west of the second meridian. Retracement in townships 9 and 10, ranges 10 and 11, townships 7 and 8, range 15, township 8, range 16, township 20, range 17, and townships 10 and 11, range 19, west of the second

APPENDIX No. 1—*Continued.*

SCHEDULE of Surveyors employed and work executed by them from April 1, 1911, to March 31, 1912—*Continued.*

Surveyor.	Address.	Description of Work.
		meridian; township 13, range 4, township 25, range 6, townships 13 and 16, range 14, township 19, range 15, and township 26, range 20, west of the third meridian; township 21, range 1, townships 10 and 11, range 5, townships 10, ranges 6 and 10, and township 8, range 21, west of the fourth meridian. Resurvey in township 16, range 13, townships 27 and 28, ranges 14 and 15, township 26, range 23, and township 33, range 26, west of the third meridian; townships 16, ranges 3 and 4, townships 14 and 15, range 10, township 19, range 21, and township 18, range 26, west of the fourth meridian. Investigation in township 15, range 3, and townships 11 and 15, range 4, west of the fourth meridian. Traverse in township 25, range 5, west of the third meridian; townships 14, ranges 21 and 22, and townships 36, ranges 24 and 25, west of the fourth meridian.
Blanchet, G. H.	Ottawa, Ont.	Survey of the twenty-third base line between the fourth and fifth meridians.
Brenot, L.	Ottawa, Ont.	Survey of the western boundary of the Peace River block from the twenty-first base line to the northwest corner of the block.
Bridgland, M. P.	Calgary, Alta.	Triangulation survey in the railway belt, British Columbia. Survey of villa lots at Banff. Investigation in township 27, range 1, and township 24, range 8, west of the fifth meridian.
Carson, P. A.	Ottawa, Ont.	Stadia traverse of North Lillooet river in township 12, east of the coast meridian.
Cautley, R. H.	Edmonton, Alta.	Contract No. 23 of 1911. Subdivision of township 49, range 12, townships 49, 50 and 51, range 13, and townships 50 and 51, range 14, west of the fifth meridian.
Chase, A. V.	Orillia, Ont.	Examination of lands in the Kamloops district of the railway belt, British Columbia, for the purpose of classification into fruit land, farming land, grazing land, timber land and worthless land. Subdivision in township 14, range 23, township 15, range 26, and townships 14 and 15, range 27, west of the sixth meridian. Traverse in township 15, range 26, and townships 13, 14 and 15, range 27, west of the sixth meridian.
Christie, Wm.	Prince Albert, Sask.	Contract No. 11 of 1911. Subdivision of townships 53, 54 and 55, range 8, townships 51, 52 and 53, range 9, and survey of the east outline of township 56, range 9, west of the third meridian.
Cote, J. L.	Edmonton, Alta.	Contract No. 21 of 1911. Subdivision of townships 45, 46 and 47, range 7, township 48, range 8, and townships 48 and 49, range 9, west of the fifth meridian. Contour survey of the townsite of Fitzhugh, in township 45, range 1, west of the sixth meridian.
Cumming, A. L.	Cornwall, Ont.	Retracement surveys in townships 7, ranges 23 and 24, west of the third meridian: township 44, range 4, township 48, range 10, townships 48 and 49, range 11, townships 50, ranges 13 and 14, and townships 44 and 45,

APPENDIX No. 1—*Continued.*

SCHEDULE of Surveyors employed and work executed by them from April 1, 1911, to March 31, 1912—*Continued.*

Surveyor.	Address.	Description of Work.
		range 15, west of the fourth meridian. Subdivision of parts of township 19, range 7, and township 20, range 8; survey of part of the east outline of township 20, range 7, west of the fifth meridian. Traverse in townships 44 and 45, range 15, west of the fourth meridian, and townships 19 and 20, range 7, west of the fifth meridian.
Davies, T. A.	Edmonton, Alta.	Contract No. 19 of 1911. Subdivision of townships 67, 68 and the north third of 66, ranges 10, 11 and 12, west of the fourth meridian. Retracement of lots in Lac la Biche settlement in township 67, range 12, west of the fourth meridian.
Day, H. S.	St. John, N.B.	Settlement surveys at Pelican, Grand Rapids, McMurray, McKay and Chipewyan, on Athabaska river. Traverse of part of Athabaska river near McKay.
Deans, W. J.	Brandon, Man.	Subdivision in township 8, range 26, and townships 2, 3 and 4, range 29, west of the sixth meridian; townships 2 and 38, west of the coast meridian; and townships 14, 17, 18, 19, 20, 22 and 25, east of the coast meridian. Resurvey in townships 2 and 3, range 29, west of the sixth meridian; townships 2 and 38, west of the coast meridian; and townships 17, 18, 19, 20, 22 and 23, east of the coast meridian. Traverse in township 8, range 26, and township 2, range 29, west of the sixth meridian, and townships 20, 22 and 25, east of the coast meridian. Survey of timber berth No. 544, in township 2, west of the coast meridian and berth No. 553, in townships 17 and 18, east of the coast meridian.
Fairchild, C. C.	Brantford, Ont.	Contract No. 27 of 1911. Subdivision of townships 57, ranges 14, 15, 16 and 17, and township 56, range 18, west of the fifth meridian.
Fletcher, J. A.	Ottawa, Ont.	Latitude observations along the principal meridian in townships 35 and 48, and along the fourth meridian in townships 62 and 89.
Fontaine, L. E.	Levis, Que.	Inspection of contracts Nos. 15, 29, 30 and 31 of 1910, and contracts Nos. 21, 22, 23, 24, 27 and part of Nos. 20 and 28 of 1911. Re-inspection of contracts Nos. 22 and 23 of 1909. Correction survey in township 47, range 5, and townships 48 and 49, range 6, west of the fifth meridian. Survey of part of timber berth No. 1727, in townships 48 and 49, range 6, west of the fifth meridian.
Francis, J.	Portage la Prairie, M.	Subdivision of parts of townships 43 and 44, range 20, townships 45 and 46, range 23, and township 46, range 24, west of the fifth meridian.
Gibbon, Jas.	Vancouver, B.C.	Contract No. 2 of 1911. Subdivision of townships 28 and 29, ranges 7 and 8, and township 29, range 9, west of the principal meridian.
Green, T. D.	Ottawa, Ont.	Contract No. 20 of 1911. Subdivision of townships 41, 42, 43 and 44, range 7, township 41, range 8, and township 39, range 9, west of the fifth meridian.

APPENDIX No. 1—*Continued.*

SCHEDULE of Surveyors employed and work executed by them from April 1, 1911, to March 31, 1912—*Continued.*

Surveyor.	Address.	Description of Work.
		Survey of timber berth No. 1788 in townships 40 and 41, range 9, west of the fifth meridian.
Hawkins, A. H.	Listowel, Ont.	Survey of the twenty-second base line across ranges 1 to 20, west of the fifth meridian.
Heathcott, R. V.	Edmonton, Alta.	Contract No. 26 of 1911. Subdivision of townships 49 and 50, range 20, and township 50, range 21, part of township 49, range 21, and the south third of townships 51, ranges 19, 20 and 21, west of the fifth meridian.
Herriot, G. H.	Ottawa, Ont.	Subdivision in township 48, range 26, and townships 48 and 49, range 27, west of the fifth meridian. Correction surveys in townships 51 and 52, range 24, west of the fifth meridian. Contour survey of the land adjoining the Fiddle Creek hot springs in Jasper Forest Park reserve in western Alberta.
Holcroft, H. S.	Toronto, Ont.	Contract No. 29 of 1911. Subdivision of township 73, range 16, townships 73, 76 and portions of 74 and 75, range 17, townships 74, 75 and 76, range 18 and part of township 76, range 19, and survey of the east outline of township 73, range 19, west of the fifth meridian.
Hubbell, E. W.	Ottawa, Ont.	Inspection of contracts Nos. 9, 10, 12, 13, 15 and 16 of 1911; partial inspection of contracts No. 6 of 1910 and No. 11 of 1911. Part subdivision of township 52, range 16, west of the third meridian. Resurvey in townships 45, ranges 27 and 28, west of the second meridian, and townships 45 and 46, range 5, west of the third meridian. Traverse in township 52, range 17, west of the third meridian.
Inkster, O.	Edmonton, Alta.	Contract No. 28 of 1911. Subdivision of townships 56, ranges 19, 20 and 21, townships 55, 56 and the north third of 54, range 22, and the south two-thirds of township 54, range 23, west of the fifth meridian.
Kimpe, M.	Edmonton, Alta.	Contract No. 22 of 1911. Subdivision of townships 48 and 49, range 10, townships 48, 49, 50 and 51, range 11, and townships 48, 50 and 51, range 12, west of the fifth meridian. Survey of timber berth No. 1749 in townships 42 and 43, ranges 13 and 14, west of the fifth meridian.
Laurie, R. C.	Battleford, Sask.	Contract No. 13 of 1911. Subdivision of townships 50, 51 and 52, range 11, and townships 52, ranges 12 and 13, west of the third meridian.
Lighthall, A.	Vancouver, B.C.	Subdivision in township 7, range 29, west of the sixth meridian; township 6, range 4, and townships 4, 5, 6 and 7, range 5, west of the seventh meridian; townships 40 and 41, east of the coast meridian. Resurvey in township 7, range 29, west of the sixth meridian; townships 4 and 6, range 5, west of the seventh meridian; townships 15, 40 and 41, east of the coast meridian. Traverse in township 7, range 29, west of the sixth meridian, township 6, range 4, and townships 4, 5 and 6, range 5, west of the seventh meridian; townships 15, 40 and 41, east of the coast meridian.

APPENDIX No. 1—*Continued.*

Schedule of Surveyors employed and work executed by them from April 1, 1911, t March 31, 1912—*Continued.*

Surveyor.	Address.	Description of Work.
		Levelling along the street lines at Woodhaven on Bedwell bay, British Columbia. Survey of timber berth No. 547 in township 7, range 29, west of the sixth meridian; timber berths Nos. 546, 548 and 549, in township 6, ranges 4 and 5, west of the seventh meridian.
Lonergan, G. J..	Buckingham, Que.. ..	Inspection of contracts Nos. 27, 28, 32 and 33 of 1910, and contracts Nos. 29, 30, 31 and 32 of 1911. Miscellaneous resurveys in townships 50, 51 and 53, range 27, and townships 50, 51, 53 and 54, range 28, west of the fourth meridian. Correction survey at St. Albert settlement.
McFarlane, J. B... ..	Toronto, Ont..	Production of the fourth meridian from the northeast corner of section 13, township 95 to the northeast corner of township 105 Survey of the twenty-fourth base line across ranges 1, 2, 3 and 4, west of the fourth meridian.
McFarlane, W. G... ..	Toronto, Ont..	Contract No. 32 of 1911. Subdivision of townships 77, 78, 79 and 80, ranges 13, 14 and 15, west of the sixth meridian.
McGrandle, H...	Wetaskiwin, Alta... ..	Contract No. 25 of 1911. Subdivision of township 51, range 17 and townships 49, 50 and the south third of 51, range 18, west of the fifth meridian.
MacLennan, A. L.. ...	Toronto, Ont..	Subdivision of townships 56, ranges 25 and 26 and part subdivision of township 57, range 26 and township 56, range 27, west of the principal meridian. Mounding along the fifteenth base line in ranges 25 and 26, west of the principal meridian. Traverse in townships 56, ranges 24, 25 and 26, west of the principal meridian. Survey of booming site on Carrot river, in townships 56, ranges 26 and 27, west of the principal meridian.
McMillan, Geo..	Ottawa, Ont..	Production of the twenty-first base line across ranges 13 to 26, west of the sixth meridian. Survey of the west boundary of the Peace River block from the twenty-first base line to the southwest corner of the block.
McNaughton, A. L.. ..	Cornwall, Ont..	Part subdivision of townships 46, ranges 18 and 19, townships 47 and 48, range 20, and township 48, range 21, west of the fifth meridian Survey of the east outline of township 45, range 20, west of the fifth meridian.
Martindale, E. S.. ...	Kingsmill, Ont..	Part subdivision of township 17, ranges 4 and 5, townships 17 and 18, range 6, and townships 18 and 19, range 7, west of the fifth meridian. Resurvey in township 23, range 33, west of the principal meridian. Correction survey in township 52, range 4, and townships 36 and 37, range 12, west of the third meridian. Retracement survey in townships 7, ranges 3, 4 and 5, west of the fourth meridian. Traverse of south Saskatchewan river across township 48, range 24A, west of the second meridian.
Matheson, H..	Ottawa, Ont..	Correction survey in townships 52 and 53 range 21, townships 51, 52 and 53, range 22 and townships 52 and 53, range 23, west of the fifth meridian.

APPENDIX No. 1—*Continued.*

SCHEDULE of Surveyors employed and work executed by them from April 1, 1911, to March 31, 1912—*Continued.*

Surveyor.	Address.	Description of Work.
Miles, C. F.	Toronto, Ont.	Inspection of contracts Nos. 14, 20 and 22 of 1910. Contracts Nos. 17, 18 and 19 of 1911, and part of contract No. 10 of 1910. Re-inspection of contract No. 26 of 1909. Subdivision in townships 61 and 62, range 3, west of the fourth meridian. Retracement in townships 15, 16 and 17, range 27, west of the second meridian and in township 14, range 26, west of the third meridian.
Moberly, H. K.	Moosomin, Sask.	Survey of timber berths Nos. 1681 and 1682 in township 44, range 9, townships 44 and 45, range 10, and township 45, range 11, west of the second meridian.
Montgomery, R. H.	Prince Albert, Sask.	Contract No. 10 of 1911. Subdivision of townships 53, 54 and 55, range 6, townships 54 and 55, range 7 and survey of the east outlines of townships 56, ranges 6, 7 and part of 8, west of the third meridian. Survey of timber berth No. 1686 in townships 51, ranges 4 and 5, west of the third meridian.
Morrier, J. E.	Ottawa, Ont.	Contract No. 9 of 1911. Subdivision of townships 53 and the south two-thirds of 54, ranges 25 and 26, townships 53, ranges 27 and 28, west of the second meridian, and the east half of township 53, range 1, west of the third meridian. Survey of timber berth No. 1785 in townships 44, 45 and 46, range 11, townships 44 and 45, range 12, and township 44, range 13, west of the second meridian.
Nash, T. S.	Ottawa, Ont.	Investigation survey in township 2, range 21, west of the principal meridian.
Pequegnat, M.	Berlin, Ont.	Contract No. 3 of 1911. Subdivision of township 33, range 8, and townships 32 and 33, ranges 9 and 10, west of the principal meridian.
Plunkett, T. H.	Meaford, Ont.	Correction survey and mounding along the fifth meridian through townships 93 to 110, inclusive, and portions of townships 81, 92, 111 and 112; the twenty-eighth base line across ranges 1, 2 and part of 3, and the twenty-ninth base line across part of range 1, west of the fifth meridian.
Ponton, A. W.	Edmonton, Alta.	Production of the principal meridian from the thirteenth to the sixteenth base line.
Powell, W. H.	Ottawa, Ont.	Contract No. 14 of 1911. Subdivision of townships 61, ranges 12, 14 and 15, and the south two-thirds of townships 62, ranges 12, 13, 14 and 15, west of the third meridian.
Purser, R. C.	Windsor, Ont.	Subdivision in township 52, range 20, west of the fourth meridian. Miscellaneous resurveys in township 6, range 9, townships 5 and 25, range 29 and township 8, range 31, west of the principal meridian; township 5, range 7 and township 33, range 21, west of the second meridian; township 36, range 2, township 34, range 3, and township 36, range 6, west of the third meridian; township 43, range 1, township 45, range 2, township 43, range 4, township 44, range 5, township 41, range 9, and township 49, range 20, west of the fourth meridian. Traverse in township 38, range 19, west of the second meridian, and township 43, range 2, west of the third meridian.

APPENDIX No. 1—*Continued.*

SCHEDULE of Surveyors employed and work executed by them from April 1, 1911, to March 31, 1912—*Continued.*

Surveyor.	Address.	Description of Work.
Ransom, J. T.	Toronto, Ont.	Contract No. 5 of 1911. Subdivision of township 39, range 4, township 39 and the south two-thirds of township 40, range 5, and townships 39 and 40, ranges 6 and 7, west of the second meridian.
Rinfret, C.	Montreal, Que.	Retracement surveys in township 17, range 16, townships 17, ranges 17 and 19, township 17, range 18, townships 16, ranges 21 and 22, townships 15 and 16, range 23, townships 14, 15 and 16, range 24, townships 17 and 18, range 25, townships 15, 16, 17 and 18, range 26, and township 18, range 27, west of the second meridian. Resurvey in township 25, range 29, township 29, range 31, and townships 32, ranges 32 and 33, west of the principal meridian; township 30, range 14, and township 16, range 25, west of the second meridian, township 23, range 6, township 22, range 9, and townships 14 and 15, range 28, west of the third meridian; township 26, range 16, west of the fourth meridian. Traverse in township 32, range 1, west of the second meridian, and township 28, range 15, west of the fourth meridian.
Robinson, E. W.	Ottawa, Ont.	Survey of the second meridian from the northeast corner of township 61, to the northeast corner of section 1, township 68. Production of the fifteenth base line across ranges 1 to 21, west of the second meridian.
Rolfson, O.	Walkerville, Ont.	Production of the twenty-second base line across ranges 13 to 26, west of the sixth meridian; survey of the east outlines of townships 83 and 84, and retracement of part of the east outline of township 82, range 13, west of the sixth meridian.
Ross, J. E.	Kamloops, B.C.	Subdivision in townships 16, 17 and 18, range 14, and townships 16 and 19, range 15, west of the sixth meridian.
Roy, J. E.	Quebec, Que.	Contract No. 12 of 1911. Subdivision of townships 49 and 50, range 9 and townships 50, 51 and 52, range 10, west of the third meridian.
Saint Cyr, A.	Ottawa, Ont.	Survey of the seventeenth base line across ranges 13 to 26, and subdivision surveys in townships 65, ranges 26 and 27, west of the third meridian. Reposting along fourth meridian through townships 61, 62 and 63.
Scott, W. A.	Galt, Ont.	Subdivision in townships 32 and 33, range 10 and township 32, range 11, west of the third meridian; townships 9, 10, 12 and 13, range 4, and survey of the east outline of township 11, range 5, west of the fifth meridian. Correction survey in township 26, range 15, west of the third meridian.
		Retracement in townships 7 and 8, range 6, township 8, range 7, townships 45 and 46, range 16, township 45, range 17, and township 60, range 25, west of the fourth meridian. Traverse in township 41, range 13, west of the fourth meridian.
Smith, J. H.	Edmonton, Alta.	Contract No. 31 of 1911. Subdivision of township 83 and part of township 82, range 24, townships 82 and 83 and survey of the east

APPENDIX No. 1—*Continued*

SCHEDULE of Surveyors employed and work executed by them from April 1, 1911, to March 31, 1912—*Continued.*

Surveyor.	Address.	Description of Work.
		outlines of townships 84, ranges 25 and 26, west of the fifth meridian; township 79, range 3, townships 75, 76, 78, 79 and the north third of township 74, range 4, and townships 75, 76 and the north third of 74, range 5, west of the sixth meridian.
Steele, I. J.	Ottawa, Ont.	Contract No. 31 of 1911. Subdivision of townships 61 and the south two-thirds of township 62, ranges 24, 25, 26 and 27, west of the third meridian.
Stewart, L. D. N.	Saskatoon, Sask.	Contract No. 8 of 1911. Subdivision of townships 49, 50, 51, 52 and 53, range 11, west of the second meridian.
Stewart, W. M.	Saskatoon, Sask.	Contract No. 16 of 1911. Subdivision of townships 58, 59 and 60, ranges 18 and 19, and survey of the east outline of township 57, range 18, west of the third meridian.
Stock, J. J.	Ottawa, Ont.	Contract No. 30 of 1911. Subdivision of townships 77, 78, 79 and 80, range 17, township 80, range 18, and portions of townships 75, 76 and 77, range 16, west of the fifth meridian.
Street, P. B.	Toronto, Ont.	Subdivision in township 5, range 4, and townships 5 and 8, range 5, west of the fifth meridian. Retracement in townships 21, ranges 4 and 5, and township 23, range 6, west of the principal meridian; townships 2, ranges 11 and 12, townships 1 and 2, range 13, townships 2, ranges 14 and 15, and townships 7, ranges 29 and 30, west of the fourth meridian. Correction survey in township 9, range 21, west of the second meridian. Traverse in township 23, range 3, east of the principal meridian and township 4, range 1, west of the fifth meridian.
Taggart, C. H.	Ottawa, Ont.	Subdivision in townships 23 and 24, range 18, and townships 24 and 25, ranges 19 and 20, west of the fifth meridian; township 23, range 1, townships 22 and 23, range 2, townships 17, ranges 12 and 13, townships 17 and 18, range 14, townships 16, 17 and 18, ranges 15 and 16, township 16, range 17, and townships 17, ranges 18 and 19, west of the sixth meridian. Resurvey in townships 21, 22 and 23, range 1, townships 22 and 23, range 2, and township 16, range 17, west of the sixth meridian. Traverse in township 23, range 18 and township 21, range 29, west of the fifth meridian; townships 21 and 22, range 1, townships 22 and 23, range 2, township 20, range 6, township 22, range 17 and township 17, ranges 18 and 19, west of the sixth meridian. Survey of timber berth No. 545 in township 23, range 18, west of the fifth meridian and timber berth No. 550 in township 20, range 6, west of the sixth meridian.
Teasdale, C. M.	Concord, Ont.	Part of contract No. 3 of 1910. Subdivision of township 39, range 10, west of the second meridian.
Thompson, W. T.	Grenfell, Sask.	Survey of timber berths Nos. 1666, 1667, 1668, 1669, 1670 and 1671 near Sipanok channel in eastern Saskatchewan, and timber berth No. 1790 in township 38, range 28, west of the principal meridian.

APPENDIX No. 1—*Concluded.*

SCHEDULE of Surveyors employed and work executed by them from April 1, 1911, to March 31, 1912—*Concluded.*

Surveyor.	Address.	Description of Work.
Waddell, W. H.	Edmonton, Alta.	Contract No. 17 of 1911. Subdivision of townships 58, 59 and 60, range 22, townships 59 and 60, range 23, and township 60, range 24, west of the third meridian. Contract No. 39 of 1911. Subdivision of townships 58, 59 and 60, ranges 20 and 21, west of the third meridian.
Waldron, J.	Moosejaw, Sask.	Contract No. 6 of 1911. Subdivision of township 40 and the north third of township 39, range 8, townships 38 and 40, and the west halves of townships 39 and 41, range 9, the east third of township 41, range 10, the west half of township 41, range 11 and township 41, range 12, west of the second meridian.
Walker, C. M.	Guelph, Ont.	Retracement in townships 13 and 14, range 7, west of the principal meridian. Subdivision in townships 21, 22 and 23, range 6, west of the fifth meridian. Mounding in township 24, range 6, west of the fifth meridian.
Wallace, I. N.	Calgary, Alta.	Levelling northerly from Prince Albert and Lloydminster along the third and the fourth meridians.
Young, W. H.	Lethbridge, Alta.	Contract No. 24 of 1911. Subdivision of township 49, range 14, townships 49, 50 and 51, range 15, and township 51, range 16, west of the fifth meridian.

APPENDIX No. 2.

SCHEDULE showing for each surveyor employed from April 1, 1911, to March 31, 1912, the number of miles surveyed of township section lines, township outlines, traverses of lakes and rivers and resurvey, also the cost of the 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.
						$	$ cts.	
Akins, J. R.	83	49	....	2	13	27,800	207 46	Day.
Allison, C. B.	281	20	131	....	43	9,997	23 14	Contract.
Aylen, J.	216	18	18	5	25	7,582	29 50	"
Aylsworth, C. F.	....	....	25	54	7	9,554	120 91	Day.
Baker, J. C.	277	36	14	....	32	9,556	29 22	Contract.
Bennett, G. A.	4	....	35	168	20	5,232	25 28	Day.
Blanchet, G. H.	....	150	....	....	15	26,340	175 60	"
Brenot, L.	39	31	....	....	7	17,431	249 01	"
Cautley, R. H.	296	36	23	....	35	10,539	29 69	Contract.
Christie, Wm.	280	33	145	....	45	11,225	24 51	"
Côte, J. L.	282	24	....	....	30	9,119	29 80	"
Cumming, A. L.	4	....	37	144	22	12,193	54 19	Day
Davies, T. A.	33	42	110	....	486	12,483	25 69	Contract.
Day, H. S.	....	....	93	....	93	7,875	84 68	Day.
Deans, W. J.	2	....	29	23	81	8,525	105 25	"
Fairchild, C. C.	23	24	....	....	258	8,722	33 81	Contract.
Francis, J.	11	5	8	12	140	10,907	77 91	Day.
Gibbon, Jas.	20	....	39	3	275	7,117	25 88	Contract.
Green, T. D.	282	30	31	8	351	9,227	26 29	"
Hawkins, A. H.	....	120	....	....	120	18,938	157 82	Day
Heathcott, R. V.	231	40	111	....	382	9,330	24 42	Contract.
Herriot, G. H.	27	3	13	18	61	8,181	134 11	Day.
Holcroft, H. S.	347	42	22	....	411	12,197	29 68	Contract.
Inkster, O.	264	24	41	....	32	9,178	27 90	"
Kimpe, M.	426	42	60	....	528	14,881	28 18	"
Laurie, R. C.	19	12	54	....	265	6,692	25 25	"
Lighthall, A.	20	....	[illegible]	31	60	8,939	148 98	Day.
MacLennan, A. L.	10	11	70	26	210	6,525	31 07	"
Martindale, E. S.	57	12	6	134	209	10,753	51 45	"
Matheson, H.	....	....	4	109	152	3,579	23 55	"
McFarlane, J. B.	....	88	....	....	88	22,717	258 15	"
McFarlane, W. G.	586	96	70	....	752	19,395	25 79	Contract.
McGrandle, H.	150	28	....	....	178	5,566	31 27	"
McMillan, Geo.	25	44	....	4	73	19,653	269 2	Day.
McNaughton, A. L.	86	18	7	....	111	10,564	95 17	"
Montgomery, R. H.	261	60	206	6	533	12,310	23 10	Contract.
Morrier, J. E.	236	36	8	....	352	9,304	26 4	"
Pequegnat, M.	210	21	1	10	256	7,030	27 46	"
Plunkett, T. H.	....	....	....	130	130	17,661	135 85	Day.
Penton, A. W.	....	72	....	....	72	14,233	197 68	"
Powell, W. H.	278	50	164	....	492	12,063	24 52	Contract.
Purser, R. C.	10	....	47	80	137	4,940	36 06	Day.
Ransom, J. T.	335	....	18	6	359	10,685	29 76	Contract.
Rinfret, C.	....	....	16	787	803	10,840	13 50	Day.
Robinson, E. W.	....	163	....	....	163	16,753	102 78	"
Rolfson, O.	....	90	....	2	92	26,944	292 87	"
Roy, J. E.	240	12	214	....	466	10,045	21 56	Contract.
Saint Cyr, A.	9	82	....	15	106	13,879	130 93	Day.
Scott, W. A.	30	24	8	168	230	9,467	41 16	"
Smith, J. H.	555	79	58	2	694	18,967	27 33	Contract.
Steele, I. J.	300	40	126	....	466	11,921	25 58	"
Stewart, L. D. N.	240	36	27	....	303	8,866	29 26	"
Stewart, W. M.	295	48	37	....	380	10,934	28 77	"
Stock, J. J.	324	54	18	....	396	11,492	29 02	"
Street, P. B.	10	4	5	288	307	8,746	28 49	Day.
Taggart, C. H.	57	....	38	20	115	10,426	90 66	"
Teasdale, C. M.	48	....	12	....	60	1,580	26 33	Contract.
Waddell, W. H.	566	36	225	....	827	19,554	23 64	"
Waldron, J.	290	....	....	1	291	8,570	29 45	"
Walker, C. M.	75	26	9	22	132	11,348	85 97	Day.
Young, W. H.	212	30	10	6	258	8,177	31 69	Contract.
Total	10,098	2,041	2,577	2,317	17,033	715,247		

APPENDIX No 3.

LIST of lots in the Yukon Territory, survey returns of which have been received from April 1, 1911, to March 31, 1912.

GROUP No. 2.

Lot No.	Acres.	Surveyor.	Year of Survey.	Date of Approval.	Claimant.	Remarks.
228	10·00	F. H. Kitto....	1911	Apr. 12, 1912...	Granville Power Co........	Surface.
295	1·60	"	1911	Mar. 21, 1912.	Chas. Fisher...........	Surface.
298	160·00	"	1911	Mar. 21, 1912 ..	Chas. Fisher........	Surface.
321	51·65	"	1911	Apr. 12, 1912..	Granville Power Co	"Husky" Min. Cl.
322	51·65	"	1911	Apr. 12, 1912...	Granville Power Co	"Whiteside" "
323	51·65	"	1911	Apr. 12, 1912 ..	Granville Power Co......	"Boyle" "
324	51·65	"	1911	Apr. 12, 1912...	Granville Power Co	"Kitto" "
325	51·65	"	1911	Apr. 12, 1912...	Granville Power Co	"Alexander" "
326	51·65	"	1911	Apr. 12, 1912...	Granville Power Co........	"Granville" "
333	51·65	"	1911	Apr. 12, 1912 ..	Granville Power Co	"Morgan" "
334	51·65	"	1911	Apr. 12, 1912...	Granville Power Co......	"Maggie" "
335	51·65	"	1911	Apr. 12, 1912 ..	Granville Power Co.........	"North Fork" "
336	51·65	"	1911	Apr. 12, 1912 ..	Granville Power Co.........	"Elma" "
337	51·65	"	1911	Apr. 12, 1912 ..	Granville Power Co.........	"White Channel John," Min. Claim
338	51·65	"	1911	Apr. 12, 1912...	Granville Power Co	"Stella" "
340	22·3	"	1911	Apr. 12, 1912...	John Lee	Surface.

GROUP No. 5.

Lot No.	Acres.	Surveyor.	Year of Survey.	Date of Approval.	Claimant.	Remarks.
115	45·56	H. G. Dickson.	1908	Jan. 2, 1912....	William Clark	"Verona" Mineral Claim.
162	43·39	" ..	1912	Apr. 12, 1912...	H. G. Dickson	"Spring Creek" "
173	160·00	" ..	1910	Sept. 26, 1911...	Karl Weik	"Keewenaw" "
174	51·65	" ..	1910	Sept. 26, 1911...	"	"Gladstone" "
175	37·19	" ..	1910	Jan. 5, 1912.....	"	Surface.
201	50·02	" ..	1910	Sept. 26, 1911...	"	"Northwest" Mineral Claim.
202	46·50	" ..	1910	Sept. 26, 1911...	"	"Poppy" "
203	41·64	" ..	1910	Sept. 26, 1911...	"	"Leary" "
204	50·06	" ..	1910	Sept. 26, 1911...	"	"Evening Star" "
205	46·53	" ..	1910	Sept. 26, 1911...	"	"Monteray" "
206	51·65	" ..	1910	Sept. 26, 1911...	"	"Star Ruby" "
207	44·71	" ..	1910	Sept. 26, 1911...	"	"Wild Rose" "
208	51·65	" ..	1910	Sept. 26, 1911...	"	"Big Four" "
209	50·58	" ..	1910	Sept. 26, 1911...	"	"Alice" "
210	50·90	" ..	1910	Sept. 26, 1911	"	"Solo" "
211	43·67	" ..	1910	Sept. 26, 1911...	"	"Brimstone No. 1 Min. Cl.
212	50·24	" ..	1910	Sept. 26, 1911...	"	"King Bee" "
213	23·39	" ..	1910	Sept. 26, 1911...	"	"J. C." "
214	44·62	" ..	1910	Sept. 26, 1911...	"	"Vivian" "
215	33·76	" ..	1910	Sept. 26, 1911 ..	"	"White Pass" "
216	38·02	" ..	1910	Sept. 26, 1911...	"	"Skagway" "
217	40·45	" ..	1910	Sept. 26, 1911 ..	"	"Yukon" "
218	24·94	" ..	1910	Sept. 26, 1911 ..	"	"Bismarck" "
219	51·65	" ..	1910	Sept. 26, 1911...	"	"Contact"
220	39·78	" ..	1910	Sept. 26, 1911...	"	"Zelandian" "
221	25·92	" ..	1910	Sept. 26, 1911...	"	"Rawhide" "
222	64·61	" ..	1911	Dec. 29, 1911...	J. O. Williams *et al.*.........	"May" "
223	23·89	" ..	1911	Dec. 29, 1911...	"	"Shamrock" "

GROUP No 6.

Lot No.	Acres.	Surveyor.	Year of Survey.	Date of Approval.	Claimant.	Remarks.
115	51 65	H. G. Dickson..	1910	....	A. R. Auston *et al*	"Utah" Min. Claim.
116	51·08	" ..	1910	....	"	"Rambler" "
117	45·38	" ..	1910	... .	"	"Montana" "
118	51 65	" ..	1910	....	"	"Colorado" "
119	50 09	" ..	1910	....	"	"Texas" "
120	49 68	" ..	1910	....	"	"Reco" "

GROUP No. 10.

Lot No.	Acres.	Surveyor.	Year of Survey.	Date of Approval.	Claimant.	Remarks.
15	51·65	H. G. Dickson..	1910	May 31, 1911...	John McMeekin *et al.*......	"Bonanza" Min. Cl.
16	160 00	"	1910	May 31, 1911...	"	"County Antrim" Min. Claim.
17	51·65	"	1910	Jan. 5, 1912...	Karl Anderson...........	"Sunnyside" "
19	51·20	"	1910	May 31, 1911 ..	John McMeekin *et al*	"Eldorado" "
20	43 81	" ...	1910	May 31, 1911...	"	"Hazel May" "
21	30 71	"	1910	May 31, 1911...	"	"Leroy" Fractional Min. Claim.
22	10·49	"	1911	Sept. 25, 1911...	S. Rawlinson.............	Surface.
27	31·82	"	1910	Apr. 12, 1912...	Thos. E. Bee *et al*....	"North Star" M. Cl.
28	48 75	"	1910	Apr. 12, 1912...	"	"South Star" "
29	15 33	"	1910	Apr. 12, 1912...	"	Surface.
30	15·70	"	1910	May 31, 1911...	John McMeekin *et al*.......	"Star" Fract. M. Cl.
31	9 93	" .. .	1910	Sept. 25, 1911...	Thos. E. Bee	Surface.
32	5·10	"	1910	Sept. 25, 1911...	C. F. Mack...............	Surface.

GROUP No. 15.

Lot No.	Acres.	Surveyor.	Year of Survey.	Date of Approval.	Claimant.	Remarks.
3	5·65	H. G. Dickson..	1911	Jan. 4, 1912...	Harry Chambers...........	Surface.

APPENDIX No. 4.

LIST of miscellaneous surveys in the Yukon Territory, returns of which have been received from April 1, 1911, to March 31, 1912.

Year.	Surveyor.	Description of Survey.
1904	C. W. MacPherson.........	Yukon Crossing-Whitehorse division, in fifteen sections of ten miles each, of the Dawson-Whitehorse road.
1911	H. G. Dickson..............	Last division of Carmack's reference traverse for the Department of the Interior.

APPENDIX No. 5.

STATEMENT of work executed in the office of the Chief Draughtsman:—

Letters of instruction to surveyors	241
Progress sketches received and filed	1,142
Declarations of settlers received and filed	86
Returns of timber berths received	29
Plans received from surveyors	330
Field books received from surveyors	552
Timber reports received	235
Observations for magnetic declination received	746
Preliminary township plans prepared	328
Sketches made	5,995
Maps and tracings made	80
Plans of Yukon lots received	64
Plans of miscellaneous Yukon surveys received	16
Returns of surveys examined—	
Township subdivision	276
Township outline	252
Road plans	293
Railway plans	180
Yukon lots	64
Miscellaneous Yukon surveys	16
Mineral claims	51
Timber berths	49
Correction and other miscellaneous surveys	196
Township plans compiled	500
Townsite settlement and other plans compiled	19
Proofs of plans examined	34
Township plans printed	797
Townsite and settlement plans printed	11
Miscellaneous plans printed	106
Descriptions written	11
Areas calculated	1,635
Pages of field notes copied	343
Applications for various information dealt with	2,973
Files received and returned	1,848
Letters and memoranda drafted	8,711
Books received from Record Office and used in connection with office work	5,266
Books returned to Record Office	5,417
Plans other than printed township plans received from Record Office and used in connection with office work	951
Plans returned to Record Office	890
Volumes of plans received from Record Office and used in connection with office work	140
Volumes of plans returned to Record Office	129
Books sent to Record Office to be placed on record	484
Plans other than township plans sent to Record Office to be placed on record	137
Sectional maps (3 miles to 1 inch)—	
Revised	43
Reprinted	34
Sectional maps (6 miles to 1 inch)—	
Reprinted	23

APPENDIX No. 6.

LIST of new editions of Sectional Maps compiled from April 1, 1911, to March 31, 1912.

Scale 3 miles to one inch.

No.	Name.	No	Name.	No.	Name.	No.	Name.
18	Wood Mountain....	119	Regina.........	172	Fairford............	271	Mossy Portage ......
23	Emerson..	120	Qu'Appelle....	173	Washow	313	Brulé. ....
64	Porcupine	121	Riding Mountain....	213	Athabaska..	318	Shell River....... ..
65	Macleod............	122	Manitoba House....	214	Rocky Mt. House...	319	Prince Albert North
68	Swift Current.......	123	Fort Alexander.	216	Sullivan Lake.	320	Carrot River ....
70	Moose Mountain....	163	Donald............	221	Swan River.	366	Saddle Lake.........
71	Brandon...	165	Rosebud..	266	Ribstone Creek......	462	Dunvegan.........
72	Portage la Prairie...	169	Touchwood.........	269	Prince Albert South.		
73	Winnipeg..........	170	Yorkton	270	Pasquia....		

Scale 6 miles to one inch.

No.	Name.	No.	Name.	No.	Name.	No.	Name.
20	Souris.........	71	Brandon............	169	Touchwood.	219	Humboldt........
21	Turtle Mountain.. .	72	Portage la Prairie...	172	Fairford...........	221	Swan River..........
64	Porcupine	73	Winnipeg...	173	Washow	267	Battleford.........
68	Swift Current.......	118	Rush Lake..........	214	Rocky Mt. House...	268	Carlton.... ....
69	Moose jaw	120	Qu'Appelle.........	216	Sullivan Lake. ...	366	Saddle Lake ....
70	Moose Mountain ...	163	Donald.	218	Saskatoon		

APPENDIX No. 7.

STATEMENT of work executed in the Photographic Office from April 1, 1911 to March 31, 1912.

—	3¼ x 3¼	3¼ x 5½	5 x 7	8 x 10	10 x 12	11 x 14	15 x 18	16 x 18	18 x 20	20 x 24	24 x 30	24 x 32	30 x 36	32 x 49	36 x 42	42 x 48	Total.
Dry plates and films	....	580	832	....	....	23	....	....	....	....	....	....	....	....	....	....	1,435
Bromide prints	....	18	4	17	5	344	....	80	96	13	24	....	21	....	38	69	732
Solio prints	....	....	1,081	202	....	29	....	....	....	....	....	....	....	....	....	....	1,312
Velox prints	366	6,522	3,664	13	57	....	....	....	....	....	....	....	....	....	....	....	10,622
Artura prints	....	332	1,027	4	....	....	....	....	....	....	....	....	....	....	....	....	1,363
Vandyke prints	....	....	8	10	13	18	....	56	82	48	62	....	114	....	99	9	519
Blue prints	....	42	8	25	71	47	....	85	90	79	140	....	104	....	61	98	853
Lantern transparencies	195	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	195
Photographs mounted	....	443	614	21	1	15	....	22	16	....	4	....	....	....	....	....	1,136
Wet plate negatives	....	....	....	67	....	174	105	978	116	21	....	2	....	....	....	....	1,463
Photo-litho plates	....	....	....	....	....	....	....	....	1,114	....	....	....	....	27	....	....	1,141
Totals	561	7,937	7,238	359	150	650	105	1,221	1,511	161	230	2	242	27	198	176	20,771

APPENDIX No. 8.

STATEMENT of work executed in the Lithographic Office from April 1, 1911, to March 31, 1912.

Month.	Maps.			Township plans.			Forms.		
	No.	Copies.	Impressions.	No.	Copies.	Impressions.	No.	Copies.	Impressions.
1911.									
April..........	8	4,000	4,000	122	24,400	24,400	1	600	1,200
May..........	11	7,150	15,375	38	7,600	8,200	2	10,600	10,600
June..........	1	150	150	1	200	200	4	375	375
July..........	15	4,400	5,225	87	17,100	18,400	2	550	650
August..........	15	11,025	26,825	58	11,600	12,800	9	4,000	4,900
September..........	13	5,950	7,125	155	31,000	31,000	7	6,260	6,260
October..........	16	7,250	7,250	37	7,206	7,206	3	720	920
November..........	8	3,820	3,820	158	31,600	31,600	3	2,220	2,220
December..........	10	4,500	4,500	98	19,600	19,600	......	....	....
1912.									
January..........	11	16,280	71,075	55	11,000	12,000	9	19,925	22,925
February..........	9	4,125	5,250	......	....	....	4	2,500	2,500
March..........	17	87,825	156,140	32	6,100	6,400	6	15,200	15,200
Total..........	134	156,475	306,735	841	168,006	171,806	50	62,950	67,750

RECAPITULATION.

——	No.	Copies.	Impressions.	Cost.
Maps..........	134	156,475	306,735	2,734 00
Townships..........	841	168,006	171,806	4,060 00
Forms..........	50	62,950	67,750	850 00
Grand total..........	1,025	387,431	546,291	7,644 00

APPENDIX No. 9.

LIST of employes 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. Division.	Sub-division.	Duties of Office.	Salary.
				$
Deville, E., D.T.S., LL.D.	1	A	Surveyor General	3,650
	Correspondence.			
Brady, M.	1	B	Secretary	2,400
Cullen, M.J.	3	A	Stenographer	1,200
Moran, J. F.	3	A	Typewriter and clerk	900
Williams, E. R.	3	A	Correspondence clerk	900
Addison, W. G.	3	B	Typewriter	800
Pegg, A.			Messenger	800
O'Meara, M.T.			"	550
Pick, A. C.			"	500
	Accounts.			
Hunter, R. H.	2	A	Accountant	2,100
Wilkinson, Percy	3	A	Asst. Accountant	1,100

Chief Draughtsman's Office—General direction and supervision of the technical work.

Shanks, T., B.A.Sc., D.L.S.	1	B	Chief draughtsman	2,550
Brown, T. E., B.A.	1	B	Asst. chief draughtsman	2,550

Chief Draughtsman's Office, First Section—Survey instructions and general information.

Name.	Classification. Division	Classification. Sub-division.	Duties of Office.	Salary.
				$
Barber, H. G., Grad. S.P.S.	2	A	Chief of section	1,900
Rice, F. W., Grad. School of Mining	2	A	Asst. chief of section	1,900
MacIlquham, W. L., B.Sc.	2	A	„ „	1,900
Peaker, W. J., Grad. S.P.S	2	A	„ „	1,600
Sylvain, J	2	A	„ „	1,650
Carroll, M. J., Grad. S.P.S	2	B	Draughtsman	1,600
Rochon, E. C.	2	B	„	1,400
McRae, A. D., B.A., B.Sc	2	B	„	1,400
Grant, A. W., B.A	2	B	„	1,400
Hayward, H. E., B.Sc	2	B	„	1,300
Milliken, J. B., B.A., B.Sc.	2	B	„	1,300
MacMillan, J.P., B.E.	2	B	„	1,300
Wadlin, L. N., B.Sc	2	B	„	1,200
Cordukes, J. P., B.Sc	2	B	„	1,200
Gagnon, J. N. H., B.A.S	2	B	„	1,050
Armstrong, W. B., B.Sc	2	B	„	1,200
Spero, J. E	2	B	„	1,200
Nevins, L. A., B.A	2	B	„	1,200
McDonald, J. F., B.A	2	B	„	1,200
Holbrook, C. H	3	A	Clerk	950
Burkholder, E. L.	3	A	„	900

Chief Draughtsman's Office, Second Section—Surveys in Manitoba, Saskatchewan, Alberta and Yukon Territory.

Name.	Division	Sub-division	Duties of Office.	Salary.
Nash, T. S., Grad. S.P.S., D.L.S	1	B	Chief of section	2,550
Burgess, E. L., Grad. S.P.S., D.L.S., O.L.S	2	A	Asst. chief of section	1,900
Dennis, E. M., B.Sc	2	A	„ „	1,900
Elder, A. J., Grad. S.P.S., D.L.S.	2	A	„ „	1,900
Henderson, F. D., Grad. S.P.S., D.L.S.	2	A	„ „	1,900
Hill, S. N., Grad. S.P.S	2	A	„ „	1,900
Genest, P. F. X., Q.L.S	2	A	„ „	1,900
Robertson, D. F., Grad. S.P.S.	2	A	„ „	1,700
Kitto, F.H., D.L.S.	2	A	In charge of Dawson office	1,600
Sutherland, H. E., B.Sc.	2	B	Draughtsman	1,400
McClennan, W. D.	2	B	„	1,600
Roger, A., O.L.S.	2	B	„	1,600
Spreckley, R. O.	2	B	„	1,500
Goodday, Leonard	2	B	„	1,400
Bray, R. P	2	B	„	1,400
Harrison, E. W.	2	B	„	1,300
Ault, H. W	2	B	„	1,300
Lytle, W. J.	2	B	„	1,050
LaBeree, E. E.	2	B	„	1,050
Jones, G. S., Grad. S.P.S., O.L.S.	2	B	„	1,050
Bradley, J. D	2	B	„	1,050
Cagnat, G. H.	2	B	„	1,050
Fournier, O. E., B.A.S.	2	B	„	1,050
Thomas, A. S., B.Sc.	2	B	„	1,200
Smith, H. C.	2	B	„	1,200
Macdonald, J. A.	3	B	Clerk	800

Chief Draughtsman's Office, Third Section—(Imperial Building, Queen street). Copying plans for reproduction.

Name.	Classification. Division	Sub-division.	Duties of Office.	Salary.
				$
Engler, Carl., B. A., D.L.S.	1	B	Chief of section	2,100
May, J. E.	2	A	Asst. chief of section	1,900
O'Connell, J. R.	2	A	Draughtsman	1,700
Moule, W. J.	2	B	"	1,600
Helmer, J. D.	2	B	"	1,100
Dawson, R. J.	2	B	"	1,100
Archambault, E.	2	B	"	1,100
Clarke, G. N	2	B	"	800
Watters, James	3	A	Printer	1,200
McLennan, A. G	3	A	Clerk	1,200
Brown, A.	3	A	"	900
Ebbs, E. J	3	A	"	900
Baril, C.	3	B	Draughtsman	750

Chief Draughtsman's Office, Fourth Section—(Metcalfe street, corner of Slater). British Columbia surveys.

Rowan-Legg, E. L.	2	A	Chief of section	2,050
Gillmore, E. T. B., Grad. R.M.C.	2	A	Asst. chief of section	2,000
Lawe, H., D.L.S.	2	A	" "	1,900
Morley, R. W.	2	A	" "	1,900
Weld, W. E.	2	A	" "	1,900
Wilson, E. E. D., B. Sc.	2	A	" "	1,600
Harris, K. D.	2	B	Draughtsman	1,300

Chief Draughtsman's Office, Fifth Section—(Imperial Building, Queen street). Mapping.

Smith, J.	1	B	Chief of section	2,550
Begin, P. A.	2	A	Asst. chief of section	1,950
Flindt, A. H.	2	A	" "	1,700
Blanchet, A. E.	2	B	Draughtsman	1,600
Davies, T. E. S	2	B	"	1,600
Perrin, V.	2	B	"	1,600
D'Orsonnens, A.	2	B	"	1,600
Davy, E.	2	B	"	1,400
Villeneuve, E.	2	B	"	1,100
Bergin, W.	2	B	"	1,100
Howie, Jas.	2	B	"	1,000
Purdy, W. A	2	B	"	1,100
Brigly, J. H.	2	B	"	1,300

Chief Draughtsman's Office, Sixth Section—(Imperial Building, Queen street).
Scientific and topographical work.

Name.	Classification. Division	Sub-division	Duties of Office.	Salary.
				$
Dodge, G. B., D.L.S	1	B	Chief of section	2,550
Coté, J. A., Grad. R.M.C	2	A	Asst. chief of section	1,600
Watt, G. H., Grad. S.P.S., D.L.S	2	A	" "	1,900
Blanchard, J. F	2	B	Draughtsman	1,050
Chartrand, D. E., B.Sc	2	B	"	1,100
Colquhoun, G.A., B.Sc	2	B	"	1,200
Cousineau, A., B.Sc	2	B	"	1,100
Dozois, L. O. R., Grad. R.M.C	2	B	"	1,100
Freeland, J. J., M.A	2	B	"	1,200
Herbert, W. H., B.Sc	2	B	"	1,200
Parry, H., B.Sc., D.L.S.	2	B	"	1,000
Ross, R.C., B.Sc	2	B	"	1,200
Lynch, F. J	3	B	Typewriter	800
Watson, J. W	3	B	Clerk	750

Geographic Board (Woods Building, Slater street).

Whitcher, A. H., F.R.G.S., D.L.S	2	A	Secretary	2,100 00

Photographic Office (Metcalfe street, corner Slater street).

Carruthers, R. K	2	A	Process photographer	1,900
Woodruff, John	2	A	Chief "	1,900
Smith, L. G	2	B	Photographer	800
Whitcomb, H. E	3	A	"	1,200
Morgan, W. E	3	A	"	1,200
Kilmartin, A	3	A	Asst. photographer	900
Devlin, A	3	B	"	800
Ouimet, E. G	3	B	"	800

Lithographic Office (unclassified) (Metcalfe street, corner Slater street).

Name.	Occupation.	Salary.
Moody, A	Foreman	$27 00 per week.
Burnett, E	Lithographer	25 00 "
Thicke, C. R	"	23 00 "
Deslauriers, J. H	Transferrer	20 00 "
Bergin, J	Printer	21 00 "
Thicke, H. S	"	20 00 "
Boyle, S	Stone polisher	15 00 "
Gagnon, J	Press feeder	12 00 "
Kane, P	"	9 50 "
Easton, R. M	Printer	19 50 "
Hare, E. H	Asst. photographer	15 00 "

APPENDIX No. 10.

LIST of Dominion Land Surveyors who have been supplied with Standard Measures.

Name.	Address.	Date of Birth.	Date of Appointment or of Commission.	Remarks.
Akins, James Robert	Ottawa, Ont	Sept. 2, '76	Mar. 14, '10	
Allison, Calvin Bruce	SouthWoodslee, Ont.	June 16, '84	Mar. 28, '10	
Ashton, Arthur Ward	Ottawa, Ont	Nov. 5, '80	May 29, '08	
Austin, George Frederick	Not known		April 14, '72	
Aylen, John	North Bay, Ont		May 29, '85	
Aylsworth, Charles Fraser	Madoc, Ont	April 21, '62	May 13, '86	O. L. S.
Baker, James Clarence	Vermilion, Alta	May 12, '78	May 18, '06	
Baker, Mason Hermon	St. Thomas, Ont	July 9, '84	Aug. 6, '08	O. L. S.
Bartlett, Ernest	Smithville, Ont	'83	Jan. 16, '11	
Bayne, George A	Winnipeg, Man	Oct. 25, '50	April 14, '72	M. L. S.
Beatty, David	Parry Sound, Ont	Dec. 22, '42	April 14, '72	O. L. S.
Begg, William Arthur	Hamilton, Ont	July 15, '82	June 8, '09	
Belanger, Phidime Roch Arthur	Ottawa, Ont	Mar. 5, '53	May 17, '80	Inspector of Surveys, Topographical Surveys Branch, Dept. of the Interior.
Belleau, Joseph Alphonse	Ottawa, Ont	Sept. 30, '56	May 15, '83	Topographical Surveys Branch, Dept. of the Interior.
Belyea, Albert Palmer Corey	Edmonton, Alta		July 14, '09	
Bemister, George Bartlett	Winnipeg, Man		June 11, '78	M. L. S. Engineering Dept. C. N. R.
Bennett, George Arthur	Eden, Ont	May 18, '86	Aug. 25, '10	
Berry, Edward Wilson	Seaforth, Ont	Aug. 26, '81	May 18, '11	
Bigger, Charles Albert	Ottawa, Ont	Aug. 15, '53	Mar. 30, '82	B.C.L.S., O.L.S., Assistant Superintendent Geodetic Survey.
Bingham, Edwin Ralph	Fort William, Ont	'78	Oct. 25, '06	O. L. S.
Blanchet, Guy Houghton	Ottawa, Ont	Feb. 12, '84	Mar. 10, '10	
Boswell, Elias John	Not known		Mar. 18, '03	O. L. S., M. L. S.
Bourgeault, Armand	St. Jean Port Joli, Que	Feb. 23, '58	Mar. 29, '83	Q. L. S.
Bourgault, Charles Eugene	Lauzon, Levis, Que	Sept. 6, '61	Feb. 21, '88	
Bourget, Charles Arthur	Lauzon, Que	Aug. 26, '51	May 14, '84	Q. L. S.
Bowman, Edgar Peterson	West Montrose, Ont		Sept. 26, '07	O. L. S.
Bowman, Herbert Joseph	Berlin, Ont	June 18, '65	Feb. 16, '88	O. L. S.
Brabazon, Alfred James	Ottawa, Ont		May 13, '82	Boundary Survey, Dept. of the Interior.
Brady, James	Golden, B. C	Nov. 24, '40	April 14, '72	O. L. S., B. C. L. S.
Bray, Samuel	Ottawa, Ont	Nov. 5, '46	Nov. 14, '83	O. L. S., Chief Surveyor, Dept. of Indian Affairs.
Bray, Lennox Thomas	Amherstburg, Ont	Mar. 14, '77	Feb. 18, '03	O. L. S.
Brenot, Lucien	Ottawa, Ont	Aug. 31, '87	Mar. 18, '10	
Bridgland, Morrison Parsons	Calgary, Alta	Dec. 20, '78	Mar. 10, '05	
Broughton, George Henry	Penticton, B.C	Aug. 12, '86	June 3, '09	B. C. L. S.
Brown, Charles Dudley	Winnipeg, Man	Feb. 25, '83	April 4, '10	
Brown, Edgar Carl	Regina, Sask	Nov. 28, '86	May 23, '11	
Brown, Thomas Wood	Edmonton, Alta		June 21, '09	
Brownlee, James Harrison	Vancouver, B.C	Mar. 22, '56	April 15, '87	M. L. S., B. C. L. S.
Bucknill, Walter Birch	Vancouver, B.C	May 8, '73	Mar. 19, '08	B. C. L. S.
Burd, James Henry	Weyburn, Sask	Sept. 7, '71	May 18, '11	O. L. S., S. L. S.
Burgess, Edward LeRoy	Ottawa, Ont	May 5, '78	Feb. 23, '05	O. L. S., T. S. Branch, Dept. of Interior.
Burnet, Hugh	Victoria, B.C		June 22, '85	O. L. S., B. C. L. S.
Burwash, Nathaniel Alfred	Whitehorse, Y.T	Sept. 28, '79	Mar. 6, '07	O. L. S.
Burwell, Herbert Mahlon	Vancouver, B.C	Oct. 23, '63	Feb. 17, '87	B. C. L. S.
Campbell, Alan John	Sidney, B.C	Oct. 1, '82	April 13, '09	
Campbell, Alexander Stewart	Kingston, Ont	Mar. 7, '80	Mar. 6, '09	
Carbert, Joseph Alfred	Medicine Hat, Alta	Feb. 4, '56	May 12, '80	O.L.S., District Engineer and Surveyor, Dept. of Public Works, Alberta.
Carpenter, Henry Stanley	Regina, Sask	Feb. 8, '74	Feb. 20, '01	Dept. of Public Works, O. L. S.
Carroll, Cyrus	Regina, Sask	Dec. 6, '34	April 14, '72	O. L. S.

SESSIONAL PAPER No. 25b

APPENDIX No. 10.—*Continued.*

LIST of Dominion Land Surveyors who have been supplied with Standard Measures—*Continued.*

Name.	Address.	Date of Birth.	Date of Appointment or of Commission	Remarks.
Carson, Percy Alexander	Kamloops, B.C.	Dec. 25, '77	Feb. 22, '06	Hydrographic Survey.
Carthew, William Morden	Edmonton, Alta	Oct. 19, '86	Mar. 29, '10	
Cautley, Reginald Hutton	Edmonton, Alta	Dec. 6, '79	May 1, '05	
Cautley, Richard William	Edmonton, Alta	Aug. 3, '73	Sept. 2, '96	
Cavana, Allan George	Orillia, Ont	Jan. 22, '58	Nov. 16, '76	O L S.
Charlesworth, Lionel Clare	Edmonton, Alta	Nov. 17, '73	Mar. 24, '03	O L.S., Dept. of Public Works for Alberta.
Chase, Albert Victor	Orillia, Ont	Mar. 4, '83	Oct. 11, '10	O L. S.
Chilver, Charles Alonzo	Walkerville, Ont	Feb. 8, '83	Feb. 22, '07	
Christie, William	Prince Albert, Sask	Feb. 13, '76	Mar. 22, '06	
Clarke, Charles Wentworth	Regina, Sask	Nov. 19, '75	Mar. 24, '10	
Cleveland, Ernest Albert	Vancouver, B C	May 12, '74	June 27, '99	B C L S.
Coates, Preston Charles	Victoria, B C	May 16, '81	Apr. 19, '07	B.C L S.
Cokely, Leroy S.	Merritt, B C	Nov. 23, '84	Mar. 22, '10	
Côté, Joseph Adelard	Prince Albert, Sask	June 5, '64	May 14, '84	
Côté, Jean Léon	Edmonton, Alta	May 6, '67	Mar. 21, '90	
Cotton, Arthur Frederick	Nassett, B C	Aug. 8, '52	May 11, '80	O L S., B.C L.S.
Craig, John Davidson	Ottawa, Ont	Jan. 30, '76	Feb. 24, '02	Boundary Surveys, Dept. of the Interior.
Cumming, Austin Lewis	Cornwall, Ont	Aug. 25, '82	Feb. 3, '10	
Cummings, Alfred	Fernie, B.C	July 3, '80	Mar. 3, '09	B.C L S.
Cummings, John George	Cranbrook, B. C	Nov. 19, '73	Feb. 17, '04	B C L.S
Dalton, John Joseph	Weston, Ont.	June 12, '54	Apr. 17, '79	O L.S., D.T.S.
Davies, Thomas Attwood	Edmonton, Alta		Feb. 22, '06	
Dawson, Frederick James	Ashcroft, B C	Sept. 22, '86	Sept. 12, '10	
Day, Harry Samuel	St. John, N. B.	Nov. 14, '85	Mar. 9, '10	
Deans, Williams James	Brandon, Man	May 4, '60	May 13, '86	O L S.
de la Condamine, C.	High River, Alta	Feb. 13, '75	May 4, '10	
Dennis, John Stoughton	Calgary, Alta	Oct. 22, '56	Nov. 19, '77	D T S.
Denny, Herbert C.	Not known		Apr. 1, '82	
Dickson, Henry Godkin	Whitehorse, Y. T.	Mar. 29, '64	Mar. 19, '89	M L S.
Dickson, James	Fenelon Falls, Ont.	Oct. 30, '34	Apr. 14, '72	O L.S.
Dobie, James Samuel	Thessalon, Ont.	Oct. 15, '73	Mar. 22, '06	O L S.
Doupe, Jacob Lonsdale	Winnipeg, Man	Sept. 14, '67	Oct. 6, '88	M.L.S., Asst. Land Commissioner for C.P.R.
Drewry, William Stewart	Nelson, B.C	Jan. 20, '59	Nov. 14, '83	O.L S., B C L S.
Driscoll, Alfred	Edmonton, Alta	July 2, '65	Feb. 23, '87	B.C L.S.
Drummond, Thomas	Montreal, P Q.	1856	June 24, '78	D T S.
Ducker, William A	Winnipeg, Man	Apr. 4, '52	Mar. 30, '83	O.L.S., M L S.
Dumais, Paul T. Concorde	Hull, P.Q	Jan. 2, '47	Mar. 29, '82	Q.L S.
Earle, Wallace Sinclair	Victoria, B C.	Feb. 8, '89	May 18, '11	
Edwards, George	Ponoka, Alta	June 13, '42	Apr. 14, '72	O L S.
Edwards, William Milton	Lethbridge, Alta	June 21, '79	Apr. 5, '10	
Ellacott, Charles Herbert	Victoria, B C.	Dec. 24, '66	Feb. 22, '99	B C L S.
Empey, John Morgan	Calgary, Alta	Apr. 16, '71	Feb. 23, '05	O.L S
Engler, Carl	Ottawa, Ont	Sept. 30, '72	Feb. 23, '05	T S. Branch, Dept. of Interior.
Fairchild, Charles Courtland	Brantford, Ont.	Feb. 21, '67	Feb. 20, '01	O.L.S.
Farncomb, Alfred Ernest	Edmonton, Alta	May 22, '73	Mar. 12, '02	O L S.
Fawcett, Thomas	Ottawa, Ont	Oct. 28, '48	Nov. 18, '76	O L S., D T S. Boundary Surveys, Dept. of Interior.
Fawcett, Adam	Gravenhurst, Ont.		Feb. 22, '93	
Ferguson, George Hendry	Toronto, Ont	Jan. 20, '83	June 2, '09	
Findlay, Allan	Winnipeg, Man	Oct. 15, '80	Mar. 21, '08	
Fletcher, James Allan	Fletcher, Ont	Mar. 26, '89	May 18, '11	
Fontaine, Louis Elie	Levis, P.Q.	Oct. 3, '68	Nov. 30, '92	
Francis, John	Portage la Prairie, M	Dec. 22, '52	June 17, '75	M L S.
Galletly, James Simpson	Brooklin, Ont.	Apr. 15, '88	May 18, '11	
Garden, James Ford	Vancouver, B.C	Feb. 19, '47	May 13, '80	B C L S.
Garden, George H	Lethbridge		Apr. 14, '72	Deputy Surveyor for N.B.
Garden, Charles	Not known		Apr. 14, '72	Deputy Surveyor for N.B.

APPENDIX No. 10.—*Continued.*

LIST of Dominion Land Surveyors who have been supplied with Standard Measures—*Continued.*

Name.	Address.	Date of Birth.	Date of Appointment or of Commission.	Remarks.
Garner, Albert Coleman	S. Qu'Appelle, Sask.	Sept. 6, '78	May 27, '07	
Gauvreau, Louis Pierre	Not known		Apr. 14, '72	
Gibbon, James	Vancouver, B.C.	June 25, '60	Feb. 12, '91	O.L.S.
Glover, Arthur Edward	Toronto, Ont.	Mar. 4, '87	Mar. 11, '11	
Gordon, Maitland Lockhart	Vancouver, B.C.		Feb. 18, '04	B.C.L.S.
Gordon, Robert John	Lethbridge, Alta.	June 18, '69	Mar. 12, '02	
Gore, Thomas Sinclair	Victoria, B C.	1852	Apr. 19, '79	B.C.L.S.
Graham, John Robertson	Vancouver, B.C.	Apr. 18, '87	May 26, '10	
Gray, James Edward	Toronto, Ont.	Oct. 12, '81	Mar. 11, '11	
Green, Alfred Harold	Nelson, B.C	Jan. 20, '79	Feb. 23, '05	B.C.L.S.
Green, Thomas Daniel	Ottawa, Ont.	Dec. 21, '57	May 19, '84	O. L. S.
Green, Frank Compton	Nelson, B. C.		May 8, '03	B. C. L. S.
Grover, George Alexander	Toronto, Ont.		Feb. 18, '04	
Hamilton, Charles Thomas	Vancouver, B. C.	July 29, '84	May 18, '11	
Hamilton, James Frederick	Lethbridge, Alta.	Apr. 4, '69	June 2, '09	
Harris, John Walter	Winnipeg, Man.	Feb. 26, '45	Apr. 14, '72	O. L. S., M. L. S., City Surveyor.
Harrison, Edward	Belleville, Ont.		May 14, '10	
Harvey, Charles	Kelowna, B. C.	May 5, '76	Feb. 17, '04	B. C. L. S.
Hawkins, Albert Howard	Listowel, Ont	July 27, '62	Mar. 6, '06	
Heaman, John Andrew	Winnipeg, Man.	June 3, '75	July 15, '09	O. L. S.
Heathcott, Robert Vernon	Edmonton, Alta.	July 7, '81	May 13, '07	
Henderson, Walter	Not known		Nov. 17, '83	
Herriot, George Henry	Souris, Man.	Feb. 23, '83	Sept. 18, '09	
Heuperman, Frederick Justinus	Calgary, Alta.	July 23, '87	Mar. 13, '11	
Heuperman, Lambertus Fred.	Calgary, Alta.	Sept. 20, '81	Mar. 29, '10	
Hobbs, Wilfrid Ernest	Winnipeg, Man.	Mar. 12, '87	Mar. 5, '12	
Holcroft, Herbert Spencer	Toronto, Ont.	Sept. 4, '77	Feb. 18, '03	O. L. S.
Hopkins, Marshall Willard	Edmonton, Alta.	May 24, '61	Feb. 20, '01	O. L. S.
Hubbell, Ernest Wilson	Ottawa, Ont	Nov. 5, '62	May 19, '84	Chief Inspector of Surveys, Topographical Surveys Branch, Dept. of Interior.
Inkster, Oluff	Edmonton, Alta.	Mar. 25, '85	May 18, '11	
James, Silas	Toronto, Ont.	June 19, '34	Apr. 14, '72	O. L. S.
Jephson, Richard Jermy	Brandon, Man	Feb. 5, '54	May 12, '80	O. L. S., B. C. L. S.
Johnson, Alfred William	Kamloops, B. C.	Feb. 23, '74	Mar. 12, '02	B. C. L. S.
Keith, Homer Pasha	Edmonton, Alta.	Aug. 30, '85	Feb. 1, '11	
Kimpe, Maurice	Edmonton, Alta.	Jan. 17, '76	May 13, '07	
King, William Frederick	Dominion Observatory, Ottawa, Ont.	Feb. 19, '54	Nov. 21, '76	D.T.S. Chief Astronomer Dept. of Interior.
Kirk, John Albert	Summerland, B. C.	Jan. 9, '54	May 11, '80	O. L. S., B. C. L. S.
Kitto, Franklin Hugo	Dawson, Y. T.	Mar. 28, '80	Mar. 6, '08	
Klotz, Otto Julius	Dominion Observatory, Ottawa, Ont.	Mar. 31, '52	Nov. 19, '77	O. L. S., D. T. S., Astronomer, Dept. of Int.
Knight, Richard H.	Edmonton, Alta	June 7, '77	Feb. 18, '04	
Lang, John Leiper	Toronto, Ont.		Oct. 14, '08	
Latimer, Frank Herbert	Penticton, B. C.	May 23, '60	Nov. 13, '85	
Laurie, Richard C.	Battleford. Sask.	Jan. 31, '58	April 27, '83	
Lawe, Henry	Ottawa, Ont.	Feb. 28, '38	April 14, '72	O. L. S., M. L. S., Topographical Surv. Branch Dept. of Interior.
Lemoine, Charles Errol	Ville Montcalme, P. Q.		Mar. 31, '82	Q. L. S.
Lendrum, Robert Watt	Strathcona, Alta.	July 24, '34	May 15, '80	O. L. S.
Lighthall, Abram	Vancouver, B. C.	Mar. 30, '78	Dec. 25, '09	
Lindsay, James Herbert	Regina, Sask.	Nov. 27, '82	May 18, '11	
Lonergan, Gerald Joseph	Buckingham, P. Q.	Oct. 8, '71	Feb. 28, '01	Q.L.S., Insp. of Surveys. Dept. of Interior.
Loucks, Roy Wm. Egbert	Saskatoon, Sask.	Oct. 31, '84	Mar. 1, '12	
Lumsden, Hugh David	Ottawa, Ont.	Sept. 7, '44	April 14, 72	O. L. S.
MacLennan, Alexander L.	Toronto, Ont.	May 10, '78	Feb. 23, '05	
MacPherson, Charles Wilfrid	Dawson, Y. T.	Sept. 6, '71	Mar. 7, '00	O. L. S.

APPENDIX No. 10.—*Continued.*

LIST of Dominion Land Surveyors who have been supplied with Standard Measures—*Continued.*

Name	Address.	Date of Birth.	Date of Appointment or of Commission.	Remarks.
Magrath, Charles Alexander...	Ottawa, Ont........	April 22, '60	Nov. 16, '81	B. A. Sc., O.L.S., B.C.L.S., D. T. S., Member International Waterways Commission.
Martindale, Ernest Smith......	Kingsmill, Ont.....	May 20, '86	Mar. 11, '11	
Martyn, Oscar William........	Mitchell, Ont	Dec. 2, '88	Mar. 11, '11	
Matheson, Hugh......... ...	Ottawa, Ont......	May 2, '79	May 9, '11	
Meadows, William Walter.....	Maple Creek, Sask..	May 27, '73	Feb. 23, '05	O. L. S.
Miles, Charles Falconer	Toronto, Ont........	Jan. 30, '38	Apr. 14, '72	O.L.S. Inspector of Surveys, Dept. of Interior.
Mitchell, Benjamin Foster.....	Calgary, Alta	June 16, '80	April 16, '08	A. L. S.
Moberly, Harford Kenneth.....	Moosomin, Sask.....	—— '69	April 21, '03	
Molloy, John......	Winnipeg, Man. ..	Jan. 13, '49	April 14, '72	M. L. S.
Montgomery, Royal Harp......	Prince Albert, Sask	May 20, '82	Feb. 23, '05	O. L. S.
Moore, Herbert Harrison	Calgary, Alta	Dec. 1, '69	Feb. 17, '04	
Morrier, Joseph Eldedge......	Prince Albert, Sask	Aug. 29, '74	May 16, '07	
McArthur, James Joseph.. ...	Ottawa, Ont.	May 9, '56	April 17, '79	Boundary Survey, Dept. of Interior.
McCaw, Robert Daniel.........	Sidney, B. C.... ...	May 24, '83	Mar. 23, '09	
McColl, Gilbert Beebe	Winnipeg, Man.....	Oct. 8, '82	Mar. 20, '07	M.L.S., D.T.S
McColl, Samuel Ebenezer	Winnipeg, Man.....	July 17, '86	May 18, '11	
McDiarmid, Stuart Stanley....	Vancouver, B. C....	Aug. 4, '81	Feb. 23, '05	B.C.L.S
McEwen, Duncan Findlay.....	Edmonton, Alta....	Aug. 7, '73	May 18, '11	
McFadden, Moses.	Vancouver, B. C....	Aug. 26, '26	April 14, '72	O.L.S., M.L.S.
McFarlane, Walter Graham ...	Toronto, Ont	Sept. 28, '75	May 19, '05	
McFarlane, John Baird	Toronto, Ont	Feb. 25, '79	June 3, '08	
McFee, Angus......	Red Deer, Alta. ...	July 14, '46	April 19, '79	
McGeorge, William Graham. ..	Chatham, Ont.. ...	Mar. 22, '87	Mar. 21, '10	
McGrandle, Hugh........	Wetaskiwin, Alta...	Mar. 12, '57	Mar. 30, '83	O.L.S.
McKenzie, John..............	New Westminster, B. C....	Oct. 31, '47	Nov. 18, '87	
McLean, James Keachie.......	Ottawa, Ont........	Dec. 19, '51	April 1, '82	O.L.S. Dept. of Indian Affairs.
McMaster, William Angus Alexander..........................	Palmerston, Ont....	Feb. 1, '85	July 6, '10	
McMillan, George.	Finch, Ont	Dec. 9, '69	Feb. 22, '06	
McNaughton, Alexander L....	Cornwall, Ont......	Sept. 30, '81	Feb. 23, '05	O.L.S., B.C.L.S.
McPherson, Archibald John. ..	Regina, Sask.	—— '70	Feb. 21, '01	
McPhillips, George	Winnipeg, Man.....	April 26, '48	June 17, '75	O.L.S., M.L.S.
McPhillips, Robert Charles	Winnipeg, Man.....	April 24, '56	May 17, '80	
McVittie, Archibald W........	Victoria, B.C......	May 5, '58	Mar. 30, '82	B.C.L.S.
Nash, Thomas Sanford.	Ottawa, Ont	July 2, '75	Feb. 18, '01	Topographical Surveys Branch, Dept. of Inter.
Neville, Everett A...	Ruthven, Ont.......	Jan. 8, '87	May 18, '11	
Ogilvie, William	Ottawa, Ont	April 7, '46	April 14, '72	O.L.S.
O'Hara, Walter Francis..	Ottawa, Ont	....	Feb. 19, '95	O L.S.
Ord, Lewis Redman...........	Hamilton, Ont......	Oct 17, '56	April 1, '82	O.L.S.
Palmer, Philip Ebenezer.... .	Dorchester, N.B...	Mar. 6, '88	Mar. 7, '12	
Parsons, Johnstone Lindsay R..	Regina, Sask . .	Jan 18, '76	Feb. 23, '05	O.L.S.
Patrick, Allan Poyntz..........	Calgary, Alta. ...	July 18, '49	Nov. 19, '77	B.C.L.S., D.T.S.
Patten, Thaddeus James. ...	Little Current, Ont..	Feb. 4, '59	Mar. 29, '83	O.L.S.
Pearce, William..............	Calgary, Alta	Feb. 1, '48	May 10, '80	O.L.S., B.C.L.S.
Pearce, Seabury Kains.	Calgary, Alta	Dec. 6, '87	Mar. 9, '11	
Pequegnat, Marcel	Berlin, Ont	April 27, '86	June 6, '10	
Peters, Frederic Hatheway .. .	Calgary, Alta	Nov. 4, '83	Mar. 4, '10	Commiss'er of Irrigation.
Phillips, Edward Horace.	Saskatoon Sask. ...	Dec. 19, '78	Feb. 24, '02	
Phillips, Harold Geoffrey......	Saskatoon, Sask....	Sept. 3, '87	April 23, '10	
Pierce, John Wesley..........	Ottawa, Ont..... ...	....	Dec. 21, '09	
Plunkett, Thomas Hartley.....	Meaford, Ont.	June 1, '78	Mar. 12, '08	
Ponton, Archibald William....	Edmonton, Alta....	Jan. 25, '59	May 18, '81	O.L.S.
Powell, William Henry.......	Vancouver, B.C...	Dec. 22, '84	Feb. 22, '11	
Proudfoot, Hume Blake	Saskatoon, Sask....	June 23, '58	Mar. 28, '82	O.L.S.
Purser, Ralph Clinton.........	Windsor, Ont.....	April 7, '86	Feb. 2, '11	

APPENDIX No. 10.—*Continued.*

LIST of Dominion Land Surveyors who have been supplied with Standard Measures—*Continued.*

Name.	Address.	Date of Birth.	Date of Appointment or of Commission.	Remarks.
Rainboth, Edward Joseph	Ottawa, Ont	....	May 19, '81	Q.L.S., O.L.S.
Ransom, John Thomas	Toronto, Ont	Aug. 24, '88	Jan. 14, '11	
Reilly, William Robinson	Regina, Sask	Aug. 10, '57	Nov. 17, '81	O.L.S., M.L.S.
Richard, Joseph Francois	Ste. Anne de la Pocatiere, P.Q	....	May 13, '82	
Rinfret, Claude	Montreal, P.Q	Jan. 5, '86	Mar. 20, '08	Q.L.S.
Rinfret, Raoul	Montreal, P.Q	July 16, '56	Feb. 20, '60	Q.L.S.
Ritchie, Joseph Frederick	Prince Rupert, B.C	May 23, '63	Jan. 7, '89	B.C.L.S.
Robertson, Henry H	N. Timiskaming, P.Q.	Sept. 13, '47	April 14, '72	Q.L.S.
Roberts, Sydney Archibald	Victoria, B.C	April 10, '48	May 16, '85	B.C.L.S.
Roberts, Vaughan Maurice	Goderich, Ont	Mar. 22, '64	May 17, '86	
Robinson, Ernest Walter P.	Ottawa, Ont	May 8, '80	May 1, '08	
Robinson, Franklin Joseph	Regina, Sask	Oct. 20, '70	Feb. 20, '00	Deputy Minister of Public Works.
Rolfson, Orville	Walkerville, Ont	Feb. 26, '85	July 11, '08	
Rombough, Marshall Bedwell	Morden, Man	Oct. 14, '35	April 14, '72	M.L.S.
Rorke, Louis Valentine	Toronto, Ont	Feb. — '65	Aug. 13, '91	O.L.S. Inspector of Surveys for Ontario.
Ross, George	Welland, Ont	June 12, '53	Nov. 21, '82	O.L.S.
Ross, Joseph Edmund	Kamloops, B.C	Jan. 9, '61	Feb. 12, '91	O.L.S., B.C.L.S.
Routly, Herbert Thomas	Haileybury, Ont	Jan. 20, '78	Feb. 15, '11	
Roy, George Peter	Quebec, P.Q	Oct. 1, '52	Nov. 17, '81	Q.L.S.
Roy, Joseph George Emile	Quebec, P.Q	Mar. 14, '86	May 25, '10	
Saint Cyr, Jean Baptiste	Montreal, P.Q	Dec. 17, '66	Feb. 17, '87	Q.L.S.
Saint Cyr, Arthur	Ottawa, Ont	Nov. — '60	Feb. 17, '87	
Saunders, Bryce Johnston	Edmonton, Alta	Oct. 17, '60	Nov. 16, '84	O.L.S.
Scott, Walter Alexander	Galt, Ont	Aug. 8, '85	Mar. 9, '09	
Seager, Edmund	Kenora, Ont	Nov. 22, '38	April 14, '72	O.L.S.
Sewell, Henry DeQuincy	Toronto, Ont	April 18, '48	May 16, '85	O.L.S.
Seymour, Horace Llewellyn	Edmonton, Alta	June 11, '82	Feb. 22, '06	O.L.S.
Shaw, Charles Aeneas	Greenwood, B.C	Nov. 16, '53	May 10, '80	O.L.S., B.C.L.S.
Shepley, Joseph Drummond	N. Battleford, Sask	Sept. 13, '79	Mar. 12, '06	
Smith, Charles Campbell	Ottawa, Ont	Jan. 1, '73	Feb. 22, '06	O.L.S.
Smith, Donald Alpine	Claude, Ont	Sept. 22, '80	April 21, '10	
Smith, James Herbert	Edmonton, Alta	Nov. 9, '76	Feb. 23, '05	
Soars, Henry Martin Robinson	Edmonton, Alta	April 22, '77	Nov. 2, '08	
Speight, Thomas Bailey	Toronto, Ont	Feb. 8, '59	Nov. 16, '82	O.L.S.
Starkey, Samuel M	Codys, N.B	Sept. 4, '37	April 14, '72	
Steele, Ira John	Ottawa, Ont	April 6, '81	April 16, '08	
Stewart, Elihu	Collingwood, Ont	Nov. 17, '44	April 14, '72	O.L.S.
Stewart, Lionel Douglas N	Collingwood, Ont	....	Jan. 27, '10	
Stewart, Will Malcolm	Saskatoon, Sask	Nov. 26, '84	June 6, '07	
Stewart, Louis Beaufort	Toronto, Ont	Jan. 27, '61	Nov. 22, '82	O.L.S., D.T.S. Professor of Surveying and Geodesy, University of Toronto.
Stewart, Alexander George	Ottawa	Aug. 16, '87	Mar. 14, '10	
Stewart, George Alexander	....	....	April 14, '72	O.L.S.
Stock, James Joseph	Ottawa, Ont	Aug. 16, '87	Mar. 2, '10	
Street, Paul Bishop	Toronto, Ont	Dec. 3, '81	Mar. 29, '10	
Stuart, Alexander Graham	Buckingham, P.Q	July 16, '88	May 9, '11	
Summers, Gordon Foster	Haileybury, Ont	....	Oct. 20, '10	
Taggart, Charles Henry	Ottawa, Ont	.... '83	May 9, '11	
Talbot, Albert Charles	Calgary, Alta	April 5, '56	May 13, '80	
Taylor Alexander	Portage la Prairie, Man	Aug. 6, '75	June 9, '04	M.L.S.
Taylor, William Emerson	Owen Sound, Ont	Aug. 3, '81	Dec. 16, '10	
Teasdale, Charles Montgomery	Concord, Ont	Oct. 18, '79	Mar. 9, '06	
Thompson, William Thomas	Grenfell, Sask	Nov. 1, '53	Nov. 19, '77	D.T.S.
Tipper, George Adrian	Brantford, Ont	July 25, '86	May 18, '11	
Tracy, Thomas Henry	Vancouver, B.C	June 25, '48	April 14, '72	O.L.S., B.C.L.S.
Tremblay, Alfred Joseph	Les Eboulements, P.Q.	....	Feb. 18, '90	

APPENDIX No. 10.—*Continued.*

LIST of Dominion Land Surveyors who have been supplied with Standard Measures—*Continued.*

Name.	Address.	Date of birth.	Date of Appointment or of Commission.	Remarks.
Tremblay, Albert Jacques....	Edmonton, Alta.....	July 25, '87	Mar. 1, '12	
Turnbull, Thomas........	Winnipeg, Man.......	May 26, '57	Mar 29, '82	O. L. S.
Tyrrell, James William......	Hamilton, Ont	May 10, '63	Feb. 16, '87	O. L. S.
Underwood, Joseph Edwin...	Saskatoon, Sask......	Nov. 3, '82	May 18, '11	
Vaughan, Josephus Wyatt...	Vancouver, B. C	Oct. 17, '45	June 11, '78	B.C. L.S.
Vicars, John Richard Odlum.	Kamloops, B.C.	April 16, '55	May 17, '86	O.L.S., B.C.L.S.
Waddell, William Henry	Edmonton, Alta.....	Mar. 23, '83	Mar. 25, '07	O.L.S.
Waldron, John	Moosejaw, Sask......	Aug. 1, '72	April 2, '07	
Walker, Claude Melville.....	Guelph, Ont.... ...	Oct. 16, '84	Mar. 11, '11	
Wallace, James Nevin.. ...	Calgary, Alta	Aug. 21, '70	Feb. 20, '00	O. L.S.
Warren, James	Walkerton, Ont.	Nov. 7, '37	April 14, '72	
Watt, George Herbert........	Ottawa, Ont...	Feb. 5, '76	Feb. 24, '02	
Weekes, Abel Seneca........	Edmonton, Alta	Feb. 17, '66	Feb. 11, '92	
Weekes, Melville Bell........	Regina, Sask.........	Nov. 28, '74	Feb. 18, '03	O.L.S.
Wheeler, Arthur Oliver ..	Sidney, B.C..........	May 1, '60	Nov. 21, '82	O. L. S., B. C. L.S.
White-Fraser, George W. R. M	Ottawa, Ont..........	— — '61	Feb. 21, '88	D. T. S.
Wiggins, Thomas Henry. ...	Saskatoon, Sask.	Aug. 24, '63	Feb. 18, '96	O. L. S.
Wilkins, Frederick W. B.. ..	Norwood, Ont	June 27, '54	May 18, '81	O. L.S., D. T.S
Wilkinson, William Downing	Not known............	....	Feb. 22, '93	
Williams, Guy Lorne	Enderby, B. C........	Mar. 3, '79	June 24, '08	B. C. L.S.
Wilson, Reginald Palliser....	Winnipeg, Man	July 9, '72	Jan. 26, '11	M. L. S.
Woods, Joseph Edward......	Pincher Creek, Alta...	Oct. 13, '61	Nov. 14, '85	
Young, Walter Beatty. ..	Winnipeg, Man.......	July 6, '80	Mar. 25, '05	M. L. S.
Young, William Howard.. .	Lethbridge, Alta	June 8, '78	May 17, '07	

REPORTS OF SURVEYORS

GENERAL REPORTS OF SURVEYORS

1911-1912

APPENDIX No. 11.

ABSTRACT OF THE REPORT OF J. R. AKINS, D.L.S.

SURVEY OF THE NORTH BOUNDARY OF THE PEACE RIVER BLOCK.

We left Edmonton on March 1 with four pack ponies to a sleigh, each sleigh being loaded with about twenty-five hundred pounds. A team of heavy horses was purchased at Athabaska Landing to assist the pack ponies in rough places, and many times they proved indispensable. Dunvegan was reached on March 23, but the ice was then considered unsafe and the freighters would not risk their horses on it. It was accordingly decided to take the overland route. For a distance of about twenty-five miles north of Dunvegan the country is nearly open, and the ground was almost bare of snow, but north of that in the woods the snow was very deep. The weather again turned cold, and a crust formed on the snow so hard that some of the freighters refused to go farther and accordingly went back. On April 15 it turned warm and wagons had to be used for transport in the open and sleighs in the bush. Boundary lake was reached on April 28, and the following day search was made for the old monuments on the twenty-second base which was the initial point of our survey. These monuments, though placed there twenty-eight years ago, were found with little difficulty, and the east outlines of townships 85, 86, 87 and 88 were run north to the twenty-third base line, which is the north boundary of the Peace River block at the northeast corner.

The survey of the north boundary of the block was begun on May 29, and notwithstanding the extremely wet weather the northwest corner of the block was reached on September 23, a distance of one hundred and two miles being run, mostly through wooded country and heavy timber.

On reaching the northwest corner of the block I learned that Mr. L. Brenot, D.L.S., required assistance to enable him to complete the survey of the west boundary before the cold weather would set in, so we moved south to meet him and the two parties completed the west boundary on October 12.

I then moved to the northeast corner of the block and produced the twenty-third base easterly. The line runs along the top of the Clear hills for about thirty miles, and because no horse feed grows on these hills much difficulty was experienced in transportation. The last camp on the line was supplied by man-packing, so that after completing twenty-two miles we were compelled to quit work as the nearest horse feed (which was only frozen grass) was ten miles from the base line.

A sleigh road was made from the Fort St. John trail to the Clear hills to intersect the base line and a cache was built to store the supplies which we left. As the snow was getting deep and the rivers frozen, we closed operations and left for Edmonton arriving there on January 7.

The portion of the Peace River block lying north of Peace river has splendid soil, and though the season is short, the growth is rapid and very luxuriant. About twenty-five per cent. of the country is open, the open part lying chiefly along Peace and Pine rivers. Grass and pea-vine grow in abundance. Although the Indians put up no hay for their horses, allowing them to run all winter, a rancher would have to put up feed for his stock for at least three months in the year and sometimes longer. Hay can be obtained in the flats and good feed can be got by cutting the grass on the uplands.

The climate along the north boundary of the block is not suitable for grain growing. This is no doubt due to the many muskegs through which the line runs and the large ones in close proximity to the line, as nearer the river the climate is very different, and at Fort St. John vegetables are grown successfully.

Considerable timber grows in the northeast part of the block but the quality is not first class, being composed of spruce, poplar, and jackpine. A large quantity of pulp-wood could be obtained.

The only mineral seen was outcrops of coal on Doig river. Sandstone suitable for building purposes was found on Pine and Doig rivers.

Game is rather scarce north of Pine river as it is hunted by the Beaver Indians, but moose, bears, and caribou are to be found. Grouse of several varieties are very plentiful and the streams contain many kinds of fish including grayling and different kinds of trout.

Photo by J. R. [illegible], D.L.S.

Looking East on the Twenty-third Base Line, Range Fourteen, West of the Sixth Meridian.

APPENDIX No. 12.

ABSTRACT OF THE REPORT OF C. F. AYLSWORTH, D.L.S.

MISCELLANEOUS SURVEYS IN MANITOBA AND SOUTHERN SASKATCHEWAN.

My first work of the season was the survey of a summer resort on Arbor island in Max lake, which is situated in township 1, range 20, west of the principal meridian in the Turtle Mountain forest reserve. The surface of the island is undulating and is about ten feet above the water of the lake. The beach is sandy while the lake abounds with all kinds of fish. A good road leads to the lake from Boissevain in township 3, range 20. An old-settled agricultural district lies between Boissevain and Max lake. Wheat raising is the principal industry followed in this district but there is sufficient mixed farming to meet the domestic demand. The prosperity of the district is shown by the good farm buildings, churches, schools and roads.

The forest growth in the Turtle Mountain reserve is greatly retarded by the fires which sweep over it. These fires get beyond control of the fire rangers and destroy not only the growing timber, but also the alluvial soil on the surface, thus retarding future vegetation.

Having completed the subdivision at Max lake, we left on May 24 for Moose mountain where our next work lay, passing through Deloraine, Napinka, Redvers and Cannington Manor. We found good roads all the way. The districts around Deloraine and Napinka are among the oldest settled portions of Manitoba and possess soil of the best fertility. From Napinka to Cannington Manor, settlement is of more recent date, but it is improving rapidly. From Cannington Manor to Fish lake there are good roads during dry seasons, but they are hilly, and during wet seasons are very heavy.

We reached Fish lake on section 15, township 10, range 3 west of the second meridian on June 1 and performed the subdivision surveys required in several summer resorts surrounding the lake. Fire has not done any damage in the Moose Mountain forest reserve in which this lake is situated, and the timber and scrub are all growing luxuriantly. There are roads through the mountains leading to Fish lake from Old Cannington Manor, Carlyle and Arcola. Fish lake is a fairly large body of water surrounded by sandy beaches and contains many varieties of fish.

Having finished the surveys at Fish lake on July 13 we left the following day for Tyndall to retrace the east and south boundaries of St. Peter's Indian reserve across townships 13, 14, and 15, range 6, east of the prinicpal meridian. On section 10 of township 13 is the Garson limestone quarry which employs about 100 men. The surface stone throughout this township is limestone and the land, though hard to clear of stones, is very productive, growing heavy crops of wheat, oats and vegetables. In townships 14 and 15 the land is somewhat lower, but the soil is of a superior quality.

This work having been completed we closed our survey operations for the season on November 21.

APPENDIX No. 13.

ABSTRACT OF THE REPORT OF P. R. A. BELANGER, D.L.S.

MISCELLANEOUS SURVEYS AND INSPECTION OF CONTRACTS IN MANITOBA AND SASKATCHEWAN.

After organizing my party at Winnipeg I proceeded to Pointe-du-Bois whence we travelled up Winnipeg river, partly on the ice and partly by boat, arriving at the the place of my first work on April 20, 1911.

The surveys to be made here consisted of subdivision and traverses in township 16, range 16, and townships 15 and 16, range 17, east of the principal meridian.

The country covered by these surveys may be described as a rough, rocky, timbered country broken by tamarack and spruce swamps and numerous lakes. Some good farming land, however, can be found in scattered pieces along Winnipeg river, principally along the south bank in range 16, in a timber limit. Some of the islands would also make fine farms, but the whole is heavily timbered.

Large game, and fish such as pike, pickerel and sturgeon, are abundant.

Winnipeg river averages from thirty to fifty chains in width and is very deep. It affords the only practicable route for transportation across the country, and, from Pointe-du-Bois where it has been dammed, now forms a smooth sheet of water over forty feet deep, extending about nine miles northeast to Lamprey falls which, owing to the effect of the dam, have entirely disappeared. From there easterly, with the exception of three or four short stretches of swift water, the current is slow and the river is easily ascended with canoes or rowboats up to the Ontario boundary. Since the building of the dam a moderate-sized boat may run from Pointe-du-Bois right to the Ontario boundary.

At present this country may be reached by travelling from Winnipeg to Lac-du-Bonnet via the Canadian Pacific railway, from there to Pointe-du-Bois via the Winnipeg City Power railway, and thence by boat up the river. It may also be reached from Kenora travelling by boat down the river, but this route is unsuitable, as several portages have to be made to avoid dangerous falls and rapids.

Lumber is still the chief asset of this district. A large percentage of the timber has already been destroyed by fires, but what is left is suitable for all purposes, from first-class lumber to ties, posts and poles, there being also an abundance of pulp-wood and cord-wood. This timber is all in close proximity to the banks of the river, or is on islands and therefore easily accessible.

I found numerous traces of mica on the river banks which, for the most part, are rocky, and also in the interior three miles north of the river, but did not come across any large veins.

The city of Winnipeg has now finished the construction of an immense power plant by the damming of Pointe-du-Bois falls and has developed energy amounting to over 100,000 horse-power.

From Pointe-du-Bois I proceeded *via* Winnipeg to Oak Point settlement where I secured my horses and drove to my second work at Fisher River settlement. The work here consisted of the inspection of Mr. Tyrrell's contract No. 2 of 1910 and the survey of a small settlement called Fisher Bay.

This settlement is situated on the west shore of Fisher bay, from which it derives its name, and the bay itself forms part of lake Winnipeg. The settlement is very small and comprises only ten lots which are all occupied by half-breed fishermen coming from Fort Churchill, Oxford House, Norway House and Cross lake. The land they occupy is very good for mixed farming but, with the exception of marshes at the western end of the settlement and small cleared openings near the shore of the lake, it is heavily timbered. Fisher Bay settlement is accessible by boat from all points on lake Winnipeg. There is also a wagon road which leads to Fisher river, and from there roads lead south, east and west. These roads, however, need to be greatly improved before there can be any heavy traffic over them.

From Fisher Bay I drove to Oak Point settlement through the new St. Peter's Indian reserve on Fisher river, and through numerous settlements. All along the way I was agreeably surprised to see the wonderful change that has taken place since my last trip through that country in 1910. There are still, however, large tracts of vacant land in the vicinity of Island lake where cattle raising and dairying could be profitably carried on.

My next work was the inspection of survey contracts east of Prince Albert. I first examined Mr. Teasdale's contract covering townships 44 to 48, range 11, west of second meridian. I reached this work by following a lumber road from the railway siding to the lumber camp, situated near the north boundary of township 45, and from there by an old pack-trail as far as the centre of township 46, but farther north pack-horses had to be used. A wagon road can be easily made along this pack-trail, which, in this range, leads in a northerly direction to Carrot river near the north boundary of township 48. The country covered by this contract is generally rolling and, with little exception, is heavily timbered, part of the timber being included in the timber berth covering the north half of township 45 and the south half of township 46. The land is first class, but it needs to be cleared before it can be settled.

Returning to Peesane I proceeded southerly from the railway siding to Mr. Ransom's contract No. 5 of 1911, covering townships 39 and 40, ranges 4, 5, 6 and 7, west of the second meridian, but inspected only a portion of it as the whole contract was not completed.

My next work was the inspection of Mr. Stewart's contract No. 8 of 1911, situated north of Carrot river, in range 11. To reach this work I went north to Tisdale, a thriving town on the Canadian Northern railway, and from there followed the main road passing through Forester, New Osgoode, and Arborfield. The two first-named places are thickly settled; the last-named one is comparatively new, though very promising, and as soon as the land is opened, this settlement will compare favourably with the others. The land is first class but the great drawback to all these settlements is the want of a sufficient number of machines to thresh the grain; this shortage proved ruinous to numerous farmers whose grain was not yet threshed in December and was under snow for the winter.

Leaving Arborfield I followed Carrot river for a few miles to Mr. Stewart's contract comprising townships 49 to 53, range 11. The surface of these townships is flat and covered with a thick growth of small poplar and willow which keeps it wet. The only trail in the interior of the townships is the surveyors' trail which leads northerly to Saskatchewan river.

Large game, such as moose and deer, is very plentiful, while partridges and prairie-chickens are also abundant in the whole district. No minerals of any kind were found.

Having completed the inspection of all the contract surveys in the Carrot river district that were ready for inspection, I returned to Tisdale and, on December 2, left for Gypsumville, reaching there on the 6th. Here my work consisted of the inspection of Mr. Pequegnat's contract No. 3 of 1911 and the performance of some retracement and resurvey work in townships 31 and 32, range 9, and township 33, range 8, west of the principal meridian.

The country covered by this contract is for the greater part unfit for settlement at the present time, though some good homesteads suitable for mixed farming are found. The chief drawback is the lack of roads, but besides this inconvenience the land is heavily covered with bush of different kinds. On the other hand, the fact that Gypsumville lies in township 32, range 9, and is the present terminus of the Oak Point branch of the Canadian Northern railway, where the famous gypsum mines are worked to so much advantage, should be an inducement to settlers to seek land in that direction.

It is hardly credible that similar country crossed by the railway from Oak Point to Gypsumville, which only a few years was considered chiefly unfit for settlement, is now mostly settled and has thriving villages at every station along the line.

Gypsumville is still only a small village composed of a first-class general store where the post-office is kept, a boarding house and a few houses, all owned by the Gypsum company who use them for their employees. It is situated within twenty chains of the mines in section 26, township 32, range 9.

Gypsum is also found at a short distance east and southeast of Gypsum lake in township 33, range 8, but the mine has not been worked yet. Good spruce timber is available in township 33, range 8, and the lumber intending settlers may require will be easily obtained here. This township is reached by the road from lake St. Martin from which there is also a road leading to Gypsumville.

APPENDIX No. 14.

ABSTRACT OF THE REPORT OF G. A. BENNETT, D.L.S.

MISCELLANEOUS SURVEYS IN SASKATCHEWAN AND ALBERTA.

My first work was the survey of the dry bed of a lake in township 10, range 11, west of the second meridian, the dry bed of Grassy lake in townships 9 and 10, ranges 10 and 11, and the bed of a lake nearly dry in township 9, range 10. The settlers in this district are progressive and prosperous. Large farm buildings and handsome houses have replaced the sod stable and shack while six-horse teams or traction engines are used for breaking the land. Hay was formerly obtained from the dry lake beds, but these are rapidly being cultivated and are found to produce excellent crops of wheat and flax. Drinking water is scarce and small towns find difficulty in procuring an adequate supply of good quality.

I next retraced some lines in townships 10 and 11, range 19, in townships 7 and 8, range 15, and in township 8, range 16. I also placed monuments defining the west boundary of township 20, range 17, along Indian reserve No. 75. This latter district is partly covered by bluffs of poplar and willow. Although the land was homesteaded many years ago little effort has been made to increase the small natural patches of prairie. The area of cultivated land, is therefore, somewhat limited but as no damage results from hail or frosts, a fair living is made by the farmers.

On June 21 I began the traversing of the right bank of South Saskatchewan river and the resurvey of lands along the river in township 25, range 5, and township 19, range 15, west of the third meridian. This resurvey proved so extensive, as no monument of the original survey could be found near the river, that the work was not entirely completed. The land in the valley will not prove valuable wheat land but vegetables and small fruits grow well. Irrigation will be necessary to obtain the best results but water for this purpose is easily obtained from the small streams flowing into the river.

A retracement survey in township 13, range 4, and a verification survey of islands in Johnston lake was the next work, and on August 15, I began the examination of the survey of townships 13 and 16, range 14, and township 16, range 13, in which large errors in the original survey were found.

From there I proceeded to Rosetown *via* Saskatchewan Landing and retraced erroneous lines in township 19, range 15, and township 26, range 20. Dry lake beds were resurveyed in townships 27 and 28, ranges 11 and 15, township 26, range 23, and township 33, range 26.

This tract of apparently semi-desert known as 'the great plains' has become the home of thousands of progressive and enterprising farmers. Grain growing is carried on extensively, and breaking at the rate of thirty acres per day, is being done with gasoline traction engines. Some idea of the extensive scale on which operations are being carried on may be gathered from the fact that one farmer ordered thirty new binders to harvest his crop this year.

Surveys of dry lake beds were also made in township 11, range 4, townships 14 and 15, ranges 3 and 4, and township 18, range 26. Partially dry lake beds were also surveyed in townships 14 and 15, range 10, and township 18, range 26. A traverse was made of Ghost Pine lake in townships 36, ranges 21 and 25, all west of the fourth meridian.

The probable factor affecting the variation of the level of the lakes appears to be the increase or decrease of the permeability of the surrounding soil in the depressions. It was observed that when large areas were plowed up near the lake basin the volume of water was much lessened. Fire also is an active agent as it destroys the impervious layer of peaty matter found in the lake bottoms whenever the lake becomes sufficiently dry. Lakes in the prairie were found drying up, while lakes in the bush country were larger than when originally surveyed.

Erroneous lines were retraced in township 21, range 1, townships 10 and 11, range 5, townships 10, ranges 6 and 10, and township 8, range 21. A traverse of Little Bow river was made in township 14, range 21, all west of the fourth meridian.

The surveying season was unusually cold and wet. Frost occurred on August 25 and the continued wet weather rendered threshing so difficult that on December 11, the date of closing survey operations, thousands of acres of grain on the prairie were still in the stook.

Photo by J. R. Akins, D.L.S

Pack Train along Pine River—Peace River Block.

APPENDIX No. 15.

ABSTRACT OF THE REPORT OF G. H. BLANCHET, D.L.S.

SURVEY OF THE TWENTY-THIRD BASE BETWEEN THE FOURTH AND FIFTH MERIDIANS.

The starting point of our work was reached by sending the horses along the trail close to the fourth meridian, while the men and supplies went in scows on Athabaska river to McMurray and thence by Clearwater river to the fourth meridian.

Camp was pitched on June 10, 1911, three miles west of the fourth meridian, and, after turning off the base line and checking our starting point, the production of the line westerly was begun on June 17.

Through the first nine ranges the line follows very closely Clearwater river the general course of which is westerly. The valley of this river has an average depth of about six hundred feet and is from two to three miles in width.

The northeast corner of section 36, township 88, range 1, is seventeen chains south of the top of the Clearwater valley. The valley here was formerly heavily timbered with spruce, balsam, birch and poplar. Much of this timber, however, has been destroyed by frequent fires which have swept most of the country back of the river valley.

For a distance varying from a few chains to several miles back from the river valley the country consists of fairly well-drained poplar and jackpine ridges and spruce swamp, but in general on both sides of the river beyond the direct drainage area afforded by it and its tributary streams the country is principally muskeg containing patches of jackpine and broken by occasional poplar ridges.

The base line runs into the valley on the north boundaries of section 34 and 35, range 1, the valley here containing some excellent spruce. It also passed within three-quarters of a mile of the Whitemud falls on Clearwater river in the northwest quarter of section 2, range 1. These falls are admirably situated for the development of power, being capable of producing about 3,500 horse-power.

Gypsy creek flows in a northwesterly direction across township 88, range 1, crossing the base line on the north boundary of section 31, where it has a considerable valley. Some good spruce is to be found along this valley while on either side are poplar and jackpine ridges.

Limestone outcrops in many places along this portion of Clearwater river render navigation impossible. The Cascade rapids occur about one mile north of the northeast corner of section 32, township 88, range 2. They form the head of navigation on Clearwater river. Below this point boats with a draught of four feet could find sufficient water if carefully navigated among the numerous sand-bars. A brief description of this river might be given here. The distance from its juncture with the Athabaska at McMurray to the Cascades corresponds to forty-seven miles by the base line and is probably sixty-five miles by the river. It discharges about five thousand cubic feet a second till joined by Christina river from the south in range 7. This increases its volume by about one-half. The current averages two and one-halt miles an hour and the width of the river varies from six to twelve chains. Numerous islands, generally timbered, occur. The banks are about twelve feet high, being sufficient probably to prevent flooding on the flats. The valley is almost everywhere heavily wooded with spruce, poplar and birch, with a dense underbrush.

Mineral springs, chiefly salt and sulphur, occur in many places along the river. These indications of salt were confirmed at the oil prospect near McMurray where in boring they found a bed of salt several hundred feet thick. Salt marshes, some of considerable extent, occur along the river valley.

In range 2 the base line passes through a mixed country of poplar and jackpine, with muskeg to the south.

Edwin creek, flowing through a deep wooded valley, crosses the line on the north boundary of section 34, range 3. This stream has its source in the muskegs in township 87, range 1, and flows northwesterly, being joined by many small feeders, the whole forming an excellent drainage system for the country adjacent to it. Several salt springs were noticed in its valley and a very strong sulphur spring is located at its mouth.

The Highhill river flows into the Clearwater from the north in the westerly side of range 3. It is about sixty feet wide and has a fair flow of water, but is too much broken by rapids for ordinary navigation.

In range 4 the line runs through an extensive muskeg, a bay of which approaches the banks of the Clearwater on the north. To the southwest this muskeg extends almost to Christina river, while to the south and southeast it includes the swampy tract occupied by Gordon and Gypsy lakes. Most of this country may be made suitable for agriculture by drainage. The chief hindrance to natural drainage is the surface moss through which water percolates very slowly even on a considerable slope. At the same time this is one of Nature's best provisions for the conservation of moisture. This feature is noted throughout the north where in many cases the divide between two rivers is a muskeg, the seepage from which feeds the tributary streams of both rivers.

In range 5 the line runs down to Clearwater river following the valley of Cottonwood creek and crossing several salt marshes near the river. Exposures of tar sand and outcrops of impure lignite were observed here.

Through ranges 6, 7, 8 and 9, the line followed the river fairly closely. It was decided, therefore, to send the horses to McMurray and move camp by scow. This necessitated considerable hard climbing but was otherwise satisfactory and gave the horses a good rest and splendid feeding ground, the benefit of which was felt in the heavy work of the fall and winter.

The weather in the latter part of July and nearly all through August and September was very unsettled, scarcely a day passing without rain. This was unfortunate not only on account of the discomfort and delays caused, but the excessive precipitation kept the creeks and muskegs at very high water till freeze-up, making trail location very difficult. Besides, as the rainy season extended through the haying time it was almost impossible to put up hay.

In range 7 Christina river flows into the Clearwater from the south. It is a considerable stream having a flow of about two thousand cubic feet a second. Its course is too much broken by rapids for ordinary navigation although small scows can be tracked up. Its basin which extends to the south for over seventy-five miles is separated from that of the Athabaska by the Little Rocky mountains. An extensive burned area runs southwest from the mouth of Christina river, patches of prairie some several hundred acres in extent having been formed by these fires.

The soil in the Clearwater valley is almost everywhere good, the subsoil varying from clay to clay loam and sandy clay with a surface of from two to ten inches of black loam. It is for the most part heavily timbered, spruce predominating on the river flats and poplar on the higher slopes of the valley. The large timber and heavy underbrush should indicate good growing conditions.

On the north side of the Clearwater, near its mouth, the country back from the valley becomes higher and drier, good patches of spruce and jackpine being found far back from the river.

Between the Christina and Athabaska rivers the country is drained by two fairly large streams, Hangingstone creek and Cameron creek (formerly known as Horse creek). As these streams and their tributaries have deep valleys the country here is rough. It is for the most part covered with a well grown second-growth poplar.

McMurray settlement is situated at the juncture of the Clearwater and Athabaska rivers in range 9, being about three miles north of the base line. This was an important post in the early Hudson's Bay days before the railway. Situated at the juncture of the two principal trade routes it naturally became the receiving depot for furs and the distributing point from which supplies brought here by the long water route from Winnipeg were sent to the various posts throughout the north. With the building of the Canadian Pacific railway the Winnipeg-McMurray water route was abandoned in favour of Edmonton and the Athabaska, and since then the importance of McMurray in the fur trade has been small, except as the head of steamboat navigation on the lower Athabaska. During the last few years, however, with the realization of the agricultural and commercial possibilities of northern Alberta, the admirable situation of McMurray with regard to the waterways, in addition to the water-powers, timber, tar sand, and the possibility of oil in its vicinity, has re-awakened interest in it. Last season three companies were engaged in boring for oil between McMurray and Fort McKay, forty miles down stream. The season's results were considered satisfactory. Telegraphic connection with Edmonton is urgently needed and a winter road would be a great boon to the district.

The banks of Athabaska river are steep and range from 400 to 600 feet high, but below the juncture with the Clearwater the valley widens out forming extensive flats generally well wooded. Numerous islands occur in the river.

From its crossing in range 10 to range 17, the base line gradually diverged from the Athabaska, being about twenty miles north of it in the latter range. The country passed through was characteristic of the Athabaska country which might be generalized as follows. The strip adjacent to the river valley having a width of half a mile to several miles is well drained by numerous small streams, whose deep valleys as they approach the river make the country bordering the river valley extremely rough. This strip is generally well timbered where not fire-swept. Continuing back from the river muskegs are encountered in increasing number and extent till finally the country becomes muskeg, broken by islands and ridges of poplar and jackpine. As in the Clearwater district, there are no serious physical obstacles hindering drainage and usually the swampy surface is comparatively shallow. The surface moss is a poor conductor of heat so that the ice formed beneath it during the winter melts very slowly in the summer, thus preventing the country from drying up.

Two fairly large streams flow into the Athabaska from the north, one in range 10 and the other in range 14. This latter rises in several lakes in township 88, range 15, about which there are extensive hay meadows. The scarcity of horse feed made it necessary to start feeding oats on September 15, and on October 15 it was considered advisable to send out all the horses except the eight required for winter work. Transportation between the departure of the horses and the freeze-up, when we could use sleighs, was difficult. Heavy frosts occurred early in November freezing the muskegs sufficiently to bear the horses. This happened rather providentially as we were then camped on a point with burnt muskeg extending for miles on all sides except the east.

In range 15 the line entered the Thickwood hills which are composed of a series of ridges having a general northeast and southwest course, separated from one another by strips of muskeg. They extend from Athabaska to McKay river.

Snowstorms on November 6 and 7 marked the beginning of winter, the thermometer dropping to 30° below zero. On November 9 I divided the party, sending six men and four horses back to the Athabaska river, now 30 miles away, to open the pack-trail into a sleigh road and to bring up two sleigh loads of oats and supplies. Meanwhile the remainder of the men and horses I left to open up a trail to a cache at the Brule rapids on the Athabaska and to locate if possible some hay which an Indian was to have put up. Both parties encountered many difficulties and it was not till November 25 that the two parties united at the end of the line, arriving within a few minutes of each other.

The line continued through the Thickwood hills in ranges 15 and 16, passing through some good spruce, though here, too, the fires have done considerable damage. This timber could probably be handled either from the Athabaska or McKay rivers. The soil on these hills is excellent.

In range 17 the line dropped from the hills rather abruptly into a country principally muskeg which extends westward to range 20, rising slightly to the west. This country is drained on the north by McKay river and on the south by the Little Buffalo, both of which flow in an easterly direction into Athabaska river. The swampy surface is for the most part shallow as is evidenced by a heavy growth of large tamarack which covers most of this country. Several of the small feeders of McKay river cross the base line in range 19.

In range 20 ridges of jackpine occur and on the westerly side of the range a fairly large lake was crossed, the shores of which are heavily timbered with spruce, poplar, birch and jackpine. Several other lakes occur in the vicinity of the base line, in ranges 21 and 22. There is no well-defined ridge marking the height of land here although to the south it becomes quite pronounced. The levels and drainage indicate the centre of range 22 as being the summit of the height of land. Areas of good agricultural lands occur in the country adjacent to the height of land, especially in the vicinity of the lakes. The prevailing timber is poplar but much of it has been destroyed by fire.

Proceeding westward from the height of land large areas of muskeg, for the most part burnt over, are encountered. The relative amount of muskeg and poplar lands varies considerably in the Wabiskaw valley, the general impression received being favourable as to the agricultural possibilities of this district.

Wabiskaw river crosses the base line in the centre of range 23, and is about six chains wide. It is navigable from its principal source in Wabiskaw lake through to Peace river for scows drawing two feet of water. Its course is much broken by rapids but it is doubtful if power developed in these would have commercial value. In the vicinity of the base line its banks are from four to ten feet high and it flows through a valley fifty feet deep and half a mile wide.

West of the river, after passing through the poplar ridges immediately adjacent to it, muskeg country was encountered extending across range 24. Beyond this the country becomes hilly and rises sharply to the west. Formerly extensive forests flourished on these hills which continued to the west beyond the fifth meridian, but fires have destroyed much of them although some considerable patches of merchantable timber still remain.

The base line was completed to the fifth meridian on February 28, 1912, and after the completion of the necessary work for closing, the party set out for Athabaska Landing, arriving there on March 17.

APPENDIX No. 16.

ABSTRACT OF THE REPORT OF L. BRENOT, D.L.S.

SURVEY OF PART OF THE WESTERN BOUNDARY OF THE PEACE RIVER BLOCK.

Having completed the organization of my party, I left Edmonton on March 3, 1911, and proceeded via Athabaska Landing and Grouard to Peace River Crossing where I arrived on the 20th. From there I proceeded to Dunvegan on the ice and thence to Spirit River settlement. There I left my sleighs and proceeded westerly towards Pouce Coupé prairie by pack-trail, there being no sleigh road.

It would not be a difficult matter to convert this pack-trail into a sleigh trail, as not more than one-fifth the distance is heavily timbered, the remaining four-fifths having been burnt over so often that it is almost bare prairie.

From Pouce Coupé prairie I followed an old Indian pack-trail that leads northwesterly from Pouce Coupé to Peace river, and on April 15 arrived at the camp of Mr. Geo. McMillan, D.L.S., in range 15, on the twenty-first base, which he was then engaged in surveying. I with my party assisted Mr. McMillan to produce this base to the westerly boundary of the Peace River block which was reached on August 11, and the following day I began the survey of the western boundary of the block northerly from the base line.

I had completed the survey of this line to the north boundary of section 25, township 86, on September 28, when Mr. J. R. Akins, D.L.S., who had completed the survey of the north boundary of the block, came to my assistance with his party. The two parties working together made good progress and on October 12 the northwest corner of the block was reached.

At the intersection of the western and northern boundaries I erected a monument and besides the large iron post I placed a spruce post marked 'N.W. cor. P.R.B.'

Two days later I started homewards, reaching Spirit River settlement on November 10, and Edson on December 6. I paid off the party at Edmonton on the 11th and reached Ottawa on the 18th.

DESCRIPTION OF THE COUNTRY ALONG THE WESTERN BOUNDARY OF THE PEACE RIVER BLOCK NORTH OF THE 21ST BASE LINE.

The first mile and a half north of the base line is sloping down towards Peace river, which the boundary intersects at about half a mile below what is known as the Peace river canyon. On the south side of the river there is no flat, the hill ending abruptly at the edge of a cut bank about 120 feet above the water level. This cut bank greatly facilitated the triangulation of the river, as there are inaccessible wooded islands on the line and the south bank is covered with a heavy growth of small poplar. Down the river and situated approximately in the south-east quarter of section 13, township 81, range 26, lies Hudson Hope, which comprises only the fur-trading posts of Revillon Bros. and the Hudson's Bay Co. On the north side of the river is a small flat, which is heavily timbered with spruce, and from the top of the bank which is about 800 feet above the level of the river, to a little beyond the centre of township 81, there is a heavy growth of small poplar. The soil to this point is chiefly light sandy loam and not very good for agricultural purposes, while the country northwards to the northwest corner of township 81 is timbered with small spruce and jackpine. As the surface is covered with moss there is no vegetation. In section 23, township 81, the line crosses a pack-trail known as the 'Rocky mountain portage,' connecting Hudson Hope with Cust's House at the head of Peace river canyon.

Township 82 is fairly open, scattered second-growth poplar of about two inches and willow scrub being the only bush. It is perfectly level except sections 11 and 26 which are crossed by deep ravines through which flow Lynx creek and its north branch; both these creeks furnish an abundant supply of good clear water throughout the summer. The soil like that in the preceding township is not very suitable for agricultural purposes, and there is very little vegetation except at the bottom of the two ravines mentioned above.

The southern part of township 83 is rolling country and is timbered with poplar from three to eighteen inches in diameter, alder and willow scrub, but the northern half is covered with many hay meadows from which hundreds of tons of wild hay could easily be cut. The soil is of a much better class than that in the two preceding townships, being generally from three to twelve inches of humus overlying a subsoil of clay loam and in some places sandy loam. There is a good pack-trail leading from this township to the mouth of Halfway river.

A small river known to the Indians as the Red river and having an average width of one chain flows in a southeasterly direction through township 84 to Peace river. In its valley are numerous patches of open prairie, some being over a hundred acres in area. These prairie spots are covered with a luxuriant growth of pea-vine, the soil being extremely fertile. This would be an ideal place for ranching. Both banks of the river, which are over 200 feet high, afford good shelter for stock and the river furnishes an abundant supply of water. Brook-trout and grayling abound in this stream.

In the centre of township 85 we came across Ground Birch creek, which is from thirty to sixty links wide and two to three feet deep at low water. Being a mountain stream it rises very quickly and to a great height, the high water mark being about ten feet above its normal level. A fine prairie extends for about one and a half miles on either side of the creek. The soil of this tract is very good being chiefly humus three to six inches in depth overlying a sandy loam subsoil. The northern part of the township is timbered with heavy spruce and poplar from six to eighteen inches in diameter.

All of township 86 except section 35, in which Halfway river is crossed, is too broken to be suitable for settlement. It is timbered chiefly with jackpine and spruce from four to fourteen inches in diameter, with a thick undergrowth of willow scrub.

Halfway river at low water has an average width of three chains, a depth of four feet and a current of three miles per hour. Its source is in the Rockies and, like all mountain streams, it rises very quickly. At high water the average width is about ten chains.

On the north side of the river the country rises by benches up to the centre of township 87, range 25, there being an extensive flat after each rise. These flats are mostly prairie with a few scattered bluffs of poplar and some spruce. The soil is very fertile; in fact it is the best that was seen on this line, being composed chiefly of clay or sandy loam to a depth of eighteen inches.

In the southern part of township 87, the boundary intersects the R. N. W. M. P. pack-trail from Fort St. John to Fort Graham.

THE TRAIL FROM THE WEST BOUNDARY OF THE BLOCK TO FORT ST. JOHN.

This trail follows along the north side of Halfway river in an easterly direction for about twenty miles, then in a southeasterly direction to Cache creek, down the east side of the latter to its mouth at Peace river, and thence on the north side of Peace river to Fort St. John. Most of the country through which it passes is rolling open prairie. The soil varies, being very fertile in the valleys of the Halfway and Peace rivers, but poor and unsuitable for settlement elsewhere. As plenty of hay and water could be obtained, mixed farming should be a success in the valleys.

In the northern part of section 19, township 87, range 25, the country begins to fall gently to the north branch of Halfway river. The timber is chiefly jackpine and spruce, but there is also a great amount of deadfall. The north branch of Halfway river is a small stream about two chains in width and two to three feet in depth, with a current of about two to three miles per hour. It flows in a southeasterly direction and empties into Halfway river about fifteen miles from the intersection of the latter stream with the boundary. The country to the north of this branch rises gradually to a height of about 700 feet above the river. In the first three miles the land greatly resembles that north of the Halfway, but in the last two miles it slopes gently to the north and is timbered with heavy spruce and poplar from six to twenty-four inches.

During the summer months the heat is generally tempered by cool breezes blowing from the Rocky mountains, which lie about ten miles west and almost parallel to the western boundary of the block. There was no frost that would injure grain before September 18.

The game of this region comprises moose, bears, partridges, prairie-chickens and almost all species of fur-bearing animals, but ducks and geese are scarce.

APPENDIX No. 17.

REPORT OF M. P. BRIDGLAND, D.L.S.

TRIANGULATION SURVEY IN THE RAILWAY BELT OF BRITISH COLUMBIA.

CALGARY, March 4, 1912.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour to submit the following report of my field operations on the triangulation in British Columbia, in connection with the Trigonometrical Section of the Topographical Survey of Canada, for the season of 1911.

The work was commenced May 8, and in accordance with your instructions dated April 24, 1911, directing that the eastern part of the triangulation be retraced, an attempt was made to find station I, on the fifth meridian, and station II, on Nose hill.

At the latter station the old wooden hub was found. Station I was re-established as nearly as possible in its original position on the fifth meridian, 17·25 chains south of the northeast corner of section 13, township 24, range 1. Of the next four stations established by Mr. Drewry in 1890, old hubs were found at station V (Sarcee Butte), and station VI (Cochrane). At stations III and IV (Brushy Ridge and Spy Hill) no trace remained of the original stations, and these were accordingly re-established on the highest points of the ridges. Angles were read at all these points giving a new set of angles for four triangles at the eastern extremity of the system. Also stations III, IV and VI were connected with the nearest monuments of the Dominion Lands system. Each of the above stations was marked by a brass bolt embedded in cement, the top of the bolt being about two feet below the surface of the ground, and flush with the surface of the cement. The bolt in each case was stamped with a triangle and with the number of the station in Roman numerals. The apex of the triangle faces north, is at the centre of the head of the bolt, and is the geodetic point. For reference points three-foot iron posts were used and at least one placed at every station except station V. These posts were driven down to within about five inches of the top and were stamped with 'T.S.' and the number of the station on one side, and 'W.P.' followed by the distance in feet and the bearing to the station on the opposite side. At station V (Sarcee Butte) which was on a rocky ridge, two iron reference bolts were cemented into solid rock and their bearings and distances from the station measured.

An effort was also made to locate Mr. Drewry's base near Cochrane which he had established in 1890 and marked by iron bars. The post at the east end was found, but the post at the west end had evidently been removed.

As is usually the case in this class of work, considerable time was lost through unfavourable weather. Also much delay was caused by excessive refraction. It was found impossible to sight on signals with any certainty between 8 A.M. and 5 P.M., except on cloudy days.

On June 5, a start was made for Revelstoke, two of the party having been sent ahead to get the horses and outfit stored at Golden. A stop of one day was made at Morley to locate station VII (Chiniki) and connect it with the Dominion Lands system. The station was found and tied in to the post at the intersection of the north boundary of township 24, range 7, west of the fifth meridian, and the south boundary of the Stony Indian reserve. This station was not permanently marked.

By June 8 the party was camped at Revelstoke and ready to commence work on the western part of the triangulation. Owing to a very heavy snowfall and a later spring, work on the higher peaks was found to be impossible and a short exploratory trip was made to Salmon Arm to select points to help in the expansion of the base. The western part of Bastion mountain was visited but was found unsuitable. Permanent signals were erected on Granite mountain and on Fly hill about five miles southwest.

In the meantime two of the party had twice attempted to erect a signal on Queest mountain above Shuswap lake, but owing to the great depth of snow, they were unable to do so. Later on, about June 28, this was done. The ascent was made from Craigellachie, crossing Gorge creek some distance north of the railroad. There is much fine timber in this district. The ascent by this route, and also the descent, was found to be very tiresome and tedious. Later on the mountain was ascended from Malakawa, the ascent being made easily in about six hours.

An attempt was made to locate the sixth meridian, a short distance east of Revelstoke. Owing to fire and lumbering operations the monuments here have been destroyed and the nearest existing post is the northeast corner of section 34, township 23, two miles farther west. Owing to the canyon-like nature of the Illecillewaet valley it was found impossible to make a direct tie to Mount Albert, and later on a secondary station was established on Mount Mackenzie. This station served to connect Mount Albert with the above-mentioned section corner, and also helped to connect Mount Begbie and Mount Copeland with the northeast corner of section 33, township 23, range 2, west of the sixth meridian.

Throughout all of June and the early part of July, it was cloudy most of the time and considerable rain fell, so that it was very difficult to get any work done. Accordingly, having instructions to make connections between Cascade mountain (station XII) and Storm mountain (station XIV) Mount Bonney (station XXV) and the posts of the Dominion Lands system, it was decided to move to Banff, and on June 11 camp was pitched near the town.

A suitable base was found which could be connected by a short traverse to the middle of the north boundary of section 1, township 26, range 12, west of the fifth meridian. The ascent of Cascade mountain, from the west side offers no difficulty. An old wagon road leads up Fortymile creek to the water-works dam. From there the route leads northerly along the side of the mountain gradually ascending until a deep canyon is reached, whence a steep slope leads directly to the ridge from which the main peak is easily accessible. The slopes throughout are easy, there being no standing timber and very little windfall. The station lies on the highest southerly point of the mountain. The old cairn had fallen over but the base was still intact. It was rebuilt to a height of 6·7 feet.

On Juy 17, the party moved to Castle mountain. A good base about 143 chains long was obtained about two miles west of the station and by means of this, Storm mountain was connected with the survey posts in the valley. An azimuth observation was taken at the west end of the base. The route followed from the railroad to Storm mountain was practically the same as that described by Mr. Carson in his report of 1906, contained in the annual report of the Topographical Surveys Branch for the year 1906-1907.

Our next move was to Glacier where a base sixty chains in length was selected just east of the Ross Peak water-tank. By means of two secondary stations, one on the side of Mount Cheops and the other on Mount Abbott, this base was connected to Mount Bonney.

The ascent of Mount Bonney was made by what seems to be a new and very much easier route than those previously followed. A light camp was taken to the head of a small valley which joins Illecillewaet river about a mile west of Ross Peak station. From there a steep but easy climb leads to the snow field at the back of Mount Bonney. Crossing this snow field, the ridge above the basin of Loop creek was reached and from there the arête runs directly to the summit. Under favourable circumstances it should not be a difficult matter to make the ascent from Glacier in a day and a half, if the first afternoon were devoted to taking camp to the head of the valley, and the day following to the ascent of the mountain and the return trip.

On the evening of August 4, we returned to Revelstoke. At first the smoke was very dense owing to forest fires close by, but heavy rains soon remedied this. As soon as the weather permitted, camp was taken part way up Mount Mackenzie, and on August 9, the peak was ascended and the return trip made to the railroad the same day. The route followed was the same as that taken in 1910. The station was, marked by the usual brass bolt stamped with a triangle and the number of the station 'XXXIVA.' The apex of the triangle faces north and is at the centre of the head of the bolt. Two iron reference bolts were also placed, one six feet south and the other six feet north from the station. A cairn five feet in diameter at the base and seven feet high was built above the station.

The next station visited was Albert (XXVII) following the route described by Mr. Carson in his report for the season of 1909, contained in the annual report of the Topographical Surveys Branch for the year 1909-10. Owing to difficulties connected with the location of station XXXII near Camborne, we could not complete the work at this point and had to return again later in the season.

On returning to Revelstoke, it was decided to visit Mount Griffin (XXXIX) leaving two of the party to ship the horses and outfit to Camborne, thus saving all the time usually lost in shipping and moving camp. Accordingly a light camp was taken to timber-line on Mount Griffin just below the signal following the same route as in 1910. Two days were spent there reading angles and taking azimuth observations. The station is marked by a brass bolt stamped with a triangle and the number of the station, 'XXXIX.' Two iron reference bolts were also placed, one 13·5 feet south and the other 18 feet north of the station. All bolts were cemented in solid rock. Above the station a cairn five feet in diameter at the base and 9·3 feet high was built.

On August 10, main camp was reached above Camborne. As soon as possible, camp was taken to timber-line below Mount Burniere following the trail to the Burniere mine. This trail had been recently cleared out and was in much better condition than in the previous year. On ascending Mount Burniere, the following day, it was found necessary to establish a station on a peak about 500 feet higher and about two miles farther west. This peak proved to be very suitable for a station and angles were read and an azimuth observation taken. This station was called Incomappleux.

The peak consists of a long narrow ridge with precipitous rock faces on the south side and glaciers on the north. The station is near the eastern end of the ridge, and is marked by a brass bolt stamped with a triangle and the number of the station, 'XXXII.' Four reference bolts, marked, were placed as follows: the first four feet north, the second and third each distant five feet from the centre and bearing south 65° east and south 20° west respectively, and the fourth four feet distant and bearing south 55° west. All bolts were cemented in solid rock. Over the station a cairn four feet in diameter at the base and 6·5 feet high was built.

At Mount Burniere, a secondary station was established. This station overlooks the Incomappleux valley and should be very useful for making any necessary connection with the monuments of the Dominion Lands system in the valley. The station was marked by the usual brass bolt stamped with a triangle and the number of the station, 'XXXIIA.' Four reference bolts were placed as follows: one north 5·5 feet, the second north 84° east and 6·3 feet distant, the third bearing south 34° 30′ east and distant 7·9 feet, and the fourth bearing north 82° west and 12·6 feet distant from the centre. A cairn five feet in diameter at the base and 8·4 feet high was built.

On August 29 we returned to Revelstoke, but were again delayed by rain. As soon as the weather permitted, we again ascended Mount Albert and completed the work there. An azimuth observation was also taken at this point.

On September 5 a start was made for Mount Copeland, near the head of Jordan river. The Jordan trail had been partially repaired during the summer, but it was still in poor condition. On the first day camp was taken as far as possible by horses and on the second a light camp was taken to an amphitheatre below the peak. Two days were lost through bad weather, but the third day was beautifully clear. The station is marked by a brass bolt stamped with a triangle and the number of the station, 'XXXVII.' Three reference bolts were placed as follows: one bearing south 82° east and distant 4·7 feet, the second bearing south 5° west and distant 7·1 feet, and the third bearing north 36° 30′ west and distant 7·0 feet from the station. A cairn five feet in diameter at the base and seven feet high was built.

On September 10 we again reached Revelstoke, and next day started for Mount Begbie, hoping that we might have a few days of continuous fine weather. This hope was vain. We camped at an elevation of about 6,500 feet on the side of Mount Begbie the second day. The weather had been fine but about four o'clock heavy black clouds rolled over the summit and it was not until September 25 that we were able to make the ascent. Then the mountain was covered with about eighteen inches of fresh snow and the weather was cold, making instrument work on top very difficult and disagreeable. This station is on the highest eastern point of the mountain. It is marked by a brass bolt stamped with a triangle and 'XXXVIII.' Three reference iron bolts were placed, each six feet from the station and bearing east, south and west, respectively, from it.

The party next moved to Enderby and camped on Shuswap river, a short distance below the village. While preparations were being made to visit Mount Mara and Mabel mountain, a station was established on a low bare knoll near the northeast corner of section 22, township 19, range 9, west of the sixth meridian. The station is marked by a brass bolt stamped with a triangle and the letter 'E.' Three iron reference bolts were placed, one bearing south 42° 25′ east and distant 12·3 feet, the second bearing south 53° west and distant 12·2 feet, and the third bearing north 56° 20′ west and distant 4·7 feet from the centre. All bolts are cemented in solid rock.

On October 2 we started for Mount Mara near the summit of the Hunters range. The route followed was exactly the same as that taken the previous year. The signal was marked by a brass bolt stamped with a triangle and the number of the station, 'XLII.' Four iron reference bolts were placed bearing north, east, south and west from the signal, the first three being six feet and the fourth nine feet distant from it. All bolts were cemented in solid rock.

The next trip was to Mabel mountain. This was reached by crossing Mabel lake and following the Indian trail up the mountain. The trail has not been used recently and is fast becoming obliterated. The station itself lies in the western part of the summit, overlooking Mabel lake. It is marked by the usual brass bolt stamped with a triangle and the number of the station, 'XLI.' Four iron reference bolts were placed as follows: the first north 4° 30′ east and distant 4·4 feet, the second north 71° 00′ east and distant 11·3 feet, the third south 32° 30′ west and distant 11·2 feet, and the fourth north 66° 40′ west and distant 10·5 feet from the signal. All bolts were cemented in solid rock. On the west bank of Kingfisher creek, starting at the northeast corner of section 15, township 19, range 6, a line about 120 chains long was run in a northwesterly direction. This line was carefully measured and affords a direct tie to the iron post at the above section corner.

Our next move was to Salmon Arm. From here a light camp was taken up to Malakawa in order to ascend Queest mountain. On October 20 we started and reached the summit about two o'clock. Owing to clouds and slight snow flurries, we could do nothing that evening and spent the night shivering around a camp-fire. Fortunately the next morning was clear and we completed our work and returned to Malakawa in time to catch the evening train to Salmon Arm. At Queest mountain (station "XLIII") no permanent marks were left. The station is on the southwest point of the mountain and is marked by a cairn four feet in diameter at the base and 6·5 feet high.

On returning to Salmon Arm a few days were spent ranging out the base and taking magnetic observations where possible. The horses were sent down to Vernon, arrangements having been made to winter them there, and on October 28 the outfit was shipped to Calgary.

On November 1, finding it possible to do so, I took an azimuth observation at station I, on the fifth meridian, using as a reference object a signal at station II, on Nose hill.

From October 3 to 23 I was engaged in making a survey of some villa lots at Banff, and a correction survey near Airdrie, in township 27, range 1, west of the fifth meridian. Owing to snow and intensely cold weather it was found impossible to make satisfactory progress and consequently when the latter survey was completed, I closed work for the season.

I have the honour to be, Sir,

Your obedient servant.

M. P. BRIDGLAND, D.L.S.

APPENDIX No. 18.

ABSTRACT OF THE REPORT OF A. V. CHASE, D. L. S.

EXAMINATION OF LAND AND MISCELLANEOUS SURVEYS IN THE KAMLOOPS DISTRICT OF THE RAILWAY BELT.

The examination of that portion of the Tranquille forest reserve not done by R. D. McCaw, D. L. S., in 1910, was our first work of the season. This portion of the reserve is very rough and rolling. There is no merchantable timber and except for a few stretches of grazing land it might be considered useless were it not for the fact that the thick growth of small scrub timber, which proves more or less of a snow shelter, prevents too rapid evaporation of the moisture collected there during the winter, and thus acts as a sort of reservoir to regulate the stream flow. It is all over 1,000 feet above sea-level and its highest point is 6,000 feet.

The valley of Tranquille river in townships 22 and 23, range 20, west of the sixth meridian was next examined. The surface in the latter township is composed of steeply sloping land and gulches, very rough and useless for agricultural purposes. Some merchantable fir is found in the southwest part of the township, but the grazing has been destroyed by the frequent forest fires, except in a few flats and sloughs.

The land in the valley of Criss creek in township 23, range 21, is all steep and precipitous, and unfit for cultivation of any kind, but some land suitable for growing hay and the hardier vegetables lies along this creek in township 24, range 20. The possibility of growing cereals there is doubtful as frost occurred very frequently in July.

On the hills east and west of Criss creek there is considerable fir and bull pine of medium size, chiefly in the western part of township 23, but to the north in township 24 and in the higher altitudes this is replaced by smaller timber and scrub with jackpine. Some good grazing land is found in the northwest part of township 23, range 21.

Our next work was the examination of lands along Deadman river and its tributaries north of the sixth correction line. This river flows southwesterly through a valley bounded by steep precipitous hills, showing outcrops of solid rock on the west side and steeply rolling land on the east side. Almost all the good workable bottom-land in this valley is disposed of. Some fir of medium size grows on the slope east of Deadman river, and jackpine grows farther north. There is very little grazing land in this valley.

Rising rapidly from Deadman river toward the west the land reaches an altitude of 4,000 feet above sea-level in about two miles, while the centre of township 23, range 23, is about 5,700 feet. Although large areas of jackpine occur, there is no timber of merchantable value, but some meadows were found in township 23, range 23, and timber grass grows throughout the whole area.

On July 26 I moved camp to Pass valley and commenced the examination of lands in ranges 23 and 24, south of the sixth correction line, and north of Thompson river. Range 23 of this locality is very rough, particularly in the valley of Eightmile creek north of Pass valley. No agricultural land that could be profitably irrigated was found although attempts have evidently been made to bring water from Cache creek into this range, a ditch having been found running from Cache creek, through a small area of workable land in the northwest corner of township 21, and emptying into Tsotin lake which in turn is a reservoir for Eightmile creek. Land in this area rises rapidly to the north from Pass valley reaching a height of 4,000 feet above sea-level at a distance of from one and one-half to two miles therefrom. To the west of Eightmile creek valley, the land rises to Cache creek hills and towards the east to over 4,000 feet above sea-level in the northeast part of township 21, range 23. The timber of value found in township 22, range 23, consists of an area of fir of medium size in the neighbourhood of Pass valley in the southeast portion of the township. Some grazing land is found in the southern part consisting principally of timber grass of fair quality. Except for the above-mentioned area, all the land is timbered, jackpine and scrub predominating.

Township 21, range 23, is more open, the only timber of note being found on about three square miles of the heights of Cache creek hills to the west of Eightmile creek, and from four to five square miles in the northeasterly part of the township. It consists mostly of fir and bull pine of medium size with jackpine predominating in the higher altitude in the northeast part. The open land in the immediate vicinity of Eightmile creek is rough and rolling and fit only for grazing, as is nearly all of the undisposed-of part of the south half of this township, north of Thompson river. Owing to its low altitude and extreme heat, most of this land has been burned almost bare of grass of any kind.

Moving camp to a point on Cache creek near the north boundary of township 21, on July 29, I continued the examination in range 24, in townships 21 and 22. The former is traversed through the centre from east to west by Semlin valley which lying at an elevation averaging 1,700 feet above sea-level, comprises nearly all the lands of agricultural value in this township, except those along Bonaparte river. That part of the undisposed-of lands in this township south of Semlin valley and east of Bonaparte river is composed almost altogether of high, open, rolling land with light slightly alkaline soil, gravelly in places, in such a position as to present no possibilities of profitable irrigation and is useful only as grazing land. To the west of Bonaparte river the land rises very steeply and the undisposed-of parts are of no agricultural value on account of the excessive cost of irrigating such small workable flats from the only available source of water, Bonaparte river. Undisposed-of lands to the north of Semlin valley are composed almost entirely of high rocky hills, fairly well timbered in the northeasterly part of the township with scrub fir and bull pine of medium size, but they are more open near Cache creek and Semlin valley. These hills give fair grazing on the north slopes. In Semlin valley itself there are some small areas of undisposed-of workable land to the north of the lands already taken up, but as there is not sufficient water supply to irrigate the lands already patented, there is small chance of these other small areas being of any agricultural value. An estimate by a competent engineer was made in the interests of the settlers in this valley of the cost of bringing water from Bonaparte river. He found on account of the small amount of fall per mile in the Bonaparte that it would cost in the neighbourhood of $80,000, a price considered prohibitive, considering the small additional area that would be served.

In township 22, range 24, the land rises steeply to the north reaching an elevation of 4,000 feet above sea-level at a distance of from one and one-half to two and one-half miles north of the south boundary. The land is very rough with the exception of a small area along the south boundary in sections 1 and 2, where probably eighty acres of workable land is found. The only timber of value grows along the south boundary and consists of fir and bull pine of medium size, but these quickly give place to jackpine as one goes north. Grazing is poor on the south slopes.

The lands in Scottie creek valley in township 23, range 25, are in general of a steep, precipitous nature, although a small area of workable sandy loam soil was found along the north side of the creek near the east boundary of the township, at an elevation of about 3,000 feet above sea-level. This area could be irrigated and would probably be fit for cereals as it is fairly well sheltered. The land rises rapidly to the north and south of Scottie creek, and eastward toward the centre of township 23, range 23. About three square miles of ranges 23 and 24 in this watershed and in the neighbourhood of Hi-Hium creek are below 4,000 feet above sea-level, but the remainder is all high land. The only other lands adjacent to Scottie creek of possible agricultural value are along a small branch of Scottie creek in the northeast part of township 23, range 25. Some areas here are of good flat workable land but adequate irrigation does not appear a profitable possibility. East of the centre of range 24 and north of the sixth correction line the land is all timbered with small growth, mostly of jackpine. Recent fires have burned over most of the east half of township 23, range 24, and a small portion of the southeast part of fractional township 24, range 24, destroying most of the small growth as well as some of the larger jackpine. There is considerable fir of medium size to the south of Scottie creek in range 25, and bull pine with stretches of small jackpine to the north. Some very good grazing land exists in this valley.

The valley of the Bonaparte through townships 22 and 23 presents no workable land which is not disposed of with the exception of a small area adjoining the northern boundary of the railway belt. Possibly an area of fifty acres of the west half of section 29 is workable land. Being at an elevation of 1,800 feet above sea-level this is of agricultural value. These townships are chiefly remarkable for the rough, steep nature of the land adjoining the valleys; much outcrop of solid rock shows to the east of the Bonaparte and steeply rolling land lies to the west. In the lower altitudes the land is rather barren of either timber or grass growth, but as the altitude increases east or west, scrub timber appears, changing to bull pine and fir of medium size at an altitude of about 3,500 feet above sea-level. Timber grass is found in fair quantities where the timber grows thickly.

The valley of Maiden creek holds only very little undisposed-of or irrigable land of agricultural value. This is in section 3, township 23, range 26, and is of such small acreage as to be unworthy of attention. Its altitude, about 3,700 feet above sea-level, is such as to exclude anything but hay growing. The slopes on the south side of Maiden creek present a very fair and uniform growth of fir and scattered bull pine, but on the slopes having a southern exposure the timber is more of a scrubby variety. Grazing is also much better on the shaded north slopes than on the more exposed south slopes.

The valley of Hat creek, through township 22, is very rough in those lands not disposed of, rising steeply to the north and south of the creek bottom to over 5,000 feet in the west part of the township and to 5,000 feet in the Trachyte hills in the east part of township 21, range 26. This area shows no agricultural land of sufficient extent to warrant the expense of irrigation, the small areas of workable land being of such location as to make profitable irrigation, considering the area, very impracticable.

The southeasterly slopes to the northwest of Hat creek are very rough and precipitous, especially in the west part of townships 22, ranges 26 and 27. The land is in general timbered, with open stretches near the creek bottom. On account of the amount of rocky country in this locality, the timber is of rather small size and not of merchantable value. The northerly slopes to the southeast of Hat creek are covered with a better class of timber, although in the immediate vicinity of the creek bottom the land is somewhat open as on the north side. No land of agricultural value was discovered in this locality.

On September 19 I proceeded to Lytton to arrange for the commencement of miscellaneous surveys in that district and on September 25, having completed arrangements and procured the additional men for my party, I moved to Canford to commence subdivision work in township 14, range 23. I surveyed the north boundary and east and west centre line of section 11 and ran a small portion of the east boundary of Lower Nicola Indian reserve No. 10 to determine the bearing thereof and tied the east boundary by traverse to the Dominion system. With the exception of the river-flats of small acreage this locality is rolling, hilly country, timbered with bull pine and fir.

On October 5 I moved to Lytton and proceeded to survey a small portion of the fourth correction line where it crosses Fraser river and a portion of section 35, township 14, range 27, west of Fraser river. I made a traverse of the east bank of Fraser river through sections 26 and 35 of the same township and also of the south bank of Thompson river in township 15, range 26, as far up-stream as could be conveniently done from this camp, and surveyed a portion of the north boundary of section 8.

I next traversed the north side of Thompson river easterly until compelled to abandon this by the blasting operations of the Canadian Northern railway construction. I also surveyed portions of sections 7, 8, 17 and 18 in this township. I found one new settler in section 17, developing a very good bench of about forty acres, but the remainder of the area surveyed is very steeply rolling and of little value except for timber and grazing.

On October 31 I commenced the traverse of Fraser river on the west bank through sections 2, 11, 14 and 27, township 14, range 27, and tied Lytton Indian reserve No. 26 to the Dominion system. I then continued the traverse of Fraser river southerly on the east bank through section 36, township 13, range 27, tying on to what appeared to be the remains of a wooden post, mound and bearing trees on the north boundary of Kanaka Bar Indian reserve No. 2.

Heavy rains and snowstorms becoming prevalent I discontinued work in this locality and with the temperature 7° below zero, moved north with a view to continuing the work on Thompson river traverse and tying in all the unfinished work there, reaching Gladwin on November 11. On account of weather conditions, I discontinued the work after tying in the traverses to section 10, townhsip 15, range 26. I moved in to Lytton on November 16 and after shipping my outfit to Kamloops, disbanded the party.

APPENDIX No. 19.

ABSTRACT OF THE REPORT OF A. L. CUMMING, D. L. S.

MISCELLANEOUS RESURVEYS IN SOUTHERN SASKATCHEWAN AND ALBERTA.

The first work of the season, which consisted of the complete retracement of township 7, range 23, west of the third meridian, was commenced on May 28. The northerly two-thirds of this township is a high gently rolling prairie. The southern portion is broken by two large coulees which afford the best shelter for cattle during the winter, and are largely used by ranchers as a winter camp. Pearce's coulee, through which Frenchman river flows, runs in a southeasterly direction and occupies sections 1, 2, 3 and 12. A rancher is located on section 2 and has a large part of it under irrigation. The other coulee runs north from section 2 including parts of sections 11, 14, 15, 22 and 23, and is thickly overgrown with willow and small poplar. Both coulees vary in width from one hundred yards to one mile.

The soil is mostly clay and the township is well suited for mixed farming or ranching. A few outcrops of lignite and bituminous coal were found but no large seams were discovered. Beaver are very plentiful in Pearce's coulee.

Township 7, range 24, which I next resurveyed, is very similar in the character of the soil and general appearance to township 7, range 23. The northerly two-thirds is practically all settled and a great portion of it is under cultivation. The township is well supplied with water as four creeks run through it. Outcrops of coal are found, and a seam is being worked at the north boundary, which supplies the local demand. Although this township is very well adapted for farming it is even better suited for ranching.

My next work was in townships 19 and 20, ranges 7 and 8, west of the fifth meridian. I went by rail from Swift Current to High river and proceeded from the latter place with wagons up the north fork of Sheep river through Black Diamond and Millarville to the northeast corner of section 33, township 20, range 4. From there I used a pack outfit following a rough trail along the north fork of Sheep river through excellent cattle ranching country. After following the river for about ten miles we branched to the north and proceeded by a very circuitous route to the northeast corner of township 20, range 7, arriving there on August 11.

This district is very mountainous, some of the peaks being over ten thousand feet high. The highest limestone ridges are bare and broken, while the slopes are covered with heavy spruce and jackpine with some heavy windfall. The sides of the mountains are deeply gorged in many places which made the work both difficult and dangerous. The locality can be more easily reached by the wagon road which follows the south branch of Sheep river, and at almost any season of the year heavy loads can be hauled over this road which is now opened up to section 9, township 19, range 6.

The south fork of Sheep river flows through the centre of township 19, range 7; its valley varies from a quarter of a mile to two miles in width. The south half of this township contains exceedingly rich coal fields, and it is claimed that the coal is a semi-anthracite containing 75 per cent of carbon.

The mountain slope is heavily timbered with spruce and some tamarack, but considerable damage has been done by fire. Building stone could be quarried. The soil is a clay mixed with gravel except in the valley where it is much richer. Game consisting of caribou, deer, bears, mountain-sheep, foxes, wolves and partridges is found.

Owing to unfavourable weather I closed operations on December 7, and disbanded my party, retaining only one assistant with whom I was engaged on miscellaneous surveys near Edmonton until January 24, 1912.

APPENDIX No. 20.

ABSTRACT OF THE REPORT OF H. S. DAY, D.L.S.

SETTLEMENT SURVEYS IN NORTHERN ALBERTA.

Leaving Edmonton on May 30, 1911, we travelled by trail to Athabaska Landing. From here, having secured a scow, we proceeded by water to Pelican portage, travelling through a country which appeared to be heavily timbered chiefly with spruce and poplar, and making the journey of one hundred and twenty miles in three days and two nights.

I laid out eighteen lots here on the west side of the river. The valley at this place is not very wide and is almost three hundred feet deep. From the top of the hill the country is quite level and is covered with poplar, spruce, balsam and some birch. A short distance back from the edge of the valley are swamps extending all the way to Wabiskaw. These swamps, however, are not over eighteen inches deep and when the timber and moss are removed the land will be good for farming.

The soil throughout the settlement at Pelican portage is first and second class, and the timber, though good in places, is not sufficient to warrant the survey of timber berths. A gas well, bored fifteen years ago, is still burning with a flame of about thirty feet. It is hoped to also find oil here and an oil boring outfit is being placed in readiness to begin operations in the spring. A winter road extends from Pelican portage to Wabiskaw, and is very much used by the trading companies.

The country around Grand Rapids, forty miles from Pelican portage, where my next survey work was, has been burned over, and a scrubby growth of willow, poplar and spruce has grown up among the deadfall. The valley here ranges in depth from three hundred and fifty to five hundred feet. Some of the land is well adapted to farming, but a large amount of it is very wet. The river is from twenty-five to thirty-five chains wide and has cut its way through a ridge of sandstone which extends two miles above and one mile below Grand Rapids island. An enormous amount of power could be developed here as there is a drop of about sixty feet in half a mile.

I laid out twenty-eight lots on the easterly side of the river, and traversed Grand Rapids island, leaving for McMurray, ninety miles distant, on August 18. This distance was covered in less than thirteen hours, and as it is practically all rapids the trip proved very exciting.

About thirty miles above McMurray the tar sands commence, the tar banks in places being one hundred and fifty feet high. The valley on the western side of the river at McMurray is three hundred and fifty feet deep, but there are several river flats with excellent soil in the vicinity. The timber consists of very thick poplar, spruce and birch, the spruce being heavy but too scattered to be of much value. The whole country is underlaid with tar either in sand or limestone formation and it seems probable that this tar deposit will have much to do with the future development of the district. Some of this tar sand was laid on the streets of Edmonton, Calgary and Vancouver last summer and seems to make an excellent paving.

With the large quantity of pulpwood in sight there is an excellent opportunity for the manufacture of tar paper; moreover the sand after removing the tar is, according to a geological report, of excellent quality for manufacturing glass. Some attempts have been made to burn the limestone of this district and the results show a very good quality of lime. There are also large deposits of salt. The soil is good throughout and several settlers have fine gardens in which they raise all kinds of vegetables.

I laid out fourteen lots on the westerly side of the river, and these will probably be homesteaded very soon, but as the twenty-third base line has already been surveyed it did not seem advisable to lay out more lots. I connected my survey with the base line and also with Mr. Selby's survey of 1910.

Work being finished here on September 22, I moved to McKay, thirty-five miles distant, the tar sands and limestone continuing to show all along the river.

At McKay the valley of the river is not more than fifty feet deep. The timber while heavy in places has mostly been burned and replaced by a scrubby growth of spruce and poplar with some jackpine. On the westerly side of the river the country is generally level except where it is broken by the valley of McKay river. There is, however, a great deal of swamp and the soil is generally poor.

The Athabaska Oil and Asphalt company started boring operations for oil last summer. There are indications of coal under the settlement and from a boring made by Mr. Von Hammerstein there is a stream of brine flowing. The odor of sulphuretted hydrogen can be detected at least a quarter of a mile from this well.

After laying out seventeen lots here we left for Chipewyan on October 13 and continued to pass banks of tar sand until thirty miles below McKay. Ten miles below McKay Col. Fenn is at present boring for oil. He bored through eighty feet of tar sand and sixty feet of pure tar which it is claimed contains a large percentage of oil.

Good progress was made until we reached the mouth of Athabaska river where we were detained by head winds for three days and reached Chipewyan only on the 21st having taken nine days to make the one hundred and ninety mile trip.

The north shore of Athabaska lake is practically all rock with a scrubby growth of jackpine, poplar, spruce and willow. There are occasional patches of soil where the Indians have small gardens. The position of the settlement suits the Indians very well as the fur catch is very large each year and Athabaska lake is well supplied with fish, which is a large item in the Indian's diet and on which he feeds his dogs entirely. The southern side of the lake is probably the largest breeding ground for geese and ducks in America. The settlers, most of whom are well to do, shoot large numbers of them, one man managing to secure nine hundred and sixty geese in two weeks.

After laying out forty-two lots, some of which were necessarily very small, at Chipewyan, we left for Edmonton, arriving there on December 12.

APPENDIX No. 21.

ABSTRACT OF THE REPORT OF W. J. DEANS, D. L. S.

MISCELLANEOUS SURVEYS IN THE RAILWAY BELT, BRITISH COLUMBIA.

I left Vancouver on May 16 for my first work of the season which consisted in laying out timber berth No. 544 in section 34, township 2, west of the coast meridian.

This section is situated about one mile south of Port Mann, the new city which the Canadian Northern Railway company is building on Fraser river. The land is consequently very valuable, the adjoining lands being held at from three to four thousand dollars an acre. The surface is undulating and covered with a thick growth of large fir and cedar with heavy underbrush. The soil is either black loam or clay and would produce fruit, vegetables or grain. The Yale and Westminster wagon road which runs through this section was widened during the past season for the convenience of automobiles and now forms part of a through automobile road to the gulf of Mexico.

My next work was the survey of a portion of section 10, township 38, west of the coast meridian, after which I surveyed timber berth No. 553, in township 17, east of the coast meridian. The lands comprising this berth are situated about one mile north of the Canadian Pacific railway and are at a height of from 500 to 800 feet above Fraser river. The surface is hilly and covered with fir, hemlock, cedar and thick underbrush. The soil is good, mostly clay and is well adapted for garden vegetables, small fruits and grain. The settlers in this part are engaged in dairying and raising small fruits and poultry. The principal market is Mission City. From this station the fruit is shipped to points as far east as Winnipeg, one hundred and ten thousand dollars' worth having been shipped during the season of 1910. A jam factory which is located there uses such fruit as will not stand shipping on account of ripeness.

The Northern Power company are developing power from Stave lake and have in course of construction an electric railway which will run close to timber berth No. 533. This will afford cheap and efficient transportation and will enable the settlers to go more extensively into farming pursuits and fruit culture.

Having finished this work on June 26, I performed two small surveys, one in section 2, township 4, range 29, and the other in sections 9 and 10, township 4, range 26, west of the sixth meridian. In the latter survey most of the land occupies the side of a steep mountain and is covered with a growth of alder, birch and poplar, interspersed with some large cedar and fir. The soil is loose rock mixed with clay and is not suitable for agricultural purposes. Strawberries grow in great profusion along the shore of Harrison river and when cultivated attain a great size. The market however is very limited so that extensive cultivation would be useless at the present time. The waters of the river abound with fish.

My next work was to retrace the boundaries of section 19, township 22, east of the coast meridian, near Sumas lake. The settlers around this lake are engaged in cattle raising, dairying and fruit raising. The low land around the lake known as Sumas prairie produces large quantities of hay and is well adapted for the growing of small fruits, while the bench lands situated about twenty or thirty feet above the lake are especially well adapted for the cultivation of cherries, those produced being unexcelled for size, colour and flavour. The B. C. E. railway skirts the shore of the lake making the place easy of access.

On July 17 I moved to Cultus lake to survey sections 18, 19 and 20, in township 25, east of the coast meridian. These sections are very rough and covered with heavy timber, only small patches being suitable for agricultural purposes. After surveying the south boundaries of sections 2 and 3, in township 19, and investigating the divergence between the international boundary and the south boundary of section 5, township 22, east of the coast meridian, I left for township 3, range 29, west of the sixth meridian, where I completed a small survey, and made some small additional surveys in timber berth No. 553, in township 17, east of the coast meridian.

We completed this work on September 26, and moved to township 20, east of the coast meridian to survey lands suitable for farming purposes and to traverse the south shore of Fraser river through the township. Owing to the recent construction of the Canadian Northern railway through this township most of the original monuments along the river have been destroyed. I extended the line from the north side of the river and retraced a number of lines in order to obtain closings within reasonable limits. Three squatters along the flats near the railway are engaged in fishing and raising a few cattle and vegetables.

In township 8, range 26, west of the sixth meridian, I expected to run about fifteen miles, but about two weeks were spent trying to locate reference posts along the railway, most of these having long ago disappeared. I retraced about five miles of the C. P. R. traverse and reestablished reference points on rocks, cutting an arrow with an old drill. I also retraced the boundaries of the Indian reserve to the south of Spuzzum creek and also the boundaries of lot 4.

Owing to unfavourable weather conditions I closed operations on November 20.

APPENDIX No. 22.

ABSTRACT OF THE REPORT OF J. A. FLETCHER, D. L. S.

OBSERVATIONS FOR LATITUDE IN NORTHERN ALBERTA.

I left Ottawa on June 12, 1911, and travelled via Edmonton, Athabaska Landing, Athabaska river and Clearwater river to the fourth meridian in township 89, where my first observation was taken.

Arriving at Athabaska Landing too late to travel by the Hudson's Bay company's boats I was compelled to travel the remaining distance by canoes. Accordingly I hired two experienced rivermen, one for each canoe, and left Athabaska Landing on June 26.

The current in Athabaska river is quite strong and good progress was made down the river by simply drifting. The only place along the river where farming was attempted was at Calling river where mixed farming is carried on successfully. The absence of open land along the river retards settlement in most places. At Grand rapids the outfit was portaged on the tramway to the foot of the island which is about half a mile long. Some companies have proposed developing power at Grand rapids, but the long transmission required, over 170 miles to Edmonton, has prevented the installation of a power plant. Fifty thousand horse-power could be developed easily. Owing to the recent rains the water in the river was quite high and as the swells at the foot of Grand Rapids island were larger than usual some difficulty was experienced loading the canoes. The weight of the outfit added somewhat to the danger of running the rapids at this point, but the trip was made without any damage to the instruments, only a small amount of water being taken in each canoe.

From Grand rapids to McMurray the river runs much faster, but the rapids may all be run with a canoe lightly loaded. At the Crooked rapids and also at Big Cascade rapids, the canoes were let down close to the shore by means of a rope. In this way the large swells due to the high water were avoided. At Mountain rapids the outfit was portaged about three hundred yards along the south bank of the river. From McMurray the remainder of the canoe trip was made up-stream against the current of Clearwater river. We paddled part of the way, but where the water was sufficiently shallow a pole from ten to twelve feet long was used to pole up. An experienced man with a pole in the stern of a loaded canoe can travel as fast as two men paddling. The trip from McMurray to Cascade rapids was made in three days.

From the Cascade rapids to the fourth meridian there are several rapids and some long portages which rendered pack-horses necessary for the remainder of the trip. The canoemen were paid off here and Mr. Blanchet, D. L. S., who was working on the twenty-third base line in this vicinity, furnished me with five horses in charge of his second packer. We followed the pack trail along the north side of the river as far as the meridian. This trail is rather steep in several places, but the footing is good.

There is considerable merchantable spruce along the valley of Clearwater river. This valley is from one to two miles wide and is wooded with poplar, jackpine, spruce and birch. A few open spots occur along the river-valley, the only one of any extent being at the junction of the Pembina and Clearwater rivers, where some good land is seen. Grass grows abundantly for a timbered country and pea-vine is noticed in considerable quantity all along the river.

The fourth meridian was reached on July 15, and as the weather was favourable for observing, in ten days I had observed and computed sufficient pairs of stars to be assured that the resulting latitude was of the accuracy desired.

On clear nights the thermometer dropped regularly to almost freezing-point but did not go below. The sun rose very early in July at this latitude (56° 42′) and by nine o'clock in the morning the shade was very agreeable. The temperature was much more uniform in cloudy weather, and cold nights were not in evidence. While on the fourth meridian several jackfish were caught in Clearwater river with a trolling line. These fish weighed from five to twelve pounds and were in good condition owing to the water in the river being rather cold. There are some beaver along the river, as evidenced by the poplar trees having been felled and the bark eaten. Muskrats and porcupines as well as ducks and partridges were seen. Bear and moose tracks were also frequently noticed.

We returned to McMurray and travelled up Athabaska river with the Hudson's Bay company's transport which left McMurray on August 9. For transportation of freight between McMurray and Pelican flat-bottomed scows are used, each carrying about five tons and tracked by ten men, the crews doubling at the rapids. The steamer, *Northland Sun,* met the scows at Pelican and the freight was transferred from the scows to the steamer. It took about three and a half days for the steamer to reach Athabaska Landing.

Observations were next taken on the principal meridian at two points, on the north shore of Lake Winnipeg, in township 48, near Big Black river fishing station, and on the south shore in township 35, near Kinwow bay. The station near Big Black river was very conveniently reached, as the Northern Fish company who own this station run the steamer *Wolverine* quite frequently to the northern end of the lake.

A short distance back from the shore swampy country is met and north of township 30 practically no homesteading has taken place on lake Winnipeg. Large quantities of whitefish, pickerel, jackfish, and goldeye are shipped annually from lake Winnipeg. The principal meridian strikes the northern shore about three miles from Big Black river and is easily reached by rowboat. Considerable cloudy and hazy weather was experienced at this station but by September 23 sufficient observations had been taken. We left Big Black river on the 25th and reached Snake island that night. From Snake island we went by sailboat to the principal meridian in township 35, reaching there on the 29th. Rain for a few days delayed observations but the succeeding weather was ideal for observing. The sky was cloudless and the air clear, while the temperature was delightful, the minimum ranging from 40° to 50° F. each night. By October 9 the observation was completed, and we returned to Snake island in time to catch the steamer *Wolverine* on the return trip to Selkirk.

The last observation was taken in township sixty-two, on the fourth meridian. From Lloydminster we followed the meridian trail to Onion lake. A large part of the wheat in this district suffered from the frost as the large amount of rainfall during the summer caused a greater growth of straw than usual and the ripening of the grain was delayed. Many of the settlers in this district are just starting farming and have no live stock to which the frozen grain could be fed. They are forced to sell their wheat at about thirty-five cents per bushel, and when it is considered that it takes a large quantity of frozen grain to make a bushel, the price realized is small. Those with stock to feed fare much better as the price for live stock is good. It would seem that the settlers in this district who go in for mixed farming and do not rely on the wheat crop alone are much more successful. Several settlers have located north of Saskatchewan river and the land there seems well adapted for grazing, water and natural shelter being available in all localities. From Onion lake the trail was followed by way of Frog lake to Cold lake. The land in the neighbourhood of the lake at this latter place is first class and much of the country is open. During the season of 1911 upwards of one hundred homesteaders are said to have located in this vicinity. Cold lake has a fine gravelly beach and the water is exceptionally clear. This lake has been over-fished in recent years and for the winter, 1911-12, the fishermen have moved to Primrose lake farther north.

During the first three weeks of November the weather was very cold and for the most part cloudy. Most of the observations on the fourth meridian, in township 62, were taken at temperatures from 10° to 20° below zero. On November 14 our work being finished we left for home, going first to Lloydminster and thence to Ottawa, where we arrived on December 1.

APPENDIX No. 23.

ABSTRACT OF THE REPORT OF L. E. FONTAINE, D. L. S.

INSPECTION OF CONTRACT SURVEYS IN WESTERN ALBERTA.

I left Edmonton on February 22, 1911, for Entwistle, which I made a base of operations for the examination of survey contracts Nos. 15, 29, 30 and 31 of 1910, and the re-examination of contract No. 22 of 1909.

I next performed some corrections in contract No. 16 of 1909, and opened the necessary section lines to define timber berth No. 1727, in townships 48 and 49, range 6, west of the fifth meridian, which work was finished on August 25.

Leaving for Edson, which I made my base for further work, I proceeded with the inspection of survey contracts Nos. 22, 23, 27 and part of 28 of 1911. I then returned to Gainford, stored part of the outfit and left for Edmonton, arriving there on November 23.

On December 2, after purchasing supplies and securing transport outfit, I returned to Gainford and proceeded with the inspection of survey contracts Nos. 21, 24 and the addition to 22.

This work being finished I returned to Edson on February 10, 1912.

APPENDIX No. 24.

ABSTRACT OF THE REPORT OF J. FRANCIS, D. L. S.

SUBDIVISION SURVEY IN THE WESTERN PART OF CENTRAL ALBERTA.

After organizing my party at Edmonton I left for Bickerdike on April 14, 1911, and from there followed the trail along the valley of the west fork of Embarras river.

On account of the lateness of the season and the scarcity of horse feed we did not reach our starting-point, township 45, range 23, west of the fifth meridian, until May 12. The northeast portion of this township lies between the main ranges of the Rocky mountains and an outer range which I have named the 'McLeod Mountains.' This latter range or spur, branching from the main range near the northwest corner of township 46, range 24, runs in a southeasterly direction to the centre of township 45, range 21, and through range 22 and part of range 21 it forms the divide between the Atlantic and Arctic waters. Between these ranges lies a very hilly country, the slopes being generally wooded, while the intervening valleys have narrow openings, generally more or less muskeg, with creeks of the finest water running through them.

In this part of the country coal seems abundant, as it is here that all leasing and development work has been done. The coal was visible in many places in these hills, principally in the creek beds, and scars and gulches of the hillsides.

The continental divide, which is a bare stony ridge, enters township 45, range 23, on section 25, passes westward and merges into the mountain range on section 20. It continues from there northwesterly one or two miles, rounding the headwaters of the north branch of Brazeau river, then turning south and southeasterly, divides the waters of Rocky river from those of the Little Brazeau.

The southwestern part of this township lies amid the rocky peaks and bald mountains of the first northeastern range of the Rockies.

The south part of the township is drained by the north branch of the Brazeau, while the northern two tiers of sections are drained by the south branch of McLeod river. This latter branch is made up very quickly by numerous creeks seeping from the hillsides and flowing in every direction.

Sections 27, 28, 35 and 36, contain small bodies of spruce and pine timber fit for railroad ties. This grows principally along the slopes facing the south, while those slopes facing the north grow stunted spruce and balsam of no value.

This scanty growth is undoubtedly caused by the ground remaining frozen to some extent during the entire year.

On and near the centre of section 33, along McLeod river, the Mountain Park Coal company are erecting their mining camp buildings and propose to mine coal at an early date.

The spur line of the Grand Trunk Pacific is surveyed as far as this section and is at present under construction. This spur line joins the main branch near the Yellowhead mines in township 49, range 21. A portion of section 36, and of the adjoining section 1, township 46, range 23, which have been surveyed by Mackenzie and Mann as coal claims, were retraced. Some prospecting work has been done and as far as could be seen excellent coal abounds through these sections. The south part of township 46, range 23, which I subdivided, contains the McLeod range of mountains, the middle of this range passing from east to west through the township near its centre. The highest hilltops are bare and rocky, being from 1,500 to 2,000 feet above the valleys. The south slopes are in some places wooded with timber of no great value. Numerous creeks, gulches and ravines cut this range in every direction making the township very rough and broken. Branches of McLeod river in ranges 22 and 23, pierce the mountain range and drain the northeastern slope of the next range of the Rockies.

Near the east boundary of the northeast quarter of section 24, township 46, range 24, two branches unite to form the main branch of McLeod river, one coming from a southeasterly direction, the other and larger branch coming from the west, this latter branch continuing west for about six miles where it divides up into a number of creeks. The railroad survey follows the branch which comes from the southeast and continues for about five miles up the stream.

The portion subdivided in township 46, range 24, lies between the McLeod mountains and the mountain range separating the McLeod waters from those of Rocky river. The portion still unsurveyed is bald, rough and mountainous, with no timber and apparently no minerals. Numerous creeks which have their sources in the mountains on the east side of range 25, join together on section 30 and form the west branch of McLeod river which flows easterly through the township. This river is about one chain in width with water from one to one and a half feet in depth, the current, as usual with mountain streams, being very swift with numerous little falls and rapids. Where the river does not pass through rock formation, the bottom is often spread out, the stream often occupying a very small portion of its bed.

The heavy slopes facing the river are timbered with spruce, pine, and balsam, that growing on the north slopes being small, stunted and of no value. The timber growing on the south slopes, more especially through the centres of sections 28, 29 and the east half of 30, is fairly well grown and is large enough for ties or sawlogs. My estimate of this strip is fully one million feet.

Pack-trails following up McLeod river give access to all the three townships in which my work lay, while an alternative one following up the north branch of Brazeau river and crossing the divide in township 45, range 23, reaches the head of the south fork of McLeod river. After next season the railroad will enable prospectors, tourists and visitors to easily reach this part of the country where a delightful month of cool weather can be experienced at any time during the summer. Owing to the rivers in those townships surveyed not being large, little power could be obtained from them during the winter.

Game was not plentiful in this part, a few bears and several flocks of mountain-sheep being all that was seen. Fish of the trout variety were obtained in the north branch of Brazeau river and the west branch of McLeod river. The soil is good only in very small patches, and in no place is it fit for agricultural purposes.

It is well that these townships have been placed in the forest reserve as the summer frosts and short season preclude the growth of any cereal crops; also there is no hay and very small areas of pasture. Mountains of limestone with sandstone and shale make up the rock formation.

Several small patches of timber on favourable slopes will yield sufficient ties to equip the railroad which is being built and to supply pit props for all the mines which may be worked.

On September 22, in eight inches of new snow, we left for Brazeau river, reaching there on the 26th, after cutting pack-trail for one day.

From this date until the end of October the weather was splendid, being the only lengthy spell of good weather we experienced during the whole season. In township 44, range 20, west of the fifth meridian, sections 5, 6, 7, 8, 17, 18, 19 and 20 were surveyed, and the east outline of the township was resurveyed. The western tier of four sections is generally wooded with green timber of medium size, while the rest of the township surveyed was covered with small pine, spruce and brule. These sections are hilly, being made so by Thistle river and its tributaries which flow eastward into the Brazeau. Along the east outline sections 13 and 24 contain some timber of fair size which continues into range 19 and seems to extend far enough to make four or five square miles of very good merchantable timber. The soil in this township is poor, and the open places, being generally muskeg, afford no pasturage or hay. In township 43, range 20, sections 11, 12, 13 and the south half of 14, are still covered with green timber consisting of pine and spruce, generally small but containing a large number of trees fit for lumber and railroad ties. The north part of the township is covered with brule and second-growth scrub pine, while the greater part of the south half is still green and unburnt, the green timber extending into township 42, range 20.

The northeast corner of the township, on the outline, is near the centre of the northwestern end of the Bighorn range, and is nearly 1,000 feet above Brazeau river. The east boundary of sections 1 and 12 runs along a comparatively level bench and is all in green timber.

The soil in township 43 is similar to that in township 44, the climate not being suitable for agriculture on account of summer frosts and the shortness of the season Those townships can only be reached by pack-trail, from the north via the Pacific Pass mines, from the south via Banff or Laggan and across Saskatchewan river, or by trail up the Saskatchewan and Brazeau rivers. Brazeau river runs northerly through those two townships; its valley, cut through rock formation, is very narrow and deep, being about five to six chains wide at the top and one to two chains at the bottom, with a depth of from 100 to 150 feet. The river has a swift current and is from two to three feet deep. Dams could be constructed and power obtained in every mile of its course, the water supply in winter, however, being much less than in summer.

APPENDIX No. 25.

ABSTRACT OF THE REPORT OF A. H. HAWKINS, D.L.S.

SURVEY OF THE TWENTY-SECOND BASE LINE WEST OF THE FIFTH MERIDIAN.

On March 22, 1911, our party left Edmonton for Wabiskaw via Athabaska Landing, arriving there April 3. We then moved to Horse lakes where my cache had been placed and storing the sleighs there we used a pack-train for the remainder of the journey. Deep snow detained us for several days, but we finally reached the intersection of the fifth meridian and the twenty-second base on April 25.

The following day we began the production of the base, and on September 22, 1911, having completed it to the east boundary of range 21, we started on our return trip to Edmonton via Peace River Crossing, Grouard and Athabaska Landing.

Throughout the season very wet weather prevailed, rain having fallen upon ninety days, between April 25 and October 1, so that we lost about twenty days, on account of rain, and the constant moisture kept the ground soft, making trail cutting and travelling a very serious matter. During the early part of the season cloudy weather interfered very much with the observations.

The country from the fifth meridian to Peace river and south to the twenty-first base line is all very similar in character, and might very well be described as a gently rolling surface, covered with poplar, spruce, willow and alder, with forty to fifty per cent of swamp, marsh and muskeg and numerous small lakes, most of which are rather marshy along the shores. A number of creeks, usually small, flow to every point of the compass, as the country is the height of land for waters flowing south and east to Wabiskaw and Bear rivers, north to Loon and Lubicon lakes, and west and northwest to Peace river. No hills of any account are to be found in this locality, the so-called Cadotte mountains and Horse hills being not more than one hundred feet above the general level of the surrounding country. Horse hills lie in ranges 2 and 3, and are covered with a very heavy growth of poplar and spruce timber. In fact the best timber seen throughout the whole line is, I think, to be found on these hills. The poplar would measure from three to thirteen inches in diameter and the trees, running from thirty to fifty-five feet in length, are clean and sound. The spruce would measure six to twenty-two inches in diameter, fifty to seventy feet in height, and would without doubt make excellent lumber.

The extent of this area of timber is not great, being about seven to nine miles in an east and west direction and from one to three miles in width, and on account of tho scarcity of timber fit for milling in this locality this should be reserved for the settlers.

There is a small amount of timber to be found along the south shore of Lubicon lake, but it is only in patches and does not compare with that on Horse hills, there being a very considerable amount of shaky and punky timber. The same remarks apply also to the timber on Cadotte mountains.

The timber is generally very light and the land could be easily cleared as the stumps of the poplar and balm of Gilead decay very quickly once the tree is cut. There is, I think, quite enough timber for the settlers' use but nothing to warrant commercial lumbering, as wood is the fuel that settlers in this district will probably have to depend upon at least for some time.

At present it is a rather difficult matter to get into this country as the only summer roads are the pack-trails and, in a wet season, these are generally very poor and could scarcely be called roads. A sleigh road leads from Fish camp on Athabaska river about forty-five miles up-stream from Athabaska Landing which may be travelled on the ice from Calling lake, Rock Island lake, Wabiskaw and Trout lakes, or from Wabiskaw. Wabiskaw river may be followed as far as it may be desired to go towards Peace river.

The twenty-second base line crosses the trail about two and a half miles northwest of Horse lakes, in range 3, section 31. The summer trail into this country passes somewhat farther west keeping close to Trout river, and crossing the line in range 4. This trail passes through some very good land. In fact I think the country in the Trout river valley is well adapted for settlement as large portions of it are comparatively open and support a very excellent growth of grass, vetches and pea-vine.

To reach the country in the vicinity of Lubicon lake about range 13, one could go by Grouard, thence to Whitefish lake trading post by the wagon road, and from this point by a sleigh road to Lubicon lake. It is reported that a good summer pack-trail extends north to Buffalo lake.

While there are many muskegs, and marshes, the country from range 11 to Peace river is said to be good, the soil is excellent and around Lubicon lake are many open patches and places that would require but little effort to make them ready for cropping. Large amounts of hay are put up by the Indians in the vicinity of this lake and a number of Indians have their winter houses about three-quarters of a mile south of the lake and own a herd of fifty or sixty head of rather fine cattle which were in excellent condition.

The country in ranges 19 and 20 is comparatively open having been burned over and is now largely covered with scrub and brush, easily cleared. In many places good tracts of hay, redtop, pea-vine and marsh grasses grow and the district would make an admirable cattle or horse range. A large tract might very easily be brought under cultivation with a small amount of clearing.

This locality is accessible from Peace River Crossing by a pack-trail which is rather rough and broken as several very deep ravines leading to Peace river have to be crossed in order to reach the open country. In all probability, however, those lands to the west of the river will prove to be more attractive to the settler as they are more easily reached and the country seems to be more open.

A fine tract of country lies between Peace River Crossing and the small prairie extending two or three miles south to the twenty-first base line. Since this line was run, in the spring of 1910, five or six settlers have settled on the small prairie north of the base line. They had very fair crops and comfortable-looking houses and stables.

Game consisting of bears, moose, spruce-hens and willow and ruffed grouse was fairly plentiful throughout the whole of the country crossed by this base line. A few ducks and geese were seen on the larger lakes, and in range 10 a large colony of beaver were noticed.

Muskrats were quite numerous, but mink, foxes and wolves were very scarce. Rabbits appeared to be more numerous than for several years past. Fish were reported as being plentiful in Trout river and whitefish as being abundant in Lubicon and Cadotte lakes.

Hay was plentiful throughout the length of the line and little or no trouble in finding horse feed was experienced after June 1. The best hay meadows were seen in range 10, from four to six miles north of the base line, and in the vicinity of Lubicon lake. Neither minerals of economic value nor coal was found.

Summer frosts will probably prevail in this country until settlement is well advanced and the numerous marshes and swamps drained.

There is probably ten to fifteen per cent more muskeg east of range 10 than was found to the west of this point and the western portion of this locality is probably the best adapted for settlement.

The soil varies from sandy loam to heavy clay loam, and but comparatively little sandy land was seen, the clay loam and humus seeming to prevail.

The country along the base line is fairly well adapted to mixed farming once communication with markets is established, as the soil is fertile and easily cleared Cattle and horses thrive during the summer on the native grasses. Wood for building and fuel is everywhere abundant and water is plentiful throughout the entire locality.

APPENDIX No. 26.

ABSTRACT OF THE REPORT OF G. H. HERRIOT, D.L.S.

SUBDIVISION AND TOPOGRAPHICAL SURVEY NEAR PRAIRIE CREEK.

From Prairie Creek we travelled by a freight road to township 49, range 27, west of the fifth meridian. Our work in this township was the completion of the subdivision of the southern portion in so far as it was deemed practicable.

The land in the part subdivided lies mostly in the valley of the Athabaska, and is in part almost level or gently sloping. The most southerly row of sections, however, is broken by Folding mountain and Fiddle Creek range. The valley of Athabaska river to the south is well wooded with spruce and jackpine. The soil is a light sandy clay, and does not produce a very luxuriant growth.

Having completed the work in this township we proceeded with the subdivision of the land lying in the valley of Fiddle creek and its tributary Sulphur creek, extending our lines from the thirteenth base line as far south as the not springs located in section 8, township 48, range 26. The subdivision thus includes a portion of townships 48, ranges 26 and 27.

The subdivision being completed about August 20, we proceeded with the work of obtaining sufficient data for the construction of a topographical map of the land in the vicinity of the hot springs. The map was to be on such a scale, and to cover such an area, that it would be possible to project thereon a system of roads, and a water-distribution service. The chief road was one from the hot springs to the railway, and the water distribution service to be such that water might be carried to the Grand Trunk Pacific hotel site near the railway and also to the site of a small chalêt in close proximity to the springs.

The area covered by the topography might be described as a narrow belt extending along both sides of the valley of Sulphur creek from a little south of the hot springs to its junction with Fiddle creek, and thence as a similar strip along Fiddle creek. Three main traverses were run, one along the bed of Sulphur and Fiddle creeks, and one along each side of the creeks a short distance up the hillside. Occasionally it was necessary to cover some small area by a subsidiary traverse. Levels were carried from a bench-mark on the Grand Trunk Pacific railway near the Jasper Park collieries, along the old pack-trail, to Fiddle creek, and thence up Fiddle and Sulphur creeks to the hot springs.

On October 21 a point was reached about a quarter of a mile north of the north boundary of section 24, township 48, range 27, and as the weather was becoming too cold for sketching and slide-rule work we confined our traverses to one along the new pack-trail, and another along the bed of Fiddle creek to its junction with Athabaska river.

The country covered by our subdivision and topographical survey is rather rough, being cut by several deep V-shaped valleys. It is, moreover, everywhere covered with heavy windfall making travel very difficult. Fortunately in the summer of 1910 a kind of pack-trail was opened from the end of the Jasper Park collieries wood trail up as far as the hot springs. This trail although very rough, passing as it does through several small muskegs, across three of the deep creek valleys and in places along the rough stony beds of Fiddle and Sulphur creeks, was of great value to us.

Also about midsummer under the directions of the Dominion Parks commissioner, a better pack-trail was opened from the wood trail before mentioned to the hot springs. This trail is very good and is moreover very picturesque. It follows along the west

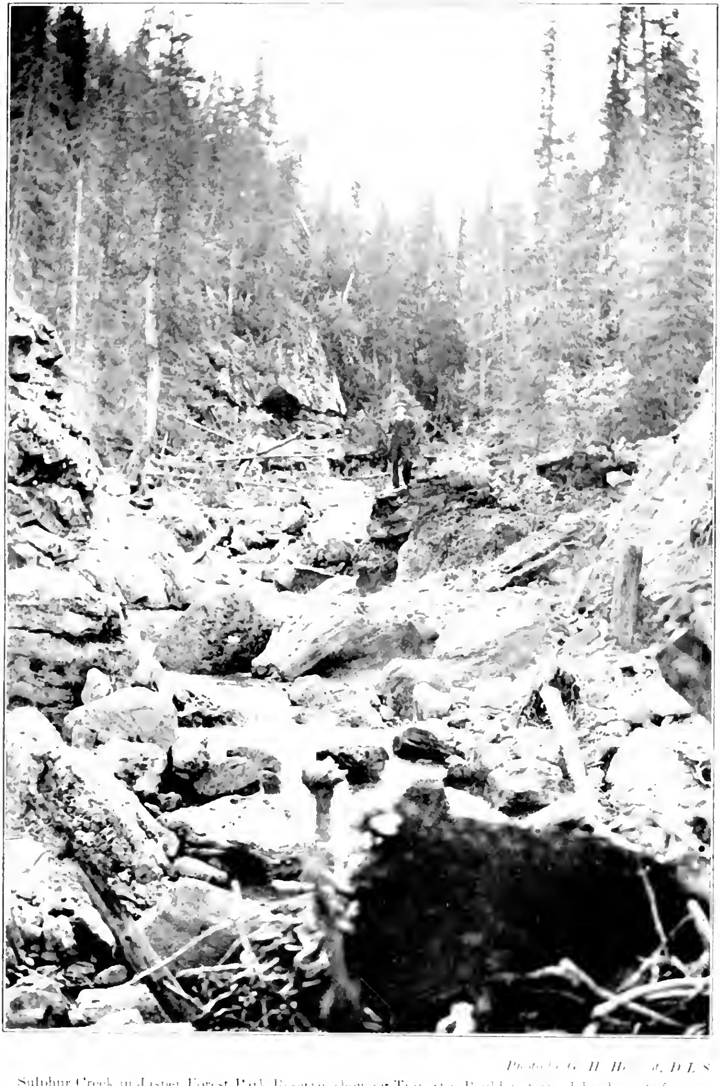

Photo by G. H. H[illegible]d, D.L.S.

Sulphur Creek in Jasper Forest Park Reserve, showing Travertine Boulders formed by deposits from Hot Springs

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side of Fiddle creek from Morris creek to a point near the mouth of Sulphur creek, and from there it follows the west side of Sulphur creek to the hot springs. Perhaps the most beautiful scenery met with, is where the trail meanders along the edge of the bench above the Sulphur creek canyons, which, although not more than one hundred feet deep, are very beautiful.

The greater part of townships 48, ranges 26 and 27, is broken by mountains, the main ones being Fiddle Creek range, Folding mountain and the range of which Roche Miette is a part. Fiddle Creek range is a very prominent limestone ridge which seems to have been thrust up so that the strata appear to be almost standing on edge. Fiddle creek cuts through it in two or three places, forming deep narrow canyons. The grandest of these is situated in section 2, township 49, range 25, and is not more than two miles from the Grand Trunk Pacific railway.

Fiddle creek, the main stream in this area, flows in a northwesterly direction across the townships before mentioned, and empties into Athabaska river at the south end of Brule lake. It is a small stream from twenty to thirty feet in width, with a current of from six to nine miles an hour, and is essentially a mountain stream, in that it follows a winding course along a wide boulder-strewn bed. In periods of heavy rain or rapid melting of the snow on the mountains it becomes greatly swollen carrying with it gravel and boulders. So incessantly has it been carrying debris of every description into the Athabaska, that a large fan-shaped deposit has been formed at its mouth, thus forcing that river close against the rocky bank on the north side, and gradually filling the southern end of Brule lake. In the short distance our subdivision extended, three main tributaries were met with, all occurring on the west side, and in order of occurrence as you travel up-stream are known as Morris, Villeneuve and Sulphur creeks.

From a scenic point of view, Sulphur creek is by far the most important. It enters Fiddle creek in section 19, township 48, range 26, and from there follows a winding course through sections 18, 17 and 8. In section 18 it is joined by a branch stream from the west that is known as the west branch of Sulphur creek. This stream is quite small, being only about fifteen or twenty feet wide. It has a very rapid current, and on one stretch it is very tortuous, winding back and forth in serpentine curves. In this part it has cut a narrow canyon with walls about one hundred feet in height which are almost vertical.

About one and three-quarter miles up the east branch of Sulphur creek at the centre of a broken anticline in which the limestones are standing at a high angle the hot springs are to be found. The hills on either side rise to about one thousand feet above the bed of the creek, and low down in the valley almost on the level of the creek are the hot springs, four large ones and several lesser ones. The many large boulders of travertin found higher up the slope would indicate that at one time the springs issued much higher up the hillside.

The fissuring through which the springs emerge extends for a distance of about 200 feet. The temperature of the main springs ranges from 112 degrees Fahr. in the coolest to 128 degrees Fahr. in the hottest although observations made this summer indicate that the temperature varies slightly with the weather conditions, and especially after a heavy rainfall. The water is charged with gases that give off a smell of sulphur, and the water is quite sulphurous to the taste. From an attempt made to guage the flow of the several springs, it was estimated that the approximate discharge is about one hundred and fifty gallons per minute. It was a rather difficult matter to guage the flow as in some places the water breaks through the loose boulders at the edge of the creek bed.

A sample of the water was submitted to the chemist at the Experimental Farm. His report shows that sulphates of lime and magnesia form the larger part of the dissolved solids, and are the materials that are being deposited by the springs.

Following the same line of faulting southeast there are found several large springs, but none that could be called hot springs. They are all depositing large quantities of lime and magnesia and may be found to be of medicinal value.

The sides of the valleys are covered with much standing dead pine and spruce from six to thirty inches in diameter, while the ground itself is covered with a heavy windfall of this dead timber varying from two to eight feet in depth. A second growth of young jackpine has sprung up almost everywhere. In sections 13, 14 and 23, township 48, range 27, however, there is a nice area of live spruce from eight to twenty inches with a few balsam averaging eight inches in diameter. At present, however, this timber is practically inaccessible. The Jasper Park collieries have been using great quantities of the sound dead timber for props in their coal mine.

The soil is mostly of a sandy boulder clay, in some places being covered with a slight depth of vegetable mould. The dead timber would indicate its richness. It is not suitable for agricultural purposes on account of its roughness and the immense amount of clearing necessary, and as a grazing country it is at present impossible, as an animal cannot stray a dozen feet from the pack-trail owing to the windfall. We were occasionally forced to send our horses out to the few suitable grazing areas that occur in that section, as they could not always find feed convenient to our camps.

In section 6, township 49, range 27, is the mouth of the tunnel of the Jasper Park collieries. Several outcrops of coal seams are to be seen on Morris, Villeneuve and Mountain creeks and the company are extending their workings as rapidly as possible.

In this area the climate is that characteristic of the eastern slope of the Rockies. The summer season from May until September is essentially the rainy season, as scarcely a day passes without at least a shower.

It is indeed unfortunate that the half-breeds and Indians made a final slaughter of the game in this section just prior to its being set aside as a natural park. During our sojourn in the park we saw very few wild animals and few signs of their presence. Five or six deer, three black bears and a few partridges were all that were seen. The heavy windfall is of course a great drawback to the country as a game preserve. Athabaska river is but sparsely stocked with pike and rainbow and bull-trout, and the smaller mountain streams are probably too swift and rocky to carry even the mountain trout. The park authorities however exercise a very strict patrol, and it should be a matter of but a few years till game again becomes plentiful.

It is not unlikely that these springs have been known to the Indians for many years, and that they made frequent pilgrimages there with their sick and ailing. Old pack-trails that lead towards the springs can be followed for short distances, and old teepee poles are still to be seen in the neighbourhood. A rude basin has also been shaped so that the water from one of the outlets flows into it.

The area to which this report has especial reference has been set aside as a national park, thus ensuring to the people of Canada, a heritage that may become one of the greatest health and pleasure resorts in the whole land.

The greatest need of this area, if it is to become an important health resort, is a good wagon road from the railway to the hot springs. Two routes are possible. The first of these would leave the railway near the Jasper Park collieries and climbing over the hills to Fiddle creek, would follow the west side of Fiddle and Sulphur creeks to the springs. This would necessitate the crossing of several small muskegs, the deep valleys of two or three tributary creeks and the overcoming of some rather heavy grades. It would moreover, before Fiddle creek is reached, lead through a strip of country devoid of scenery.

The second and better route would lead from the railway along the east side of Fiddle creek as far as the Grand Trunk Pacific hotel site. From there the road would take a long loop to the southeast gradually rising up the east slope of Fiddle Creek range until a suitable altitude is reached, when it would switch back still following the east slope of the ridge in a northwesterly direction, and climbing steadily to a point directly above the canyon on Fiddle creek. From this point the road would cut along the edge of the limestone ridge, following along a contour until the canyon is passed, thence gradually descending to the first bench above the creek bed on the east side. This bench would be traversed until Sulphur creek is reached where it would be necessary to cross Fiddle creek on a bridge. From there the east slope of Sulphur creek would be followed to the hot springs. Such a road would be both expensive and difficult to construct. It would also involve some rather difficult engineering problems at the Fiddle creek canyon. As has been previously pointed out, the canyon is formed by Fiddle creek cutting through a limestone ridge in which the strata are standing almost vertical. Immediately to the south of this ridge and on both sides of Fiddle creek is a very soft stratum about one hundred feet in width. The soft stratum has been so eroded as to leave a wide gap between the nose of the ridge and the bench to be reached beyond the canyon. It may be possible to cut a road along the almost vertical face of the limestone to a point where a short bridge could be constructed across the gap before mentioned. Once the bench to the south has been gained it would simply be a matter of following a course that would entail the least cost of construction. Although the first cost of constructing this road would be much higher than that of the other road, it would have a decided advantage in length and in the less cost of maintenance. The up-keep would depend only upon the few loose rocks that might come down, and the occasional falling trees; while the other route would have the disadvantage of muskegs, a longer stretch of trail that would continually be obstructed with falling timber, and possibly two more bridges to keep in repair. Moreover the canyon road would have the decided advantage of having very much finer scenery along its route.

Adjoining the proposed site for the new Grand Trunk Pacific railway company's hotel in this district and immediately to the north of it is a fine gently sloping area that is eminently suited as a townsite. This area is dry, slightly wooded and has a very fine outlook towards Athabaska river and the mountains beyond. Also a few villa lots could be laid out in the immediate neighbourhood of the hot springs, for on the right side of Sulphur creek, about a quarter of a mile from the springs and just above the first slope, a small gently sloping bench is found. Moreover, a small stream rises in the upper part of the bench and could be used as a regular source of water supply. The altitude of the bench is such that water may be piped directly from the hot springs to bath-houses erected there. Furthermore, although the valley of Sulphur creek about the upper springs is quite narrow, right at the lower spring the valley widens sufficiently to allow room for a good sized bath-house.

It is hoped that it may be possible to pipe the water from the hot springs to the Grand Trunk Pacific hotel site and bath-houses to be erected near it. In this connection it may be pointed out that at Banff the water at a temperature of about 102 degrees Fahrenheit is piped a distance of about 1,640 feet with scarcely any appreciable loss in temperature. The pipe is wrought-iron and is protected from the weather by being properly packed about with moss in a wooden box two feet square. The velocity through this pipe would of course be quite rapid as the fall is 460 feet from the inlet to the outlet at the storage reservoir. The loss of temperature would however depend upon several factors, namely, the weather conditions, the protection of the pipe, the diameter and length of the pipe, the velocity of flow, and also on the fraction of the cross-section of the pipe the water occupies. Under the most favourable conditions it is reasonable to expect that the water at a mean temperature of 118 degrees Fahrenheit may be piped from the Sulphur creek springs to the site before mentioned, with no greater loss of temperature than 8 or 10 degrees. The length of pipe would probably require to be about seven miles, and the fall in that distance would be about 1,200 feet or about an average fall of 170 feet per mile. In regard to piping water to the villa site, the length of pipe would not exceed 1,500 feet and the loss of temperature could be made practically negligible.

APPENDIX No. 27.

ABSTRACT OF THE REPORT OF E. W. HUBBELL, D.L.S.

RESURVEYS AND INSPECTION OF CONTRACTS IN SASKATCHEWAN.

We left Prince Albert on May 1, 1911, and arrived at Shellbrook the following day. This is a place of about 350 inhabitants and has a new creamery, a branch of the Bank of Commerce and two elevators, as well as graded roads and sidewalks. The Canadian Northern Railway company is extending its line from here to Battleford. The line is already in operation as far as Blaine Lake, a daily service is inaugurated between Shellbrook and Prince Albert and great quantities of lumber and wood for fuel are conveyed daily from Big River to Prince Albert, a distance of about one hundred miles. This section of the country is well settled and produces lumber, fire-wood, wheat, oats and vegetables.

At Mistawasis, in the Snake Plain Indian reserve, we were delayed for a day by the immense bush fires which raged for several days, destroying great tracts of timber through this section of the country, as well as several houses and stacks of hay.

My first work was the resurvey of township 46, range 5, west of the third meridian, which we commenced on May 9, and finished on June 5.

The surface of this township is undulating, while poplar and willow clumps alternate with open patches of prairie. About 80 per cent is admirably adapted for agricultural purposes. The soil in general is sandy loam and is suitable for the production of wheat, oats, flax and vegetables. All the homestead lands are taken, many being patented, and most of the railway lands are disposed of. A considerable portion of the township is under cultivation, and many of the farms and buildings are very fine. Plenty of wood for fuel is obtainable, but the standing timber is scarcely of merchantable dimensions. The various small lakes furnish a permanent and ample supply of fresh water for stock, and good drinking water is obtained from wells twenty to thirty feet deep. In a large part of the township the sections are fenced, the road allowances are graded and bridges are built where necessary. The surveyed trail from Duck Lake to Green Lake crosses this township and was connected with our survey lines. Skipton post-office, situated in the southwest quarter of section 22, has a semi-weekly mail service from Duck Lake, a place about twenty-six miles distant. The new branch of the Canadian Northern railway from Prince Albert to Battleford passes within a mile of the north boundary of the township.

Marcelin, a small but growing village about six miles west, on the railway, is the nearest place of business. It is the centre of a prosperous agricultural district and at present shows every indication of unusually rapid advancement This section of the country is admirably adapted for mixed farming, and has all the requisites for the new settler.

From Marcelin we proceeded to Meeting lake, following the old Jackfish trail. The trail is now ploughed up in many places, showing the rapidity with which this section of the country is being settled. New houses are being erected in every direction and the country in general has made a marked advancement during the past year.

We reached townships 48 and 49, range 10, and township 49, range 11, west of the third meridian, of contract No. 6 of 1910, on a fairly good trail from Meeting lake, which goes via Witchekan lake to Green Lake. The soil in these townships is in general black loam, varying in depth from three to ten inches, with clay subsoil; in some places, however, sandy loam with gravel is found. The surface is slightly rolling and is thickly covered with poplar four to twelve inches in diameter, willow, a little birch and some scattered clumps of spruce. Both poplar and spruce are suitable for building purposes. There appears to be a scarcity of hay marshes, although willow swamps are numerous, and there is little, if any, open land and no settlers. Altogether this portion of the country in its present condition is not well adapted to settlement. The nearest express office is North Battleford on the Canadian Northern railway about seventy miles distant, and the nearest post-office is Mullingar distant about fifteen miles.

We finished the inspection of this contract on June 15, and the following day left for Prince Albert, passing, en route, through the Doukhobor villages, crossing Saskatchewan river at Carleton ferry (where the old-time ferry is still in operation), from there to Duck Lake and Macdowall, and thence to Prince Albert, arriving there June 24. Duck Lake is a small town on the Canadian Northern railway. It does not show the usual signs of advancement compared with other towns in this part of Saskatchewan, but on the contrary it seems to be just where it was ten years ago. To a considerable extent this is due to the fact that Rosthern, a small but thriving town on the same railway about eleven miles to the south attracts most of the trade from the surrounding district, it being one of the centres of the greatest wheat growing section of northern Saskatchewan. While passing through the Doukhobor villages, a decided improvement was noticeable in these people, the one time 'Community system' is practically non-existent, and the Doukhobors now appear as prosperous farmers, while their crops, when we saw them about June 20, were excellent, the wheat being then about eighteen inches high. Though they still retain many of their old customs they are gradually becoming Canadianized.

After repairing the outfit and replenishing our supplies we moved via Macdowall to township 45, range 27, west of the second meridian, to resurvey the northern third of this township. This work was commenced June 30 and finished July 15.

The surface of this portion of the township is undulating to rolling, with bluffs of poplar around the numerous lakes and ponds; there is also considerable underbrush. In these bluffs the poplar runs to twelve inches in diameter and is suitable for building purposes. The soil, in general, is black loam averaging about eight inches in depth, with a clay subsoil, and is admirably suited for the growing of grain and vegetables. There is an abundance of good water. Many of the road allowances throughout this township are graded and bridges are built where necessary. In addition to this there are a number of excellent trails which radiate in all directions. All the homesteads in this township are entered for and a fair portion of the land is under cultivation, wheat, oats and vegetables being the principal products. The nearest post-office and village is Macdowall situated on the Canadian Northern railway about seven miles distant.

This district is well adapted for mixed farming. Great quantities of fire-wood are cut in this vicinity and shipped by rail via Macdowall to the various cities and towns in northern Saskatchewan.

My next work was the subdivision of a portion of township 52, range 16, west of the third meridian, distant by trail about 140 miles. In this portion of the country great progress in agriculture is apparent in all directions, houses and fences are being built everywhere, and large areas of land are under cultivation. This progress is more noticeable in the vicinity of Blaine Lake where there are two Doukhobor villages. These Doukhobors no longer live in communities but cultivate the land and act independently of each other. The results are infinitely superior to their original methods and in a few years it will be difficult to find a more thrifty class of settlers. The extension of the Canadian Northern railway from Shellbrook to Battleford passes close to Blaine Lake and when finished will be of incalculable value to this section of the country. There is much vacant land in this vicinity, mostly prairie and, judging from the crops raised by the Doukhobors, it must be of excellent quality, although in places both land and water are alkaline.

We arrived at this township on July 26, and camped in section 1, on the shore of Birch lake, a beautiful and extensive sheet of good, clear water containing several small wooded islands.

We commenced this work July 27, and finished August 3, during which time, we also traversed the west shore of Midnight lake and another large lake situated in the western part of this township. Jackfish, whitefish and sucker are found in both these lakes.

The southern portion of this township is level, some of it is open prairie and scattered hay meadows, and the remainder is covered with poplar ranging from two to ten inches in diameter, and willow, but much of this timber has been fire-killed. The soil is black loam averaging about eight inches in depth with clay subsoil. There are, however, several small patches of sandy country. Plenty of wood is available for fuel, but there is scarcely any fit for building purposes and none of commercial value.

The lakes above mentioned have large hay meadows along their shores from which great quantities of hay are cut annually by the several ranchers in this vicinity. There are a few settlers with first year crops, and the country to the south and east is filling up rapidly. The nearest post-office is Glenbush, about twenty miles south, and North Battleford is the nearest express office, railway station and business centre. There is a weekly mail service between these two places.

On August 4 we left Midnight lake and proceeded by a good trail to Turtle lake to inspect contracts Nos. 15 and 16 of 1911, in the Meadow Lake district. These contracts consisted of townships 58, 59 and 60, ranges 17, 18 and 19, townships 57, ranges 17 and 18, and township 56, range 17.

East of Turtle lake we passed a fairly large lake, around the shores of which are a number of settlers. The country through which we passed is hilly in places and fairly well wooded with poplar and willow. We camped for the night at Turtle lake, where there is a general store having limited supplies. Turtle lake is one of the prettiest and largest lakes in this section of country. It is about twenty-two miles long and in places, five miles wide. The water is very clear, pure and excellent for drinking, while jackfish, whitefish and sucker are plentiful. Great quantities of fish are salted, dried and kept for winter use. There is a fine sandy beach surrounded by some excellent timber suitable for building purposes.

From here we proceeded in a northerly direction past the northeast corner of Brightsand lake, which is another fine body of water, surrounded by timber. The trail we travelled is the one in general use to Meadow Lake in summer, and although roundabout, is preferable to the new trail, which has recently been made from Battleford to Meadow Lake in range 17, when the frost is out of the ground. This new trail when finished will be much shorter than the one now travelled, and a great boon to intending settlers in the north. The Meadow Lake country is one of the finest tracts of unsettled country in Saskatchewan. The surface is, in general, level except in township 56, range 17, and the soil is black loam suitable for the production of wheat, oats and vegetables. The timber, on the whole, is of comparatively small dimensions, although in places it is sufficiently large for manufacturing purposes, especially in the northern townships. There are numerous openings, more especially in townships 59 and 60, range 17, admirably adapted for immediate settlement. Meadow lake, situated in township 59, ranges 16 and 17, is a fairly large sheet of fresh water surrounded by hay marshes. Meadow, Makwa and Rabbit rivers and several large creeks with a few small lakes furnish an ample and excellent supply of fresh water. Hay and fuel are plentiful. Indian Reserve No. 105, about four miles square, adjoins Meadow lake. A large band of Indians live here and a small store is kept by a Mr. Morin, which supplies a limited quantity of provisions. Most of the freight is brought in via Green Lake about forty miles distant, on a fairly good trail, although at high water there is some difficulty in crossing Meadow river. Game and fish are plentiful. In this district large black timber-wolves are seen; they are very savage at certain times of the year and will then unhesitatingly attack a man. There is a post-office here with a monthly mail service from Green Lake. This fine country, with its many natural resources, will undoubtedly in a short time be the centre of an extensive settlement. It is an ideal mixed farming district and lacks only railway communication to make it one of the most desirable places for settlement and ranching in Saskatchewan. Upon the completion of our inspection we returned to Glenbush via Midnight lake by the new road, previously mentioned, in range 17. We experienced considerable difficulty crossing our outfit over some of the floating muskegs, having to corduroy several places, pack our complete outfit across on our backs, and haul our wagons through by hand. Our next work was the inspection of contract No. 13, 1911, comprising townships 50, 51 and 52, range 11, and townships 52, ranges 12 and 13, west of the third meridian, which we commenced on September 6. We reached this contract via the old Buffalo lake trail from Glenbush. The soil in general is black loam with clay subsoil, suitable for the production of wheat, oats, barley and vegetables. The surface is level, with the exception of township 52, range 13, which is slightly rolling and is covered, for the most part, with small poplar and willow, although in township 52, range 13, and the southern half of township 50, range 11, there is some larger poplar and scattered clumps of spruce and jackpine, but not in sufficient quantities for manufacturing purposes. There are numerous open patches and hay sloughs, and the land around Witchekan lake, from which hundreds of tons of hay are obtained annually, is low and marshy. Witchekan lake occupies the greater part of township 51, range 11, and is about five miles across at its widest point. There are several large creeks flowing into and out of this lake which abounds with jackfish and sucker. The water is not good for drinking. Quantities of fire-wood can be readily obtained in these townsihps. We did not observe any indications of coal, lignite veins or minerals. There are several ranchers around Witchekan lake who own large herds of cattle, this country being admirably adapted for ranching. There are no other settlers, although much of the land is excellent for homesteading. A band of Sioux Indians have established a camping ground on the north end of the lake and have been residing there for a number of years. They are most desirous of obtaining a portion for a reserve and have several shacks and numerous teepees in which they live the whole year. Glenbush is the nearest post office, and has a weekly mail service from Battleford about fifty miles distant, while the nearest railway is the Big River branch of the Canadian Northern railway. There are trails radiating in every direction from Witchekan lake. From here we proceeded via the Green Lake trail, to township 53, range 9, a portion of contract No. 11, of 1911, and inspected nine miles of line, but owing to unfavourable weather conditions we were unable to obtain an astronomical observation. This portion of the country is heavily wooded and hilly.

Our next work was the inspection of contract No. 10, of 1911, comprising townships 53, 54 and 55, range 6, and townships 54 and 55, range 7, west of the third meridian. We entered this contract from the south on a good trail branching from the Green Lake trail, which leads to the Big River sawmills situated on Cowan lake. The surface throughout is level to rolling and is covered with poplar, jackpine, spruce, birch and willow, a small percentage of which is suitable for manufacturing purposes. There are innumerable small lakes and hay sloughs in every direction. Big river averaging about two chains in width and being quite deep in places passes through townships 54 and 55, range 7, and is utilized for the conveyance of sawlogs from various lumber camps to the Big River mills. There is but little open country in this district, and no settlers, although the soil is suitable for the production of cereals. The nearest post-office is Boutin in section 1, township 52, range 8. A branch line of the Canadian Northern railway from Shellbrook to Big River passes through townships 54 and 55, range 7. Once a week a passenger train leaves Prince Albert for Big River, returning the same day. Mixed and freight trains are running continually, but very irregularly. The Big River Lumber company is a gigantic enterprise, controlling most of the timber limits in this district. The capacity of the mills is 75,000,000 feet per annum. When everything is in running order the estimated cut is

7,000 logs (about 400,000 feet) every twenty-four hours. They employ about 3,000 men in the mills and camps, and 300 teams. Big River village is situated on the south end of Cowan lake, has a population of 800, Catholic and Presbyterian churches, a general store and a school with a daily attendance of 60. The average wages paid for labour is from $26 to $40 per month with board and lodging. Cooks are paid from $75 to $90. Lumber, firewood and whitefish are shipped in immense quantities to Prince Albert and other points. Having completed the inspection of this contract on October 2, we proceeded to Prince Albert and after replenishing our supplies and having many repairs made to our outfit which had suffered to some extent on our long trip, we got our horses shod and left for contract No. 9, of 1911. This comprises townships 53, ranges 25, 26 and 27, parts of townships 54, ranges 25 and 26, west of the second meridian, and part of township 53, range 1, west of the third meridian. Following the Candle lake trail we crossed Garden river on a good bridge, and leaving this trail in township 52, range 24, reached the southeast corner of township 53, range 25 by one of our own trails where we commenced our inspection. There are no trails in this contract except those cut out by the contractor and the trail to Montreal lake, passing through township 53, range 1, west of the third meridian.

In general, the alluvial soil is black loam, varying in depth from two to six inches with sandy clay subsoil, suitable for the production of cereals and vegetables. The surface is level and low and covered with poplar four to twelve inches in diameter, interspersed with numerous extensive marshes and several large lakes of good water. A fair percentage of the timber is suitable for manufacturing purposes and railway ties, but recent fires have destroyed great quantities of timber in this district. There are but few hay meadows. Spruce river (Little Red river) and Garden river are the principal streams in this contract, the former being used by the lumbermen for conveying sawlogs to Saskatchewan river. Game, comprising moose, elk and jumping deer is very plentiful and we noticed a fresh beaver dam on Garden river. There are no settlers in this portion of the country, which in its present condition is not desirable for immediate settlement. The nearest place of business is Prince Albert about thirty-five miles distant.

From here we proceeded via Shellbrook, passing through a fairly well-settled district, to contract No. 11 of 1911, comprising, in part, townships 51, 52 and 53, range 9, west of the third meridian, where we arrived on November 3. We entered this contract from the east by a trail which connects with the Green Lake trail half a mile north of Boutin post-office and commenced inspection on November 4. The surface of these townships is rolling and hilly and is covered with poplar, birch and willow, of small dimensions, the poplar occasionally reaching a diameter of twelve inches. In the northern townships, however, the timber which is poplar, spruce and jackpine, with small birch and willow, is much larger and there is a quantity of spruce suitable for manufacturing purposes. There are a number of muskegs, a few creeks and an occasional hay slough. Big river meanders through townships 52 and 53, range 9, averaging sixty links wide, two to ten feet deep, with a current from two to four miles an hour. This river runs through a valley about two hundred feet deep, half a mile wide, and in several places wooded to the water's edge.

The soil throughout is a sandy loam with sand or gravel subsoil, and owing to the hilly surface, these townships are not well adapted for agricultural purposes, being better suited for ranching.

In townships 51 and 52, there are no trails other than those cut by the contractor. Boutin, on the Green Lake trail, is the nearest post-office, but Marcelin, between forty and fifty miles distant, is the nearest place of business.

We next inspected contract No. 12 of 1911, comprising townships 49 and 50, range 9, and townships 50, 51 and 52, range 10, west of the third meridian.

We entered this contract on a surveyor's rough trail and commenced the inspection on November 11.

The surface of these townships is level to rolling and is timbered for the most part with small poplar, birch and willow, although there are some scattered clumps of poplar and spruce of larger dimensions suitable for building purposes, particularly in township 52, range 10. There is a regular entanglement of small lakes throughout this contract.

The numerous hay marshes make this section of the country admirably adapted to ranching, and there are already several ranchers in this vicinity who appear to be doing well. The large amount of dead timber standing in several of the lakes show that in late years the water in these lakes has risen considerably. The greater portion of these townships is covered with small timber which can be easily cleared, and the soil which is black loam up to six inches in depth with sandy subsoil (although in places sandy loam is found with subsoil of sandy clay or gravel) makes a large tract of this land suitable for agricultural purposes. Fire-wood is abundant all through this section of the country. There is very little open country which is not muskeg or swamp, and except for the ranchers mentioned there are no settlers. North Battleford is the nearest place of any size where business is transacted, and Boutin the nearest post-office.

In addition to several branch trails to the different ranches there is a trail from Boutin post-office running through townships 50, ranges 9 and 10, and connecting with the trail from Witchekan lake to Marcelin, in township 49, range 11.

After the completion of this contract we moved into township 50, range 11, a portion of contract No. 13 not previously inspected. This township is for the greater part heavily timbered with poplar, willow and scattered clumps of spruce, and there are no settlers. There is a fine creek running through this township, and one or two inferior trails. We traversed a portion of Witchekan lake while at work here and then moved camp across Witchekan lake on the ice to township 53, range 9, in which we did some further inspection. The snow by now had become so deep that travelling on wheels was next to impossible, so I decided to stop work for the season and move into Shellbrook where I had made arrangements for the wintering of the outfit.

Marked advancement in settlement was apparent this season in every direction. Districts that a few years ago were uninhabited, are now well settled. Railways are being built all through the country, and towns are springing up in every direction. Settlement and progress are very much in evidence, and the settlers seem prosperous and contented.

The townships surveyed this year will open for entry thousands of homesteads, and although the new country opened is for the greater part bush, there are many sections ready for cultivation.

During the season we had several days of excessive heat, on May 5, the thermometer registering 100 degrees in the shade, and on the 10th of the same month a severe snowstorm lasted twenty-four hours. On October 30, we were able to cross several lakes on the ice and November was also very cold, the mercury sinking to 36 degrees below zero on the 25th.

On June 2 wheat was up five inches. The greatest amount of rain fell during the month of July. On September 4 a heavy frost did great damage to crops in Saskatchewan, and on November 6 the snow was six inches deep and by the end of the month it was over two feet.

We did not perceive any indications of minerals or coal during the survey. Great quantities of game, both of the feathered variety and of deer, abound throughout this country, moose and elk being very numerous north of Saskatchewan river.

APPENDIX No. 28.

ABSTRACT OF THE REPORT OF A. LIGHTHALL, D.L.S.

SURVEYS IN THE NEW WESTMINSTER DISTRICT IN THE RAILWAY BELT OF BRITISH COLUMBIA.

I arrived at Vancouver from Ottawa on April 18, 1911, and having purchased my supplies and organized my party I moved up the north arm of Burrard inlet to Bedwell bay. The work here consisted of the taking of some levels in the townsite of Woodhaven which had been laid out by Mr. A. W. Johnson, D.L.S.

Woodhaven is beautifully situated. It is only a few miles from Vancouver, faces the salt water and has a plenteous supply of fresh water procured from a small lake about a mile inland. The surface is rolling and any land not required for townsite purposes would make excellent farm land.

Having finished the work there on May 10, I proceeded to Pitt lake to survey several timber berths and to mark out as much of the limit of the railway belt as could be conveniently reached from the lake. The land there is very mountainous and surveying was slow, considerable time being spent in travelling to and from camp. The work might be more expeditiously carried on if a larger party were employed and two or three men kept packing provisions continuously, as much time is always lost when the regular party are moving camp.

The land will never be good for anything but timber as it is sometimes hard to find a place level enough to pitch a tent. Game is fairly plentiful, consisting of goats, bears, deer and grouse. Considerable water-power could be developed on Rainbow creek, which has a drop of about eight hundred feet in a quarter of a mile, and at low water has a flow of approximately five thousand cubic feet per minute.

Our next work was along Silver creek which flows into Pitt river from the west side just at the foot of the lake. Along this creek a tract of low, wet land extends for about two miles from its mouth. It is about a mile wide and has been formed by a deposit from the surrounding hills. This land is covered at high water, rendering it unfit for agriculture at present; but by dyking, it could be made into a good agricultural district well suited for grain growing or dairying. The higher ground at the foot of the hill is heavily timbered but would make good fruit-farming land as the soil is very fertile. It is easy of access as New Westminster can be reached by boat. The rock formation is granite with evidences of iron and copper but no minerals have yet been found in commercial quantities.

After doing some subdivision work in township 4, range 5, west of the seventh meridian, we surveyed a timber berth on Harrison lake, about eighteen miles from the foot of the lake. Harrison river at that season was very shallow and swift, but in high water it is sufficiently deep for large steamers to run to the lake. The mountains, though as high as around Pitt lake being about five thousand feet above sea-level, are not so steep and rugged, but the timber is smaller. As there is little agricultural land around Harrison lake the logging industry is likely to be the only one which will flourish. A summer resort has been opened up at the hot springs at the foot of the lake, and the district attracts sportsmen as bears and deer are numerous.

Stave river, a part of which I traversed next, is a rapid stream and navigable only for about two miles from its mouth. The surrounding country seems to be well adapted to fruit-growing as it is rolling, very fertile and well drained. The Western Electric company have developed a fine water-power on this river and have transmission lines to Vancouver and the surrounding district.

Having finished the traverse of Stave river on November 16, I paid off the party, stored the outfit and returned to Vancouver.

Photo by G. H. Herriot, D.L.S.

Freighting on the trail from Prairie Creek to Jasper Park

APPENDIX No. 29.

ABSTRACT OF THE REPORT OF G. J. LONERGAN, D. L. S.

INSPECTION OF CONTRACTS IN NORTHERN ALBERTA.

I reached Edmonton during the first week of April, 1911, and outfitting at once, started on the inspection of townships 62 to 66, inclusive, ranges 1, 2 and 3, west of the fifth meridian. There is a good trail from Edmonton to Belvedere and from this place there is but one road which gradually gets worse until you reach township 64, range 2, where it ends. In the above-mentioned townships there is some very good land in places. The northern part is chiefly sand ridges covered with jackpine and tamarack swamps, but the southern part is a clay loam mostly covered with heavy windfall. At one time this southern part was a spruce forest, but fire killed the timber and the wind blew the trees down making it almost impossible to get through. However it is only a matter of time till a second fire will burn up the windfall leaving the land ready for plowing.

My next work was a restoration survey of the northerly third of township 50, range 27, west of the fourth meridian. Most of this township is settled upon and as it is only about thirty-five miles from Edmonton with a fairly good road following the north bank of Saskatchewan river, it is easily seen that what land is left is practically useless for farming, although under the provisions of the provincial Drainage Act there are some very large marshes that can without much difficulty be drained and then the remaining quarter sections will make good farms.

While at this work I received your instructions to proceed to the Peace River district to examine the contracts there. It was now the end of June and as we had had a month of continual rain I knew that the trail would be practically impassable, I therefore arranged transportation for the party and outfit from Athabaska Landing to Grouard by steamer. During the winter travel over this trail is easy, there being no hardships for either men or horses. About every eight or ten miles along the road there are stopping-places, hay and stable accommodation and a bunk-house where the teamsters cook their meals and sleep, the charges being very reasonable.

Grouard, situated at the west end of Lesser Slave lake, is a settlement of about five or six hundred people. The Hudson's Bay company and Revillon Bros. have each a large store. There are also a couple of other merchants, two blacksmith shops, one drug store, two doctors, a telegraph office and a land office. The Roman Catholic mission have a large Indian school with two hundred children in attendance. The town being at the end of navigation and surrounded by a good farming country, is bound to be in the near future a place of some importance. The trail from Grouard to Peace River Crossing, a distance of about eighty miles, passes for the first forty miles through a thick poplar bush with scattered spruce both of which are large enough for lumbering purposes. The north half of the trail runs through more open country with large patches of prairie, and the soil changes from a clay to a sandy loam. Very little of this land is taken up. There are a few settlers with about three hundred acres broken, ready to crop in the spring of 1912.

Peace River Crossing is in a valley about six hundred and fifty feet deep. There are about a dozen houses, two stores, a post-office and a telegraph office. A cable ferry for teams, propelled by the current, crosses the river. There are two steamboats running between Fort Vermillion, one hundred and fifty miles down stream, and Hudson Hope, one hundred and fifty miles up stream. On the west side of the river and about fifteen miles up stream in the valley are situated the Roman Catholic and Church of England missions and schools. They have beautiful farms producing and ripening all kinds of common vegetables and grains, also a flour mill where they do public grinding. Mr. Brick, a farmer located between the two missions, told me that he had successfully grown wheat for the past twenty-six years and it was never affected by frost.

Rising from the valley is a plateau about seventy miles by thirty miles in area, three-quarters of which is open country while the remainder is bluffs of poplar and willow scrub with a few scattered spruce. The soil varies from a clay to a sandy loam and in some places a heavy black loam. Settlers are scattered all along the trail from Peace River Crossing to Dunvegan, but there is room for thousands of others. I would not consider it advisable to start cattle ranching as the soil is too fertile and it will be but a few years till the country will be fenced up by farmers, and pasture lands will be as scarce as in the southern parts of the province.

At Dunvegan there is another cable ferry crossing Peace river, and south of the river valley begins the Spirit river district. The soil here is equal to the best I ever saw in Manitoba or Saskatchewan, about eighty per cent prairie, and farming is but in its infancy. I saw some unthreshed oats that would easily weigh forty pounds to the measured bushel. There is one store and a church in this settlement, and although the settlers are few, all whom I met were well satisfied that they had settled where they are. About fifteen miles south of the river is the north side of the Saddle hills, and for the next twenty miles the trail passes through thick poplar six to eight inches in diameter, with scattered patches of spruce ten to twenty inches in diameter. The hills in themselves are but slight elevations with no rocks. About the centre of township 74 is the north side of Grande Prairie. It extends from Smoky river on the east to Beaverlodge river on the west, and is bounded on the south by Wapiti river. It is about seventy-five miles long by thirty wide. In the west end there is less scrub and I would consider the soil better for farming, there being more black and sandy loam, while in the east the soil is chiefly a clay loam.

Grande Prairie settlement is situated in township 71, range 6, west of the sixth meridian. It has one large frame store, a school, a blacksmith shop, a land office, and a Roman Catholic church, with a dozen other houses. Its rival town, Beaverlodge, twelve miles west on Saskatoon lake, has Revillon's and Hudson Bay company's stores, a branch of the Canadian Bank of Commerce, a post office and a Church of England mission school. They also expect to have a telegraph office soon as the wires were up as far as Dunvegan last November. The settlers around Grande Prairie, like those along Spirit river, and between Peace River Crossing and Dunvegan, are scattered from one end of the district to the other making it quite clear that the soil is good all over, while each settler thinks he has the best location.

My next work was at Pouce Coupé prairie in the Peace River block. Leaving Saskatoon lake I went due west to Beaverlodge river, thence up that river to Sinclair lake and from there a wagon trail was tracked through the scrub to Swan lake and down the south bank of Pouce Coupé river. This trail was but recently made and as there are no bridges across the many creeks, travelling was very slow. I can speak only of the southeast corner of the block. The surface of this part is rolling, the soil is a clay loam and about ninety per cent of it is prairie. From what I saw of it I would advise people who want to go in for cattle or horse ranching to settle here. Hay can be cut in abundance and there is ample supply of water in the creeks. Regarding frost the country is higher than the places previously mentioned but it being situated on the east end of the Pine pass it is reported that the warm winds from the coast protect it. There is but one settler in the district and he told me that spring was much earlier here than at Grande Prairie, with less snow during the winter.

Having completed the inspection of the contract I returned to Grouard and again loading up with supplies I started to inspect a contract west of Big Prairie settlement going as far west as Little Smoky river. From range 19 west of the fifth meridian eastward the country traversed is covered chiefly with poplar six to eight inches in diameter and scattered spruce, with occasional patches of willow scrub and a small amount of prairie. From Winagami lake west to Smoky river is a large tract of good farm land without a settler. I was informed by an old hunter that the good land extended north almost to Peace River Crossing. The soil is a sandy loam and the country is almost level with about fifty per cent willow scrub, the rest being open prairie. The pea-vine climbs up the willow scrub making a net-work very difficult to get through. The grass in this whole district cannot be surpassed by any in the western provinces. There will be no difficulty in obtaining water, as wells could be sunk anywhere and water obtained in less than twenty-five feet.

On November 16 the work for the season being completed, we broke camp and started for Edmonton going via Grouard and Sawridge.

APPENDIX No. 30.

ABSTRACT OF THE REPORT OF E. S. MARTINDALE, D.L.S.

MISCELLANEOUS SURVEYS IN SOUTHWESTERN ALBERTA.

Having completed the organization of the party at Medicine Hat we proceeded to our first work in township 7, range 3, west of the fourth meridian.

This township lies immediately south of the forest reserve at the western end of the Cypress hills, and is broken by the valley of Lodge creek. This valley is about a mile wide and has banks varying from 300 to 400 feet in height. To the east of the coulee the land lies in a fairly level bench broken by ravines, which, in the northern portion of the township, are wooded with small spruce, and poplar and willow scrub; to the west, the country is rough and hilly. Most of the northern and eastern portion, the soil of which is loam, is taken up and is being rapidly fenced. The settlers are mostly English and German, and are following the methods of mixed farming.

The great drawback to this district is the uncertainty of obtaining sufficient moisture to grow and mature the crops. A few attemps are being made to irrigate in the Lodge coulee, but the supply of water available is not sufficient to allow of any extensive operations.

Retracement work was continued in township 7, ranges 4 and 5. Township 7, range 4, is rough and hilly and is used almost altogether for ranching purposes. Township 7, range 5 is not so hilly and the western part is being taken up by settlers.

Wood for fuel can be obtained in the northern part of township 7, range 3, and lignite is found in some of the ravines of the same township. Many of the settlers obtain their fuel from a small coal mine which is being operated near Eagle Butte post-office in township 6, range 4.

In the latter part of June I was informed by parties living in the foot-hills, that conditions in the mountains were favourable for surveying. Accordingly the retracement work was brought to a close and the outfit was shipped from Seven Persons on the Crowsnest line of the Canadian Pacific railway to the town of High River. I proceeded to Calgary to purchase ponies and a pack outfit for use in the mountains.

Leaving High River on July 4, we reached township 17, range 4, west of the fifth meridian, the following day. A good wagon road runs westward from High River to the foot-hills and follows the north bank of Highwood river into the mountains. The country which a few years ago was used exclusively for ranching is now settled and fenced, and is devoted to the growing of grain. The rancher has been driven back into the foot-hills where he is protected from the further encroachments of the homesteader by summer frosts.

On July 6 the subdivision of township 17, range 4, was commenced, and, completing this a week later, the survey of township outlines was begun. This work was in typical foot-hill country, consisting of a succession of high ridges, more or less sparsely wooded with scrubby jackpine and poplar. Trap creek, a small swift mountain stream was crossed in section 25. The north boundaries of townships 17, ranges 5 and 6, were next surveyed. The main ridge of the Highwood range was crossed in section 35, township 17, range 6; it runs in a northwesterly direction at an altitude of from 8,500 to 9,500 feet. While in the Trap creek valley and before crossing the mountains, the block composed of sections 34 and 27, township 17, range 5, was outlined. The country along the eastern portion of the north boundary of range 5 is similar to that along the east boundary except that the ridges are higher and more rocky and are in some cases covered with small jackpine. Trap creek was again crossed in section 33. The first genuine mountain work was experienced here and extended partially across range 6.

An outcrop of soft coal, bright and clean, and apparently of good quality was noticed in the bank of Trap creek at the point where it is crossed by the east boundary of section 31, range 5. There is no timber worth mentioning in the Trap creek valley, except a small area at the head of the creek in section 36, range 6. However, the difficulties to be overcome in getting it to market are too great to make it of any commercial value.

In crossing the Highwood range it was necessary to move the outfit down Trap creek to Highwood river, then along the lumber company's road to their camp in section 21, township 17, range 6.

Highwood river is crossed by the north boundary of range 6 at the northeast corner of section 31. It is a swift mountain stream about forty feet wide and one and one-half feet deep. The country between the Highwood range and the river is similar to the foot-hills in appearance and consists of high sandstone ridges, which, generally speaking, run parallel to the river. It had been well timbered along the outline, but was overrun by the fierce forest fire of 1910. Practically all of the timber in townships 17 and 18, range 6, which was spruce and jackpine up to thirty inches in diameter, was included in timber berths Nos. 1429 and 579, while that in range 7 lies in timber berth No. 292. A portion of that in timber berth No. 292 lying near the British Columbia boundary escaped the fire. The Lineham Lumber company operating on timber berth No. 579, had one large camp working on the burnt timber last winter (1910-1911), and are also working on it again this winter.

The subdivision in townships 18, ranges 6 and 7, was completed on October 16, and we next proceeded with the subdivision in township 17, range 6, completing it by the middle of November.

The coal in the Highwood valley is found in the high sandstone ridges before mentioned. According to analyses which have been made, it is practically an anthracite. This field when opened up should yield a large supply of first-class household fuel. The district is readily reached and a railway into it could be built without meeting any serious constructional difficulties by following Highwood river into the mountains.

Several deer were seen, also some blue grouse, spruce partridge and ptarmigan.

The work of the Highwood valley being completed, we moved to township 19, range 7, by following up Sheep river. The subdivision was completed by December 1, and we arrived in High River on the 3rd.

After paying off the party and making arrangements for the wintering of the outfit, I commenced the small miscellaneous surveys in northern Saskatchewan, for which I had received instructions. On this work I was accompanied by one assistant. We first investigated the marking of a witness post on the north boundary of township 36, range 12, west of the third meridian. The land here is mostly settled and is used for grain growing.

We next traversed the south bank of South Saskatchewan river across township 48, range 24, west of the second meridian, and, after investigating the old traverse of the north bank, traversed that also. The country is partially wooded with small poplar and there has as yet not been very much settlement. A ferry is maintained at the point where the surveyed trail from Prince Albert crosses the river in this township.

The marking of a witness post near the southeastern end of Fish lake in township 52, range 4, west of the third meridian, was next investigated and the necessary corrections made. No settlement has yet been made in this township. The country is gently rolling, more or less thickly grown up with small brush and is also partially wooded with poplar. The timber has practically all been taken out from around the southeast end of the lake.

A resurvey of the south boundary of section 1, township 23, range 33, west of the principal meridian, was next made. This district is settled and some of the farmers have fine houses and barns. While engaged on this work the weather was very cold and severe and as mounding could not be done without serious inconvenience we closed operations for the season and arrived home on January 11, 1912

APPENDIX No. 31

ABSTRACT OF THE REPORT OF H. MATHESON, D.L.S.

RESURVEYS IN SOUTHWESTERN ALBERTA.

On December 3, 1911, I took over the party and outfit of Mr. G. H. Herriot, D.L.S., and began correction surveys in townships 52 and 53, ranges 21, 22 and 23, and township 52, range 24, west of the fifth meridian.

Athabaska river, which I traversed through these townships, runs northeasterly through townships 52, ranges 23 and 24, and townships 53, ranges 22 and 23. Its banks are from two to three hundred feet high. McLeod river, which has banks from forty to sixty feet high, and which I also traversed, runs easterly and northeasterly through townships 52, ranges 21 and 22 respectively.

The Grand Trunk Pacific railway runs between the McLeod and Athabaska rivers and the Canadian Northern railway company are building a parallel line a short distance to the north. Much of the grading is already done but no steel is yet laid. Most of the country was at one time fairly well timbered with spruce, pine, tamarack, poplar, and a little white birch, but owing to frequent forest fires a large part of this district is now covered with brulé and small pine. Merchantable timber still grows on the banks of the Athabaska in townships 52, ranges 23 and 24, along the Grand Trunk Pacific railway in ranges 22 and 23, and in the valley of McLeod river. Patches of good timber are also found in other parts.

The soil varies from almost pure sand to sandy loam and in places boulders are found. The surface of townships 52 and 53, ranges 21 and 22, is mostly flat and much of this area is covered with shallow muskegs which could be easily drained and which are wooded with small spruce and tamarack. Between the muskegs are sandy ridges covered with jackpine. No attempts have been made at cultivation but scattered bunches of good timothy near the railroad give evidence of the fertility of the soil.

The principal industry is making railroad ties where suitable timber can be found convenient to the railroad, and two sawmills are now in course of erection.

Many trails are found between the Athabaska and McLeod rivers, along which packhorses can travel, and roads were cut along the railway at the time of construction, so that travelling through this district is an easy matter.

Photo by G. H. Hamilton, D.L.S.

Fiddle Creek Canyon, Jasper Forest Park Reserve

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APPENDIX No. 32.

ABSTRACT OF THE REPORT OF C. F. MILES, D. L. S.

INSPECTION OF SURVEY CONTRACTS AND MISCELLANEOUS RESURVEYS IN SOUTHERN SASKATCHEWAN.

Our survey operations for the season were commenced on May 6 at Many Island lake. The work there consisted of building monuments left unfinished last season when the dry bed of the lake was subdivided. Owing to the large amount of rainfall causing a greater area of the lake bed to be covered by water the expectations of the settlers with regard to the quantity of hay to be secured will scarcely be realized this year but under ordinary conditions I believe large quantities of hay may be obtained there. From there we moved to Bigstick lake where our work consisted of restoring some obliterated monuments in township 14, range 26, west of the third meridian. The trail we followed to this place passed through a grazing country and large flocks of sheep as well as horses and cattle were observed. No dwellings were seen although some of the land had been recently broken by homesteaders.

After completing this work and some retracement in township 46, range 27, west of the second meridian, I left for Edmonton and from there, on July 3, proceeded to the inspection of contract No. 22 of 1910, which consisted of townships 61, 62, 63, 64 and 65, range 18, west of the fourth meridian. On our way to this contract we passed through Pakan, a small settlement in township 58, range 17, west of the fourth meridian. This was formerly an old Hudson's Bay post and went by the name of Victoria. It has stores, a hospital, post-office flour-mill and blacksmith shop. A ferry crosses Saskatchewan river at this point and a mail coach runs to Lamont, a station on the Canadian Northern railway. From Pakan we proceeded north through Galician and Russian settlements. There we saw good crops and well fenced farms, and their thatched houses washed with white clay on the outside give the impression of thirft and industry. A portable sawmill was in operation at White-earth river.

The surface of the townships in contract No. 22 is rolling and interspersed with marshes and hay meadows. The soil consists of a layer of black loam of variable depth over a subsoil of sandy loam. The timber is mostly poplar and spruce with some tamarack in the muskegs.

After completing the inspection of contract No. 22 I made a partial inspection of contract No. 20 of 1910, which lies southwest of lac la Biche, and then proceeded to contract No. 26 of 1900, passing through Lac-la-Biche settlement. We reached township 63, range 10, west of the fourth meridian which is in the westerly portion of this contract and continued the inspection easterly. We then moved easterly along Beaver river to township 61, range 3, where we made some resurveys. While on our way to the latter township I went to St. Paul-de-Metis for supplies. This is the largest place north of the railway. It has several general stores, two hotels, two blacksmith shops and a number of other industries. A daily mail stage runs to Vegreville, which lies about sixty-five miles to the southwest on the Canadian Pacific railway.

Our next work was the subdivision of a portion of the west part of Cold Lake Indian reserve. West of the reserve the country is nearly all solid woods except where it is interspersed with sloughs or hay marshes. The reserve is mostly open prairie. Along the trails in the reserve, fields of grain, mostly oats, were seen, also some patches of wheat. Most of the wheat as well as some of the oats was injured by frost. Potatoes, however, appeared to be a successful crop.

After resurveying a portion of township 62, range 2, we returned to contract No. 26, of 1909, which lies west of Cold lake and completed the inspection of the eastern half. This part of the contract is all wooded and the soil is generally light. Cold lake is a large body of water, said to be sixty fathoms deep and teeming with whitefish and salmon trout. Fishing on an extensive scale is carried on here in winter, the fish being taken on sleighs to the Canadian Northern railway, nearly one hundred miles distant.

I next inspected contract No. 14 of 1910, which lies northwest of Cold lake. The country in this contract is similar to that in contract No. 26 of 1909, except that the muskegs are more numerous and of greater extent. There are also a number of lakes, one of which in townships 65, ranges 2 and 3, covers approximately eight thousand acres.

We completed this inspection on November 7 and returned to Cold Lake settlement and thence to contract No. 18 of 1911, which lies southeast of Cold lake. The trail we followed passed through undulating country wooded with poplar and spruce. East of the fourth meridian the country passed was level and more open with a sparse growth of jackpine and scrub poplar. North and south of the trail the country is more heavily wooded. South of Mudie lake is all fairly level, being mostly hay meadows.

The inspection of contract No. 18 being finished we moved to contract No. 17 of 1911, and completed this work on December 7. We then proceeded to township 54, range 22, west of the third meridian, to perform some resurvey, following a good trail through partly open country wooded in places with poplar and jackpine. About nine miles from St. Walburg we saw the first settler and farther south found practically open prairie well settled.

As our next work was retracement in township 67, range 12, west of the fourth meridian, we left for Lac-la-Biche settlement via St. Paul-de-Metis. The journey, which occupied five days, was through fairly open country with plenty of hay except at the crossing of Beaver river.

Having finished this work and also some retracement along the correction line west of Egg lake, I proceeded with the inspection of contract No. 20 of 1910. The townships in this contract are very level with poplar woods predominating. It would seem that this section was best suited for mixed farming and cattle raising.

On January 26, 1912, we closed operations for the season and started for Athabaska Landing.

APPENDIX No. 33.

ABSTRACT OF THE REPORT OF A. L. MACLENNAN, D.L.S.

SUBDIVISION AND MISCELLANEOUS SURVEYS AT LE PAS

The village of Le Pas, situated on the south side of Saskatchewan river, has a population of about 400. There are in the place several stores, a dentist, a newspaper office, schools, churches and two hotels. The Finger Lumber company has just completed the first section of a large sawmill. When completed they expect it to have a daily capacity of about 40,000 feet of lumber and to employ about 5,000 men. The spruce logs for the mill are obtained from extensive timber limits some 60 miles up Carrot river, a stream which flows into Saskatchewan river about two miles from Le Pas.

On the north side of the river and opposite the village is an Indian settlement with a population of about 450.

Our work consisted of the survey of a booming site on Carrot river for the Finger Lumber company, and subdivision surveys in township 56, range 25, and townships 56 and 57, range 26, west of the principal meridian. There are in these townships numerous lakes and sloughs, some of which, however, are very shallow. Reader lake in township 57, range 26, being only about three feet deep.

The soil is very light and in many places is merely light gravel covered by thick moss. Spruce timber grows very thickly but it is rather stunted. The surface is slightly rolling but is not hilly with the exception of a high ridge on the north bank of Saskatchewan river.

On account of the sandy nature of the soil vegetables and particularly potatoes, will likely be grown by the homesteaders settling in the vicinity of Le Pas. The extensive hay meadows which border the sloughs will enable cattle-raising to be carried on but cereals cannot be successfully grown unless some means of draining the extensive swamps can be found

Whitefish, pike, pickerel and sturgeon are plentiful in Saskatchewan river and ducks are also numerous, while fur-bearing animals consisting of bears, foxes, mink and muskrats are found in considerable numbers.

APPENDIX No. 34.

ABSTRACT OF THE REPORT OF J. B. McFARLANE, D.L.S.

SURVEY OF PARTS OF THE FOURTH MERIDIAN AND THE TWENTY-FOURTH BASE LINE WEST OF THE FOURTH MERIDIAN.

I reached the northeast corner of section 13, township 95, range 1, west of the fourth meridian, where my work was to begin, on June 15. Work was continued on the meridian until September 27, the line being then completed to the north boundary of township 105. A pack-trail was cut this far north and a sleigh trail as far north as section 12, township 102. Here a cache was built for supplies near a small lake around which there was some good hay and about two tons of this was cut. The intention was to freight supplies this far north, as soon as snow came, for the production of the line. This plan was frustrated by the fact that oats were not sent down the Athabaska as ordered. However, the line has been run through the most thickly timbered country and freighting can be done much easier from the north. Hay was also put up at all points along the line where any could be found. About twenty-two tons in all were put up and the greatest distance between places where hay was secured was from Clearwater river to the north boundary of township 95

As the distance from the Clearwater to township 105 was too far to pack, being at least 120 miles by trail, the outfit was moved south on September 28 and reached the 24th base line on October 8. Here supplies had still to be packed from the Cascades on the Clearwater although the horses had been eating frozen grass for a month and a half, and hay was too far away to be used. By November 7 there was about five inches of snow on the ground and a load of supplies was taken from the Clearwater on sleighs, reaching the camp on the base line on the 13th. The sleighing was so poor that only supplies for the immediate use of the party could be hauled. On November 27 the 24th base line was completed across ranges 1 to 4, west of the fourth meridian, and a sleigh trail was cut from the meridian to section 35, township 92, range 4.

On November 28 we started for Prince Albert via the old Hudson's Bay company's winter trail from Clearwater via Methye portage, Methye lake, Buffalo lake, Ile a la Crosse, then by a new trail overland, crossing Beaver river at La Plonge, thence to Doré lake, Sled lake and DeLaronde lake. The ice was good on all the lakes and rivers but the northern part of the new trail was scarcely broken and consequently rough. On reaching the Hudson Bay company's post on Methye lake we got the oats left there by Mr. Wallace the fall before and as our horses had been on short rations they made the rest of the journey very well.

We reached Big River on December 19, and after waiting two days for a train we reached Prince Albert, where the party was paid off on December 22

DESCRIPTION OF THE COUNTRY ALONG THE FOURTH MERIDIAN.

The land along the fourth meridian from township 95 to township 99, inclusive, is close to a watershed and is composed of rolling sand hills. A number of creeks, all taking their rise within a few miles east of the meridian, flow westerly or northwesterly across the line. The creeks in general take their rise in muskegs. The small creeks generally have muskeg along their courses and often lose their channels crossing muskegs and form again where they have more fall. Creeks of medium size are in general dammed by beaver and consequently have a growth of willow and grass along their banks. This grass in the beaver ponds and old beaver meadows is the only hay in this district and is almost the only grass in all the country I worked in this season

The larger streams, such as Firebag river, which crosses the northeast corner of section 25, township 96, have apparently enough water for the beaver without dams. Along these streams the entire river flats consist of wet muskeg from the water's edge to the rising ground forming the banks of the valleys. The water in all the streams is fresh and fish are plentiful in all the creeks and lakes.

The northeast corner of section 36, township 100, is crossed by Richardson river which is the largest stream the line crossed this season. This stream, at the meridian, is about 300 feet wide, three feet deep and has a current of about two miles per hour. It is called Jackfish river by the Indians and empties into a small lake at the southwest end of Athabaska lake. The valley of this river is deep, being about 550 feet lower than the hills in the southern part of township 100, and it is about a mile wide except where joined by creek valleys. Its sides are rough, broken hills. The river flows northwest and a rough range of hills crosses the line in township 101, running from the river northeasterly. The north side of these hills is rough, and broken with deep ravines. From here the altitude drops rapidly to the north as far as the meridian was run, indicating that the slope from here is towards Athabaska lake. Throughout township 102 the country is much the same formation, rough sand hills averaging about 200 feet above the valleys and ravines. On many of the hilltops throughout this country from township 95 to township 102 the sand is fine enough to blow but there is too much gravel and stones mixed with it to have shifting sand hills even where the timber is thin enough for the wind to strike the hills.

North of township 102 the country is different, townships 103, 104 and 105 are much nearer level and 103 and 104 especially are very stony and dotted with small lakes. On some of the small ridges in these townships no soil can be seen among the stones forming the ridges. South of township 104 very little limestone was seen but from the southern part of this township north, about one-third of the loose rock is limestone. No solid rock projections were seen but boulders up to to ten feet in diameter were met with. In township 103, Old Fort river takes its rise a few miles east of the meridian and crosses the line on section 13. It flows through many small lakes, generally with several rapids between, and at some of these considerable power might be developed. Another small river takes its rise in the southern part of township 104, and flows northerly from a small lake on sections 12 and 13. This stream crosses the line on the east boundaries of sections 13 and 36, in township 105, and continues in a northerly direction. There are some rapids on this but I think none so valuable as on Old Fort river.

This stretch of country from township 95 to township 105 has very little protection from fire. The land is about nine-tenths sand with a growth of jackpine on it and the small muskegs, lakes or creeks wide enough to stop a fire are comparatively insignificant. There is therefore very little of this area that does not get burnt over on an average once in ten years, and consequently there is no timber of value. Nearly all trees six inches in diameter have been scorched several times. Their growth is stunted and they are dead on one side. There is a great deal of thick second-growth jackpine and in many paces thick windfall. There is no open country as about three years after a fire the young jackpine is up thick enough to kill what grass has started on the fresh brulé. The soil is destroyed as well as the timber and the usual covering on the sand is one to two inches of moss and needles. The only timber of value noticed was a few small patches of fourteen-inch spruce and ten-inch birch, poplar, balsam and jackpine on sections 1 and 2, township 101, on the slope of the north side of the valley of Richardson river. On account of the predominant sandy soil this country is not suitable for agriculture. The muskegs that can be drained might form good soil but these form a small proportion of the land. Summer frosts were prevalent and the season short. Rain was plentiful but generally in small or drizzly showers. There is enough fall to all creeks so that no land is flooded but the water in the muskegs rises or falls according to the amount of rain. The country is in general roughly rolling to hilly and the depth and width of the valleys, the sides of which are generally steep, increase with the size of the streams in them. Wood fuel is everywhere plentiful, but no minerals were noticed. Game is fairly plentiful throughout this country, and fine specimens were seen of moose, caribou, bears, wolves, foxes, beaver, mink, marten and ermine. The three latter are very small for their species. Chickens and ducks are also numerous. All this country is an old Indian hunting-ground and the whole country is traversed by hunting-trails mostly running in an easterly direction and consequently of no use for survey trails.

TWENTY-FOURTH BASE LINE WEST OF THE FOURTH MERIDIAN.

Ranges 1 and 2 along the 24th base consist mostly of rolling sand hills covered with small jackpine. From the west side of range 2 the water flows north, while from the east side of range 1 the water flows southwest. The divide between the water flowing north and the water flowing into Clearwater river crosses township 93, range 1, and the northwest part of township 92, range 2, in a southwesterly direction, around a large muskeg basin emptying north including the most of township 92, range 3, and thence to the northwest over the large plateau called 'Muskeg mountains.' Townships 92 and 93, range 3, are taken up largely with a basin containing jackpine, spruce, tamarack and birch, which nowhere averages above six inches in diameter It has a gentle slope to the east and empties to the north. This basin looks like a wide depression through which a large creek would flow to the south into High Hill river. But the hills to the west are the highest in the locality and as the rise is gentle and unbroken the hills look much lower than they are. Range 4 is on the top of the 'Muskeg mountains.' The base line passes over the summit at the middle of the range reaching an altitude of 2,330 feet. The plateau consists of stony stretches of sand almost level, with patches of muskeg and the whole is covered with jackpine, spruce and tamarack averaging less than six inches in diameter.

APPENDIX No. 35.

ABSTRACT OF THE REPORT OF GEO. McMILLAN, D.L.S.

SURVEY OF THE TWENTY-FIRST BASE LINE ACROSS PEACE RIVER BLOCK.

The survey of the twenty-first base line was begun on March 31, 1911, at the northeast corner of township 80, range 13, west of the sixth meridian.

The monument marking this corner which was 16.70 chains too far south was moved into correct position and from this point the base line was produced westward.

Half a mile west of the starting point is Pouce Coupé river, a swift stream about 110 feet wide. It rises in Sucker lake and flows into Peace river about twelve miles north. The valley is two miles wide and about 550 feet deep at the base line, the depth increasing all the way to Peace river. Along the river high rocky banks and river flats alternate.

The soil in range 13 is principally clay, the vegetable loam having been burnt away, and nearly all the timber is fire-killed. This dead standing timber consists of jackpine, spruce and poplar varying in size from four to sixteen inches in diameter. There is hardly any fallen timber as the trees have not been dead long enough to fall. Range 13 is the roughest part of the base line, there being two deep valleys. The deeper one is made by Pouce Coupé river while the other one, three miles west, is almost as deep, although the stream in the latter is only a few feet wide.

The surface in range 14 is undulating with no ravines, and the soil and timber are more thoroughly burned than in range 13. The north limit of Pouce Coupé prairie is about three miles south of the base line and runs in a southwesterly direction, the timbered area widening to the south of the line as far west as the Kiskatinaw river in range 16. Peace river is about nine miles north of the line and the Kiskatinaw flows into it about the middle of the range. For the first two miles north there is a series of beaver meadows and for the remaining distance to Peace river there is heavy green spruce up to thirty inches in diameter.

The soil and surface of the east half of range 15 resembles that of range 14, and in section 33 commences a forest of spruce, jackpine, balsam and poplar extending with one interruption to Pine river. This forest comprises about two hundred square miles of timber up to forty inches in diameter and is accessible to Kiskatinaw and Pine rivers. The other streams between these two rivers are not large enough for rafting logs and it is probable that they dry up in summer. The soil in this forest is a sticky clay loam covered with a thick green living moss which holds the moisture and which must have protected the timber from destruction when fires destroyed so much surrounding it.

Kiskatinaw river is crossed by the base line in section 35, range 16. It has its source near that of Red Willow river and is very crooked and swift. It has a stony bottom and a valley about two miles wide and 550 feet deep. It cannot be forded in high water and on May 2 its waters were so charged with sediment that they resembled black ink and were totally unfit for drinking. In its banks are some thin seams of coal, lumps of which are constantly falling into the water. To the west of the river the line runs through about eight miles of large scrub, small poplar and some large green spruce, the heavy forest previously referred to being to the north. Near the east end of the north boundary of section 32, range 17, the base line crosses the pack-trail leading from Fort St. John to Pouce Coupé and Grande Prairie. This trail seems to be very old and is the leading thoroughfare for hunters and others going to and from Fort St. John. From Kiskatinaw river to Grande Prairie this trail has been widened and improved into the present wagon road.

The district from the Fort St. John pack-trail to Pine river comprises part of the green forest already referred to. It is from from four to nine miles wide and about twenty-four long including ranges 18, 19, 20 and four miles in range 21. To the north and south of this green timber the surface is rolling and covered with thick large scrub of willow and poplar and patches of second growth poplar, jackpine and spruce.

Pine river is intersected by the base line in section 32, range 21. It rises in the mountains and is the second largest stream in the Peace River block. It has a stony bottom, is from ten to twenty chains wide and twenty feet deep at high water, and has a valley two miles wide and seven hundred feet deep. There are some prairie flats along its course where much hay can be procured and back of these flats are high, bare hillsides producing pea-vine and other grasses excellent for pasturage.

From Pine river to Moberly river, a distance of about thirteen miles, the surface is rolling and scrubby with occasional patches of large spruce. There are some small swamps that can be easily drained and in some places hay can be procured. The soil is suitable for stock-raising and farming. Water is abundant and there is plenty of timber for fuel and other requirements.

Moberly river was crossed in section 32, range 23. Its banks are low, resembling those of eastern rivers, and the water is of a light brown colour. It has a swift current, is about 100 feet wide and two feet deep in the rapids and can be forded almost anywhere. It has its source in Moberly lake about twelve miles south of the base line and flows northeasterly into Peace river.

From Moberley river to the western extremity of the block the soil becomes more sandy and is timbered with spruce, poplar and jackpine of medium size except in the valley of Peace river where the trees reach thirty and forty inches in diameter. The soil in the Peace river valley is of the very best quality, there being in some places about two feet of vegetable loam. The pack-trail from Moberly lake to Hudson Hope is reached near the northwest corner of section 32, range 25. It is a very old and well-beaten trail and is in good condition.

The Peace river valley is entered about the middle of the north boundary of section 36, range 26, the last mile of the 21st base line being in the valley. The last post was planted at 38·40 chains west of the northeast corner of section 35 on August 12, and the same day a start was made on the west boundary of the block.

Adjoining the west boundary from the 21st base south there is no land suitable for settlement except a strip about one mile wide along Moberly river in section 27, township 78. This strip is good as far east as Moberly lake, a distance of about three miles. The surface of the remainder is hilly and the soil swampy or stony. In township 80 there are some spruce up to thirty inches in diameter but through townships 79, 78, 77 and 76, no valuable timber was met with. These townships are largely covered with willow scrub of large size and so thick that the tops and branches have grown together in such a manner that they have to be pulled to the ground after being chopped off. There is also considerable small poplar, jackpine and spruce which are of no value.

There is a small lake near the north boundary of township 79 and about two miles east. This lake is about one hundred chains long and forty chains wide and is surrounded by a floating muskeg.

Moberly lake, which is about fifteen miles long and four miles wide, is situated in townships 78, ranges 24 and 25, and is the most important lake in the Peace River block. It contains large numbers of whitefish, jackfish and trout while innumerable geese and ducks are found on its waters. On the west and north sides there are ridges about half a mile from the lake, the intervening space being a scrubby prairie. On this prairie are found wild fruits, such as cherries, strawberries, raspberries, saskatoon berries and blueberries. I saw there also potatoes, turnips and radishes which were equal in size to those grown in Ontario and which had been matured without injury from frost.

The southwest corner of the block is on a bare sidehill and is about 120 chains from the west branch of Pine river. The survey was completed on October 10 and the next day with the party I left for Edmonton.

The route followed was the Pine river pack-trail which leads to Pouce Coupé and traverses the prairie nearly all the way. For about twelve miles this trail follows Pine river valley then turning north follows the prairie above the valley uniting with the trail from Moberly lake to Pouce Coupé, about range 22. It is a good trail all the way and there are good fords across Pine and Kiskatinaw rivers.

That agriculture can be successfully carried on in the Peace River block seems very probable. The soil seems well adapted for raising crops, the climate alone being doubtful. Although crops of last season were frosted, the area under cultivation was very small and that is hardly a fair test for a large area. The rainfall was excessive and the crops, slow in maturing, were caught by the frosts. There is a prairie west of Kiskatinaw river which I think is as large as Pouce Coupé prairie. It comprises a valley beginning at the river and averaging from four to ten miles wide and with a few interruptions extends to the southwest corner of the block. The soil is good and is suitable for agriculture and stock-raising. There are blue-joint meadows, wheat grass and other wild grasses in abundance. The scrub lands, except in range 26, are also good but hard to clear.

The timber lands comprise the forest previously referred to and also some valuable timber in all the river-valleys. I think it hardly necessary to retain this forest as a timber reserve as there is plenty of timber scattered elsewhere to meet the requirements of settlers.

Pouce Coupé, Kiskatinaw, Pine and Moberly rivers contain a permanent supply of fresh water and water-powers can be developed on them all. The permanency of the supply of the smaller streams is doubtful, depending to a great extent upon whether the season is wet or dry.

Shale rock and thin seams of coal appear in the banks of all the rivers, but no other minerals were met with although there is said to be a limestone deposit on Pouce Coupé prairie.

The game consists of moose, deer, partridges and prairie-chickens, and the fur-bearing animals are the black bear, grizzly bear, lynx, otter, beaver, marten, mink, fox and weasel.

The spring season was cold and backward in the timber lands and the snow remained till May 1. On Pouce Coupé prairie there was considerable new grass as early as May 15, the first summer frost occurred on July 19 and frequently after that date, while four inches of snow fell on September 12.

APPENDIX No. 36.

ABSTRACT OF THE REPORT OF A. L. McNAUGHTON, D.L.S.

MISCELLANEOUS SURVEYS IN WESTERN ALBERTA.

My survey operations for the season were commenced on July 21, 1911, the first work being in township 46, range 19, west of the fifth meridian. After carrying on subdivision here for about three weeks I moved to township 45, range 20, and surveyed the east outline. The route followed to this township was along the bed of Southesk river. This would have been impassable at high water as the stream had to be crossed and re-crossed several times.

Our next camp, on Pembina river, was reached by an old trail over the hills. A splendid view of the Rocky mountains may be obtained from this trail. On a clear morning the bare hilltops permit an unobstructed view of a hundred miles of snow-topped peaks glistening in the sun. From here we continued subdivision work in township 46, range 19, until October 5. During this period we had a three days' snowstorm which lasted from September 20 to 22. From that time on, however, the weather was fine.

On October 6 we moved camp to Coal creek and from this date until December 20 we were engaged in the subdivision of land contiguous to the Alberta Coal branch of the Grand Trunk Pacific railway. From there we moved camp over the frozen muskegs to the north boundary of township 46, range 19, and by December 30 had completed the subdivision of the northerly two-thirds of this township, with the exception of the correction line.

We then left for Edmonton, via Edson, arriving there on January 4, 1912.

Up to the present the district surveyed has been reached by pack-trail from Big Eddy, a place on the main line of the Grand Trunk Pacific railway. This trail, which is in poor condition, follows McLeod river southwest from Big Eddy to the mouth of Embarras river, thence up this river about five miles, where it divides, one branch following the west fork of the river to township 48, range 21, and the other following the east fork to township 47, range 19. Another trail running southeasterly from township 48, range 21, connects the termination of these two trails. About forty-five miles of wagon road was also built last spring along the branch line of the railroad, but it was almost impassable in the wet season. It is expected that the railway will be in operation next spring as far as township 49, range 21, and will be completed to township 47, range 19 during the summer.

The north part of township 46, range 19, is nearly level, consisting of muskeg and intervening ridges of jackpine. Toward the southwest the country becomes more hilly, rising into high ranges on the south and west boundaries. This is one of the few areas in the district which show no trace of having been swept by forest fires. Green spruce and jackpine predominate but are of no immediate commercial value. At the forks of the Pembina and westerly along the river are occasional meadows which afford good pasture during the summer months. An outcrop of coal was seen on the south bank of Pembina river, about half a mile west of the mouth of the Little Pembina. This land has been leased to the Pacific Pass Coal company.

The Alberta Coal branch through ranges 20 and 21 traverses a broken hilly country following a chain of valleys considerably lower than the surrounding hills. These hills occasionally rise five or six hundred feet above the valleys. The most prominent range parallels the railway on the north side and is a continuation of the watershed between the Embarras and Pembina rivers in township 47, range 19. Southwest of the railway in townships 47 and 48, range 20, the surface rises through irregular hills to a nearly level plateau, which extends a few miles to the south. In range 21 this plateau is again lost in broken hills. The district throughout is covered with brulé and second-growth jackpine and is no doubt underlaid by the same seams of coal which outcrop in township 47, range 19, and township 49, range 21. Good pasture is found on some of the bare hillsides, two or three miles north of the railway and especially in the northwest part of township 48, range 20.

The east boundary of township 45, range 20, traverses a broken hilly country. Beginning at the twelfth base line, which is at this point about three-quarters of a mile north of Brazeau river, a gradual ascent of half a mile leads to the top of the range dividing the Brazeau and Southesk rivers, and a broken descent of two miles to Southesk river follows. This river apparently has a glacial source, as its water has the characteristic blue colour of such streams and is very cold. The river flows between high cut banks and the current is very swift. Continuing, a broken ascent of two miles along the line leads to the watershed between the Southesk and Pembina rivers. There is a very noticeable difference between the waters flowing into these two rivers. The Southesk waters are very clear, while streams flowing towards the Pembina are discoloured by vegetable matter. This difference is probably due to a greater rainfall in the Pembina valley and consequently a more luxuriant growth of mosses. North of the divide there is a broken descent of two and one-half miles to Pembina river. The south four miles of the east outline of township 45, range 20, passes through a burnt country covered with brulé and small jackpine. North of this the outline passes through green spruce and jackpine, also of small size.

The soil throughout the district surveyed is for the most part a sandy clay or loam and is saturated with water, especially in the green bush and on the northern slopes of the higher hills. I have seen a packhorse mired on a fresh trail along a hilltop. This indicates the presence of a soil almost similar to quicksand. However, this is exceptional as there is generally firm footing, except in muskegs.

During the summer months rain-storms, and especially showers in the afternoon, are very frequent. No matter how fine the morning there is always a probability of a shower before night. The clouds are formed on the mountain tops and travel some distance eastward before breaking. Owing to the elevation, there is a possibility of frost on clear nights at any time of the year. The fall weather is, as a rule, very fine, especially during the months of October and November and, owing to the greater strength of the chinook winds, the winter is not so severe as in the prairie country.

The greatest asset of this district is the immense areas of coal beds. Seams up to fifteen feet in thickness have been found and worked and the coal is of good quality for steam purposes. There are possibilities for the development of water-power on the Brazeau and Southesk rivers, but on account of the abundant supply of coal, capable of being economically mined, such development is unlikely in the near future.

APPENDIX No. 37.

ABSTRACT OF THE REPORT OF T. S. NASH, D.L.S.

INVESTIGATION SURVEY IN SOUTHWESTERN MANITOBA.

On September 11, 1911, I was instructed to proceed at once to make an investigation of the survey monuments in township 2, range 21, west of the principal meridian. I accordingly left Ottawa on September 12 and arrived at Boissevain three days later.

This place is a thriving little town at the junction of the Great Northern and Canadian Pacific railways, and is surrounded by an excellent wheat-growing district. As threshing was in progress at that time I was able to secure the assistance of only one man in that vicinity, but after reaching the township where I was to work I obtained the help of another man with his horse and rig. The township is favourably situated for agriculture, being on the northerly slope of Turtle mountain. The northerly half of the township being prairie, was almost all under cultivation, more than half of the boundaries were fenced and many of the road allowances were improved, some being graded. The owners for the most part live in well-built houses of brick or stone, have excellent barns and fine stock and enjoy a very good telephone service. Practically all the monuments in the northerly half still exist or their positions are indicated by fences or crop lines. The southerly half of the township was formerly covered with heavy bush and only wooden posts were planted in the original survey. As this district has been repeatedly swept by fire, no trace whatever remains of the old lines or posts. The settlement in the southerly part is more recent. Much of the land has to be cleared of brulé and scrub before it can be broken, so that the proportion under cultivation is much less. A fine second growth of poplar is springing up in many parts under the protection from fire afforded by the cultivated areas. This is in marked contrast to the condition observed in the Turtle Mountain forest reserve in township 1 adjoining, where fires continue to keep all second growth eradicated.

The soil throughout the township is a black clay loam producing excellent crops of wheat, oats, barley and vegetables.

The lack of survey monuments in the southerly half of the township is a source of much dissatisfaction to the settlers, as they do not wish to do any breaking ground beyond their proper boundaries, nor to do any permanent fencing till they know where their boundaries are. As it is not known where the road allowances are, there is but one road, which is at all improved, opened through the bush. This lack of proper roads and bridges is a great drawback to the settlers as it is only with great difficulty that they can market their produce.

Having completed the search for monuments, I returned to Ottawa, arriving there on October 2.

APPENDIX No. 38.

ABSTRACT OF THE REPORT OF T. H. PLUNKETT, D.L.S.

LEVELLING ALONG FIFTH MERIDIAN AND ADJOINING BASE LINES AND MISCELLANEOUS SURVEYS.

My instructions were to complete a line of spirit levels along the fifth initial meridian from its intersection with Athabaska river in township 71 to the north boundary of township 112, over the twenty-ninth base line in range 1, and the twenty-eighth base line through ranges 1 to 17, inclusive. In addition certain corrections were desired on the meredian and some incompleted monuments were to be built.

The previous experience of surveyors showed that this country should be entered while the frost is still in the ground and preferably over the snow in early spring. Accordingly on March 14 I left Edmonton for Wabiskaw where I was to begin work, arriving there with my outfit and supplies on the 23rd.

I had intended travelling on the ice on Wabiskaw river, one hundred and fifty miles to its intersection with the fifth meridian, but owing to the great depth of snow early in the season, the ice was not strong enough to bear horses. As sufficient dog teams could not be obtained, we were compelled to wait until boats could be used. In the meantime we hired two dog teams and ran levels south from Wabiskaw along the fifth meridian to Athabaska river.

This work was completed on May 6 and the main camp was again reached on May 13. The boat which we had built was then loaded and sent in charge of my assistant to township 91, where the river intersects the meridian, while I with the remainder of the party ran levels north from Wabiskaw.

Considerable trouble was experienced navigating the river owing to low water, but by May 26 our provisions were safely stored at the intersection of the river and meridian in township 91, and the party reunited in township 83.

Our way ahead now seemed clear for at least ninety miles of work but about this date the almost incessant rains which characterized this season in the West commenced and very soon the swamps and muskegs began to delay us and continued to seriously hamper our operations as well as make life miserable for the party.

Work was carried on under these conditions until township 104 was reached. Here the swamps and muskegs became less numerous and although the rain continued until August 21 the wading through the foul-smelling swamp water was so greatly decreased that the party seemed to revive and take renewed interest in the work.

Peace river in township 111 was reached on September 6, and as our packhorses began to show the ill-effects from their long journey it was decided to give them a much-needed rest. Good pasture lands being convenient the remainder of the meridian north of Peace river, and the 29th base line, were completed without the aid of ponies, supplies and a limited camp outfit being packed by the men.

On our return to the 28th base line on September 20, our horses showed a great improvement and work was continued on the base line until October 2, when four ranges had been completed.

It was now considered advisable to commence our long journey homeward. Frost had come fairly early and the horse feed was not as good as it would otherwise have been at this date. The long trail between us and Edmonton made us doubtful if our horses would stand the journey if exposed to the severe cold which we would surely get if we remained later. Severe weather did overtake us even with our early start but fortunately not until we had reached Wabiskaw where hay was available.

On our arrival at Wabiskaw on November 4 we found that the season of 1911 had been the wettest for twenty years. Hay was scarce, it having been found impossible to cut the large meadows in the vicinity of Wabiskaw lakes owing to their flooded condition, while the continuous rains had prevented the proper curing of large quantities of hay obtained farther back from the settlement.

Regarding the agricultural adaptability of the country traversed by me this season, little need be said. The report of Mr. A. W. Ponton, D.L.S., appearing in the annual report of the Topographical Surveys Branch for 1908-9, deals fully with this question. A copy of that report I found invaluable to a stranger penetrating this wilderness, and, having referred to it constantly during my trip, I can fully endorse his views on the suitability of this country for agriculture. The general information supplied by him regarding the country was found most accurate and greatly facilitated our work this season.

According to the present inhabitants of this district the spring of 1911 was unusually late. Growth at Wabiskaw did not commence until May 15, and it was almost June 1 before any green feed was available for horses north of Wabiskaw, but on May 6 grass had attained a growth of four inches at the intersection of the fifth meridian and Athabaska river in township 71. Once commenced, however, the grass and foliage came out rapidly and by June 20 these were at their best.

Frost at night continued until May 29, but after that date no frost was noticed, with the exception of a degree or two on July 20, until August 25 and 26, when a severe frost occurred in township 109, which seems to have been general.

September was, generally speaking, a fine month. Frost at night occurred on the 9th, 18th, 19th, 20th and 21st, while on the 20th snow fell to a depth of three inches, but this was all gone on the 23rd.

October, until the 18th, was exceptionally fine, frost occurring only on the 2nd, 3rd and 4th. On the 18th we experienced a severe northwest gale, snow falling to a depth of six inches on the high land in township 95, and after that date frost was experienced nightly while the swamps were frozen sufficiently to bear ponies after the 25th.

November was very cold, snow falling to a depth of four or five inches on the 6th, 7th and 8th, with the thermometer at zero at Wabiskaw. The weather became steadily colder until the 15th when 40 degrees below zero was experienced by the party on the summit of Pelican mountains; after that date, however, the weather moderated although winter weather prevailed throughout the month.

The spring of 1911 came on very dry. No rain fell during April, and May, with the exception of light showers on the 5th, 9th and 29th, was also dry. A violent rain and hail-storm occurred on June 2 which flooded the swamps and muskegs rendering the pony trails very heavy and in places impassable. In June there were twelve days during which heavy rains occurred and July was also very wet, rain falling on seventeen days, while during August rain fell on every day of the first twenty except the 19th. The remainder of the month was fine and comparatively dry.

It was found that comparatively small areas along the meridian are at present fit for settlement and these locations are at present so isolated and so difficult of access that it is highly improbable that settlers will find their way to them over the route followed by me this year.

Many first-class locations are to be found north of township 104 and west along the 28th base and these are easy of access compared with the country between Wabiskaw post and township 104.

Practically the whole country as far north as township 106 is covered with moss from six inches to two feet in depth. This moss has prevented the water from draining off the land, acting very much like a huge sponge, and has given it its swampy nature. The fact that so much of this swamp and muskeg exists should not lead to the conclusion that it is a flat country, presenting difficult drainage problems. This is not at all the case and the presence of the greater number of these wet areas is in my opinion altogether accounted for by the presence of the moss. I have found in many places almost impassable swamps on slopes of from ten to fifteen degrees. In some localities where forest fires have occurred during very dry seasons the moss is removed and the country is now dry and ready for settlement.

While at the confluence of the Red and Peace rivers I was told by the Hudson Bay manager there that the Indians in that country are burning a crude oil but the location of their supply is as yet known only to themselves. An attempt to obtain samples of this oil was unsuccessful.

Game is abundant. Prairie-chickens were seen as far south as Wabiskaw while grouse were very numerous all along the meridian and from township 100 north. Rabbits too are much more plentiful than for some years previously and this according to the fur traders bespeaks a much larger yield of fur in the near future.

All through the country the beavers are rebuilding their dams and appear to be increasing rapidly in numbers. Moose, caribou and bears appear to be plentiful except north of Peace river where the Indian hunters complain of the ravages of wolves among the young caribou and moose. No wolves, however, were seen by the party.

APPENDIX No. 39.

ABSTRACT OF THE REPORT OF A. W. PONTON, D.L.S.

SURVEY OF PART OF THE PRINCIPAL MERIDIAN.

On March 2, having completed my organization and secured the necessary outfit including dogs and dog-sleighs, we took train from Selkirk to Gimli, where supplies had already been forwarded. There two teams of horses with bob-sleighs awaited us and on March 3 a start was made for the North.

The route followed was from Gimli to Icelandic River settlement by ice, from Icelandic River by trail across country to Fisher Bay settlement, from Fisher Bay on the ice following the west shore of the bay to Stony point and around this point to my starting place on the meridian in township 35. From Gimli to Stony point there is a well-established winter road followed by freighters hauling fish from Outer Sturgeon and Reindeer islands to Gimli, and stopping places occur at intervals of about fifteen miles. On the 13th a start was made on the meridian and work proceeded until the 20th, when I decided to dispense with the services of six dog teams and their drivers, as it had become evident soon after passing Berens island that it would be impossible to obtain a sufficient supply of fish to feed the nine teams of dogs with which I had started.

Having reduced my transportation to three dog teams, the line was continued from day to day as the weather conditions permitted until the mainland on the north side of Big Black River bay in section 36, township 48, was reached on April 4.

On the 5th an attempt was made to produce the meridian on the mainland, but the snow was found to be too deep in the bush and too wet to proceed farther with the limited means of transportation at my disposal. At the same time I had been compelled to cache the greater part of my supplies far behind on Burton island. These supplies could not be brought up unless we could depend on the winter temperature continuing late into the month.

Having decided to return to Selkirk to await the opening of navigation, and to obtain a party and outfit, including canoes, suitable for carrying on the work under summer conditions, I started for the south on April 6, reaching Berens river on the 8th. There my dog trains were dispatched to Burton island to secure supplies and iron posts from cache, and on their return these were stored at the Hudson's Bay company's post, a port of call for steamers. Burton island can be approached only by tugs. I was delayed a couple of days at Berens river, owing, first to water on the ice, and then to a violent blizzard, but on the cessation of the latter the water had disappeared off the ice and on the 15th a start was made for Gimli, which was reached without incident on the 20th. On the following day we arrived at Selkirk, where my small party was paid off, with the exception of my two assistants. The chief incidents of such a campaign on the ice are blizzards and snow-blindness. I was fortunate with regard to the former, being actually caught only once without some shelter other than that which a tent affords, but with regard to snow-blindness, the picket man and myself were the chief sufferers, owing to the constant necessity of removing our coloured glasses.

The opening of navigation was unusually late in the spring of 1911, owing to the low temperature which continued throughout the month of May, and it was June 6 before I could get passage by steamer to Big Black river. Work was resumed on the meridian on the 10th and continued without interruption, other than delays caused by difficulties of transportation, until September 28 when the sixteenth base line was reached. During September the weather was cold and disagreeable, rain falling on seven and snow on two days. The country being generally floating muskeg, ice would form at night which had to be broken with the feet at every step, and much endurance was required to stand in ice cold water all day. Transportation was thus rendered almost impossible, and supplies could no longer be kept up at this particular season. With the limited supplies on hand, I decided to make an effort to run the sixteenth base line far enough west to intersect Nelson river, or for about six miles, with the view to making both the meridian and the base line more accessible whenever their further production might be required. However, after running it nearly two miles, bad weather in the form of rain, snow and fog, caused delay which threatened to bring about a famine, and it became necessary to pick up our packs and make for the river to get in touch with Norway House by means of canoes as soon as possible. I had also, previous to this date, received notice from the Northern Fish company that it would be necessary for my party to be at Warren's Landing by October 11 to catch their steamer *Wolverine*, which would make her last trip to Selkirk on that date.

Arriving at Nelson river on October 1, we waited till the 5th for the arrival of a motor boat from Norway House. After proceeding up-stream in this boat for a couple of miles the motor failed, but by good fortune a York boat happened along and by travelling all night we were enabled to reach Norway House on the morning of the 6th. From this post we travelled by the Hudson Bay steamer *Highlander* to Warren's landing, and from there by the steamer *Wolverine* to Selkirk, where my party was paid off.

The country along the meridian between townships 48 and 60 was found to be all of the same general nature—low, with swamps and muskegs alternating with outcrops of rock of the Laurentian formation. These outcrops invariably run in a northeast and southwest direction. Patches of dry ground covered with spruce from two to eight inches in diameter were occasionally met with, but in no case were they observed to cover any large area. The soil in such cases was sand or frozen clay. The soil throughout is generally black vegetable muck, which, even in event of draining, cannot be regarded as suitable for agriculture. Along the banks of the Belanger, Gunisao and McLaughlin rivers occasional patches of sandy loam occurred where farming could be followed on a small scale.

The country is timbered wtih spruce, jackpine, tamarack, poplar and birch, but in no instance was it found of sufficient size for milling purposes. Evidences of recent fires were observed, but on the whole they have not spread far owing to large areas of open muskeg. Timber cannot reach a greater growth than six to eight inches, as the roots rest on perpetual ice. In view of the approaching scarcity of timber, the drainage of this country may be a profitable investment at no distant date. Jackpine is confined to the rock areas, but none of sufficient size for railroad ties was observed.

There are apparently no beaver meadows and the only hay is muskeg grass.

The water is generally very clear and good, and this applies even to the muskegs. Few creeks were crossed, and all were small. Belanger, Gunisao and McLaughlin rivers are fine streams averaging one hundred feet in width. These streams are of varying depth and have no perceptible current, except in the vicinity of small falls, which occur at intervals.

Water-powers with heads of from two to ten feet can be obtained on these rivers, with apparently a permanent supply of water.

The climate cannot be judged by the weather conditions of 1911, as they were unusual throughout Manitoba, Saskatchewan and Alberta, a late spring being followed by poor ripening weather. Potatoes of excellent quality are grown at Norway House.

This district lies within the Laurentian area, and the rock, being massive and without cleavage, is not generally suitable for building purposes.

No minerals of economic value were observed and the Laurentian rocks seem unpromising in that direction.

Game of the feathered variety is plentiful. Ducks abound along the rivers in their season. Several cow moose were seen and, I understand, that both moose and caribou are numerous.

Fish is the staple food of the Indians and the supply seems to be always plentiful.

APPENDIX No. 40.

ABSTRACT OF THE REPORT OF R. C. PURSER, D.L.S.

MISCELLANEOUS RESURVEYS IN MANITOBA, SASKATCHEWAN AND ALBERTA.

A considerable portion of the season's work consisted of the survey of lakes which had never been plotted and in the investigation of lakes that had wholly or partly dried up since the original survey. To the former class belong the surveys made in township 25, range 9, west of the principal meridian, township 38, range 19, and township 33, range 21, west of the second meridian, township 42, range 2, west of the third meridian, township 43, range 1, township 45, range 2, township 44, range 5, and township 41, range 9, west of the fourth meridian. To the latter class belonged the surveys made in township 6, range 9, west of the principal meridian, township 38, range 19, west of the second meridian, and township 36, range 2, west of the third meridian.

In township 6, range 9, west of the principal meridian a lake was found to have almost completely dried up which at the time of the original survey had contained about 100 acres. Upon the completion of a drainage ditch which was in the process of construction at the time of our survey, the remainder would soon be rendered totally dry and fit for agricultural purposes.

Retracements were made in township 8, range 31, west of the principal meridian, and township 34, range 3, west of the third meridian. In the former over fifty-two miles of line were retraced.

Some monuments were corrected in townships 5 and 25, range 29, west of the principal meridian, and township 43, range 4, west of the fourth meridian.

An investigation of duplicate monuments was made in township 39, range 1, west of the third meridian, and of lost monuments in township 49, range 20, west of the fourth meridian. It was while engaged on this latter work that cold weather and deep snow came effectually concealing any remains of lost monuments there may have been here and forcing us to close the season's operations. In township 5, range 7, west of the second meridian, the east boundary of section 34 had been omitted from the original survey. This was run and the quarter section monument established.

In township 52, range 20, west of the fourth meridian, an original survey was made. This township was formerly all included in the Cooking Lake forest reserve, but recently the southwest portion was withdrawn; this part was subdivided. Almost all of the part surveyed had been squatted upon. One man had cleared and cropped as much as thirty-five acres in the last three years and had erected a very comfortable two-storey house as well as stables and drive shed. This township is about thirty miles easterly from Edmonton on the Grand Trunk Pacific railway and is becoming increasingly popular as a summer resort for the residents of that city. In Cooking lake itself, there is good fishing and the region is also well suited for duck and partridge shooting.

In township 36, range 6, west of the third meridian, three islands in the immediate vicinity of the city of Saskatoon which had not previously been surveyed, were traversed. The largest of these islands was wanted by the city of Saskatoon for park purposes.

APPENDIX No. 41.

ABSTRACT OF THE REPORT OF C. RINFRET, D. L. S.

MISCELLANEOUS RESURVEYS IN SOUTHERN SASKATCHEWAN AND ALBERTA.

Having organized my party at Moosejaw I left that place on May 6, 1911, for the scene of my first survey work. This consisted of the retracement of townships 16, ranges 21, 22, 23 and 24, west of the second meridian.

These four townships are situated in the best grain growing district in southern Saskatchewan, and are very well settled, only a few railroad sections being uncultivated. The main line of the Canadian Pacific railway runs through townships 16, ranges 23 and 24, and very close to the other two townships. Lack of good water is the greatest drawback, it being impossible to obtain water in some cases even by drilling hundreds of feet.

I next retraced townships 17, ranges 18, 17 and 16, west of the second meridian, in the order named. The land in ranges 18 and 17 is sandy and undulating, and generally second-class, while that in range 16 is very good, although partly covered by brush and sloughs. Very little of the later township is under cultivation but all the even-numbered sections are taken up.

After resurveying nine miles in township 19, range 17, I moved to township 15, range 23, which I resurveyed. This township has good soil and is well settled. Water can be easily obtained from Moosejaw creek which crosses the township, and a branch of the Canadian Pacific railway runs through the town of Drinkwater situated in the northern part.

A retracement was then made of township 16, range 26, in which the city of Moosejaw is located, and a few miles of retracement was performed in townships 17 and 18, ranges 25 and 26, and township 18, range 27, west of the second meridian.

A start was made for townships 14 and 15, range 28, west of the third meridian. In this district the surface is rolling with a sandy loam soil which gets heavier in the northern part. The south third of township 14 is composed of worthless quicksand, and although half of the township is taken up only a small portion is cultivated.

I finished the survey of these townships on August 29 and moved to township 26, range 16, west of the fourth meridian, going via Bassano, a village of about five hundred inhabitants. This place has grown up within the last two years since the Canadian Pacific railway have constructed a large dam on Bow river for irrigation purposes about three miles to the southwest. About two-thirds of this township is fairly level and the soil is good.

The southwest part, across which Red Deer river flows in a valley four hundred feet deep, is cut up by coulees which render it useless for farming. After traversing a lake in township 28, range 15, I left for township 26, range 9, west of the third meridian, which I resurveyed. This township is in one of the best grain growing districts, and was the only place visited where the crops did not suffer from frost. Although over fifty miles from any railroad it is being settled rapidly. Wood is still used as fuel but the supply is limited.

After surveying nineteen miles in township 22, range 6, west of the third meridian, I returned to township 16, range 25, west of the second meridian, and made an investigation for duplicate monuments. I continued the investigation in townships 14, 15 and 16, range 24.

A heavy fall of snow followed by extremely cold weather forced me to abandon work in township 14, range 24. I accordingly stored the outfit at Moosejaw and left for Kamsack. With my assistant and one man I surveyed parts of township 29, range 31, and townships 32, ranges 32 and 33. I also traversed a portion of Assiniboine river.

After surveying one mile in township 25, range 29, and traversing Shillingthorpe lake in township 26, range 31, west of the principal meridian, I made an investigation survey in township 30, range 14, west of the second meridian, after which I closed operations for the season.

APPENDIX No. 42.

ABSTRACT OF THE REPORT OF E. W. ROBINSON, D.L.S.

SURVEY OF PART OF THE SECOND MERIDIAN.

The northeast corner of township 61 on the second meridian, which was the starting point of my survey, was reached on July 25, 1911, the party having travelled from Le Pas by steamer to the mouth of Sturgeon river, and from there by canoe to the meridian.

Namew lake is a fine body of water connected by English and Whitey narrows with Cumberland lake. The shores are mostly well timbered with spruce, tamarack, jackpine and poplar up to ten inches in diameter. It is well stocked with fish, the principal varieties being lake-trout, whitefish, jackfish and pickerel.

Sturgeon river throughout its entire length from Amisk lake to its outlet at Namew lake is treacherous for canoe travel, as the current is swift and there are numerous rapids. A large quantity of freight for the North passes by this route and at certain stages of the water it is possible to run the whole length in York boats. There is a narrow strip of good land on each side of this river varying from five to thirty chains in width, suitable for agriculture. The soil is a sandy loam with spruce, tamarack and poplar up to eight inches growing thereon. On July 26 I commenced work on the second meridian in township 62. There is some good spruce here up to twenty-two inches, with tamarack, jackpine, poplar and birch up to eight inches. The soil is a sandy loam with considerable rock in places. The high land extends to the west about two miles and then drops suddenly into the extensive muskegs which lie to the south of Amisk lake. Sturgeon river was crossed in section 13, and on the north side of the river the line soon entered an extensive muskeg. Small spruce and tamarack cover the whole area, and narrow ridges, three or four feet higher than the surrounding muskeg, are found at intervals. These ridges carry spruce, tamarack and jackpine up to eight inches. Most of the muskeg has a hard-pan or rock bottom, and very few are of the floating variety. It is worthy of note that in digging the pits for the monuments at corners, frost and ice was usually encountered at a depth of ten or twelve inches. The maximum daily temperature at this time was about 75° or 80° Fahr., but the upper layer of dry moss on the muskegs acts as a very efficient non-conductor of heat. The nights were invariably cool as one would expect and summer frosts were of common occurrence. If the muskegs were drained and cultivated, and I am of the opinion that they could be made into excellent hay land, the soil would absorb heat during the day, and this being radiated gradually throughout the night, would overcome these summer frosts. About the centre of section 1, in township 63, the line enters a stony ridge well timbered with jackpine, poplar, spruce and tamarack up to ten inches in diameter. Small patches of swamp are distributed throughout. This ridge extends to the shore of Mari lake and lies generally to the southeast of this lake. A fair amount of pulpwood could be obtained here and some logs are large enough for milling purposes. Mari lake is about seven miles long and from one and a half to three miles in width. Its waters are well stocked with mari from which it obtains its name, whitefish, jackfish and pickerel. From the lake there is a water route leading from the southwestern corner to Amisk lake, and from a bay in the east side to Athapapuskow lake, or Papuskow lake as it is sometimes called. A water route does not necessarily mean direct water connection but oftimes a string of lakes connected by portages. North of Mari lake the country becomes higher, while rocky and sandy ridges are the common features and these are covered with small poplar, jackpine, spruce, tamarack and some willow. These ridges are from fifty to two hundred and fifty feet high, the approach sometimes being gradual, but oftentimes a precipitous rock bluff. Muskegs and swamps have a rich black muck soil and clay subsoil, and small lakes occur between the ridges. In townships 64 and 65 the limestone formation changes to granite, and several discoveries of mineral have been reported on the contract between these two formations, iron pyrites being seen at several points. The granite is seamed with small veins of quartz and quartzite, and 'iron cappings,' which are considered to be sometimes an indication of mineral, are common. In section 12, township 65, we crossed Sucker creek which flows into Amisk lake. This is a main route of travel to the east and northeast. The country continues of the same description except that the lakes have rocky shores. No timber of milling size was found with the exception of odd trees, but there is a large quantity of spruce up to eight inches in diameter suitable for pulp-wood. Mixed with the spruce there is jackpine, tamarack, poplar and birch averaging from six to eight inches. Echo lake was crossed in section 25, township 65. North of Echo lake the rock ridges become more broken, but the country is generally of the same description. The multitude of small lakes in this country is worthy of notice. It was difficult to map all the lakes even close to the line, and east and west they seemed as numerous. From the top of any rocky ridge it was the ordinary experience to be able to see three or four small lakes. In section 1, township 67, a change occurred in the timber, and we entered brulé country. The fire happened about twenty-five years ago and covered a very extensive area. It took place during a very dry season and not only destroyed the timber, but burnt what little soil there was on the ridges. Small jackpine, spruce, and birch are now growing up. In section 25, township 67 we crossed a creek about seventy feet wide which I believed to be the one that I heard ran into Wildnest lake. It was explored for some distance but the lake was not found. Our provisions were now very short so I determined to discover this lake if possible. I left camp with my explorer and we travelled to the northwest and north for three days. Many lakes were found, some large and some small, but we were compelled to turn back without finding Wildnest lake, as I knew that by this time the provisions in camp, even on short rations, were barely sufficient to take us back to Amisk lake where I had a small cache. On October 7 I therefore started back. Trying to find a shorter route to Amisk lake I came across a strip of fine spruce approximately in section 23, township 66, range 1. The trees ran from twenty-four inches to thirty inches in diameter; the belt was about thirty chains in width where it was crossed and in length it seemed to extend for a considerable distance. We reached the cache on Amisk lake during the afternoon of the 8th, where I had left enough provisions to take the party to Le Pas. It was a sad disappointment to hungry men to find that the cache has been robbed and that all the meat, sugar, jam and baking powder had disappeared. Fortunately some flour, beans, and a little butter was left. I was now compelled to send to Wildnest lake for some provisions by the Sturgeon Weir river route—a long and arduous trip. I therefore despatched six men with my assistant in charge and they made the round trip in eight days, arriving back on October 16. The weather was very stormy and I hesitated to risk canoes on Amisk lake. However on the 18th we made a start and arrived at the mouth of Tearing river on Cumberland lake on the 23rd. The weather was now cold, some snow had fallen and the shallow bays were freezing at nights. I accordingly left my camp and outfit at Tearing river and on the morning of the 24th left by canoe for Le Pas. I travelled by the Tearing river and found that this passed through a low swampy country. The banks are lined with grey willow, cottonwood and some water-birch. There was considerable water in this river and only two short rapids. I heard subsequently that the steamboat is able to use this channel in high water. I arrived at Le Pas during the afternoon of the 25th and commenced arranging my outfit for the winter's work on the fifteenth base line. Winter had now set in and the marshes, swamps and small lakes were frozen. Saskatchewan river was carrying slush ice, but it was November before it was frozen across.

During this season's work we did not see any large quantity of land immediately available for agriculture. Most of the swamps and muskegs if drained would make excellent hay land and some root crops would do well. The climate was on the whole favourable with plenty of sunshine, and although summer frosts were experienced these I believe could be overcome through cultivation. At Cumberland House on Cumberland lake all vegetables do well, and the fact that tomatoes are raised successfully year after year is sufficient evidence as to the climate. The winters are similar to those of Manitoba but with a heavier fall of snow, from two to three feet being the usual quantity. Through most of the district traversed we found spruce and poplar suitable for pulpwood, with larger milling spruce close to Amisk lake. Fish are plentiful in all lakes except the small marshy ones. Amisk lake in particular has the reputation of supplying the largest and finest whitefish in this section of the country, and also has in its waters jackfish, pickerel and lake-trout. Cumberland lake is rapidly filling up with the sediment brought down by Saskatchewan river and here the fishing is poor. Jackfish and goldeye are the most common varieties obtained and at certain seasons even these are scarce.

SURVEY OF PART OF THE FIFTEENTH BASE LINE WEST OF THE SECOND MERIDIAN.

On November 23 I left Le Pas for the survey of the fifteenth base line, travelling by the Cut Off and Saskeram lake to Tearing river where I camped. At this date winter had well started. The rivers and lakes had frozen over and about fourteen inches of snow covered the ground.

I experienced considerable difficulty when organizing my party at Le Pas in obtaining a sufficient number of dog trains. There has been a great demand for dogs during the last few years by survey parties locating the Hudson Bay railway, and they are accordingly scarce and of inferior quality.

I commenced work on November 29 at the northeast corner of section 36, township 56, range 1, west of the second meridian, which falls in one of the large willow marshes so characteristic of Saskatchewan river valley. On the west side of this marsh is a good belt of spruce, jackpine, tamarack, poplar and birch, averaging twelve inches with occasional spruce up to sixteen inches in diameter. Small swamps and patches of brulé are found throughout this area. The base line crosses Tearing river in section 33. This river varies from five to thirty chains in width and in places has many channels separated by islands. It is an outlet from Cumberland lake to Saskatchewan river and runs through a low marshy country, which within comparatively recent years was a bay of Cumberland lake. At present Tearing river carries a considerable quantity of Saskatchewan river water which will be explained more fully subsequently in this report.

West of Tearing river the base line continues through a marshy country, until in section 35, township 56, range 2, it enters the fringe of timber along the old channel of Saskatchewan river. This belt runs from five to fifty chains in width and consists of large cottonwood with some good spruce, poplar, birch and elm. I made an attempt here to connect the Cumberland Indian reserve to the base line, but found that the boundary lines of the reserve ran through marshes, and with the snow on the ground it was impossible to definitely locate the lines and corner posts. I made enquiries on the reserve and no one seemed to know the exact location of the corners, but I was informed that in the summer-time a post, or the remains of one, could probably be shown me. As I had already delayed my party I considered it advisable to postpone this work until next summer when I would be passing this point. On the west side of the channel the line crosses a similar belt of timber and then emerges into the extensive area of willow swamps, hay meadows and shallow lakes which lie to the south of Saskatchewan river. Large numbers of muskrats are to be found in these swamps and it is a famous rat-hunting ground for the Cumberland Indians. The base line continues in these swamps through ranges 2, 3, and 4. In range 5 a few ridges of higher land were encountered with spruce, tamarack, birch, poplar and cottonwood growing thereon. These ridges are separated by large willow marshes. The old channel of Saskatchewan river was crossed again in range 6 and on the west side some excellent spruce and tamarack was found. The spruce ran up to twenty inches in diameter and the tamarack to eighteen inches. There is also considerable tie timber and pulp-wood there. One lake and several marshes divide this timber belt into different sections. To the north of this belt lies an extensive area of swamps and shallow lakes through which run several old channels of Saskatchewan river.

At the commencement of range 8 we crossed Torch river which is now the main channel of Saskatchewan river. Some years ago during a season of very high water Saskatchewan river broke through its left bank in section 2, township 56, range 8, now known as the 'Cut Off,' and, cutting a channel into Torch river, found its way into Cumberland lake. A sand bar formed across the original channel and now only during high water can this old channel be used for navigation. In fact from August of each year there is barely enough water for canoe travel. For the first few years after the river changed its course it took a channel through townships 57, ranges 7 and 6, into a long bay at Cumberland lake. Owing to the current being checked by meeting the water of Cumberland lake the matter held in suspension, and Saskatchewan river in flood time carries an enormous quantity, was deposited, and rapidly filled up this bay; consequently the river was forced to seek new outlets to Cumberland lake. Many new channels were formed but were quickly filled in. A few years ago a channel was cut entering Cumberland lake at Pine Bluff, and at present the bulk of the Saskatchewan water flows this way. The water from Cumberland lake has two outlets into the original Saskatchewan channel, viz. Big Stone and Tearing rivers. Both these rivers have rapids in their course but are navigable most of the summer season for small steamboats. About twenty-five years ago a bay of Cumberland lake stretched to the southeast along the present course of Tearing river. This is now filled in and Tearing river pursues a tortuous course through swamp lands and hay meadows. During the season of extreme high water the whole of this section of the country, with the exception of a few high points, is flooded. A considerable quantity of suspended matter is deposited during each of these floods and many shallow lakes have been first marshes and then hay meadows within the lifetime of some local residents. The soil is a rich black muck on a hardpan or rock bottom. If the summer floods of Saskatchewan river were controlled and drainage of a comprehensive nature undertaken, a considerable area of country, now the abode of the muskrat and bittern, would become available for settlement.

The base line was continued through range 8 and Torch river was again crossed. The banks are well timbered with spruce up to fourteen inches in diameter, cottonwood and tamarack to eighteen inches and white poplar and birch. South of Torch river the country is swampy with the exception of one ridge carrying spruce, tamarack and poplar. There is also a well-defined ridge of the same class of timber stretching to the north. I had a cache of supplies established on this river last summer and the line passed within ten chains of it. The success of this winter's work is largely due to the fortunate placing of this cache. To prevent delay in base line work it is essential that a cache be established ahead on the line and when a surveyor is fortunate enough to have one well placed he realizes how it assists the work.

Torch river was again crossed in range 9. South of the line lies an extensive spruce and tamarack muskeg. Along the river the fringe of spruce, tamarack and poplar continues and the soil is an excellent sandy loam. There is a nice strip of spruce up to ten inches in diameter lying along a small creek entering Torch river from the north in section 11. To the north the country is generally a spruce and tamarack muskeg with bluffs of spruce and tamarack up to eight inches on the higher land. At the commencement of range 10 a tributary of Torch river was crossed and along both banks was found some excellent spruce, tamarack and white poplar up to fourteen inches in diameter. The timber is clean and well suited for ties.

This creek averages about one hundred and fifty feet in width and apparently has a swift current with many rapids. From an examination of the timber along the bank there is evidently a large volume of water flowing when the stream is in flood. West of this creek it is spruce and tamarack muskeg, with narrow ridges covered with jackpine, tamarack and spruce up to eight inches in diameter. Most of the muskeg is what is known as 'dry' muskeg, but there are some open swamps. The trees are very stunted on these muskegs and evidently have a hard struggle to survive. One spruce tree two and one-half inches in diameter was examined and its annular rings showed it to be one hundred and twenty years old. This kind of country continues through ranges 10 and 11, and for a considerable distance north and south of the base line. In section 31, range 12, a creek was crossed which proved on exploration to be the same one that was crossed in range 10. There was still some fine timber about its banks, the principal varieties being spruce, tamarack and cottonwood from eight to fourteen inches in diameter.

Passing into range 13 the line again enters spruce and tamarack muskegs while to the south of the base lies a large open swamp. The spruce and tamarack muskeg continues to the north and is crossed by sandy ridges carrying jackpine and spruce up to eighteen inches in diameter. Proceeding westerly through range 14, the country rises somewhat and the ridges become more prominent. South of the line is an area of spruce from six to eight inches in diameter suitable for pulpwood. Jackpine and spruce up to eight inches were found on the ridges. Between the ridges there was the customary spruce and tamarack muskeg with patches of open swamp. A well-defined ridge of small jackpine was crossed at the commencement of range 15, and west of this a large open muskeg about seven miles long by three miles wide.

Farther west again the country rises and the ridges, covered with jackpine and spruce averaging six inches in diameter, are more pronounced. Between the ridges tamarack and spruce muskegs are found. To the southwest could be seen a range of hills trending in a northwesterly direction.

Through range 16 the low sandy ridges continue, becoming higher toward the western part of the range. Small jackpine cover the summits of the ranges with small spruce, tamarack, and some poplar and birch on the slopes. The usual muskegs and swamps are found between the ridges. In the eastern part of range 17 the base line crosses a well-defined range of sand hills covered with small jackpine. South of the base line the hills have a general trend to the southeast. To the north of the base line they run to the northwest for about three miles and then turn due north for about nine miles, where a range of hills from the west joins. They are partially timbered with small jackpine, large patches of snow showing up prominently from a distance. The lower slopes of these hills have small jackpine, spruce, tamarack, poplar and birch. In section 33 a small creek was crossed and to the west of this the country again rises into rolling, sandy, jackpine ridges. In section 31 two small creeks were crossed which join, and flowing a little to the east of south enter White Gull creek, which empties into Torch river. In section 35, range 18, the base line crosses the located line of the Hudson Bay Pacific railway, which commences at Prince Albert. This line follows a well-defined ridge timbered with small jackpine, spruce, tamarack, poplar and birch. A fire ran through this section of the country a few years ago and destroyed some good jackpine, spruce and tamarack. The soil is generally a light sandy loam with some areas of good clay loam in the lower places. If this railway line is constructed, some good agricultural land will be available for settlement along this ridge. At present the only means of access is by a wagon road leading from Fort a la Corne. This road crosses the base line in section 33, range 18, and passes to the south through a rolling sand-ridge country with brulé, windfall and second-growth jackpine. The brulé country continues through range 19 with small jackpine, spruce and poplar now growing up. The soil is a light sandy loam with some patches of heavier soil. In section 31 we crossed White Gull creek which flows to the southeast emptying into Torch river. A range of hills shows up prominently to the north, distant about ten miles, and extensive muskegs lie along the base of these hills. In range 20 more muskegs are found with scattered small spruce and tamarack. White Gull creek runs to the north of the base line and with its tributaries drains the area between the line and the range of hills to the north. Entering range 21 the land becomes somewhat drier, especially to the south, the rolling sand-hills so characteristic of this section of the country being noticed. North of the line is White Gull lake, a body of water about six miles long by two miles wide. The southern shore is marshy, but the northern shore is somewhat bolder. To the north of the lake is a range of low hills, carrying some fair spruce and poplar up to ten inches in diameter. There is a trail about six miles long running between Candle and White Gull lakes. In summer, however, travel over it is difficult owing to the many muskegs crossed. This trail intersects another one which runs from Candle lake north to White Swan lake. On March 13, having completed range 21, I decided to cease work for the season. The weather had turned warm, the snow had gone from the south side of some of the ridges and transportation was accordingly difficult.

I brought the outfit out by following the White Gull trail to Candle lake and thence across Candle lake to the fish camp on the west side. The trail then crosses the narrow strip of land between Candle lake and Little Candle lake and follows the east shore of the latter lake to its southeastern corner. From this point an excellent wagon road runs to Prince Albert. Some good spruce, poplar, tamarack and birch were found along the road until we neared Fox plains where the country has been burnt. There we passed the first settlement and the homesteaders reported that they expected an influx of new settlers in the spring when there would be a demand for homesteads farther north along this road. During the summer time this road is sometimes difficult to travel owing to wet places. We reached Prince Albert on March 17, and from there proceeded to Le Pas where I disbanded the party.

Generally speaking the timber in the section of the country traversed by this base line is not large enough for milling purposes. The eastern part of the base line runs through a swampy and muskeg country, comparatively little land being dry enough to support timber of any size. In township 57, range 1 is a scattered belt of spruce up to sixteen inches with jackpine, tamarack, poplar and birch. Along both banks of Saskatchewan river one finds spruce, poplar, tamarack, cottonwood, birch and elm. This strip varies from a few chains to fifty chains in width and there are many places where logging could be profitably conducted, although the patches of merchantable timber are small. In range 7 we crossed an area of first-class spruce and tamrack, the timber being clean and sound. Along Torch river in range 9, and its tributary in range 10, we found spruce, tamarack and poplar from ten to fourteen inches. Much of this timber would be suitable for ties, and Torch river could be used to drive them down to Saskatchewan river. The tributary of Torch river was again crossed in range 12, and similar timber was found along its banks. There are, however, many rapids on this creek and driving would be difficult. This was the last timber we crossed of immediate market value. On some of the ridges farther west there are small areas of spruce suitable for pulp-wood and some tamarack of small size.

The fishing in Cumberland lake is yearly becoming of less importance owing to the lake filling up. The other lakes passed are all too shallow for fish, except White Gull lake in ranges 21 and 22, which is reported to be well stocked with jackfish and pickerel. Game is plentiful, moose and caribou being found in considerable numbers. Fur-bearing animals are fairly numerous, the principal varieties being marten and lynx.

APPENDIX No. 43

ABSTRACT OF THE REPORT OF O. ROLFSON, D.L.S.

SURVEY OF THE TWENTY-SECOND BASE LINE ACROSS THE PEACE RIVER BLOCK.

I left Edmonton on March 2 and travelling via Athabaska Landing, Grouard and Peace River Crossing, reached Dunvegan on the 25th. Sleighing was good all the way except along the prairie south of Peace River Crossing, where the snow was fast disappearing. The ice was followed from Athabaska Landing to Grouard (except for ten miles east of Sawridge) and also from Peace River Crossing to Dunvegan.

As the ice above Dunvegan was considered unsafe, one of our freighters having broken through, we decided to follow the trail leading to Fort Grahame. This trail, cut by the Royal Northwest Mounted Police during the Klondike 'rush,' leaves the overland route from Peace River Crossing to Dunvegan at a point about ten miles north of the latter place, and, going north and west, leads to Island lake where there is an Indian settlement. From here the trail runs northwesterly through beaver meadows, scrubby prairies and poplar bluffs to a large prairie on the east side of Clear river. This prairie, over three hundred acres in extent, is surrounded by poplar and spruce, with a lake at the south side.

After crossing Clear river the trail turns southwesterly crossing several streams with valleys three hundred feet deep and passing through spruce and jackpine woods till Boundary lake is reached. This lake is about one mile wide and two miles long with grassy shores along which a great amount of medium quality hay could be cut. The trail runs west from Boundary lake through spruce, poplar, jackpine and open prairie, crossing North Pine river at the mouth of Fish creek. During low water the river is about two feet deep, but at high water a man must swim his horses and raft his supplies from the upper ford about two miles up the stream. The valley is over six hundred feet deep and the grades are very steep. South of the valley of Fish creek the country is level and after travelling ten miles through light poplar and open prairie, Fort St. John, lying at the foot of the hills on the north side of Peace river, is reached.

From Fort St. John to Fort Grahame the trail, which is not much better than a widely cut pack-trail, is much rougher and crosses numerous deep valleys. The bridges across the streams are in bad repair and many of the grades are washed away.

We reached Boundary lake on April 27, and after building a cache we commenced our work from the northeast corner of township 84, range 13, west of the sixth meridian, as established by Mr. J. R. Akins, D.L.S. We ran the east boundary of townships 84 and 85, in range 13, and the jog on the correction line to the line run from the south, thus forming the tie between the twenty-first and twenty-second base lines.

This east boundary almost immediately runs into a spruce and tamarack swamp, extending for over two miles, then through heavy windfall and standing dead timber grown up with young poplar and jackpine. With the exception of one or two small areas which have been burned oftener and are now grown over with poplar, this continues as far south as the correction line. All along the jog the timber is mostly poplar, the country undulating and well watered by good fresh-water streams.

After completing the meridian we moved north and commenced work on the twenty-second base line which we completed on October 13.

This line through ranges 13, 14, 15, 16, and 17, passes through undulating country, the surface of which is covered with spruce, jackpine and poplar with occasional openings of scrubby prairie. This scrubby prairie and light poplar country is the result of fires destroying the original timber. The soil is a good clay loam with grass, wild vetch and pea-vine.

North Pine river is crossed in section 36 of range 18. At low water this river is two hundred feet wide and about two feet deep, but at high water it is three hundred feet wide and more than eight feet deep with a current of four miles per hour. The valley is over six hundred feet in depth and averages one mile across. Sandstone of good quality was noted in the cut banks of this river.

Through ranges 18 and 19 the country is rolling and the timber is almost all poplar with willow scrub. A large prairie lies to the north of the line and much of the country south as far as Peace river is scrubby prairie.

Charlie lake, crossed in the western two miles of range 19, extends for about seven miles northwesterly and southeasterly. It is drained from the south by Fish creek which runs into North Pine river.

In range 20 the line passes through a belt of good heavy spruce with a few strips of poplar, many of the trees being three feet in diameter and perfectly sound. With the exception of a few small areas of poplar and jackpine this belt extends about one mile south and eight miles north of the line. The timber moreover could be marketed without great expense as it could be rafted to Peace river via Charlie lake, Fish creek and North Pine river.

The country is hilly and well watered by fresh streams, while the soil is black loam and clay. From the hills west of Charlie lake one can see the mountains in the distance.

Through range 21 and the east half of range 22 the country is still hilly but the timber is poplar and scrub with an occasional small belt of spruce. The soil is clay and clay loam and the underlying rock appears to be limestone.

Through the middle of range 22 flows Cache creek while just beyond the west boundary of the range is its west branch. Between these two streams is a level stretch of country extending to the streams themselves while the country to the north is hilly. Part of the surface is prairie and the rest is covered with poplar.

The country through range 23 is rolling, the surface being covered with small brulé, spruce and tamarack swamps and small strips of jackpine and poplar. The soil near the line is very sandy but a good area of farming land lies about six miles to the north.

Halfway river flows southerly through the middle of section 31 in range 23, in a valley five hundred feet in depth and varying from a half mile to a mile in width. At low water the stream is about three hundred feet wide and four feet deep with a current of five miles per hour, but in some places the river narrows to straight rock walls with a very swift current while in others it has wide gravel bars strewn with driftwood and even whole trees. At high water it is over a quarter of a mile wide in places and at least ten feet deep in mid-stream.

From the valley of the river to the west boundary of the block the country is mostly undulating and the surface is covered with jackpine, spruce, poplar, willow, alder, and spruce and tamarack swamps while the creeks are few until nearing the west boundary. About six miles south of the line in range 24 there is an area of about forty square miles of good farming land in which the soil is clay and clay loam.

About one mile south of the line in the middle of range 24 and turning abruptly south into Peace river a stream about forty feet wide and one foot deep flows through a valley three-quarters of a mile across and nearly three hunderd feet in depth.

Grayling are found in North Pine river, grayling, speckled trout and pike in Halfway river, and rainbow trout in the stream running through range 24. In the spring ducks, geese, partridges and prairie-chickens are plentiful, while rabbits are numerous at all times. Black bears and moose are seen occasionally. Most of the fur-bearing animals and large game, however, are exterminated, so that the Indians now go north nearly to Fort Nelson river for their winter's hunt.

Potatoes, carrots, beets, cabbage, parsnips and lettuce of excellent quality are raised at Fort St. John, and one settler there states that in addition to the above he has ripened tomatoes, rhubarb, squash and on one occasion watermelons. Wheat has never been tried here, but we were informed that as a general rule there is no serious frost in the valley before October, although along the line frost was noted on July 13, 20, 21 and 23, and on August 8.

Fort St. John is situated on the north side of Peace river about five miles above the mouth of Pine river. The Hudson's Bay company, and Revillon Bros., each have a post here, and the British Columbia agent has his office on the south side of the river. The Hudson Bay company's steamer makes three trips a year between St. John and Fort Vermillion.

We commenced our return trip on October 16 arriving at Fort St. John on the 23rd.

While crossing Halfway river one of our men was accidentally drowned and although the party searched for two days no trace of his body could be found.

The pack-trail from St. John to Tremblay's ranch on Pouce Coupé prairie is good, the country being well watered and feed excellent. As well as one can judge from travelling a pack-trail this prairie will make good farm land, and when Grande Prairie district is settled this appears to be the natural direction for newcomers to move and make their homes. A wagon road to Fort St. John can be built with but little work except at the crossing of Little Kiskatinaw and Pine rivers.

APPENDIX No. 44.

ABSTRACT OF THE REPORT OF A. SAINT CYR, D.L.S.

SURVEY OF PART OF THE SEVENTEENTH BASE LINE FROM BEAVER RIVER WEST TO THE FOURTH MERIDIAN.

Before continuing the production of the seventeenth base line from the point where we ceased operations in the fall of 1910, I proceeded to township 57 on the third meridian and from the point where the road to Montreal lake crosses the meridian in section 13 I made a traverse survey of the lake, in order that its position might be shown correctly on the maps.

Having completed this work I returned to Prince Albert, and on March 22, 1911, set out for the initial point of my survey of the base line, west of Beaver river.

I followed the winter road from Green Lake to Cowan river and then travelled over the ice on this stream and Beaver river to Rat creek, where the winter road ascends to the top of the benches rising west of Beaver river.

In that distance there are some rapids and I had been informed that the ice had already given way in places. It was feared that, if the mild weather with which we had lately been favoured, continued, the water would rise in Cowan river breaking the thin ice over the rapids and making it difficult for us to reach the base line.

As it was urgent that all our outfit, supplies and a large amount of horse feed should be brought west of Beaver river before the general break up came, I hired additional help at Green Lake settlement.

On March 31, having finished all my business at Green Lake, and after making arrangements to have mail brought to my camp at intervals during the season, I left for the seventeenth base line.

The road we followed in returning to the base line is part of the road travelled in the winter by the mail carrier and also the freighters going to the settlements and the fur-trading posts at Lac la Plonge and Ile a la Crosse. It is a long and circuitous route and has, besides, serious drawbacks.

Two years ago companies were formed to develop the fish industry in the northern part of this province and the winter traffic created by this new industry which must pass over this road, added to the transportation of the large amount of goods required by the fur-trading companies in provisioning their posts and the northern settlements, has led all the parties whose trade interests call them into this northern country to seriously consider the advisability of continuing northwards beyond Doré lake the new road opened last winter to this place.

It would give a continuous overland route which they claim would also be much shorter than the one followed at present.

My transport outfit consisted of ten flat sleds which had been made broader than usual in this country. These can be used to advantage over fairly level country or on well beaten roads, when a pony will haul loads averaging five hundred pounds. For the transportation of the horse feed and the baggage of the party, I took the double sleds which I had used on my two previous winter surveys. On March 31 the survey of the seventeenth base line was resumed at the northeast corner of section 35, township 64, range 13, west of the third meridian.

It progressed rapidly across ranges 13, 14, 15 and 16, where many large open swamps are intersected by the line. Being still frozen they afford the best route for moving the outfit between camps, and on the lakes the ice remained firm enough to carry teams till the end of April, or long after the snow had disappeared. By that time we had come to the high land north of Waterhen lake. The only obstacle met with, west of Beaver river, was the crossing of Waterhen river, near range 15; here large rafts were built and were used for ferrying our outfit.

The ponies also had to be transported on these rafts to the opposite side of the river as the water was not deep enough to allow them to swim and the bottom is too soft and treacherous to risk taking horses across this stream, which for several miles on both sides of the base line is quite wide. During the summer the survey went on without interruption, the country gradually improving for travelling as we moved westward. By July 24 the line had been completed to the east shore of Cold lake in section 32, township 64, range 25.

From the northeast corner of this section a tie was made on the fourth meridian north of Cold lake by surveying the east boundaries of sections 5, 8, 18, 19, and the north boundaries of sections 8 and 19 in township 65, range 26. Thence the line was produced across fractional township 65, range 27, to the fourth meridian, where it struck two chains and thirty-two links south of the northeast corner of section 24, range 1.

On August 9 the survey of the seventeenth base line and the levels along this line had all been completed to the fourth meridian.

DESCRIPTION OF THE COUNTRY ADJOINING THE SEVENTEENTH BASE LINE, FROM RANGE THIRTEEN TO THE FOURTH MERIDIAN.

West of Beaver river which, from its confluence with the outlet of Green lake, flows across range 12, is a strip of nearly level country with many open swamps, a few of which, when drained, could be converted into profitable hay meadows.

The soil on the higher lands, which are at present wooded with poplar and birch, is good. At intervals are found ridges where jackpine grows. These ridges are more frequently met in the southern half of township 64 in the vicinity of Beatty creek, a small tributary to Beaver river, which it joins seven miles south of the base line.

Travelling westward across ranges 13 and 14, several large lakes are passed, which drain into Waterhen river, four miles north of the base line. This stream leaves Waterhen lake near the northeast corner of township 63, range 16, and flows northeasterly to the east outline of range 14, thence its course is due east for seven miles where it joins Beaver river.

Many rapids are encountered on Waterhen river in that distance of twenty-five miles, and though the Indians who ascend this stream in canoes have made artificial channels by removing the worst obstacles, they sometimes upset their loads in going through these intricate places.

Waterhen river is 100 yards wide, in its widest part, and at seventeen miles from its mouth receives a large creek which comes from the north through range 15. The Indians report that they can ascend this stream in their canoes a distance of eighteen or twenty miles.

This stream is intersected by the line three-quarters of a mile from its mouth. Along it the country is fairly open and although the land is stony in many places the soil is good and wild hay, pea-vine and vetch grow on the prairie patches found at intervals in the valley.

The aspect of the valley of Waterhen river varies greatly. It is widest for four miles below Waterhen lake but, farther down, the benches at intervals approach to the river banks, their steep slopes reaching down to the water's edge.

In such places there are rapids separated by stretches of comparatively slack water confined by low swampy meadow lands. Similar meadow lands are found also near the mouth of Waterhen river, and extending back three or four miles to the first rapids. The wild hay which grows in this vicinity is of good quality and is found partly on the flats along each bank of the river, but mostly on certain islands, for, a short distance below the last rapids, the river divides into many channels

A larger quantity of good hay could be cut here by the Indians if the land was cleared of the clumps of willow dispersed all over these flats. Then instead of using the primitive way of cutting hay with scythes as is their custom, light mowing machines such as are used around the settlements of Green Lake, Island Hill and Meadow Lake could be used to advantage.

At about eight miles up stream from Aubichon's stopping-place more hay meadows are reported to exist. Before reaching these, however, the valley narrows, while from the right bank of the river rises a range of round knolls across which run, through narrow gorges, the drainage of the lakes and wet swamps found west of Beaver river.

As the fall is considerable between Waterhen river and the wet lands, these could easily be drained.

Between the crossing of the river by the line near the northeast corner of township 54, range 15, and Waterhen lake, a few narrow meadows adjoin both banks of the river. At one or two places on the north side, when approaching the old Indian village, these meadows extend inland from a quarter to one mile back from the river, to the foot of the high wooded hills.

At the site of the old Indian village the hills recede from the river and the intervening country is not so broken. It has, moreover, been to a large extent cleared of the heavy timber by repeated fires which have overrun it.

Of this spruce forest there now remains only a block of three square miles which is crossed by the line in sections 35 and 36, range 16. The trees are from ten to thirty-six inches in diameter. Two miles north of this block of timber are lakes, the largest of which covers nearly all of sections 14 and 23 in township 65.

The rolling country to the east is wooded with poplar, birch and scattered spruce. More lakes are found to the northeast where the country becomes low and swampy and where I came to impassable quaking bogs which probably drain into the largest tributary of Waterhen river.

A similar low country is also reported to exist in the west half of township 65, range 15, and to extend far towards the seventeenth correction line.

East of Waterhen lake the country is hilly. Poplar bush extends to the middle of range 15, where low and sometimes very boggy lands lead to a lake lying in the northeastern part of township 63. This low country surrounds the lake to the south and continues far to the east where most of its drainage goes to the Beaver by way of Beatty creek. Many small lakes surrounded by hay meadows are reported along the course of this creek.

A large stream flows out from the east side of the lake in township 63, and turning northwards runs along the foot of pine wooded hills which rise a short distance from the northernmost bay of this lake. It eventually connects with another large lake in section 33, township 64.

The Hudsons' Bay company's trading post at Waterhen lake is built on the east side, on an arm of the lake, which separates it from the Indian village. Across these narrows there is hard bottom and as the water is not over two feet and a half deep in ordinary seasons, the Indians frequently ford this with their ponies.

This trading post is the end of the winter road to Green Lake, which crosses Beaver river a short distance from Island Hill. From the post this road passes through a rolling country wooded mostly with poplar and birch and extending three miles beyond the south shore of Waterhen lake. Thence to Beaver river, the route is over nearly level country with good soil where wild hay grows in profusion.

Two deep bays cut into the north shore of Waterhen lake and from the northeast bay Waterhen river flows. This bay is shallow and the mud banks are covered with tall grass and reeds which are frequented in the summer by countless flocks of the birds from which the lake derives its name. Their eggs are very delicious to eat and are much prized by the Indians on account of their not having the peculiar fishy flavour noticed in the eggs of some other kinds of aquatic birds.

Flotten river flows into the northwest bay which extends past the north boundary of township 63, range 17. It is a rapid stream which carries to Waterhen lake the waters of Flotten lake, a body of water seven miles long and three miles wide. The river being a succession of rapids, cannot very well be used in going from one lake to the other. There is, however, a good portage five miles long, which runs to the east side of the river up to the south end of Flotten lake and thence northwards through the country east of the lake.

The country on both sides of this river and lake has been visited by fires. The surface is quite hilly near the lower reach of the river but has a better appearance near the base line where it is more level, while patches of prairie land are often seen interspersed with poplar bluffs and clumps of spruce.

Some large spruce from ten to twenty-four inches was noticed along the north shore of Waterhen lake east of the mouth of Flotten river, which will cover tracts of from five to ten acres.

The rest of the country adjacent to and north of Waterhen lake is wooded with poplar four to ten inches in diameter. Birch also grows along the lake shore and on most of the hills, while large jackpine ten to twenty inches are also frequently seen.

Flotten lake covers the central part of township 65 and extends to its north boundary. East of the lake are three miles of dry and sparsely wooded land which borders on the large stretch of low country noted across range 16.

North of Flotten lake there is a strip of burnt-over country half a mile in width and north of this is twenty square miles of large spruce timber which it is estimated will yield 30,000,000 feet of lumber.

Two small creeks flow across this forest and discharge into the lake. Two trails lead to this block of timber, one of which starts from the northwest bay of Waterhen lake and goes to the east edge of the heavy timber, and the other begins at the north shore of Flotten lake, going three miles north through heavy timber, then turning northeast and probably joining the other trail.

From range 18 to range 24 the base line passes over a succession of high hills and crosses some wide deep valleys. These valleys lead to a depression which extends west from Waterhen lake to the fourth meridian.

In that depression lie lac des Isles and Pierce lake, which, with their connecting rivers, form a continuous water route between Cold and Waterhen lakes.

Of the many valleys crossed by the line in that distance of forty miles two deserve mention, because through them access may be had to the northern country which otherwise is difficult to reach owing to the large quantities of windfall.

In each of these valleys are well-defined trails indicating that they are frequented by the Indians on their hunting trips. Good pasture is also found along the creeks which wind through these valleys.

The first valley was intersected by our survey in the west half of range 19. Three miles south of the line in the valley there is two hundred acres of large spruce, while smaller areas are reported at intervals farther south. The other valley follows the east outline of range 23, and about midway between the valleys in section 32, range 21, occurs the highest elevation met with on our survey. Both valleys where the line crosses are very deep and are about half a mile wide between the crests of the benches. Towards the south the valleys become gradually wider while their benches get considerably lower.

Very little timber suitable for lumbering is now found in these valleys, the sides of which are wooded mostly with poplar.

The streams which flow in these valleys are fed by numerous springs rising in the hillsides, the water being strongly impregnated with iron. The whole country is covered with second-growth poplar, birch and pine, while the soil consists of clay loam sometimes mixed with gravel and stones. This country is too rough for farming but when cleared of the light woods and scrub which grow in places, it would be suitable for stock-raising. Grass grows everywhere through the light poplar woods and on the hillsides. Such is the general character of this elevated land.

Through ranges 24 and 25 the land is undulating and not so stony in the vicinity of the line, though a few miles north of the line the country again becomes rough. The hills are covered with deadfall and there are large tracts wooded with jackpine which has been killed by a fire which must have occurred very recently as the dried leaves are still on the trees.

The soil consists of sandy loam six inches deep with a subsoil of clay.

In section 34, township 64, range 24, is a lake surrounded by hay lands north of which, in section 4, grow some large spruce. The line cuts through the south limit of this clump of timber and then through three miles and a half of swampy land.

In section 35, range 25, we crossed an Indian trail in the valley of a creek which flows into Pierce lake, four miles to the south. West of this stream is a strip of large green poplar and beyond this again is a stretch of several miles of fire-killed timber and windfall.

In the summer of 1910 a disastrous fire swept over these dense forest lands. It appears to have closely followed the pine woods which always contain masses of inflammable material, but to have hardly penetrated the poplar woods. The fire appeared to have started about three miles south of the base line in range 25 and fanned by the high winds to have spread in a generally northwesterly direction to the valley of Primrose river. There its progress does not seem to have been checked to any extent, as recently burnt-over areas were seen west of that stream. These forest fires are hard to account for. Indians seldom visit the country and they always carefully put out their camp fires, even going to the trouble of banking them with clay. These Indians seem to understand pretty well too that it is in their interest to preserve the forests which are the haunts of game on which they mostly subsist. After each fire moose and deer will leave the country and will not return for several years. I believe that some of the forest fires are caused by lightning, for, many times after an electrical storm which is always followed by high winds, I have noticed clouds of smoke rising from sections of the country where we had not previously noticed any indications of fire.

From range 26 to the fourth meridian the land is rolling and densely wooded with second-growth poplar, birch and balm of Gilead.

At one mile and a half west of the corner of township 64, range 26, the line runs through heavy timber, mostly spruce, covering two square miles. It is estimated that this timber will yield 1,500,000 feet of lumber. Large jackpine from eight to fifteen inches, suitable for railway ties, is found in quantities at many places and spruce from eight to twelve inches is scattered over all the country west of range 25.

The base line ends in section 32, range 26, at the east shore of Cold lake, a large body of water covering about 140 square miles, but in order to check our work the survey was continued around the north shore of the lake up to the meridian.

Wooded ridges generally surround the east side of the lake and I noticed at several places bold sandy bluffs along its shore.

The east shore of Cold lake, near the end of the base line, forms a deep bay, and from there is its outlet, a wide and rapid stream containing several islands, which we forded a short distance from the bay. The bottom is gravel and stones, and its crossing is safe at all times during the summer. This stream runs southeast to Pierce lake, five miles distant. The level of Pierce lake being 110 feet lower than that of Cold lake explains sufficiently the rapids on this stream.

Owing probably to the risk of upsetting their canoes in the rapids, the Indians make use of a portage over the hills between the two lakes.

Pierce lake is about eight miles long and four wide. It lies mostly in townships 63 and 64, range 25. Its outlet is at the east end of the lake and forms by its expansions two smaller lakes before it joins lac des Isles, six miles farther east.

The last mentioned lake is about eight miles south of the base line and extends across ranges 22 and 23. Where Waterhen river enters lac des Isles the Hudson's Bay company has established a fur-trading post, which is connected by a wagon road to their other post situated north of Waterhen river, and close to the east end of this lake.

One of the roads from Onion Lake settlement comes to the trading post at Pierce lake, so that access to this district is possible at all times.

South of Pierce lake are miles of hay land and a Cree settlement has sprung up in the neighbourhood. All these people own horses and wagons, but none of them appear to have attempted any cultivation of the soil although it is very good. They are satisfied with putting up hay at which occupation they were all busy when we passed at the end of August.

Besides the wagon roads which follow the more open sections there are many pack-trails winding across the woods.

From Sandy bay along the south shore of Pierce lake a pack-trail leads to section 12, township 63, range 1, west of the fourth meridian, passing within half a mile of Cold lake.

We followed this trail when returning to the meridian to complete the levels along that line; it was necessary to widen it somewhat to allow our loaded pack-horses to pass through the woods.

After crossing the hills near Pierce lake this road turns southwesterly towards a more level country which is covered with poplar bluffs alternating with patches of willow scrub near the lakes and hay marshes.

At Cree lake, which is five or six miles east of the meridian, we came to a belt of fine spruce trees up to thirty-six inches. They grow in thick clumps near the lake, but are more scattered, though still of large size, as one approaches the meridian.

The timber begins in the northwest quarter of township 63, range 26, and extends southwest across range 27. There were indications of a recent fire having been started in the vicinity of Cree lake which is frequented by the Indians, but after skirting the west edge of the forest this fire luckily died out within a short distance of the best timber.

Growing among the spruce are poplar from ten to fifteen inches and cottonwood ten to twenty-four inches. Through the woods of this country there is a heavy undergrowth of hazel and other low bushes.

The Cold lake district offers real advantages for mixed farming. Some sections in the surveyed part were taken up a few years ago and the homesteaders have proved the fertility of the soil for growing cereals and all kinds of ordinary vegetables.

There is also plenty of upland hay which is always mixed with large quantities of pea-vine. Wild hay of good quality is also found in the lower land near lakes and ponds and all the creeks contain fresh water.

Last summer many prospective settlers brought their families with the intention of taking up sections of the still unoccupied surveyed lands southwest of Cold lake.

This district is far from being isolated, as some of the roads lead south to the older settlements, while others reach St. Paul-de-Metis and Vegreville.

There is a general store and a post-office near Beaver river which is crossed by ferry.

From Cold Lake post-office in section 15, township 62, range 2, a new road leads in the direction of the Cree settlement, fifteen miles east of the meridian. We came out that way and in order to avoid a long detour we corduroyed this road where it crosses a neck between some hay marshes which spread for a considerable distance north and south. This road has never been properly cleared of brush and till recently was used as a sled road, but it could be improved at a small cost.

CLIMATE.

During the spring and until the end of June we enjoyed dry, fair weather which had also the effect of subduing to a noticeable extent the mosquitoes and kindred pests, but in July and the first part of August hardly a day passed without heavy showers, often accompanied by hail-storms. August and September proved to be ideal months for our work. The summer was appreciably cooler than in Prince Albert, and summer frosts were experienced in the months of July and August, the ice in some cases being a quarter of an inch thick on the water in the tent.

Large game, still plentiful in this country, consists of deer and moose, whose well-beaten paths cross the land in all directions. Bears and the smaller fur-bearing animals, such as mink, marten and weasels, also were met. Of the feathered game ruffed grouse, prairie-chickens, swamp partridges, &c., are quite common in some localities, while ducks and other aquatic birds are seen all summer. Such birds as the pelican and the loon, which are seldom seen near the settlements, remain all summer on the lakes in the northern country.

There is a large supply of various species of fish in all the larger lakes and streams. They consist of pike, pickerel and carp. Trout and whitefish with the above-mentioned varieties are caught all summer in Cold lake but in all such lakes as Pierce lake, lac des Isles and Waterhen lake they are caught during the winter only. Berries such as cranberries, saskatoon berries, wild cherries, strawberries and raspberries are plentiful, and also another luscious kind which grows in all muskegs.

Although no minerals of economic value were discovered in the district adjacent to the base line, there are some localities where bog iron must exist, as proved by the abnormal deviations of the magnetic needle recorded at such places.

APPENDIX No. 45.

ABSTRACT OF THE REPORT OF W. A. SCOTT, D.L.S.

MISCELLANEOUS RESURVEYS IN SOUTHERN SASKATCHEWAN AND ALBERTA.

My first work consisted of the retracement of townships 7 and 8, range 6, and township 8, range 7, west of the fifth meridian. The country in this vicinity is fairly well settled and is rapidly becoming fenced up. The trails followed at present are chiefly old trails, but in a few years the road allowances will be the only means of travel.

This part, and in fact the whole country from the main line of the Canadian Pacific railway south to the international boundary, was devoted chiefly to the raising of horses, but in the last few years as the homestead lands in the West have been rapidly taken up, this part has been filling up with settlers, until now ranching to any large extent has ceased.

The surface is rolling prairie of which only a very small part, the deep coulees of the small creeks, cannot be brought under cultivation. The greater number of these creeks are dry for the most of the year and only those of considerable size continue to run during the summer. The rainfall is light, the greater part of the moisture being precipitated during the months of May, June and July, and the climate may be said to be dry. The question of water supply is one of paramount importance and will eventually be solved by irrigation or dry farming.

The nearest railway at present is the Crowsnest branch of the Canadian Pacific railway, there being no other railway between this and the international boundary. This means that some of the settlers have a haul of sixty or seventy miles.

There seems to be a large number of small mines in this vicinity where lignite is mined in small quantities to supply a local market.

The next work was the survey of coal lands in townships 9, 10, 11, 12 and 13, ranges 4 and 5, west of the fifth meridian. The best route for reaching these townships is by leaving the Crowsnest branch of the Canadian Pacific railway at either Cowley or Lundbreck and following a fairly good wagon road to the 'Gap' which is the pass of Livingstone river through the Livingstone range. The road as far as the 'Gap' is fairly good, but beyond that it is merely a trail. Wagons may be used up Racehorse creek a distance of four miles, then up Livingstone river to the fourth base line and up the northwest branch as far as section 9, township 12, range 4, where there is a building, once used by the Great West Coal company, but now deserted. There are good pack-trails following the courses of all the large creeks. These pack-trails have been improved to a very great extent by the fire rangers located in this district during the past season, and I believe more improvements along this line will be carried on during the ensuing years.

The Livingstone range follows a course almost due north and distant about two miles from the east boundary of range 4. Between the Livingstone range and the range of mountains defining the boundary between Alberta and British Columbia the country is of a mountainous nature but there are no distinct mountain ranges. There are many hills as high as the Livingstone range itself, but they are almost all wooded except the tops which are bare rugged rocks. There is scarcely any timber of any commercial value east of the east boundary of range 5, but from there west to the boundary of Alberta there is a great deal of jackpine from twelve to thirty inches in diameter.

The greater part of townships 9, 10, 11 and 12, range 4, was burned over in July, 1910, and most of the timber was destroyed. However, in some places where the fire burned at night or during a day with little or no wind, it was confined chiefly to the ground and underbrush and the trees were not killed. This was the case to a greater extent in the northerly townships than in the southerly part as there was more windfall in the latter.

The hills abound in coal of a very good quality. On almost every hilltop could be seen an exposure of a coal seam and sometimes several seams. The dip of the rocks is to the west and varies from 30 to 60 degrees, while the strike is almost due north. This formation gives an easy slope from the west ending abruptly at the hilltop in a precipitous rock face towards the east. The coal formation as a rule lies immediately below a conglomerate formation which is readily distinguished from the other formations.

All the streams have a good fall and are very rapid, and water-power could be developed on almost any of them, for although the flow of water would be comparatively small, there is almost no limit to the head that could be secured.

The streams teem with trout and many tourists take advantage of this sport. There are also a few deer and bears and there are mountain sheep and goats in the more rugged parts. There is an ever increasing number of sportsmen visiting this country and they are pushing farther and farther back into the mountains as the trails are opened.

The season for survey work in these mountains is rather short as it is not profitable to commence work west of the Livingstone range before June and operations have to be closed some time in November. There was so much snow in November of the past season that the party was withdrawn and paid off on the 16th.

During the remainder of the season a number of miscellaneous surveys were performed in Alberta and Saskatchewan, including work in townships 32 and 33, range 10, township 32, range 11, and township 26, range 15, west of the third meridian, and township 41, range 13, townships 45 and 46, range 16, township 45, range 17, and township 60, range 25, west of the fourth meridian.

APPENDIX No. 46.

ABSTRACT OF THE REPORT OF P. B. STREET, D.L.S.

MISCELLANEOUS SURVEYS IN MANITOBA, SASKATCHEWAN AND ALBERTA.

The party was organized for the season at Lethbridge and having made all the necessary arrangements we left there on May 10 for Milk River where we arrived the following day. The district from Lethbridge to Stirling is mostly undulating prairie, with a rich clay loam soil. Under the irrigation system good crops are grown, and the majority of the farms are wholly cultivated. South of Stirling the country is more rolling, but the soil is uniformly good, and the crops are usually heavy. Here we saw irrigation ditches entirely filled with dirt which had drifted in during a heavy windstorm on the previous Saturday. The whole district is settled by Mormons.

We commenced the retracement of township 2, range 13, west of the fourth meridian on May 11, and completed it on June 1. Milk river flows easterly through the southern part of this township and is the chief source of water supply for the settlers. The soil is mostly sandy loam and is better suited for mixed farming than grain growing. The whole township is settled but only about twenty per cent of the land was under cultivation last season.

Our next work was a restoration and retracement survey of township 2, range 12, which was completed on June 15. Part of this township is under lease to the Deer Creek Cattle company, but the remainder is all settled. The soil is sandy loam and considerable stone and gravel is found in places. The constant hot winds in this district dry up and scorch the vegetation early in the summer and there are many years when a wheat crop cannot be raised. Mixed farming, would, however, prove successful.

On June 16, we commenced the retracement of township 2, range 14, but our progress was greatly impeded by the inaccessible banks of Milk river, the trails which formerly led to the fords having been fenced up by the settlers. The soil in this township is clay loam and holds the moisture much better than in townships 2, ranges 12 and 13, and I would judge that dry farming would be successful.

Having completed the work here, we left on June 30, for the Crowsnest pass which we reached on July 10. The country through which we passed on this trip looked very prosperous, and the grain, although a little backward at that time of the year, looked very healthy and promised a fine yield. Around Raymond a great many sugar beets are grown for the Knight Sugar company which is located there. Small fruits are also grown successfully in this district, and some settlers have recently planted fruit trees which may prove a successful venture.

West of Cardston one canot help noticing the decided improvement in the vegetation over that in the vicinity of Milk River. There is a great deal of cultivated land west of Belly river, although most of the old ranchers have kept a portion of their holdings for pasture. The settlers in the Pincher Creek district are turning to mixed farming and stock-raising, as the last two years have proven that in this district wheat crops cannot be depended upon, on account of the early frosts which occur owing to the high altitude.

At Crowsnest business was very quiet, as, owing to the coal strike, many miners had left the district temporarily.

Our work here, in township 8, range 5, west of the fifth meridian, consisted in extending subdivision lines across Sentinel and Summit mountains and traversing a portion of Island lake. Here we lost a few days owing to the clouds descending to an altitude of 6,000 feet which was below the level of our work in the mountains. No indications of coal were seen in this township, as the rocks are mostly of limestone formation. Limestone is quarried and burned in section 7.

Our next work was in township 5, range 4, and consisted of the extension of subdivision lines to include certain coal lands. For this work, owing to the mountainous nature of the country, frequent flying camps were necessary. The northwest quarter of this township contains some rather poor timber, but the remainder contains an unusual amount of first-class timber. Spruce from twelve to forty-two inches is found in large quantities as well as some good jackpine, but very little fir was seen, as the altitude was too great.

The coal seams of the Premier Coal company have some remarkable showings, and the seams can be traced across country for miles. It is an excellent coking coal and burns very clean.

Our work in township 5 was at an altitude of from 6,000 to 7,000 feet, and here as at Crownest, we were delayed by cloudy weather. On September 5 snow fell to the depth of one foot and there were several snowfalls more before the end of the month.

From here we moved to township 4, range 1, where we traversed Fisk lake. This township, as well as several townships south and east, is well adapted for ranching, as there is an abundance of feed, water and shelter. The present settlers, however, seem to prefer farming, and a great deal of baled hay is annually shipped from this district.

After doing some retracement work in township 7, range 30, west of the fourth meridian, we left for Milk River to retrace township 2, range, 15, which we reached on November 3.

The weather turned very cold on the 7th, the temperature falling to —20°, and a strong wind blowing made a regular blizzard till the 10th.

We finished the retracement of this township on November 21, and on the following day I paid off the party retaining only one assistant.

During the remainder of the season I and my assistant removed some duplicate monuments in township 9, range 21, west of the second meridian, traversed Icelandic river in township 23, range 3, east of the principal meridian, retraced some lines in township 21, range 4, and investigated the marking of a witness post in township 23, range 6, both west of the principal meridian. Having finished this work, I paid off my assistant at Winnipeg and left for Toronto, where I arrived on December 29.

APPENDIX No. 47

ABSTRACT OF THE REPORT OF C. H. TAGGART, D.L.S.

SURVEYS IN THE RAILWAY BELT, BRITISH COLUMBIA, IN THE VICINITY OF KAMLOOPS.

My first work was establishing the north limit of the Monte Hills forest reserve. The route to this work was along the road from Kamloops to 'grand prairie' for twelve miles. From there a branch road to Campbell lake was followed, and then a rough wagon road to Wolf lake. From there to where the north boundary of the reserve crosses the summit of the hills, there being no road, a pack-trail had to be cut out.

The surface of the country along this boundary is very rough and is densely wooded with jackpine from three to fifteen inches in diameter, and scattered spruce up to forty inches. The soil is a sandy loam with gravel subsoil, and in some places the rock is found close to the surface, while in others it is solid rock outcrops.

The south limit of the railway belt in townships 16, ranges 15 and 16, was our next work. To reach this we had to return over our old route to Campbell lake, and then proceed via Barnhartvale and Napier lake. The road between these two places follows a narrow valley the bottom lands of which produce hay and alfalfa in large quantities, and while cattle-raising was formerly the chief industry, fruit growing is now obtaining prominence. At the foot of Trapp lake a large portion of land is being divided into fruit farms of ten and twenty acres each and an extensive irrigation system is to be installed.

In townships 16, ranges 16 and 17, some good grazing land was noticed, but easterly from section 21 in range 16, the country becomes rough and rocky, and difficulty was experienced in getting a road for the pack-horses. As our next work lay in township 17, range 13, we cut out a pack-trail to the wagon road along Salmon river. The district around 'grand prairie' in this township is being subdivided into fruit farms, and the water of Salmon river is to be used for irrigation purposes.

We next proceeded to timber berth No. 550 on Kingfisher creek, in township 20, range 6, which was our next work. A good wagon road took us as far as Enderby on the Okanagan branch of the Canadian Pacific railway. From Enderby to the mouth of Kingfisher creek the road was rough and from there on we were forced to follow the creek bed through water waist deep and very swift.

The survey of timber berth No. 545 in township 23, range 18, west of the fifth meridian was our next work, and having completed this on August 17 we began subdivision in section 12, township 24, range 19. In this valley, from Golden south to the limit of the railway belt, there is a rich agricultural district, but the best land is included in timber berths, and although the timber is cut off very little improvement has been made as titles cannot be obtained by the squatters, some of whom have lived there for ten years. Wherever development has taken place the results obtained have been excellent, especially with the small varieties of fruit. The bench lands as well as the bottom-lands are being taken up, and though the former may require irrigating an abundant supply of water is available from the mountain streams. Good roads lead through the valley and steamers ply on the river.

We completed the work in this valley on September 30 and left for Revelstoke to perform some surveys in township 23, range 2, west of the sixth meridian. This was completed on October 26, and from then until November 28, we were engaged in traversing the right bank of Columbia river in township 22, range 2, and township 21, range 1, retracing section lines in the same townships and also performing a small amount of traverse in township 21, range 1, west of the sixth meridian, and in township 21, range 29, west of the fifth meridian. During the progress of this work we experienced a three days' blizzard followed by a three days' sleet and rain-storm which greatly retarded our progress.

The lower Columbia valley south of Revelstoke averages about one and a half miles in width. It is mostly covered with a dense growth of under brush and is timbered with cedar from four to twelve feet in diameter. Some hemlock of good size was also noticed but cedar is the chief asset. The soil is mostly a sandy loam with gravelly subsoil, and so porous that irrigation is necessary. Fruit growing here is only in the experimental stage yet, but good crops of vegetables grow wherever the land has been developed, and a convenient and ready market is found in Revelstoke.

The work in the vicinity of Revelstoke being finished we moved to Kamloops to survey the south limit of the railway belt westerly from the southeast corner of section 25, township 17, range 16, west of the sixth meridian, and also to perform some retracement and resurvey in the same district.

From here we moved to Trout lake in township 17, range 19, west of the sixth meridian, to make a traverse of the lake, establish section corners and lay out building lots for summer cottages. The lake is in the centre of the Long Lake forest reserve, twenty-one miles from Kamloops, and is accessible by a wagon and automobile road. It is the only convenient summer resort for Kamloops, and being twenty-nine hundred feet higher than the city the air is always fresh even in the hottest weather.

Our last work was the survey of a parcel of land in township 22, range 17, west of the sixth meridian, in the valley of North Thompson river. The Canadian Northern railway company are making rapid progress with the construction of their line on the east side of the river, and it is expected that this portion of the road will be in operation within two years.

APPENDIX No. 48.

ABSTRACT OF THE REPORT OF C. M. WALKER, D.L.S.

MISCELLANEOUS SURVEYS IN SOUTHWESTERN ALBERTA

We left Calgary on May 9 for township 21, range 7, west of the fifth meridian, where our first work of the season was located. The eastern boundary of this township for the first four miles, follows along the steep sidehill of a high mountainous ridge which, previous to the fires of 1910, was covered with a fair growth of spruce and jackpine from six to fifteen inches in diameter; now, however, this ridge, as well as the greater part of the township, presents a very desolate appearance, consisting only of barren rock slides and brulé with here and there a clump of dead spruce or jackpine.

Elbow river flows northward at a distance of from thirty to eighty chains to the west of the east boundary of this township, until near the northeast corner of section 21 where it flows east into township 21, range 6. Its width varies from seventy-two to three hundred links, and it has a uniform, though rapid fall, although no rapids of any account occur along this part of it course. The river-flat, consisting of gravel bars, has a breadth of five to forty chains in range 6, and this would prove an ideal storage basin for power purposes, as there is an excellent location for a dam in section 8, township 22. That such a storage basin is necessary to develop power is evidenced by the fact that on May 27 there was no flow of water in the main stream of Elbow river above Fisher branch, and three days later, when the snow began to melt, our horses were swept off their feet and carried about fifty yards down stream while fording this same river. A rise of two feet in the stream in six hours is not an unusual occurrence.

Our next work was the survey of the north and east boundaries of township 21, range 6. The east outline runs through country similar to that in the township to the west, though there is much less rock and the ridges are not so high. The surface, however, is rolling and cut by deep ravines. Threepoint creek canyon crosses the east boundary of section 1 in a northeasterly direction. It is four to five hundred feet deep and has loose broken shaly precipitous sides; there are, however, no indications of coal. A valley running northwest from Threepoint creek contains the only valuable land in this township. It includes section 11, the west halves of sections 11 and 34, sections 15, 22, 27, and the east halves of sections 28 and 33. The land in this valley is inclined to be boggy, but it could be very easily drained. It produces excellent hay, and, along with several small adjoining valleys, would make a good ranching district. The climate, however, would render farming out of the question as we had snowstorms or heavy frost every week throughout the whole season. No indications of minerals were found in this township, but game, consisting of deer and prairie-chickens appeared to be plentiful.

Having completed the work in township 21, range 6, we moved to township 22 to perform some subdivision surveys. The western third of this township and sections 28 and 33 are exceedingly rough, being composed of steep hillsides, bluffs and canyons from four to nine hundred feet deep. Some good spruce is found in section 6, and along Prairie creek in the northeast quarter of section 18, but elsewhere fires have destroyed all the merchantable timber. A redeeming feature of this part of the country is the remarkable number of outcroppings of lignite which occur in the vicinity of Canyon creek. As almost all of these outcroppings occur on approximately the same level it would appear to indicate the presence of a seam or seams extending for some miles up the canyon.

Considerable development work has already been done. The southeastern portion is very rough with no standing timber of any account, and, though the surface consists of mountainous ridges, it shows no indications of minerals whatever.

A strip of level land extends along the south bank of Elbow river in sections 9, 10, 11, 15 and 16. It has excellent drainage facilities, and consists of good clay and sandy loam on a gravel subsoil, but summer frosts prevent the raising of even potatoes. Hay, however, grows in this flat, and also in a flat on the north side of the river in sections 24 and 25. Sulphur springs are located along the north branch of Canyon creek in sections 29 and 32, which give a strong taste and odor to the water.

Elbow river enters this township on the south boundary of section 4. The river flat varies from twelve chains to the bed itself and consists of gravel bars and boulders with here and there an occasional spruce. The rapids begin where the river enters section 5 and form a continuous series of cataracts to the centre of section 8, where an ideal location for a dam is formed by the high, rocky banks which are only eighty links apart at the river level. This dam could be used for either power or storage purposes.

The next rapids begin where the river enters section 16, and terminate at the falls, where there is an abrupt drop of about thirty feet, the entire volume of water passing between rock projections only forty links apart. From the falls to the mouth of Canyon creek in section 15 the river is a continual series of rapids, and in the canyon of the Elbow in the eastern part of section 15, the river has worn its way several hundred feet below the surface and runs through a rocky defile about one chain in width. A dam could be erected at the head of the canyon at little expense, as construction material is abundant.

After completing the traverse of this portion of Elbow river we resurveyed the east boundary of township 23, range 7, as far as the northeast corner of section 12, and produced the line by triangulation over Moose mountain, which is about eight thousand feet high. Immense gulches over one thousand feet deep and severe snowstorms greatly retarded our progress.

Many outcroppings of coal appear around Moose mountain, particularly in sections 4, 5, 8 and 9, in township 23, range 6. Several seams from four to twenty feet thick have been uncovered in section 8, and in the northeast quarter of the section a tunnel about one hundred and fifty feet in length has been driven into the hillside. The coal is said to be excellent for steam producing purposes.

The entire western portion of township 23 is very rough while the eastern part is more open and includes several hay meadows. There are no large streams and consequently no water-powers, but Little Jumpingpound and Bragg creeks have their sources there.

Our next work was a resurvey in townships 14, ranges 7 and 8, west of the principal meridian. Township 14, range 7, is very wet and covered with a dense growth of reeds and rushes eight to ten feet high. The southern tier of sections contains some tillable land but the remainder of the township is mostly under water. Delta, a small summer resort in section 14, is the terminus of a branch of the Canadian Northern railway. The shore of the lake at Delta is sandy and very shallow furnishing an ideal place for bathing.

Having traversed the lake across range 7 I performed some subdivision in range 8 and closed operations for the season on January 4, 1912.

APPENDIX No. 49.

ABSTRACT OF THE REPORT OF J. N. WALLACE, D.L.S.

LEVELLING NORTH FROM PRINCE ALBERT AND LLOYDMINSTER.

Our work for the season of 1911 consisted chiefly of the running of two lines of levels, one northerly from Prince Albert and the second northerly from Lloydminster. These were run to connect the levels along the meridians and base lines with railway elevations, these latter being, at present, the only available sources of information in the western provinces regarding sea-level.

A reference to the system of levels taken along base lines may serve to explain the necessity of these connections. The system of taking levels along base lines was inaugurated in 1908. In that year sixty-six miles were run along part of the eleventh base line west of the fifth meridian. During the seasons of 1909, 1910 and 1911 levels were run along more than eleven hundred miles of line, making a total of over two thousand four hundred miles of levels, all of this being along meridians or base lines. The distribution of the mileage is as follows:—

Along the principal meridian and adjoining base lines two hundred and fifty miles, along the second meridian and base lines westerly seventy miles, along the third meridian and westerly two hundred and thirty miles along the fourth meridian and westerly five hundred and eighty miles, and along the fifth meridian and westerly six hundred and twenty miles. No levels have yet been run along the sixth meridian itself, but six hundred and thirty miles have been run on base lines to the west of it.

These levels, while not yet connected as a whole, are, as far as possible, connected in groups. Owing to the fact that levels were not taken in former years, and on account of the great expense it would cost to now reopen, for the purpose of taking levels, lines surveyed years ago, it is not possible to directly connect many of the new level lines. This difficulty, however, will rapidly disappear as time goes on, as levels are now taken along all base and meridian lines, thus keeping up a continuous connection. Each season's work will then be commenced with a known elevation, not on an assumed one, as at present, and the level records will be immediately available for use in themselves, and will afford comparison with other connected lines.

As regards the accuracy with which these lines have been run, the only checks available up to the present date have been the closing of two circuits, and the comparison between themselves of the two level lines always run along each base line or meridian during its survey. The circuits were composed of two neighbouring base lines with meridian lines as east and west boundaries. In the first case, the total length of circuit was three hundred and sixty-two miles, and the closing error 1·79 feet, which would correspond to a mean error of +0·005 feet per mile, or an accidental error of ±0·09 feet per mile. In the second case the circuit was two hundred and four miles long and closed within 1·16 feet, the corresponding errors being ·0·006, and ±0·08 feet per mile. So far as the comparison of original and check levels on each line affords indication of accuracy, this difference may be considered as very seldom exceeding ±0·05 feet over any one mile.

It is seen from this that the lines of the base line system are sufficiently accurate to make the present uncertainties of railway elevations in different parts of the West altogether greater than any accumulated errors which are likely to occur in the system and for this reason something better than railway elevations is necessary on which to base the elevations. The area over which the system extends is too great for a single connection with one precise elevation, but several connections should be made, the most suitable points of connection being near the southerly end of each of the meridians. When a precise line of levels has been run along some railway extending east and west it will form a fundamental basis from which to run these connections northerly.

It was as a part of this general project of connecting the whole base line system, and in order to obtain reliable sea-level elevations at intervals that the two lines already referred to were undertaken. As already stated the first was from Prince Albert. It runs northerly along the Montreal lake road for thirty miles, to the intersection of the third meridian and the fourteenth base. The second a line of eighty-three miles long was run northerly from Lloydminster to the sixteenth base connecting with it a few miles east of the fourth meridian. In the first case the temporary datum used was that of the city of Prince Albert, which probably originated from the survey line of the Regina-Prince Albert railway many years ago. As regards the Lloydminster line, the datum used was that of the Canadian Northern railway. Both these data are more or less uncertain within a possible limit of as much as thirty feet, but in both cases absolutely no other datum was available for temporary use. Both these connecting lines of levels were run in the field by Mr. C. de la Condamine, D.L.S. He reports as follows:—

'I left Calgary on May 30, for Prince Albert to run a line of levels to connect the third meridian levels with an elevation in Prince Albert. I reached there next day and at once began to organize my party. As a preliminary I drove from Prince Albert to the northeast corner of township 52, range 1, to ascertain the best route to follow and to identify Mr. Saint Cyr's bench-marks on the meridian.

Actual levelling operations were commenced at Prince Albert on June 12 by connecting the rail level at the Canadian Northern railway station with a permanent bench-mark which I established on the post-office building, and with a bench-mark I found on the railway bridge over Saskatchewan river, which latter was subsequently found to have been established on an assumed datum, by the Public Works Department survey of this river.

The line of levels was then run northerly along the surveyed highway known as the Montreal lake road.

No difficulty of a serious nature was encountered, but the country being somewhat hilly in many places and the road not being cut out very wide where it runs through bush, many small delays occurred.

The total distance along the line of levels from Prince Albert to the southerly end of Mr. Saint Cyr's work is thirty miles. This work was completed on July 14.

The main object of the work was to connect the levels of the third meridian and neighbouring base lines to a railway datum, but in addition bench-marks were established along the whole route from Prince Albert. These consist of an iron section post, sunk in two feet of concrete under ground and appearing about six inches above the surface.

Three bench-marks were established at Prince Albert and seven others were placed between there and the north of township 52, at which latter point connection was made to Mr. Saint Cyr's bench-marks. The intermediate bench-marks were, as a rule, placed near the survey posts marking the angles of the road survey, reference distances being recorded to the survey post and the number of the post noted. The bench-mark is a round solid iron post flattened near the top and marked 'B.M.,' with a number following.

I found the general elevation on the third meridian at the north of township 52 to be two hundred and eighty-three feet above the rail level of the Canadian Northern railway at Prince Albert. Taking this latter as at an elevation of 1,393 feet above sea-level (which is not at all a certain elevation, but the best available at present) this would make the north of township 52 at a general elevation of some 1,676 feet above sea-level.

On completing this work I proceeded at once to Lloydminster in order to run a line of levels northerly from the railway there to give a datum for the levels along the fourth meridian and adjoining base lines.

I reached Lloydminster on July 15, and after establishing several bench-marks in the town and connecting them to rail level at the station, the line was run northerly, following in general close to the fourth meridian. From Lloydminster to Onion Lake the country is all prairie, but north of Onion Lake it is wooded and as the line of levels had to be run along the only available wagon road, which is very crooked, the full length of sight could not be taken except in a few cases.

Two routes could be followed from Lloydminster. One is a surveyed highway following near the meridian, generally good except that it has many steep gradients across townships 52 and 53. The other is a more generally travelled road which crosses Saskatchewan river at Hewitt landing. This latter is not so hilly as the graded road but it is longer and on the whole it was thought best, for purposes of easier recording of bench-marks, to keep along the graded road in the immediate vicinity of the meridian, and this was the route I followed.

The only difficulty encountered was the crossing of Saskatchewan river at the fourth meridian. The river is over one thousand one hundred feet wide and, when I crossed it I was unable to find any sand-bar on which to set up the level, or indeed any means of shortening the distance. I then proceeded as follows:

The instrument was adjusted carefully and the error of adjustment measured. Then a rodman crossed the river and established a temporary bench-mark on the south shore of the river. The rod was thirteen feet long and the stadia constant was 1 100. It was therefore possible to bring the three wires on the rod. After several trials the instrument was set up on the north shore at such an elevation that the middle wire came about at the middle of the rod. Then the second rodman established a temporary bench-mark near the instrument at such an elevation that the middle wire came near the middle of the rod. This was necessary to allow the north rod to be sighted on from the south shore. The three wires were read on the far rod and then on the near rod. The instrument was then shifted and the process was repeated three times, this giving nine readings on each rod. Results were compared at once and as they agreed satisfactorily it was thought a fourth setting was unnecessary. In order to correct the error of adjustment of the instrument I repeated the same process with the instrument set up on the south shore. The rods were interchanged, the one which was on the south shore being on the north one in the second operation

Of course at such a distance it was impossible to read the hundredths of a foot; even the figures indicating the tenths could not be read but the tenths could be counted and the hundredths estimated.

In order to give some idea of the accuracy of this method I give below the values of the upper and lower intervals read on the far rod:

Intervals. . . .	5·580 5·530	5·710 5·710	5·750 5·750	5·680 5·760	5·630 5·640	5·670 5·700
Difference. . .	0·050	0·000	0·000	0·080	0·010	0·030

The value of one division of the level was 10″ of arc. It was therefore possible to estimate about 3″. At a distance of one thousand one hundred and forty feet, this gives a possible error of about 0·02 of a foot. The maximum error due to this cause when reading an interval is therefore 4/100 of a foot and the probable error 0·028. Two differences are beyond this value. Probably the largest error comes from the fact that the wires cover several hundredths of a foot and therefore the hundredths cannot be estimated with accuracy.

North of Onion Lake I followed the Ministikwan lake trail. This crosses the fifteenth base about four hundred feet east of the northeast corner of section 33, range 26, and the sixteenth base about a quarter of a mile west of the northeast corner of section 33, range 25. Though rough it is a good wagon road and very few muskegs occur.

Connection was made on the fifteenth and sixteenth base lines to bench-marks already established during the survey of these two base lines.

From Lloydminster to Saskatchewan river one line of levels was run northerly and at the end of the season as a check, a second line was run southerly while north of Onion Lake the work was checked by a second line in sections about a mile long. This latter I consider much the better way. Camp need not be moved so often, and account can be kept of the way the work is proceeding, so that if any small errors are accumulating they can be at once detected, and means taken to avoid their continuance. Moreover, temporary bench-marks may become unreliable if the check levels are delayed for any length of time.

Permanent bench-marks, of the same nature as those left on the Prince Albert line, were left along the route from Lloydminster to Onion Lake, but north of Onion Lake, owing to lack of cement I had to use trees for bench-marks.

The country is undulating to within one mile of the north boundary of township 51, where the elevation is about one hundred feet below Lloydminster. From here northerly the land is hilly but still falling northward, the lowest elevation being in the southerly part of township 52, where the elevation is two hundred and twenty-five feet below Lloydminster. The ground then rises, attaining its highest elevation near the northeast corner of section 12, in township 53, where it is about one hundred and ten feet higher than Lloydminster. From here northerly the land falls again to Saskatchewan valley; the level of the water in August was four hundred and eighty feet below Lloydminster when I was going north and six feet lower when returning in October. The elevation of the rail at Lloydminster, according to the Canadian Northern railway, is 2,102 feet above sea-level. Using this as a temporary datum the elevation of the river would be 1,626 feet in August and 1,620 feet at the end of October.

Going north from Saskatchewan river the general elevation of the country steadily rises. About two miles north of the river its elevation is 1,820 feet. At Onion Lake, the ground in front of the English mission is 1,970 feet. The Hudson's Bay post being on a local hill is a good deal higher. Where the Ministikwan lake trail crosses the north of township 55, the elevation is 2,190 feet, or eighty-eight feet above Lloydminster.

From here there is a fall northerly to the valley of Beaver river. The water in Blackfoot lake is 1,989 feet and that of Mudie lake is 1,722 feet above sea-level.

Having made connection to bench-marks on the sixteenth base, I returned to Onion Lake and checked the whole line southerly from there to Lloydminster, where I ceased work on November 8.

All the computations on the two lines run have been completed, and the corrections found to connect the data used during the survey of the several base lines with the elevations at Prince Albert and Lloydminster. These corrections give a temporary approximate sea-level datum for over eight hundred miles of levels already run which, while no more accurate than the best available datum at these two railway points, is yet much better than the previously entirely unknown conditions, under which the levels along base lines have had to be run in the past.

APPENDIX No. 50.

THE DETERMINATION OF THE MAGNETIC DECLINATION, DIP AND TOTAL FORCE IN WESTERN CANADA.

D. E. Chartrand, B.Sc.

Although the compass is not used in running lines on Dominion Land surveys, it is a valuable accessory especially in unexplored parts of the country. Where no line of definite bearing is available, it may be used advantageously as a finder of Polaris in daylight observations for azimuth. To accomplish this, however, a knowledge of the local magnetic declination is necessary; in other words one must know within a reasonable degree of accuracy the angular interval between magnetic north and astronomic north.

Historical sketch.

The accurate determination of the magnetic elements in western Canada dates as far back as the year 1842 when Lieutenant J. H. Lefroy, under the direction of the Royal Society, made a magnetic survey of that portion of the country. Magnetic observations were taken in the year 1887 by the Topographical Surveys Branch. Nothing further to any extent was done by this Branch until 1908 when Dominion Land surveyors employed by the Department were instructed to observe the magnetic declination during the course of their surveys.

An isogonic map, on a very small scale, was published in 1904, chiefly from data obtained from Lefroy's survey and the 187 observations of this Branch. Some information along the International boundary and around the Great Lakes was obtained from the United States Coast and Geodetic Survey. This map was intended only for the use of Dominion Land Surveyors employed by the Department.

In 1911 an isogonic map, on a very small scale, of that portion of Canada south of the 54th parallel of latitude was prepared and published in two sections, one for eastern Canada and the other for the western provinces. The declinations used for the western section were derived from the observations of this Branch. The sources of information for the compilation of the eastern section were: the Director of the Meteorological Service at Toronto, the British Admiralty charts, and the United States Coast and Geodetic Survey.

Area covered.

As the survey operations under this Branch are confined entirely to the lands under the control of the Dominion government, the stations occupied since 1908 are limited to the provinces of Manitoba, Saskatchewan, Alberta and British Columbia. The districts where meridian, base line and subdivision surveys have been in operation since that date have been dotted with stations for the magnetic declination. A special effort has been made to gather magnetic data from the settled districts by means of travelling parties employed on miscellaneous surveys. These surveyors generally cover a wide stretch of country and provide the only means now at our disposal of observing the magnetic elements in the settled parts of western Canada.

DECLINATION.

Description of Compass.

The determination of the magnetic declination is made by means of a trough compass attached to the standards of the transit theodolite used on the Dominion Land surveys. The needle is made as light as possible in order to reduce friction on the pivot to a minimum. The graduation of the end blocks consists of a single fine line and readings are made on both ends of the needle. The range of readings of a first-class needle, well balanced, and in the hands of a competent observer, can be expected not to exceed two minutes. The original method of attaching the compass to the standards consisted of a hook at one end and a thumb-screw at the other, but as this was not always found to be satisfactory, the hook was discarded, and the compass attached by thumb-screws at both ends.

Method of Observing.

The method adopted for the determination of the magnetic meridian is given in Appendix C of the Manual of Instructions for the Survey of Dominion Lands. The observer is instructed to proceed as follows and to note the following remarks:—

1. Place the instrument on a section line and after adjustment set the vernier to read the astronomical bearing of the line.

2. Release the lower clamp, direct the telescope on the line and fasten the lower clamp.

3. Release the vernier clamp and turn the vernier plate until the north end of the magnetic needle, observed with a magnifying glass, is seen exactly opposite the zero mark. Tap the trough lightly with the pencil or hit the milled parts of the foot screws with the finger nail to be sure that the needle has taken the position of rest. Note the reading of the horizontal circle. Take several readings by repeating the operation.

4. Repeat operation No. 3 for the south end of the needle.

5. Enter in the notes the place of observation, date, hour of the day, weather and other remarks, if any. It is important to record auroras occurring within 24 hours of the time of observation.

The observations should be taken only when the needle is nearly stationary, say in the afternoon after 5 P.M., if possible.

In taking the needle out of the trough, whether to rebalance it or to clean the agate, care should be taken to see that it is put back in its proper position. If replaced in the reverse position the index correction would be altered. For this reason, to safeguard against error, the position of the compass whether 'compass west' or 'compass east,' should be entered in the remarks after each observation when observing.

The returns should also state whether the observations are recorded in the mean time of the place or standard time.

The direction of the magnetic needle is subject to a daily fluctuation called the diurnal variation. During the greater part of the night the direction is not far from normal. In the early morning the north end of the needle in Canada moves towards the east, reaching its maximum deflection about 7 or 8 A.M. The motion is then reversed, the north end travelling westward, and crossing the normal direction about 10 or 11 A.M. The extreme western position is reached in the afternoon and then the needle comes back to its normal position at some time after 5 or 6 P.M. This march is subject to wide variations during magnetic storms. The magnitude of the diurnal variation is not constant. Observations at both eastern and western elongations of the needle on the same day, that is between 7 and 8 A.M. and between 1 and 2 P.M., give the best results and it is desirable that when convenient they may be taken then. This gives not only the best value for the declination, but also the diurnal variation, which it is very useful to know. Failing this, however, the best time to observe is after 5 P.M. when the needle is about in its normal position. It is true that the normal position in crossed generally between 10 and 11 A.M. but the motion being very rapid and the time of crossing uncertain, the afternoon observation is preferable.

The place of observation must be at least three or four hundred yards away from wires carrying direct electric current. There must be no iron near the instrument.

The observer must make sure that he has no iron or nickel on his person. If any magnetic object is not brought closer to the needle than fifteen or twenty times the distance at which an appreciable deflection is first produced, the effect on the needle is negligible in observations of this kind. Avoid transportation of the instrument on electric cars as there are instances of the polarity of the needle being reversed in such an intense magnetic field.

If the needle is sluggish the observation cannot be accurate. The sluggishness is generally due to a dull pivot or a scratched cap. To keep both in proper condition the needle must always be lowered gently on its pivot and never be allowed to play except when actually in use.

Instrumental constant.

Through the courtesy of the Director of the Meteorological Service at Toronto, the index correction of every instrument used for observing was determined both at the beginning and at the close of the survey season, whenever possible. If a serious discrepancy was found between the two determinations, it was investigated and the observations taken with the instrument rejected unless the cause of the discrepancy could be satisfactorily explained.

Reduction of observations.

In order to give a character of homogeneity to the declination observations, a reduction to a common epoch had to be applied to the observed data. To accomplish this a knowledge of the diurnal and secular variation is necessary. Again as the diurnal variation is subject to extreme fluctuations magnetic storms must be detected. The only method at our disposal for reduction was making use of the daily records of the declinometer at Agincourt, but the observatory being far away from where our observations had been taken, it was thought advisable to compare by actual experiments the fluctuations of the compass in western Canada and those at Agincourt. An observer was instructed to observe the magnetic declination at Rosthern, Sask., during the whole of November, 1910. Rosthern was occupied on account of being advantageously situated as a base station. The observations were taken from 7 A.M. to 4 P.M. at periods ranging from half an hour to one hour, care being taken to observe the needle at its two elongations. The work was carried out in a small silk tent in order to shelter the instrument from the influence of the wind and storms. A comparison of the results of these observations with a diurnal variation observation taken at Jasmin, Sask., on July 10, 1910, disclosed a diurnal range of the compass in July almost double of that at Rosthern in November.

Later, in the office, copies of the photographic traces of the declinometer at Agincourt were made for the days on which diurnal variation observations had been taken in the western provinces. On these copies were plotted the diurnal variation observations taken in the West so as to correspond in mean local time to the traces of the declinometer, and the points were joined by straight lines. From this investigation useful information was derived for the reduction of our magnetic declinations. According to our expectations mostly all magnetic disturbances shown on the traces of the declinometer were recorded on the diurnal variation curve and both occurred at practically the same instant.

Tables I and II show the comparison of results which has led us to adopt the use of the magnetic records of Agincourt for the reduction of our declination observations. It shows that this method of reduction is well worth the trouble, the precision of the resulting declination being apparently increased about two and one half times. It is felt, however, that this is not much more than a 'make shift' a case of 'doing the best you can with what you have,' and that what we require for proper reductions are the records of an observatory in the Northwest.

In applying reductions the observations have been reduced to the mean of the month of the year in which they were taken. To reduce an observation to the mean of the month, the following procedure was adopted: a tabulation of the mean monthly declinations of each year was obtained from the magnetic observatory at Agincourt. The declination, for the corresponding date and mean local time at which the observation to be reduced was taken, was scaled from the trace of the declinometer at Agincourt. If the trace showed the declination then fairly steady the difference between the mean declination of the month and the actual declination scaled from the trace was applied as a correction to the observation.

To reduce an observation to January of the same year, the difference between the mean declination of the month in which the observation was taken and the mean declination of January was applied to the observation reduced to the mean of the month.

In the absence of any definite knowledge of the secular variation a plus correction of three minutes per year, which agrees closely with the mean secular variation of the corresponding western portion of the United States as shown on the isogonic map of the United States Coast and Geodetic Survey published in 1905, was adopted for the reduction of our declination observations to January 1st, 1912 (1912.0). From the few stations in the West which have been reoccupied this would appear to be a close approximation, and the maximum error from this general assumption cannot be large as the period for reduction covers only three years.

Compilation of Isogonic Map.

In the compilation of the isogonic map accompanying this report the reduced observations only were made use of, except in districts where no other data were available, in which case the declinations as observed were used and the curves of equal declination shown in dotted lines. The observations used for the compilation of this map are appended in Table 4. The observations are arranged in the order of township and range, and the date of each observation is given to the nearest tenth of the year. Column six gives the actual observed declination before any reductions have been applied, and column seven gives this declination reduced to the period 1912.0.

Dip and Total Force.

During the season 1908 dip and total force observations were taken by Mr. J. E. Morrier, D.L.S., at Norway House, Oxford House, Fort Churchill and York Factory.

In 1910 similar observations were taken by Mr. C. Engler, D.L.S., during his trip from Athabaska Landing to Fort Smith and subsequently by Mr. J. A. Cote at different points between Edmonton and Calgary. Unfortunately the results of these observations were lost during a fire at Carstairs, Alberta.

During the miscellaneous surveys made by Mr. P. A. Carson, D.L.S., in 1910, about 24 stations were occupied for dip and total intensity, between Swan River, Man., and Lashburn, Sask. Every complete observation consisted of a dip, a total force and a dip, the mean dip being used in working out the total force. This complete observation was generally duplicated at every station. In some instances the same station was reoccupied during the season and the results compared with those already obtained.

The instruments used for the determination of these magnetic elements were Dover dip circles, the constants of which where determined both before and after every season's work. The total force constant was the mean of at least six observations.

The results of the observations for dip and total force are given in Table 3.

The following is a copy of the "Directions for the use of the dip circle and attachments in observing for magnetic declination, dip and total force."

Selection of Stations.

The conditions to be satisfied in choosing a magnetic station are freedom from present and probable future local disturbance, combined with convenience of access. Proximity of electric railways, masses of iron or steel, gas or water pipes, buildings of stone or brick, should be avoided. A quarter of a mile from the first, 500 feet from the second, 200 feet from the third and fourth may be considered safe distances. The station should be at least 50 feet from any kind of building. If any doubt arises in the selection of a station on account of the possible existence of local disturbances, two intervisible points a hundred yards or more apart should be selected and the magnetic bearing of the line joining them observed at both. A lack of agreement between the two results is evidence of local disturbance.

When taking the observations, the instrument box, especially the bar magnets, should be 40 or 50 feet away for the declination observation and 25 or 30 feet for the dip and total force observations. All knives, &c., should be removed from the person. It should be noted also that iron is frequently present in buttons, hats, neckties, etc.

Care and Adjustment of Instrument.

Care should be taken to keep the instrument in good adjustment, clean and free from dust. A camel hair brush, pith, chamois and tissue paper are supplied for that purpose and will be found in the box.

The dipping needles should be carefully guarded against moisture, and after use should always be wiped dry with chamois or tissue paper. They should be put back in the box with poles of opposite polarity at the same end and should be magnetised afresh for each station.

The bar magnets should be touched with the hands as little as possible and should always be wiped with chamois or tissue paper after the observation to prevent rusting. They should not be allowed to touch each other except at their opposite poles and, when placed in the box, the ends of opposite polarity should be connected by a soft iron armature.

The instrument is levelled in the ordinary way with the plate level.

Magnetic Declination.

1. The trough compass supplied should be attached to the upper horizontal plate by means of the two thumb-screws and the telescope to the vernier arms of the vertical circle. The observation for magnetic declination is then taken and recorded in accordance with the instructions given for magnetic declination observations with the D.L.S. pattern transit.

2. The magnetic meridian may also be determined by means of the dipping needle. Set the vertical circle verniers to read 90° and revolve the instrument in azimuth until the needle is bisected by the microscopes and read the horizontal circle. As the dipping needle points vertically when in the magnetic prime vertical, in this way the magnetic prime vertical is found and by applying 90° the magnetic meridian.

The magnetic meridian found in this manner is sufficiently accurate, however, only for the dip and total force observations. Method No. 1 is preferable and should always be adopted when possible.

Magnetic Dip.

The needles for the dip observations are carried on the lid of the instrument box. Taking out one of these needles carefully wipe with tissue paper and clean the pivots with pith and having also carefully cleaned the agate planes in the box with pith, place the needle on the brass v's with the face of the needle to the face of the instrument. (The face of the needle is that side which is lettered, the face of the instrument that side which is graduated.) Turn the instrument in azimuth until it lies in the magnetic meridian (previously determined in the declination observation) and with its face to the east, and lower the needle gently on the agate planes. It will now swing in the approximate position of the dip. When it settles it ought to be slightly raised and lowered once or twice by means of the screw, so as to ensure its being exactly in the centre of the instrument. The vernier arm of the vertical circle is now turned until the north, that is the lower end, is seen to be bisected by the crosshair of the microscope: the lower vernier is then read. Similarly, the upper end is bisected by the upper microscope and the upper vernier read; the needle is then slightly disturbed by the screw and the readings repeated until there are three readings for each end. The instrument is now turned 180° in azimuth so that the face of the instrument is now west and the same number of readings taken for this position. The needle is then taken out of the glass box and reversed end for end of its axis, so that it faces the other way. The six readings are again taken as before for both ends of the needle.

The needle is then taken out of the box, and its polarity reversed in the following manner. Put the needle on the reversing block, face up and secure by the brass centre piece which is intended to protect the axis. Place the reversing block so that the north end of the needle will be on the right hand and the south end on the left. Now take the bar magnets one in each hand, the north pole of the magnet in the right hand lowermost and south pole of the magnet in the left hand, and bring the opposite poles of the two magnets down on the needle, near its centre and one on each side of the brass centre piece. Draw them slowly and steadily outwards over the needle, carrying them over its ends and lifting them some inches above the level of the needle, bring them back to the middle position again and repeat. This should be done five times. Care should be taken to have the motion as nearly parallel to the axis of the needle as possible; the ledge on each side of the reversing block is intended to act as a guide for the magnets to ensure this. The needle is then put face down in the reversing block and the operation repeated in the same way. The polarity of the needle will then be completely reversed.

The observations taken before reversal are now repeated. The mean of the observed inclinations in the eight positions is the dip.

It will be noticed that the mean resulting dip will, by the *reversal* of the *dip circle*, be free from any small error in the verticality of vertical axis and also eliminate index error of vertical circle; that the *reversal* of the face of the needle on the agates will eliminate the error caused by any want of perpendicularity of the axis of the needle to the needle; that the *reversal* of the *polarity* will correct for any want of balance of the two ends of the needle.

Total Force.

The total intensity may be determined with a dip circle by Lloyd's method when suitable standardization observations have been made at a station where the dip and intensity are known. This method involves first the determination of the angle of dip with a loaded needle, and second, a determination of the angle through which another needle is deflected by the loaded needle when the latter is placed at right angles to it in the place provided between the reading microscopes and protected by the brass shield. As the determination of total intensity by this method is relative, it is necessary to guard, as far as possible, against any change in the magnetism of the two needles and to use the same weight in the field as during the standardization observations. Their polarities *must never be reversed,* therefore, and they must not be allowed in close proximity to the bar magnets when these are being used to reverse the polarity of the regular dip needles. They are found in the copper box at the bottom of the instrument box. The needle which is weighted with the small wire is the loaded needle and is called the 'statical needle'; the other is called the 'dipping needle.' *Neither of these needles must ever be touched with the bar magnets.* Turn the instrument into the magnetic meridian with its face to the east. Revolve the vertical verniers until the tangent screw points to the north. By means of the small brass clips, attach the statical needle to the vernier plate with its face to the east and its north end next to the tangent screw and put the brass protecting shield in position over it. Place the dipping needle in the usual way on the agate planes, now, moving the vernier arms, read the inclination of the swinging needle as before, both north and south ends, then reverse the vertical vernier plate so that the tangent screw is south of the centre and read the inclination again. It should be noted here that the vertical circle is graduated into quadrants from 0 to 90 degrees, and that these inclinations should always be read from the nearest zero, so that if in the former part of the observation, the north end of the dipping needle should be deflected by the statical needle past the vertical line, the reading to be entered is 180 degrees less the actual vernier reading, and, if in the latter part of the observation, the north end of the dipping needle be deflected above the horizontal, the vernier must be entered with a minus sign. The algebraic difference of the two readings is twice the deflection.

The dipping needle is now put away. The statical needle is taken off the vernier plate and placed on the agates, its inclination is now read in four positions in the same way as in an observation for dip, that is, instrument face east, needle face east. Instrument west, needle west. Instrument west, needle east. Instrument east, needle west.

Frequency and Time of Observations.

The observations should be taken at least twice at each station whenever possible. Should the two observations not agree within 5 or 6 minutes a third observation should be taken. The most desirable time of day to observe is about the time of eastern and western extremes of declination, say at 8 A.M. and 1 P.M., and it is suggested that when convenient these times be adopted.

Suitable forms for the observations are provided. The constant "A" used in the form is a constant for the two total force needles. That and the index correction to the compass have to be determined at the magnetic observatory at Agincourt.

TABLE No. 1.

COMPARISON of the Daily Declination Observations taken by D. E. Chartrand at Rosthern in November, 1910, with Agincourt Magnetic Observatory Record.

AGINCOURT ROSTHERN.

Time	Nov. 1.	Nov. 2.	Nov. 3.	Nov. 4.	Nov. 5.	Nov. 7.	Nov. 10.	Nov. 11.	Nov. 12.	Nov. 14.	Nov. 15.
7.00	30·0	27·0	26·0	29·0	31·5	27·0	39·5	31·0	32·0	30·0	28·0
7.30	27·5	24·5	27·0	32·0	31·5	28·0	37·5	29·5	30·5	30·0	31·0
8.00	26·0	28·0	27·5	24·5	31·3	26·5	29·0	30·5	30·5	30·5	33·5
8.30	28·0	27·0	26·5	25·5	30·0	29·2	29·0	30·0	30·5	35·0	30·0
9.00	27·0	30·0	29·0	30·0	31·0	33·0	25·5	33·0	31·5	34·5	29·0
9.30	....	....	....	....	....	....	....	....	....	....	....
10.00	23·0	30·0	27·0	31·0	30·0	27·5	29·0	28·5	32·0	32·5	30·5
11.00	26·5	28·0	26·0	27·5	31·0	26·0	28·5	30·0	31·0	31·5	31·0
11.30	25·5	26·0	26·5	26·5	29·2	27·5	29·5	32·0	31·0	30·5	31·0
12.00	....	....	....	....	....	....	....	....	....	....	....
12.30	26·0	26·0	26·5	30·0	30·0	28·0	30·5	31·2	30·0	30·5	31·0
1.00	26·5	26·5	30·0	31·0	29·0	28·5	32·0	31·0	27·5	32·5	31·0
1.30	26·0	26·0	28·0	29·0	30·0	28·0	34·5	30·0	27·5	32·0	30·0
2.00	26·0	27·0	29·5	30·0	29·5	27·0	....	30·0	26·5	30·0	34·0
2.30	27·0	28·5	28·0	31·8	30·5	30·5	....	30·0	32·0	30·0	28·0
3.00	26·0	29·0	28·5	31·5	30·0	29·0	....	29·0	31·0	28·0	30·0
4.00	25·0	29·0	30·5	35·0	33·0	31·0	....	31·0	30·8	31·0	31·0
4.30	25·5	30·0	30·0	32·0	35·5	34·0	....	30·5	30·5	33·0	30·0
Mean	26·31	27·66	27·91	29·96	30·81	28·79	31·32	30·45	30·30	31·34	30·56
Residuals	+3·66	+2·34	+2·59	+5·04	+4·69	+5·21	+8·18	+2·55	-1·70	+3·66	+3·41
	3·34	−3·16	−·91	−5·46	1·81	2·79	5·82	1·95	3·80	−3·34	2·56

TABLE No. 1—*Concluded.*

COMPARISON of the Daily Declination Observations taken by D. E. Chartrand at Rosthern in November, 1910, with Agincourt Magnetic Observatory Record—*Concluded.*

AGINCOURT–ROSTHERN—*Concluded.*

Time.	Nov. 16.	Nov. 17.	Nov. 21.	Nov. 22.	Nov. 23.	Nov. 24.	Nov. 25.	Nov. 26.	Nov. 27.	Nov. 30.
7.00	28·0	......	33·0	......	......	......	......	......	......	......
7.30	32·0	......	31·5	26·0	30·0	31·0	29·0	21·0	30·5	24·0
8.00	34·0	......	32·0	31·5	30·0	30·5	33·5	25·0	35·0	31·5
8.30	26·5	30·0	32·0	35·0	30·0	32·0	29·5	26·5	37·5	27·5
9.00	26·5	33·0	31·0	30·0	29·7	32·5	29·0	29·5	35·5	28·0
9.30	......	......	......	......	28·0	32·0	27·0	......	......	30·0
10.00	28·5	26·5	38·5	32·5	28·0	34·0	27·5	28·0	32·5	30·0
11.00	28·5	32·0	35·0	37·0	29·0	34·5	32·5	31·5	30·5	33·5
11.30	29·0	30·0	32·0	35·0	29·0	32·5	34·0	31·5	......	29·0
12.00	......	......	......	......	......	......	......	......	......	......
12.30	31·0	31·5	30·0	26·0	32·5	25·0	31·5	30·0	31·5	31·5
1.00	27·5	29·0	28·5	23·0	31·0	24·0	30·5	29·5	32·0	36·5
1.30	28·5	......	30·8	30·0	28·0	25·0	34·0	29·5	......	31·5
2.00	30·0	......	31·5	36·5	29·5	33·0	34·5	28·0	35·5	31·0
2.30	37·0	......	26·5	27·0	33·5	27·5	29·0	29·5	34·0	32·0
3.00	28·5	......	29·0	30·0	33·0	28·5	30·0	29·5	31·5	29·5
4.00	33·0	......	30·5	28·0	32·0	30·5	32·0	29·5	32·5	27·5
4.30	28·0	......	31·5	28·5	28·0	......	......	......	......	......
Mean	30·22	30·29	31·46	30·40	30·07	30·17	31·10	28·46	32·81	30·20
Residuals	8·78	+2·71	7·04	6·60	-3·13	-4·33	3·40	3·04	-4·69	+6·30
	3·72	3·79	4·96	7·10	2·07	6·17	4·10	7·46	4·81	6·20

	0·03
Mean for the month	+9·47
	9·03
Mean residual	±2·29

TABLE No. 11.

COMPARISON of the Magnetic Declination at Rosthern, Sask., as obtained without any Reduction and as obtained by Reduction from Magnetic Observatory Records at Agincourt.

Time	November 1.				November 2.				November 3.				November 4.				November 5.			
	Without Reduction.		With Reduction.		Without Reduction.		With Reduction.		Without Reduction.		With Reduction.		Without Reduction.		With Reduction.		Without Reduction.		With Reduction.	
	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.
	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′
7.00	24 76.2	+04.3	24 72.7	+00.8	24 75.3	+03.4	24 74.8	+02.9	24 77.7	+05.8	24 76.2	+04.3	24 77.2	+05.3	24 73.7	+01.8	24 73.3	+01.4	24 70.8	−01.1
7.30	24 78.7	+06.8	24 75.2	+03.3	24 78.2	+06.3	24 77.7	+05.8	24 77.2	+05.3	24 74.7	+02.8	24 74.5	+02.6	24 70.5	−01.4	24 74.6	+02.7	24 70.6	−01.3
8.00	24 79.5	+07.6	24 76.0	+04.1	24 76.9	+05.0	24 73.4	+01.5	24 77.5	+05.6	24 75.0	+03.1	24 82.2	+10.3	24 77.7	+05.8	24 73.9	+02.0	24 70.4	−01.5
8.30	24 78.2	+06.3	24 74.7	+02.8	24 78.4	+06.5	24 75.4	+03.5	24 77.7	+05.8	24 75.2	+03.3	24 80.7	+08.8	24 77.2	+05.3	24 75.9	+04.0	24 72.9	+01.0
9.00	24 77.2	+05.3	24 75.2	+03.3	24 74.8	+02.9	24 72.3	00.4	24 75.6	+03.7	24 73.1	+01.2	24 75.2	+03.3	24 71.7	−00.2	24 73.4	+01.5	24 70.9	−01.0
10.00	24 77.7	+05.8	24 79.2	+07.3	24 71.5	00.4	24 72.0	+00.1	24 74.7	+02.8	24 75.2	+03.3	24 71.4	−00.5	24 71.9	00.0	24 72.8	+00.9	24 72.3	+00.4
11.00	24 72.2	+00.3	24 75.7	+03.8	24 71.9	00.0	24 74.4	+02.5	24 72.8	+00.9	24 76.3	+04.4	24 70.2	−01.7	24 74.7	+02.8	24 69.5	−02.4	24 71.0	−00.9
11.30	24 73.1	+01.2	24 77.6	+05.7	24 72.3	+00.4	24 75.8	+03.9	24 72.2	+00.3	24 75.7	+03.8	24 69.8	−02.1	24 75.8	+03.9	24 69.9	−02.0	24 72.9	+01.0
12.30	24 72.2	+00.3	24 76.7	+04.8	24 72.1	+00.2	24 76.6	+04.7	24 70.9	−01.0	24 75.4	+03.5	24 67.5	−04.4	24 72.0	+00.1	24 69.3	−02.6	24 72.3	+00.4
1.00	24 72.5	+00.6	24 76.0	+04.1	24 71.5	+00.4	24 76.0	+04.1	24 68.3	−03.6	24 72.8	+00.9	24 67.0	−04.9	24 71.0	−00.9	24 70.9	−01.0	24 73.4	+01.5
1.30	24 73.5	+01.6	24 76.5	+04.6	24 72.3	+00.4	24 76.8	+04.9	24 70.2	−01.7	24 73.7	+01.8	24 70.0	−01.9	24 73.0	+01.1	24 70.1	−01.8	24 72.1	+00.2
2.00	24 74.1	+02.2	24 76.6	+04.7	24 72.1	+00.2	24 75.1	+03.2	24 69.9	−02.0	24 72.9	+01.0	24 69.0	−02.9	24 72.0	+00.1	24 70.9	−01.0	24 72.4	+00.5
2.30	24 74.2	+02.3	24 74.7	+02.8	24 72.7	+00.3	24 74.2	+02.3	24 71.1	−00.8	24 74.1	+02.2	24 65.1	−06.8	24 68.1	−03.8	24 70.3	−01.6	24 71.3	−00.6
3.00	24 76.0	+01.1	24 75.5	+03.6	24 73.0	+01.1	24 73.5	+01.6	24 71.5	−00.4	24 74.0	+02.1	24 68.3	−03.6	24 70.8	−01.1	24 69.4	−02.5	24 70.9	−01.0
4.00	24 77.4	+05.5	24 76.9	+05.0	24 73.0	+01.1	24 72.5	+00.6	24 70.7	−01.2	24 71.2	−00.7	24 65.7	−06.2	24 68.2	−03.7	24 68.9	−03.0	24 69.4	−02.5
4.30	24 76.0	+04.1	24 75.5	+03.6	24 72.1	+00.2	24 71.6	−00.3	24 71.2	−00.7	24 71.7	−00.2	24 68.0	−03.9	24 70.5	−01.4	24 66.2	−05.7	24 66.7	−05.2

TABLE No. 11—*Continued.*

COMPARISON of the Magnetic Declination at Rosthern, Sask., as obtained without any Reduction, &c.—*Continued.*

Time.	November 7.				November 8.				November 9.				November 10.				November 11.			
	Without Reduction.		With Reduction.		Without Reduction.		With Reduction.		Without Reduction.		With Reduction.		Without Reduction.		With Reduction.		Without Reduction.		With Reduction.	
	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.
	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′
7.00	24 75.6	+03.7	24 75.1	+03.2	24 75.0	+03.1	....	......	24 72.9	+01.0	....	......	24 65.6	−06.3	24 63.1	−08.8	24 72.6	+00.7	24 70.6	−01.3
7.30	24 77.1	+05.2	24 74.1	+02.2	24 75.1	+03.5	....	......	24 75.2	+03.3	....	......	24 65.7	−06.2	24 65.2	−06.7	24 74.9	+03.0	24 72.9	+01.0
8.00	24 78.4	+06.5	24 75.9	+04.0	24 74.8	+02.9	....	......	24 76.7	−05.2	....	......	24 74.0	+02.1	24 73.5	+01.6	24 74.1	+02.2	24 71.6	−00.3
8.30	24 76.9	+05.0	24 72.9	+01.0	24 69.4	−02.5	....	......	24 76.8	−05.1	....	......	24 74.8	+02.9	24 73.3	+01.4	24 76.2	+04.3	24 72.7	+00.8
9.00	24 73.7	+01.8	24 69.2	−02.7	24 73.5	+01.6	....	......	24 74.9	+03.0	....	......	24 75.8	+03.9	24 76.3	+04.1	24 72.9	+01.0	24 69.4	−02.5
10.00	24 75.1	+03.2	24 73.6	+01.7	24 73.8	+01.9	....	......	24 76.8	+04.9	....	......	24 73.7	+01.8	24 72.7	+00.8	24 75.0	+03.1	24 73.5	+01.6
11.00	24 73.5	+01.6	24 76.0	+04.1	24 72.5	+00.6	....	......	24 71.7	−00.2	....	......	24 73.7	+01.8	24 73.2	+01.3	24 72.1	+00.2	24 71.6	−00.3
11.30	24 71.6	−00.3	24 75.1	+03.2	24 69.8	−02.1	....	......	24 73.8	+01.9	....	......	24 72.0	+00.1	24 72.5	+00.6	24 69.3	−02.6	24 69.8	−02.1
12.30	24 68.7	−03.2	24 74.2	+02.3	24 63.6	−08.3	....	......	24 66.8	−05.1	....	......	24 69.5	−02.4	24 72.0	+00.1	24 68.1	−03.8	24 71.1	−00.8
1.00	24 68.0	−03.9	24 73.5	+01.6	24 66.1	−05.8	....	......	24 65.2	−06.7	....	......	24 67.9	−04.0	24 70.4	−01.5	24 67.6	−04.3	24 72.1	+00.2
1.30	24 68.9	−03.9	24 74.0	+02.1	24 69.8	−02.1	....	......	24 67.7	−04.2	....	......	24 66.0	−05.9	24 68.5	−03.4	24 68.3	−03.6	24 72.8	+00.9
2.00	24 69.9	−02.0	24 71.4	+02.5	24 65.9	−06.0	....	......	24 64.9	−07.0	....	......	24 70.9	−01.0	....	......	24 68.3	−03.6	24 72.8	+00.9
2.30	24 69.1	−02.8	24 71.6	−00.3	24 64.6	−07.3	....	......	24 65.9	−06.0	....	......	24 69.8	−02.1	....	......	24 69.6	−02.3	24 73.1	+01.2
3.00	24 70.1	−01.8	24 72.6	+00.7	24 72.8	+00.9	....	......	24 73.0	+01.1	....	......	24 72.2	+00.3	....	......	24 71.0	−00.9	24 73.5	+01.6
4.00	24 70.4	−01.5	24 70.9	−01.0	24 66.5	−05.4	....	......	24 71.7	−00.2	....	......	24 65.7	−06.2	....	......	24 70.3	−01.6	24 70.8	−01.1
4.30	24 66.8	−05.1	24 68.3	−03.6	24 71.1	−00.8	....	......	24 69.8	−02.1	....	......	24 79.4	+07.5	....	......	24 70.4	−01.5	24 70.9	−01.0

TABLE No. II—*Continued.*

COMPARISON of the Magnetic Declination at Rosthern, Sask., as obtained without any Reduction, &c.—*Continued.*

Time.	November 12.				November 14.				November 15.				November 16.				November 17.			
	Without Reduction.		With Reduction.		Without Reduction.		With Reduction.		Without Reduction.		With Reduction.		Without Reduction.		With Reduction.		Without Reduction.		With Reduction.	
	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.
	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′
7.00	24 72.2	+00.3	24 69.7	−02.2	24 76.0	+04.1	24 72.5	+00.6	24 74.9	+03.0	24 72.4	+00.5	24 74.6	+02.7	24 73.6	+01.7	24 69.8	−02.1	....	......
7.30	24 73.6	+01.7	24 71.1	−00.8	24 75.4	+03.5	24 71.9	00.0	24 73.8	+01.9	24 71.3	−00.6	24 64.0	−07.9	24 63.0	−08.9	24 72.8	+00.9	....	......
8.00	24 73.7	+01.8	24 71.2	−00.7	24 75.1	+03.2	24 71.6	−00.3	24 72.5	+00.6	24 69.0	−02.9	24 69.1	−02.8	24 68.1	−03.8	24 68.3	−03.6	....	......
8.30	24 74.2	+02.3	24 70.7	−01.2	24 71.5	−00.4	24 68.0	−03.9	24 74.7	+02.8	24 72.2	+00.3	24 75.8	+03.9	24 75.3	+03.4	24 67.5	−04.4	24 72.5	+00.6
9.00	24 73.9	+02.0	24 70.9	−01.0	24 72.0	+00.3	24 68.5	−03.4	24 74.5	+02.6	24 73.0	+01.1	24 74.7	+02.8	24 75.2	+03.3	24 68.4	−03.5	24 69.9	−02.0
10.00	24 72.9	+01.0	24 70.4	−01.5	24 72.6	+00.7	24 70.1	−01.8	24 71.5	−00.4	24 71.0	−00.9	24 75.8	+03.9	24 74.3	+02.4	24 73.0	+01.4	24 75.5	+03.6
11.00	24 70.3	−01.6	24 71.3	−00.6	24 67.8	−04.1	24 70.8	−01.1	24 69.7	−02.2	24 71.7	−00.2	24 73.1	+01.2	24 73.6	+01.7	24 70.3	−01.6	24 69.8	−02.1
11.30	24 68.7	−03.2	24 71.2	−00.7	24 69.1	−02.8	24 71.6	−00.3	24 68.5	−03.4	24 71.0	−00.9	24 72.4	+00.5	24 73.9	+02.0	24 69.9	−02.0	24 71.9	00.0
12.30	24 68.3	−03.6	24 71.8	−00.1	24 66.7	−05.2	24 71.2	−00.7	24 67.1	−04.8	24 71.6	−00.3	24 67.8	−04.1	24 71.3	−00.6	24 67.0	−04.9	24 70.5	−01.4
1.00	24 69.2	−02.7	24 74.7	+02.8	24 66.0	−05.9	24 70.0	−01.9	24 66.0	−05.9	24 71.5	−00.4	24 71.3	−00.6	24 71.8	+02.9	24 68.7	−03.2	24 72.7	+00.8
1.30	24 69.2	−02.7	24 74.7	+02.8	24 66.3	−05.6	24 69.8	−02.1	24 67.1	−04.8	24 72.1	+00.2	24 70.4	−01.5	24 73.4	+01.5	24 68.9	−03.0	24 71.9	00.0
2.00	24 70.8	−01.1	24 75.3	+03.1	24 68.9	−03.0	24 72.4	+00.5	24 64.3	−07.6	24 68.8	−03.1	24 70.1	−01.8	24 72.6	+00.7	24 68.7	−03.2	24 75.7	+03.8
2.30	24 67.1	−04.8	24 70.6	−01.3	24 69.4	−02.5	24 72.9	+01.0	24 70.2	−01.7	24 74.2	+02.3	24 62.5	−09.4	24 65.0	−06.9	24 72.2	+00.3	24 69.6	−02.3
3.00	24 68.4	−03.5	24 70.9	−01.0	24 70.6	−01.3	24 74.1	+02.2	24 69.0	−02.9	24 72.0	+00.1	24 72.0	+00.1	24 74.0	+02.1	24 66.6	−05.3	24 72.3	+00.4
4.00	24 69.3	−02.6	24 71.3	−00.6	24 70.0	−01.9	24 70.5	−01.4	24 69.1	−02.8	24 71.1	−00.8	24 68.3	−03.6	24 69.8	−02.1	24 69.8	−02.1	24 63.2	−08.7
4.30	24 69.7	−02.2	24 71.2	−00.7	24 68.9	−03.0	24 69.4	−02.5	24 70.9	−01.0	24 72.4	+00.5	24 72.1	+00.2	24 74.6	+02.7	24 67.7	−04.2	....	... .

TABLE No. II—*Continued.*

COMPARISON of the Magnetic Declination at Rosthern, Sask., as obtained without any Reduction, &c.—*Continued.*

Time.	November 18.				November 19.				November 21.				November 22.				November 23.			
	Without Reduction.		With Reduction.		Without Reduction.		With Reduction.		Without Reduction.		With Reduction.		Without Reduction.		With Reduction.		Without Reduction.		With Reduction.	
	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.
	° '	'	° '	'	° '	'	° '	'	° '	'	° '	'	° '	'	° '	'	° '	'	° '	'
7.00	24 55.7	−16.2	......	......	24 57.2	−14.7	......	......	24 71.4	−00.5	24 69.9	−02.0	......	......	......	......	......	......	......	......
7.30	24 69.2	−02.7	......	......	24 59.5	−12.4	......	......	24 72.5	+00.6	24 71.0	−00.9	24 72.5	+00.6	24 77.0	+05.1	24 75.3	+03.1	24 72.8	+00.9
8.00	24 66.2	−05.7	......	......	24 57.1	−14.8	......	......	24 72.2	+00.3	24 69.7	−02.2	24 72.2	+00.3	24 70.7	−01.2	24 75.1	+03.2	24 72.6	+00.7
8.30	24 55.1	−16.8	......	......	24 52.9	−19.0	......	......	24 73.0	+01.1	24 69.5	−02.4	24 72.0	+00.1	24 67.5	−04.4	24 75.1	+03.2	24 72.6	+00.7
9.00	24 59.2	−12.7	......	......	24 58.3	−13.6	......	......	24 73.7	+01.8	24 71.2	−00.7	24 74.2	+02.3	24 72.7	+00.8	24 75.3	+03.4	24 72.8	+00.9
9.30	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	24 75.5	+03.6	24 74.0	+02.1
10.00	24 64.7	−07.2	......	......	24 70.5	−01.4	......	......	24 66.5	−05.4	24 64.0	−07.9	24 70.3	−01.6	24 69.8	−02.1	24 74.6	+02.7	24 74.1	+02.2
11.00	24 64.4	−07.5	......	......	24 52.3	−19.6	......	......	24 67.7	−04.2	24 67.2	−04.7	24 64.4	−07.5	24 64.9	−07.0	24 71.8	−00.1	24 73.3	+01.4
11.30	24 59.2	−12.7	......	......	24 49.0	−22.9	......	......	24 68.3	−03.6	24 69.8	−02.1	24 63.2	−08.7	24 66.7	−05.2	24 69.6	−02.3	24 73.6	+01.7
12.30	24 58.9	−13.0	......	......	24 56.2	−15.7	......	......	24 69.1	−02.8	24 72.6	+00.7	24 68.9	−03.0	24 76.4	+04.5	24 64.5	−07.4	24 70.0	−01.9
1.00	24 63.0	−08.9	......	......	24 58.6	−13.3	......	......	24 69.9	−02.0	24 73.4	+01.5	24 70.8	−01.1	24 78.8	+06.9	24 66.2	−05.7	24 71.7	−00.2
1.30	24 66.2	−05.7	......	......	24 59.2	−12.7	......	......	24 68.2	−03.7	24 71.7	−00.2	24 66.2	−05.7	24 71.7	−00.2	24 69.1	−02.8	24 74.6	+02.7
2.00	24 65.8	−06.1	......	......	24 62.0	−09.9	......	......	24 67.5	−04.4	24 71.0	−00.9	24 61.0	−10.9	24 65.5	−06.4	24 67.9	−04.0	24 72.9	+01.0
2.30	24 76.3	+04.4	......	......	24 64.1	−07.8	......	......	24 72.0	+00.1	24 75.5	+03.6	24 70.8	−01.1	24 74.8	+02.9	24 64.3	−07.6	24 68.8	−03.1
3.00	24 68.2	−03.7	......	......	24 65.2	−06.7	......	......	24 70.6	−01.3	24 73.1	+01.2	24 69.3	−02.6	24 72.3	+00.4	24 65.8	−06.1	24 69.3	−02.6
4.00	24 67.9	−04.0	......	......	24 68.6	−03.3	......	......	24 70.0	−01.9	24 71.5	−00.4	24 71.6	−00.3	24 75.1	+03.2	24 67.7	−04.2	24 70.2	−01.7
4.30	24 67.2	−04.7	......	......	24 69.9	−02.0	......	......	24 70.4	−01.5	24 70.9	−01.0	24 71.7	−00.7	24 73.7	+01.8	24 70.9	−01.0	24 74.4	+02.5

TABLE No. II—*Continued.*

COMPARISON of the Magnetic Declination at Rosthern, Sask., as obtained without any Reduction, &c.—*Continued.*

Time.	November 24.				November 25.				November 26.				November 27.				November 28.			
	Without Reduction.		With Reduction.		Without Reduction.		With Reduction.		Without Reduction.		With Reduction.		Without Reduction.		With Reduction.		Without Reduction.		With Reduction.	
	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.
	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′	′	° ′		° ′	′	° ′	′	° ′	′
7.30	24 74.4	+02.5	24 71.4	−00.5	24 75.[illegible]	+03.4	24 73.3	+01.4	24 77.8	+05.9	24 80.8	+08.9	24 72.9	+01.0	24 71.9	00.0	24 71.8	−00.1		
8.00	24 74.6	+02.7	24 72.1	+00.2	24 72.[illegible]	+00.2	24 68.6	−03.3	24 77.5	+05.6	24 77.0	+05.1	24 68.0	−03.9	24 67.5	−04.4	24 72.1	+00.2		
8.30	24 73.7	+01.8	24 70.2	−01.7	24 75.9	+04.0	24 73.4	+01.5	24 76.5	+04.6	24 75.0	+03.1	24 67.3	−04.6	24 64.8	−07.1	24 56.5	−15.4		
9.00	24 73.5	+01.6	24 70.0	−01.9	24 75.8	+03.9	24 73.8	+01.9	24 76.4	+04.5	24 72.9	+01.0	24 68.1	−03.8	24 65.6	−06.3	24 68.5	−03.4		
9.30	24 72.2	+00.3	24 69.7	−02.2	24 77.0	+05.1	24 75.5	+03.6	...	...	...	...	...	...	...	...	...	...		
10.00	24 69.6	−02.3	24 68.1	−03.8	24 73.5	+01.6	24 75.0	+03.1	24 74.7	+02.8	24 73.2	+01.3	24 69.1	−02.8	24 69.6	−02.3	24 66.3	−05.6		
11.00	24 64.8	−07.1	24 67.8	−04.1	24 67.8	−04.1	24 69.8	−02.1	24 70.0	−01.9	24 71.5	−00.4	24 67.2	−04.7	24 71.7	−00.2	24 58.8	−13.1		
11.30	24 65.2	−06.7	24 70.2	−01.7	24 65.5	−06.4	24 69.0	−02.9	...	...	...	...	...	...	...	...	24 64.8	−07.1		
12.30	24 69.2	−02.7	24 76.7	+01.8	24 65.5	−06.4	24 69.0	−02.9	24 68.6	−03.3	24 72.1	+00.2	24 66.9	−05.0	24 70.4	−01.5	24 67.9	−04.0		
1.00	24 70.2	−01.7	24 77.7	+05.8	24 67.9	−04.0	24 71.9	00.0	24 69.5	−02.4	24 73.0	+01.1	24 67.4	−04.5	24 70.9	−01.0	24 69.2	−02.7		
1.30	24 68.8	−03.1	24 76.3	+04.4	24 64.0	−07.9	24 68.5	−03.4	...	...	...	...	...	...	...	...	24 67.3	−04.6		
2.00	24 63.2	−08.7	24 69.2	−02.7	24 63.1	−08.8	24 67.6	−04.3	24 70.2	−01.7	24 74.2	+02.3	24 66.4	−05.5	24 66.9	−05.0	24 58.1	−13.8		
2.30	24 69.3	−02.6	24 74.8	+02.9	24 69.9	−02.0	24 73.4	+01.5	24 69.7	−02.2	24 73.2	+01.3	24 68.4	−03.5	24 67.9	−04.0	24 64.6	−07.3		
3.00	24 70.6	−01.3	24 74.1	+02.2	24 67.5	−04.4	24 72.0	+00.1	24 70.7	−01.2	24 73.2	+01.3	24 68.7	−03.2	24 71.2	−00.7	24 65.0	−06.9		
4.00	24 69.7	−02.2	24 71.7	−00.2	24 66.2	−05.7	24 70.2	−01.7	24 71.1	−00.8	24 73.1	+01.2	24 67.8	−04.1	24 70.3	−01.6	24 63.2	−08.7		

TABLE No. 11—*Concluded.*

COMPARISON of the Magnetic Declination at Rosthern, Sask., as obtained without any Reduction, &c.—*Concluded*

Time.	November 29.				November 30.			
	Without Reduction.		With Reduction.		Without Reduction.		With Reduction.	
	Decl.	v.	Decl.	v.	Decl.	v.	Decl.	v.
	° ′	′	° ′	′	° ′	′	° ′	′
7.30	24 74.5	+02.6	…	…	24 77.9	+06.0	24 77.4	+05.5
8.00	24 57.5	−14.4	…	…	24 72.6	+00.7	24 70.6	−01.3
8.30	24 51.4	−20.5	…	…	24 77.4	+05.5	24 74.9	+03.0
9.00	24 58.2	−13.7	…	…	24 75.9	+04.0	24 73.4	+01.5
9.30	24 58.1	−13.8	…	…	24 74.4	+02.5	24 72.4	+00.5
10.00	24 60.7	−11.2	…	…	24 73.0	+01.1	24 71.5	−00.4
11.00	24 59.9	−12.0	…	…	24 68.5	−03.4	24 68.0	−03.9
11.30	24 58.0	−13.9	…	…	24 70.8	−01.1	24 72.8	+00.9
12.30	24 67.1	−04.8	…	…	24 67.5	−04.4	24 71.0	−00.9
1.00	24 68.9	−03.0	…	…	24 63.0	−08.9	24 65.5	−06.4
1.30	24 76.1	+04.2	…	…	24 66.1	−05.8	24 70.6	−01.3
2.00	24 68.0	−03.9	…	…	24 66.1	−05.8	24 70.6	−01.3
2.30	24 65.1	−06.8	…	…	24 66.0	−05.9	24 71.5	−00.4
3.00	24 62.0	−09.9	…	…	24 67.5	−04.4	24 73.5	+01.6
4.00	24 62.4	−09.5	…	…	…	…	…	…

Mean Declination for November .... 24° 71′ 9

	Without Reduction.	With Reduction.
Maximum Residual	22′ 9	8′ 9
Mean Residual	....	2′ 2

TABLE No. 3.

Place.	Tp.	Rge.	Mer.	Date.	Time.	Dip. ° ′	Time.	Total Intensity.	Observer.
40·00 W. 10·00 S.—N.E. cor. sec. 18	40	22	3	14 10 10	9.03 A	77 26·8	9 30 A	9·79763	D. E. Chartrand.
" "	40	22	3	14 10 10	9.58 A	77 26·3	10 25 A	9·79777	"
10·00 S. 15·00 E.—¼ p. W. by 31	37	24	3	23 10 10	1.57 P	77 15·2	2 27 P	9·79601	"
" "	37	21	3	23 10 10	2 51 P	77 13·9	3 19 P	9·79632	"
5·00 S.—½ p. E. by sec. 9.	21	4	2	15–6 10	3.30 P	77 42·8	4 10 P	9·80050	"
" "	21	4	2	15 6-10	4 45 P	77 39·7	5 25 P	9·80047	"
" "	21	4	2	15 6–10	5 57 P	77 41·5	......	......	"
" "	21	4	2	19 6 10	8 47 A	77 43·5	9 30 A	9·80055	"
" "	21	4	2	19– 6 10	10 07 A	77 43·0	10 40 A	9·80052	"
" "	21	4	2	19 6 10	11 15 A	77 43·6	......	......	"
30·00 W. 10·00 S.—N.E. cor. sec. 3	35	1	3	31 7-10	9 18 A	77 34·5	9 51 A	9·80269	"
20·00 S. 3·00 E.- " 12	34	3	3	3 8 10	1 45 P	77 38·9	2 27 P	9·80184	"
" "	34	3	3	3 8 10	3 07 P	77 39·8	3 35 P	9·80181	"
22·00 N. 35·00 W.—S.E. cor. sec. 9	33	4	3	10 8 10	2 21 P	77 19·7	3 09 P	9·80057	"
15·00 N. 14·00 W.—N.E. " 36	38	5	3	12 8 10	2.21 P	77 52·1	2 56 P	9·79928	"
" " 36	38	5	3	12 8-10	3.34 P	77 53·2	4 09 P	9·79937	"
At N.E. cor. sec. 29	22	6	2	9 6 10	2 16 P	77 48·8	3 39 P	9·79976	"
" "	22	6	2	9 6 10	4.24 P	77 48·5	4.54 P	9·80018	"
" "	22	6	2	9 6 10	5.21 P	77 50·3	......	......	"
" "	22	6	2	12 6 10	9 49 A	77 49·9	10 36 A	9·80005	"
" "	22	6	2	12 6–10	11 16 A	77 50·5	11.54 A	9·80049	"
" "	22	6	2	12– 6 10	12 24 P	77 50·7	......	......	"
22·00 N. 35·00 W.—S.E. cor. sec. 9	33	4	3	9 10 10	9 39 A	77 21·6	10 06 A	9·80005	"
" "	33	4	3	9–10 10	10.39 A	77 22·3	11 09 A	9·80006	"
5·00 N. 25·00 W.—N.E. cor. sec. 22	32	16	2	17 7 10	9 25 A	78 15·6	10.00 A	9·80178	"
" "	32	16	2	17 7–10	10 28 A	78 16·1	10 58 A	9·80098	"
" "	32	16	2	17 7 10	11.30 A	78 15·8	......	......	"
10·00 W.—Centre sec. 36	32	20	2	27 7 10	7 13 P	78 03·4	7 43 P	9·80143	"
30·00 W.—N.E. cor. sec. 3	35	1	3	30 7–10	4.36 P	77 35·7	5 01 P	9·80312	"
" "	35	1	3	30– 7 10	5 31 P	77 33·0	5 58 P	9·80337	"
" "	35	1	3	30 7 10	6 36 P	77 33·4	......	......	"
At N.E. cor. sec. 8	26	12	2	6 7–10	2.15 P	77 53·1	2 47 P	9·80046	"
" "	26	12	2	6– 7 10	3.20 P	77 53·7	4.00 P	9·80029	"
" "	26	12	2	6– 7–10	4.30 P	77 54·3	......	......	"
3·00 E. of N.E. cor. sec. 22	33	22	2	16– 7 10	1.30 P	78 01·0	2.02 P	9·80131	"
" "	33	22	2	16– 7–10	2 30 P	78 02·6	2.55 P	9·80082	"
" "	33	22	2	16 7-10	3.25 P	78 02·1	......	......	"
20·00 N.—N.E. cor. sec. 17	36	27	Pr.	31– 5-10	3.05 P	79 05·2	3 52 P	9·80566	"
" "	36	27	Pr.	31– 5–10	4.47 P	79 04·7	......	......	"
" "	36	27	Pr.	1– 6 10	9.25 A	79 10·8	10.17 A	9·80531	"

" "	36	27	Pr.	1-6-10	11 00 A	79	10·3	...	...	"
" "	36	27	Pr.	3-6-10	1 05 P	79	05·9	1.42 P	9·80560	"
" "	36	27	Pr.	3-6-10	2 25 P	79	05·9	2.57 P	9·80564	"
" "	36	27	Pr.	3-6-10	3 32 P	79	06 1	...	...	"
5·00 N. 15 00 E.—¼ E. by 29	45	21	2	1-9-10	9 20 A	79	01 1	10 00 A	9·79947	"
" "	45	21	2	1-9-10	10.35 A	79	04·3	11.10 A	9·79929	"
20·00 S.—S.E. cor. sec. 5	49	26	2	3-9-10	1 57 P	79	13·5	2 32 P	9·80196	"
" "	49	26	2	3-9-10	3 00 P	79	12 9	3.30 P	9·80237	"
At ¼ post W. by sec. 30	43	16	3	12-9-10	11 21 A	77	42·3	12 00 M	9·79765	"
At ¼ post W. by sec. 30	43	16	3	12-9-10	12.32 P	77	42 3	1 12 P	9·79763	D. E. Chartrand.
20·00 S. 20 00 E.—N.W. cor. sec. 7	45	18	2	6-10-10	9 19 A	79	03 2	10 22 A	9·80052	"
" "	45	18	2	6-10-10	10 54 A	79	03·0	11 27 A	9·80075	"
15·00 W.—N.E. cor. sec. 18	48	25	3	25-9-10	9 36 A	78	18 5	10·11 A	9·79757	"
" "	48	25	3	25-9-10	10 48 A	78	20 2	11 26 A	9·79756	"
10 00 S. 10 00 E.—¼ P.W. by 6	39	2	3	29-9-10	8 10 A	78	15·2	8 40 A	9·80204	"
" "	39	2	3	29-9-10	9 12 A	78	14 8	9.52 A	9·80303	"
20 00 S.—S.E. cor. sec. 5	49	26	2	1-10-10	10 07 A	79	13·3	10 39 A	9·80241	"
" "	49	26	2	1-10-10	11 09 A	79	15·3	11 37 A	9·80205	"
10 00 S. 5 00 E.—N.E. cor. 19	37	22	2	18-8-10	8 45 A	78	28 7	9.20 A	9·80135	"
" "	37	22	2	18-8-10	9 52 A	78	29 6	10 25 A	9·80138	"
30 00 S. 5 00 E. N.E. cor. 31	42	3	3	23-8-10	8 25 A	78	14 6	9.02 A	9·80410	"
" "	42	3	3	23-8-10	9.47 A	78	15 3	10.27 A	9·80391	"
At N.E. cor. sec. 12	49	4	3	27-8-10	9.44 A	78	45·1	10 24 A	9·79879	"
" "	49	4	3	27-8-10	10.59 A	78	45 4	11 31 A	9·79909	"
Churchill East Peninsula—Lat. 58° 47′ 31″, long. 94° 10′ 00″	...	...	...	23-8-08	11.48 A	84	38 0	12 44 P	9·80441	J. E. Morrier.
	...	...	...	23-8-08	3 11 P	84	36·8	11 32 A	...	"
" " "	...	...	...	30-8-08	11 32 A	84	41 3	12 34 P	9·80323	"
" " "	...	...	...	30-8-08	3 48 P	84	34 1	4 27 P	9·80341	"
Churchill West Peninsula—Lat. 58° 46′ 47″, long. 94° 11′ 00″	...	...	...	22-9-08	10.55 A	84	33 5	11 55 A	9·80623	"
" " "	...	...	...	22-9-08	2 05 P	84	35 1	2 50 P	9·80401	"
" " "	...	...	...	1-11-08	11 20 A	84	35 4	12 17 P	9·80609	"
" " "	...	...	...	1-11-08	1 00 P	84	36 9	1 36 P	9·80531	"
H. B. Post, Norway House—Lat. 53° 58′ 00″, long. 97° 52′ 00″	...	...	...	18-6-08	10 14 A	80	58 9	12 01 P	9·80534	"
	...	...	...	18-6-08	1 35 P	80	58 2	2 28 P	9·80461	"
H. B. Post, Norway House Lat. 53° 58′ 00″, long. 97° 52′ 00″	...	...	...	21-6-08	10 14 A	80	58 0	11 14 A	9·80511	"
	...	...	...	21-6-08	1 38 P	80	57 1	2 22 P	9·80603	"
H. B. Post, Oxford House Lat. 54° 53′ 30″, long. 95° 15′ 00″	...	...	...	27-6-08	12 12 P	82	31 6	12 57 P	9·80766	"
	...	...	...	27-6-08	2 19 P	82	31 9	2 54 P	9·80681	"
H. B. Post, York Factory Lat. 57° 00′ 00″, long. 92° 28′ 00″	...	...	...	7-7-08	4 18 P	83	32 9	5 35 P	9·80695	"
	...	...	...	8-7-08	9 52 A	83	27 1	10 24 A	9·80218	"
" " "	...	...	...	8-7-08	2 24 P	83	27 0	...	...	"
" " "	...	...	...	8-7-08	5 20 P	83	30 9	5 57 P	9·80268	"
" " "	...	...	...	10-7-08	9 01 A	83	27 5	9 46 A	9·80304	"
" " "	...	...	...	10-7-08	10 40 A	83	36 3	11 12 A	9·80072	"
71 11 N. 71 01 E. N.E. cor. sec. 7	66	22	4	19-5-10	10 40 A	78	04 5	11 24 A	9·79341	Carl Engler.
" "	66	22	4	19-5-10	12 10 P	78	03 1	...	...	"
" "	66	22	4	20-5-10	2 32 P	78	04 3	3 27 P	9·79335	"
" "	66	22	4	20-5-10	3 44 P	78	00 6	...	...	"
Grand Rapids, Athabaska River	84	17	4	31-5-10	10 04 A	79	28 5	11 18 A	9·79420	J. A. Cote.
" "	84	17	4	31-5-10	12 42 P	79	28 6	...	...	"

TABLE No. 3—*Concluded.*

Place.	Tp.	Rge.	Mer.	Date.	Time.	Dip.	Time.	Total Intensity.	Observer.
						° ′			
" "	84	17	4	1- 6-10	9 30 A	79 27·3	10 21 A	9·79391	Carl Engler.
" "	84	17	4	1 6-10	11 06 A	79 26·8	.....	.....	"
Below Boiler Rapids, Athabaska River	....	....	....	5- 6-10	5.57 P	79 31·2	6.32 P	9·79874	"
Big Cascade, Athabaska R	....	....	....	7- 6-10	4 22 P	79 39·1	5 00 P	9·79499	J. A. Cote.
"	....	....	....	7- 6-10	5 32 P	79 42·9	.....	.....	"
Fort McMurray, S. Shore Athabaska R., opp. island	....	....	....	10- 6 10	3 22 P	79 58·1	4.00 P	9·79727	"
" " "	....	....	....	10 6-10	4 24 P	79 57·7	.....	.....	Carl Engler.
" " "	....	....	....	13 6 10	2.11 P	80 00·1	3.00 P	9·79634	"
" " "	....	....	....	13 6-10	3 39 P	79 58·1	.....	.....	"
Fort Chipewyan	....	....	....	17 6-10	3.33 P	81 08·2	4.03 P	9·79649	J. A. Cote.
Smith Landing, S.W. cor. H. B. Co. Res.	....	....	....	23 6-10	3 42 P	81 55·0	4 20 P	9·81617	"
" "	....	....	....	23- 6 10	4.54 P	81 49·4	.....	.....	Carl Engler.
Ft. Smith, near Obs'ng Tent	....	....	....	11- 7-10	4 20 P	81 57·3	5.05 P	9·79420	J. A. Cote.
" "	....	....	....	12 7 10	3.27 P	81 57·9	4.16 P	9·79346	"
" "	....	....	....	12- 7 10	4 55 P	81 59·0	.....	.....	"
Fort Chipewyan.	....	....	....	6- 8-10	10.43 A	81 09·7	12.21 P	9·79512	Carl Engler.
"	....	....	....	6- 8-10	1 20 P	81 09·2	.....	.....	"
Ft. McMurray, Point of Mag. Obs'ns	....	....	....	10 8 10	9 19 A	80 02·8	10 09 A	9·79621	"
" "	....	....	....	10 8 10	10 49 A	80 00·1	.....	.....	"
Grand Rapids, E. shore of river	....	....	....	21- 8-10	10 15 A	79 28·5	10 52 A	9·79333	"
" "	....	....	....	21- 8-10	11 22 A	79 29·6	.....	.....	"

TABLE No. 4.

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912·0	Observer.
					° ′	° ′	
At ¼ sec. cor. E. by sec. 36	19	1	Pr	1910 4	12 28 5	12 33 4	P.R.A. Belanger.
11 00 N.—N.E. cor. sec. 12	29	1	"	1910 5	12 53 8	12 57 6	E. W. Robinson.
60 00 N.— " 12	29	1	"	1910 5	12 47 2	12 52 0	"
40 00 N.— " 1	30	1	"	1910 6	13 05 1	13 10 6	"
30 00 N.— " 24	30	1	"	1910 6	13 02 7	13 08 2	"
28 00 W.— " 31	32	1	"	1910 8	13 43 5	13 46 0	"
59.00 W.— " 7	33	1	"	1910 8	13 39 9	13 43 1	"
10 00 N.— " 35	33	1	"	1910 8	12 22 7	....	"
15 00 N.— " 1	34	1	"	1910 8	13 37 2	....	"
20.00 N.— " 24	34	1	"	1910 8	13 46 7	13 49 2	"
20 00 N.— " 24	34	1	"	1910 8	13 46 3	13 49 8	"
7 00 N.— " 1	35	1	"	1910 8	13 46 0	13 47 5	"
11.00 N.— " 13	35	1	"	1910 8	13 46 7	13 47 2	"
1.52 N.—¼ cor. E. by sec. 36	35	1	"	1911 2	14 46 6	14 47 7	A. W. Ponton
1.52 N.—¼ " 36	35	1	"	1911 2	14 49 9	14 52 0	"
26.88 N.—¼ " 24	36	1	"	1911 2	13 11 5	13 12 6	"
53.00 N.—N.E. cor. sec. 36	37	1	"	1911 2	13 09 6	13 10 7	"
33.00 N.— " 36	37	1	"	1911 2	13 04 6	13 05 7	"
63.00 N.— " 36	37	1	"	1911 2	13 31 6	13 27 2	"
63.00 N.— " 36	37	1	"	1911 2	13 31 8	13 27 4	"
31.00 N.— " 13	38	1	"	1911 2	11 41 2	11 45.3	"
31.00 N.— " 13	38	1	"	1911 2	11 39 4	11 43 5	"
30.00 N.— " 36	38	1	"	1911.2	13 08 7	13 12 8	"
57.00 N.— " 36	39	1	"	1911 2	12 51 5	....	"
57.00 N.— " 36	39	1	"	1911 2	12 50 6	....	"
23.00 N.— " 1	41	1	"	1911 2	12 51 5	12 54 6	"
23.00 N.— " 1	41	1	"	1911 2	12 49 3	12 52.4	"
1.00 N.— " 36	41	1	"	1911 2	12 41 4	12 44.5	"
59.00 N.— " 13	42	1	"	1911 2	12 52 7	....	"
59.00 N.— " 13	42	1	"	1911 2	12 55 8	12 57 9	"
56.00 N.— " 24	43	1	"	1911 2	13 16 9	13 13 0	"
14.00 N.— " 12	44	1	"	1911 2	13 50.7	13 47.3	"
8.00 N.— " 1	46	1	"	1911 2	14 03 8	14 03 9	"
11.00 N.—¼ cor. E. by 36	48	1	"	1911 3	13 05 2	13 09.6	"
11.00 N.—¼ " 36	48	1	"	1911 3	13 04 1	13 05 5	"
63.62 N.—N.E. cor. sec. 13	51	1	"	1911 5	13 15 9	13 17 1	"
49 40 N.— " 36	51	1	"	1911 5	13 42 5	13 42 5	"
45.00 N.— " 12	52	1	"	1911 5	14 48 6	14 47 8	"
8.00 N.— " 36	52	1	"	1911 6	14 09 4	14 09 3	"
31.04 N.— " 25	53	1	"	1911 6	13 31 0	13 29 9	"
38 27 N.— " 13	54	1	"	1911 6	13 38 9	13 37.4	"
31.75 N.— " 25	54	1	"	1911 6	13 31 0	13 29.5	"
1.61 N.— " 12	55	1	"	1911 6	13 44 6	13 42.1	"
47.63 N.— " 12	55	1	"	1911 6	13 36 7	13 36 2	"
24.00 N.— " 24	55	1	"	1911.6	13 16 1	13 13 6	"
8.45 N.— " 25	55	1	"	1911 6	13 50 7	13 51 2	"
73 82 N.— " 1	56	1	"	1911 6	13 37 1	13 33 6	"
10 67 N.— " 24	57	1	"	1911 7	15 14 9	15 11 9	"
53 77 N.— " 25	57	1	"	1911 7	14 38 1	14 34 1	"
53.77 N.— " 25	57	1	"	1911 7	14 33 1	14 29 1	"
56 54 N.— " 12	58	1	"	1911 7	13 21 5	13 16 5	"
1.00 N.— " 25	58	1	"	1911 7	15 00 2	14 56 2	"
52.52 N.— " 25	60	1	"	1911 7	14 25.2	14 25 2	"
At N.E. cor. sec. 1	15	2	"	1910 4	12 36 7	....	P.R.A. Belanger.
" " 14	24	2	"	1910 8	12 58 7	13 05 8	"
10.00 E.—N.E. cor. sec. 33	32	2	"	1910 8	13 31 4	13 34 9	E. W. Robinson.
18.00 W.— " 35	18	3	"	1910 4	13 39 3	13 40 2	P.R.A. Belanger
42.00 S.— " 23	26	3	"	1909 9	13 21 4	13 26 4	"
12.00 E.— " 31	32	3	"	1910 8	13 35 3	13 36 8	E. W. Robinson.
32.00 W.— " 35	32	3	"	1910 8	12 47 1	....	"
10.00 E.—¼ cor. N. by sec. 34	20	4	"	1910 4	13 42 8	13 43 9	P.R.A. Belanger.
40.00 S.—N.E. cor. sec. 33	27	4	"	1909 9	13 29 8	13 36 8	"
At N.E. cor. sec. 33.	32	4	"	1910 8	13 36 1	13 36 6	E. W. Robinson.
¼ sec. cor. E. by sec. 13.	21	5	"	1912 0	13 17.1	13 14 4	P. B. Street.
10.00 E.—N.E. cor. sec. 35	32	5	"	1910 7	14 03 9	14 00 7	E. W. Robinson.
At ¼ cor. E. by sec. 36	22	6	"	1910 5	13 27 7	13 29.5	P.R.A. Belanger.
30.00 S.—N.E. cor. sec. 11	23	6	"	1912 0	12 49 6	12 42 9	P. B. Street.

TABLE No. 4—*Continued.*

Place.	Tp.	Rge	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912.0	Observer.
					° ′	° ′	
At N.E. cor. sec. 22	26	6	Pr.	1909.9	14 16.9	11 19.5	P.R.A. Belanger.
8 00 W.—N.E. cor. sec. 33	32	6	"	1910.7	13 54.7	13 56.1	E. W. Robinson.
21 00 W.— " 36	32	6	"	1910.7	13 45.3	....	"
31 00 E.— " 32	32	6	"	1910.7	13 51.6	13 52.0	"
20 00 N.— " 20	21	7	"	1910.5	13 20.8	13 24.6	P.R.A. Belanger.
At N.E. cor. sec. 22	27	7	"	1909.9	13 32.6	13 46.2	"
28 00 S.—N.E. cor. sec. 20	32	7	"	1909.4	14 10.5	14 23.4	"
26 00 W.— " 32	16	8	"	1909.9	13 46.1	13 44.1	W. J. Deans
At N.E. cor. sec. 30	16	8	"	1909.9	13 27.5	13 27.5	"
" " 30	16	8	"	1909.9	13 22.9	13 28.9	"
" " 30	16	8	"	1909.9	13 11.0	13 14.0	"
40.00 W.—N.E. cor. sec. 19	16	8	"	1909.9	14 18.9	14 17.9	"
41 00 W.— " 30	16	8	"	1909.9	13 05.9	13 07.9	"
At ¼ sec. cor. E. by sec. 26	22	8	"	1910.5	13 27.4	13 32.2	P.R.A. Belanger.
S.E. cor. sec. 4	26	8	"	1908.6	13 56.3	14 10.1	"
Centre—E. by. sec. 15	33	8	"	1912.0	14 10.0	14 04.3	"
11 50 N.—N.E. cor. sec. 17	6	9	"	1911.5	14 36.6	14 35.8	R. C. Purser.
41.00 W.—N.E. cor. sec. 31	16	9	"	1909.8	14 12.9	14 09.6	W. J. Deans
41.00 W.— " 31	16	9	"	1909.8	14 25.8	14 22.5	"
At N.E. cor. sec. 21	16	9	"	1909.8	12 41.7	12 40.1	"
30 00 E.—N.E. cor. sec. 30	16	9	"	1909.8	14 08.8	14 13.5	"
20 00 E.— " 31	16	9	"	1909.8	14 05.4	14 12.1	"
20 00 E.— " 31	16	9	"	1909.7	14 12.4	....	"
20 00 E.— " 31	16	9	"	1909.7	14 04.3	14 13.3	"
20.00 E.— " 31	16	9	"	1909.8	14 16.4	14 12.1	"
At N.E. cor. sec. 33	16	9	"	1909.8	14 04.3	14 09.0	"
40 00 E.—N.E. cor. sec. 32	16	9	"	1909.8	14 01.8	14 07.0	"
40 00 E.— " 32	16	9	"	1909.8	13 56.1	13 58.8	"
40 00 E.— " 32	16	9	"	1909.8	13 57.0	13 53.7	"
At N.E. cor. sec. 29	16	9	"	1909.8	14 10.9	14 11.6	"
" " 29	16	9	"	1909.8	14 17.8	14 13.5	"
" " 30	16	9	"	1909.8	14 30.8	14 27.5	"
" " 30	16	9	"	1909.8	14 22.2	14 22.9	"
" " 30	16	9	"	1909.8	14 26.0	14 21.7	"
" " 30	16	9	"	1909.8	14 08.4	14 11.1	"
30 00 E.—N.E. cor. sec. 30	16	9	"	1909.8	14 11.1	14 13.8	"
At N.E. cor. sec. 7	16	9	"	1909.8	14 54.8	14 58.5	"
" " 19	16	9	"	1909.8	14 58.5	14 58.2	"
" " 19	16	9	"	1909.8	15 03.3	15 02.0	"
" " 31	16	9	"	1909.8	14 10.6	14 06.3	"
" " 32	16	9	"	1909.8	13 51.9	13 53.6	"
" " 3	16	9	"	1909.8	14 31.1	14 32.8	"
" " 32	16	9	"	1909.8	13 46.5	13 41.2	"
" " 31	16	9	"	1909.8	14 02.2	14 04.9	"
" " 7	16	9	"	1909.8	13 50.7	13 52.4	"
" " 5	16	9	"	1909.8	14 43.9	14 46.6	"
" " 3	16	9	"	1909.8	14 28.9	14 32.6	"
" " 32	16	9	"	1909.8	13 57.5	14 06.2	"
" " 32	16	9	"	1909.8	13 40.6	13 47.9	"
" " 33	16	9	"	1909.8	14 06.6	14 13.9	"
" " 20	16	9	"	1909.8	14 38.2	14 37.9	"
30 00 E.—N.E. cor. sec. 30	16	9	"	1909.8	14 18.0	14 14.7	"
30.00 E.— " 30	16	9	"	1909.8	14 17.8	14 21.1	"
20.00 E.— " 31	16	9	"	1909.7	14 17.7	14 23.7	"
20 00 E.— " 31	16	9	"	1909.7	14 09.8	14 06.8	"
At N.E. cor. sec. 11	30	9	"	1910.5	13 54.9	13 50.9	P.R.A. Belanger.
44.00 S.—N.E. cor. sec. 31	30	9	"	1909.4	15 03.0	15 01.1	"
10.60 E.— " 22	32	9	"	1912.0	13 14.0	13 09.3	"
62 00 N.— " 7	33	9	"	1912.0	13 47.9	13 43.2	"
At S.E. cor. sec. 6	15	10	"	1910.8	13 22.3	....	"
At N.E. " 24	16	10	"	1909.8	15 12.4	15 14.1	W. J. Deans.
" " 36	16	10	"	1909.8	14 40.3	14 37.0	"
" " 1	16	10	"	1909.8	15 51.5	15 48.2	"
" " 36	16	10	"	1909.8	14 41.4	14 50.1	"
40.00 W.—N.E. cor. sec. 36	16	10	"	1909.8	14 23.7	14 26.4	"
At N.E. cor. sec. 36	16	10	"	1909.8	14 36.0	14 38.7	"
" " 12	16	10	"	1909.8	11 59.5	12 00.2	"

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912.0	Observer.
					° ′	° ′	
At N.E. cor. sec. 36	16	10	Pr.	1909.8	14 36.0	14 38.7	W. J. Deans.
" " 23	17	10	"	1909.8	13 21.5	13 25.2	"
" " 34	17	10	"	1909.8	13 50.3	13 52.0	"
" " 24	17	10	"	1909.8	13 55.0	13 53.7	"
" " 23	17	10	"	1909.8	13 31.2	13 29.9	"
" " 25	17	10	"	1909.8	14 26.6	14 29.3	"
" " 25	17	10	"	1909.8	14 15.0	14 18.7	"
" " 24	17	10	"	1909.8	13 44.4	13 46.1	"
" " 7	18	10	"	1910.8	13 12.0	13 16.1	P. R. A. Belanger.
11.00 N.—N.E. cor. sec. 14	30	10	"	1909.5	14 19.9	......	"
At N.E. cor. sec. 36	8	11	"	1910.8	12 50.8	12 49.9	"
3.00 E.—¼ sec. cor. sec. 33	22	11	"	1908.8	15 30.9	15 37.3	W. J. Deans.
At N.E. cor. sec. 33	19	12	"	1909.5	14 41.7	14 40.9	"
" " 33	19	12	"	1909.5	14 33.4	14 49.6	"
" " 33	19	12	"	1909.5	14 32.9	14 42.1	"
" " 33	19	12	"	1909.5	14 57.7	14 55.9	"
" " 35	19	12	"	1909.5	14 31.7	14 48.9	"
41.00 W.—N.E. cor. sec. 31	19	12	"	1909.5	14 39.6	14 45.8	"
41.00 W.— " 31	19	12	"	1909.5	14 46.2	14 43.1	"
40.00 E.— " 29	20	12	"	1909.9	14 30.2	14 33.2	"
40.00 E.— " 29	20	12	"	1909.9	14 46.2	14 48.2	"
At N.E. cor. sec. 28	20	12	"	1909.9	14 34.6	14 37.6	"
" " 28	20	12	"	1909.9	14 47.8	14 49.8	"
" " 21	20	12	"	1909.9	14 41.9	14 41.9	"
50.00 E.—N.E. cor. sec. 17	20	12	"	1909.9	14 31.8	14 37.8	"
50.00 E.— " 17	20	12	"	1909.9	14 46.9	14 46.9	"
At N.E. cor. sec. 21	20	12	"	1909.9	14 44.9	14 49.9	"
15.00 S.—N.E. cor. sec. 4	20	12	"	1909.6	14 25.4	14 44.3	"
At N.E. cor. sec. 28	20	12	"	1909.9	14 54.6	14 53.6	W. J. Deans.
40.00 E.—N.E. cor. sec. 29	20	12	"	1909.9	14 42.0	14 41.0	"
50.00 " " 17	20	12	"	1909.9	14 43.5	14 41.5	"
At N.E. cor. sec. 21	20	12	"	1909.9	14 48.9	14 49.9	"
" " 21	20	12	"	1909.9	14 43.7	14 44.7	"
" " 21	20	12	"	1909.9	14 58.2	15 05.2	"
15.00 S.—N.E. cor. sec. 4	20	12	"	1909.6	14 51.5	14 50.4	"
20.00 E.— " 9	20	13	"	1909.6	14 52.6	......	"
25.00 W.— " 30	20	13	"	1909.6	15 02.5	......	"
20.00 E.— " 9	20	13	"	1909.6	14 38.7	......	"
20.00 E.— " 9	20	13	"	1909.6	14 49.3	14 47.4	"
20.00 E.— " 9	20	13	"	1909.6	14 39.8	14 52.9	"
4.00 S.—S.E. cor. sec. 14	27	13	"	1909.3	14 49.7	14 56.7	"
At N.E. cor. sec. 10	28	13	"	1909.3	15 00.4	15 09.6	"
18.42 W.—N.E. cor. sec. 36	28	14	"	1908.7	14 46.7	14 52.2	P. R. A. Belanger.
15.00 W.— " 32	17	15	"	1909.8	14 15.9	......	J. Francis.
At N.E. cor. sec. 32	17	15	"	1909.8	15 11.1	......	"
" " 22	18	15	"	1909.8	14 47.6	14 45.9	"
30.00 W.—N.E. cor. sec. 29	18	15	"	1909.9	14 36.7	14 42.7	"
20.00 W.— " 28	18	15	"	1909.9	14 53.5	14 51.5	"
32.00 W.— " 21	18	15	"	1909.8	14 39.7	......	"
4.00 W.— " 5	18	15	"	1909.8	14 40.4	14 42.1	"
35.00 W.— " 36	18	15	"	1909.8	14 25.5	14 32.8	"
0.50 E.— " 28	18	15	"	1909.8	14 41.5	14 38.8	"
7.00 S.— " 5	18	15	"	1909.8	14 42.5	14 47.2	"
15.00 E.— " 4	18	15	"	1909.8	15 03.8	15 02.5	"
21.00 N.— " 5	18	15	"	1909.8	14 51.7	14 55.4	"
25.00 S.— " 3	18	15	"	1909.8	15 05.4	15 16.1	"
66.00 S.— " 5	18	15	"	1909.8	14 25.2	14 23.9	"
3.00 S.— " 15	19	15	"	1909.9	14 09.2	14 07.2	"
34.00 W.— " 12	19	15	"	1909.9	14 21.7	14 28.7	"
At N.E. cor. sec. 11	30	15	"	1910.5	15 32.5	15 37.9	T. H. Plunkett.
" " 8	31	15	"	1909.6	15 09.3	15 17.4	P. R. A. Belanger.
" " 10	32	17	"	1909.6	16 07.8	16 07.9	"
" " 32	32	18	"	1909.6	16 40.0	16 43.1	"
45.00 N.—N.E. cor. sec. 9	32	18	"	1910.6	16 35.1	16 37.2	"
45.00 N.— " 9	32	18	"	1910.6	16 37.6	16 39.7	"
21.00 S.— " 25	1	20	"	1911.4	14 55.7	14 55.5	C. F. Aylsworth.
27.00 S.— " 8	18	20	"	1910.3	14 49.8	14 54.0	P. R. A. Belanger.

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912 0.	Observer.
					° ′	° ′	
At N.E. cor. sec. 35	23	20	Pr.	1908.7	15 48.1	....	W. J. Deans.
" " 36	34	20	"	1910.6	18 41.4	18 48.5	P. R. A. Belanger.
At S.E. " 1	35	20	"	1909.5	17 29.8	17 30.0	"
21.00 S.—N.E. cor. sec. 25	1	21	"	1911.4	14 53.1	....	C. F. Aylsworth.
20.00 N.—S.E. " 36	1	21	"	1911.4	14 51.6	....	"
20.00 S.—N.E. " 36	1	21	"	1911.4	14 55.3	14 58.1	"
65.00 S.— " " 36	1	21	"	1911.4	14 56.1	14 57.9	"
At S.E. cor. sec. 7	20	21	"	1910.7	15 44.3	15 43.8	"
30.00 W.—N.E. cor. sec. 35	56	21	"	1911.1	17 56.4	....	E. W. Robinson.
10.00 E.—¼ sec. cor. N. by 12	20	22	"	1910.3	16 26.3	16 29.5	P. R. A. Belanger.
At N.E. cor. sec. 11	20	22	"	1910.3	16 25.9	16 34.1	"
" " 31	56	22	"	1911.1	18 02.6	18 05.3	E. W. Robinson.
10.00 W.—N.E. cor. sec. 31	56	22	"	1911.1	18 07.1	18 13.1	"
20.00 N.— " 36	56	22	"	1911.1	18 02.2	....	"
25.00 W.— " 31	56	24	"	1911.1	18 17.3	18 20.0	"
17.00 E.— " 35	56	24	"	1911.1	17 23.7	17 26.4	"
55.00 E.— " 34	56	24	"	1911.1	18 13.2	18 15.9	"
38.00 E.— " 35	56	25	"	1911.1	18 30.2	18 32.9	"
At N.E. cor. sec. 4	13	26	"	1909.5	17 48.1	17 56.7	O. Rolfson.
37.00 W.—N.E. cor. sec. 2	13	26	"	1909.4	17 57.9	18 04.8	"
37.00 W.— " 2	13	26	"	1909.5	17 53.1	17 57.3	"
30.00 W.— " 31	56	26	"	1911.1	18 17.9	....	E. W. Robinson.
At N.E. cor. sec. 35	56	26	"	1911.1	18 35.4	18 36.1	"
3.00 S.—N.E. cor. sec. 35	22	27	"	1908.5	14 38.8	14 47.3	W. J. Deans.
20.00 N.— " 17	36	27	"	1910.4	18 29.7	18 28.8	D. E. Chartrand.
20.00 N.— " 17	36	27	"	1910.4	18 29.5	18 29.6	"
20.00 N.— " 17	36	27	"	1910.4	18 26.2	18 30.3	"
20.00 N.— " 17	36	27	"	1910.4	18 24.1	18 28.2	"
20.00 N.— " 17	36	27	"	1910.4	18 21.0	18 30.6	"
20.00 N.— " 17	36	27	"	1910.4	18 17.0	18 25.1	"
20.00 N.— " 17	36	27	"	1910.4	18 37.1	18 33.2	"
20.00 N.— " 17	36	27	"	1910.4	18 30.0	18 30.1	"
20.00 N.— " 17	36	27	"	1910.4	18 27.4	18 31.5	"
20.00 N.— " 17	36	27	"	1910.4	18 24.2	18 32.3	"
20.00 N.— " 17	36	27	"	1910.4	18 21.5	18 30.6	"
20.00 N.— " 17	36	27	"	1910.4	18 17.9	18 27.0	"
20.00 N.— " 17	36	27	"	1910.4	18 19.5	18 28.6	"
20.00 N.— " 17	36	27	"	1910.4	18 19.8	18 27.9	"
20.00 N.— " 17	36	27	"	1910.4	18 21.6	18 27.7	"
20.00 N.— " 17	36	27	"	1910.4	18 24.2	18 28.3	"
20.00 N.— " 17	36	27	"	1910.4	18 26.5	18 29.6	"
20.00 N.—N.E. cor. sec. 17	36	27	"	1910·4	18 31·2	18 33·3	"
20.00 N.— " 17	36	27	"	1910.4	18 25.9	18 27.5	"
20.00 N.— " 17	36	27	"	1910.4	18 34.0	18 30.5	"
20.00 N.— " 17	36	27	"	1910.4	18 36.7	18 32.2	"
20.00 N.— " 17	36	27	"	1910.4	18 37.5	18 33.6	"
20.00 N.— " 17	36	27	"	1910.4	18 35.8	18 32.9	"
20.00 N.— " 17	56	27	"	1910.4	18 33.6	18 31.7	"
20.00 N.— " 17	36	27	"	1910.4	18 32.7	18 33.8	"
20.00 N.— " 17	36	27	"	1910.4	18 27.7	18 33.8	"
20.00 N.— " 17	36	27	"	1910.4	18 28.0	18 38.6	"
20.00 N.— " 17	36	27	"	1910.4	18 20.6	18 30.2	"
20.00 N.— " 17	36	27	"	1910.4	18 20.7	18 29.8	"
20.00 N.— " 17	36	27	"	1910.4	18 19.5	18 22.6	"
20.00 N.— " 17	36	27	"	1910.4	18 19.3	18 28.4	"
20.00 N.— " 17	36	27	"	1910.4	18 20.1	18 28.2	"
10.00 E.— " 35	56	27	"	1911.1	18 26.0	18 27.7	E. W. Robinson.
At N. E. cor. sec. 36	56	28	"	1911.1	18 43.4	18 44.1	"
15.21 E.—N. E. cor. sec. 23	25	29	"	1911.5	17 15.9	17 16.1	R. C. Purser.
At N. E. cor. sec. 12	25	29	"	1911.5	16 27.5	16 27.7	"
41.00 E.—N. E. cor. sec. 31	56	29	"	1911.1	18 40.2	....	E. W. Robinson.
25.00 W.— " 33	56	29	"	1911.1	18 45.8	18 51.5	"
10.00 E.— " 35	56	29	"	1911.1	18 41.9	18 43.6	"
5.00 S.— " 17	25	30	"	1909.7	16 52.4	....	J. Francis.
At N. E. cor. sec. 31	56	30	"	1911.0	18 42.1	18 45.1	E. W. Robinson.
40.14 S.—N. E. cor. sec. 29	8	31	"	1911.5	15 14.4	15 13.5	R. C. Purser.
10.00 N.—N. W. " 21	29	31	"	1911.9	19 43.5	19 39.0	C. Rinfret.

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912 0	Observer.
					° ′	° ′	
At S. E. cor. sec. 31	30	31	Pr.	1910 4	17 19 2	17 17 3	C. F. Aylsworth.
At S. E. cor. sec 31	30	31	"	1910 4	17 12 0	17 17 1	"
5.00 E.—N. E. cor. sec. 31	56	31	"	1911 0	19 20 0	19 22 0	E. W. Robinson.
4.00 S.— " 22	25	32	"	1909 6	18 21.8	18 17.9	J. Francis.
46.00 N.— " 16	25	32	"	1909 6	17 48 0	18 01 1	"
36.00 E.— " 15	25	32	"	1909 6	18 23 2	18 20 3	"
25.00 S.— " 10	25	32	"	1909 6	17 56 3	18 08 4	"
8.50 N.— " 30	25	32	"	1909 6	17 28 6		"
40 09 E.— " 6	25	32	"	1909 6	17 57.7	18 09 8	"
56.00 N.—S. E. " 32	25	32	"	1909 6	17 09 2	17 21 3	"
30.00 N.—N. E. " 6	25	32	"	1909 6	18 06 3	18 04 4	"
5 00 W.— " " 36	28	32	"	1909 6	16 42 0	16 55 5	"
At N. E. cor. sec. 35	28	32	"	1909 6	16 13 9	17 28 3	"
At. N. E. cor. sec. 7	29	32	"	1909.5	18 07 6	18 05 8	"
59.00 N.—N. E. cor. sec. 11	29	32	"	1909 6	16 45 2	16 42 1	"
At N. E. cor. sec. 17	29	32	"	1909 5	17 47.5	17 47.2	"
43.00 W.—34.00 N—N. E. cor. 27	29	32	"	1909.6	16 38 4	16 59 0	"
10.00 S.—N. W. cor. fr. sec. 31	31	32	"	1909 6	18 11.8		"
45.00 S—N. W.—cor. fr. sec. 3	32	32	"	1909 6	18 22 7	18 25 8	"
At N. E. cor. sec. 13	32	33	"	1911 9	19 24 1	19 19 7	C. Rinfret.
" 10	24	1	E. Pr.	1908 4	13 17 4	13 26 0	P.R.A. Belanger.
25.00 W.—S. E. cor. fr. tp. 27.	27	1	"	1911.7	12 58 8	13 01 0	"
20.00 W.—N. E. cor. sec. 33	28	1	"	1910 4	12 26 6	12 31 1	E. W. Robinson.
At N. E. cor. sec. 36	28	1	"	1910.4	12 28 1	12 35 6	"
10 00 W.—N. E. cor. sec. 31	28	2	"	1910.4	12 25.4	12 30 9	"
60·00 W.—N. E. cor. sec. 7	29	2	"	1911.7	11 45 4	11 39 4	P.R.A. Belanger.
At N. E. cor. sec. 18	29	2	"	1911.7	12 06.9	12 04 1	"
30·00 N.—S. E. cor. sec. 1	22	3	"	1910.7	12 11.8	12 13 8	"
30·00 W.—N. E. cor. sec. 31	28	3	"	1910.5	12 21.7		E. W. Robinson
10 00 E.— " 32	28	3	"	1910 5	12 18 8	12 22 0	"
25·00 W— " 35	28	3	"	1910 5	12 18 6	12 25 8	"
10 00 E.— " 33	28	4	"	1910 5	12 13 4	12 15 2	"
10 00 W.— " 35	28	4	"	1910.5	12 14 0	12 18 8	"
30·00 N.— " 24	13	5	"	1911.6	9 51 2	9 49 7	C. F. Aylsworth.
30 00 N.— " 24	13	5	"	1911.6	9 53 1	9 51.6	"
30 00 N.— " 24	13	5	"	1911.6	9 52 3	9 50 8	"
30·00 N.— " 24	13	5	"	1911.6	9 53 0	9 49 5	"
11 00 E.— " 31	28	5	"	1910.5	12 03 0	12 06 8	E. W. Robinson.
42 00 N.—N. W. " 29	14	6	"	1911 3	13 06 8	13 10 9	C. F. Aylsworth.
42 00 N.— " " 29	14	6	"	1911 3	13 08 7	13 12 8	"
12 00 W.—S. E. cor sec 2	15	6	"	1911 8	13 30 3	13 28 3	"
12 00 W.— " 2	15	6	"	1911 8	13 30 5	13 28 5	"
12 00 W.— " 2	15	6	"	1911 8	13 30 4	13 28 4	"
12·00 W.— " 2	15	6	"	1911 8	13 50 4	13 27 4	"
At S. E. cor. sec. 3	15	6	"	1911 8	13 10 7	13 04 7	"
" 3	15	6	"	1911 8	13 10 5	13 05 5	"
42 00 W.—S E. cor. sec 3	15	6	"	1911 8	13 21 4	13 21 4	"
42 00 W.— " 3	15	6	"	1911 8	13 20 4	13 20 4	"
20 00 W.— " 4	15	6	"	1911.8	13 17 3	13 12 3	"
20 00 W.— " 4	15	6	"	1911.8	13 17 5	13 13 5	"
30·00 W.— " 5	15	6	"	1911 8	12 15 6	12 45 6	"
30 00 W.— " 5	15	6	"	1911 8	12 45 9	12 45 9	"
20·00 S.—N. E. cor. sec. 4	15	6	"	1911 8	13 22 1	13 18 1	"
20 00 S.— " 4	15	6	"	1911 8	13 21 7	13 17 7	"
40·00 S.— " 4	15	6	"	1911.8	13 18 5	13 14.5	"
40 00 S.—N. E. cor. sec. 4	15	6	"	1911.8	13 19 1	13 15 1	C. F. Aylsworth
5 00 N.—N.W. " 5	15	6	"	1911 8	12 07 4	12 04 2	"
5 00 N.— " " 5	15	6	"	1911 8	12 08 5	12 05 3	"
40·00 W.—N.E. " 19	15	6	"	1911 8	12 33 7	12 30 5	"
40 00 W.— " " 19	15	6	"	1911 8	12 33 4	12 30 2	"
40 00 N.—N.W. " 20	15	6	"	1911 8	12 48 1	12 42 9	"
40 00 N.— " " 30	15	6	"	1911 8	12 47 7	12 42 5	"
30 00 E.—N.E. " 32	15	6	"	1911 9	12 34 5	12 28 0	"
30 00 E.— " " 32	15	6	"	1911 9	12 33 4	12 27 9	"
50 00 E.— " " 33	15	6	"	1911 9	12 58 2	12 54 7	"
50 00 E.— " " 33	15	6	"	1911 9	12 57 5	12 54 0	"
43 00 E.— " " 34	15	6	"	1911 9	12 39 0	12 35 5	"

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912.0	Observer.
					° ′	° ′	
40·00 W.—N.E. cor. sec. 30	16	7	E. Pr.	1910.7	12 10 7	12 11 7	P. R. A. Belanger
10·00 W.— „ „ 1	1	13	„	1910.0	9 30 1	....	„
6 00 S.—¼ sec. cor. E. by 17	11	13	„	1910.7	11 00 0	11 00 0	„
41·50 N.—N.E. cor. sec. 23	10	14	„	1909.8	11 32 2	11 39 5	„
At N.E. cor. sec. 6	11	14	„	1910.7	9 14 8	9 15 8	„
16 00 N.—N.E. cor. sec. 1	1	15	„	1908.5	9 31 1	9 40 6	„
At N.E. cor. sec. 24	1	15	„	1910.7	8 51 4	......	E. W. Hubbell.
At „ „ 24	10	15	„	1909.8	10 05 7	10 10 0	P. R. A. Belanger
At „ „ 6	2	16	„	1910.7	9 20 7	9 21 7	E. W. Hubbell.
30·00 S.—N.E. cor. sec. 36	3	16	„	1910.7	10 26 6	10 26 1	„
30 00 S.— „ „ 10	4	16	„	1910.7	10 22 8	....	„
20 00 N.— „ „ 3	5	16	„	1910.8	8 43 1	....	„
At N.E. cor. sec. 11	10	16	„	1909.8	10 46 0	10 49 7	P. R. A. Belanger
53 65 S.—N.E. cor. sec. 29	16	16	„	1911.3	9 10 3	....	„
1 77 S.— „ „ 15	16	16	„	1911.4	12 11 9	12 12 7	„
1 18 N.—N.E. cor. sec. 13	16	16	„	1911.4	10 13 6	....	„
At N.E. cor. sec. 31	2	17	„	1910.7	9 11 4	9 17 4	E. W. Hubbell.
At „ „ 7	4	17	„	1910.8	9 33 3	......	„
At „ „ 8	10	17	„	1909.8	8 28 0	....	P. R. A. Belanger
33·61 S.—N.E. cor. sec. 15	16	17	„	1911.6	10 44 6	10 57 1	„
71 06 S.— „ „ 9	16	17	„	1911.5	10 14 4	10 16 5	„
8·09 S.— „ „ 17	16	17	„	1911.5	8 42 2	......	„
30·00 N.—N.E. cor. sec. 24	56	1	2	1911.0	19 00 6	19 03 6	E. W. Robinson.
At N.E. cor. sec. 36	56	1	2	1911.0	19 18 6	19 21 6	„
7 00 E.—N.E. cor. sec. 35	56	1	2	1911.9	19 09 3	19 04 8	„
10 00 E.— „ „ 34	56	1	2	1911.9	19 21 3	19 16 8	„
36·00 N.— „ „ 12	57	1	2	1911.2	18 47 0	18 49 1	„
30·00 S.— „ „ 1	58	1	2	1911.2	19 07 1	19 08 2	„
30 00 N.— „ „ 12	58	1	2	1911.2	18 39 0	18 41 1	„
20·00 S.— „ „ 25	58	1	2	1911.2	19 11 2	19 13 3	„
45·00 N.— „ „ 1	59	1	2	1911.2	19 30 1	19 32 2	„
30 00 S.— „ „ 24	59	1	2	1911.2	19 34 9	......	„
10 00 S.— „ „ 36	59	1	2	1911.2	19 17 0	19 20 1	„
10 00 N.— „ „ 24	60	1	2	1911.2	19 51 8	......	„
17 00 N.— „ „ 13	61	1	2	1911.2	20 07 5	20 08 6	„
15 00 N.— „ „ 25	61	1	2	1911.2	20 03 0	......	„
8 72 N.— „ „ 12	62	1	2	1911.6	20 41 5	20 40 4	„
10 00 S.— „ „ 13	62	1	2	1911.6	20 43 6	20 46 5	„
65 00 N.— „ „ 24	62	1	2	1911.6	21 03 4	21 03 3	„
20 00 S.— „ „ 36	62	1	2	1911.6	20 57 5	......	„
10 00 N.— „ „ 1	63	1	2	1911.6	21 22 5	21 24 0	„
20 00 S.— „ „ 24	63	1	2	1911.6	21 20 9	21 17 4	„
5 00 S.— „ „ 1	64	1	2	1911.6	21 42 8	21 41 3	„
12 00 S.— „ „ 25	64	1	2	1911.7	20 35 3	20 29 5	„
35 00 N.— „ „ 13	65	1	2	1911.7	21 32 9	21 30 1	„
16 00 N.— „ „ 1	66	1	2	1911.7	22 33 0	22 28 0	„
30 00 N.— „ „ 13	67	1	2	1911.7	20 36 6	20 33 6	„
20 00 S.— „ „ 6	44	2	2	1910.4	18 41 4	18 45 3	E. W. Hubbell.
18 00 W.— „ „ 33	56	2	2	1911.9	19 17 6	19 13 2	E. W. Robinson.
16 00 N.— „ „ 14	10	3	2	1911.5	17 06 5	17 10 7	C. F. Aylsworth.
16 00 N.— „ „ 14	10	3	2	1911.5	17 07 4	17 11 6	„
16 00 N.— „ „ 14	10	3	2	1911.5	17 07 1	17 14 7	„
16 00 N.— „ „ 14	10	3	2	1911.5	17 08 5	17 13 0	„
16 00 N.— „ „ 14	10	3	2	1911.5	17 09 1	17 13 3	„
At ¼ cor. E. by sec. 17	21	3	2	1910.5	18 44 6	18 41 5	P. A. Carson.
Centre of sec. 16	21	3	2	1910.5	18 41 8	18 44 6	„
„ „ 16	21	3	2	1910.5	18 51 3	18 49 1	„
At N.E. cor. sec. 32	21	3	2	1910.5	18 17 0	18 21 4	„
At ¼ post E. by sec. 17	21	3	2	1910.5	18 47 4	18 44 8	„
„ „ 17	21	3	2	1910.5	18 46 0	18 42 9	„
„ „ 17	21	3	2	1910.5	18 29 0	18 37 9	„
„ „ 17	21	3	2	1010.5	18 28 8	18 37 2	„
„ N.E. cor sec. 21	44	3	2	1910.4	20 59 1	21 03 0	E. W. Hubbell.
60 00 N.—N.E. cor sec. 8	45	3	2	1910.4	19 33 0	19 35 9	„
3 00 W.— „ „ 33	56	3	2	1911.9	18 25 4	18 23 0	E. W. Robinson.
40·00 S.— „ „ 9	21	4	2	1910.6	18 34 2	18 36 7	P. A. Carson.

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912·0	Observer.
					° ′	° ′	
40·00 S.—N.E. cor. sec. 9	21	4	2	1910.6	18 42.2	18 39.2	P. A. Carson.
At N.E. cor. sec. 16	21	4	2	1910.6	18 36.0	18 42.5	"
At ¼ cor. E. by sec. 9	21	4	2	1910.6	18 44.4	18 39.9	"
At ¼ cor. E. by sec. 9	21	4	2	1910.6	18 26.4	18 34.9	"
15.00 E.—N.E. cor. sec. 26	24	4	2	1909.7	18 26.3	18 21.3	J. Francis.
30.00 S.— " 27	24	4	2	1909.7	18 15.2	18 21.0	"
At N.E. cor. sec. 34	24	4	2	1909.7	18 19.5	18 20.5	"
" " 21	24	4	2	1909.7	18 06.2	18 04.2	"
50.00 W.—N.E. cor. sec. 32	24	4	2	1909.7	18 19.0	18 26.0	"
30.00 W. 20.00 N.—S.E. cor. 23	24	4	2	1909.7	17 56.2	18 04.2	"
43.94 E.—N.W. cor. sec. 2	25	4	2	1909.4	17 52.8	17 57.7	"
3.00 W.—N.E. cor. sec. 12	44	4	2	1910.4	17 41.5	17 45.4	E. W. Hubbell.
5.00 E.— " 33	56	4	2	1911.9	19 55.8	19 49.4	E. W. Robinson.
10.00 E.— " 31	56	4	2	1911.9	20 18.8	....	"
2.00 W.— " 36	11	5	2	1909.5	17 16.6	17 20.8	O. Rolfson.
10.00 E.— " 31	11	5	2	1909.6	17 41.2	17 47.3	"
40.00 S.— " 21	12	5	2	1909.6	17 14.2	17 18.3	"
60.35 S.— " 24	12	5	2	1909.6	17 34.0	17 41.9	"
5.00 S.—S.E. cor. sec. 8	12	5	2	1909.6	17 29.9	17 38.0	"
54.00 S.—N.E. cor. sec. 5	12	5	2	1909.6	17 28.1	17 35.2	"
40.00 E.— " 8	12	5	2	1909.6	17 16.6	17 26.7	"
1.00 E. S.E. cor. sec. 4	12	5	2	1909.6	17 45.8	....	"
40.00 S.—N.E. cor. sec. 1	27	5	2	1909.4	18 54.2	19 01.1	J. Francis.
At S.E. cor. sec. 3	28	5	2	1910.6	18 49.4	.....	C. F. Aylsworth.
At N.E. cor. sec. 8	40	5	2	1911.8	18 32.9	18 26.7	P. R. A. Belanger
2.00 N.—N.E. cor. sec. 8	40	5	2	1911.8	18 18.3	18 15.1	"
29.05 N.— " 20	44	5	2	1910.4	19 48.5	19 52.9	E. W. Hubbell.
11.00 W.— " 34	56	5	2	1911.9	20 28.2	20 23.8	E. W. Robinson.
20.00 W.— " 36	56	6	2	1912.0	20 17.7	20 14.0	"
23.00 W.— " 33	56	6	2	1912.0	20 33.4	20 29.7	"
17.00 W.— " 32	56	6	2	1912.0	21 02.7	20 57.0	"
56.00 N.—S.E. cor. sec. 16	14	7	2	1909.8	18 46.7	18 49.4	O. Rolfson.
At N.W. cor. sec. 31	14	7	2	1909.8	18 55.3	18 57.0	"
At S.E. cor. sec. 4	14	7	2	1909.8	19 32.5	19 33.2	"
" " 6	23	7	2	1910.4	18 27.4	18 26.5	D. E. Chartrand.
" " 6	23	7	2	1910.4	18 15.7	18 17.8	"
64.50 W.—N.E. cor. sec. 22	40	7	2	1911.8	20 03.3	19 58.1	P.R.A. Belanger.
At N.E. cor. sec. 7	42	7	2	1910.3	20 06.2	20 11.4	E. W. Hubbell.
" " 36	56	7	2	1912.0	21 05.7	20 59.0	E. W. Robinson.
" " 33	7	8	2	1909.7	17 56.8	18 01.8	O. Rolfson.
" " 8	37	8	2	1909.8	21 55.5	21 54.2	E. W. Hubbell.
10.00 S.—N.E. cor. sec. 8	37	8	2	1909.8	21 57.7	....	"
77.00 S.— " 1	38	8	2	1909.5	21 21.2	21 26.6	"
12.00 E.—N.W. cor. sec. 31	41	8	2	1910.3	20 23.4	20 27.6	"
At S.E. cor. sec. 1	43	8	2	1910.3	20 26.7	20 31.9	"
At N.E. cor. sec. 24	44	8	2	1911.0	20 51.4	20 57.3	"
" " 36	56	8	2	1912.0	20 11.2	20 04.5	E. W. Robinson.
At S.E. cor. sec. 5	15	9	2	1909.8	18 34.6	18 38.9	O. Rolfson.
5.00 N.—N.E. cor. sec. 18	30	10	2	1911.9	19 50.3	19 47.8	P.R.A. Belanger.
3.74 N.— " 25	42	10	2	1910.3	20 32.4	20 41.6	E. W. Hubbell.
20.00 S.— " 34	44	10	2	1911.0	20 29.2	20 28.1	"
40.00 W.— " 36	9	11	2	1911.4	20 14.3	20 21.1	G. A. Bennett.
At ¼ cor. E. By. sec. 29	23	11	2	1910.5	18 38.6	18 43.0	P. A. Carson.
" " " 29	23	11	2	1910.5	18 41.6	18 44.0	"
At N.E. cor. sec. 35	45	11	2	1911.8	21 22.3	21 15.3	P. R. A. Belanger
10.00 W.—N.E. cor. sec. 33	45	11	2	1911.8	19 36.6	19 33.6	"
40.00 N.—N.E. cor. sec. 1	47	11	2	1911.8	21 19.4		"
40.00 W.—S.E. cor. sec. 2	47	11	2	1911.8	20 28.7	20 24.7	"
At centre—E. By. sec. 23	49	11	2	1911.9	19 16.1	19 07.6	"
" " " 21	50	11	2	1911.9	18 56.7	18 46.2	"
33.00 W.—S.W. cor. sec. 2	51	11	2	1911.9	18 31.5	18 28.0	"
50.00 S.—N.E. cor. sec. 32	1	12	2	1909.7	18 13.0	18 11.8	O. Rolfson.
41.00 E.— " 32	1	12	2	1909.7	18 05.3	18 18.1	"
50.00 S.— " 4	1	12	2	1909.7	18 03.2	18 08.2	"
At N.E. cor. sec. 12	1	12	2	1909.7	18 23.5	18 20.5	"
At S.E. cor. sec. 3	1	12	2	1909.7	18 00.5	18 10.5	"

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912.0	Observer.
					° ′	° ′	
6.00 S.—N.W. cor. sec. 36	2	12	2	1909.7	18 06.3	18 17.3	O. Rolfson.
At S.E. cor. sec. 4	2	12	2	1909.7	18 19.9	18 15.9	"
16.00 N.—S.W. cor. sec. 6	2	12	2	1909.7	18 14.8	18 12.8	"
10.00 S.—N.E. cor. sec. 12	2	12	2	1909.7	18 18.4	18 26.4	"
At S.E. cor. sec. 6	2	12	2	1909.7	18 33.4	18 31.4	"
At N.E. cor. sec. 21	2	12	2	1909.7	18 21.6	18 29.6	"
At S.E. cor. sec. 6	2	12	2	1910.7	18 13.7	18 14.2	C. F. Aylsworth.
15.00 S. of ¼ post E. by sec. 8	26	12	2	1910.5	19 24.3	19 25.7	P. A. Carson.
15.00 " " " S.	26	12	2	1910.5	19 27.1	19 28.5	"
15.00 " " " S.	26	12	2	1910.5	19 25.4	19 23.8	"
15.00 " " " S.	26	12	2	1910.5	19 28.2	19 25.6	"
15.00 " " " S.	26	12	2	1910.5	19 27.7	19 27.1	"
15.00 " " " S.	26	12	2	1910.5	19 27.1	19 25.5	"
15.00 " " " S.	26	12	2	1910.5	19 25.1	19 27.5	"
15.00 " " " S.	26	12	2	1910.5	19 21.6	19 24.0	"
15.00 " " " S.	26	12	2	1910.5	19 17.5	19 22.9	"
15.00 " " " S.	26	12	2	1910.5	19 14.4	19 23.3	"
15.00 S. of ¼ post E. by sec. 8	26	12	2	1910.5	19 11.6	19 18.1	"
15.00 S. " " S.	26	12	2	1910.5	19 08.5	19 15.9	"
15.00 S. " " S.	26	12	2	1910.5	19 08.9	19 16.3	"
15.00 S. " " S.	26	12	2	1910.5	19 10.1	19 18.0	"
15.00 S. " " S.	26	12	2	1910.5	19 13.2	19 20.1	"
15.00 S. " " S.	26	12	2	1910.5	19 16.4	19 21.8	"
15.00 S. " " S.	26	12	2	1910.5	19 17.5	19 21.4	"
15.00 S. " " S.	26	12	2	1910.5	19 19.3	19 22.7	"
15.00 S. " " S.	26	12	2	1910.5	19 16.6	19 20.0	"
60.00 W.—N. E. cor. sec. 9	44	12	2	1909.8	18 30.9	18 28.6	E. W. Hubbell.
At N. E. cor. sec. 33	47	12	2	1909.7	18 59.5	18 58.5	"
" " 20	49	12	2	1909.7	19 25.0	19 31.0	"
42.00 E.—S. E. cor. sec. 5	3	13	2	1909.7	18 07.3	18 09.3	O. Rolfson.
At N. E. cor. sec 24	42	13	2	1909.8	17 57.0	17 49.7	E. W. Hubbell.
" " 36	50	13	2	1909.8	20 01.5	20 02.2	"
20.00 N.—N. E. cor. sec. 2	52	13	2	1909.8	23 29.6	23 21.3	"
10.00 E.—S. E. " 5	3	14	2	1909.7	18 08.7	18 14.5	O. Rolfson.
15.00 S.—N. E. " 30	27	14	2	1910.5	19 15.2	19 11.6	P. A. Carson.
11.00 E.—¼ cor. S. by 29	27	14	2	1910.5	19 01.3	19 07.2	"
67.45 N.—N. E. cor. sec. 12	42	14	2	1910.4	19 25.2	19 25.1	E. W. Hubbell.
At N. E. cor. sec. 16	50	14	2	1909.7	23 16.0	23 20.0	"
15.00 S.—N. E. cor. sec. 8	8	15	2	1911.6	21 02.6	....	G. A. Bennett.
25.00 S.— " " 3	18	15	2	1909.8	15 05.4	....	J. Francis.
At ¼ cor. E. by sec. 36	27	15	2	1910.5	19 05.4	19 00.8	P. A. Carson.
" " " 25	27	15	2	1910.5	19 02.0	19 03.4	"
At S. E. cor. sec. 25	27	15	2	1910.5	19 06.5	19 02.9	"
5.00 E.—N. E. cor. sec. 21	17	16	2	1911.5	19 02.9	19 03.0	C. Rinfret.
At N. E. cor. sec. 21	17	17	2	1911.5	18 53.3	18 53.4	"
" " 10	19	17	2	1911.5	18 30.2	18 29.4	"
" " 10	19	17	2	1911.5	18 38.5	18 31.7	"
" " 10	19	17	2	1911.5	18 30.8	18 34.0	"
20.00 S.—¼ E. by sec. 10	31	17	2	1910.5	19 28.7	19 31.7	D. E. Chartrand.
At N. E. cor. sec. 22	17	18	2	1911.5	18 46.9	18 48.0	C. Rinfret.
" " 15	34	18	2	1910.6	19 46.8	19 48.9	P. A. Carson.
" " 15	34	18	2	1910.6	19 48.6	19 50.7	"
Lac la Rouge	71	19	2	1909.6	24 27.1	24 31.2	L. R. Ord.
"	71	19	2	1909.7	24 14.4	....	"
"	71	19	2	1909.7	23 46.4	23 50.4	"
"	71	19	2	1909.5	24 56.2	25 04.8	"
"	71	19	2	1909.5	24 49.0	24 56.2	"
"	71	19	2	1909.6	24 00.2	24 07.1	"
"	71	19	2	1909.6	20 23.4	20 27.5	"
"	71	19	2	1909.6	26 15.8	26 21.9	"
"	71	19	2	1909.6	22 50.8	22 57.7	"
"	71	19	2	1909.6	24 28.2	24 34.1	"
30.00 W.—N. E. cor. sec. 13	42	21	2	1910.8	19 37.4	19 39.5	D. E. Chartrand.
5.00 S. 10.00 E. ¼ cor. E. by 29	45	21	2	1910.7	20 28.2	20 21.2	P. A. Carson.

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination.		Observer.
					Obs'd.	Reduced to 1912·0	
					° ′	° ′	
5.00 S. 10.00 E. ¼ cor. E. by 29	45	21	2	1910.7	20 25.7	20 18.7	P. A. Carson.
5.00 S. 10.00 ″ 29	45	21	2	1910.7	20 24.1	20 17.1	″
5.00 S. 10.00 ″ 29	45	21	2	1910.7	20 24.5	20 18.5	″
5.00 S. 10.00 ″ 29	45	21	2	1910.7	20 23.7	20 19.7	″
5.00 S. 10.00 ″ 29	45	21	2	1910.7	20 22.0	20 21.5	″
5.00 S. 10.00 ″ 29	45	21	2	1910.7	20 18.6	20 20.6	″
5.00 S. 10.00 ″ 29	45	21	2	1910.7	20 15.5	20 21.4	″
5.00 S. 10.00 ″ 29	45	21	2	1910.7	20 14.1	20 20.9	″
5.00 S. 10.00 ″ 29	45	21	2	1910.7	20 12.3	20 17.8	″
5.00 S. 10.00 ″ 29	45	21	2	1910.7	20 13.0	20 16.5	″
5.00 S. 10.00 ″ 29	45	21	2	1910.7	20 12.8	20 16.3	″
5.00 S. 10.00 ″ 29	45	21	2	1910.7	20 12.4	20 14.4	″
5.00 S. 10.00 ″ 29	45	21	2	1910.7	20 13.4	20 15.4	″
5.00 S. 10.00 ″ 29	45	21	2	1910.7	20 15.0	20 17.0	″
5.00 S. 10.00 ″ 29	45	21	2	1910.7	20 24.0	....	″
5.00 S. 10.00 ″ 29	45	21	2	1910.7	20 19.5	20 19.3	″
At N. E. cor. sec. 35	46	21	2	1908.7	21 14.5	21 20.0	W. R. Reilly.
15.00 E.—N. E. cor. sec. 31	46	21	2	1908.7	20 58.8	21 05.3	
2.00 N.—N. E. cor. sec. 11	48	21	2	1910.5	21 21.9	21 27.7	E. W. Hubbell.
60 00 S.— ″ ″ 31	49	21	2	1909.4	21 18.3	21 26.2	W. R. Reilly.
30 00 S.— ″ ″ 19	49	21	2	1909.4	20 59.6	21 05.3	″
20 00 S.— ″ ″ [illegible]	49	21	2	1909.4	21 12.3	21 13.0	″
20.00 S.— ″ ″ 30	49	21	2	1909.4	21 15.7	21 21.4	″
20 00 E.—S. W. ″ 28	49	21	2	1909.4	21 00.6	21 03.5	″
20 00 S.—N. E. ″ 33	49	21	2	1909.4	20 46.8	20 55.7	″
10 00 S.—N. E. ″ 28	49	21	2	1909.4	21 02.1	21 07.0	″
60 00 E. S. W. ″ 27	49	21	2	1909.4	20 43.9	20 53.8	″
60.00 S.—N. E. ″ 34	49	21	2	1909.4	21 18.4	21 21.3	″
30 00 S.—N. E. ″ 11	49	21	2	1909.4	21 44.1	21 52.0	″
50 00 S.—N. E. ″ 25	49	21	2	1909.4	21 43.1	21 44.0	″
30 00 W.—S. E. ″ 17	49	21	2	1909.4	20 55.3	20 56.2	″
20 00 S.—N. E. ″ 27	49	21	2	1909.4	21 05.7	21 13.6	″
50 00 S.—N. E. ″ 22	49	21	2	1909.4	21 21.7	21 24.6	″
30 00 E.—S. W. ″ 18	49	21	2	1909.4	20 57.6	21 08.0	″
30.00 W.—N.E. cor. sec. 19	49	21	2	1909.4	21 14.0	21 19.9	W. R. Reilly.
20.00 S.— ″ 32	49	21	2	1909.4	21 13.3	21 22.2	″
30.00 S.— ″ 29	49	21	2	1909.4	20 51.9	21 00.8	″
60 00 S.— ″ [illegible]	49	21	2	1909.4	20 58.7	21 01.6	″
Sta. 6 Traverse of Dead Moose Lake	38	22	2	1910.6	20 09.6	20 02.1	P. A. Carson.
At ¼ cor. W. by sec. 31	45	22	2	1910.7	20 01.6	....	″
″ ″ 31	45	22	2	1910.7	20 08.5	20 05.3	″
At N.E. cor. sec. 33	46	22	2	1908.7	21 09.8	21 17.3	W. R. Reilly.
At S.E. cor. sec. 4	15	23	2	1911.5	19 36.4	19 38.6	C. Rinfret.
At N.E. cor. sec. 34	15	23	2	1911.5	19 28.1	19 31.3	″
5.50 W.—N.E. cor. sec. 25	38	23	2	1910.6	19 57.9	20 01.0	P. A. Carson.
At N.E. cor. sec. 31	16	24	2	1911.4	19 20.9	19 20.7	C. Rinfret.
10 00 N.—N.E. cor. sec. 4	47A	24	2	1908.9	21 50.7	21 55.8	W. R. Reilly.
70 00 S.— ″ 31	40	24	2	1910.6	22 44.4	22 49.5	C. F. Miles.
40 00 W.— ″ 8	63	24	2	1911.2	23 23.6	....	A. Saint Cyr.
N.E. cor. sec. 35	52	25	2	1911.8	22 15.2	22 11.2	E. W. Hubbell
At. N.E. cor. sec. 21	15	26	2	1911.6	19 29.0	....	C. Rinfret.
″ ″ 20	16	26	2	1911.6	20 01.4	20 00.3	″
3 00 N.—N.E. cor. sec. 36	53	26	2	1911.8	22 37.4	22 34.1	E. W. Hubbell.
40 00 N.— ″ 6	58	26	2	1911.1	23 50.6	23 35.3	A. Saint Cyr.
At N.E. cor. sec. 28	58	26	2	1911.1	22 52.0	....	″
5 00 S.—N.E. cor. sec. 32	15	27	2	1911.4	19 57.8	20 01.2	C. F. Miles.
30.00 S.— ″ 17	15	27	2	1911.4	19 24.4	19 27.8	″
75·61 W.— ″ 36	45	27	2	1911.5	21 43.9	21 44.1	E. W. Hubbell.
At N.E. cor. 27	45	27	2	1911.5	22 15.7	22 15.9	″
30 00 S.—N.E. cor. sec. 21	45	27	2	1909.7	23 03.5	23 07.5	W. R. Reilly.
65.00 N.— ″ 17	45	27	2	1909.7	23 22.2	23 23.7	″
20.00 W.— ″ 17	45	27	2	1909.7	23 24.8	23 28.6	″
10.00 W.— ″ 22	45	27	2	1909.8	23 06.1	23 05.1	″
30.00 S.— ″ 14	45	27	2	1909.8	23 04.9	23 09.6	″

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912 0	Observer.
					° ′	° ′	
14 00 E.—N.E. cor. sec. 15	45	27	2	1909 8	23 08.0	23 08.7	W. R. Reilly.
60 00 S.— " 23	45	27	2	1909 8	23 08.7	....	
45 00 S.— " 31	48	27	2	1910.6	22 49.8	22 50.9	C. F. Miles.
6 00 S.— " 8	49	27	2	1910.6	23 30.5	23 31 6	E. W. Hubbell.
15.00 E.— " 12	15	28	2	1911.4	19 28.2	19 30 6	C. F. Miles.
40.00 W.— " 14	45	28	2	1909.7	24 39 2	21 43 0	W. R. Reilly.
40.00 S.— " 14	45	28	2	1909.6	21 29 7	24 35 8	"
76 00 W.— " 19	36	1	3	1909 6	22 50 6	23 00 7	"
At S.E. cor. sec. 6	36	1	3	1909 6	21 53 6	21 59 7	"
8 00 E.—N.E. cor. sec. 22	36	1	3	1909.6	22 06 7	22 04 8	"
60 00 W.— " 12	36	1	3	1909.6	22 20.0	22 29 1	"
40 00 W.— " 7	36	1	3	1909.6	22 14 6	22 14 7	"
16 00 S.— " 9	36	1	3	1909.6	22 19 3	22 19 2	"
8.00 N.— " 12	36	1	3	1909.6	22 30.3	22 46 2	"
24 00 S.— " 22	36	1	3	1909.6	22 17.9	22 28.3	"
24 00 S.— " 14	36	1	3	1909 6	22 32 7	22 34 1	"
12.00 N.— " 10	41	1	3	1909 5	20 51 3	21 03 5	"
26 00 S.— " 27	41	1	3	1909 5	20 43 5	....	"
50.00 S.— " 27	41	1	3	1909.5	21 02 6	21 02 8	"
70 00 S.— " 9	41	1	3	1909.5	21 08 1	21 15 3	"
10.00 S.— " 20	41	1	3	1909.5	21 41 3	21 50 5	"
30.00 S.— " 31	41	1	3	1909 5	21 16 3	21 16 5	"
30 00 S.— " 20	41	1	3	1909.5	21 21.1	21 28 3	"
At N.E. cor. sec. 9	41	1	3	1909 6	20 51.8	20 58 2	"
20 00 W. N.E. cor. sec. 20	41	1	3	1909 6	21 32 8	21 41 7	"
8 00 E.— " 21	41	1	3	1909.6	20 55 2	20 54 1	"
6 00 E.— " 23	41	1	3	1909.6	21 05.3	21 10.2	"
64 00 S.— " 4	42A	1	3	1909.5	21 26 0	21 37 2	"
34 00 S.— " 10	42A	1	3	1909.5	21 22.9	21 22 1	"
20.00 W.— " 16	42A	1	3	1909.5	22 07.3	22 14 5	"
At N.E. cor. sec. 24	45	1	3	1909 6	25 31.7	25 37 8	"
77.00 S.—N.E. cor. sec. 1	53	1	3	1910 0	22 50.2	22 52 5	A. Saint Cyr.
9.00 S.— " 1	56	1	3	1909 1	22 27.9	22 37 3	"
2.88 E.—N.W. cor. sec. 34	56	1	3	1909.8	23 09 7	23 12.4	Wm. Christie.
7 15 E.— " 33	56	1	3	1909.8	22 59.1	22 56.8	"
" " 33	56	1	3	1909 8	22 51.9	22 59.6	"
23 00 N.—N.E. cor. sec. 25	59	1	3	1910.4	23 55.4	23 59.3	A. Saint Cyr.
" " 25	59	1	3	1910.4	23 55.9	23 53.8	"
" " 25	59	1	3	1910 4	23 38.8	23 46.7	"
" " 25	59	1	3	1910.4	23 39.6	23 44.5	"
" " 25	59	1	3	1910.4	22 55.3	22 59.2	"
" " 25	59	1	3	1910.4	23 53 8	23 52 7	"
" " 25	59	1	3	1910 4	23 37.0	23 45.9	"
" " 25	59	1	3	1910.4	23 40.3	....	"
40 00 N.—N.E. cor. sec. 34	59	1	3	1910.4	25 27.1	25 24.2	"
" " 34	59	1	3	1910.4	25 08 6	25 16 7	"
55 00 N.— " 13	60	1	3	1909.2	22 43 1	....	"
75 00 N.— " 12	61	1	3	1910 5	23 34 9	23 38 7	"
10.00 N.— " 36	62	1	3	1910.5	25 29.4	25 32.8	"
40.00 N.— " 25	63	1	3	1910.6	24 32.4	21 34.5	"
40 00 N.—N.E. cor. sec. 21	64	1	3	1910.6	25 04·1	25 03·2	A. Saint Cyr.
At N.E. cor. sec. 24	64	1	3	1910 6	24 54·4	24 57 5	"
41 00 E.—N.E. cor. sec. 31	36	2	3	1911.6	21 55 9	....	R. C. Purser.
1 50 N.— " " 19	43	2	3	1911.6	23 47 4	23 43 3	"
20 56 E.—N.W " 35	56	2	3	1909 7	24 08·9	....	Wm. Christie.
60 34 E.— " " 31	56	2	3	1909.7	23 52 1	....	"
47 48 E.— " " 35	56	2	3	1909.7	23 56·9	....	"
13 00 W.—N.E. " 33	60	2	3	1909.4	23 16·0	23 23·7	A. Saint Cyr.
30.00 W.— " " 32	64	2	3	1910.6	24 32 9	24 33 0	"
19 00 S. 3 00 W.—N.E. cor. sec. 34	42	3	3	1910.8	25 19·5	25 15·2	D. E. Chartrand.
19 00 S. 3 00 W.— " 34	42	3	3	1910.8	25 12·2	25 13 9	"
19.00 S. 3 00 W.— " 34	42	3	3	1910.8	25 18·4	25 14·1	"
19 00 S. 3 00 W.— " 34	42	3	3	1910.8	25 11·5	25 14·2	"
19.00 S. 3 00 W.— " 34	42	3	3	1910.8	25 17 7	25 14 4	"

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912·0	Observer.
					° ′	° ′	
19.00 S. 3.00 W.—N.E. cor. sec. 34	42	3	3	1910.8	25 08·3	25 11·0	D. E. Chartrand.
19.00 S. 3.00 W.— " 34	42	3	3	1910.8	25 22·2	25 15·9	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.8	25 05·1	25 05·8	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.8	25 15·9	25 11·6	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.8	25 09·3	25 11·0	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.8	25 18·4	25 14·1	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.8	25 08·0	25 12·2	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 16·2	25 11·6	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 07·6	25 08·0	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 14·2	25 09·6	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 08·3	25 10·7	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 16·0	25 12·4	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 06·0	25 06·4	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 11·9	25 11·3	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 04·3	25 06·2	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 15·8	25 14·2	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 07·8	25 09·2	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 13·7	25 09·1	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 07·5	25 08·9	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 15·..	25 10·7	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 04·5	25 07·9	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 14·6	25 10·0	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 03·2	25 07·6	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 15·9	25 10·3	"
19.00 S. 3.00 W.— " 54	42	3	3	1910.9	25 03·1	25 06·0	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 17·8	25 19·2	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 08·6	25 10·0	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 12·9	25 11·3	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 06·4	25 05·8	"
19.00 S. 3.00 W.— " 34	42	3	3	19.0.9	25 17·9	25 17·3	"
19.00 S. 3.00 W.— " 34	42	3	3	1910.9	25 03·0	25 04·1	"
30.00 S. 5.00 E.— " 34	42	3	3	1910.6	25 18·1	25 08·4	P. A. Carson.
30.00 S. 5.00 E.— " 34	42	3	3	1910.6	24 56·1	24 59·7	"
At S.E. cor. sec. 1	43	3	3	1910.6	24 44·3	24 43·4	"
" 1	43	3	3	1910.6	24 40·3	24 37·4	"
15.00 W.—N.E. cor. sec. 9	47	3	3	1909.5	25 07·8	25 14·0	A. L. McNaughton
2.00 N. " 9	47	3	3	1909.5	25 04·0	25 11·2	"
At N.E. cor. sec. 11	48	3	3	1909.8	24 23·8	24 31·5	W. R. Reilly.
" 23	48	3	3	1909.7	24 47·2	24 53·2	"
38.00 S.—N.E. cor. sec. 14	48	3	3	1909.8	24 42·5	24 39·2	"
12.00 E.— " 11	48	3	3	1909.8	24 34·2	24 40·9	"
18.00 S.— " 2	48	3	3	1909.8	24 33·7	24 40·4	"
54.00 S.— " 7	48	3	3	1969.8	24 39·4	24 41·1	"
75.00 S.— " 10	48	3	3	1909.7	24 59·7	25 05·7	"
45.00 S.— " 27	48	3	3	1909.7	24 51·7	24 52·7	"
66.00 S.— " 22	48	3	3	1909.7	24 51·2	24 59·2	"
At N.E. cor. sec. 10	48	3	3	1909.7	24 57·9	24 58·9	"
48.00 W.—N.E. cor. sec. 34	48	3	3	1909.7	24 08·9	24 09·9	"
56.00 W.— " 31	48	3	3	1909.7	24 15·9	24 14·9	"
70.00 W.— " 34	48	3	3	1909.7	24 16·9	24 12·9	"
15.00 W.— " 32	48	3	3	1909.7	24 37·7	24 47·7	"
66.00 S.— " 29	48	3	3	1909.7	24 38·2	....	"
43.00 S.— " 19	48	3	3	1909.7	24 42·1	24 46·1	"
At N.E. cor. sec. 32	48	3	3	1909.7	24 33.3	....	"
" " 17	49	3	3	1909.9	24 34·0	24 34·0	"
20.00 E.—N.E. cor. sec. 8	49	3	3	1910.6	24 44·1	24 44·7	P. A. Carson.
20.00 E.— " 8	49	3	3	1910.7	24 34·1	24 40·9	"
20.00 E.— " 8	49	3	3	1910.7	24 35·0	24 41·8	"
76.20 E.—N.W. cor. sec. 33	56	3	3	1910.7	23 39·6	23 40·0	Wm. Christie.
31.50 E.— " 34	56	3	3	1909.7	23 32·5	23 40·9	"
69.19 E.— " 36	56	3	3	1909.7	23 41·3	23 45·3	"
55.00 W.—N.E. cor. sec. 35	60	3	3	1909.4	23 59·0	23 58·7	A. Saint Cyr.
55.00 W.— " 35	60	3	3	1909.4	23 34·9	23 43·6	"
75.00 W.— " 35	64	3	3	1910.7	24 09·5	24 10·3	"
4.00 E. ¼ cor. S.E. by. 1	39	4	3	1910.7	24 21·8	24 25·8	P. A. Carson.

TABLE No. 4.—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912·0	Observer.
					° ′	° ′	
12 60 W.—S E. cor. sec. 1..........	39	4	3	1910 7	24 28·5	24 28·5	P. A. Carson.
5 00 S.—N.E. cor. sec. 8............	46	4	3	1909 7	23 18·4	23 22·4	A.L.McNaughton
11 00 S.— " " 17	47	4	3	1909.7	24 17 8	.... ..	"
5 00 S.— " " 9....	47	4	3	1909.7	24 10·8	24 08 8	"
10 00 E.— " " 7............	47	1	3	1909 7	23 15 8	23 19 8	"
72 00 S.— " " 13..........	48	4	3	1909 8	24 36 5	24 31·2	W. R. Reilly
38 00 S.— " " 1..........	48	4	3	1909.8	24 29 0	24 36 7	"
50 00 S.— " " 36....	48	4	3	1909.7	24 04 2	24 11 7	"
34 95 E.—N.W. cor. sec. 33	56	4	3	1909.7	22 36 1	22 39 6	Wm. Christie.
34.95 E.— " " 33.	56	4	3	1909 7	22 43 1	22 40·6	"
77 00 E.— " " 34	56	4	3	1909.7	23 00·6	23 09·1	"
70 00 W.—N E. cor. sec. 34	60	4	3	1904 4	22 03·1	22 08 8	A. Saint Cyr
75.00 E.—N E. cor. sec. 31..........	64	4	3	1910.7	24 04·3	24 04·3	"
50 00 N.— " " 19..........	7	5	3	1908 6	20 21·7	20 28 9	C. F. Miles.
30.00 N.— " " 5....... ..	25	5	3	1911.5	24 13 0	24 15·2	G. A. Bennett.
10 00 N.—S E. cor. sec. 1...........	39	5	3	1910 6	24 09·9	24 10 0	P. A. Carson.
10 00 N.— " " 1.....	39	5	3	1910 6	24 19·7	24 17·8	"
12 00 N.—S.E. cor. sec. 1...........	39	5	3	1910.6	24 13·8	24 11·9	D. E. Chartrand.
1·00 S.—N.E. cor. sec. 9.....	46	5	3	1911.4	22 52·7	....	E. W. Hubbell.
14 00 S.— " " 23............	46	5	3	1911.4	23 31·1	23 34·5	"
At N E. cor. sec. 7................	49	5	3	1910.7	20 47·2	20 42·0	P. A. Carson.
" "	49	5	3	1910.7	20 44 9	20 40·7	"
15 20 E.—N.W. cor. sec. 35.........	56	5	3	1909.7	20 39 5	20 43·0	Wm. Christie.
40 03 E.— " " 35.........	56	5	3	1909.7	20 56 0	20 54 0	"
67.00 E.— " " 35.........	56	5	3	1909.7	20 29·9	20 39·9	"
53 61 E.—N.W. cor. sec. 33.........	56	5	3	1909 7	21 09·5	21 07·5	"
12 15 E.— " " 34.........	56	5	3	1909.7	20 52·2	21 00·2	"
56.00 W.—N.E. cor. sec. 34.........	60	5	3	1909.4	22 01·6	22 12·5	A. Saint Cyr.
56.00 W.— " " 34.........	60	5	3	1909.4	22 21·5	22 22 4	"
65 00 E.—N.E. " 32.........	61	5	3	1910.7	23 26·2	23 29·2	"
At S E. cor. sec. 5.......	23	6	3	1911.8	21 04·4	21 00·4	C. Rinfret
15 00 W.—center sec. 24............	33	6	3	1910.6	23 04 0	22 57·5	P. A. Carson.
At centre sec. 24....................	33	6	3	1910.6	22 46·3	22 55·4	"
3.00 N.—N E. cor. sec. 34.........	53	6	3	1911.7	21 00·7	20 59·7	E. W. Hubbell.
4 00 N.—S E. " 5.........	55	6	3	1911.7	20 52·9	20 48·9	"
1.67 E.—N.W. cor. sec. 31..........	56	6	3	1909.7	22 38·6	22 37·4	Wm. Christie.
35 20 E.— " " 31..........	56	6	3	1909.7	21 26·0	21 37·8	"
16 17 E.— " " 32..........	56	6	3	1909.7	20 36·5	20 40·3	"
16 17 E.— " " 32..........	56	6	3	1909.7	20 39·3	20 41·1	"
39 00 E.— " " 32..........	56	6	3	1909.7	20 16·2	20 30·0	"
50.00 E.— " " 33.....	56	6	3	1909.7	21 42 9	21 39·9	"
20.20 E.— " " 34..........	56	6	3	1909.7	22 21·4	22 33·4	"
49 16 E.—N.W. " 34..........	56	6	3	1909.7	22 43 9	22 36·9	"
8 74 E.— " " 35....	56	6	3	1909.7	22 12·6	22 22·6	"
23.00 E.—N.E. cor. sec. 34..........	64	6	3	1910.7	25 33·1	25 34·1	A. Saint Cyr.
At N E. cor. sec. 12....	1	7	3	1909 8	20 42·1	20 38 8	C. F. Miles.
55 00 E.—N E. cor. sec 11...	50	7	3	1910.8	21 35 5	....	E. W. Hubbell.
60 00 N.— " " 8.........	52	7	3	1910.8	22 07 3	22 08 4	"
35 00 N.— " " 4.......	53	7	3	1910 8	23 23 0	23 22 7	"
47 00 E—S.E. cor. sec. 3	55	7	3	1911.7	23 31 0	23 27 0	"
65 37 E.—N.W. " 32	56	7	3	1909 6	25 33·3	25 35 4	Wm. Christie.
61 91 E.— " " 33	56	7	3	1909.7	24 52 4	24 48·2	"
60.00 E.— " " 34	56	7	3	1909.7	21 56 0	22 09 8	"
15.00 W.—N.E. cor. sec. 36.........	60	7	3	1909.5	23 04·1	23 08 7	A. Saint Cyr.
40 00 W.— " " 33.........	61	7	3	1910.8	25 36·0	25 37·1	"
At N E. cor. sec. 31................	64	7	3	1910.8	25 25·5	25 26·6	"
1 00 N.—N.E. cor. sec. 17	49	8	3	1910.8	22 24 9	22 24·0	E. W. Hubbell.
15 00 N.— " " 3..	50	8	3	1910.8	22 58·2	22 58·3	"
15 00 N.— " " 24.	51	8	3	1910.8	23 22 0	23 22·1	"
At N.E, cor. sec. 34	51	8	3	1910.8	23 34·2	23 32·9	"
" " 36...........	51	8	3	1910.8	23 09·9	23 08·6	"
37 86 E.—N.W. cor. sec. 35.........	56	8	3	1909.6	24 45·4	24 43·5	Wm. Christie.
10 00 E.— " " 36.........	56	8	3	1909.6	25 45·2	25 55·3	"
55.25 E.— " " 33.........	56	8	3	1909.6	25 49·0	25 55·1	"
18.20 E.— " " 34.........	56	8	3	1909.6	25 45·3	25 41·4	"
50.29 E.— " " 34....	56	8	3	1909 6	24 37·8	24 49·9	"

TABLE No. 4.—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912 0	Observer.
					° ′	° ′	
31.00 W.—N.E. cor. sec. 35	60	8	3	1909 5	25 41 1	25 12 6	A. Saint Cyr.
34.00 W.— " " 35	60	8	3	1909.5	25 34 3	25 47.5	"
24.50 W.— " " 33	60	8	3	1909.5	25 25 2	25 38 1	"
55.00 W.— " " 31........	64	8	3	1910.8	25 31 8	25 27 9	"
55.00 W.— " " 31........	64	8	3	1910 8	24 25 1	24 28 2	"
N E. cor. sec. 32...	50	9	3	1911 9	23 57 6	......	E. W. Hubbell.
62.50 E.—N.E. cor. sec. 21..... ...	51	9	3	1911 9	24 29 5	24 26 0	"
45.50 E.— " " 23....	52	9	3	1911 8	24 30.4	24 26.2	"
5 00 S.— " " 26.	53	9	3	1911.9	24 25 3	24 20 9	"
72.00 E,—N.W. cor. sec. 32	56	9	3	1909 6	23 17 1	23 22 2	Wm. Christie.
75.03 E.— " " 34........	56	9	3	1909 6	23 21.3	23 27 4	"
15.00 W.—N.E. " 34	60	9	3	1909 6	23 52 5	23 58.4	A. Saint Cyr.
15 00 E.— " " 31........	64	9	3	1910 8	24 30 8	24 29 5	"
At N.E. cor. sec. 33	21	10	3	1909.4	21 34 6	21 32 7	C. F. Miles
At N.W . " 19	49	10	3	1911 5	24 40 0	24 44 1	E. W. Hubbell.
34.40 W.—N.E. cor. sec. 33........	50	10	3	1911 9	24 23.9	24 18.4	"
30.00 W.—N.E. " 33........	51	10	3	1911 9	23 38 9	23 34.4	"
32.55 E.—N.W. " 32..........	56	10	3	1909 6	24 49 0	24 52.9	Wm. Christie.
57.50 W.—N.E. " 35	60	10	3	1909 6	23 23 9	23 28.0	A. Saint Cyr.
At N.E. " 12	49	11	3	1911 4	24 20 0	......	E. W. Hubbell.
20.00 S.—N.E. " 33..........	51	11	3	1911 9	22 17 7	22 13 2	"
At N.E. " 35..........	51	11	3	1911.7	22 19 3	22 15.3	"
8.55 E.—N.W. " 23....... ..	56	11	3	1909 6	25 23 8	25 31.7	Wm. Christie.
7.00 W.—N.E. " 32.... ...	60	11	3	1909 6	24 42.9	24 42.0	A. Saint Cyr.
40.02 N.— " 9.........	49	12	3	1909 9	24 35 2	24 34 2	W. R. Reilly.
10.00 S.— " 5.........	49	12	3	1909 9	24 24 5	24 31.5	"
40.00 N.— " 10.........	49	12	3	1909 9	24 20 4	24 26.4	"
20.00 N.— " 6.........	49	12	3	1909.9	24 23 8	24 21 8	"
At N.E. cor. sec. 23	49	12	3	1909 9	24 28.2	24 34.2	"
10.00 S.—N.E. cor. sec. 2	49	12	3	1909 9	24 27 6	24 27 6	"
10 00 N.— " 7.......... ..	49	12	3	1909 9	24 17 1	24 21.1	"
9 00 S.— " 32	50	12	3	1910.9	24 16 7	24 17 1	E. W. Hubbell.
At N.E. cor. sec. 12	52	12	3	1911.7	24 04 9	24 01.9	"
67 00 E.—N.W. cor. sec. 34	56	12	3	1909.6	25 29 1	25 36 3	Wm. Christie.
10 00 W.—N.E. " 31.........	60	12	3	1909 6	25 21 8	35 26 9	A. Saint Cyr.
30 00 W.— " " 32	3	13	3	1909 7	29 41 6	......	C. F. Miles.
At N.E. cor. sec. 19...	50	13	3	1910 9	24 21 5	......	E. W. Hubbell
1 00 E.—S.E. cor. sec. 1	51	13	3	1910 9	24 24 2	24 23 6	"
17 00 S.—N.E. cor. sec. 15	52	13	3	1911.7	23 20 0	23 16 0	"
48 30 E.—N.W. " 36	56	13	3	1909 5	24 20 1	....	Wm. Christie.
63 00 W.—N.E. " 31.... . .	60	13	3	1909 7	26 10 4	26 13 4	A. Saint Cyr.
At N.E. cor. sec. 33....	64	13	3	1911 3	26 46 5	......	"
" "	64	13	3	1911 3	27 01.6	......	"
" "	64	13	3	1911.3	27 03 4	27 04 8	"
" "	64	13	3	1911 3	26 57 8	27 00 2	"
At N.E. cor. sec. 31......	52	14	3	1910 9	25 26 6	25 28 0	E. W. Hubbell.
53 35 E.—N.W. cor. sec. 33	56	14	3	1909 5	26 57 3	27 04 5	Wm. Christie.
At N.E. cor. sec. 31................	64	14	3	1911.5	25 20 5	25 20 9	A. Saint Cyr
At Post, sec. 1, lot 1, group 267.. ..	41	15	3	1910 7	24 27 7	24 26 7	P. A. Carson.
10.00 W.—Post, No. 1, lot 1, gr. 267	41	15	3	1910 7	24 29 0	24 30 5	"
17.32 E.—N.W., cor. sec. 32	56	15	3	1909 5	26 55 3	......	Wm. Christie.
70 00 E.— " 32	56	15	3	1909 5	27 06 6	27 16 2	"
18.40 E.— " 33	56	15	3	1909.5	27 04 0	27 10 6	"
18 40 E.— " 33	56	15	3	1909 5	27 16 6	27 17 7	"
57 93 E.— " 33........	56	15	3	1909 5	27 13 4	27 26 0	"
9.00 W.—N.E. cor. sec. 33.	64	15	3	1911 3	26 29 4	26 30 8	A. Saint Cyr.
6.00 N.—9.00 W. ¼ cor. N. By. 6...	47	16	3	1910.7	24 17 7	24 23 7	P. A. Carson.
At S.W. cor. sec. 6.	52	16	3	1911 6	25 56 3	26 55 8	E. W. Hubbell.
60 63 S.—N.E. cor. sec. 24.........	53	16	3	1910 9	26 31 8	26 33 2	"
45 00 E.—N.W. " 32	56	16	3	1909 5	26 51 6	26 56.2	Wm. Christie
12 79 E.— " " 33	56	16	3	1909.5	26 46.8	26 57.4	"
20.00 W.—N.E. cor sec. 34.........	60	16	3	1909 8	25 01 1	25 03 8	A. Saint Cyr.
56.00 W... " " 34	64	16	3	1911 3	25 37 0	......	"
At ¼ cor. E. by sec. 12	47	17	3	1910 7	24 22 4	24 22 4	P. A. Carson.
At N.E. cor. sec. 31.	53	17	3	1910 8	26 17 3	26 23 4	C. F. Miles.
17.00 N.—S.E. cor. sec. 4...........	56	17	3	1911.7	26 02 0	25 58 2	E. W. Hubbell

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912.0.	Observer.
					° ′	° ′	
50.00 E.—N.W. cor. sec. 31	56	17	3	1909.4	26 23.5	26 22.4	Wm. Christie.
52.00 E.— " 32	56	17	3	1909.4	25 56.6	.....	"
At N.E., cor. sec. 35	57	17	3	1911.7	26 35.1	26 31.3	E. W. Hubbell.
" " 21	59	17	3	1911.6	26 03.5	26 01.0	"
22.00 W.—N.E., cor. sec. 34	60	17	3	1909.8	25 14.0	.....	A. Saint Cyr.
7.00 W.— " 36	64	17	3	1911.4	25 34.7	25 29.7	"
45.00 S.— " 26	1	18	3	1909.7	20 01.9	20 00.9	C. F. Miles.
30.00 N.— " 11	25	18	3	1909.5	22 01.2	22 03.6	"
At N.E. cor. sec. 8	53	18	3	1910.8	26 40.3	26 45.6	"
" 34	53	18	3	1910.8	26 04.5	26 07.6	"
" 31	56	18	3	1909.4	25 57.1	26 00.0	Wm. Christie.
65.55 E.—N.W. cor. sec. 32	56	18	3	1909.4	25 37.4	25 48.3	"
At N.E. cor. sec. 34	58	18	3	1911.6	26 16.5	26 16.0	E. W. Hubbell.
" 10	59	18	3	1911.6	26 22.0	26 19.5	"
25.00 W.—N.E. cor. sec. 33	60	18	3	1909.8	25 45.9	.....	A. Saint Cyr.
At N.E. cor. sec. 32	60	18	3	1911.6	25 47.2	25 46.7	E. W. Hubbell.
78.00 W.—N.E. cor. sec. 33	64	18	3	1911.4	26 50.9	26 49.7	A. Saint Cyr.
10.00 W.—S.E. cor. sec. 3	55	19	3	1910.7	26 11.2	26 10.7	C. F. Miles.
67.00 E.—N.W. cor. sec. 32	56	19	3	1909.4	26 11.7	26 17.4	Wm. Christie.
26.65 S.—N.E. cor. sec. 20	58	19	3	1911.6	25 31.9	25 29.4	E. W. Hubbell.
At N.E. cor. sec. 36	60	19	3	1911.6	25 30.3	25 28.8	"
" 34	60	19	3	1911.6	25 17.9	25 18.4	"
25.00 W.—N.E. cor. sec. 33	60	19	3	1909.9	25 35.4	25 38.4	A. Saint Cyr.
64.00 W.— " 34	64	19	3	1911.4	26 51.0	26 53.8	"
30.00 N.— " 29	54	20	3	1910.7	25 00.2	25 00.2	C. F. Miles.
At N.E. cor. sec. 10	54	20	3	1910.8	25 04.1	25 09.2	"
At N. E. cor. sec. 19	56	20	3	1910.7	26 10.7	.....	C.F. Miles
36.22 E.—N. W. cor. sec. 32	56	20	3	1909.4	26 42.8	26 38.5	Wm. Christie
2.00 E.— " 33	56	20	3	1909.4	26 23.3	26 29.0	"
75.00 W.—N. E. cor. ssc. 34	60	20	3	1909.9	25 15.2	.....	A. Saint Cyr.
27.00 W.— " 34	64	20	3	1911.4	26 00.1	26 02.5	"
At N. E. cor. sec. 36	56	21	3	1910.7	33 13.5	33 09.9	C. F. Miles.
1.00 E.—N. W. cor. sec. 34	56	21	3	1909.4	26 09.6	26 15.3	Wm. Christie.
At N. E. cor. sec. 19	57	21	3	1910.7	25 25.9	.....	C. F. Miles.
22.00 W.—N. E. cor. sec. 36	64	21	3	1911.5	26 35.9	26 30.5	A. Saint Cyr
22.00 W.— " 36	64	21	3	1911.5	26 16.9	26 21.0	"
66.00 W.— " 34	64	21	3	1911.5	26 21.2	26 19.8	"
At N. E. cor. sec. 35	53	22	3	1910.8	24 35.5	.....	C. F. Miles.
27.00 E.—N. W. cor. sec. 33	56	22	3	1909.4	26 15.7	26 17.9	Wm. Christie.
12.00 W.—N. E. " 32	64	22	3	1911.5	26 07.5	26 06.6	A. Saint Cyr.
At N. E. cor. sec. 14	3	23	3	1909.7	21 32.7	21 31.7	C.F. Miles.
10.00 N.—N. E. cor. sec. 15	7	23	3	1911.4	21 35.9	.....	A.L. Cumming.
20.00 N.— " 26	7	23	3	1911.5	21 37.2	21 34.3	"
5.00 N.— " 7	7	23	3	1911.5	21 26.4	21 28.5	"
20.00 S.— " 25	7	23	3	1911.5	21 40.9	21 40.0	"
40.00 S.— " 18	37	23	3	1910.8	24 13.7	24 13.8	P. A. Carson.
10.00 N.—S. E. cor. sec. 6	54	23	3	1909.9	24 25.3	24 27.3	G. J. Lonergan.
20.00 N.—N. E. cor. sec. 28	55	23	3	1910.8	26 10.7	.....	C.F. Miles.
50.00 S.— " 4	56	23	3	1910.8	26 32.0	.....	"
62.00 E.—N. W. " 32	56	23	3	1909.3	26 12.4	26 15.4	Wm. Christie.
At N. E. cor. sec 33	57	23	3	1910.8	26 08.5	26 09.6	C. F. Miles.
69.00 W.—N. E. cor. sec. 33	64	23	3	1911.5	25 33.8	25 38.9	A. Saint Cyr.
15.00 N.— " 14	7	24	3	1911.5	21 37.4	21 37.5	G.L. Cumming.
30.00 S.— " 16	7	24	3	1911.5	21 41.4	21 35.5	"
10.00 N.—S. E. " 4	7	24	3	1911.5	21 25.9	21 33.0	"
8.00 N.—N. E. " 20	7	24	3	1911.5	21 30.3	21 30.5	"
10.00 N.—S. E. " 2	54	24	3	1909.9	24 26.5	24 32.5	A. J. Lonergan.
63.00 E.—N. W. " 35	56	24	3	1909.3	26 14.8	26 18.0	Wm. Christie.
10.00 S.—N. E. " 29	57	24	3	1910.5	25 49.6	25 54.4	H.S. Holcroft.
30.00 S.— " 21	58	24	3	1910.8	25 43.7	25 43.8	C.F. Miles.
30.00 W.— " 33	64	24	3	1911.5	26 29.4	26 24.6	A. Saint Cyr.
30.00 W.— " 33	64	24	3	1911.5	26 17.0	26 22.2	"
30.00 W.— " 33	64	24	3	1911.5	26 20.9	26 19.1	"
At N. E. cor. sec. 32	14	25	3	1910.5	22 29.9	22 34.7	C.F. Miles.
" " 21	15	25	3	1910.5	23 53.6	23 54.0	"
" " 25	37	25	3	1910.8	24 07.9	.....	P.A. Carson.

TABLE No. 4.—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912.0	Observer.
					° ′	° ′	
At N.E, cor. sec. 25	37	25	3	1910 8	24 11.2	24 10.3	P. A. Carson.
35.00 N.—N E. cor sec. 26	37	25	3	1910.8	23 47.7	23 53 8	"
At N E. cor. sec. 5	47	25	3	1910 7	21 17.2	24 19 2	"
15 00 W —N.E. cor. sec. 18	48	25	3	1910 7	24 47.1	24 50 6	"
15 00 W.— " 18	48	25	3	1910 7	21 49 2	24 51 2	"
15 00 W.— " 18	48	25	3	1910.7	24 47 6	24 45 6	"
15.00 W.— " 18	48	25	3	1910 7	24 46 ˙	24 45 5	D. E. Chartrand.
15 00 W.— " 18	48	25	3	1910 7	21 43.5	24 43 5	"
15.00 W.— " 18	48	25	3	1910 7	24 36 4	24 36 4	P. A Carson.
15.00 W.— " 18	48	25	3	1910 7	24 34.5	21 35.5	"
15.00 W.— " 18	18	25	3	1910 7	24 30 7	24 34 7	"
15.00 W.— " 18	48	25	3	1910 7	24 33.9	24 40 9	"
15.00 W.— " 18	18	25	3	1910 7	24 26.6	24 34 6	"
15.00 W.— " 18	48	25	3	1910.7	24 37.7	24 43 7	D. E Chartrand
15 00 W.— " 18	48	25	3	1910 7	24 37 3	24 43 3	"
15.00 W.— " 18	18	25	3	1910 7	24 37.1	24 44 1	"
15 00 W.— " 18	48	25	3	1910.7	21 40.8	24 46 3	"
15 00 W.— " 18	48	25	3	1910 7	21 38 9	24 40 9	"
15.00 W.— " 18	48	25	3	1910.7	24 41.6	24 42 1	"
15.00 W.— " 18	48	25	3	1910 7	24 39.0	24 39 5	"
15.00 W.— " 18	48	25	3	1910 7	24 38 8	24 38.8	"
15 00 W.— " 18	48	25	3	1910 7	21 39 4	24 39.4	"
15.00 W.— " 18	48	25	3	1910 7	24 41.0	24 41.0	"
62.00 E.—N.W cor. sec 32	56	25	3	1909 3	26 25.5	26 20 7	Wm. Christie
33 00 E.—N W. cor. sec. 33	56	25	3	1909.3	25 45.9	25 55.1	"
60.00 N.—N.E. " 23	57	25	3	1910 5	26 01 5	25 57 9	H. S Holcroft.
At N.E cor sec. 27	57	25	3	1910.5	25 43 9	25 44 3	"
Near S E. cor. sec. 31	63	25	3	1911 6	26 21.4	26 17.9	A. Saint Cyr
64 00 W.—N.E. cor. sec. 36	64	25	3	1911 5	25 49.6	25 50 8	"
43.00 W.— " 33	64	25	3	1911.5	25 52 4	25 19.6	"
10.00 S. 30 00 W.—N E. cor. sec. 19	40	26	3	1910.8	23 40.8	23 36.9	D. E Chartrand.
"	40	26	3	1910.8	23 43.6	23 40.7	P. A. Carson
"	40	26	3	1910 8	23 44 2	23 39 3	"
30.00 N.—S E cor. sec. 11	54	26	3	1909.8	24 42.1	....	G. J Lonergan
10.00 S.—N E. " 31	55	26	3	1909 8	26 37.9	26 53.2	"
5 00 S.— " " 32	55	26	3	1909 8	26 27.6	26 29 9	"
At N.E. cor. sec 35	56	26	3	1909 3	25 53.0	25 57.2	Wm. Christie.
5.00 N.—N. E. cor. sec. 7	57	26	3	1910.8	25 21.1	25 19.8	C.F. Miles.
At N. E. cor. sec. 35	59	26	3	1910 8	26 00.7	26 00 4	C. F. Miles
48 00 W.—N.E. cor. sec. 31	60	26	3	1910 2	25 23 4	25 30.6	A. Saint Cyr.
15.00 W.— " 35	60	26	3	1910 1	25 02 9	25 08 9	"
13.00 W.— " 31	64	26	3	1911.6	24 40 8	24 39·7	"
13.00 W.— " 34	64	26	3	1911.6	24 48·6	24 44·5	"
13.00 W.— " 34	64	26	3	1911.6	24 37·8	24 41·2	"
8.00 N.— " 7	65	26	3	1911.6	25 52 9	25 50·8	"
At ¼ cor. N. by sec. 7	48	27	3	1910.7	25 26·6	25 29 6	P. A. Carson.
10.00 S.—N.E. cor. sec. 11	53	27	3	1909.9	25 40 4	25 39 4	G. J. Lonergan.
10.00 E.— " " 35	55	27	3	1909.8	27 14 4	27 11·7	"
15.00 N.—S.E. " 1	56	27	3	1909.8	27 13·5	27 09·8	"
72 50 E —N.W. " 36	56	27	3	1909.3	25 54 0	25 57·2	Wm. Christie.
30.25 W.—N.E. " 36	60	27	3	1910 2	25 15·4	25 20·1	A. Saint Cyr.
40.00 S.— " " 24	14	28	3	1911 6	21 40 9	21 39 4	C. Rintret.
3.00 N.— " " 21	15	28	3	1911.7	22 40·9	22 38·1	"
20.00 N.— " " 1	1	29	3	1909 6	21 10 9	21 42 0	C. F. Miles.
40.00 N.— " " 9	14	1	4	1910 9	22 13·5	22 12 2	"
13.80 E.— " " 8	13	1	4	1911.7	25 03 2	24 59 2	R. C. Purser.
20.00 S.— " " 34	57	1	4	1909.8	25 21 2	....	G. J. Lonergan.
5.00 N.—S.E. " 3	58	1	4	1909 8	25 14·3	25 13·0	"
20.00 S —N.E. " 31	62	1	4	1909 8	25 18·4	25 21 1	"
12.00 S " " 25	62	1	4	1911.6	26 05 0	26 01·5	A. Saint Cyr.
12.00 S.— " " 25	62	1	4	1911 6	26 18 6	26 12 1	"
12 00 S.— " " 25	62	1	4	1911 6	26 18 5	26 13 0	"
12.00 S — " " 25	62	1	4	1911.6	26 00·2	26 03 7	"
5.00 N.—S.E. " 5	63	1	4	1909 8	25 29 0	25 31 7	G J. Lonergan.
7.00 N —N.E. " 25	63	1	4	1909 2	25 15·2	25 11 3	J. N. Wallace.
40.00 N — " " 12	63	1	4	1911 6	25 58 3	25 50 8	A. Saint Cyr.

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912·0	Observer.
					° ′	° ′	
40 00 N.—N.E. cor. sec. 12	63	1	4	1911 6	25 46 2	25 46·7	A. Saint Cyr.
40 00 N.— " " 12	63	1	4	1911 6	25 51 1	25 48·6	"
2 30 S.— " " 24	65	1	4	1911 6	26 15 8	26 13·3	"
2.00 N.— " " 13	65	1	4	1911.6	26 04 2	26 01·7	"
2 00 N.— " " 13	65	1	4	1911 6	26 19 1	26 08 6	"
2 00 N.— " " 13	65	1	4	1911 6	26 01 1	26 06 6	"
2.00 N.— " " 13	65	1	4	1911 6	26 08 2	26 05·7	"
2 00 N.— " " 13	65	1	4	1911.6	26 00·9	26 06 4	"
39.00 N.—S.E. " 13	65	1	4	1909 3	25 48·6	25 51 8	J. N. Wallace.
5 00 N.—N.E. " 25	67	1	4	1909 3	26 31·0	26 25 2	"
61 21 W.— " " 35	68	1	4	1910 4	26 44 0	26 49 1	Wm. Christie.
19.00 W.— " " 32	68	1	4	1910.4	26 37·5	26 39 6	"
9.00 N.—S.E. " 25	69	1	4	1909 4	26 18 1	26 13 0	J. N. Wallace.
75.00 S.—N.E. " 1	69	1	4	1909.4	27 22 6	27 16·3	"
64 00 N.—S.E. " 1	71	1	4	1909 5	26 53 1	26 49·5	"
16 05 W.—N.E. " 33	72	1	4	1910 6	26 24·4	26 24 2	B. J. Saunders.
59.41 W.— " " 34	76	1	4	1910.7	27 44·9	27 46·9	Wm. Christie.
68.27 W.— " " 21	76	1	4	1910.7	27 11·5	27 11·5	"
80.70 S.— " " 1	77	1	4	1909.8	28 08·2	28 11·9	J. N. Wallace.
3.00 N.— " " 13	78	1	4	1909.8	27 10·4	27 10 1	"
7.00 N.— " " 25	78	1	4	1909.8	27 07·1	26 57·8	"
14.00 N.— " " 13	79	1	4	1909.8	26 54·3	26 49·0	"
5.00 N.— " " 1	80	1	4	1909.9	26 14·7	26 08·9	"
40 00 N.—N.E. " 24	80	1	4	1909 9	27 06·8	27 02·2	J. N. Wallace.
65 00 N.— " " 1	82	1	4	1910.5	28 04·5	28 08·3	"
47.00 N.— " " 12	83	1	4	1910.5	28 33 0	28 38·8	"
75 65 N.—S.E. " 25	83	1	4	1910.5	28 59·5	29 04·3	"
53 00 N.— " " 1	86	1	4	1910 6	27 34·0	27 39·1	"
64.00 N.—N.E. " 25	86	1	4	1910.6	27 41·8	27 46·9	"
33.84 N.— " " 13	87	1	4	1910.6	25 42·5	25 45·6	"
1 64 N.— " " 25	87	1	4	1910 6	27 24·1	27 29·2	"
5 00 W.— " " 35	88	1	4	1911 5	31 09 9	31 07·0	G. H. Blanchet.
72.31 N.—S.E. " 1	88	1	4	1910.6	28 10·4	28 14 5	J. N. Wallace.
77 24 N.—N.E. " 12	88	1	4	1910.6	28 29·3	28 35·4	"
26 00 N.— " " 12	89	1	4	1910.7	30 32 2	30 36 7	"
21 61 N.— " " 36	89	1	4	1910.7	29 48·2	29 49·7	"
53.00 N.— " " 24	90	1	4	1910.7	26 05·5	.. ....	"
10.00 N.— " " 1	91	1	4	1910.8	26 22 2	....	"
45 00 N.— " " 24	91	1	4	1910.8	26 19·3	26 23·4	"
5 00 S.— " " 36	91	1	4	1910.8	25 49 3	25 48·4	"
70 00 N.— " " 12	92	1	4	1910.8	27 29·1	27 25 2	"
70 00 N.— " " 12	92	1	4	1910.8	27 19 7	27 23 8	"
70 00 N.— " " 12	92	1	4	1910 8	27 23·7	....	"
24.23 W.—N.E. " 36	92	1	4	1911.8	28 16·7	28 10 7	J. B. McFarlane.
59.00 N.— " " 24	93	1	4	1910.8	30 18·5	30 14 2	J. N. Wallace.
59 00 N.— " " 24	93	1	4	1910.8	30 19·7	30 18 1	"
59 00 N.— " " 24	93	1	4	1910 8	30 31·3	30 30·0	"
32 00 N.— " " 24	94	1	4	1910 9	30 57·1	30 52·5	"
32 00 N.— " " 36	94	1	4	1910 9	30 49·1	30 47 0	"
32 00 N.— " " 36	94	1	4	1910 9	30 48·3	30 49·7	"
3.00 N.—N.E. cor. sec 1	95	1	4	1910.9	31 08 8	... .	J. N. Wallace.
24.93 N.— " 24	96	1	4	1911.5	31 13·3	31 15·4	J. B. McFarlane.
1 27 N.— " 1	97	1	4	1911.5	31 20 8	31 22 9	"
68.67 N.— " 1	97	1	4	1911.5	31 05·1	31 07·2	"
53 41 N.— " 12	97	1	4	1911.5	31 14 8	31 18·0	"
51 07 N.— " 13	97	1	4	1911.5	31 13 3	31 13·5	"
2.20 N.— " 24	97	1	4	1911.5	31 15·0	31 16·2	"
77.73 N.— " 21	97	1	4	1911.5	31 31·3	31 32·5	"
10.33 N.— " 12	98	1	4	1911 5	31 21·6	....	"
76 46 N.— " 24	98	1	4	1911.5	30 58·0	30 57·2	"
31.96 N.— " 1	99	1	4	1911 5	31 16 7	31 18 9	"
9 73 N.— " 13	99	1	4	1911.5	30 22·3	30 22·5	"
29.77 N.— " 1	100	1	4	1911.6	30 01 8	30 01 7	"
29 77 N.— " 1	100	1	4	1911.6	29 58·5	29 58 4	"
13 75 N.— " 12	100	1	4	1911.6	30 09·9	30 09·8	"
45.20 N.— " 24	100	1	4	1911 6	32 11·3	32 10·2	"

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912.0	Observer.
					° ′	° ′	
37.26 N.—N.E. cor. sec. 36	100	1	4	1911.6	32 15·2	32 16 7	J. B. McFarlane.
23.05 N.— " 12	101	1	4	1911.6	32 03·7	32 02·2	"
27.67 N.— " 36.........	101	1	4	1911.6	33 08·7	33 07·2	"
51.72 N.— " 25.........	101	1	4	1911.6	33 27 4	33 25·9	"
7.67 N.— " 1	102	1	4	1911.6	33 41 1	33 40·9	"
69.72 N — " 1.........	102	1	4	1911.7	33 33 6	33 31·8	"
2.31 N.— " 25.........	102	1	4	1911 7	31 41 9	31 39 1	"
69.72 N.— " 1	102	1	4	1911 7	33 33 3	33 30 5	"
23 85 N — " 25	102	1	4	1911 7	31 40 0	31 38 2	"
57.38 N.— " 13.........	102	1	4	1911 7	31 48 3	31 44 5	"
74 64 N.— " 1.........	103	1	1	1911 7	31 26·3	31 22 3	"
71.60 N.— " 13.........	103	1	4	1911 7	31 19 8	31 15·8	"
30.58 N.— " 21.........	103	1	1	1911 7	31 17·2	31 14 2	"
78 70 N.— " 36	104	1	4	1911 7	30 44 2	30 39 2	"
13.12 N.— " 1.........	104	1	4	1911 7	31 19 0	31 14.0	"
16.84 N.— " 12.........	104	1	4	1911 7	31 07 8	31 02 8	"
55.33 N.— " 13.........	104	1	1	1911 7	31 08 3	31 01 3	"
15.64 N — " 13.........	104	1	4	1911 7	31 11 1	31 07 1	"
75.64 N.— " 24.........	105	1	4	1911 7	30 45 1	30 41·1	"
47.11 N.— " 1.........	105	1	4	1911 7	30 44 0	30 42 0	"
7.00 S — " 2.........	62	2	4	1909 8	24 59·2	25 00·9	G. J. Lonergan
50.00 N — " 23.........	62	2	4	1909 8	24 56·1	24 57 8	"
27.00 W.— " 35.........	68	2	4	1910 4	26 52 4	26 58 5	Wm. Christie.
26.36 W — " 33.........	68	2	4	1910 4	27 15·5	27 21 6	"
43.06 W.— " 31.........	68	2	4	1910 4	27 09·0	27 13·1	"
0.04 W.— " 35	72	2	4	1910 7	27 40·7	27 44·7	B. J. Saunders.
68 04 W.— " 36.........	76	2	4	1910 7	26 52 6	26 56·1	Wm. Christie.
68 27 W.— " 32.........	76	2	4	1910 7	26 47·4	26 45·9	"
36.69 W.— " 35.........	92	2	4	1911 8	29 19 6	29 15 6	J. B. McFarlane.
66 17 W — " 35	92	2	4	1911 8	29 02 0	29 00·0	"
69 59 W — " 34.........	92	2	4	1911 8	28 15 3	28 11·3	"
42.09 W — " 33.........	92	2	4	1911 8	28 05 2	28 03 2	"
At N.E. cor. sec. 7..................	3	3	4	1910 4	21 59·3	22 05 4	C. F. Miles.
60 00 N.—N.E. cor. sec. 7	3	3	4	1909 6	23 08 2	....	"
On trial line 50 00 N.—S.E. cor 3 .	7	3	4	1911 4	21 52 5	21 57·9	E. S. Martindale.
20 00 N.—N.E. cor. sec. 8.........	53	3	4	1910 5	26 18 3	26 22 1	G. J. Lonergan.
10 00 N — " 31.........	61	3	4	1911 7	25 36 0	25 33 0	C. F. Mils.
35 00 N.— " 17.........	61	3	4	1911 8	26 22 9	26 18·9	"
10 00 S — " 34	63	3	4	1910 6	25 46 0	25 48 1	G. J. Lonergan.
20 00 S — " 4.........	64	3	4	1910 6	25 46 1	25 48·2	"
11.91 W.— " 35	68	3	4	1910 5	26 55 9	26 59 7	Wm. Christie.
61.97 W.— " 31	68	3	4	1910 5	26 12 6	26 17·4	"
3.58 W.— " 26	72	3	1	1910 8	28 26 0	....	B. J. Saunders.
36 95 W.— " 35	76	3	4	1910 7	26 50 6	26 52 6	Wm. Christie.
36 21 W.— " 34.........	76	3	1	1910 7	26 53 8	26 52 8	"
65.23 W.— " 36	76	3	1	1910 7	27 32 2	27 33 7	"
33 30 W.— " 35	88	3	4	1911 5	29 16·4	29 16 6	G. H. Blanchet.
64.17 W.— " 35	92	3	4	1911 8	31 21 3	31 15 1	J. B. McFarlane.
62 00 W.— " 34.........	92	3	4	1911 8	31 24 1	31 18 9	"
6.14 W.— " 33.........	92	3	4	1911 8	31 24 0	31 27 8	"
43.70 W.— " 33.........	92	3	4	1911 8	30 48 3	30 43·1	"
43 70 W.— " 33.........	92	3	4	1911 8	30 40 0	30 35·8	"
On trial line 5 00 N.—N.E. cor. 8...	7	4	4	1911 4	22 11 1	22 14 5	E. S. Martindale.
At N. E. cor. sec. 4..............	11	4	4	1911 8	21 55 8	21 50 8	G. A. Bennett.
At " 1	16	4	4	1911 8	22 39 6	22 34 6	"
15.00 S.—N.E. cor. sec. 29.........	61	4	4	1909 7	26 53 1	26 57·1	G. J. Lonergan.
30 00 E.— " 33.........	62	4	4	1909 7	26 54 8	26 51·8	"
20.00 S — " 35.........	63	4	4	1910 6	27 25 2	....	"
58.72 W.— " 34.........	68	4	4	1910 5	26 58 3	27 03 1	Wm. Christie.
75 00 W.— " 32.........	68	4	4	1910 5	26 19 1	26 23 9	"
73.43 W.— " 35.........	72	4	4	1910 8	27 55 5	27 55 1	B. J. Saunders.
12.51 W.—N.E. cor. sec. 35.........	76	4	4	1910 7	27 27 7	27 27 7	Wm. Christie.
62.56 W.— " 32.........	76	4	4	1910 7	27 24 9	....	"
41 11 W.— " 36.........	92	4	4	1911 9	31 39 7	31 33 2	J. B. McFarlane.
13.03 W.— " 34.........	92	4	4	1911 9	31 42·9	31 38 4	"
On trial line at N.E. cor. sec. 9	7	5	4	1911.5	22 50·3	22 51 4	E. S. Martindale.

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912.0	Observer.
					° ′	° ′	
63.87 E.—N.E. cor. sec. 12	44	5	4	1911.7	25 34·9	25 31·9	R. C. Purser.
13.75 W.— " 35	68	5	4	1910.5	26 13·3	26 21·1	Wm. Christie.
32.36 W.— " 32	68	5	4	1910.5	26 23·6	26 28·0	"
42.56 W.— " 34	72	5	4	1910.9	26 59·7	26 59·6	B. J. Saunders.
27.88 W.— " 33	76	5	4	1910.8	27 08·9	27 10·0	Wm. Christie.
72.82 W.— " 31	76	5	4	1910.8	26 46·3	26 50·4	"
12.88 W.— " 35	88	5	4	1911.5	29 10·7	29 12·9	G. H. Blanchet.
15.00 W.— " 34	4	6	4	1910.4	22 42·8	22 46·9	C. F. Miles.
15.00 S.— " 29	63	6	4	1910.6	26 16·2	26 15·3	G. J. Lonergan.
60.40 W.— " 36	68	6	4	1910.5	27 12·9	27 17·3	Wm. Christie.
58.03 W.— " 32	68	6	4	1910.5	27 02·0	27 05·4	"
60.56 W.— " 35	76	6	4	1910.8	26 04·6	26 08·2	"
13.32 W.— " 36	88	6	4	1911.6	29 47·9	29 44·8	G. H. Blanchet.
14.00 W.— " 31	88	6	4	1911.6	32 09·6	32 07·1	"
15.00 N.—S.E. cor. sec. 33	63	7	4	1910.6	26 34·8	26 36·4	G. J. Lonergan.
10.00 N.— " 3	64	7	4	1910.6	26 27·7	26 29·8	"
10.00 N.— " 3	64	7	4	1910.6	26 16·8	26 17·9	"
52.83 W.—N.E. cor. sec. 36	68	7	4	1910.5	26 33·6	26 37·0	Wm. Christie.
65.97 W.— " 33	68	7	4	1910.5	26 37·2	26 42·6	"
77.39 W.— " 35	76	7	4	1910.8	23 19·8	23 20·9	"
75.05 W.— " 32	76	7	4	1910.8	25 57·0	25 56·1	"
7.28 W.—N.E. cor. sec. 34	68	8	4	1910.5	27 15·2	27 21·6	"
77.00 W.— " 33	68	8	4	1910.5	26 55·1	26 59·5	"
5.37 W.— " 36	76	8	4	1910.8	26 46·2	26 47·3	"
20.71 W.— " 33	76	8	4	1910.8	28 03·5	28 04·6	"
16.00 W.— " 36	88	8	4	1911.6	29 08·5	29 06·0	G. H. Blanchet.
76.39 W.— " 32	88	8	4	1911.7	29 55·2	29 55·4	"
Fort Chipewyan	112	8	4	1910.6	28 35·0	28 28·1	C. Engler.
15.00 E.—N.E. cor. sec. 21	7	9	4	1910.4	22 41·5	22 46·6	C. F. Miles.
40.00 S.— " 16	58	9	4	1909.8	26 21·9	26 21·6	H. S. Holcroft.
40.00 " 16	58	9	4	1909.8	26 22·1	26 24·8	"
30.00 N.—N.E. cor. sec. 22	61	9	4	1909.7	26 57·1	....	G. J. Lonergan.
30.00 S.— " 20	63	9	4	1910.6	27 29·3	....	"
7.10 W.— " 36	68	9	4	1910.5	26 58·6	27 04·0	Wm. Christie.
72.25 W.— " 35	68	9	4	1910.6	26 41·8	26 49·9	"
45.50 W.— " 33	76	9	4	1910.8	28 24·8	28 23·9	"
9.21 W.— " 31	76	9	4	1910.8	30 11·6	30 11·2	"
38.13 W.— " 33	88	9	4	1911.7	29 19·5	29 13·5	G. H. Blanchet.
6.00 N.— " 6	15	10	4	1911.8	23 48·4	23 44·4	G. A Bennett.
At S.E. cor. sec. 6	15	10	4	1911.8	23 42·1	23 40·1	"
At N.E. " 8	15	10	4	1911.8	23 55·7	23 53·7	"
40.00 S.—N.E. cor. sec. 2	58	10	4	1909.7	26 24·7	26 28·7	H. S. Holcroft.
40.00 S.— " 2	58	10	4	1909.7	26 18·1	26 23·1	"
15.00 N.—S.E. " 3	61	10	4	1909.7	26 47·0	26 46·0	G. J. Lonergan.
15.00 N.—N.E. " 21	62	10	4	1909.7	27 16·1	27 16·1	"
45.00 S.— " 32	63	10	4	1911.7	27 14·5	27 11·7	C. F. Miles.
2.05 W.— " 36	68	10	4	1910.6	25 53·0	25 58·1	Wm. Christie.
48.84 W.— " 34	68	10	4	1910.6	27 00·0	27 05·1	"
50.77 W.— " 32	68	10	4	1910.6	27 23·9	27 26·0	"
7.80 W.— " 33	88	10	4	1911.7	29 03·4	28 54·4	G. H. Blanchet.
Fort McMurray, S. shore Athabaska R. op. Is.	88	10	4	1910.4	29 50·0	29 54·1	C. Engler.
" "	88	10	4	1910.4	29 53·0	29 59·1	"
" "	88	10	4	1910.6	29 48·0	29 50·1	"
" "	88	10	4	1910.6	30 15·2	....	"
73.47 W.—N.E. cor. sec. 35	68	11	4	1910.6	27 37·0	27 41·1	Wm. Christie.
36.58 W.— " 32	68	11	4	1910.6	27 34·5	27 36·6	"
45.00 W.— " 33	88	11	4	1911.7	29 54·4	29 54·4	G. H. Blanchet.
Athabaska River, at Powder Shack	96	11	4	1910.5	26 01·7	26 05·5	C. Engler.
At S.W. cor. H.B. Co. residence	125	11	4	1910.5	28 04·1	28 07·5	J. A. Coté.
" "	125	11	4	1910.5	28 10·9	28 12·3	C. Engler.
18.00 N.—N.E. cor. sec. 33	1	12	4	1911.4	22 52·4	22 49·8	P. B. Street.
At N.E. cor. sec. 10	2	12	4	1911.4	23 08·6	....	"
5.00 S.—N.E. cor. sec. 8	12	12	4	1910.8	23 49·2	23 50·3	W. A. Scott.
20.00 N.— " 6	57	12	4	1909.7	26 16·1	26 16·1	H. S. Holcroft.
20.00 N.— " 6	57	12	4	1909.7	26 09·2	26 15·2	"

TABLE No. 4.—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1910·0	Observer.
					° ′	° ′	
20.00 W.—N.E. cor. sec. 35	65	12	4	1910.6	27 11.7	27 11.8	G. J. Lonergan.
2.00 N.—S.E. cor. sec. 2	66	12	4	1910.6	27 14.3	27 13.9	"
60.25 W.—N.E. " 35	68	12	4	1910.6	28 00.6	28 03.7	Wm. Christie.
13.21 W.— " 32	68	12	4	1910.6	28 07.4	28 09.0	"
Athabaska River, Big Cascades E. side of river	87	12	4	1910.4	30 55.0	30 56.1	J. A. Coté.
" "	87	12	4	1910.4	30 46.5	30 48.6	C. Engler.
" "	87	12	4	1910.4	29 59.2	30 03.3	"
Fort Smith	127	12	4	1910.6	32 55.1	32 56.2	J. A. Coté.
"	127	12	4	1910.6	32 46.9	32 57.5	"
"	127	12	4	1910.6	32 47.1	32 48.7	"
"	127	12	4	1910.6	33 08.1	33 07.2	"
"	127	12	4	1910.6	32 53.7	32 55.8	"
"	127	12	4	1910.6	32 55.2	33 01.3	"
"	127	12	4	1910.6	32 51.4	32 52.5	"
"	127	12	4	1910.5	33 04.6	33 08.0	"
"	127	12	4	1910.5	32 58.7	33 07.1	"
"	127	12	4	1910.5	32 59.2	33 04.6	"
"	127	12	4	1910.6	33 07.7	33 06.8	"
"	127	12	4	1910.6	32 55.9	32 58.0	"
"	127	12	4	1910.6	32 57.1	33 02.2	"
"	127	12	4	1910.6	32 58.0	32 57.6	"
"	127	12	4	1910.6	33 08.7	33 05.8	"
"	127	12	4	1910.5	33 07.9	33 11.3	"
"	127	12	4	1910.5	33 13.8	33 14.2	"
"	127	12	4	1910.5	33 10.6	33 19.0	"
"	127	12	4	1910.5	32 52.1	33 01.5	"
"	127	12	4	1910.5	32 48.3	32 51.7	"
"	127	12	4	1910.5	33 10.1	33 05.5	"
"	127	12	4	1910.5	33 08.1	33 17.5	"
"	127	12	4	1910.5	32 49.9	32 55.8	"
"	127	12	4	1910.5	32 55.5	32 57.9	"
"	127	12	4	1910.5	33 01.0	33 02.4	"
"	127	12	4	1910.5	32 54.0	33 03.9	"
"	127	12	4	1910.5	32 53.1	32 59.5	"
"	127	12	4	1910.5	32 53.4	32 55.3	"
"	127	12	4	1910.5	33 11.4	33 09.8	"
"	127	12	4	1910.5	32 55.4	33 05.8	"
"	127	12	4	1910.6	32 52.4	32 59.5	"
"	127	12	4	1910.6	32 51.2	32 54.8	"
"	127	12	4	1910.6	33 12.2	33 08.3	"
"	127	12	4	1910.6	32 54.4	33 01.5	"
Centre L.S. 7, sec. 4	2	13	4	1911.4	22 19.1	22 19.9	P. B. Street.
0.75 N.E.—N.E. cor. sec. 10	2	13	4	1911.4	22 31.5	22 30.3	"
0.75 N.E.— " " 10	2	13	4	1911.4	22 32.5	22 31.3	"
Centre of E. by section 26	61	13	4	1908.5	27 15.5	27 27.8	G. J. Lonergan.
10.00 S.—N.E. cor. sec. 33	63	13	4	1909.7	27 02.0	27 05.0	"
15.00 W.— " " 11	64	13	4	1909.7	27 18.9	27 19.9	"
11.00 N.—¼ sec. cor. E. by 16	2	14	4	1911.5	22 19.8	22 12.9	P. B. Street.
11.00 N.—¼ " " 16	2	14	4	1911.5	22 16.7	22 17.8	"
12.00 S.—N.E. cor. sec. 9	2	14	4	1911.5	22 06.1	22 05.2	"
Athabaska River Below Boiler Rapids	87	14	4	1910.4	31 56.1	31 58.2	C. Engler.
47.66 N.—N.E. cor. sec. 33	1	15	4	1911.9	22 58.3	22 53.8	P. B. Street.
12.00 S.— " " 11	64	15	4	1909.7	26 48.6	26 49.6	G. J. Lonergan.
42.69 W.— " " 32	88	15	4	1911.9	31 13.9	....	G. H. Blanchet.
50.00 W.— " " 31	88	15	4	1911.9	31 09.0	....	"
45.00 S.— " " 5	26	16	4	1911.7	24 02.9	24 00.5	C. Rinfret.
At ¼ sec. cor. E. by sec. 18	46	16	4	1910.9	25 26.6	25 29.0	P. R. A. Belanger
63.90 W.—N.E. cor. sec. 31	88	16	4	1912.0	29 48.5	29 45.8	G. H. Blanchet.
At N.E. cor. sec. 24	26	17	4	1911.7	24 22.0	....	C. Rinfret.
43.22 E.—N.E. cor. sec. 23	41	17	4	1909.6	25 01.0	....	H. S. Holcroft.
43.22 " " 23	41	17	4	1909.6	24 53.1	24 58.2	"
38.00 W. 8.00 N.—N.E. cor. 13	41	17	4	1909.6	24 47.9	25 04.0	"
At N.E. cor. sec. 3	42	17	4	1909.6	25 09.4	25 08.5	"
" 3	42	17	4	1909.6	24 52.7	25 04.8	"

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912·0	Observer.
					° ′	° ′	
38.24 W.—N.E. cor. sec. 21	42	17	4	1909.6	24 58.2	24 57.1	H. S. Holcroft.
32 00 W. 65.00 N.—N.E. cor. 21	42	17	4	1909.6	25 04.4	25 03 3	"
32 00 W. 65.00 N. " 21	42	17	4	1909 6	24 51.6	25 06 5	"
8.00 W.—N.E. cor. sec. 7	43	17	4	1909.5	24 55 4	25 03 1	"
8.00 W. " " 7	43	17	4	1909 5	25 06 4	25 11 6	"
4.00 N.—N.E. cor. sec. 33	64	17	4	1911 6	28 00 8	28 02 3	C. F. Miles.
10.00 S.— " " 23	68	17	4	1910 7	27 37 9	27 35.9	G. J. Lonergan.
10.00 N.— " " 34	68	17	4	1910 7	27 31 7	27 31 7	"
Athabaska R., Grand Rapids Is	84	17	4	1910 4	31 23 6	31 30.5	C. Engler.
"	84	17	4	1910 4	31 38.8	31 40 7	"
"	84	17	4	1910.4	31 26.1	31 31.0	J. A. Coté.
"	84	17	4	1910 4	31 36 3	31 41.2	"
"	84	17	4	1910 4	31 33.0	31 37 1	"
"	84	17	4	1910 4	31 32.0	31 35 1	C. Engler.
"	84	17	4	1910 4	31 43.7	31 39.8	"
"	84	17	4	1910 4	31 29.1	31 41.2	"
"	84	17	4	1910.4	31 24.2	31 34 3	"
"	84	17	4	1910.4	31 25 1	31 29 2	"
"	84	17	4	1910 7	31 41 0	31 40 2	"
9.00 W. 17.00 N.—N.E. cor. sec. 21	43	18	4	1909.5	26 41.5	26 55.1	H. S. Holcroft.
At N.E. cor. sec. 20	45	18	4	1909 5	26 07.0	26 06.6	"
" 20	45	18	4	1909 5	25 44 6	25 52 2	"
15.00 S.—N.E. cor sec. 4	62	18	4	1911.6	27 00.5	26 58 4	C. F. Miles.
45.00 N.—S.E. cor. sec. 25	62	18	4	1910.8	27 24.7	27 23 4	G. J. Lonergan.
10.00 N.—N. E. cor. sec. 21	67	18	4	1910 7	26 41 6	26 41 6	"
"Bull's" House H. B. Co's. Warehouse, N. end Buffalo Lake	96	18	4	1911 0	28 28.5	28 28.9	J. N. Wallace.
5.00 E.—N. E. cor sec. 26	29	19	4	1908 7	24 55.5	....	G. J. Lonergan.
47.18 S.— " " 10	44	19	4	1909 7	26 16.2	26 13.2	H. S. Holcroft.
47.18 S.— " " 10	44	19	4	1909.7	26 16.3	26 19.3	"
10.00 E., 24.00 N. N. E. cor. sec. 30	44	19	4	1909 4	26 09.9	26 05 8	"
10.00 E., 24.00 N. " 30	44	19	4	1909.4	25 55.9	26 00.8	"
40.00 E.—S. E. cor. sec. 5	50	20	4	1908.5	27 08.9	27 17 4	G. J. Lonergan.
39.00 S.—N. E. cor. sec. 5	52	20	4	1911.8	27 09.6	27 05.6	R. C. Purser.
At S. E. cor. sec. 5	63	20	4	1910 8	28 24.5	28 24 6	G. J. Lonergan.
30.00 S —N. E. cor. sec. 33	68	20	4	1910.7	28 04.6	28 04.6	"
7.00 N.— " " 20	19	21	4	1911.7	23 36.2	23 36.2	G. A. Bennett.
At N. E. cor. sec. 35	59	21	4	1908.9	27 32.6	......	G. J. Lonergan.
2.00 N.—1/4 cor W. by sec. 31	62	21	4	1910 8	28 16.7	28 15 8	"
At N. E. cor. sec. 33	62	21	4	1910 8	28 59 7	28 59.8	"
50.00 W.—N. E. cor. sec. 19	63	21	4	1910.8	28 47.5	....	"
10.00 E.— " " 19	62	22	4	1910 8	28 55 5	29 00 1	"
10.00 N.—S. E. " 16	63	22	4	1910.8	28 44 1	28 45.7	"
71.11 N. 67.63 E.—N. E. cor. sec. 7	66	22	4	1910 8	28 14.1	28 07.8	J. A. Coté.
71.11 N. 67.63 E.— " 7	66	22	4	1910.8	28 00 0	28 01.7	"
71.11 N. 67.63 E.— " 7	66	22	4	1910 8	28 10.0	28 05.7	"
71.11 N. 67.63 E.— " 7	66	22	4	1910.8	28 03.5	28 03.2	"
71.11 N. 67.63 E.— " 7	66	22	4	1910 8	28 12.7	28 11.9	"
71.11 N. 67.63 E.— " 7	66	22	4	1910 8	28 04 0	28 07 7	"
71.11 N. 67.63 E.— " 7	66	22	4	1910 9	28 11 5	28 10 9	"
71.11 N. 67.63 E.— " 7	66	22	4	1910.9	28 11 8	28 07.2	"
71.11 N. 67.63 E.— " 7	66	22	4	1910.9	28 04 9	28 08 3	"
71.11 N. 71.01 E.—N. E. cor. sec. 7	66	22	4	1910 4	28 01.1	......	C. Engler.
71.11 N. 71.01 E.— " 7	66	22	4	1910.4	27 51.9	27 58.8	"
71.11 N. 71.01 E.— " 7	66	22	4	1910.4	28 01.5	28 07.4	"
71.11 N. 67.63 E.—N. E. cor. sec. 7	66	22	4	1910.9	28 14.8	28 11.2	J. A. Coté.
71.11 N. 67.63 E.— " 7	66	22	4	1910.9	28 07.3	28 06.7	"
71.11 N. 67.63 E.— " 7	66	22	4	1910.8	28 12.0	28 11.1	"
71.11 N. 67.63 E.— " 7	66	22	4	1910.8	27 59.6	28 05.2	"
71.11 N. 67.63 E.— " 7	66	22	4	1910 8	28 13 2	28 08.9	"
71.11 N. 67.63 E.— " 7	66	22	4	1910.8	28 01.9	28 03.6	"
71.11 N. 67.63 E.— " 7	66	22	4	1910.8	28 13.7	28 10.4	"
71 11 N. 67.63 E.— " 7	66	22	4	1910.8	28 04.1	28 06.8	"
71.11 N. 67.63 E.— " 7	66	22	4	1910.8	28 12.9	28 11 6	"
71.11 N. 67.63 E.— " 7	66	22	4	1910.8	27 59.3	28 02.0	"
71.11 N. 67.63 E.— " 7	66	22	4	1910.8	28 11.9	28 06.6	"

TABLE No. 4—*Continued.*

Place	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912·0	Observer.
					° ′	° ′	
71.11 N. 67.63 E.—N.E. cor. sec. 7..	66	22	4	1910.8	27 58 7	28 00 4	J. A. Coté.
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 12 0	28 08 4	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 07 3	28 08 7	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 15 0	28 13.4	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 08 5	28 09 9	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 12 3	28 13 7	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 04 9	28 06.8	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 12 6	28 08 0	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 06 5	28 07 9	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 14 0	28 09 4	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 05 5	28 11 9	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 11.7	28 09 1	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 05.5	28 09 9	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.8	28 10 2	28 15 3	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.8	28 03.8	28 05.9	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.8	28 11.7	28 09 8	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.8	27 55 9	28 00 0	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.8	28 12.7	28 13 8	"
71.11 N. 67.63 E.— " 7	66	22	4	1910.8	28 03.2	28 06 8	"
71.11 N. 67.63 E.— " 7	66	22	4	1910.8	28 07 5	28 06 6	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.8	28 02 2	28 05 3	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.8	28 10 3	28 13 9	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.8	28 02 3	28 04 4	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 07 4	28 14 8	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 00 2	28 04 6	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 04.1	28 09.5	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 03 9	28 05.3	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 11 6	28 10 0	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 06 5	28 07 9	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 14 0	28 09 4	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 03 2	28 05 6	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 10 5	28 05.9	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 03 5	28 04 9	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 09.5	28 05.9	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	27 59 4	28 02 8	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 13.5	28 09 9	"
71.11 N. 67.63 E.—N.E. cor. sec. 7..	66	22	4	1910.9	28 05.5	28 05 9	J. A. Coté.
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 12 9	28 09 3	"
71.11 N. 67.63 E.— " 7..	66	22	4	1910.9	28 05 3	28 03 7	"
10.00 N.—S.E. cor. sec. 15..........	69	23	4	1910.7	28 16 1	28 18 1	G. J. Lonergan.
E. By. sec. 33	61	24	4	1908.7	28 40 4	28 17 9	"
40.00 E.—N. E. cor. sec 11........	36	25	4	1911.7	25 31.9	25 32 9	G. A. Bennett.
40.00 E.— " 11..........	36	25	4	1911.7	25 26 8	25 25 8	"
40.00 E.— " 11..........	36	25	4	1911.7	25 31 2	25 28.2	"
10.00 S.—N. W. " 19	62	25	4	1909.9	27 13 4	27 17.0	G. J. Lonergan.
10.00 N.—N.E. " 26..........	62	26	4	1909.9	27 12 5	27 12.7	"
10.00 N.—S.E. " 1.........	63	26	4	1909.9	27 05 4	27 02 0	"
50.00 S.—N.E. " 29	50	27	4	1911.5	27 44 2	27 41 3	"
10.00 N.—S.E. " 31..........	53	27	4	1910.4	27 49 7	27 54 6	"
17.00 S.—N.E. " 7..........	7	29	4	1911.8	24 37 5	24 33 5	P. B. Street.
61.40 S.— " " 11..........	3	30	4	1908.8	23 28 2	23 41 0	W. H. Young.
31.00 W.—¼ cor. S. By. sec. 1	7	30	4	1911.8	24 48 5	24 45 5	P. B. Street.
Travers of Fish L. in sec. 36	4	1	5	1911.8	24 37 2	24 33 2	"
35.00 W.—N.E. cor. sec. 7..........	5	1	5	1910.9	25 39 8	25 40 2	J. L. Lang.
36.00 N.— " 19..........	5	1	5	1910.9	25 41 8	25 53.0	"
At N.E. cor. sec. 9................	13	1	5	1909.5	24 00 2	24 06 8	W. A. Scott.
45.00 E.—N.E. cor. sec. 8	13	1	5	1909.5	24 05.9	24 00 0	"
50.00 S.— " 17..........	13	1	5	1909.5	24 01 4	24 08 0	"
55.00 E.— " 7..........	13	1	5	1909.5	24 04 8	24 01 4	"
At " 8	13	1	5	1909.5	24 01 2	24 00 8	"
35.00 E.— " 8..........	13	1	5	1909.5	23 57 7	24 02 8	"
At " 19..........	13	1	5	1909.5	23 42.0	23 41 6	"
30.00 N.— " 19	13	1	5	1909.4	24 00 6	23 57.0	"
62.00 W.— " 7..........	13	1	5	1909.5	23 58.3	24 04 4	"
10.00 S.— " 18..........	13	1	5	1909.5	24 06 8	24 03 4	"
35.21 E.— " 31..........	80	1	5	1910.6	29 29.7	29 30.8	A. H. Hawkins.

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912 0	Observer.
					° ′	° ′	
At N.E. cor. sec. 36	86	1	5	1910.7	30 08.2	30 07.0	A. H. Hawkins.
15 00 S.— " 36	81	1	5	1911.4	29 51.9	29 54.7	T. H. Plunkett.
At ¼ Post—E. by. sec. 1	83	1	5	1911.4	29 57.8	29 58.6	"
33 00 N.—N.E. cor. sec. 12	84	1	5	1911.4	30 51.3	30 52.1	"
At ¼ Post—E. by. sec. 24	84	1	5	1911.4	30 43.6	30 42.4	"
78 50 W.—N.E. cor. sec. 36	84	1	5	1911.3	29 48.9	29 49.3	A. H. Hawkins.
12 00 S.— " 36	85	1	5	1911.4	29 55.1	29 55.5	T. H. Plunkett
3 00 S.— " 13	87	1	5	1911.4	30 33.7	30 35.1	"
At ¼ Post E. by. sec. 24	88	1	5	1911.5	30 14.1	30 49.2	"
" " 13	90	1	5	1911.5	31 45.6	31 47.7	"
At N. E. car. sec. 24	91	1	5	1911.5	30 58.1	31 02.2	"
" " 13	92	1	5	1911.5	30 33.0	30 32.2	"
10 00 S.—N.E. cor. sec. 24	94	1	5	1911.5	30 33.2	30 36.4	"
20 00 S. ¼ Post E. by. sec. 36	95	1	5	1911.5	31 29.0	31 31.2	"
10 00 S. " " 24	96	1	5	1911.5	30 46.2	30 45.4	"
5 00 N.—N.E. cor. sec. 24	99	1	5	1911.6	30 14.0	....	"
20 00 S.— " 1	100	1	5	1911.6	30 58.0	30 57.9	"
At ¼ Post—E. by. sec. 36	100	1	5	1911.6	31 26.4	31 25.3	"
" " 25	103	1	5	1911.6	31 45.1	31 42.6	"
10.00 S.—¼ Post E. by sec. 13	104	1	5	1911.6	32 01.9	31 59.4	"
15 00 N.—N.E. cor. sec. 36	108	1	5	1911.6	32 54.5	....	"
" " 13	108	1	5	1911.6	33 00.1	32 57.6	"
5 68 S—¼ Post E. by sec. 13	109	1	5	1911.6	33 01.3	32 58.1	"
20.00 N.— " 24	110	1	5	1911.7	32 46.8	32 43.8	"
6 00 N.— " 12	110	1	5	1911.7	33 08.4	33 04.4	"
60 00 S.—N.E. cor. sec. 1	13	2	5	1909.5	24 09.3	24 13.9	W. A. Scott.
20 00 S.— " 12	13	2	5	1909.5	24 10.9	24 11.5	"
60 00 S.— " 12	13	2	5	1909.5	23 59.5	24 12.1	"
75 00 S.— " 13	13	2	5	1909.5	24 08.0	24 09.6	"
At " 12	13	2	5	1909.5	23 54.1	....	"
32 00 S.— " 5	13	2	5	1909.9	24 02.4	24 02.2	"
62 00 S.— " 8	13	2	5	1909.9	24 03.9	24 06.5	"
15 00 S.— " 8	13	2	5	1909.9	24 05.3	....	"
60 00 N.—S.E. cor. sec. 30	14	2	5	1909.5	23 14.9	....	Jas. Warren.
36 00 N.—N.W. " 19	14	2	5	1909.5	23 22.6	23 16.2	"
At N.E. " 31	14	2	5	1909.5	23 15.7	23 20.3	"
50.00 N.—S.E. " 31	14	2	5	1909.5	23 20.8	....	"
25 00 N.—N.E. " 13	14	2	5	1909.4	23 44.6	23 49.9	"
35 00 E.—N.W. " 20	14	2	5	1909.4	23 15.9	23 23.8	"
15 00 N.—S.E. " 24	14	2	5	1909.4	23 11.8	23 14.7	"
4.00 E.—N.W " 19	14	2	5	1909.4	23 17.5	23 21.4	"
45 00 W.—N. E. " 32	14	2	5	1909.5	23 17.6	23 25.2	"
50 00 N.—N. W. " 19	14	2	5	1909.5	23 11.6	23 20.2	"
At N.E " 31	14	2	5	1909.5	23 26.8	23 25.4	"
50 00 N.—N.W. " 19	14	2	5	1909.5	23 33.9	23 28.5	"
10 00 S.— " 18	15	2	5	1909.5	23 13.0	23 17.6	"
10 00 S.— " 18	45	2	5	1909.5	23 39.4	23 34.5	"
35.00 S.— " 7	15	2	5	1909.5	23 33.0	23 29.6	"
40 00 N.—N.W. cor. sec. 1	15	2	5	1909.5	23 28.3	....	Jas. Warren.
At N.E. cor. sec. 35	80	2	5	1910.6	29 29.7	29 32.8	A. H. Hawkins.
79 00 E.—N.E. cor. sec. 35	80	2	5	1910.6	29 07.3	....	"
35 00 W.— " 36	84	2	5	1911.3	30 24.2	30 25.3	"
43.00 W.— " 35	84	2	5	1911.3	30 24.2	30 27.3	"
47 50 W.— " 33	84	2	5	1911.4	30 10.8	30 10.6	"
5 00 W.— " 31	84	2	5	1911.4	30 27.5	30 25.3	"
36 00 W.— " 36	84	2	5	1911.3	30 09.0	30 11.1	"
36 00 W.— " 36	84	2	5	1911.3	30 24.0	30 25.1	"
69 79 W.— " 35	84	2	5	1911.3	30 05.1	30 09.2	"
36 67 W.— " 33	84	2	5	1911.4	30 10.5	30 10.3	"
69 83 W.— " 31	84	2	5	1911.4	30 03.2	30 01.0	"
24 80 S.— " 22	6	3	5	1908.5	24 41.9	24 49.2	W. H. Young.
At N.E cor. sec. 7	9	3	5	1909.6	23 54.0	24 00.1	W. A. Scott.
" 6	9	3	5	1909.6	23 51.5	24 00.6	"
40 00 N.—N.E. cor. sec. 6	9	3	5	1909.6	24 00.5	23 52.1	"
20 00 S.— " 6	9	3	5	1909.5	24 01.2	24 02.1	"
At N.E. cor. sec. 30	10	3	5	1909.7	23 45.8	23 44.8	"

TABLE No. 4.—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912·0	Observer.
					° ′	° ′	
65·00 N.—N.E. cor. sec. 19	10	3	5	1909.7	24 00·5	23 57·5	W. A. Scott.
45·00 N.— " 19	10	3	5	1909.7	23 50·6	23 59·6	"
20 00 N.— " 19	10	3	5	1909.7	24 00·7	23 58·7	"
70 00 N.— " 18	10	3	5	1909.7	23 51·7	24 03·7	"
50·00 N.— " 7	10	3	5	1909.6	23 49·8	24 00·1	"
50 00 N.— " 18	10	3	5	1909.7	23 59·3	23 53·3	"
30 00 N.— " 7	10	3	5	1909.6	23 51·8	23 51·1	"
21·05 W.— " 7	10	3	5	1909.6	23 56·0	24 05·3	"
36·00 S.— " 36	12	3	5	1909.9	24 04·8	24 08·4	"
At N.E. cor. sec. 25	12	3	5	1909.9	24 08·2	24 07·8	"
12 00 S.—N.E. cor. sec. 36	12	3	5	1909.9	24 08·5	24 07·1	"
30 00 N.— " 30	13	3	5	1909.5	23 48·5	23 41·9	"
At N.E. cor. sec. 29	13	3	5	1909.5	23 38·3	23 46·7	"
40·00 W.—N.E. cor. sec. 31	13	3	5	1909.5	23 49·2	23 44·3	"
40 00 N.— " 29	13	3	5	1909.5	23 39·0	23 46·4	"
At N.E. cor. sec. 29	13	3	5	1909.5	23 45·7	23 32·6	"
" 34	13	3	5	1909.5	23 38·2	23 44·2	"
7 00 N.—N.E. cor. sec. 25	14	3	5	1909.5	23 57·0	23 53·6	Jas. Warren.
At N.E. cor. sec. 25	15	3	5	1909.5	23 30·4	23 36·0	"
10 00 N.—S.E. cor. sec. 36	15	3	5	1909.5	24 50·9	24 58·5	"
10 00 S.—N.E. cor. sec. 5	63	3	5	1911.3	27 58·1	27 55·5	G. J. Lonergan.
64 49 E.— " 32	80	3	5	1910.6	31 32·6	31 35·7	A. H. Hawkins.
66 00 E.— " 34	80	3	5	1910.6	31 20·6	31 27·7	"
38·48 W.— " 36	84	3	5	1911.4	30 00·4	29 58·2	"
10 00 W.— " 35	84	3	5	1911.4	30 15·8	30 16·6	"
71·00 W.— " 32	84	3	5	1911.4	31 04·1	31 03·9	"
At N.E. cor. sec. 34	5	4	5	1909.6	24 31·6	....	W. H. Young.
44 00 S.—N.E. cor. sec. 35	5	4	5	1910.8	25 14·3	25 15·4	J. L. Lang.
12 00 S.— " 26	5	4	5	1910.8	25 00·7	25 01·8	"
60·00 S.— " 26	5	4	5	1910.8	24 59·0	25 02·1	"
10·00 W.— " 23	5	4	5	1910.8	25 07·4	25 08·5	"
40·00 W.— " 23	5	4	5	1910.8	24 58·0	....	"
10·00 S.— " 27	5	4	5	1910.8	24 59·6	25 01·7	"
20·00 N.— " 22	5	4	5	1910.8	25 08·0	25 07·1	"
20·00 E.— " 22	5	4	5	1910.8	25 07·5	25 08·6	"
45·00 E.— " 21	5	4	5	1910.8	25 03·6	25 04·7	"
35·00 W.— " 21	5	4	5	1910.8	25 02·2	25 01·3	"
35·00 N.— " 20	5	4	5	1910.8	24 59·5	24 59·6	"
70·00 N.— " 20	5	4	5	1910.8	25 00·9	24 59·6	"
39·00 W.— " 19	5	4	5	1911.6	24 23·4	24 23·9	P. B. Street.
12·50 N.— " 17	5	4	5	1911.7	24 15·2	24 12·4	"
At N.E. cor. sec. 24	5	4	5	1908.5	24 45·7	24 53·2	W. H. Young
24 00 N.—N.E. cor. sec 20	6	4	5	1909.7	24 36·5	24 33·5	
60 00 N.— " 20	6	4	5	1909.7	24 13·8	24 15·8	
70 00 E.— " 32	6	4	5	1910.7	24 48·6	24 51·6	J. L. Lang.
60·00 W.— " 36	6	4	5	1910.7	24 51·4	24 55·4	"
40 00 W.— " 35	6	4	5	1910.7	24 50·2	24 52·2	"
At N.E. cor. sec. 34	6	4	5	1910.7	24 50·0	24 50·0	"
40 00 W.—N.E. cor. sec. 33	6	4	5	1910.7	24 48·5	24 48·5	"
60·00 W.— " 34	6	4	5	1910.7	24 49·0	24 47·0	"
20·00 S.— " 27	6	4	5	1910.7	24 50·8	24 52·8	"
10 00 N.— " 26	6	4	5	1910.7	24 52·1	24 53·1	"
50 00 S.— " 26	6	4	5	1910.7	24 51·5	24 53·5	"
5·00 N.— " 11	6	4	5	1910.8	25 04·9	25 09·0	"
40 00 N.—S.E. cor, sec. 3	6	4	5	1919.8	24 59·0	24 59·7	"
At N.E. cor. sec. 4	6	4	9	1910.8	25 02·6	25 02·3	"
25 00 S.—N.E. cor. sec. 19	7	4	5	1910.6	24 41·1	24 43·2	"
10 00 S.— " 18	7	4	5	1910.6	24 42·6	24 44·7	"
20 00 N.— " 7	7	4	5	1910.6	24 41·1	24 49·2	"
12 00 E.— " 7	7	4	5	1910.6	24 43·1	24 46·2	"
40 00 E.— " 7	7	4	5	1910.6	24 41·3	24 47·4	"
5 00 S.— " 8	7	4	5	1910.6	24 45·3	24 47·4	"
60 00 S.—N.E. cor. sec. 6	7	4	5	1910.7	24 45·7	24 45·7	J. L. Lang.
19 00 W.— " 31	8	4	5	1909.8	24 00·0	....	"
55 00 W.— " 31	8	4	5	1909.8	23 55·9	24 01·6	"
40.00 W.— " 31	8	4	5	1909.8	24 01·7	....	"
50.00 W.— " 33	8	4	5	1909.7	24 00·1	....	"

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer	Date.	Declination. Obs'd.	Declination. Reduced to 1912.0	Observer.
					° ′	° ′	
35 00 W.—N.E. cor. sec. 33........	8	4	5	1909.7	24 09.9	....	J. L. Lang.
50 00 W.— " 34........	8	4	5	1909.7	24 04.6	24 05.6	"
At N.E. cor, sec. 34	8	4	5	1909.7	24 01.5	....	"
50.00 N.—N.E. cor. sec. 20........	8	4	5	1909.7	24 02.1	24 11.1	"
30 00 W.— " 32	8	4	5	1909.7	24 00.1	....	"
70 00 N.— " 20	8	4	5	1909.8	24 02.0	....	"
70 00 N.— " 20........	8	4	5	1909.8	24 01.8	....	"
At N.E. cor. sec. 36..................	8	4	5	1909.6	24 06.6	24 04.5	W. A. Scott.
72 00 N.—N.E. cor. sec. 29	8	4	5	1909.8	24 00.9	24 05.6	"
47 00 N.— " 29	8	4	5	1909.8	24 03.5	24 01.2	"
10 00 N.— " 29	8	4	5	1909.8	24 00.5	24 07.2	"
10.00 N.— " 29.......	8	4	5	1909.8	24 02.8	23 57.5	"
64 00 W.— " 31	8	4	5	1909.8	23 59.3	24 08.0	"
64 00 W.— " 31........	8	4	5	1909.8	24 01.5	23 58.2	"
35.00 W.— " 34	8	4	5	1909.7	24 02.3	24 10.3	"
18 00 W.— " 34	8	4	5	1909.7	24 04.3	24 04.3	"
30 00 W.— " 33	8	4	5	1909.7	24 05.0	24 11.0	"
20 00 W.— " 33	8	4	5	1909.7	24 04.0	24 04.0	"
40 00 N.— " 7	9	4	5	1909.8	24 02.2	24 12.9	"
20 00 N.— " 7	9	4	5	1909.8	24 01.5	23 59.2	"
52.00 N.— " 6........	9	4	5	1909.8	24 03.2	24 10.9	"
16 00 N.—N.E. cor. sec. 6	9	4	5	1909.8	24 01.6	23 58.3	"
29.00 N.— " 18........	9	4	5	1909.8	24 01.3	24 08.0	"
At " 18	9	4	5	1909.8	24 01.6	24 01.3	"
53.00 N.— " 18........	9	4	5	1909.8	24 01.6	24 04.3	"
53.00 N.— " 18........	9	4	5	1909.8	24 01.0	24 02.7	"
41.00 S.— " 1........	9	4	5	1909.6	24 00.6	24 11.5	"
At " 33........	9	4	5	1909.9	24 05.6	24 06.6	"
70.00 S.— " 6........	9	4	5	1909.8	24 02.5	23 59.2	"
51.00 S.— " 6........	9	4	5	1909.8	24 00.5	24 07.2	"
11 00 S.— " 6.	9	4	5	1909.8	24 03.1	23 56.8	"
30.00 S.— " 6........	9	4	5	1909.8	24 03.5	24 08.2	"
35.00 E.— " 23........	9	4	5	1909.6	24 04.0	24 02.1	"
30.00 N.— " 25.......	9	4	5	1909.6	24 02.6	23 59.7	"
55 00 N.— " 25........	9	4	5	1909.6	24 00.3	24 02.4	"
At " 36........	9	4	5	1909.6	24 04.7	24 02.8	"
40 00 W.— " 36.......	9	4	5	1909.6	23 57.9	24 07.0	"
30 00 N.— " 25	9	4	5	1909.6	23 59.1	24 10.2	"
At " 25........	9	4	5	1909.6	24 01.6	23 59.7	"
20.00 N.— " 26........	9	4	5	1909.6	24 03.2	....	"
At " 26...	9	4	5	1909.6	24 01.1	24 09.2	"
16 00 N.— " 6........	9	4	5	1909.8	24 02.5	24 09.2	"
65 00 W.— " 36.......	9	4	5	1909.6	23 56.0	23 55.1	"
20 00 W.— " 35	9	4	5	1909.6	23 56.2	24 08.3	"
40 00 W.— " 33...... ..	9	4	5	1909.9	24 03.8	24 00.8	"
30 00 W.— " 33..	9	4	5	1909.9	24 03.6	24 09.6	"
11 00 W.— " 33...	9	4	5	1909.9	24 05.4	24 03.4	"
60.00 W.—N.E. cor. sec. 33........	9	4	5	1909.9	24 05.1	24 10.1	"
25 00 W.— " 35.	9	4	5	1909.8	24 06.0	24 14.8	"
30.00 N.— " 20........	9	4	5	1909.8	24 05.2	24 09.9	"
30 00 N.— " 20........	9	4	5	1909.8	24 02.5	23 57.2	"
10.00 W.— " 34........	9	4	5	1909.8	24 05.8	... ..	"
12.00 N.— " 20........	9	4	5	1909.8	24 01.0	23 55.7	"
18 00 N.— " 17........	9	4	5	1909.8	24 03.8	... ...	"
30 00 N.— " 20........	9	4	5	1909.8	24 04.3	24 09.0	"
18 00 N.— " 17........	9	4	5	1909.8	24 02.6	....	"
8.00 N.— " 19........	9	4	5	1909.8	24 02.7	24 01.4	"
8.00 N.— " 17........	9	4	5	1909.8	24 02.8	24 06.5	"
43.00 N.— " 19.......	9	4	5	1909.8	24 03.4	24 10.1	"
9 00 E.— " 19	9	4	5	1909.8	24 00.1	24 05.8	"
At " 12........	9	4	5	1909.6	24 10.5	24 03.6	"
50 00 W.— " 12........	9	4	5	1909.6	23 53.7	24 00.8	"
40 00 N.— " 13.... ...	9	4	5	1909.6	24 00.9	24 10.0	"
70 00 N.— " 13........	9	4	5	1909.6	23 59.9	23 53.0	"
20 00 N.— " 13	9	4	5	1909.6	24 06.4	24 00.5	"
60.00 N.— " 12........	9	4	5	1909.6	24 01.5	24 05.6	"
At " 23...	9	4	5	1909.6	24 02.4	24 06.5	"

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912.0	Observer.
					° ′	° ′	
60.00 W.—N.E. cor. sec. 14	9	4	5	1909.6	24 04.6	23 56.7	W. A. Scott.
At " 11	9	4	5	1909.6	24 07.6	23 57.7	"
40.00 N.— " 11	9	4	5	1909.6	23 59.2	24 07.3	"
45.00 N.— " 23	9	4	5	1909.6	24 03.2	23 54.3	"
At " 23	9	4	5	1909.6	24 04.3	23 57.4	"
55.00 E.— " 23	9	4	5	1909.6	23 59.0	24 05.1	"
At N.E. cor., sec. 1	9	4	5	1909.6	24 07.2	....	"
10.00 N.—N.E. cor., sec. 12	9	4	5	1909.6	24 04.3	....	"
50.00 N.— " 1	9	4	5	1909.6	23 59.6	....	"
12.00 N.— " 32	9	4	5	1911.5	24 02.4	24 06.6	"
At " 32	9	4	5	1911.5	23 59.5	24 04.7	"
20.00 N.— " 31	9	4	5	1911.5	23 55.0	24 01.2	"
44.00 N.— " 31	9	4	5	1911.5	23 56.1	24 00.3	"
58.00 N.— " 31	9	4	5	1911.5	24 01.1	24 04.3	"
60.00 N.— " 1	10	4	5	1909.6	24 05.4	24 01.5	"
30.00 N.— " 12	10	4	5	1909.6	23 54.8	24 05.9	"
56.00 S.— " 4	10	4	5	1909.9	24 04.6	24 10.6	"
At " 12	10	4	5	1909.6	24 04.8	24 01.9	"
40.00 N.— " 12	10	4	5	1909.6	24 08.1	....	"
20.00 N.— " 24	10	4	5	1909.7	24 01.4	24 01.2	"
At " 9	10	4	5	1909.9	24 04.0	24 04.0	"
45.00 N.— " 4	10	4	5	1909.9	24 04.3	24 09.3	"
At " 9	10	4	5	1909.9	24 04.1	24 11.1	"
24.00 N.— " 4	10	4	5	1909.9	24 02.6	24 00.6	"
25.00 N.— " 25	10	4	5	1909.7	23 53.7	24 04.5	"
60.00 N.— " 24	10	4	5	1909.7	23 52.3	24 02.1	"
At " 25	10	4	5	1909.7	24 08.7	24 07.5	"
2.00 S.— " 3	10	4	5	1909.9	24 06.5	24 11.5	"
2.00 S.— " 3	10	4	5	1909.9	24 07.1	24 06.1	"
64.00 S.— " 3	10	4	5	1909.9	24 07.0	24 09.0	"
31.00 S.— " 4	10	4	5	1909.9	24 05.2	24 05.2	"
36.00 N.— " 6	10	4	5	1911.5	24 02.1	24 05.3	"
70.00 N.— " 6	10	4	5	1911.5	23 58.1	24 02.3	"
At N.E. cor., sec. 24	10	4	5	1911.6	23 57.1	23 58.6	"
67.00 N.—N.E. cor. sec. 30	10	4	5	1911.6	24 03.4	24 01.9	"
25.00 W.— " 33	11	4	5	1910.7	23 46.2	23 50.2	"
40.50 W.— " 33	11	4	5	1910.7	23 44.6	23 47.2	"
41.00 S.— " 33	11	4	5	1910.7	23 50.8	23 50.8	"
0.89 N.— " 21	11	4	5	1910.7	23 42.3	23 42.3	"
38.25 S.— " 22	11	4	5	1910.7	23 47.6	23 47.1	"
29.07 S.— " 10	11	4	5	1910.7	24 04.7	24 02.1	"
4.00 N.— " 9	11	4	5	1910.8	24 00.8	....	"
20.00 S.— " 4	11	4	5	1910.8	23 52.2	23 57.3	"
61.35 S.— " 5	12	4	5	1910.7	23 39.6	23 39.6	"
8.65 S.— " 5	12	4	5	1910.7	23 49.7	23 51.7	"
20.00 S.— " 9	12	4	5	1910.8	23 51.1	23 50.8	"
70.00 N.— " 21	12	4	5	1911.7	23 49.7	23 49.7	"
62.00 N.— " 28	12	4	5	1911.7	23 46.9	23 46.9	"
37.00 N.— " 17	12	4	5	1911.7	23 39.1	23 41.3	"
69.00 N.— " 7	12	4	5	1911.7	23 39.1	23 38.3	"
At " 19	12	4	5	1911.7	23 35.6	23 35.6	"
48.00 E.— " 19	12	4	5	1911.7	23 46.2	23 45.2	"
6.00 W.— " 20	12	4	5	1911.7	23 46.7	23 44.7	"
50.00 E.— " 20	12	4	5	1911.7	23 46.5	23 45.5	"
23.00 N.— " 9	12	4	5	1911.7	23 48.1	23 48.1	"
67.00 W.— " 19	12	4	5	1911.7	23 37.2	23 36.2	"
1.00 S.— " 13	12	4	5	1911.7	23 49.6	23 49.6	"
9.00 N.— " 20	12	4	5	1911.7	23 47.1	23 46.1	"
42.00 N.— " 29	12	4	5	1911.7	23 53.5	23 53.5	"
At N.E. cor., sec. 7	13	4	5	1911.8	23 51.9	23 49.9	"
2nd trial line, 30.00 E.-N.E., cor. 31	17	4	5	1911.6	25 15.7	25 16.6	E. S. Martindale.
5.00 S.—N.E. cor., sec. 2	20	4	5	1909.5	24 40.5	24 46.9	Jas. Warren.
50.00 S.— " 15	20	4	5	1909.5	25 18.5	25 14.9	"
45.90 W.— " 12	20	4	5	1909.5	24 43.5	24 51.9	"
10.00 N.—S.E. " 11	20	4	5	1909.5	24 53.2	25 00.6	"
65.00 W.—N.E. " 12	20	4	5	1909.5	24 43.4	24 51.8	"

TABLE No. 4—*Continued.*

Place.		Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912.0	Observer.
						° ′	° ′	
45 28 S.—N.E. cor. sec.	7........	46	4	5	1909.4	26 47.9	26 56.8	L. E. Fontaine.
15 00 W. " "	31........	80	4	5	1910.6	29 55.3	30 02.4	A. H. Hawkins.
58 15 E.— " "	32........	80	4	5	1910.6	30 17.9	30 21.0	"
10 00 W.— " "	35........	84	4	5	1911.4	30 50.2	30 53.0	"
18 00 W.— " "	32........	84	4	5	1911.4	31 27.5	....	"
4.39 W.— " "	31........	84	4	5	1911.4	31 31.2	31 32.0	"
48 50 W.— " "	32........	84	4	5	1911.4	31 28.6	31 29.4	"
5 00 N.— " "	12........	6	5	5	1909.7	23 41.3	23 49.3	W. H. Young.
41 03 N.— " "	1........	6	5	5	1909.7	24 28.3	....	"
5 00 N. " "	12........	6	5	5	1909.7	23 43.0	23 41.5	"
29 00 N. " "	26........	7	5	5	1910.6	24 42.[illegible]	24 47.6	J. L. Lang.
30 00 S.— " "	26........	7	5	5	1910.6	24 43.9	24 47.0	"
40 00 N.— " "	16........	8	5	5	1910.6	24 45.5	24 52.6	"
78 00 N.— " "	16........	8	5	5	1910.6	24 32.1	24 39.2	"
60 00 N.— " "	8........	8	5	5	1910.6	24 43.4	24 49.5	"
40 00 N.— " "	17........	8	5	5	1910.6	24 41.1	24 48.2	"
5 00 E.— " "	20........	8	5	5	1910.6	24 51.2	24 57.3	"
40 00 E.— " "	20........	8	5	5	1910.6	24 45.8	24 46.9	"
At " "	21........	8	5	5	1910.6	24 40.7	24 46.8	"
20 00 S.—N.E. cor. sec.	2........	8	5	5	1910.6	24 45.1	24 47.2	J. L. Lang.
34 00 W.— "	7........	8	5	5	1911.5	24 32.5	24 36.7	P. B. Street.
9 00 N.— "	36........	9	5	5	1911.6	24 09.2	24 07.1	W. A. Scott.
57.00 N.— "	1........	10	5	5	1911.6	23 58.8	24 01.7	"
43 00 N.— "	1........	10	5	5	1911.6	23 56.6	24 04.5	"
45.00 E.— "	12........	10	5	5	1911.6	24 01.3	24 03.2	"
75.00 E.— "	12........	10	5	5	1911.6	24 00.4	24 03.3	"
61 00 E.— "	12........	10	5	5	1911.6	24 07.2	24 05.7	"
46.30 N.— "	12........	10	5	5	1911.6	24 13.9	24 16.4	"
16 00 N.— "	24........	10	5	5	1911.6	23 58.6	23 57.1	"
At "	25........	10	5	5	1911.6	23 58.5	23 58.0	"
17 50 S.— "	36........	11	5	5	1911.8	23 55.7	23 54.7	"
60 00 S.— "	25........	11	5	5	1911.8	23 52.7	23 53.7	"
16 00 S.— "	29........	11	5	5	1911.8	23 49.2	23 46.2	"
13.00 S.— "	13........	11	5	5	1911.8	23 55.2	23 51.2	"
68.00 S.— "	13........	11	5	5	1911.8	23 54.4	23 51.4	"
37 00 S.— "	12........	11	5	5	1911.8	23 51.1	23 48.1	"
40 00 S.— "	1........	11	5	5	1911.8	23 52.5	23 48.3	"
40 00 S.— "	1........	11	5	5	1911.8	23 56.3	23 52.1	"
20 00 S.— "	36........	12	5	5	1911.7	23 49.3	23 49.3	"
1 00 S.— "	25........	12	5	5	1911.7	23 47.9	23 44.9	"
10 00 S.— "	24........	12	5	5	1911.7	23 49.8	23 46.8	"
43 00 N.— "	36........	12	5	5	1911.8	23 47.6	23 44.6	"
73 00 S.— "	12........	12	5	5	1911.8	23 49.0	23 46.0	"
47 00 S.— "	13........	12	5	5	1911.8	23 51.5	23 48.5	"
14 00 N.— "	1........	13	5	5	1911.8	23 49.0	23 46.0	"
At "	12........	13	5	5	1911.8	23 52.7	23 48.7	"
61 85 S.— "	27........	17	5	5	1911.6	25 03.6	25 07.1	E. S. Martindale.
50.00 W.— "	33........	17	5	5	1911.6	25 03.2	25 05.7	"
10 00 E.— "	31........	20	5	5	1909.7	25 09.8	25 17.8	Jas. Warren.
60 00 W.— "	31........	20	5	5	1909.7	25 06.0	25 13.0	"
51.00 W.— "	31........	20	5	5	1909.7	24 56.9	....	"
61.56 N.— "	16........	45	5	5	1909.4	26 48.4	26 58.8	L. E. Fontaine.
65 07 S.— "	31........	46	5	5	1909.4	26 24.2	26 24.9	"
22 03 S.— "	11........	47	5	5	1910.5	26 35.7	26 44.1	"
At "	33........	80	5	5	1910.6	29 43.9	29 50.0	A. H. Hawkins.
29.24 E.— "	34........	80	5	5	1910.6	29 41.7	29 50.8	"
79.10 E.— "	34........	80	5	5	1910.6	29 04.1	30 09.2	"
60.09 E.— "	32........	80	5	5	1910.6	29 44.0	....	"
32.03 W.— "	36........	84	5	5	1911.4	31 20.3	31 19.1	"
64.10 W.— "	35........	84	5	5	1911.4	31 15.4	31 13.2	"
61.50 W.— "	34........	84	5	5	1911.4	31 29.5	31 30.3	"
9.00 W.— "	33........	84	5	5	1911.4	31 16.9	31 16.7	"
38.18 W.— "	36........	17	6	5	1911.6	25 04.8	25 04.3	E. S. Martindale.
48.80 W.— "	33........	17	6	5	1911.7	25 11.8	25 12.0	"
65.57 W.— "	31........	17	6	5	1911.7	25 16.3	25 15.3	"
83.95 S.— "	27........	17	6	5	1911.8	25 00.0	24 58.0	"

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912.0	Observer.
					° ′	° ′	
62.39 N.—N.E. cor. sec. 11	17	6	5	1911.8	25 11.4	25 07.4	E. S. Martindale.
58.77 E.— ″ 22	17	6	5	1911.8	25 00.1	24 56.9	″
36.83 S.— ″ 18	18	6	5	1911.8	25 19.2	25 16.2	″
34.23 E.— ″ 7	18	6	5	1911.8	25 15.1	25 12.1	″
4.00 E.— ″ 34	20	6	5	1909.8	25 06.0	25 12.7	Jas. Warren.
20.00 W.— ″ 35	20	6	5	1909.8	25 12.2	25 10.9	″
4.00 E.— ″ 34	20	6	5	1909.8	25 10.0	25 15.7	″
10.00 E.— ″ 35	20	6	5	1909.7	24 58.4	25 03.4	″
16.00 W.— ″ 35	20	6	5	1909.8	25 03.9	......	″
32.00 W.— ″ 33	20	6	5	1909.8	25 08.2	25 15.9	″
68.00 W.— ″ 32	20	6	5	1909.8	25 06.6	25 08.3	″
30.00 W.— ″ 32	20	6	5	1909.8	25 07.0	25 09.7	″
8.00 W.— ″ 31	20	6	5	1909.8	25 11.3	25 14.0	″
At ″ 13	21	6	5	1911.5	25 15.6	25 14.7	C. M. Walker.
50.00 E.— ″ 32	21	6	5	1911.5	25 33.0	25 33.2	″
At ″ 6	22	6	5	1911.5	25 29.8	25 32.0	″
At ″ 4	22	6	5	1911.6	25 34.9	25 32.8	″
10.00 S.— ″ 1	22	6	5	1911.7	25 28.3	25 25.5	″
41.00 N.— ″ 8	22	6	5	1911.6	25 32.5	25 32.4	″
10.00 S.— ″ 18	22	6	5	1911.6	25 29.8	25 29.3	″
40.00 N.— ″ 15	22	6	5	1911.7	25 23.7	25 16.7	″
62.00 N.— ″ 21	22	6	5	1911.7	25 19.5	25 15.5	″
At ″ 28	22	6	5	1911.7	25 17.2	25 13.2	″
24.00 N.— ″ 24	22	6	5	1911.8	25 12.2	25 09.2	″
10.00 W.— ″ 36	22	6	5	1911.9	25 37.4	25 34.9	″
62.50 W.— ″ 33	22	6	5	1911.9	25 33.6	25 29.1	″
48.75 W.— ″ 33	23	6	5	1911.0	24 58.3	24 57.2	J. R. Akins.
62.50 W.— ″ 34	23	6	5	1910.9	24 57.9	24 58.2	″
40.00 N.— ″ 8	23	6	5	1911.8	25 20.8	25 19.8	C. M. Walker.
At ″ 5	23	6	5	1911.8	25 35.6	25 30.4	″
40.00 N.— ″ 4	23	6	5	1911.8	25 38.2	25 33.0	″
24.06 S.—N.E. cor. sec. 30	24	6	5	1910.9	24 53.7	24 49.1	J. R. Akins.
47.00 E.— ″ 20	24	6	5	1910.9	24 55.2	......	″
5.90 W.— ″ 7	24	6	5	1910.9	24 59.2	24 59.6	″
26.50 S.— ″ 7	24	6	5	1910.9	24 57.9	24 57.3	″
50.00 S.— ″ 21	24	6	5	1910.9	24 53.6	25 00.0	″
25.00 E.— ″ 9	24	6	5	1910.9	24 55.5	24 54.9	″
60.00 S.— ″ 6	24	6	5	1910.9	24 42.4	24 42.8	″
56.00 S.— ″ 4	24	6	5	1910.9	24 52.8	25 00.2	″
71.25 S.— ″ 22	24	6	5	1910.9	24 53.0	24 53.4	″
7.00 S.— ″ 3	24	6	5	1910.9	24 52.9	24 52.1	″
24.25 S.— ″ 11	24	6	5	1910.9	24 52.0	24 51.2	″
62.25 S.— ″ 11	24	6	5	1910.9	24 54.7	24 55.9	″
23.00 S.— ″ 2	24	6	5	1910.9	24 51.2	24 51.4	″
30.46 S.— ″ 35	45	6	5	1909.4	26 57.0	27 05.9	L. E. Fontaine.
5.11 S.— ″ 20	48	6	5	1910.5	26 13.6	26 23.4	″
6.42 S.—¼ post E. By. sec. 28	48	6	5	1911.6	26 23.9	26 23.4	″
62.51 W.—N.E. cor. sec. 31	80	6	5	1910.5	30 08.8	30 13.2	A. H. Hawkins.
34.10 E.— ″ 34	80	6	5	1910.6	30 03.9	30 09.0	″
28.00 W.— ″ 35	84	6	5	1911.4	30 35.0	30 39.8	″
30.50 W.— ″ 33	84	6	5	1911.4	30 00.6	30 03.0	″
57.00 W.— ″ 31	84	6	5	1911.4	30 35.4	30 35.8	″
52.49 W.— ″ 34	108	6	5	1910.2	32 37.2	32 41.3	A. W. Ponton.
52.49 W.— ″ 34	108	6	5	1910.2	32 30.2	32 38.3	″
52.49 W.— ″ 34	108	6	5	1910.2	32 29.3	32 38.4	″
52.49 W.— ″ 34	108	6	5	1910.2	32 28.5	32 34.6	″
52.49 W.— ″ 34	108	6	5	1910.2	32 34.5	32 34.6	″
52.49 W.— ″ 34	108	6	5	1910.2	32 38.3	32 35.4	″
52.49 W.— ″ 34	108	6	5	1910.2	32 39.4	32 39.5	″
52.49 W.— ″ 34	108	6	5	1910.2	32 35.4	32 41.5	″
52.49 W.— ″ 31	108	6	5	1910.2	32 29.4	32 39.5	″
52.49 W.— ″ 34	108	6	5	1910.2	32 26.8	32 32.9	″
52.49 W.— ″ 31	108	6	5	1910.2	32 40.7	32 38.8	″
52.49 W.— ″ 34	108	6	5	1910.2	32 39.6	32 38.7	″
52.49 W.— ″ 34	108	6	5	1910.2	32 25.7	32 29.8	″
30.63 N.—N.E. cor. sec. 12	18	7	5	1911.7	25 13.9	25 13.9	E. S. Martindale.
68.87 N.— ″ 23	18	7	5	1911.7	25 30.4	25 29.4	″

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912.0	Observer.
					° ′	° ′	
20 32 E.—N.E. cor. sec. 24	18	7	5	1911.7	25 23.7	25 23.7	E. S. Martindale.
28.91 W.— " 36	18	7	5	1911.8	25 31.9	25 30.9	"
10.00 W.— " 19	19	7	5	1911.7	25 26.5	25 26 5	A. L. Cumming.
8 00 S.— " 15	19	7	5	1911.7	25 30.1	25 26.4	"
5.00 W.—S.E. cor. sec. 1	19	7	5	1911.8	25 30.4	25 26.4	"
5 00 W.— " 2	19	7	5	1911.8	25 27 8	25 23.8	"
20.00 N.—N.E. cor. sec. 29	19	7	5	1911.8	25 29.9	25 28.9	"
10.00 S.— " 31	19	7	5	1911.9	25 28.8	25 24.3	"
At N.E. cor. sec. 36	20	7	5	1910.4	23 47.2	23 57.1	J. R. Akins.
9.00 W.—N.E. cor. sec. 31	20	7	5	1910.4	24 23.6	24 25.7	"
8 00 N.— " 24	21	7	5	1911.4	25 32.5	25 33 9	C. M. Walker.
At N.E. cor. sec. 12	22	7	5	1911.6	25 27.1	... ...	"
41.00 N—N.E. cor. sec. 12	22	7	5	1911.6	25 29.7	25 27.2	"
20.00 S.— " 24	23	7	5	1911.8	25 17.1	25 15.4	"
60.00 E.— " 22	31	7	5	1910.9	25 39.2	25 43.6	G. J. Lonergan.
19.76 S.— " 34	47	7	5	1910.5	26 15 1	....	L. E. Fontaine.
12.31 N.— " 21	49	7	5	1909.4	26 36.9	26 38 6	"
29.01 S.— " 2	51	7	5	1909.5	27 23 5	27 32 1	"
61.85 S.— " 6	52	7	5	1909.5	27 49.2	27 56.8	"
74.50 W.— " 33	55	7	5	1910.2	28 10 4	28 15.5	"
46.00 W.— " 32	61	7	5	1908.9	27 28.0	....	G. J. Lonergan.
39.80 W.— " 31	80	7	5	1910 5	29 02.7	29 08.1	A. H. Hawkins.
66.95 E.— " 32	80	7	5	1910.5	29 00.3	29 01 7	"
9.16 E.— " 34	80	7	5	1910.5	29 20.7	29 26.1	"
42.00 W.— " 31	84	7	5	1911.4	31 08.2	....	"
26.00 W.— " 36	84	7	5	1911.4	30 56.9	30 57.3	"
59 00 W.— " 34	84	7	5	1911.4	31 13.7	31 18.1	"
39.60 W.— " 32	84	7	5	1911.4	31 06.3	....	"
10 00 S.— " 23	20	8	5	1911.8	25 38.2	25 33.0	A. L. Cumming
20 00 S.— " 14	20	8	5	1911.8	25 35.2	25 30.0	"
29.19 W.— " 35	20	8	5	1910.5	25 30.7	25 28.5	J. R. Akins.
72.61 W.— " 32	32	8	5	1909.8	26 30.9	26 32.6	B. J. Saunders.
72 64 W.— " 32	32	8	5	1909.8	26 31.9	26 33.6	"
63.84 W.— " 35	32	8	5	1909 8	26 16.7	....	"
63.84 W.— " 35	32	8	5	1909 8	26 16.1	....	"
8.00 W.— " 36	36	8	5	1909.5	26 29 1	26 31.5	"
8.00 W.— " 36	36	8	5	1909.5	26 29.6	26 31.0	"
42 00 W.— " 35	36	8	5	1909.5	26 29.0	26 31.4	"
63.41 N.— " 21	37	8	5	1910 6	26 19.8	26 22.9	L. E. Fontaine.
21.94 N.— " 29	38	8	5	1910.6	26 46.2	26 45.3	"
4.45 N.— " 16	48	8	5	1911.9	27 03.9	27 00.5	"
53 15 N.—N.E. cor. sec. 9	50	8	5	1911 2	27 28.3	27 32.4	"
2 10 N.— " 3	51	8	5	1911.2	27 35.7	27 36 8	"
50 89 S.— " 4	53	8	5	1909.6	27 41.4	27 47.3	"
46 14 W.— " 35	54	8	5	1910.3	28 07.0	28 14.2	"
0 61 S. S.E. cor. sec. 5	59	8	5	1910.7	28 51.0	28 51.0	"
14.91 N.—N.E. cor. sec. 33	59	8	5	1910.7	29 10.7	29 14.7	"
39.00 W.— " 36	81	8	5	1911.5	31 12.3	31 12.4	A. H. Hawkins.
77.76 W.— " 31	84	8	5	1911 5	29 37.4	29 35.5	"
At N.E. cor. sec. 36	108	8	5	1910 3	32 53.7	33 02 4	A. W. Ponton.
" " 36	108	8	5	1910.3	32.51.1	32 55.3	"
" " 36	108	8	5	1910 3	32 53.0	.... ..	"
18·60 W.—N.E. cor. sec. 36	108	8	5	1910 3	33 07.7	33 06.9	"
18.60 W.— " 36	108	8	5	1910.3	33 07.3	33 10.5	"
At N.E. cor. sec. 36	108	8	5	1910 3	33 12.7	33 10.9	"
" " 36	108	8	5	1910.3	33 02.8	33 13.0	"
" " 36	108	8	5	1910.3	32 58.1	33 03.3	"
" " 36	108	8	5	1910 3	33 05.2	33 08.4	"
18.60 W.—N.E. cor. sec. 36	108	8	5	1910.3	33 07.7	33 07.9	"
18 60 W.— " 36	108	8	5	1910.3	32 53.3	33 01.5	"
18 60 W.— " 36	108	8	5	1910.3	32 53.4	32 57.6	"
18.60 W.— " 36	108	8	5	1910.3	32 58.8	33 02.0	"
18.60 W.— " 36	108	8	5	1910.3	33 09.6	33 11.8	"
18.60 W.— " 36	108	8	5	1910 3	32 59.4	33 05.6	"
18.60 W.— " 36	108	8	5	1910 3	32 46.3	32 55.5	"
18.60 W.— " 36	108	8	5	1910.3	32 48.7	32 57.9	"
18.60 W.— " 36	108	8	5	1910.3	32 51.8	32 59.0	"

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912·0	Observer.
					° ′	° ′	
18.60 W.—N.E. cor. sec. 36	108	8	5	1910.3	32 52.1	32 59.3	A. W. Ponton.
18.60 W.— " 36	108	8	5	1910 3	32 55 2	32 59.4	"
18 60 W.— " 36	108	8	5	1910 3	33 05 7	33 04 9	"
13.00 W.— " 35	20	9	5	1910 5	25 21.6	25 30 0	J. R. Akins.
16.00 W.— " 36	20	9	5	1910 5	25 32.8	25 30 2	"
54.00 N.— " 35	20	9	5	1910 5	25 17 7	25 25.1	"
At N.E. cor. sec. 3	21	9	5	1910 6	25 25 8	25 28 9	"
32 00 N.—N.E. cor. sec. 22	21	9	5	1910.6	25 20 7	25 25 8	"
6.00 N.— " 27	21	9	5	1910 6	25 05.4	25 08 5	"
8.00 N.— " 34	21	9	5	1910 6	25 07 4	25 12.5	"
58 00 W.— " 35	21	9	5	1910 6	25 13.7	25 18 8	"
6.00 N.— " 36	21	9	5	1910.7	25 14 0	25 17 8	"
68 00 N.— " 27	22	9	5	1910.8	25 01 7	25 08 8	"
60 25 N.— " 12	22	9	5	1910 7	25 10.4	25 15 4	"
39 00 N.— " 13	22	9	5	1910 7	25 13 6	25 13.6	"
30 00 N.— " 13	22	9	5	1910 7	25 08 2	25 13 2	"
25 00 S.— " 29	23	9	5	1909 6	24 39 3	24 39.4	Jas. Warren.
At S.E. cor sec. 30	23	9	5	1909.6	24 30 6	24 26 7	"
10.00 N.—S.W. cor. sec. 29	23	9	5	1909 6	24 32 1	24 39 7	"
20.00 N.—S.E. cor. sec. 20	23	9	5	1909 6	24 41 4	24 42.3	"
At N.E. cor. sec. 9	23	9	5	1909 6	24 44 4	24 41 5	"
30 00 S.—N.E. cor. sec. 21	23	9	5	1909 6	24 32.2	24 36 3	"
At N.E. cor. sec. 9	23	9	5	1909.6	24 33 7	24 37 8	"
5.00 E.—N.E. cor. sec. 19	23	9	5	1909 6	24 40.6	24 32 7	"
20.00 S.— " 22	23	9	5	1909 6	24 47 4	24 38 5	"
30.00 S.— " 15	23	9	5	1909 6	24 42 8	24 49 9	"
10 00 S.—N.W. cor. sec. 30	23	9	5	1909 6	24 31 0	24 35 1	"
40 00 S.—S.W. cor. sec. 32	23	9	5	1909 6	24 33 1	24 34 2	"
30.00 S.—N.W. cor. sec. 30	23	9	5	1909.6	24 31 2	24 39 3	"
40.00 E.—S.W. cor. sec. 30	23	9	5	1909 6	24 34 2	24 38 3	"
50 00 S.—N.E. cor. sec. 16	23	9	5	1909 6	24 35 4	24 36 5	"
At N.E. cor. sec. 16	23	9	5	1909 6	24 35 5	24 42 6	"
42 00 E.—N.E. cor. sec. 10	23	9	5	1909 6	24 47 0	24 59 1	"
59.00 S.— " 15	23	9	5	1909 6	24 47 4	24 52.5	"
20 00 W.— " 10	23	9	5	1909 6	24 38.3	24 50.4	"
70.00 S.— " 1	23	9	5	1909 7	24 13 2	24 53 0	"
10.00 S.— " 8	23	9	5	1909 7	24 46 6	......	"
5 00 N.— " 4	23	9	5	1909 7	24 40.5	24 40 3	"
30 00 S.— " 4	23	9	5	1909 7	24 55.5	25 01 3	"
27 00 S.— " 5	23	9	5	1909 7	24 52 2	24 58 2	"
38 00 S.— " 5	23	9	5	1909 7	24 58 0	24 58.0	"
60 00 S.— " 10	23	9	5	1909.7	24 56 2	24 55 2	"
1.00 S.— " 10	23	9	5	1909 7	24 53 6	24 51 6	"
10.00 S.— " 2	23	9	5	1909 7	24 46 5	24 52 5	"
68.00 S.— " 11	23	9	5	1909 7	24 48 4	......	"
55.25 W.— " 2	23	9	5	1910 8	25 07 8	25 08 9	J. R. Akins
46.60 W.—S.E. cor. sec. 3	23	9	5	1910.8	25 16 8	25 12 9	"
8.00 S.—N.E. cor. sec. 10	24	9	5	1910 9	24 51 1	24 53.3	"
17.00 W.— " 8	24	9	5	1910 9	24 57 3	......	"
27.00 S.— " 15	29	9	5	1909 6	24 52 9	24 50 0	Jas. Warren
30.90 W.— " 36	32	9	5	1909 8	26 37.9	26 38 6	B. J. Saunders
30.90 W.— " 36	32	9	5	1909 8	26 38 9	26 39 6	
52.95 W.—N.E. cor. sec. 31	32	9	5	1909 8	26 55.7	26 58.4	B. J. Saunders.
52.95 W.— " 31	32	9	5	1909 8	26 57.8	27 00 5	"
19.90 W.— " 32	36	9	5	1909 6	26 40 4	26 41 5	"
19.90 W.— " 32	36	9	5	1909 6	26 40 9	26 44 0	"
37.30 W.— " 35	36	9	5	1909 6	26 36 8	26 35 9	"
37.30 W.— " 35	36	9	5	1909 6	26 35 0	26 34.1	"
17.91 N.— " 14	48	9	5	1912 0	27 23 5	27 19 8	L. E. Fontaine.
2.79 N.— " 11	49	9	5	1912.0	27 37 1	27 31 4	"
14 15 N.— " 35	49	9	5	1911 2	27 33.1	27 36 2	"
7.90 N.— " 36	49	9	5	1911.2	27 30 1	27 33 2	"
39.68 S.— " 31	52	9	5	1909 5	28 00 5	28 07 7	"
13 57 N.— " 21	59	9	5	1910.7	28 07 1	28 08 1	"
At " 33	80	9	5	1910 5	29 11.5	29 19 3	A. H. Hawkins.

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912 0	Observer.
					° ′	° ′	
13.00 E.—N E. cot. sec. 34	80	9	5	1910.5	29 08.9	29 12.7	A. H. Hawkins.
0 85 E.— " 35	80	9	5	1910.5	29 24 7	29 29.1	"
20 13 W.— " 36	84	9	5	1911.5	29 38.9	29 39 0	"
73 95 W.— " 35	84	9	5	1911 5	30 01.8	30 06.9	"
2.66 W.— " 32	84	9	5	1911.5	29 40.6	29 40 7	"
28.00 W.— " 32	108	9	5	1910.3	31 49.4	31 54.6	A. W. Ponton.
28 00 W.— " 32	108	9	5	1910.3	31 43.0	31 46.2	"
28 00 W.— " 32	108	9	5	1910 3	32 00.9	32 02 1	"
28 00 W.— " 32	108	9	5	1910.3	31 47.7	31 54.9	"
28.00 W.— " 32	108	9	5	1910.3	31 52.4	31 57 6	"
45 43 W.— " 36	32	10	5	1909.8	26 37.5	....	B. J Saunders.
45.43 W.— " 36	32	10	5	1909.8	26 41.6	....	"
39.64 W.— " 32	32	10	5	1909.9	26 45.1	26 45.5	"
39.64 W.— " 32	32	10	5	1909.9	26 47.1	26 47.5	"
69.90 W.— " 32	36	10	5	1909 6	27 45.0	27 45.1	"
42 62 W.— " 34	36	10	5	1909.6	27 29 3	27 30.4	"
9.88 S.— " 28	49	10	5	1911.7	27 58.0	27 53 0	L. E. Fontaine.
5 97 S.— " 9	52	10	5	1910.3	27 40.8	....	"
56.70 E.— " 31	80	10	5	1910.5	32 41.8	....	A. H. Hawkins.
43 11 E.— " 33	80	10	5	1910.5	30 22.1	30 25.9	"
43.20 W.— " 36	84	10	5	1911.5	29 30.9	29 30.1	"
8 53 W.— " 35	84	10	5	1911.5	30 19.8	30 23.0	"
66.92 W.— " 31	84	10	5	1911.5	30 27.6	30 33.8	"
69 02 W.— " 32	36	11	5	1909.7	26 43.5	26 33.5	B. J. Saunders.
69.02 W.— " 32	36	11	5	1909.7	26 45.7	26 35.7	"
58.10 W.— " 36	36	11	5	1909.7	27 09.0	27 06.8	"
58.10 W.— " 36	36	11	5	1909.7	27 09.2	27 08.0	"
64.07 S.— " 12	48	11	5	1912.0	28 19.2	28 15.5	L. E. Fontaine.
16.38 S.— " 35	49	11	5	1911.7	27 43.5	27 40.5	"
0.38 N.— " 32	57	11	5	1909.9	29 23.8	29 26 8	"
5.00 E.— " 31	80	11	5	1910.4	29 40.0	29 44.1	A. H. Hawkins.
76 00 E.— " 31	80	11	5	1910.5	29 46.6	29 49 4	"
7 00 E.— " 33	80	11	5	1910.5	30 01.2	30 05.0	"
25.00 E.— " 34	80	11	5	1910.5	30 02.8	30 05.6	"
25 00 W.— " 34	84	11	5	1911.5	29 44.6	29 48.8	"
11.43 W.— " 33	84	11	5	1911.5	29 33.8	29 38.0	"
61.52 W.— " 33	84	11	5	1911.5	29 26.0	29 28.2	"
27.24 W— " 32	108	11	5	1910.6	33 16 4	33 15.5	A. W. Ponton.
27.24 W.— " 32	108	11	5	1910.6	33 13.7	33 20.8	"
27.24 W.— " 32	108	11	5	1910.6	33 17.6	33 21.7	"
27.24 W.— " 32	108	11	5	1910.6	33 14 3	33 16.4	"
27 24 W.— " 32	108	11	5	1910.6	33 29 1	33 26.2	"
27.24 W.— " 32	108	11	5	1910.6	33 27 7	33 27.8	"
27.24 W.— " 32	108	11	5	1910.6	33 20.1	33 26.2	"
27.24 W.— " 32	108	11	5	1910.6	33 11.8	33 14 9	"
3.30 S.— " 24	51	12	5	1911.7	28 00.6	27 56.6	L. E. Fontaine.
41.97 N.— " 22	52	12	5	1910 3	28 12.2	....	"
0 44 N.— " 24	54	12	5	1910.4	28 03.4	28 06 3	"
50.46 N.— " 23	56	12	5	1909 9	23 00.2	28 06.8	"
0.64 N.— " 32	57	12	5	1909.9	29 10.0	29 15.0	"
68.10 W.— " 31	80	12	5	1910.4	30 22.0	30 24.1	A. H. Hawkins.
4 61 E.— " 32	80	12	5	1910.4	30 20.8	30 24 9	"
5.00 E.— " 34	80	12	5	1910.4	29 51.3	29 53.4	"
6.00 E.— " 35	80	12	5	1910.4	29 48.7	29 51.8	"
20.25 W.— " 36	84	12	5	1911.5	28 57 0	29 02.2	"
64 53 W.— " 35	84	12	5	1911.5	29 25.9	29 27.1	"
30 00 W.— " 31	84	12	5	1911.6	29 17.9	29 16.8	"
41 73 W.— " 31	84	12	5	1911.6	29 16.0	29 15.9	"
54.34 W.— " 32	40	13	5	1908.7	27 35.8	27 45.3	B. J. Saunders.
8.46 N.— " 36	49	13	5	1911.9	27 48.1	27 41.6	L. E. Fontaine.
2.50 N.— " 16	50	13	5	1911 9	27 52.1	27 49.6	"
16.89 N.— " 9	51	13	5	1911.9	28 07.9	28 03.4	"
36.25 W.— " 20	56	13	5	1909.8	28 53 9	28 57 2	"
0 48 N.— " 10	57	13	5	1909 8	28 44.8	28 48.1	"
10.03 N.— " 10	59	13	5	1910.8	28 12.2	28 15.3	"

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date	Declination. Obs'd.	Declination. Reduced to 1912.0	Observer.
					° ′	° ′	
1.98 S.E.—N.E. cor. sec. 4	59	13	5	1911.4	28 19.1	28 21.5	L. E. Fontaine.
75.00 W.—N. E. cor. sec. 31	80	13	5	1910.4	30 01.0	......	A. H. Hawkins.
At " 31	80	13	5	1910.4	30 04.0	30 08.9	"
60.00 E.— " 31	80	13	5	1910.4	30 07.4	30 12.3	"
78.00 E.— " 32	80	13	5	1910.4	30 19.3	30 23.4	"
At " 34	80	13	5	1910.4	30 09.0	30 15.1	"
42.00 E.— " 35	80	13	5	1910.4	30 09.0	30 13.1	"
21.51 W.— " 35	84	13	5	1911.6	29 19.2	29 23.1	"
21.54 W.— " 35	84	13	5	1911.6	29 21.1	29 25.0	"
78.64 W.— " 31	84	13	5	1911.6	29 31.7	29 33.8	"
E. end Base (Castle Mt.) Approx. Middle N. ½ sec. 31	27	14	5	1911.6	25 53.1	25 52.0	M. P. Bridgland.
24.36 W.—N. E. cor. sec. 34	40	14	5	1908.7	27 27.8	27 38.3	B. J. Saunders.
28.01 S.— " 12	54	14	5	1911.3	27 54.2	27 56.6	L. E. Fontaine.
10.76 S.— " 34	55	14	5	1909.8	28 57.1	28 59.8	"
66.33 W.— " 31	55	14	5	1909.8	29 15.3	29 14.0	"
16.00 W.— " 31	80	14	5	1910.4	29 37.8	29 41.7	A. H. Hawkins.
23.00 E.— " 31	80	14	5	1910.4	29 36.0	......	"
20.00 E.— " 32	80	14	5	1910.4	29 43.2	......	"
45.00 E.— " 33	80	14	5	1910.4	29 48.8	29 53.7	"
5.00 E.— " 35	80	14	5	1910.4	30 03.4	30 10.3	"
10.48 W.— " 32	84	14	5	1911.6	30 22.7	30 20.2	"
39.05 W.— " 36	84	14	5	1911.6	30 54.6	30 55.1	"
27.10 W.— " 31	84	14	5	1911.6	20 34.4	30 36.9	"
32.00 W.— " 32	40	15	5	1908.8	27 14.6	27 23.4	B. J. Saunders.
32.00 W. " 32	40	15	5	1908.8	27 14.4	27 21.2	"
32.75 N.— " 15	56	15	5	1911.4	29 23.0	......	L. E. Fontaine.
At " 33	80	15	5	1910.4	29 24.8	29 26.7	A. H. Hawkins.
50.00 E.— " 34	80	15	5	1910.4	29 27.6	29 33.5	"
60.00 E.— " 35	80	15	5	1910.4	29 29.9	29 33.8	"
4.00 W.— " 36	84	15	5	1911.6	30 38.1	30 38.6	"
52.50 W.— " 34	84	15	5	1911.6	30 36.4	30 33.9	"
1.00 W.— " 31	84	15	5	1911.6	30 29.2	30 30.7	"
52.50 W.— " 34	84	15	5	1911.6	30 40.6	30 41.1	"
2.00 W.— " 34	39	16	5	1910.4	26 43.0	26 47.1	J. B. McFarlane.
19.60 W.— " 32	39	16	5	1910.4	26 38.1	26 40.2	"
69.80 S.— " 28	39	16	5	1910.5	26 40.1	26 43.9	"
10.00 W.— " 7	39	16	5	1910.5	26 26.3	26 34.1	"
78.00 W.— " 19	39	16	5	1910.5	26 31.1	26 35.9	"
69.02 S.— " 25	40	16	5	1910.4	26 43.0	26 47.9	"
0.25 S.— " 3	56	16	5	1911.4	28 21.8	28 22.2	L. E. Fontaine.
10.62 N.— " 1	57	16	5	1911.8	28 46.9	28 40.9	"
At " 19	57	16	5	1911.8	28 26.0	28 21.0	"
66.24 W.— " 31	80	16	5	1910.3	29 27.6	29 33.8	A. H. Hawkins.
21.62 E.— " 32	80	16	5	1910.4	29 24.7	29 30.6	"
22.09 E.— " 35	80	16	5	1910.4	29 29.1	29 34.0	"
30.00 W.— " 34	84	16	5	1911.6	30 21.9	30 18.4	"
50.57 W.— " 31	84	16	5	1911.7	30 22.8	30 20.0	"
43.00 W.— " 36	84	16	5	1911.6	30 16.5	30 16.0	"
18.85 W.— " 33	84	16	5	1911.6	30 13.7	......	"
18.00 N.— " 12	39	17	5	1910.5	26 40.7	26 45.1	J. B. McFarlane.
21.00 W.— " 23	39	17	5	1910.5	26 41.1	26 46.5	"
At " 22	39	17	5	1910.5	26 41.3	26 48.7	"
60.00 W.— " 32	39	17	5	1910.5	26 39.6	26 47.0	"
11.50 S.— " 26	39	17	5	1910.5	26 37.2	26 44.6	"
56.22 S.— " 23	39	17	5	1910.5	26 41.0	26 45.4	"
45.00 W.— " 22	39	17	5	1910.6	26 40.1	26 45.2	"
73.00 S.— " 28	39	17	5	1910.6	26 27.8	26 32.9	"
3.00 W.— " 36	39	17	5	1909.7	26 39.9	26 42.4	A. McFee.
At N. E. cor. sec. 36	40	17	5	1909.7	26 25.6	26 31.6	"
0.08 N.—N. E. cor. sec. 10	54	17	5	1910.8	29 12.3	29 14.4	L. E. Fontaine.
32.91 N.—N. E. cor. sec. 2	56	17	5	1911.4	27 39.6	27 42.4	"
25.00 N.—S. E. " 9	79	17	5	1911.8	29 29.3	29 26.3	G. J. Lonergan.
At S. E. " " 8	79	17	5	1911.8	29 29.7	29 23.7	"
43.07 E.—N.E. cor. sec. 31	80	17	5	1910.3	29 27.5	29 32.7	A. H. Hawkins.

TABLE No. 4—*Continued.*

Place.	Tp.	Rge	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912·0.	Observer.
					° ′	° ′	
5.57 E.—N.E. cor. sec. 34	80	17	5	1910.3	29 32.5	29 38.7	A. H. Hawkins.
10.00 W.— ″ 33	84	17	5	1911.7	29 54.7	29 52.9	″
38.00 W.— ″ 35	84	17	5	1911.7	30 06.4	30 02.4	″
At ″ 31	23	18	5	1911.7	26 04.3	26 01.5	C. H. Taggart.
2.00 N.— ″ 22	23	18	5	1911.7	25 52.5	25 49.5	″
5.00 S.— ″ 24	39	18	5	1909.7	26 42.1	....	A. McFee.
26.54 S.— ″ 31	51	18	5	1911.3	27 53.4	....	L. E. Fontaine.
17.01 N.— ″ 13	54	18	5	1910.8	28 40.8	28 39.5	″
1.10 S.— ″ 21	55	18	5	1911.4	27 58.8	27 58.6	″
32.30 S.— ″ 7	56	18	5	1911.8	28 23.7	28 19.7	″
41.45 E.— ″ 31	80	18	5	1910.3	29 28.8	29 37.0	A. H. Hawkins.
65.34 E.— ″ 34	80	18	5	1910.3	29 28.9	29 34.1	″
80.50 W.— ″ 36	84	18	5	1911.7	30 18.6	30 15.6	″
At ″ 35	84	18	5	1911.7	30 07.7	30 04.7	″
42.65 W. ″ 31	84	18	5	1911.7	30 39.6	30 35.6	″
8.00 W.—N. E. cor. sec. 16	24	19	5	1909.8	25 54.3	15 52.0	T. H. Plunkett.
20.00 N.— ″ ″ 10	24	19	5	1909.8	25 49.4	25 50.1	″
At ″ ″ 11	24	19	5	1911.6	25 45.1	25 42.6	C. H. Taggart.
33.00 E.—N. W. ″ 18	24	19	5	1911.7	25 53.3	25 39.3	″
At N. E. ″ ″ 32	40	19	5	1910.4	26 53.0	26 54.9	J. B. McFarlane.
32.00 S.—N. E. ″ 26	41	19	5	1909.5	26 27.8	....	A. McFee.
8.00 S.— ″ ″ 1	41	19	5	1909.4	26 23.0	26 29.9	″
4.00 N.— ″ ″ 27	41	19	5	1909.5	26 30.5	26 43.7	″
At ″ ″ 10	42	19	5	1909.5	26 23.8	26 34.0	″
10.00 S.— ″ ″ 1	42	19	5	1909.5	26 24.1	26 33.3	″
70.00 W.— ″ ″ 23	46	19	5	1911.6	27 36.4	27 34.3	A. L. McNaughton
70.00 S.— ″ ″ 16	46	19	5	1911.6	27 42.5	27 33.0	″
62.00 S.— ″ ″ 2	47	19	5	1910.7	27 53.9	27 56.7	″
50.00 S.— ″ ″ 4	47	19	5	1910.7	28 08.8	28 10.8	″
15.00 S.— ″ ″ 3	47	19	5	1910.7	27 59.6	27 59.6	″
45.00 S.— ″ ″ 11	47	19	5	1910.6	28 02.5	27 57.6	″
15.61 N.— ″ ″ 23	55	19	5	1911.4	28 25.6	28 24.4	L. E. Fontaine.
1.21 N.— ″ ″ 8	56	19	5	1911.8	28 39.5	28 33.5	″
10.00 N.— ″ ″ 24	80	19	5	1911.8	29 03.2	....	G. J. Lonergan.
At ″ ″ 36	24	20	5	1909.8	25 53.1	25 56.8	T. H. Plunkett.
At ″ ″ 18	25	20	5	1910.9	25 51.1	25 49.3	D. A. Smith.
24.00 W.— ″ ″ 10	25	20	5	1911.7	25 55.1	25 53.1	C. H. Taggart.
15.00 E.— ″ ″ 31	43	20	5	1910.7	27 23.2	27 23.7	O. Rolfson
30.00 S. ″ ″ 28	43	20	5	1910.8	27 11.8	27 11.8	″
36.00 S.— ″ ″ 16	43	20	5	1910.8	27 06.5	27 11.6	″
11.50 S.— ″ ″ 29	43	20	5	1910.8	27 14.6	27 15.7	″
22.00 S.— ″ ″ 20	43	20	5	1910.8	27 12.8	....	″
45.00 S.— ″ ″ 34	43	20	5	1911.8	27 29.5	27 17.5	J. Francis.
53.00 S.— ″ ″ 22	43	20	5	1911.8	27 12.7	27 08.7	″
11.00 W.— ″ ″ 11	43	20	5	1911.8	27 04.2	27 03.2	″
28.00 N. ″ ″ 11	43	20	5	1911.8	27 02.8	26 58.8	″
18.00 N.— ″ ″ 18	43	20	5	1911.8	27 12.0	27 10.0	″
15.00 W.— ″ ″ 33	44	20	5	1910.4	27 35.4	27 37.5	O. Rolfson.
8.00 N.— ″ ″ 21	44	20	5	1910.5	27 26.4	37 30.2	″
12.00 N.— ″ ″ 26	44	20	5	1910.5	27 23.4	27 36.8	″
7.00 S.— ″ ″ 27	44	20	5	1910.5	27 23.4	27 26.8	″
49.00 N.— ″ ″ 8	44	20	5	1911.7	27 29.4	27 27.4	J. Francis.
60.00 S.— ″ ″ 19	44	20	5	1911.8	27 32.3	27 29.3	″
15.00 N.— ″ ″ 7	44	20	5	1911.8	27 28.5	27 25.5	″
2.00 S.— ″ ″ 7	45	20	5	1910.6	27 55.7	27 54.8	″
5.00 S.— ″ ″ 13	45	20	5	1911.7	27 51.9	27 42.1	A. L. McNaughton
10.00 S.— ″ ″ 12	46	20	5	1911.7	28 03.5	27 53.5	″
60.00 S.— ″ ″ 27	47	20	5	1911.8	27 58.3	27 50.3	″
At N. E. cor. sec. 12	48	20	5	1910.5	28 11.9	....	″
50.00 S.—N. E. cor. sec. 8	48	20	5	1911.8	28 12.4	28 08.4	″
12.91 S.— ″ ″ 24	51	20	5	1911.3	28 07.3	28 08.7	L. E. Fontaine.
3.84 N.— ″ ″ 22	55	20	5	1911.4	28 22.6	....	″
41.00 N.— ″ ″ 29	76	20	5	1911.8	30 02.7	29 59.5	G. J. Lonergan.
35.75 W.— ″ ″ 31	84	20	5	1911.7	30 34.5	30 31.5	A. H. Hawkins.
At ″ ″ 24	25	21	5	1910.9	26 05.6	26 06.8	D. A. Smith.
20.00 S.—¼ N. by sec. 34	25	21	5	1910.8	25 52.4	25 51.5	W. J. Deans.
At N. E. cor. sec. 35	25	21	5	1910.8	25 58.8	25 58.9	″

TABLE No. 4.—*Continued.*

Place.	Tp	Rge.	Mr.	Date.	Declination. Obs'd.	Declination. Reduced to 1912 0	Observer.
					° ′	° ′	
20.00 W.—N. E. cor. sec. 32.......	25	21	5	1910 9	25 52.9	25 53 7	W. J. Deans.
71.50 S.— " " 36.......	25	21	5	1910.9	26 00.6	26 02 4	"
10.00 W.— " " 25.......	25	21	5	1910.9	25 59 0	26 00 8	"
30.00 N " " 26.....	25	21	5	1910.9	26 00.2	25 59 0	"
7.00 S.— " " 4.......	26	21	5	1910.8	26 00.1	......	"
At Centre " 10.......	26	21	5	1910 8	25 57.8	26 00 9	"
15.00 E.—N. E. " 4..	26	21	5	1910 8	25 52.2	25 56 3	"
8.00 S.— " " 3.. ...	26	21	5	1910 8	25 50 4	25 52 0	"
10.00 S.— " " 9.......	26	21	5	1910.8	25 59.2	26 00 3	"
40.00 E.— " " 8.......	26	21	5	1910 9	25 50.0	.....	"
40.00 S.— " " 6..... ..	26	21	5	1910 9	25 46.2	25 47 0	"
At centre sec. 5............... ..	26	21	5	1910 9	25 51.6	25 55 4	"
22.00 W. ¼ post on E. by sec. 6. ...	27	21	5	1911 0	26 25 4	26 22.3	P. B. Street.
21.40 S. - " N. " 7. ...	27	21	5	1911.0	26 15 7	26 18 6	"
60.00 W.—N. E. cor. sec. 36	43	21	5	1910.7	27 24 3	27 22 3	O. Rolfson.
58.00 S.— " " 1..	44	21	5	1910 7	27 28.3	27 27 8	"
45 85 W.— " " 36..... ..	44	21	5	1910 6	27 46.4	27 51.5	J. B. McFarlane.
29.63 W.— " " 35	44	21	5	1910.6	27 51.0	27 52 1	"
1 43 W.— " " 33.......	44	21	5	1910 6	27 46 6	27 51 2	"
56.40 W.— " " 32.......	44	21	5	1910 6	27 47.7	27 50 8	"
41.00 S. — " " 11..... ..	45	21	5	1910 6	27 57.0	......	J. Francis.
2 00 N.— " " 12.. ...	48	21	5	1911.9	28 16 7	28 12 2	A. L. McNaughton
10.00 S.— " " 22	48	21	5	1911.9	28 17 0	28 12 5	"
52.00 S.— " " 31.....	48	21	5	1910 7	27 56 4	27 58 4	"
At " " 19.......	48	21	5	1910 7	27 54.9	27 54 9	"
70.00 S.— " " 32.......	48	21	5	1910 8	27 51.0	27 57 7	"
50.00 S.— " " 33.......	48	21	5	1910.8	27 59.9	28 02.1	"
53.60 S.— " " 34.......	52	21	5	1909.7	27 40.0	27 45.8	L. E. Fontaine.
20.00 W. N E. cor. sec. 20.......	76	21	5	1911 8	30 00 2	29 58 2	G. J. Lonergan
At " " 11.......	27	22	5	1908.4	25 05 8	25 15.4	T. H. Plunkett
12.00 W. ¼ cor. E. by sec. 25	27	22	5	1910 9	26 11 2	26 08.1	P. B. Street
12.00 W.— " 25	27	22	5	1910 9	26 06 8	26 09 7	"
63.35 W.-N. E. cor. sec. 36	44	22	5	1910.6	27 42.7	27 48.3	J. B. McFarlane
43.82 W.- " " 32.......	44	22	5	1910.7	27 42 8	27 46 6	"
38.72 N.- " " 31.......	45	22	5	1910.8	27 45 8	27 48 9	"
39.78 N.- " " 32	45	22	5	1910 8	27 45 9	..	"
1.65 S.- " " 12.......	45	22	5	1910 6	27 46 1	27 50 2	"
65.10 N.- " " 12	45	22	5	1910 6	27 48 6	27 52 2	"
27.53 N.- " " 2.......	45	22	5	1910.6	27 41 7	27 44 3	"
48.57 W.- " " 11	45	22	5	1910 6	27 39 0	27 42 1	"
73.45 N.- " " 3	45	22	5	1910 6	27 41.0	27 43 6	"
28 40 W.- " " 10	45	22	5	1910 6	27 45 8	27 48 9	"
49.49 N.- " " 15	45	22	5	1910 7	27 45 7	27 47.5	"
26.32 N.- " " 24	45	22	5	1910.7	27 51.5	27 53 5	"
15 40 N.- " " 23	45	22	5	1910 7	27 51 9	27 53 9	"
34.17 W.- " " 34	45	22	5	1910 7	27 47.2	27 52 2	"
37.96 N.- " " 22	45	22	5	1910 7	27 50 2	27 50 7	"
29.46 W.- " " 31	45	22	5	1910 7	27 50 1	27 52 1	"
28.41 W.- " " 31	45	22	5	1910 7	27 53 9	27 56 9	"
37.15 W.- " " 33	45	22	5	1910 7	27 48 2	27 50 2	"
59.94 W.- " " 32	45	22	5	1910.7	27 46 2	..	"
5.50 W. " " 20.......	45	22	5	1910 7	27 55 6	27 51 0	"
15.73 N.- " " 30	45	22	5	1910 8	27 51 4	27 54 5	"
66.25 N.- " " 6	46	22	5	1910 8	27 41.2	27 42 3	"
38.23 W.- " " 7	46	22	5	1910 8	27 47 2	......	"
5.00 N.- " " 1..	49	22	5	1910.7	27 58 9	.	A L McNaughton
30 00 N.- " " 3..	49	22	5	1910 8	27 58 8	......	"
At " " 4.......	49	22	5	1910 8	27 47 8	27 48.9	"
27 00 N.- " " 35	48	22	5	1910.8	27 50 4	27 49 5	"
3.83 S.- " " 22	51	22	5	1911 3	27 24 6	. .	L. E. Fontaine
17 25 N.- " " 32.......	52	22	5	1910.9	27 06.3	27 07.7	"
24.36 N.- " " 11.......	52	22	5	1909 7	27 21 0	27 27 0	"
12.18 N.- " " 13.......	54	22	5	1911.1	28 44 2	28 46.0	"
45.00 E - " " 22.......	76	22	5	1911 8	29 57.0	29 54 0	G. J. Lonergan
20.00 N.- " " 23.......	76	22	5	1911 8	29 55 6	29 51.6	"
At " " 32.......	44	23	5	1911.4	27 45 6	27 48 4	J. Francis
33.28 N.- " " 36.......	44	23	5	1910 7	27 50 4	27 51.2	J. B. McFarlane

TABLE No. 4.—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination.		Observer.
					Obs'd.	Reduced to 1912.0	
					° ′	° ′	
59.45 N.–N.E. cor. sec. 1..........	45	23	5	1910.7	27 46.8	....	J. B. McFarlane.
74.10 N.– " " 12.......	45	23	5	1910.7	27 49.3	27 49.3	"
27.77 N.– " " 36	45	23	5	1910.7	28 01.3	28 01 3	"
20.00 N.– " " 29	45	23	5	1911.5	27 46.2	27 46.4	J. Franeis
20.00 N.– " " 31	45	23	5	1911.5	27 48 8	27 53.0	"
56.00 S.– " " 31	45	23	5	1911.5	27 49.5	27 52 7	"
65 00 W.– " " 12	45	23	5	1911.4	27 45.2	27 47.0	"
19.00 S.– " " 14	45	23	5	1911 4	27 45.2	....	"
42 00 S.– " " 22	45	23	5	1911.4	27 45.1	27 46.9	"
15.00 N.– " " 10	45	23	5	1911 4	27 49.2	27 50.0	"
25 60 S.– " " 15	45	23	5	1911.4	27 45.2	27 45 0	"
7.50 S.– " " 21	45	23	5	1911 4	27 36.5	27 43.3	"
5.00 N.– " " 9	45	23	5	1911.4	27 36.0	27 39.8	"
7.00 N.– " " 16	45	23	5	1911.4	27 48 1	27 52.5	"
30.00 N.– " " 4	45	23	5	1911.4	27 43.0	27 45.4	"
55.50 W.– " " 36	45	23	5	1911.4	27 41.9	27 43.3	"
22.00 N.– " " 35	45	23	5	1911.4	27 40.7	27 43.1	"
55.00 S.– " " 34	45	23	5	1911 4	27 30 0	....	"
At " " 33	45	23	5	1911 4	27 40.6	27 44.0	"
6 00 S.– " " 33	45	23	5	1911 5	27 45 0	27 49.1	"
4 00 S.– " " 28	45	23	5	1911.5	27 38.3	27 42.4	"
30 00 W.– " " 31	45	23	5	1911 5	27 43 5	27 47.6	"
46.00 W.– " " 32	45	23	5	1911 5	27 53.3	....	"
24.00 N.– " " 9	46	23	5	1911 5	27 46 8	27 48 9	"
22 00 N.– " " 5	46	23	5	1911 5	27 44.4	27 48.6	"
35 00 S.– " " 19	46	23	5	1911.6	27 53 6	27 54 1	"
53.17 N.– " " 1	45	23	5	1910.8	27 57.4	....	J. B. McFarlane.
36.00 N.– " " 5	49	23	5	1910.5	27 56 2	28 01.6	J. Francis.
44.00 W.– " " 8	49	23	5	1910.6	28 01.4	28 04 5	"
5 71 N.– " " 24	53	23	5	1909.7	28 45.4	28 49.4	L. E. Fontaine.
30 00 N.–S E. " 10	83	23	5	1911.6	31 43.8	31 42.7	G. J. Lonergan.
At N.E " 12	85	23	5	1911.6	31 37.5	31 37.4	"
15.00 S.–N.E. " 36	45	24	5	1911.5	27 52.2	27 55.4	J. Francis.
41.00 S.– " " 2.......	46	24	5	1911 6	27 58.7	27 57.6	"
8 00 S.– " " 3	46	24	5	1911.6	27 56.8	....	"
28 00 S.– " " 13.......	46	24	5	1911.6	27 59.1	27 58 6	"
3 50 N.– " " 14.......	46	24	5	1911 6	27 49.8	27 50.3	"
At " " 23.......	46	24	5	1911 6	27 45 2	27 43.7	"
At " " 22.......	46	24	5	1911.6	28 03.7	28 02 2	"
28 00 W.– " " 21.......	46	24	5	1911.7	27 59.1	27 56 1	"
22.50 N.—N.E. cor. sec. 21.........	46	24	5	1911.7	27 55·9	27 51 9	J. Francis.
28 00 N.— " 20.........	46	24	5	1911.7	27 58·8	27 55·8	"
65 00 N.— " 19.........	46	24	5	1911.7	28 00·4	27 57·4	"
7 00 W.— " 19.........	48	24	5	1910.5	28 04·4	28 07·2	"
42.00 S.— " 20	48	24	5	1910 5	28 05·6	28 10·9	"
12.00 E. 32.50 S–N.E. cor. sec. 7. .	49	24	5	1910.5	28 12·1	28 12·5	"
64 03 S.—N E. cor. sec. 3	52	24	5	1909.7	28 32·2	28 30 2	L. E. Fontaine.
5.00 N.—S.E. " 25.........	48	25	5	1910.4	27 50·5	27 55·4	J. Francis.
10 00 S.—N.E. " 23.........	48	25	5	1910.4	27 50·1	27 54·8	"
10.00 W.— " " 24.........	48	25	5	1910.5	27 59·2	28 02 6	"
50 00 N.—S.E. " 1	49	25	5	1910.4	28 03·9	28 07·5	"
40 00 N.—N E. " 1	49	25	5	1910 4	28 02·3	28 04 4	"
40 00 S.— " " 34	51	25	5	1910 8	28 26 8	28 32·9	A. L. Cumming.
17.00 N.— " " 7.........	51	25	5	1910.7	28 23 3	28 24·3	"
15 00 W.—S.E. " 5.........	51	25	5	1909 4	28 03·5	28 03 2	J. B. McFarlane.
47 62 W.—N E. " 32	56	25	5	1909.4	28 54·7	29 02 4	A. H. Hawkins.
20.00 N.— " " 28.........	26	26	5	1911 6	26 02 7	25 59 6	M. P. Bridgland.
15 00 W.— " " 20.........	50	26	5	1909.4	27 46·3	27 50 0	J. B. McFarlane.
10 00 S. 39°48′. 5 E.—N E. cor. 32...	50	26	5	1909.4	27 56 6	28 00 3	"
At N E. cor. sec. 32............	50	26	5	1909.4	28 00 0	27 54·7	"
30 00 S.— " 29............	50	26	5	1909.4	28 00·1	....	"
70 00 S.— " 33............	50	26	5	1909 4	27 48·4	27 49 6	"
8.00 E.— " 32............	50	26	5	1909.3	27 55·9	27 57·9	"
10.00 S.— " 24............	51	26	5	1910.6	28 31·2	28 34·3	A. L. Cumming.
At " 35............	51	26	5	1910.7	28 29·8	28 31·8	"
12.00 S.— " 28........	51	26	5	1910.7	28 26·1	28 29·1	"
At N.E. cor. sec. 8................	51	26	5	1910.7	28 26·4	28 26·4	"

TABLE No. 4.—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912 0	Observer.
					° ′	° ′	
7.00 N.—N.E. cor. sec. 18	51	26	5	1910.7	28 25 8	28 24 8	A. L. Cumming.
At " 19	51	26	5	1910 7	28 21 4	28 21 4	"
At " 12	51	26	5	1909 3	28 26 1	28 28 1	J. B. McFarlane.
7.00 S.— " 26	52	26	5	1910 4	28 26 6	28 31 7	A. L. Cumming.
11.00 E.— " 23	52	26	5	1910 4	28 27 8	28 34 9	"
51.00 S— " 27	52	26	5	1910 5	28 25·7	28 28 5	"
11.00 E.— " 21	52	26	5	1910 5	28 20 9	28 25·7	"
4 00 W.— " 12	52	26	5	1910 5	28 22·7	28 26 1	"
10.00 N.— " 30	52	26	5	1940 6	28 21 3	28 23·4	"
At " 9	52	26	5	1910 6	28 24·6	28 27 7	"
29 44 W.— " 33	56	26	5	1909 4	28 58 2	28 55 9	A. H. Hawkins.
41.23 W.— " 36	56	26	5	1909 4	28 59·0	28 59 7	"
40.00 W.— " 34	56	26	5	1909 4	28 55 7	28 56 4	"
38.00 S.— " 32	48	27	5	1911 4	27 33 2	27 37 6	G. H. Herriot.
37.02 S.— " 33	48	27	5	1911 5	27 32 4	27 35·5	"
2 00 N.— " 5	49	27	5	1911 4	27 55 2	27 47·6	"
10 00 N.— " 15	49	27	5	1909 5	27 50 0	27 55·2	J. B. McFarlane
At " 10	49	27	5	1909 5	27 50 8	26 48 4	"
45 00 W.— " 10	49	27	5	1909 5	27 44 7	27 53 3	"
49.00 S.— " 23	50	27	5	1909 4	27 46 4	27 50 8	"
17 00 W.— " 11	50	27	5	1909 1	27 46·8	27 51 7	"
55 00 E.— " 11	50	27	5	1909 4	27 54 3	27 50 2	"
49.00 S.— " 23	50	27	5	1909 4	27 58 6	27 54 5	"
6 00 S.— " 2	50	27	5	1909 4	27 45·0	....	"
35.00 S.— " 11	50	27	5	1909 4	27 49·6	27 52 5	"
42.00 S.— " 11	50	27	5	1909 4	28 01 4	27 55·3	"
31.10 W.— " 35	56	27	5	1909 4	29 11·4	29 14 3	A. H. Hawkins.
46 62 W.— " 34	56	27	5	1909 4	28 59·7	29 00 6	"
At " 12	48	28	5	1909 5	26 51·0	26 55 4	J. B. McFarlane.
40.00 S.— " 13	48	28	5	1909 5	27 11·3	27 04 7	"
32.00 W.— " 11	48	28	5	1909 6	27 05·8	27 10 9	"
44 00 S.— " 14	48	28	5	1909 6	27 20 3	27 12 4	"
14 00 E.— " 29	20	29	5	1910 7	25 39 7	25 39 7	G. H. Blanchet.
At S. W. cor. sec. 24	20	1	6	1908 9	24 49·3	24 55 4	T. H. Plunkett.
15.00 N.—¼ on E. By. sec. 26	21	1	6	1910 6	25 56·4	25 57 5	G. H. Blanchet.
At N. E. cor. sec. 33	21	1	6	1909 6	26 00 7	26 02 8	T. H. Plunkett.
At about centre sec. 20	22	1	6	1910.8	25 58 9	25 56 0	P. B. Street.
" 20	22	1	6	1910 8	25 47 7	25 50·8	"
40.00 S.—N. E. cor. sec. 5	24	1	6	1909.7	25 52 2	25 52·2	E. W. Robinson.
65 00 S.— " 5	24	1	6	1909.7	25 44·9	25 51 9	"
50.00 S.— " 21	45	1	6	1909 7	26 56·1	26 59 1	J. B. McFarlane.
4.00 N.— " 17	45	1	6	1909 7	26 57 9	27 00 9	"
60.00 W.— " 5	45	1	6	1909 7	26 52·9	27 02 9	"
20 00 W.— " 5	45	1	6	1909 7	27 00 1	27 00 1	"
75.00 S.— " 3	46	1	6	1909 7	27 00 1	27 04 4	"
17.00 S.— " 16	46	1	6	1909 7	26 58 6	27 08 4	"
15.00 N.— " 21	46	1	6	1909 7	27 10 3	27 11 1	"
72.00 S.— " 16	47	1	6	1909 6	26 55 6	26 58 7	"
36 00 W.—¼ sec. E. By. sec. 22	47	1	6	1909 6	27 00 9	27 09 0	"
20.00 W.— " 22	47	1	6	1909 6	27 11 8	27 14 9	"
At S. E. cor. sec. 5	47	1	6	1909 7	27 11 0	27 14 8	"
At N. E. " 16	47	1	6	1909 6	27 03 5	27 15 6	"
11 00 E.—N. E. cor. sec. 17	47	1	6	1909 6	27 14 0	27 11 1	"
Intersection of 15th Base Line and 6th Meridian	56	1	6	1909 4	28 45·8	28 52 5	A. H. Hawkins.
20.03 W.—N. E. cor. sec 35	56	1	6	1909 5	28 41 1	28 53 7	"
45.16 W.— " 31	56	1	6	1909 4	28 51 1	28 58 6	"
34.79 W.— " 32	56	1	6	1909 4	28 33 5	28 46·0	"
36.92 W.— " 33	56	1	6	1909 5	28 50 5	28 55 1	"
5.00 W.— " 36	60	1	6	1909 8	28 50·3	....	"
24 40 W.— " 35	60	1	6	1909.8	28 46 3	28 47 0	"
29.44 W.— " 33	60	1	6	1909.8	28 39 4	28 47 1	"
32.00 W.— " 33	64	1	6	1909.7	29 05 1	29 10 9	G. McMillan.
60.00 N.—S. E. " 6	82	1	6	1911 6	30 31 4	30 28 9	G. J. Lonergan.
At N. E. " 13	22	2	6	1909 6	26 08·9	......	T. H. Plunkett.
10 chs. E—N.E. " 16	23	2	6	1909 0	24 58 6	....	E. W. Robinson.
5 chs. N.— " " 20	23	2	6	1908.5	25 00·5	25 10 0	T. H. Plunkett.

TABLE No. 4.—*Continued.*

Place	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912.0	Observer.
					° ′	° ′	
At N.E. cor. sec. 13	23	2	6	1911.7	25 33·1	25 29·1	M. P. Bridgland.
10.00 N.— " " 26	23	2	6	1909.8	25 37·1	25 35·8	E. W. Robinson.
40.00 N.— " " 26	23	2	6	1909.8	25 32·4	25 37·1	"
50.00 W.— " " 7	23	2	6	1909.6	25 24·4	25 23·5	"
30.00 W.— " " 7	23	2	6	1909.6	25 17·9	25 29·0	"
34.00 W.— " " 11	23	2	6	1911.0	26 01·5	26 03·4	G. H. Blanchet.
20.00 N.—S. E. " 3	23	2	6	1909.7	26 04·1	26 10·1	T. H. Plunkett.
67.00 W.—N. E. cor. S. E. ¼ sec. 2	23	2	6	1909.7	25 56·2	25 47·2	"
10.00 S.—N. E. cor. sec. 5	24	2	6	1909.7	25 46·7	25 49·7	E. W. Robinson.
40.00 S.— " 5	24	2	6	1909.7	25 40·5	25 50·5	"
15.00 W.— " 4	24	2	6	1909.7	25 46·2	....	"
40.00 W.— " 4	24	2	6	1909.7	25 42·0	25 53·8	"
30.00 W.— " 27	24	2	6	1909.5	25 43·2	25 42·6	"
40.00 W.— " 27	24	2	6	1909.5	25 40·1	25 48·5	"
9.50 W.—N. E. cor. L. S. 4 sec. 10	24	2	6	1910.8	25 58·3	25 55·4	P. B. Street.
9.50 W.— "	24	2	6	1910.8	25 58·6	26 06·7	"
40.00 E.—N. E. cor. sec. 9	25	2	6	1909.5	25 48·6	25 47·8	E. W. Robinson.
10.00 N.—Centre sec. 10	26	2	6	1909.5	25 39·2	25 52·4	"
40.00 E.—N. E. cor. sec. 20	26	2	6	1909.5	25 50·7	25 49·3	"
15.00 E.— " 20	26	2	6	1909.5	25 43·7	25 53·8	"
At " 16	26	2	6	1909.5	25 47·0	25 48·2	"
At " 16	26	2	6	1909.5	25 42·7	25 51·9	"
40.00 S.— " 32	26	2	6	1909.4	25 50·4	....	"
40.00 S.— " 32	26	2	6	1909.4	26 00·2	25 49·1	"
30.00 W.— " 6	27	2	6	1909.5	26 15·0	26 17·6	"
5.00 W.— " 6	27	2	6	1909.5	26 10·2	26 23·8	"
35.00 W.— " 1	45	2	6	1909.7	26 52·6	....	J. B. McFarlane.
At " 1	45	2	6	1909.7	26 59·4	....	"
72.00 W.— " 11	45	2	6	1909.7	26 56·2	27 04·2	"
25.00 W.— " 11	45	2	6	1909.7	27 00·5	27 00·5	"
19.00 E.— " 3	45	2	6	1909.7	26 57·4	27 05·4	"
16.00 N.— " 3	45	2	6	1909.7	26 54·3	26 56·8	"
6.00 E.— " 7	45	2	6	1909.8	27 09·3	27 07·0	"
55.00 W.— " 7	45	2	6	1909.8	27 01·1	27 05·8	"
59.89 W.— " 36	56	2	6	1909.5	28 42·5	28 52·7	A. H. Hawkins.
31.49 W.— " 32	56	2	6	1909.6	28 51·3	....	"
2.22 W.— " 33	56	2	6	1909.5	28 44·7	28 47·9	"
27.67 W.— " 35	56	2	6	1909.5	28 42·3	28 48·5	"
71.00 W.— " 35	60	2	6	1909.8	30 12·8	30 20·5	"
At " 32	60	2	6	1909.8	29 05·0	29 06·7	"
64.00 W.— " 34	64	2	6	1909.7	29 04·8	29 10·8	G. McMillan.
5.00 N.— " 28	71	2	6	1911.6	27 45·2	27 43·7	G. J. Lonergan.
27.00 N.— " 15	45	3	6	1909.8	27 10·8	27 13·5	J. B. McFarlane.
15.00 S.— " 15	45	3	6	1909.8	27 12·6	27 11·3	"
46.00 W.— " 20	45	3	6	1909.8	27 08·7	27 15·4	"
At " 17	45	3	6	1909.8	27 20·9	27 15·6	"
56.20 W.— " 36	56	3	6	1909.6	28 38·9	28 36·8	A. H. Hawkins.
47.76 W.— " 33	56	3	6	1909.6	29 29·0	29 29·9	"
79.97 W.— " 35	56	3	6	1909.6	28 27·0	28 27·9	"
65.00 W.— " 35	60	3	6	1909.8	28 45·5	....	"
At " 31	60	3	6	1909.8	28 40·8	....	"
30.00 W.— " 33	64	3	6	1909.7	29 08·6	29 12·0	G. McMillan.
40.06 W.— " 21	80	3	6	1908.5	29 52·9	30 02·4	J. B. Saint Cyr.
3.00 S.— " 24	45	4	6	1909.8	27 12·9	27 16·2	J. B. McFarlane.
25.00 N.— " 14	45	4	6	1909.8	27 14·2	27 20·5	"
3.00 N.— " 14	45	4	6	1909.8	27 19·4	27 14·7	"
43.66 W.— " 33	56	4	6	1909.6	28 35·0	28 37·1	A. H. Hawkins.
21.80 W.— " 34	56	4	6	1909.6	28 29·0	28 25·1	"
2.08 W.— " 36	56	4	6	1909.6	28 41·1	28 44·0	"
78.38 W.— " 34	60	4	6	1909.8	28 41·4	....	"
13.00 W.— " 31	64	4	6	1909.7	29 04·0	29 09·0	G. McMillan.
At " 10	79	4	6	1911.7	29 59·4	29 55·7	G. J. Lonergan.
60.00 E.— " 9	79	4	6	1911.8	30 09·0	30 05·0	"
41.00 W.— " 7	79	4	6	1909.7	30 28·6	30 30·6	J. B. Saint Cyr.
40.00 S.— " 21	80	4	6	1908.5	29 56·9	30 08·2	"
40.05 W.— " 7	80	4	6	1908.5	29 52·5	30 03·0	"
Sta. 33, traverse E. side Mabel Lake.	29	5	6	1910.8	26 21·6	26 20·7	T. H. Plunkett.

TABLE No. 4.—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912·0	Observer.
					° ′	° ′	
0.68 W.—N. E. cor. sec. 31	56	5	6	1909 6	28 37·3	28 36 4	A. H. Hawkins.
19.76 W.— ″ 32.......	56	5	6	1909 6	28 35 2	28 36 3	″
19.76 W.—N.E. cor. sec. 32........	56	5	6	1909 6	28 17 3	28 25 4	A. H. Hawkins.
16 47 W.— ″ 33	60	5	6	1910 6	28 42 5	28 45 0	G. McMillan.
21.00 W.— ″ 32	64	5	6	1909.8	28 58·6	29 00 3	″
At ″ 32	74	5	6	1911.7	29 21·3	29 22 3	G. J. Lonergan.
At ″ 4	77	5	6	1909.6	29 32 0	29 27 1	J. B. Saint Cyr.
At ″ 26	77	5	6	1909 5	29 48·6	29 51 0	″
At ″ 28	77	5	6	1909.5	29 50·9	29 54 3	″
At ″ 30	77	5	6	1909 5	30 01·6	30 03 0	″
20.00 N.—S.E. ″ 16	77	5	6	1909 6	29 56·6	29 56 7	″
At N.E. ″ 7	77	5	6	1909 6	29 52·6	29 54 7	″
20 00 S—N.E. ″ 21	78	5	6	1909 6	30 13 8	30 19 9	″
At ″ ″ 14	78	5	6	1909 7	29 56·6	30 00 4	″
At ″ ″ 5........	78	5	6	1909 5	30 05 1	30 11·7	″
At ″ ″ 32	78	5	6	1909 7	30 25 0	30 30 0	″
At ″ ″ 19	78	5	6	1909 7	30 25 8	......	″
12.00 S.— ″ ″ 1........	78	5	6	1908 7	29 47·3	29 53 8	″
At ″ ″ 5........	79	5	6	1909 8	30 24·2	30 26 9	″
At ″ ″ 29........	79	5	6	1909.8	30 15·3	30 16 0	″
At ″ ″ 16	79	5	6	1909 7	30 23·1	30 26 1	″
At ″ ″ 14	79	5	6	1909 7	30 13 6	30 17 6	″
10.00 N.—N.W. cor. sec. 8	79	5	6	1909 8	30 33 2	30 36·9	″
20.00 E.— ″ 36	79	5	6	1909.4	30 29 7	......	″
17.00 S.—N.E. cor. sec. 7........	19	6	6	1911 8	21 19 3	21 15 3	M. P. Bridgland.
40 00 N.— ″ 9	19	6	6	1909 8	25 38 6	25 38 3	E. W. Robinson.
25.00 N.— ″ 9	19	6	6	1909 8	25 35.1	25 39 8	″
60 W 00—¼ cor. E. By. sec. 7........	22	6	6	1908 6	26 02·2	......	″
At ¼ cor. E. By. sec. 5........	22	6	6	1908 6	26 05·7	......	″
10 00 N.—N.E. cor. sec. 23........	23	6	6	1908 8	26 05·7	26 13 5	″
At ″ 7........	23	6	6	1908 8	25 46·3	25 48 1	″
At S.E. cor. sec. 6........	23	6	6	1908.8	26 08 3	26 18 1	″
15 80 W.—N.E. cor. sec. 23	56	6	6	1909.6	28 08·3	28 18 4	A. H. Hawkins.
39 00 W.— ″ 33	56	6	6	1909 6	28 19 8	......	″
10 43 W.— ″ 31........	56	6	6	1909 6	28 10·0	28 08 1	″
50.00 W.— ″ 34	56	6	6	1909.6	28 09·9	28 10 0	″
At ″ 34	56	6	6	1909 6	28 00 7	27 59 8	″
At ″ 35	56	6	6	1909 6	28 21 7	28 19 8	″
38 20 W.— ″ 34	60	6	6	1910 6	28 22 6	28 21 1	G. McMillan.
70.00 W.— ″ 33	64	6	6	1909.8	28 46 9	28 42 6	″
At ″ 26	77	6	6	1909.9	30 29 7	30 27 7	J. B. Saint Cyr.
At ″ 33	77	6	6	1909.9	31 19·2	31 22 2	″
At ″ 30	77	6	6	1909 8	31 14 4		″
At ″ 20	77	6	6	1909 8	31 05·3	31 02 6	″
40.00 E.— ″ 21........	78	6	6	1909.9	31 30 6	31·28 6	″
60.00 N.—S.E. cor. sec. 2	78	6	6	1909 9	31 14 7	......	″
At N.E. ″ 6	78	6	6	1909 9	31 25·3	31 24 3	″
61.00 S.— ″ 1	78	6	6	1909 4	30 55 8	31 00 5	″
At S.W. cor. sec. 6	79	6	6	1909 7	31 27 1	31 30 1	″
40 00 S.—N.E. cor. sec. 12	79	6	6	1909 4	30 20 3	......	″
5 00 E.— ″ 34	18	7	6	1909 8	25 37 4	25 36 1	E. W. Robinson.
30 00 E.— ″ 34	18	7	6	1909 8	25 32 0	25 37 7	″
20 00 E.— ″ 27	21	7	6	1908.7	24 13 7	24 54 2	″
26·50 W.—¼ post E. By. sec. 33........	21	7	6	1908 7	26 20·5	......	″
15 00 S.—N.E. cor. sec. 17	24	7	6	1910.7	26 05 0	26 05 0	W. J. Deans.
40.00 W.— ″ 5	24	7	6	1910.7	26 05 8	26 07·8	″
40 00 S.— ″ 6	24	7	6	1910 7	26 08 1	26 08 1	″
30 00 E.— ″ 17........	24	7	6	1910 7	26 24 1	26 26 1	″
40.00 S.— ″ 27........	24	7	6	1910 8	26 12 5	......	″
30 00 S.—Centre sec. 35........	24	7	6	1910 8	26 13·1	26 16 7	″
32.00 W.— ″ 8........	24	7	6	1910.8	25 58·7	25 59 8	″
20 00 E.—¼ E. By. sec. 27........	25	7	6	1910 7	25 20 6	25 24 1	D. A. Smith.
10.00 E.—Centre N. By. sec. 24........	25	7	6	1910 7	25 36 8	25 39 3	″
40.00 S.— ″ 11........	25	7	6	1910 8	25 36 1	25 36 5	″
3.00 E—N.E. cor. sec. 7........	26	7	6	1910.6	27 29 8	27 25 9	P. B. Street.
3 00 E.— ″ 7........	26	7	6	1910 6	27 14 5	27 23 6	″
5.00 N.—Centre sec. 6........	26	7	6	1910 7	26 48 7	26 47 2	″

TABLE No. 4.—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912 0	Observer.
					° ′	° ′	
47 40 W.—N.E. cor. sec 34	56	7	6	1909.6	27 58·9	28 09 0	A. H. Hawkins.
48 46 W.— " 34..........	56	7	6	1909.7	27 55·1	27 54·9	"
20 03 W,— " 32..........	56	7	6	1909.7	27 37·4	27 47·2	"
19 28 W.— " 31..........	56	7	6	1909.7	27 44·4	27 42 4	"
71 00 W.— " 34	60	7	6	1910 6	27 53 4	27 51·9	G. McMillan.
52 32 W,— " 31..........	64	7	6	1909.8	28 38·6	28 42 3	"
At " 36..........	21	8	6	1908.5	25 38·1	26 08·6	E. W. Robinson.
30.00 N.—Centre sec. 32......	21	8	6	1910.6	26 00·2	25 59 3	G. H Blanchet.
Traverse...	23	8	6	1910 5	24 57·2	24 59 0	"
5 00 W.—Centre sec. 16.........	23	8	6	1910 5	25 03·0	25 05·8	"
20.00 S.—N.E cor. sec. 7.........	23	8	6	1910.5	27 28·9	27 31·3	"
6.25 W.—N.W. " 23..........	24	8	6	1910.6	26 24 9	26 31 0	W. J. Deans.
25.00 W.—¼ E By. sec. 22...	24	8	6	1910.6	25 42·7	25 47 8	"
30.00 N.—¼ N by sec. 23	24	8	6	1910 6	26 48·9	26 54 0	W. J. Deans.
12.00 W —center sec. 26............	24	8	6	1910.6	26 21·4	26 22 5	"
16 00 N.—N.E. cor. sec. 22	24	8	6	1910.6	26 22·0	26 23·1	"
40 00 W — " 13..........	24	8	6	1910 7	26 02·8	26 14 8	"
40 00 W.— " 12.........	24	8	6	1910.7	25 50·0	25 53·0	"
Center section 13..	24	8	6	1910.7	25 57·8	25 58·8	"
30.00 W.—center section 13..... ...	25	8	6	1910.6	26 11·1	26 11 2	D. A. Smith.
40 00 W.—N.E. cor. sec. 1	25	8	6	1910.6	26 09·8	26 11·9	"
30.00 E.— " 13..........	25	8	6	1910.6	25 35·0	25 36·1	"
60.00 W.— " 1	25	8	6	1910.7	25 20·9	25 21·2	"
1 40 N.—Center sec. 1............	26	8	6	1910.7	26 31·0	26 31·8	P. B. Street.
20.09 W.—N.E. cor. sec. 36	56	8	6	1909.7	27 44·7	27 49 7	A. H. Hawkins.
58.84 W.— " 36..........	56	8	6	1909 7	27 39·0	27 33·0	"
53.72 W.— " 33..........	56	8	6	1909 7	27 26·8	27 25·8	"
48 14 W — " 34..........	56	8	6	1909 7	27 22·5	27 30·5	"
10.00 W.— " 35..........	56	8	6	1909 7	27 41·9	27 42·9	"
17 63 W.— " 31	64	8	6	1909 8	28 18·8	28 17·5	G. McMillan.
At " 33	70	8	6	1911.7	28 44·8	28 39·8	G. J. Lonergan.
At S.E. cor. sec. 3	71	8	6	1911 7	29 52·4	29 50 4	"
At N.E. cor. sec. 22..	19	9	6	1911 7	25 58·4	25 54·7	M. P. Bridgland.
At " 15........	19	9	6	1911.7	25 56·9	25 53·2	"
At " 16........	19	9	6	1911.8	26 04 1	26 01·1	"
32 00 W.— " 17........	20	9	6	1909.3	26 01·9	....	T. H. Plunkett.
42 00 W.— " 17........	20	9	6	1909.3	25 45·8	25 52 0	"
10 00 W.— " 31........	22	9	6	1910 6	25 57 6	.. ....	L. D. N. Stewart.
12.00 S — " 31........	22	9	6	1910 7	25 18 4	25 19·2	"
At N.E. cor. sec. 28	22	9	6	1910.7	25 46 8	25 46 8	"
15 00 S.— " 23........	22	9	6	1910.7	25 16·7	26 15 7	"
2 00 N — " 5	23	9	6	1910 6	25 23 4	25 28 5	"
32.00 S.— " 15........	23	9	6	1910.8	25 23·7	25 27 8	"
32 00 S — " 15........	23	9	6	1910.8	25 32 6	25 31·7	"
40.00 W.— " 31.	68	9	6	1909.5	27 33·1	....	G. McMillan.
11 21 E.— " 32........	88	9	6	1911 9	31 11·6	31 07·1	"
7.57 E.— " 33.. ...	88	9	6	1911.9	31 09 7	31 05·2	"
40 25 S.— " 18........	19	10	6	1909.3	25 29 1	....	T. H. Plunkett.
At S.E. cor. sec. 6.	19	10	6	1909.4	25 51·9	25 55·8	"
At N.E. " 4........	20	10	6	1911.8	25 30·9	25 25·9	M. P. Bridgland.
40 50 W —S. E. " 4........	20	10	6	1911.8	26 01·0	26 00·0	"
At N.E. " 9........	20	10	6	1911 8	25 50·1	25 49·1	"
At " " 10...	20	10	6	1911.8	25 36·2	25 34·2	"
At " " 11........	20	10	6	1911 8	25 48·8	25 46·8	"
40 25 S.— " " 6........	20	10	6	1911.8	25 52·4	25 54 4	"
At " " 33... ..	21	10	6	1910.5	25 46·8	25 51·6	W. J. Deans.
20 00 S—Center sec. 33.	22	10	6	1910.9	25 24 0	25 22 4	L. D. N. Stewart.
15 00 S.—N.E. cor. sec. 33..........	22	10	6	1911.0	25 50·4	25 46 3	"
40 00 W — " 6..........	22	10	6	1910.3	25 35 7	25 41·9	W. J. Deans.
10 00 E.—Center sec. 7............	22	10	6	1910.4	25 36 8	25 35·7	"
10 00 E — " 7............	22	10	6	1910.4	25 26 4	25 32·3	"
40 00 N —N.E. cor. sec. 6....	22	10	6	1910.4	25 27 7	25 32 6	"
At " 6..........	22	10	6	1910.4	25 39·8	25 44·7	"
At " 7..........	22	10	6	1910.4	25 32·0	25 36·9	"
40 00 W — " 7.... ...	22	10	6	1910.4	25 30·9	25 36·8	"
10 00 W.—¼ post E. by sec. 18.....	22	10	6	1910.4	25 26·3	25 30 4	"

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912·0	Observer.
					° ′	° ′	
65.61 W.—N.E. cor. sec. 17	22	10	6	1910.4	25 35·8	....	W. J. Deans.
65.61 W.— " 17	22	10	6	1910.4	25 38·1	25 44 2	"
40.00 W.— " 17	22	10	6	1910.4	25 37·2	25 43 3	"
57·54 N.— " 7	22	10	6	1910.4	25 36·9	25 41 0	"
40.00 W.— " 4	22	10	6	1910.5	25 45 7	25 49·5	"
20·00 W.— " 4	22	10	6	1910.5	25 31 8	25 39 6	"
30.00 S.— " 5	22	10	6	1910.5	25 34·2	25 40·0	"
40.00 N.— " 5	22	10	6	1910.5	25 40 5	25 43·9	"
At " 7	23	10	6	1910.5	26 16·9	26 18·3	T. H. Plunkett.
At N.E. cor. N.W. ¼ sec. 22	23	10	6	1910.4	26 17·4	26 11·3	"
At " S.E. ¼ sec. 9	23	10	6	1910.4	25 39·2	25 41 1	"
At " sec. 15	23	10	6	1910.4	25 50 6	25 52·5	"
10.00 S.—¼ post E. by sec. 14	23	10	6	1910.5	25 33·3	25 31·1	"
32.40 N.—N.E cor. sec. 11	23	10	6	1908 5	25 11·2	25 21·5	E. W. Robinson.
28.00 W.— " 31	64	10	6	1910 4	27 15·4	27 13 9	G. McMillan.
65.00 W.— " 31	68	10	6	1909.5	28 12 0	28 09 6	"
44.69 E.— " 31	88	10	6	1911.9	32 39·1	32 37·6	J. R. Akins.
13.37 E.— " 34	88	10	6	1911.9	31 41·7	31 38·2	"
13.95 E.— " 36	88	10	6	1911.9	31 34·0	31 30·5	"
35.00 W.—¼ on E. by sec. 14	22	11	6	1910.4	26 01·4	26 04·3	G. H. Blanchet.
44.00 N.—N.E. cor. sec. 11	22	11	6	1910.3	25 27 9	25 33 1	"
At " 13	23	11	6	1910.5	25 43·5	25 46·9	T. H. Plunkett.
25 00 E.—Center sec. 23	23	11	6	1910.5	26 06 6	26 08 0	"
3.00 W.—N.E. cor. sec. 28	25	11	6	1909.4	26 19·7	26 14 4	E. W. Robinson.
21.00 E.— " 28	25	11	6	1909.4	26 16·0	26 19 7	"
5.00 S.—N.E. cor. sec. 13	25	11	6	1909.4	25 55 7	26 00.4	E. W. Robinson..
40.00 S.— " 13	25	11	6	1909.4	26 00.4	25 55.1	"
Centre of section 10	25	11	6	1909.3	26 14 3	26 14 3	"
" 10	25	11	6	1909 3	26 09.6	26 17.6	"
" 7	25	11	6	1909.3	26 16 9	26 11.9	"
" 7	25	11	6	1909 3	26 11 2	26 21 2	"
41.00 W.—N.E. cor. sec. 30	25	11	6	1909 3	26 19.9	26 27 9	
47 85 W. " 32	64	11	6	1910 5	27 12.9	27 17 1	G. McMillan.
35.00 W.— " 35	68	11	6	1909.5	28 15 6	28 21 2	"
37.09 E.— " 34	88	11	6	1911.8	32 57 0	32 51 8	J. R. Akins.
75 00 E.— " 35	88	11	6	1911.8	32 40 7	32 35 5	"
60.58 E.— " 36	88	11	6	1911.8	32 34.7	32 30.5	"
14 31 S.—Centre sec. 18	23	12	6	1910 6	26 48.5	26 50 1	T. H. Plunkett.
3.00 N.—N.E. cor. sec. 14	25	12	6	1909 3	26 25.4	26 20.6	E. W. Robinson.
30.00 S.— " 14	25	12	6	1909 3	26 18 1	26 27.3	"
3.00 W.— " 25	25	12	6	1909 3	26 24 8	26 21.8	"
29.46 W.— " 34	68	12	6	1909 5	29 20 3	29 21 9	G. McMillan.
1.00 W.—¼ Post N. By. sec. 13	17	13	6	1911.5	24 42 1	24 44 3	C. H. Taggart.
20.00 W.—N.E. cor. S.E. ¼ sec. 4	22	13	6	1910.7	26 59 7	26 59 7	T. H. Plunkett.
10.00 W.— " N.W. " 4	22	13	6	1910.7	26 32 6	26 30.6	"
20.00 E.—N.E. cor. sec. 32	21	13	6	1910.7	26 26 6	26 27 6	"
13.07 W— " 34	64	13	6	1910 5	28 51 1	28 54 9	G. McMillan.
20.00 W.— " 34	68	13	6	1909 5	30 44 2	30 47 4	"
58.59 W.— " 33	80	13	6	1911 3	32 11 9	32 10 3	"
51.00 S.— " 13	83	13	6	1911.4	32 47 7	32 46.5	O. Rolfson.
17.00 S.— " 36	84	13	6	1911.4	33 17 1	33 16 9	"
At N.E. cor. sec. 13	85	13	6	1911.3	33 19.6	33 30 7	J. R. Akins.
69.06 N.—N.E. cor. sec. 24	85	13	6	1911 4	33 19.5	33 16 3	"
36.74 N.— " 36	85	13	6	1911.4	33 14 8	33 14.6	"
39.76 N.— " 1	86	13	6	1911.4	33 12.1	33 10 9	"
31.50 S.— " 13	86	13	6	1911.4	33 10.2	33 10 0	"
40.50 N.— " 24	86	13	6	1911.4	33 10 1	33 10 9	"
22.30 S.— " 25	86	13	6	1911 4	33 08 1	33 05 9	"
At " 36	86	13	6	1911 4	33 08.5	....	"
53.59 W.— " 36	86	13	6	1911.4	33 07 9	33 07.7	"
25.00 N.— " 12	87	13	6	1911.4	33 07 9	33 10.7	"
29.50 N.— " 12	87	13	6	1911 4	33 16 3	....	"
66.30 S.— " 24	87	13	6	1911 4	33 18 1	33 18.9	"
5.00 N.— " 25	88	13	6	1911 4	33 46 1	33 46 9	"
39.48 N.— " 12	88	13	6	1911 4	33 37.0	33 36.8	"
51.00 N.— " 13	88	13	6	1911 4	33 38 2	33 40 0	"
3.00 S.— " 21	16	14	6	1911 3	21 56 7	21 55 1	J. E. Ross.

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912.0	Observer.
					° ′	° ′	
At ¼ cor. N. By. sec. 34	17	14	6	1911.3	19 52.8	19 53.9	J. E. Ross.
60.00 S.—N. E. cor. sec. 32	77	14	6	1911.7	31 54.8	31 51.8	G. J. Lonergan
8.00 S.— " 31	77	14	6	1911.7	31 42.8	31 40.8	"
50.00 S.— " 31	78	14	6	1911.7	32 10.3	32 07.3	"
5.00 S.— " 7	79	14	6	1911.7	32.17.2	32 14.2	"
61.00 W.— " 34	80	14	6	1911.3	32 07.1	32 11.5	G. McMillan.
8.95 W.— " 34	84	14	6	1911.4	32 58.6	33 00.0	O. Rolfson.
72.33 W.— " 32	84	14	6	1911.4	32 15.6	32 17.0	"
56.22 W.— " 31	84	14	6	1911.4	32 17.8	....	"
23.00 W.—S.E. cor. sec. 13	16	15	6	1911.3	25 29.9	25 29.3	J. E. Ross.
43.00 E.—N.E " 33	17	15	6	1911.5	27 37.2	27 38.3	C. H. Taggart.
At N.E. cor. sec. 16	19	15	6	1911.4	27 05.9	27 05.2	J. E. Ross.
7.00 E.—N.E. cor. sec. 2	21	15	6	1910.7	25 37.6	25 41.0	R. D. McCaw.
20.00 W.— " 36	77	15	6	1911.7	31 35.3	31 32.3	G. J. Lonergan.
At N.E. cor. sec. 24	78	15	6	1911.7	31 50.3	31 47.3	
68.00 W.—N.E. cor. sec. 32	80	15	6	1911.3	32 01.1	32 05.5	A. McMillan.
56.38 W.— " 34	84	15	6	1911.5	32 11.8	32 13.9	O. Rolfson.
79.36 W.— " 31	84	15	6	1811.5	31 47.0	31 48.7	"
1.50 W.— " 22	16	16	6	1911.5	26 54.9	26 56.0	C. H. Taggart.
30.00 W.—S.E. " 24	16	16	6	1911.9	27 21.7	27 17.3	"
3.00 S.—N.E. " 32	21	16	6	1910.8	26 17.0	26 14.1	R. D. McCaw.
73.00 W.— " " 33	80	16	6	1911.3	30 24.7	30 25.8	G. McMillan.
2.44 W.— " " 34	84	16	6	1911.5	31 36.3	31 38.5	O. Rolfson.
2.44 W.— " " 34	84	16	6	1911.5	31 49.2	31 43.4	"
2.44 W.— " " 34	84	16	6	1911.5	31 37.9	31 40.1	"
27.13 W.— " " 35	88	16	6	1911.5	31 20.7	31 21.9	J. R. Akins.
63.07 W.— " " 35	88	16	6	1911.5	31 22.0	31 24.4	"
57.02 W.— " " 34	88	16	6	1911.5	31 32.7	31 36.9	"
69.45 W.— " " 31	88	16	6	1911.5	31 49.1	31 53.3	"
6.00 N.— " " 27	16	17	6	1912.0	26 18.5	26 13.8	C. H. Taggart.
6.00 N.—¼ cor. E. by sec. 18	22	17	6	1910.4	27 22.1	27 29.0	J. E. Ross.
13.00 W.—N.E. cor. sec. 34	80	17	6	1911.4	30 34.1	30 32.9	G. McMillan.
80.54 W.—N E. cor. sec. 36	84	17	6	1911.5	31 21.0	31 23.2	O. Rolfson.
12.80 W.— " 36	88	17	6	1911.5	32 01.2	32 02.4	J. R. Akins.
6.53 W.— " 34	88	17	6	1911.6	31 51.6	31.51.5	"
37.00 W.— " 31	88	17	6	1911.6	32 09.3	32 08.2	"
15.00 E.— " 36	17	18	6	1910.9	25 54.9	....	J. E. Ross.
40.25 S.—N. E. cor. sec. 11	18	18	6	1910.8	25 22.1	25 21.3	"
40.00 W.— " " 11	19	18	6	1910.9	23 33.1	23 34.0	"
2.00 E.— " " 33	21	18	6	1910.8	28 02.9	28 04.0	R. D. McCaw.
10.00 E.— " " 33	21	18	6	1910.8	25 01.4	25 01.5	"
37.00 N., 28.00 W.—N. E. cor. 31	21	18	6	1910.4	24 38.4	24 41.3	J. E. Ross.
5.00 S.—Centre sec. 20	21	18	6	1910.4	24 30.8	24 32.7	"
75.42 W.—N. E. cor. sec. 34	84	18	6	1911.6	32 03.9	31 56.8	O. Rolfson.
75.42 W.— " " 34	84	18	6	1911.6	31 40.0	31 46.9	"
75.42 W.— " " 34	84	18	6	1911.6	31 46.6	31 45.5	"
75.42 W.— " " 34	84	18	6	1911.6	31 48.8	31 47.7	"
50.06 W.—N. E. cor. sec. 35	88	18	6	1911.6	31 55.7	31 58.6	J. R. Akins.
45.61 W.— " " 33	88	18	6	1911.6	31 58.8	32 00.7	"
20.75 W.— " " 31	88	18	6	1911.6	31 45.1	31 46.6	"
68.10 W.— " " 31	88	18	6	1911.6	31 46.8	31 47.3	"
At Sta. 11.—Road Tra. sec. 35	17	19	6	1912.0	25 32.2	25 25.5	C. H. Taggart.
32.00 E.—N. E. cor. sec. 27	17	19	6	1910.6	25 14.7	25 13.0	R. D. McCaw.
34.00 W.— " " 22	21	19	6	1910.4	26 09.8	26 15.9	J. E. Ross.
Sta. O. Watching Ck. Traverse S. W. part sec. 12	22	19	6	1910.8	29 23.5	29 25.6	R. D. McCaw.
10.00 N.—Sta. 2 in N. E. part 24	22	19	6	1910.8	25 18.7	25 18.4	"
76.88 W.—N. E. cor. sec. 33	84	19	6	1911.6	31 32.5	31 32.0	O. Rolfson.
4.28 W.—N. E. cor. sec. 34	88	19	6	1911.6	31 32.8	31 35.3	J. R. Akins.
47.70 W.— " " 33	88	19	6	1911.6	31 33.1	31 31.6	"
5.00 S.— " " 29	17	20	6	1910.6	25 28.6	25 31.7	R. D. McCaw.
7.00 N.— " " 25	21	20	6	1910.4	25 47.0	25 53.1	J. E. Ross.
At 1/4 cor. E. by. sec. 1	22	20	6	1910.4	28 52.4	28 58.5	"
34.00 S.—N. E. cor. sec. 32	23	20	6	1910.7	26 34.0	26 35.8	"

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912·0	Observer
					° ′	° ′	
35.00 S.—N. E. cor. sec. 16	24	20	6	1910 7	26 18 4	26 19 4	J. F. Ross
34.21 W.— " " 34.........	84	20	6	1911 6	31 08 2	31 07 7	O. Rolfson.
21.00 W.— " " 36.........	84	20	6	1911 6	31 11.5	31 11.0	"
0.47 W.— " " 31.........	84	20	6	1911.6	31 05 8	.....	"
53.08 W.— " " 33	84	20	6	1911 6	31 06 9	31 04 4	"
4.00 W.— " " 34	88	20	6	1911 6	31 08 2	31 09 7	J. R. Akins.
47 00 W.— " " 32	88	20	6	1911 6	31 14 4	31 11 9	"
10.00 N.— " " 2	22	21	6	1910.5	27 45 7	27 48 1	J. E. Ross.
At ¼ cor. N. by. sec. 28.........	22	21	6	1910 6	26 11 7	26 17 8	"
25. 00 S.—N. E. cor. sec. 4	23	21	6	1910 6	25 44 0	25 48 1	"
20.00 S.— " " 11	24	21	6	1910 7	27 01 4	27 03 9	"
15.31 W.— " " 36	84	21	6	1911 6	31 15 3	31 14 8	O. Rolfson.
22.09 W.— " " 35.........	84	21	6	1911 7	31 09 1	31 06 3	"
70.98 W.— " " 33.........	84	21	6	1911 7	30 46 3	30 43 3	"
23·82 W.— " " 36.........	88	21	6	1911 6	31 30 9	31 31 4	J. R. Akins.
1.56 W.— " " 34.........	88	21	6	1911 6	31 39 8	31 38 3	"
31.32 W.— " " 33	88	21	6	1911.6	31 33 6	31 33 1	"
24.71 W.— " " 32	88	21	6	1911.6	31 47 4	31 41 9	"
69.62 W.— " " 31	88	21	6	1911 6	31 33 3	.....	"
6.00 E.— " " 4.	16	22	6	1910.5	25 41 0	25 47 4	R. D. McCaw.
12.00 S.— " " 13	19	22	6	1910.8	24 09 9	.....	J. E. Ross.
At " " 26	22	22	6	1910.6	27 32 1	.....	"
25.00 W.— " " 25	23	22	6	1910.6	26 53 8	.....	"
10.78 W.— " " 34	84	22	6	1911.7	31 20 9	31 17.9	O. Rolfson.
54.20 W.— " " 33	84	22	6	1911 7	31 50 8	31 47.8	"
34.78 N.—N. E. cor. sec. 35.........	88	22	6	1911.7	31 52 8	31 53 0	J. R. Akins.
72. 50W.— " " 34	88	22	6	1911.7	31 50 9	31 48 1	"
1.50 W.—centre sec. 1.........	14	23	6	1910 6	25 17.0	25 22 1	R. D. McCaw.
40.25 N.—N. E. cor. sec. 26.........	15	23	6	1910.5	23 40.9	23 44 3	"
1.00 W.— " " 4	15	23	6	1910 6	25 21.9	.....	"
20.50 N.— " " 36	20	23	6	1910.8	25 33.0	25 33.1	J. E. Ross.
38.90 W.— " " 31.........	84	23	6	1911 7	31 33.5	31 25 5	O. Rolfson.
38.90 W.— " " 31.........	84	23	6	1911 7	31 31 3	31 31 3	"
38.90 W.— " " 31.........	84	23	6	1911.7	31 23 6	31 22.6	"
38.90 W.— " " 31.........	84	23	6	1911 7	31 28 4	31 24.4	"
38.90 W.— " " 31.........	84	23	6	1911 7	31 42.1	31 35.1	"
34.56 W.—N. E. cor. sec. 36.........	88	23	6	1911 7	31 42.9	31 41.1	J. R. Akins.
47.80 W.— " " 35.........	88	23	6	1911.7	31 40 3	31 40.3	"
78.00 W.— " " 35.........	88	23	6	1911 7	31 42.2	31 39.2	"
14.24 W.— " " 33.........	88	23	6	1911.7	31 46 9	31 43.9	"
15.00 N.— " " 23.........	18	21	6	1910 5	25 43 6	25 45.4	R. D. McCaw.
48.78 W.— " " 36.........	84	24	6	1911 7	31 45 2	31 38 2	O. Rolfson.
48.78 W.— " " 36.........	84	24	6	1911 7	31 37 0	31 38 0	"
56.91 W.— " " 32.........	84	24	6	1911 7	31 32 8	31 31 8	"
70.36 W.— " " 35.........	88	21	6	1911 7	32 00 5	31 55 5	J. R. Akins.
64.17 W.— " " 34.........	88	24	6	1911 7	32 00.2	31 57 2	"
31.80 W.— " " 31.........	88	24	6	1911 7	32 08 9	32 05 9	"
17.18 W.— " " 36.........	88	24	6	1911.7	31 52 8	31 54 8	"
17.18 W.— " " 36.........	88	24	6	1911.7	32 04 1	31 56 1	"
40.00 N.— " " 12.........	17	25	6	1910 5	27 43 2	27 51 6	R. D. McCaw.
8.00 W.— " " 19.........	23	25	6	1910 9	26 46.2	.....	T. H. Plunkett.
At N.E. cor. N.W. ¼ sec. 26.........	23	25	6	1910.9	26 07 5	26 06 2	T. H. Plunkett.
27 61 W.—N.E. cor. sec 36.........	84	25	6	1911 8	31 12 8	31 06 8	O. Rolfson.
27.61 W.—N.E. " 36.........	84	25	6	1911 8	31 07 0	31 07·0	"
27.61 W.—N E. " 36.........	84	25	6	1911 8	31 09 2	31 05 2	"
71 82 W.—N.E. " 33.........	84	25	6	1911 8	31 04 2	30 53·2	"
71.82 W.—N.E. " 33.........	84	25	6	1911 8	30 56 2	30 56 2	"
9.58 N. S. W. " 6.........	87	25	6	1911 8	31 50 9	31 45·9	L. Brenot.
44.80 N.—N.W " 18	87	25	6	1911 8	32 07 8	32 03 8	"
41.00 N.—N.W " 31.........	87	25	6	1911 8	32 05·6	.....	"
23.66 W.—N.E. " 36.	88	25	6	1911 7	32 02 3	31 59 3	J. R. Akins.
23 93 W.—N.E. " 28.........	88	25	6	1911 7	32 19 8	32 18 8	"
76 23 W.—N.E. " 29.	88	25	6	1911·7	32 26·8	32 22 8	"
5.00 N.—N.W. " 2.........	82	26	6	1911·7	30 51 5	30 46.7	L. Brenot.
53 00 N.—N.W. " 23.........	82	26	6	1911 7	30 54 7	30 51 9	"
26 56 N.—N.W. " 24.........	83	26	6	1911 7	30 51·0	30 47·0	"
69 13 N.—N.W. " 13.........	84	26	6	1911 7	30 56 0	30 51 0	"

TABLE No. 4—*Continued.*

Place.	Tp.	Rge.	Mer.	Date.	Declination. Obs'd.	Declination. Reduced to 1912·0	Observer.
					° ′	° ′	
27.42 N.—N.W. cor. sec. 25	85	26	6	1911.7	31 17·7	31 15·0	"
40.00 S.—N.E. " 34	2	29	6	1911.6	24 28·5	24 25·0	W. J. Deans.
At centre sec. 35	2	29	6	1911.6	24 16·3	24 15·8	"
At N.E. cor. sec. 34	2	29	6	1911.6	24 27·8	24 26·3	"
9.60 N. ¼ post—N. by. sec. 35	2	29	6	1911·7	24 16·2	24 19·4	"
At S.E. cor. sec. 1	3	29	6	1911·6	24 19.1	24 18·6	"
At S.E. cor.—T.B. 547, sec. 4	7	29	6	1911·8	23 51·6	23 48·6	A. L. Lighthall.
At N.E. cor sec. 12	7	30	6	1911·8	23 40·4	23 35·2	"
20.00 W.—S.E. cor. sec. 1	3	3	7	1910·7	25 45·4	25 46·4	"
19.00 W.—¼ post E. by. sec. 1	4	3	7	1910·7	24 36·2	24 39·2	"
20.00 E.—N.E. cor sec. 19	6	4	7	1911·6	25 13·9	25 14·4	"
25.00 S.—N.E. " 20	6	4	7	1911·6	26 19·3	26 20·8	"
35.00 S.—N.E. " 20	6	4	7	1911·6	26 59·3	26 57·8	"
At N.E. cor. sec. 3	4	5	7	1911·8	23 50·6	23 53·6	"
20.00 S.—N.E. cor. sec. 27	4	5	7	1911·8	24 03·1	23 59·1	"
At centre sec. 2	4	5	7	1911·8	23 47·1	23 45·1	"
40.00 W.—Centre sec. 17	5	5	7	1911·7	24 28·9	24 25·9	"
50.00 E.— " 8	5	5	7	1911·7	23 20·2	23 18·2	"
20.00 W.— " 9	5	5	7	1911·7	24 39·7	24 39·7	"
At centre sec. 34	6	5	7	1911·5	25 54·9	25 58·0	"
5.00 S.—Centre sec. 35	6	5	7	1911·5	26 33·8	26 35·0	"
60.00 E.— " 26	6	5	7	1911·5	29 40·1	29 43·3	"
5.00 N.— " 24	6	5	7	1911·6	24 08·1	24 10·0	"
26.00 E.— " 24	6	5	7	1911·6	25 54·2	25 58·1	"
71.00 E.— " 24	6	5	7	1911·6	26 02·0	26 03·9	"
60.00 S.— " 26	6	5	7	1911·7	28 21·6	28 20·0	"
6.00 N. 8.00 W.—¼ cor. S. by. 35	6	5	7	1910·8	26 27·3	26 23·0	"
At centre sec. 4	7	5	7	1911·4	26 03·1	26 06·5	"
10.00 W. 2.00 N.—¼ cor. E. by. 16	6	7	7	1910·3	24 50·3	24 51·7	"
40.00 W.—N.E. cor. sec. 11	15	.....	E.C.	1911·9	24 12·3	24 10·8	"
At N.E. cor. sec. 3	15	.....	E.C.	1911·9	23 22·7	23 20·2	"
At N.E. " 30	17	.....	E.C.	1911·4	23 16·1	23 17·5	W. J. Deans.
At ¼ post E. by. sec. 31	17	.....	E.C.	1911·4	23 31·8	23 34·2	"
At ¼ post N. " 30	17	.....	E.C.	1911·5	23 19.2	23 23·3	"
At ¼ post E. by sec. 31	17	.....	E.C.	1911.5	23 37.4	23 39.5	W. J. Deans.
6.00 W.—N.E. cor. S.E. ¼ sec. 30	17	.....	"	1911.5	22 12.2	22 16.3	"
10.00 N. ¼ post N. Ry. sec. 30	17	.....	"	1911.7	23 11.0	23 09.0	"
30.00 W.—N.E. cor. sec. 31	17	.....	"	1911.7	23 32.4	23 30.4	"
At Centre " 31	17	.....	"	1911.7	22 59.6	22 55.6	"
At N.W. cor. sec. 31	17	.....	"	1911.7	23 35.9	23 32.9	"
50.00 S.—N.E. cor. sec. 6	18	.....	"	1911.7	22 38.8	22 42.8	"
20.00 S.— " " 6	18	.....	"	1911.7	22 45.0	22 42.0	"
20.00 S.— " " 6	18	.....	"	1911.7	22 55.9	22 47.9	"
20.00 N.—¼ post S. by sec. 6	18	.....	"	1911.7	23 37.6	23 33.6	"
30.00 W.—N.E. cor. sec. 6	18	.....	"	1911.7	23 24.5	23 24.5	"
At —S.E. " 6	18	.....	"	1911.7	23 20.2	23 17.2	"
15.00 S. ¼ sec. cor. N. by 13	18	.....	"	1910.4	24 35.7	24 38.8	A. L. Lighthall.
15.00 S.—N.E. cor. sec. 10	18	.....	"	1910.5	24 33.0	24 35.3	"
10.00 S. ¼ post E. by sec. 27	20	.....	"	1911.8	23 56.0	23 53.0	W. J. Deans.
40.36 N.—N.E. cor. sec. 21	20	.....	"	1911.8	23 55.4	23 52.4	"
20.00 W.—¼ post E. by sec. 24	20	.....	"	1911.8	23 51.8	23 48.8	"
20.00 E.— " " 22	20	.....	"	1911.8	24 13.6	24 08.6	"
50.00 S.—N. E. cor. sec. 24	20	.....	"	1911.8	23 53.0	23 49.0	"
2.00 S.—Centre sec. 23	20	.....	"	1911.8	23 51.7	23 48.7	"
16.00 N.— " " 17	20	.....	"	1911.8	23 52.5	23 49.5	"
3.00 N.—N.E. cor. sec. 18	20	.....	"	1911.8	23 44.6	23 40.6	"
52.00 S.— " " 21	20	.....	"	1911.8	23 56.5	23 52.5	"
20.00 E.— " " 17	20	.....	"	1911.8	23 48.1	....	"
2.00 S.—S.W. " 5	22	.....	"	1911.6	23 13.4	23 13.9	"
40.00 W.—S.E. " 6	22	.....	"	1911.6	23 14.0	23 15.5	"
At —N.E. " 19	22	.....	"	1911.5	24 21.2	24 24.4	"
At — " " 24	22	.....	"	1911.6	23 37.5	23 36.4	"
At — " " 24	22	.....	"	1911.6	23 35.3	23 34.2	"

TABLLE No. 4—*Concluded.*

Place.	Tp.	Rge.	Mer.	Date.	Declination Obs'd.	Declination Reduced to 1912 0	Observer.
					° ′	° ′	
5.00 N.—S.E. cor. sec. 5	22	..	E.C.	1911 6	23 27.5	23 27 0	W. J. Deans.
20.00 W.— " " 5	22	....	"	1911 6	23 32 3	23 33 8	"
10.00 W. Centre sec. 19.	25	.....	"	1911 6	23 29.8	23 33.7	"
20.00 W.—N.E. cor. sec. 20	25	....	"	1911.6	23 34 2	23 36 1	"
At — " " 20	25	.....	"	1911.6	23 36.8	23 37 7	"
28.00 N. 34.00 E.—N.E. cor. sec. 16	40	.....	"	1910 8	22 52.3	22 57.9	A. L. Lighthall.
20.00 N.—S.E. cor. sec. 1..	41	.....	"	1910.9	28 08.8	28 07 2	"
27 20 N.—N.E. " 27..........	2	1	W.C.	1911.4	24 19.2	24 20 0	W. J. Deans.
At —N.W. " 34..........	2	1	"	1911.4	24 14.8	24 09.6	"
22 40 W.—N.E. " 34	2	1	"	1911.4	24 13 5	24 20.3	"
N.E. cor. L.S. 13, sec. 24 of Tp......	39	......	"	1910.3	26 31.4	26 34.6	T. H. Plunkett.
" " " 24 "	39	....	"	1910.3	26 28.9	26 32 1	"
40.00 E.—N.W. cor. sec. 30........	39	.....	"	1910.4	26 28.5	26 32 4	A. L. Lighthall.

APPENDIX No. 51

THE COPYING CAMERA

OF THE

SURVEYOR GENERAL'S OFFICE

BY

E. DEVILLE, LL.D.

Surveyor General of Dominion Lands

OTTAWA
GOVERNMENT PRINTING BUREAU
1912

CONTENTS

PART I—THE CAMERA.

PART II—THE ILLUMINATION OF THE BOARD.

PART III.

THE COPYING CAMERA

OF THE

SURVEYOR GENERAL'S OFFICE

PART I.—THE CAMERA.

1. General Features of Copying Cameras.

The evolution of the copying camera from the crude wooden box of the early days to the elaborate instrument now in general use is one of the many evidences of the progress of photography. Nowhere has photography proved more useful than in survey departments: apart from the printing of maps by the various processes of photo-lithography, photo-zincography and photo-engraving, the reductions, enlargements and other copies of maps and plans required by surveyors for field use or by draughtsmen for compiling other maps and plans, are now prepared by photography instead of being made by hand as formerly. The copying camera is accordingly an important adjunct of every survey office.

The land surveys of the Canadian Government now extend over some seven thousand townships, and the number is increasing every year. A plan of each township is printed for the administration and for the public. Every time further surveys are made in a township, and this happens frequently, a new plan has to be printed. The necessity of providing, without too great an increase in the photographic staff and equipment, for the publication of such a large number of township plans, and of the other maps and plans issued by the Survey Department, has developed a copying camera presenting some peculiar features, a description of which may prove of interest.

One of the first improvements in copying cameras was in the mode of suspension. It was found that the vibrations caused by the machinery always present in business buildings, or even by the street traffic, affected the sharpness of the negative; although the vibrations did not mar the appearance of a portrait, the quality of a line negative was seriously impaired. The vibrations were prevented at first by placing the camera and the board upon a cradle suspended by ropes from the ceiling. The board was fixed at one end and the camera moved to and fro upon rails on the cradle. The rope suspension is still in use, but is somewhat inconvenient; a better combination is to support the cradle by means of springs upon a stand, and this is the mode of suspension most frequently met with. So long as the camera is small, this suspension is convenient; the work of the process worker being, as a rule, of small size, this style fulfils his requirements. For the reproduction of maps, however, the conditions are different, because maps are frequently of large size. A large camera, with a board in proportion, and a spring cradle on a stand, would be very unwieldy indeed, and most inconvenient in use. Such a combination is seldom found in survey departments, the trouble from vibrations being usually overcome by setting up the camera in a place far away from traffic and machinery. No such place was available here; the photographic office was on the top floor of a building in which lithographic presses were running, and some mode of spring suspension was imperative.

The solution adopted consists in suspending the cradle by springs from the ceiling, but instead of putting the camera and board on the cradle, they are placed underneath.

2. Camera of the Surveyor General's Office.

The board is fixed at one end of the cradle: the lens and plate are on two separate carriages sliding on two pairs of V rails. The rails for the plate carriage

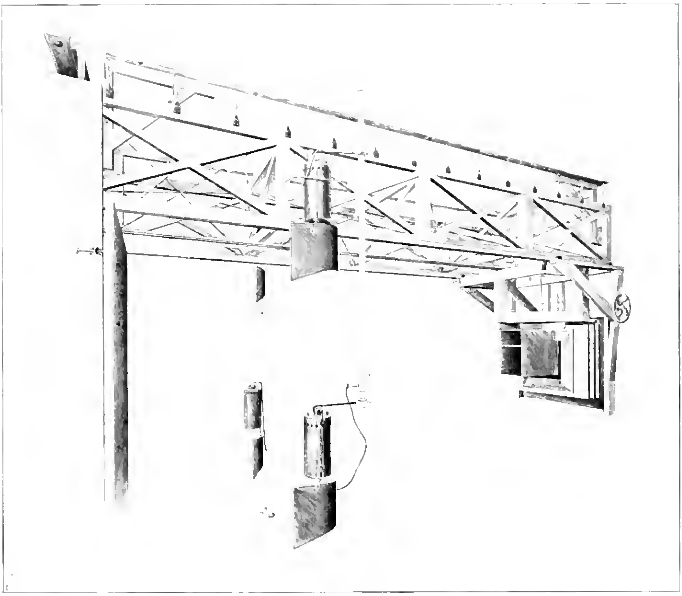


FIG. 1.—Camera fitted with short bellows for great reduction.

are outside the cradle, those for the lens carriage are inside. The lens can be brought within ten inches of the plate (Fig. 1). Bellows suspended by chains from runners under the cradle can be inserted to give any camera extension needed for enlarging (Fig. 2). Negatives for the offset lithographic press and for photographic printing are made with the camera so fitted. For half-tone and line engraving, and for printing from stones, the lens hood of the lens carriage is removed and a reverse camera substituted (Fig. 3).

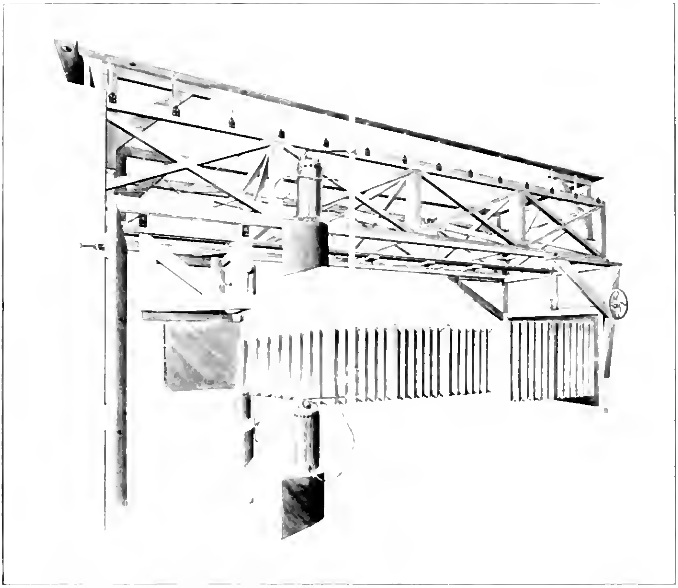


FIG. 2.—Camera fitted with long bellows for enlarging.

The cradle is fourteen feet long and four feet wide. The first cradle of this pattern, although very strong, was subject to torsional vibrations; it was replaced by the present cradle, which is wider, deeper and strongly braced by iron rods with turnbuckles. Absolute rigidity of the cradle is essential.

The swing of the whole apparatus, if suspended freely, would be inconvenient. It is limited by wooden arms bolted to the ceiling at both ends and extending inside of the cradle. Pieces of soft rubber, half an inch thick, are inserted between the arms and the cradle, thus limiting the swing without transmitting vibrations.

3. The Board.

Two uprights fixed at one extremity of the cradle are terminated at their lower ends by iron brackets upon which the weight of the board rests; it is attached to the uprights by four adjusting screws. The surface of the board is tested with a straight edge; if warped, it can be straightened by means of crossbars and bolts acting upon the cleats. About eighty per cent of the originals are of one particular size (township plans); these are placed on the board behind a glass plate held at the four corners by bolts and nuts. The original is adjusted to correct position, after which

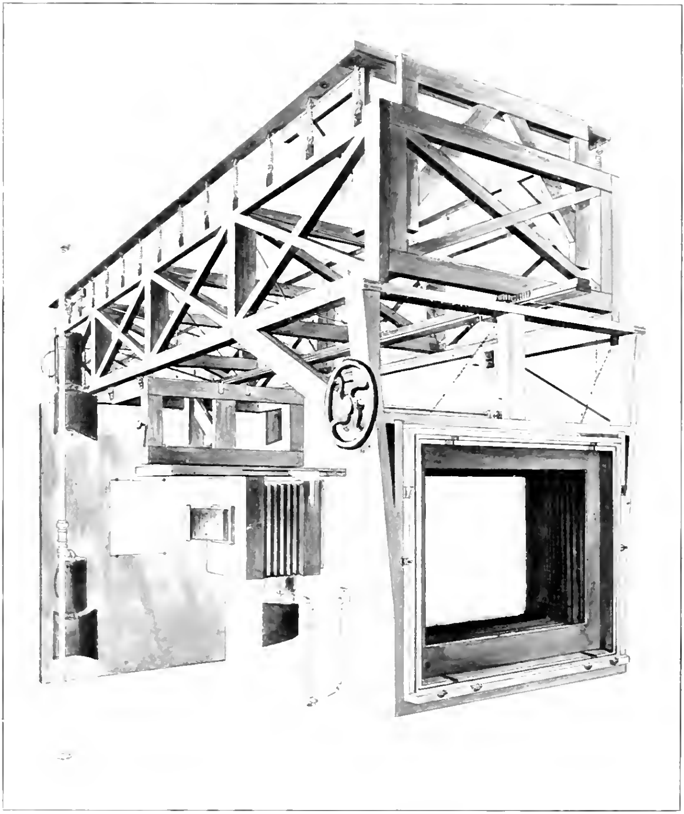


FIG. 3 - Reverse Camera.

the nuts are tightened. The insertion of the glass plate shortens the optical distance from the lens by one-third the thickness of the plate; the board has to be moved that much farther away. Originals of other sizes are pinned to the board, the glass and bolts being removed.

Through the centre of the board two lines are drawn at right angles, approximately horizontal and vertical. Likewise the two middle lines, in the direction of the width and in the direction of the height, of the original to be reproduced, are indicated by short lines drawn on the border of the original. The latter is in correct position when its middle lines coincide with the lines of the board.

At the centre of the board is a hole through which a microscope or the telescope of an optical square can be inserted for adjusting the camera; it is closed by a plug when not in use.

4. The Lens Carriage.

The lens carriage slides on two pairs of steel shoes far enough apart to prevent wabbling; the motion is given by a rack and pinion through angle gear and a crank at the side of the carriage.

The lens board fits in a rebate at the bottom of a deep hood, the object of which is to keep stray light off the interior of the camera.

The bellows fit in another rebate at the back of the hood, where they are held by two turnbuttons. A lens of 33·7 inches focus is used for most of the work: for great reductions and for the reverse camera, a lens of shorter focus is employed.

The graduations for setting the carriages in position are on an enamelled hardwood rod, 1 · 3 inches, attached to the middle of the cradle, the pointers being fastened to the carriages. The lens carriage has two pointers, one for the direct camera and one for the reverse camera. Both pointers are adjustable, and can be clamped by screws when in correct position.

5. The Plate Carriage.

Sections of bellows of convenient size can be fitted up between the two carriages, providing camera extensions from 10 inches to 11 feet. They are fastened to each

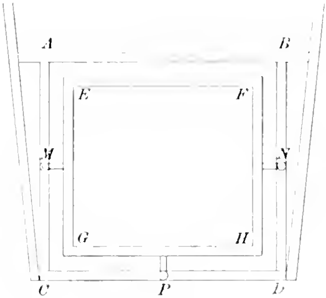


Fig. 4—Frame of Plate Carriage.

other by hooks and are supported by chains hanging from runners under the cradle. The plate carriage, like the other one, has two pairs of steel runners; they slide upon the outside V rails, the motion being given through a rack and pinion and angle gear by a large hand wheel.

The plate carriage consists of a rectangular frame, *A B C D* (Fig. 4), inside of which is another frame, *E F G H*, to which the plate-holder is attached. The inner frame is connected to the outer one by three trunnions, *M*, *N* and *P*. Each trunnion is on a steel plate which slides forwards and backwards in a steel groove by means of an adjusting screw. By turning the screw at *P*, the inner frame revolves around *M N* as an axis. By turning the screws at *M* and *N* in opposite directions, the inner frame revolves around the vertical through *P* as an axis. For moving the inner frame bodily forwards or backwards, parallel to itself, the three screws are turned in the same direction.

The four plate-holders are 24″ × 32″, 20″ × 24″, 16″ × 18″ and 10″ × 12″, respectively; they can all be attached to the inner frame in accurate register. The larger one, which is somewhat heavy, is moved about on a truck, with rubber tire wheels

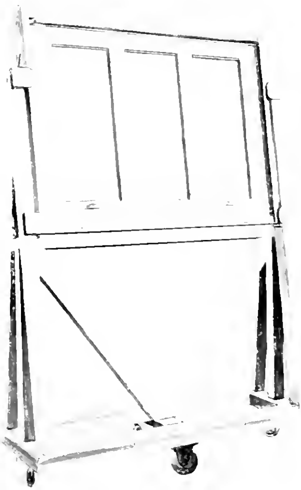


Fig. 5—Plate-holder Truck.

(Fig. 5), to which it is fastened by two turnbuttons and from which it is removed only for attaching to the camera. It remains on the truck in the dark room. When brought close to the plate carriage, a lift of a few inches brings it to its place on the camera.

The smaller holders are more easily handled; the operator always gives the preference to the smallest holder that will take in his plate.

Plates up to 20″ × 24″ are sensitized in a glass bath enclosed in a wooden case a little more than twice the height of the bath and inclined about ten degrees to the vertical. The upper half of the case is closed by a sliding panel supported by a counterweight so adjusted that the panel stays either open or closed. Another counterweight heavier than the 20″ × 24″ plates, supports by means of a rope and pulley the dipper upon which the plate is placed for sensitizing. After coating the plate with collodion and putting it on the dipper, the panel is closed and the counterweight of the dipper is slowly lifted by hand from the lower shelf upon which it was resting, allowing the plate to descend into the bath, and is deposited upon an upper shelf when the plate is completely immersed. The plate is left four minutes in the bath and then the counterweight is taken from the upper shelf and slowly brought down to the lower shelf, withdrawing the plate from the solution and leaving the bottom of the plate upon the edge of the glass bath. The plate is allowed to drip for one or two minutes, the panel is opened and the plate transferred to the plate-holder. Up to the transfer of the plate to the plate-holder, the whole operation is performed in full daylight.

6. Reverse Camera.

The reverse camera, 18″ × 20″, is used with the smaller lens; the extension is 24 inches. The front is fixed, focussing being effected by moving the back by means of a double rack, pinion and crank. A graduated brass scale on the bed indicates the reduction.

The silvered glass reversing mirror fits snugly into the groove of a rectangular board connected to the mirror box by four adjusting screws, *A*, *B*, *C* and *D* (Fig. 6). By turning the screws *A* and *B* in opposite directions, the mirror revolves around a vertical axis through its centre. Likewise by turning the screws *C* and *D* in opposite

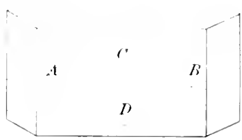


Fig. 6—Mirror Box

directions, the mirror revolves around the horizontal line in its plane through its centre.

The equipment comprises two mirrors, one being in use while the other one is out for silvering. With proper care and provided it is slightly warmed before any attempt is made to polish it, the silvering is good for six months or more. Incidentally it may be mentioned that an optically plane mirror is an expensive article; many of those found in the trade are imperfect and spoil the definition of a good lens.

A feature of this style of copying camera is its adaptability to large sizes. A large plate holder, a few extra lengths of large bellows and a larger lens are all that is needed. So far as the camera is concerned, the large plates are handled without any more trouble than the smaller ones. The size of the plate here has been limited to 24″ × 32″, merely because there is no occasion to use a larger plate.

7. Setting the Camera.

Two methods are available for setting a copying camera. By the first method the camera is adjusted at each operation so as to yield an image of a definite size and shape, which may or may not be an accurate reduction of the original. By the second method, the camera is adjusted once for all beforehand so as to yield in all cases an accurate reduction or enlargement of the original.

The first method is in general use and has some advantages. Let it be assumed, for instance, that a map has to be reduced to a rectangle 24″ × 30″. The operator rules on the ground glass a rectangle of that size, and endeavours in the usual manner to obtain an image filling approximately the rectangle so drawn. The next step is to bring one side of the image in coincidence with the corresponding side of the rectangle; this is done either by turning the board around an axis perpendicular to its face and by shifting it right or left and up or down, or by like motions of the camera. It is now found that the other sides of the rectangle do not fit, the shape of the image being an irregular quadrilateral; it has to be brought to correct shape by changing the inclination of the board to the axis of the camera. Every time an adjustment is made, it disturbs the preceding ones, which have all to be gone over again. To one without experience, the process is exceedingly tedious; like everything else, however, it is made easier by long practice, and some operators become in time very skilful. The main advantage of the method lies in the fact that, in some cases, it is possible to restore to correct proportions a drawing which has become distorted. Some kinds of paper, and especially tracing cloth, are affected by atmospheric conditions, and distortion occasionally becomes appreciable.

The advantage of the second method lies in its rapidity. The operator pins the original to the board, sets the two carriages by the scale to the reduction or enlargement marked on the job slip and exposes the plate. There is no focussing or twisting of the camera or board; in fact, no ground glass is used. This method was adopted by the office of the Surveyor General because the number of land survey plans to be reproduced is very great, and because the angles and lengths being marked in figures on the plans, scaling is unnecessary and a slight distortion would be immaterial. Moreover in an original properly cared for, distortion is seldom appreciable, and the most frequent case of distortion, that which is due to unequal expansion in the direction of and across the web of the paper, cannot be corrected by the adjustment of the camera.

8. Focussing.

Focussing is done with Carl Zeiss microscope (Fig. 7). This microscope, which has a power of 28 diameters, slides in an outer split sleeve terminated by a square base which can be applied against a glass plate. The coarse adjustment is effected by sliding the microscope in the outer sleeve till a distinct image is seen, and fastening it in that position by turning the milled screw ring at the top of the outer sleeve.

The fine adjustment is effected by screwing the body of the microscope in or out of an inner split sleeve, the second clamping ring (shown on the left of the 10 mm. division of the scale) having been released. The displacement of the microscope is read on the millimetre scale, the tenths of a millimetre being indicated by marks on the circumference of the inner sleeve and the hundredths easily estimated.

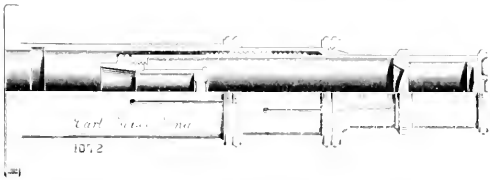


FIG. 7. Focussing Microscope.

For focussing the camera, a large piece of clear plate glass, perfectly plane, is selected, and a cross of two very fine lines is engraved in the centre with a diamond. The plate is inserted in the plate holder, engraved face towards the board, after removing the curtain and back of the holder. The base of the microscope is now applied against the back of the plate, it is set upon the engraved cross and the millimetre scale is read. The microscope is put against the plate again and is set this time upon the image of the original pinned to the board. The millimetre scale is read a second time. The difference of the two readings is the distance between the face of the glass plate and the plane of the image.

For instance, readings of 9·6 mm. on the engraved cross and 8·3 mm. on the image indicate that the image is 1·3 mm. in front of the plate, or in other words, that the plate carriage has to be moved 1·3 mm. forward in order to be in exact focus. Readings of 9·6 mm. on the engraved cross and 12·6 mm. on the image indicate that the image is 3 mm. behind the face of the glass and that the plate carriage must be moved 3 mm. backward.

9. Definitions.

The *axis of the camera* is a line through the optical centre of the lens parallel to the direction of motion, that is to say parallel to the rails. It must coincide with the optical axis of the lens; the flange of the latter must be so affixed to the camera that this condition is approximately fulfilled, otherwise the definition is impaired away from the centre of the plate.

The *centre of the board* is the point where the axis of the camera strikes the face of the board; it may be some distance from the geometrical centre.

The *centre of the plate* is the point where the axis of the camera strikes the face of the plate.

The image of the centre of the board always falls upon the same point of the plate (the centre of the plate). These two points are the only ones endowed with this reciprocal relation.

The *reduction*, *n*, is the proportion of the lines of the original to the corresponding lines of the image.

The *enlargement*, also designated by *n*, is the proportion of the lines of the image to the corresponding lines of the original.

According to these definitions, a reduction of 3·00 means that the linear dimensions of the original are three times the dimensions of the image. An enlargement of 3·00 means that the linear dimensions of the image are three times the dimensions of the original. Reductions and enlargements are never less than unity.

10. Geometry of the Copying Camera.

Relations between conjugate foci.—Let *A*, Fig. 8, be the lens in position for reducing, *u* and *v* being the distances to the board and to the plate respectively. The reduction is:—

$$n = \frac{u}{v}$$

The values of *u* and *v* are:—

$$u = (1 + n) f \qquad (1)$$

$$v = \left(1 + \frac{1}{n}\right) f \qquad (2)$$

f being the focal length of the lens.

Fig. 8.

Moving the lens to *B* for enlarging, the relations become:—

$$n = \frac{v'}{u'}$$

$$u' = \left(1 + \frac{1}{n}\right) f \qquad (3)$$

$$v' = (1 + n) f \qquad (4)$$

The various distances are accordingly as follows:—

	For reducing.	For enlarging
Board to Lens	$(1 + n) f$	$\left(1 + \frac{1}{n}\right) f$
Lens to Plate	$\left(1 + \frac{1}{n}\right) f$	$(1 + n) f$
Board to Plate*	$\left(2 + n + \frac{1}{n}\right) f$ (5)	

* 'Board to Lens' is in reality the distance to the first nodal point; 'Lens to Plate' is from the second nodal point. For 'Board to Plate', it would be necessary to add the distance between the nodal points, but this distance being eliminated in the application of these values made here, reference to the nodal points has, for the sake of simplicity, been omitted.

Differential motions.—If, the lens being at A, Fig. 9, for reducing the board is

FIG. 9.

slightly displaced from C to C', the image which at first formed in O will now be in O'. The relation between the displacement of the board, du, and of the plate, dv, obtained by differentiating (1) and (2), is:—

$$du = n^2 dv \qquad (6)$$

For an enlargement the relation is inverted:—

$$du' = \frac{dv'}{n^2} \qquad (7)$$

Thus for a reduction of 3·00, the displacement of the plate is one-ninth of the displacement of the board, while for an enlargement of 3·00, the displacement of the plate is nine times the displacement of the board.

Changes of scale.—When a map on a scale of a miles to one inch is reduced n, the scale of the copy is na miles to one inch. To reduce a map on a scale of a miles to one inch to b miles to one inch, the reduction must be $\frac{b}{a}$. Likewise, when a map on a decimal scale $\frac{1}{a}$ is reduced n, the scale of the copy is $\frac{1}{na}$. To reduce a map on a decimal scale $\frac{1}{a}$ to the scale $\frac{1}{b}$, the reduction must be $\frac{b}{a}$.

An enlargement n of a map on a scale of a miles to one inch produces a copy on a scale of $\frac{a}{n}$ miles to one inch. To enlarge the map from the scale of a miles to one inch to the scale of b miles to one inch, the enlargement must be $\frac{a}{b}$.

Likewise, when a map on a decimal scale $\frac{1}{a}$ is enlarged n, the copy is on the scale $\frac{n}{a}$. To enlarge the map from the scale $\frac{1}{a}$ to the scale $\frac{1}{b}$, the enlargement must be $\frac{a}{b}$.

When a map on a scale of a miles to one inch is reduced n' and the copy is subsequently enlarged n'', the final scale is $\frac{n'a}{n''}$ miles to one inch. A map on a scale of a miles to one inch will be changed to a scale of b miles to one inch by reducing it n' and enlarging the copy n'' provided:

$$\frac{n'}{n''} = \frac{b}{a}$$

When the copy desired is larger than the plate it is proposed to work with, the change of scale may be made in two different ways. A number of negatives sufficient to cover the whole map can be made on the desired scale; these are printed by contact and the prints are joined together to form the copy. The other way is to make a reduced negative of the whole map, to put the negative in the enlarging camera and to enlarge it to the requisite scale on a single piece of bromide paper. The first method gives a sharper result; the second method saves work and has the advantage of producing a copy on a single sheet of paper.

As an illustration, suppose a map 42″ × 54″ on a scale of 10 miles to one inch has to be reduced to 12 miles to one inch and the plate it is proposed to employ is 10″ × 12″. The reduction is:

$$n = \frac{12}{10} = 1{\cdot}20$$

The reduced map will be 35″ × 45″. Setting the copying camera at a reduction of 1·20, it takes fifteen or sixteen negatives 10″ × 12″ to cover the map. The negatives are printed by contact and the fifteen or sixteen pieces are joined together to make the finished copy.

Sharpness of the lines may not be essential, or it may be desired to save work or to have the finished copy in one piece. Should this be the case, one negative of the whole map is made to be enlarged subsequently. The ratio of the short sides of the map and plate is $\frac{42}{10}$ or 4·20, the ratio of the long sides $\frac{54}{12}$ or 4·50; therefore the reduction n' must be at least 4·50 for covering the whole map with one negative. Make the negative with $n' = 5{\cdot}00$ so as to leave a little margin on the plate. An enlargement n'' has now to be made from this negative. The relation quoted above between n', n'' and the scales gives:

$$n'' = n' \times \frac{a}{b}$$

In this case:

$$n'' = 5{\cdot}00 \times \frac{10}{12} = 4{\cdot}167$$

Therefore the map has first to be reduced 5·00 and then enlarged 4·167.

11. Adjustments of the Camera.

A good anastigmat, if used at a moderate angle, gives an image practically free from distortion, provided the board and plate are parallel and the optical axis of the lens is perpendicular to both. The last condition is sufficiently well fulfilled in a camera carefully constructed but it will not be amiss to check it. The first condition must be accurately fulfilled, means of adjustment being provided for that purpose.

Before proceeding with the adjustment, it is necessary to check, and to correct if needed, some of the details of construction.

The rails must be perfectly straight and parallel. This is checked by stretching a thread from one end of each rail to the other end, first with the cradle lying flat down and next with the cradle lying on its side. Parallelism is checked by measuring the spacing of the rails.

The board must be perfectly flat. This is checked with a steel straight edge applied on edge against the face of the board at different places and in different directions. The board is straightened by means of the screws at the back until perfectly straight in all directions.

The plates in all the plate holders must register alike. For checking this, the largest holder with the selected glass plate is attached to the camera and the bellows are removed. Two wooden rods with straight edges are clamped to the frame of the plate carriage in front of the plate holder, one of the rods being opposite the top of the plate, the other rod opposite the bottom. Each rod is adjusted so as to be parallel to the plate, the space between the plate and the edge of the rods being carefully measured. Another plate-holder with a selected glass plate is now substituted, and the space between the edge of the rods and the four corners of the plate measured. The plate-holder or its fittings must be altered until this space is exactly the same as for the large plate-holder. The other plate-holders are successively fitted in accurate register by the same process.

12. The Centre of the Board.

The first adjustment of the camera is to find the centre of the board.

Shift the plate carriage to the end of the cradle as far as it will go, attach the plate-holder after inserting the engraved glass plate and removing the curtain and back. Pin to the board, approximately in the centre, the millimetre scale shown in Fig. 10. The lens carriage is now shifted and brought by means of the focussing

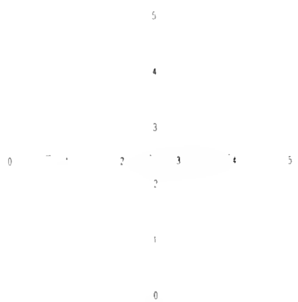


Fig. 10. Millimetre scale.

microscope to focus the image of the millimetre scale upon the face of the plate. This image will fall upon the cross engraved on the plate if the points selected as centres of the board and plate are not too far out. The vertical line of the plate will lie across the horizontal arm of the scale, and the horizontal line of the plate will lie across the vertical arm of the scale. The readings of the scale at the two crossings are noted.

The lens carriage is then shifted towards the board till the image is in focus again, and the readings of the scale are noted as before.

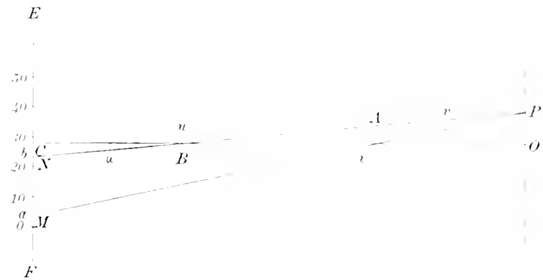


FIG. 11.

Let Fig. 11 represent a vertical section through the axis OC of the camera, EF being the board, OP the plate, A and B the first and second positions of the lens, P the horizontal line of the engraved cross, N and M the two divisions of the millimetre scale whose image falls upon P, and a and b the corresponding readings of the scale.

It will be noted that in this case $u = v'$ and $v = u'$; that is to say, the reduction and enlargement are equal:

$$n = \frac{u}{v} = \frac{v'}{u'}$$

In reducing, PO is the image of MC; hence:

$$PO = \frac{MC}{n}$$

In enlarging, PO is the image of NC; hence.

$$PO = n \times NC$$

Combining the two equations:

$$n^2 \times NC = MC$$

and:

$$NC = \frac{MN}{n^2 - 1}$$

But:

$$MN = b - a$$

and:

$$NC = \frac{b - a}{n^2 - 1}$$

The reading of the scale where it is intersected by the horizontal line passing through the centre of the board is accordingly:

$$b + \frac{b - a}{n^2 - 1}$$

Through this division of the scale, a horizontal line is drawn on the board.

The same procedure is followed for the horizontal branch of the millimetre scale and a vertical drawn through the proper division of the scale. The intersection of the horizontal and vertical lines so drawn is the centre of the board.

Through the centre of the board two lines at right angles, approximately horizontal and vertical, are drawn right across the board. Their images must be as nearly as possible parallel to the sides of the plate.

The extension of the reverse camera being comparatively short, the limit of n for enlarging is small. With small values of n, the term $\frac{b-a}{n^2-1}$ in the expression for the reading of the scale becomes inaccurate. Instead of setting the reverse camera at equal reduction and enlargement, it is preferable to set it first at the greatest reduction, n, and then at the greatest enlargement, n', the extension admits of. Keeping the same notation as before, it is easily found that the reading of the scale for the centre of the board is:

$$b + \frac{b - a}{nn' - 1}$$

13. The Centre of the Plate.

The centre of the plate is the point upon which falls the image of the centre of the board. If the camera has been accurately constructed, this point is very close to the cross engraved on the plate. For convenience in registering lithographic transfers, it is necessary that the optical and geometrical centres of the plate should nearly coincide; the discrepancy, if any, must be removed by altering the plate-holder or its fittings. For the same reason, the images of the two lines drawn across the board must be parallel to the sides of the plate; care is taken to fulfil this condition in drawing the lines.

14. Adjustment of the Board and Plate-holder Frame.

The board and plate must both be accurately perpendicular to the axis of the camera.

The adjustment is effected by means of the optical square shown in Fig. 12. It consists of a telescope attached to two brass plates between which wooden arms are bolted. At the end of each arm is a small adjusting screw. The diaphragm of the telescope bears two threads at right angles, one of them being parallel to the wooden arms. Several pairs of wooden arms of different lengths are provided; the pair used for the board has the adjusting screws at the back instead of in front. The normal plane of the optical square is indicated by lines drawn on the two brass plates and by notches on the cell of the objective.

For adjusting the optical square, the plate carriage is moved to the extreme end of the cradle, the lens and front board are removed from the lens carriage and the millimetre scale shown in Fig. 10 is pinned to the centre of the board.

Fig. 12—Optical Square.

Let AB, Fig. 13, be the plate, DE the board, O the centre of the plate, C the centre of the board. Having focussed the telescope, apply the optical square against the plate, arms horizontal, screws G and H resting against the glass and the notch of the objective cell on the vertical line O of the central engraved cross. The line is too fine to be seen with the naked eye and must be indicated by a small piece of

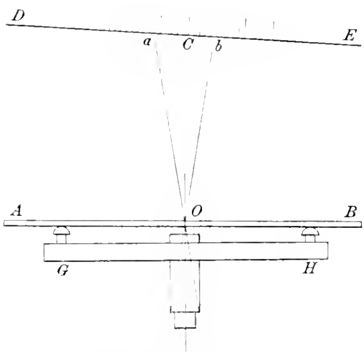
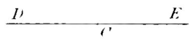


Fig. 13—Adjustment of the Optical Square

paper pasted to the glass. Looking through the telescope, the vertical thread is seen to cross the horizontal arm of the scale and the reading, a, is noted. The optical square is now reversed end for end. If the same reading, a, of the scale is obtained, the optical square is in adjustment. If not, the second reading, b, is noted, and one of the screws *G* or *H* at the end of the wooden arms is screwed or unscrewed until the reading on the scale becomes:

$$\frac{a+b}{2}$$

The adjustment of the plate-holder frame is now proceeded with. Applying the optical square against the plate *AB*, Fig. 14, arms horizontal, in the same position as before, the screws *S* and *T*, which command the slides of the trunnions, are turned in opposite directions till the vertical thread of the telescope is seen to pass through the centre *C* of the board.



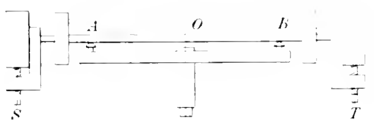


Fig. 14—Adjustment of the Plate-holder Frame.

The optical square is next fixed against the plate, wooden arms vertical, the notch of the objective cell being held on the horizontal line of the engraved cross.

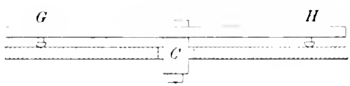


Fig. 15—Adjustment of the Board.

The bottom slide is screwed in or out until the horizontal thread of the telescope is seen to pass through the centre of the board.

The board is adjusted by the same method. The millimetre scale is stuck to the centre of the plate at O, Fig. 15, the plug in the centre of the board, C, is removed and the telescope of the optical square is inserted through the opening, arms horizontal, the line of the normal plane drawn on the instrument being brought in coincidence with the vertical line of the board. The optical square is adjusted in the manner already described by screwing in or out one of the screws, G or H. With the arms of the optical square horizontal, the board is revolved by turning in opposite directions its adjusting screws on the right and on the left until the vertical thread of the telescope is on the centre of the plate. With arms vertical, the board is revolved by turning in opposite directions its top and bottom adjusting screws, until the horizontal thread of the telescope is on the centre of the plate. Care must be taken to turn the screws evenly, otherwise the face of the board would be bent.

15. Graduations.

There is a double graduation for each lens, one side being for setting the lens carriage, and the other side for the plate carriage.

The graduation is calculated as follows: Let DE, Fig. 16, be the board, FG the plate at the far end of the cradle, CO the axis of the camera, A and B the two positions of the lens for which the image is in focus on the plate, CB being equal to AO. The focal length found by subtracting (2) from (1) is:

$$f = \frac{AB}{n - \frac{1}{n}} \qquad \text{([illegible])}$$

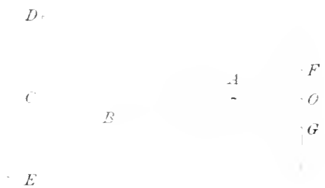


FIG. 16.

AB is the displacement of the lens carriage. It is measured on the rod attached under the cradle, the two positions being marked upon it. For focussing, the microscope is set on the plate at O, the tube is turned until the cross lines engraved on the plate are in focus and the reading of the microscope scale is noted. By repeating the operation several times the focus is accurately ascertained. Replacing the microscope on the plate, the tube is turned till the image of the board is perfectly sharp and distinct and the reading of the microscope scale is noted. This also is repeated several times. The difference of the two readings is approximately the distance the lens carriage has to be moved to bring the image of the board on the face of the plate. After moving the lens carriage, the focussing is repeated until an exact focus is obtained.

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The reduction, n, is found by measuring DE and FG.

Through the centre of the plate, O, Fig. 17, draw a parallel MN to the long sides of the plate; at equal distances from the centre and near the edge, erect perpendiculars in M and N. The crosses at the two ends of this line must be drawn with a diamond on the plate. In drawing these lines as well as the cross at the centre, the diamond must be held at the proper angle and a very light pressure exerted, hardly more than the weight of the diamond, otherwise the lines will be ragged and accurate measurements impossible. Rubbing a pencil across the lines helps to make them visible.

Upon the board, two points, A and B, are marked on the horizontal line at equal distances from the centre, C, and such that their images will fall very nearly upon the points M and N of the plate. At these points erect perpendiculars to the hori-

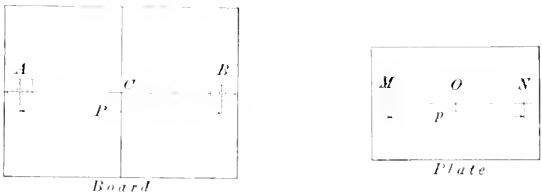

FIG. 17.

zontal line and upon the crosses so formed pin two of the millimetre scales shown in Fig. 10. Measure carefully the distances p between M and N, and P between A and B. Looking now at the plate the vertical line N will be seen to cross the horizontal arm of the scale A, and the vertical at M the horizontal scale B. Let a and b be the readings of the two scales; then the reduction is:

$$n = \frac{P + b - a}{P}$$

This value of n used in (8) gives the focal length.

It is somewhat difficult to focus accurately an enlarged image; it is, therefore, preferable to determine the position of the lens carriage at B, Fig. 16, by focussing from the board side. This is done by inserting the microscope through the centre hole of the board and resting the base against the face of the board. The reading of the microscope scale for the face of the board is ascertained by focussing a scratch on the back of a glass plate and adding the thickness of the base of the microscope.

The graduation for the plate carriage is obtained by calculating the distance board to plate for the various degrees of reduction or enlargement; this distance, given by (5), is:

$$\left(2 + n + \frac{1}{n}\right)f$$

For the lens carriage, the distance board to lens for a reduction is given by (1) as:

$$(1 + n$$

For an enlargement, it is given by (3) as:

$$\left(1 + \frac{1}{n}\right) f$$

A table of the values of $2 + n + \frac{1}{n}$ and $1 + \frac{1}{n}$ is given in Part III; it is unnecessary to give a table of $1 + n$, as it would merely be one of consecutive numbers.

The numbers of these tables have to be multiplied by f: this is quickly done with an arithmometer.

For drawing the graduation on the rod, the two reference marks at A and B, Fig. 16, are used as starting-points. The divisions are marked for every 0·01 of n; they are located by dividing into equal parts the spaces between the values of the table. The figures for the lens carriage are made black and those for the plate carriage red.

Instead of the above graduations, a single scale of equal parts, a millimetre scale for instance, might be attached to the rod and the setting of the carriages done by means of the calculated tables. This would save drawing the graduation, the setting would be somewhat more accurate and it would have other advantages.

16. Readjusting the Focus.

The board, the plate holder frame, the graduation or the pointers may, for some reason or other, become displaced. Should this happen, the image of the board will no longer form on the face of the plate when the lens and plate carriage are set on corresponding divisions of the graduation. In order to ascertain how much the board and plate-holder frame have to be moved to bring them back to correct position, the camera is set for a reduction of n, the lens carriage being at A, Fig. 18, the plate at O and the board at C. Let F be the position of the image of the board: with

FIG. 18

the focussing microscope measure the interval $OF = a$ between the plate and the image. Next move the lens carriage to B for an enlargement of n, and with the focussing microscope measure the interval $CE = b$ between the board and the image E of the plate. Let D and G be the correct positions of the board and plate respectively, y and x being the changes required to bring them to their correct places. In other words, if the board be moved from C to D, its image will move from F to G; and if the plate be moved from O to G, its image will move froom E to D. But the relation between these displacements is given by (6). It is:

$$CD = n^2 \times FG$$
$$OG = n^2 \times DE$$

or:

$$y = n^2 (a - x)$$
$$x = n^2 (b - y)$$

The values of y and x derived from these equations are:

$$y = \frac{1}{1 - \frac{1}{n^4}} \left(b - \frac{a}{n^2} \right)$$

$$x = \frac{1}{1 - \frac{1}{n^4}} \left(a - \frac{b}{n} \right)$$

The tests are made for several values of n, the mean y and x being applied as corrections with the adjusting screws of the board and plate-holder frame. The correction can also be made by changing the position of the pointers, the lens carriage pointer being moved over an interval equal to y and the plate carriage pointer $x + y$.

It will be observed that the formula breaks down for $n = 1$, when the lens is midway between the plate and the board. The reason is because the lens, when near that position, can be moved forward or backward a small distance without changing the focus. It follows that the tests are best made with high values of n.

The factor

$$\frac{1}{1 - \frac{1}{n^4}}$$

is given below for different values of n up to 3.00. Above 3.00 the factor is unity.

n	$\frac{1}{1 - \frac{1}{n^4}}$	n	$\frac{1}{1 - \frac{1}{n^4}}$
1.20	1.93	1.80	1.10
1.30	1.54	1.90	1.08
1.40	1.35	2.00	1.07
1.50	1.25	2.25	1.04
1.60	1.18	2.50	1.03
1.70	1.14	3.00	1.01

Another method of readjusting a camera which has become disarranged is to focus it accurately and to measure the reduction as has already been explained. The pointers of the lens and plate carriages can then be moved to the divisions of the graduation representing the reduction found. This method is not as good as the other one.

17. Adjustment and Graduation of the Reverse Camera.

A new centre of the board has to be determined for the reverse camera; it may not be the same as for the direct camera. The determination is made in the manner already described for the direct camera.

The board being normal to the axis of the camera, requires no further adjustment. What remains to be done is to adjust the plate holder, or rather the mirror, to set and clamp at the right place the reverse camera pointer of the lens carriage and to draw the graduation on the bed of the reverse camera.

The axis of the camera is reflected at right angles, or thereabouts, by the mirror; the condition that there shall be no distortion of the image requires that the plate be accurately perpendicular to the reflected axis. Evidently the adjustment could be made with the optical square by swinging the frame to which the plate-holder is attached, precisely as was done with the direct camera. It is preferable, however, instead of moving the plate-holder frame, to swing the mirror until the reflected axis is normal to the plate. Preference is given to the adjustment of the mirror because, being put in and taken out frequently, its position is liable to be disturbed, and because its readjustment, once its correct position has been determined, is very simple and quickly made.

The reflected axis must also be parallel, approximately at least, to the direction of motion of the plate, otherwise the centre of the plate will cease to be invariable and will change with the reduction or enlargement. Should the discrepancy be so large as to become troublesome, the fittings of the plate holder would have to be altered so as to make the plate normal to the direction of motion.

The first adjustment of the mirror can be made as follows:—

Draw a square on the plate, leaving a margin of an inch or two on the four sides; mark the four corners with a diamond, draw a corresponding square on the board so that its image shall coincide as nearly as possible with the square drawn on the plate. Unless the mirror is in adjustment, the image is not a square; the adjustment is effected by turning the mirror till the opposite sides of the image become equal.

Let *A B C D*, Fig. 19, be the square drawn on the plate and *E F G H* the image. The distortion of the sides *E G* and *F H* can be measured by pinning continuous scales of equal parts to the board along *E G* and *F H* and counting the number of divisions intercepted on each scale between the lines *A B* and *C D* of the plate. The

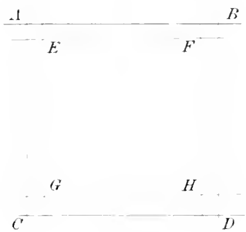

Fig. 19

ends of the scales only being used, it is sufficient to measure on the board the length of the side of the square in millimetres and to pin at each of the four corners one of the millimetre scales shown in Fig. 10. The number of divisions that would be intercepted if the scales were continuous is readily figured out from the readings of the millimetre scales. The following is the rule for rotating the mirror:—

If the number of divisions intercepted is greater at the bottom of the plate than at the top, revolve the mirror around its horizontal axis so as to bring the top of the mirror nearer to the plate.

If the number of divisions intercepted is greater on the left of the plate than on the right, turn the mirror clockwise, looking from above, around its vertical axis.

The rule may be put in another form:—

Turn the mirror so as to decrease the distance between the side of the plate intercepting the smaller number of divisions and the corresponding side of the mirror.

After the mirror has once been adjusted, the centre of the plate, that is to say the image of the centre of the board, is marked on the framed glass plate. Whenever it is necessary to adjust the mirror again, for instance when it is changed, it is sufficient to turn it so as to bring into coincidence the image of the centre of the board and the mark for the centre of the plate, without resorting again to the process of adjustment described above.

The examination of the image near the corners of the plate is difficult, especially when the lens is working at a large angle, as it should be in order that the adjustment may be accurate. The difficulty may be overcome by making a negative and measuring the sides of the quadrilateral upon the negative.

Let Fig. 20 represent a horizontal section through the axis of the camera, *DE* being the board, *AB* the plate, *G* the image of the centre, *C* of the board, *D* and *E*

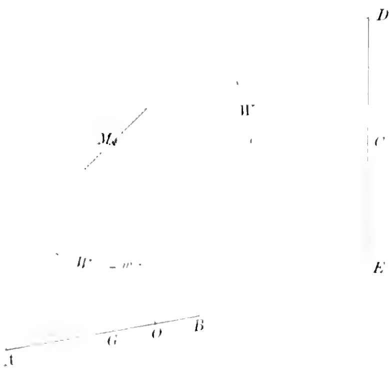

Fig. 20—Adjustment of the Mirror

the sides of the square on the board, *A* and *B* the sides of the quadrilateral image, *W* the angle subtended at the lens by half of the square, *L* the length in millimetres of the left side of the quadrilateral at *A*, and *R* the length of the right side at *B*. As represented by the figure, *L* is greater than *R*; to make them equal, the mirror must be turned so as to bring the image of the centre from *G* to *O*, the line *MO* being perpendicular to the plane of the plate. If a millimetre scale is pinned at C, the number of divisions d of the image corresponding to GO is:

$$d = n(L - R)\left[\frac{(n+1)f}{P}\right]^2$$

in which P is the side of the square on the board in millimetres.* The lengths L and R are measured on the negative. The image of the centre must be displaced towards the smaller side of the quadrilateral image.

Likewise, the image of the centre is moved towards the top or bottom according as the top or bottom side of the quadrilateral is smaller, the displacement being calculated by the same formula. In both cases the displacement is readily ascertained by means of the cross lines engraved near the centre of the plate.

Incidentally, it may be observed that the image of a square original whose opposite sides have become unequal through the stretching of the paper can be restored to correct proportions by the adjustment of the mirror calculated by the above formula, the lengths L and R being equal to the corresponding lengths of the original divided by n. The formula for rectangular originals could, if required, be easily calculated. Distortion can also be corrected by a like process in the direct camera. The need of such corrections has, however, not been felt here.

For graduating, the camera is set for a reduction such that the width of the board covers the full width of the plate; the reduction is measured by the process described for the direct camera. Having ascertained this reduction, the lens carriage pointer of the reverse camera is moved to the proper division of the graduation and firmly clamped in position. A mark is made on the bed of the reverse camera opposite the pointer, and the graduation is drawn from this mark by means of the table of the values of

$$\left(1 + \frac{1}{n}\right)f$$

which has already been calculated for the direct camera.

---

* Representing the angle GMO by w, the figure gives:

$$MA \times \cos(W - w) = MO$$

$$L = 2\,MA \times \sin W$$

Multiplying by $\cos(W - w)$:

$$L\cos(W - w) = 2\,MO \times \sin W$$

The angle w being small, its cosine can be taken as unity:

$$L\cos W = 2\,MO \times \sin W - L\sin W\sin w$$

The right hand side of the figure gives in the same manner:

$$R\cos W = 2\,MO \times \sin W - R\sin W\sin w$$

Subtracting the last equation from the preceding one, and reducing:

$$\sin w = \frac{n(L - R)}{2\,P\tan W}$$

$$GO = \sin w \times MO = n(L - R)\frac{\left(1 - \frac{1}{n}\right)f}{2\,P\tan W}$$

But d, the number of divisions of the image of the millimetre scale corresponding to GO, is $GO \times n$, and

$$\tan W = \frac{P}{2(1 + n)f}$$

Substituting these values:

$$d = n(L - R)\left[\frac{(1 + n)f}{P}\right]^2$$

It has been assumed at the start that the mirror was at the right place on the axis of the camera. This condition may not be accurately fulfilled.

Let Fig. 20*a* represent a section through the axis *CP* of the camera and the geometrical centre, *O*, of the glass plate marked by an engraved cross. The camera being set for an enlargement n', the mirror *M* is turned so as to reflect the image of the optical centre of the board, *C*, upon the geometrical centre of the plate *O*. Moving the lens carriage to *NQ* for a reduction *n*, it will usually be found that the point of

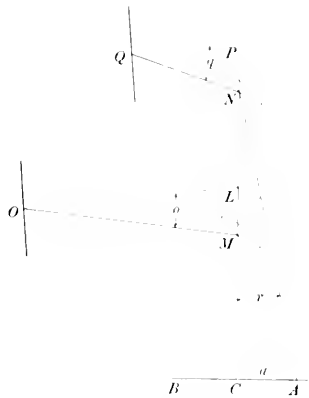

Fig. 20a.—Position of Mirror on the Axis.

the board whose image is reflected upon the central cross of the plate is no longer the centre of the board *C*, but a point *A*, *a* millimetres away from the centre. In order that the image of the centre *C* may always coincide with the central cross of the plate, the mirror must be moved from *M* to *L*, *OL* being the line followed by the central cross *O* when the plate is racked backwards and forwards. The perpendicular distance, *h*, between the two positions *M* and *L* of the mirror is:

$$h = \frac{a}{\sqrt{2}} \cdot \frac{1 + n}{nn - 1}$$

a is read on the millimetre scale glued to the plug in the centre of the board.*

* Let *QP* be the direction of translation of the plate parallel to *OL*, *PN* being equal to *LM*. Designate the angles *LOM*, *PQN* and *CNA* by *o*, *q*, and *r* respectively. The angles being small, their values are approximately:

$$o = \frac{LM}{OM}$$

$$q = \frac{PN}{QN} = \frac{LM}{QN}$$

$$r = q - o = \frac{LM}{QN} - \frac{LM}{OM}$$

But:

$$a = r \cdot CN$$

and:

$$a = CN \cdot LM\left(\frac{1}{QN} - \frac{1}{OM}\right)$$

In the latest pattern of this copying camera, provision is made for this adjustment. Fig. 20*b* is a section of the mirror box. The mirror slides into the groove *AB*, being pressed forward at the bottom by the brass springs *A* and *B*, and at the top by a spring in the centre, so as to be held by three points only and so to be free from strains. Opposite the point where the optical axis strikes the mirror is a screw *C* screwing through a brass plate *HG* fastened to the mirror box. The rounded head of the screw bears against a brass plate *LK* fastened to the mirror slide. When it is

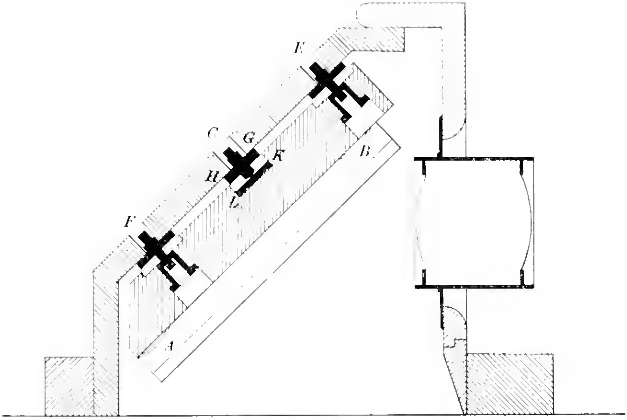

Fig. 20b. Mirror Box.

desired to move the mirror slide forward, the screws *E* and *F* and the two other adjusting screws must first be loosened and then the screw *C* is turned to the right. If the slide has to be moved in the opposite direction, the screw *C* is turned to the left and the four adjusting screws are screwed in so as to bring the mirror slide and plate *LK* in contact with the top of the screw *C*. The number of turns and fraction of a turn necessary for the displacement *b* of the mirror is calculated from the known value of the screw thread.

The board has previously been made perpendicular to the axis when making the adjustments of the direct camera. For finding the centre of the board for the reverse camera, the lens carriage is brought as close to the board as it will go and a set square applied against the board and opposite sides of the lens tube. The point so ascertained is quite accurate enough for practical purposes.

The values of CN, QN and OM, derived from (1), (2) and (4), are:

$$CN = (1+n)f$$

$$QN = \left(1+\frac{1}{n}\right)f$$

$$OM = (1+n')f$$

Substituting these values in the preceding equation and reducing:

$$LM = a\frac{1+n'}{nn'-1}$$

The mirror being inclined at 45° to the axis the perpendicular distance b between the two positions M and L is equal to LM divided by the square root of two, or:

$$b = \frac{a}{\sqrt{2}}\cdot\frac{1+n'}{nn'-1}$$

PART II.—THE ILLUMINATION OF THE BOARD.

18. Lights and Reflexions.

Electric light is so much more convenient than daylight for copying that there can be no hesitation in selecting between the two. Two kinds of light are available, viz., the mercury tube and the arc lamp. The latter is in use here.

In disposing the lights, care must be taken to secure even illumination and to avoid reflexions. Photographs on glossy paper, varnished paintings, etc., are apt to cause trouble unless the lights are outside the range of reflexion. It is different with drawings: an original on glossy tracing linen may yield a perfect negative, while one on dull paper photographed under identical conditions may produce a negative in which the lines are more or less fogged. The explanation is that the reflexions which cause the trouble are from the surface of the ink lines, while those from the blank spaces are comparatively harmless. Ordinary Indian ink dries shiny. Several photo-drawing inks are in the market, but they are not in favour with draughtsmen.

The light from an alternating current lamp is fairly uniform in all directions within a wide angle; this is not the case with direct current lamps, and the remarks which follow do not apply to them. The intensity of an arc lamp fluctuates considerably: any conclusion that may be arrived at respecting the strength of the illumination produced must be taken as a rough approximation only. Fortunately moderate variations from the normal exposure do not affect the quality of the negative.

19. Light Intensities with One Lamp.

The brightness of a surface, *BC*, Fig. 21, at various distances from a source of

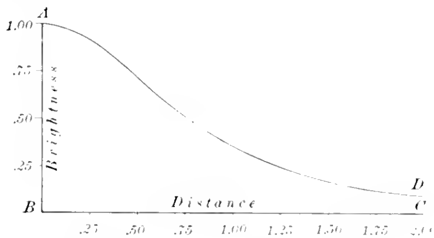

Fig. 21 - Illumination of a surface by a luminous point.

light, *A*, is represented by the curve *AD*. The curve shows that the brightness is tolerably uniform just opposite the light but falls off rapidly as the distance increases. It follows that unless the original to be copied is small, a single arc lamp has to be far away in order to give even illumination. Moreover, it has to be placed to one side for avoiding reflexions, and this is apt to show the grain of the paper.

20. Light Intensities with Two Lamps.

With two lamps, conditions are improved. Fig. 22 shows the brightness at several points of a square illuminated by two lamps opposite *A* and *B* at a distance from the square equal to half of its diagonal, the brightness of one lamp at that distance being taken as unit. The brightness is greatest just opposite the lamps and somewhat less in the centre, but it falls off rapidly away from the middle line, being only six-tenths of the greatest brightness at the top and bottom of the square. The best illumination is secured by placing the longest dimension of the original to be copied in the direction of the line of the lamps.

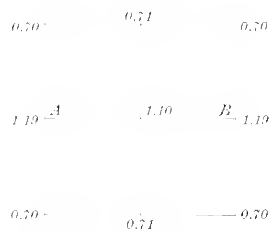

FIG. 22—Brightness of a square illuminated by two lamps.

By increasing the distance of the lamps one-fifth, making it equal to $AB \times .85$, the uniformity of the illumination, shown in Fig. 23, is somewhat better; it is uniform along the middle line, and nearly seven-tenths of its greatest value at the top and bottom of the square. This illumination is sufficient to yield a good nega-

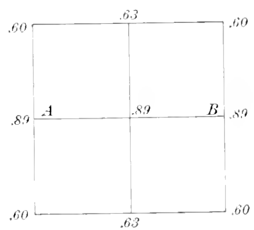

FIG. 23—Brightness of a square illuminated by two lamps.

tive of a line drawing. Still the operator might as well have all chances in his favour, and a better result is obtained with four lamps.

21. Light Intensities with Four Lamps.

The most even illumination in this case is secured by placing the lamps at equal distances from the board and from the axis of the camera.

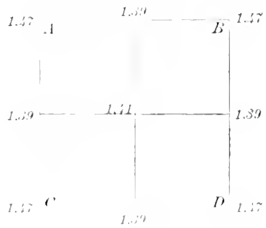

FIG. 24. Brightness of a square illuminated by four lamps.

Fig. 24 shows the brightness of a square illuminated by four lamps opposite the corners *A*, *B*, *C*, *D*, the distance from the board being equal to $\frac{1}{2} AB \sqrt{2}$. By placing the lamps a little closer to the board, the brightness is greater at the margin than in the centre, and this is as it should be for producing even illumination on the plate.

22. Reflexions and Focal Length of the Lens for Two Lamps.

The trouble from reflexions is not peculiar to artificial light: it arises in daylight from a bright background behind the camera or from light reflected by a polished camera front or by the lens mount. No good reason exists why the front of

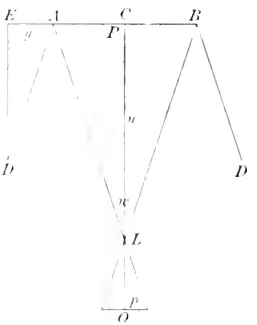

FIG. 25.

the camera should be polished: it is preferable to have it dull and dark. A lens protected by a deep hood, as it should always be, cannot reflect stray light. The space behind the camera should preferably be dark.

Arc lamps must be placed far enough from the axis of the camera to be beyond the range of reflexion, their distance depending upon the dimensions of the original to be copied and the focal length of the lens. Considering first the case of two lamps, let AB, Fig. 25, represent the original pinned to the board, OC the axis of the camera, L the lens, u the distance from the lens to the board, O the plate, P and p the widths of the original and plate. From A and B draw the lines AD and BD', making the same angle with the board as AL and BL. Reflexions are avoided if the lamps are kept outside of the lines AD and BD'. Let them be put in D and D'. From D let fall a perpendicular DE to the plane of the board, and denote AE by y. It has been shown that in order to produce tolerably uniform illumination, the distance DE from the lamps to the board must be about ·85 $\times$ 2 EC, or:

$$DE = \cdot 85\,(2\,y + P)$$

Similar triangles give:

$$\frac{DE}{y} = \frac{u}{\frac{1}{2}\,P}$$

Combining the two equations:

$$\frac{2\,y + P}{P} = \frac{\frac{u}{P}}{\frac{u}{P} - .85} \qquad (9)$$

$2\,y + P$ is the separation DD' of the two lamps. The numerical value of the ratio $\frac{2\,y + P}{P}$ for the various values of $\frac{u}{P}$ and the angle $2\,W$ subtended at the lens by the width of the original, are given below:—

$\frac{u}{P}$	$\frac{2y+P}{P}$	$2\,W$
1	6.67	53°
2	1.74	28
2.55	1.50	22
3	1.40	19
4	1.27	14
5	1.20	11

These figures illustrate how important it is to work with a lens of long focus. For:

$$\frac{u}{P} = 1$$

that is to say when the distance from the lens to the board is equal to the width of the original, the separation of the lamps must be 6·67 times the width of the original and their distance from the board 5·67 times the width. This would be impracticable for originals of large dimensions. For convenience in working, the lamps should not be farther apart than one and a half times the width of the largest originals. The table shows that this requirement is fulfilled when the distance from the lens to the board is 2·55 times the width of the original, the angle subtended at the lens being 22°.

The limitation of the separation of the lamps to one and a half times the width of the original determines the minimum focal length of the lens. Noting that:

$$\frac{P}{u} = \frac{np}{(n+1)f}$$

and

$$y = \tfrac{1}{4}P$$

Equation (9) gives:

$$f = 2.55p\frac{n}{n+1}$$

This shows that the greater the reduction, the longer the focal length must be. For a reduction not exceeding 1·25:

$$f = 1.45\,p$$

This is very nearly the diagonal of a square plate. The rule sometimes given in text books that the focal length must be equal to the diagonal of the plate is therefore correct so long as the reduction is small. For a reduction of 3·00 the focal length would have to be

$$f = 1.9\,p$$

which is 1·34 times the diagonal.

The conclusion that the focal length required increases with the reduction must be qualified. It rests upon the assumption that the whole plate is covered by the image, but when the reduction reaches a certain limit, the image with originals of ordinary dimensions becomes too small to cover the plate and the rule ceases to apply.

Another conclusion from (9) is that the wider the original, the farther apart the lamps have to be. For a rectangular original, the best position for avoiding reflexions is accordingly across the line of the lamps, the longest dimension being vertical if the lamps are to the right and left of the camera. But it has been shown that the most uniform illumination is secured when the longest dimension is parallel to the line of the lamps; this is another argument against the use of only two lamps for large work.

23. Reflexions and Focal Length of the Lens for Four Lamps.

With a four lamps outfit, D and D', Fig. 25, may be taken to represent the projections of the lamps. It was found that for uniform illumination:

$$DE = \tfrac{1}{2}P\sqrt{2}$$

This and a consideration of the similar triangles in the figure give:

$$\frac{2y + P}{P} = \frac{\frac{u}{P}}{\frac{u}{P} - \text{[illegible]}}$$

The numerical values of the ratio, $\frac{2y + P}{P}$, of the distance between two adjoining lamps to the width of the original, and of the angle $2W$ subtended at the lens, is given below for various values of $\frac{u}{P}$.

$\frac{n}{P}$	$\frac{2y+P}{P}$	$2W$
1	3.42	53°
2	1.55	28
2.12	1.50	27
3	1.31	19
4	1.22	14
5	1.16	11

A comparison with the table for two lamps shows at once the superiority of the four lamps equipment. The lamps need not be put so far apart, and they are closer to the board, thus giving stronger illumination. For instance, when the distance from the lens to the board is twice the width of the original ($\frac{n}{P}=2$), the separation of the two lamps of a pair (side of the square) is only 1·55 times the width of the original, while it is 1·74 times the width with two lamps. The four lamps are at a distance 1·1 P from the board against 1·5 P for two lamps. Another advantage is that it is sufficient to place the four lamps beyond the range of reflexion for the shortest dimension of the original, while the two lamps must be beyond the range for the greatest dimension.

Limiting again the separation of the two lamps of a pair to one and a half times the width of the original, the focal length required is deduced as before:

$$f=2.12p\frac{n}{n+1} \qquad (10)$$

The largest plate of the camera of the Surveyor General's office is 24″ × 32″. The lens was selected and the lamps disposed for a reduction of 2·00. The original which, reduced twice, fills the plate must be 48″ × 64″; no larger originals are handled in the office. The lamps are placed above and below the range of reflexion, that is to say the height of the plate, 24″ is taken for p in (10). The formula gives:

$$f=33''.9$$

The focal length of the lens actually used is 33·7 inches (856·4 mm.); it is employed for enlargements and for reductions up to 2·45 when the plate carriage is at the extreme end of the cradle.

For the reduction of 2.00, the original being 48 inches high, the normal disposition of the lamps would be a square of 72 inches side (one and a half times 48 inches), and their distance from the board seven-tenths of 72 inches or 50 inches. They have, however, been placed a little closer to the board and form a smaller square so as to give more light to the margin of the board than to the centre. According to the explanation given, there can be no reflexion up to a reduction of 2·00, nor can there be any between 2·00 and 2·45, because the image no longer fills the plate.

Very little work requires a reduction of more than 2·45. For such work a lens of 18″·6 focus (472·9 mm.) is provided: its range extends from 2·45 to 6·65, in connection with small plates, the image being always small with such large reductions. This small lens is also used on the reverse camera, which is for work of comparatively small size. Its range there is from an enlargement of 1·20 to a reduction of 5·80.

PART III

TABLE

PART III.—TABLE OF FACTORS FOR COMPUTING THE GRADUATION OF A COPYING CAMERA AND OF COMPARATIVE EXPOSURES.

Reduction or Enlargement n	Lens Carriage $1+\frac{1}{n}$	Plate Carriage $2+n+\frac{1}{n}$	Comparative Exposures: Enlarging $(1+n)^2$	Comparative Exposures: Reducing $(1+\frac{1}{n})^2$	Reduction or Enlargement n	Lens Carriage $1+\frac{1}{n}$	Plate Carriage $2+n+\frac{1}{n}$	Comparative Exposures: Enlarging $(1+n)^2$	Comparative Exposures: Reducing $(1+\frac{1}{n})^2$
1.00	2.00000	4.00000	4.0	4.0	3.25	1.30769	5.55769	18.1	1.7
.05	1.95238	.00238	2	3.8	.30	.30303	.60303	.5	
.10	.90909	.00909	4	6	.35	.29850	.64850	18.9	
.15	.86956	.01956	6	4	.40	.29411	.69411	19.4	
.20	.83333	.03333	8	3	.45	.28985	.73985	8	1.6
.25	.80000	.05000	5.0	.2	.50	.28571	.78571	20.2	
.30	.76923	.06923	3	.1	.55	.28169	.83169	.7	
.35	.74074	.09074	5	0	.60	.27777	.87777	21.2	
.40	.71428	.11428	7	2.9	.65	.27397	.92397	6	
.45	.68965	.13965	6.0	.8	.70	.27027	.97027	22.1	
.50	.66666	.16666	2	.7	.75	.26666	6.01666	.6	
.55	.64516	.19516	5	6	.80	.26315	.06315	23.0	
.60	.62500	.22500	7	6	.85	.25974	.10974	5	
.65	.60606	.25606	7.0	5	.90	.25641	.15641	24.0	
.70	.58823	.28823	2	1	.95	.25316	.20316	5	
.75	.57142	.32142	5	4	4.00	.25000	.25000	25.0	
.80	.55555	.35555	8	4	.05	.24691	.29691	5	1.5
.85	.54054	.39054	8.1	3	.10	.24390	.34390	26.0	
.90	.52631	.42631	4	3	.15	.24096	.39096	5	
.95	.51282	.46282	7	2	.20	.23809	.43809	27.0	
2.00	.50000	.50000	9.0	2	.25	.23529	.48529	.6	
.05	.48780	.53780	3	2	.30	.23255	.53255	28.1	
.10	.47619	.57619	6	2	.35	.22988	.57988	6	
.15	.46511	.61511	9	1	.40	.22727	.62727	29.2	
.20	.45454	.65454	10.2	1	.45	.22471	.67471	.7	
.25	.44444	.69444	6	.1	.50	.22222	.72222	30.2	
.30	.43478	.73478	9	0	.55	.21978	.76978	.8	
.35	.42553	77553	11.2	0	.60	.21739	.81739	31.4	
.40	.41666	81666	.6	0	.65	.21505	.86505	.9	
.45	.40816	85816	9	0	.70	.21276	.91276	32.5	
.50	.40000	.90000	12.2	0	.75	.21052	.96052	33.1	
.55	.39215	.94215	6	1.9	.80	.20833	7.00833	6	1.4
.60	.38461	.98461	.9	9	.85	.20618	.05618	34.2	
.65	.37735	5.02735	13.3	9	.90	.20408	.10408	8	
.70	.37037	.07037	7	.8	.95	.20202	.15202	35.4	
.75	.36363	.11363	14.1	.8	5.00	.20000	.20000	36.0	
.80	.35714	.15714	4	8	.05	.19801	24801	6	
.85	.35087	20087	8	8	.10	.19607	.29607	37.2	
.90	.34482	.24482	15.2	8	.15	.19417	.34417	8	
.95	.33898	28898	6	8	.20	.19230	.39230	38.4	
3.00	.33333	.33333	16.0	8	.25	.19047	.44047	39.1	
.05	.32786	.37786	.4	7	.30	.18867	.48867	7	
.10	.32258	.42258	8	7	.35	.18691	.53691	40.3	
.15	.31746	.46746	17.2	7	.40	.18518	.58518	41.0	
.20	.31250	.51250	6	7	.45	.18348	.63348	.6	

FACTORS FOR COMPUTING GRADUATION OF COPYING CAMERA AND COMPARATIVE EXPOSURES.

Reduction or Enlargement	Lens Carriage	Plate Carriage	Comparative Exposures.		Reduction or Enlargement	Lens Carriage	Plate Carriage	Comparative Exposures.	
			Enlarging	Reducing				Enlarging	Reducing
n	$1+\frac{1}{n}$	$2+n+\frac{1}{n}$	$(1+n)^2$	$(1+\frac{1}{n})^2$	n	$1+\frac{1}{n}$	$2+n+\frac{1}{n}$	$(1+n)^2$	$(1+\frac{1}{n})^2$
5.50	1.18181	7.68181	42.2	1.4	7.75	1.12903	9.87903	76.	1.2
.55	.18018	.73018	.9		.80	.12820	.92820	77.	
.60	.17857	.77857	43.6		.85	.12738	.97738	78.	
.65	.17699	.82699	44.2		.90	.12658	10.02658	79.	
.70	.17543	.87543	.9		.95	.12578	.07578	80.	
.75	.17391	.92391	45.6		8.00	.12500	.12500	81.	
.80	.17241	.97241	46.2		.05	.12422	.17422	81.	
.85	.17094	8.02094	.9		.10	.12345	.22345	82.	
.90	.16949	.06949	47.6	1.3	.15	.12269	.27269	83.	
.95	.16806	.11806	48.3		.20	.12195	.32195	84.	
6.00	.16666	.16666	49.0		.25	.12121	.37121	85.	
.05	.16528	.21528	.7		.30	.12048	.42048	86.	
.10	.16393	.26393	50.4		.35	.11976	.46976	87	
.15	.16260	.31260	51.1		.40	.11904	.51904	88.	
.20	.16129	.36129	.8		.45	.11834	.56834	89.	
.25	.16000	.41000	52.6		.50	.11764	.61764	90.	
.30	.15873	.45873	53.3		.55	.11695	.66695	91.	
.35	.15748	.50748	54.0		.60	.11627	.71627	92.	
.40	.15625	.55625	.8		.65	.11560	.76560	93	
.45	.15503	.60503	55.5		.70	.11494	.81494	94	
.50	.15384	.65384	56.2		.75	.11428	.86428	95.	
.55	.15267	.70267	57.0		.80	.11363	.91363	96	
.60	.15151	.75151	.8		.85	.11299	.96299	97	
.65	.15037	.80037	58.5		.90	.11235	11.01235	98	
.70	.14925	.81925	59.3		.95	.11173	.06173	99	
.75	.14814	.89814	60.1		9.00	.11111	.11111	100	
.80	.14705	.94705	.8		.05	.11049	.16019	101.	
.85	.14598	.99598	61.6		.10	.10989	.20989	102.	
.90	.14492	9.04492	62.4		.15	.10928	.25928	103.	
.95	.14388	.09388	63.2		.20	.10869	.30869	104.	
7.00	.14285	.14285	64.0		.25	.10810	.35810	105.	
.05	.14184	.19184	.8		.30	.10752	.40752	106.	
.10	.14084	.21084	65.6		.35	.10695	.45695	107.	
.15	.13986	.28986	66.4		.40	.10638	.50638	108.	
.20	.13888	.33888	67.2		.45	.10582	.55582	109.	
.25	.13793	.38973	68.1		.50	.10526	.60526	110.	
.30	.13698	.43698	.9		.55	.10471	.65471	111.	
.35	.13605	.48605	69.7		.60	.10416	.70416	112.	
.40	.13513	.53513	70.6		.65	.10362	.75362	113.	
.45	.13422	.58422	71.4		.70	.10309	.80309	114.	
.50	.13333	.63333	72.2		.75	.10256	.85256	115.	
.55	.13245	.68245	73.1		.80	.10204	.90204	117.	
.60	.13157	.73157	74.0		.85	.10152	.95152	118.	
.65	.13071	.78071	.8		.90	.10101	12.00101	119.	
.70	.12987	.82987	75.7	1.2	.95	.10050	.05050	120.	