THE

NATIONAL PHYSICAL LABORATORY.

REPORT OF THE OBSERVATORY DEPARTMENT,

RICHMOND, SURREY,

AND OF

THE OBSERVATORY, ESKDALEMUIR,

LANGHOLM, DUMFRIESSHIRE,

FOR THE YEAR 1909.

WITH APPENDICES.

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THE NATIONAL PHYSICAL LABORATORY.

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Student Assistant—J. S. Dines, B.A.
Boy Clerks—W. R. Corrin, Jun., G. H. Harris, R. R. Strand, J. G. Durham, F. Levin.
Caretaker, &c.—W. R. Corrin, Sen., with wife as housekeeper.

THE OBSERVATORY, ESKDALEMUIR,

LANGHOLM, DUMFRIESSHIRE.

Superintendent—G. W. Walker, M.A., A.R.C.Sc.
Observer—A. E. Gendle.
Computer—W. C. Parkinson.
Mechanic and Caretaker—M. Black, with wife as housekeeper.
Assistant to Mechanic—R. Laidlaw.

REPORT ON THE OBSERVATORY DEPARTMENT FOR THE YEAR ENDING DECEMBER 31, 1909, MADE BY THE SUPERINTENDENT TO THE DIRECTOR.

The work at the Kew Observatory in the Old Deer Park at Richmond, now forming the Observatory Department of the National Physical Laboratory, has been continued during the year 1909 as in the past.

This work may be considered under the following heads :—

I. Magnetic observations.
II. Meteorological observations.
III. Seismological observations.
IV. Experiments and Researches in connection with any of the departments.
V. Verification of instruments.
VI. Rating of Watches and Chronometers.
VII. Miscellaneous.

I. Magnetic Observations.

The magnetographs have been in constant operation throughout the year, and the usual scale value determinations were made in February.

The ordinates of the photographic curves representing Declination and Horizontal Force were then found to be as follows :—

Declinometer : 1 cm. $= 0^\circ\ 8'{\cdot}7$.
Bifilar, for 1 cm. $\delta H = 0{\cdot}00051$ C.G.S. unit.

In January the instruments were generally examined and cleaned and the clock attended to.

The principal magnetic disturbances recorded took place on the following dates, viz. :—January 3, 30-31 ; March 19, 28-29 ; May 14, 18 ; September 25, 30 ; and October 19.

The most remarkable disturbance of the year was that which commenced suddenly at about 11.43 a.m. on September 25. During the next 9 hours there was an almost uninterrupted succession of large oscillatory movements in the magnetic curves, especially those of declination and horizontal force. The storm was of comparatively short duration, no movements of any great size being recorded after 8 p.m. on September 25, and by 1 a.m. on September 26 little trace of disturbance was left. When the storm was at its height, the oscillatory movements were so rapid that the record left on the photographic paper was frequently too faint to show minute details, and the limits of registration were exceeded. An account of this storm was given in "Nature," September 30.

The hourly means and diurnal inequalities of the Declination and Horizontal Force for 1909 for the quiet days selected by the Astronomer Royal have been tabulated as usual, and the results will be found in Appendix I, (pp. 13-18), together with the monthly means of the Inclination as derived from the absolute observations. Owing, however, to the disturbance of the vertical force produced by electric trams, it has been found impossible to tabulate the curves for this element satisfactorily. This has led to the omission of the tables of diurnal inequalities of vertical force and inclination published previous to 1902.

A correction has been applied to the horizontal force curves for the diurnal variation of temperature, use being made of the records from a Richard thermograph as well as of the eye observations of a thermometer.

The mean values at the noons preceding and succeeding the selected quiet days are also given, but these of course are not employed in calculating the daily means or inequalities.

The following were the mean results for 1909 :—

From curves	Mean Westerly Declination......	16° 10′·8 W.
	Mean Horizontal Force	0·18506 C.G.S. unit.
From absolute observations, corrected	Mean Inclination	66° 59′·7 N.
	Mean Vertical Force...............	0·43588 C.G.S. unit.

The absolute observations have been reduced to the mean value for the day by applying corrections based on the diurnal variation observed in previous years.

Observations of absolute declination, horizontal intensity, and inclination have been made weekly as a rule.

A table of recent values of the magnetic elements at the Observatories whose publications are received at Kew will be found in Appendix IA (pp. 19, 20).

At the request of the Hydrographer a course of Magnetic Instruction has been given to Lieutenant C. W. Tinson, R.N.

On the application of Captain Power, R.N., of the Navigation School, H.M. Dockyard, Portsmouth, permission was given for parties of young naval officers to visit the Observatory on May 27, 28, and November 11 and 12.

At the request of Mr. Davis, Director of the Argentine Meteorological Office, facilities were given to Dr. Schultz for comparing his magnetometer with the Kew magnetic instruments. Observations were taken at intervals between November 8 and 23.

In July, Dr. W. S. Bruce, Director of the Scottish Oceanographical Laboratory, Edinburgh, applied for the loan of a dip circle for an Arctic expedition. Barrow circle No. 23 and 1 pair of needles and bar magnets were lent to him. These were safely returned on December 29.

Throughout the year in the determinations of the horizontal force, deflections have been made at three distances, 22·5, 30 and 40 cms. The intention expressed in last year's Report was to treat this as the standard method for the year 1909, in place of the previous practice of confining observations to two distances. It has, however, appeared desirable before introducing the change, to have a satisfactory redetermination of the moment of inertia of the collimating magnet, and as it has been found impossible to complete this during the current year, it has been decided in the present Report to give results based as heretofore on the two deflection distances, 30 and 40 cms. only.

II. Meteorological Observations.

The several self-recording instruments for the continuous registration of Atmospheric Pressure, Temperature of Air and Wet-bulb, Wind (direction, pressure and velocity), Bright Sunshine and Rain have been maintained in regular operation throughout the year, and the standard eye observations for the control of the automatic records have been duly registered.

The tabulations of the meteorological traces have been regularly made, and these, as well as copies of the eye observations, with notes of weather, cloud, and sunshine, have been transmitted, as usual, to the Meteorological Office.

With the sanction of the Meteorological Office, data have been supplied to the Institute of Mining Engineers, and the editor of "Symons Monthly Meteorological Magazine."

Regular cloud observations have also been made with the Fineman nephescope on 39 days, in connection with the International scheme of balloon ascents, the results being transmitted through the Meteorological Office.

The usual meteorological tables will be found in Appendix II (pp. 21-28).

Solar Radiation. — The observations begun in 1907 with the Ångström Pyrheliometer have been regularly carried out. On bright days observations are made between 11.30 a.m. and 0.30 p.m.

A summary of the results will be found in Appendix II, Table IV. (p. 24).

Earth Thermometers.—The two Symons' earth-thermometers on the lawn, one at a depth of 1 foot and the other at a depth of 4 feet, have been read at 10 a.m., 4 p.m., and 10 p.m. daily throughout the year, and the 10 a.m. readings have been forwarded weekly to the Meteorological Office, together with the corresponding readings of the Solar Radiation and Terrestrial Radiation thermometers. A summary of the results appears in Appendix II, Table V. (p. 25).

Electrograph.—This instrument worked generally in a satisfactory manner during the year.

The Leclanché battery was overhauled and replenished on July 27, and has proved satisfactory in use, the potential, which is measured thrice weekly by a Paul "moving coil" galvanometer, keeping steady at about 43 volts. Check determinations of the scale value of the Electrograph were made on March 12, September 12 and December 17, and showed that no appreciable change had taken place.

The portable Electrometer White No. 53, which is regularly used for taking eye observations of atmospheric electricity at the fixed station on the lawn, had its scale value altered through an accident on June 25 from 290 to 250 volts for one complete turn of the lifting-screw. Determinations of its scale value were made in the Physics Department at Teddington on February 5, July 19, October 7 and December 1.

Use was also made of portable electrometers Nos. 80 and 81 for subsidary observations.

A series of curves—ten a month—have been selected as representative of the variations of potential on electrically "quiet" days, defined as days when irregular fluctuations of potential are fewer than usual. These curves have been tabulated and the results appear, with the permission of the Meteorological Office, in Appendix II, Tables VI. and VII. (pp. 26, 27). Owing presumably in large measure to the fewness of the selected days, the values deduced from the actual curve measurements show in some months a considerable non-cyclic element. This element has been eliminated from the diurnal inequality in Table VII in the way customary in dealing with meteorological data.

Observations on the rate of loss of electric charge have been taken throughout the year with an Elster and Geitel "Dissipation Apparatus." The observations were made in a systematic way between the hours of 2 and 4 p.m., except on days when rain was falling or the wind was high. An abstract of the results appears in Appendix II, Table VIII (p. 28). As usual a_+ and a_- denote the percentage losses per minute of positive and negative charges respectively.

Inspections.—In compliance with the request of the Meteorological Office, the following Observatories and Anemograph Stations have been visited and inspected:—Stonyhurst, Fleetwood, Plymouth, Falmouth, Scilly Isles and Radcliffe Observatory (Oxford), by Mr. Baker; and Deerness (Orkney), Aberdeen, Glasgow, Alnwick Castle, North Shields, Yarmouth, Geldeston and Shoeburyness, by Mr. Constable.

III. Seismological Observations.

Professor Milne's "unfelt tremor" pattern of seismograph has been maintained in regular operation throughout the year; particulars of the time of occurrence and the amplitude in millimetres of the largest movements are given in Appendix III, Table I (p. 29). The largest disturbances recorded took place on January 23, July 30 and October 20-21.

A detailed list of the movements recorded from January 1 to December 31, 1909, has been made and sent to Professor Milne, and will be found in the circulars for 1909 of the British Association "Seismological Investigations" Committee.

On the initiative of Prof. J. Milne, F.R.S., a number of very minute movements which would have been neglected in previous years have been counted as earthquakes on the strength of their coincidence in time with similar movements at Shide and elsewhere. This has led to a large *apparent* increase in the total number of earthquakes recorded during the year. None of these small movements, however, appears in Appendix III, Table I (p. 29), which is thus strictly comparable with the analogous tables published in previous Reports.

IV. Experimental Work.

Fog and Mist.—The observations of a series of distant objects, referred to in previous Reports, have been continued. A note is taken of the most distant of the selected objects which is visible at each observation hour.

Atmospheric Electricity.—The comparisons of the potential, at the point where the jet from the water-dropper breaks up, and at a fixed station on the Observatory lawn, referred to in previous Reports, have been continued, and the observations have been taken every day when possible, excluding Sundays and wet days. The ratios of the "curve" and the "fixed station" readings have been computed for each observation. Besides checking the action of the self-recording electrometer, these serve to reduce the curve readings.

The method hitherto in use for taking absolute readings of the potential gradient is fairly satisfactory as a check on the working of the electrograph. The results are, however, affected by the proximity of the instrument and observer, and the site, though the best available within a convenient distance of the Observatory, is not wholly ideal. Experiments have been carried out during the year by the Superintendent with the active assistance of Mr. E. G. Constable and Mr. J. S. Dines—in continuation of experiments made some years ago, which had to be suspended through lack of time—with a view to eliminating so far as possible disturbing effects due to the observer and apparatus. These effects have proved to be larger than had been supposed. They affect of course only absolute values of the potential gradient, and not the type of the diurnal or annual inequalities. It is hoped with the commencement of 1910 to introduce an improved method of observing. The site has also been improved by removing some fruit trees, which according to a rough calculation might have reduced the potential gradient very slightly.

During the latter part of the year Mr. J. S. Dines has taken a number of observations with Mr. C. T. R. Wilson's apparatus for determining the vertical current and the charge on unit surface, from which the potential gradient can be calculated. These observations have been taken in part synchronously with the ordinary absolute determinations of the potential gradient and with the "dissipation" observations made with Elster & Geitel's apparatus. Some interesting results have thus been obtained as to the relationships of the different methods and instruments.

Radio-Integrators.—At the request of Mr. J. J. Hicks, radio-integrators of the late Dr. W. E. Wilson's pattern, but containing liquids other than alcohol, were compared over a considerable time with the original alcohol radio-integrators, readings with which have continued throughout the year.

Pressure Tube Comparisons.—The experiments referred to in last year's Report have been continued by Mr. J. S. Dines, and it is hoped that they will soon be completed. A good many comparisons of pressure tube and Robinson anemometer records during short intervals have also been made in connection with the testing of a new type of cup anemometer.

Hygrometrical Observations.—Mr. J. S. Dines' observations with hygrometers in closed rooms have been continued, and he has also made a comparison between the results obtained from Assmann's ventilated instrument out of doors and those given by the thermograph in the screen. It is hoped to publish an account of these investigations ere long.

V. Verification of Instruments, exclusive of Watches and Chronometers.

The subjoined is a list of the instruments—exclusive of watches and chronometers—examined in the year 1909, compared with a corresponding return for 1908.

	Number tested in the year ending December 31.	
	1908.	1909.
Air-meters	13	20
Anemometers	13	18
Aneroids	86	174
Artificial horizons	7	11
Barometers, Marine	53	85
,, Standard	113	110
,, Station	59	34

Binoculars	1,238	2,292
Compasses	30	20
Hydrometers	613	728
Inclinometers	6	11
Levels	13	10
Magnetographs	1	—
Magnets	3	1
Rain Gauges	11	6
Rain-measuring Glasses	37	8
Sextants	1,154	1,281
Sunshine Recorders	—	1
Telescopes	3,177	5,288
Theodolites	27	27
Thermometers, Clinical	18,752	25,861
,, Deep sea	5	50
,, *High Range	2	—
,, Hypsometric	42	27
,, Low Range	112	114
,, Meteorological	4,719	4,968
,, Solar radiation	—	2
,, Standard	70	125
,, Other Forms	13	29
Unifilars	2	4
Miscellaneous	20	13
Total	30,391	41,318

Duplicate copies of corrections have been supplied in 95 cases.

The number of instruments rejected in 1908 and 1909 on account of excessive error, or for other reasons, was as follows :—

	1908.	1909.
Thermometers, clinical	82	74
,, ordinary meteorological	50	135
Sextants	175	207
Telescopes	164	132
Binoculars	242	65
Various	121	198

There were at the end of the year at the Observatory undergoing verification, 2 barometers, 461 thermometers, 5 hydrometers, 29 sextants, 313 telescopes, 326 binoculars, 1 dip circle, 13 various.

VI. Rating of Watches and Chronometers.

The number of watches sent for trial this year shows a considerable increase, the total being 380, as compared with 252 in 1908 and 246 in 1907.

The number of entries for each class of test, and the results of the examination were as follows —

* The testing of high range thermometers has been transferred to Teddington.

Entries.		Results of trial.	
		Received Certificates.	Failed.
Class A	253	201	52
Class B	70	55	15
Subsidiary trial	57	43	14

The marked improvement in performance to which attention was drawn in last year's Report has been maintained, and 110 movements have obtained the distinction of "especially good."

The following figures show the percentage number of watches obtaining the distinction "especially good," as compared to the total number obtaining class A certificates :—

Year	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.
	35·4	35·5	31·6	42·4	50·2	44·7	47·5	43·0	56·8	54·7

The number of watches obtaining 90 marks and upwards, has shown another considerable increase, the total being 25, as compared with 15 last year.

In Appendix IV (pp. 30-32) will be found a table giving the results of trial of the 50 watches which gained the highest number of marks during the year. The first place was taken by the keyless double-roller going-barrel Bar-lever watch No. 344762, sent by Messrs. Vacheron & Constantin, Geneva, which obtained the high total of 94·5 marks.

Marine Chronometers.—These also show an increase, the entries being 108, as compared with 82 last year. Of these, 82 obtained certificates and 26 failed. The percentage of failures, 24, is slightly above the average value.

VII. Miscellaneous.

Commissions.—The following accessories have been procured, examined, and forwarded to the institutions on whose behalf they were purchased :—

Paper.—Prepared photographic paper has been supplied to the Observatories at Hong Kong, Oxford (Radcliffe), and through the Meteorological Office to Aberdeen and Valencia, and in quarterly instalments to the India Office, for use in Indian Observatories.

Sunshine cards and anemograph sheets have been sent to Hong Kong and metallic sheets to St. Petersburg.

Thermometers.—Six standard thermometers have been made for the Australian Commonwealth Meteorological Service.

Test for Policemen's Chronograph Watches.—At the request of the Metropolitan Police a special scheme for the testing of the chronograph watches used in timing motor cars has been prepared and submitted for the consideration of the Police Authorities.

National Antarctic Expedition.—The discussion of the magnetic curves brought back by the National Antarctic Expedition of 1902-4, and of the synchronous observations taken at the co-operating stations, on which the Superintendent has been engaged during the last two years, has been completed, and has appeared in the volume of "Magnetic Observations" recently published by the Royal Society.

By permission of the Royal Society, an account of some of the phenomena was also included in the presidential address given by the Superintendent, in February, to the Physical Society.

Magnetic Disturbances at Kew.—A paper dealing with some of the phenomena of the magnetic disturbances recorded at Kew from 1890 to 1900 has been prepared by the Superintendent and communicated to the Royal Society.

List of Instruments, Apparatus, &c., the Property of the National Physical Laboratory Committee, at the present date out of the custody of the Director, on Loan.

To whom lent.	Articles.	Date of loan.
The Science and Art Department, South Kensington.	Articles specified in the list in the Annal Report for 183	1876
Lord Rayleigh, F.R.S.	Standard Barometer (Adie, No. 655).........	1885
New Zealand Government.	Dip Circle, by Barrow, with one pair of Needles and Bar Magnets.....................	1899
	Tripod Stand	1899
Sir E. Shackleton	Unifilar Magnetometer, by Jones, marked N.A.B.C.	1907

Library.—During the year the Library has received publications from :—

18 Scientific Societies and Institutions of Great Britain and Ireland,

125 Foreign and Colonial Scientific Establishments,

as well as from several private individuals.

The card catalogue has been proceeded with.

CHARLES CHREE,

Superintendent.

APPENDICES TO THE REPORT OF THE SUPERINTENDENT OF THE OBSERVATORY DEPARTMENT.

APPENDIX I. MAGNETIC OBSERVATIONS, 1909, KEW OBSERVATORY.

Latitude 51° 28′ 6″ N., and Longitude 0^{h} 1^{m} $15^{s}.1$ W.

The results in the following Tables I to IV are deduced from the magnetograph curves, which have been standardised by observations of Declination and Horizontal Force. The observations were made with the Collimator Magnet K.C.I. and the Declinometer Magnet K. O. 90 in the 9-inch Unifilar Magnetometer, by Jones.

Inclination observations were also taken with the Inclinometer No. 33, by Barrow with needles 3½ inches in length. Table V gives the monthly means of these observations as actually taken, and also as corrected to the mean of the day from previous years' results. It also gives monthly values of the Vertical Force, calculated from the corrected values of the Inclination and the mean monthly values of the Horizontal Force.

The values of Inclination and Vertical Force are a little influenced by electric tram currents, which produce apparently a slightly enhanced value of Vertical Force throughout the day. The Declination and Horizontal Force inequalities are not absolutely above suspicion in this respect, but any uncertainty that may exist in their case is undoubtedly small.

The Declination and Horizontal Force values given in Tables I to IV are prepared in accordance with the suggestions made in the fifth report of the Committee of the British Association on comparing and reducing Magnetic Observations.

The following is a list of the days during the year 1909 which were selected by the Astronomer Royal, as suitable for the determination of the magnetic diurnal inequalities, and which have been employed in the preparation of the magnetic tables :—

January	6, 9, 17, 22, 23.
February..................	5, 11, 15, 18, 19.
March	7, 11, 12, 16, 24.
April	7, 8, 15, 21, 22.
May........................	3, 5, 9, 24, 29.
June	4, 8, 12, 19, 27.
July........................	6, 7, 10, 20, 25.
August.....................	5, 6, 16, 17, 21.
September	12, 13, 17, 18, 19.
October	5, 13, 16, 17, 28.
November	4, 5, 12, 25, 28.
December	5, 7, 8, 11, 28.

Table I.—Hourly Means of the Kew Declination as determined from the selected

Hours	Preceding noon.	Midt.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
	(16° + West.)						Winter.						
1909. Months	′	′	′	′	′	′	′	′	′	′	′	′	′
Jan. ...	15·6	12·8	13·1	13·4	13·5	13·4	13·5	13·2	13·2	12·7	12·6	13·2	14·3
Feb. ...	17·0	13·7	13·9	13·4	13·6	13·7	13·5	13·1	13·4	13·3	14·0	14·5	14·9
Mar. ...	16·7	11·4	11·6	11·6	11·4	11·6	12·1	11·4	11·6	10·3	10·8	11·8	13·8
Oct. ...	13·7	8·3	8·3	8·5	8·6	8·4	8·4	7·7	7·0	6·1	6·4	7·9	11·2
Nov. ...	12·0	8·2	8·4	8·1	8·2	8·3	8·4	8·1	7·6	7·5	7·5	8·4	10·1
Dec. ...	9·9	6·7	6·9	6·7	6·6	6·8	7·0	6·7	6·4	6·2	5·8	6·3	7·6
Means	14·1	10·2	10·4	10·3	10·3	10·4	10·5	10·0	9·9	9·3	9·5	10·4	12·0
							Summer.						
	′	′	′	′	′	′	′	′	′	′	′	′	′
April ...	16·2	11·1	11·3	11·3	11·4	11·2	11·6	10·3	9·2	7·5	7·3	9·4	12·8
May ...	15·7	10·0	9·8	9·7	9·9	9·6	8·9	7·6	6·8	6·1	6·6	8·9	12·2
June ...	14·2	9·7	9·7	9·7	9·5	8·9	8·1	6·9	6·9	6·8	8·2	9·6	12·2
July ...	13·3	9·0	9·1	9·0	9·2	8·9	8·3	7·5	7·1	6·5	7·2	7·8	10·5
Aug. ...	15·2	8·6	8·4	8·0	8·1	8·0	7·0	6·2	5·8	5·8	7·3	9·6	12·2
Sept....	13·7	8·3	8·1	8·3	8·4	8·3	8·3	8·0	7·5	6·6	6·8	7·7	9·7
Means	14·7	9·5	9·4	9·3	9·4	9·1	8·7	7·8	7·2	6·5	7·2	8·8	11·6

Table II.—Diurnal Inequality of the

Hours	Midt.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
						Summer Means.						
	′ −1·2	′ −1·2	′ −1·3	′ −1·2	′ −1·5	′ −1·9	′ −2·9	′ −3·4	′ −4·1	′ −3·4	′ −1·8	′ +1·0
						Winter Means.						
	′ −0·8	′ −0·6	′ −0·7	′ −0·6	′ −0·6	′ −0·5	′ −0·9	′ −1·1	′ −1·6	′ −1·4	′ −0·6	′ +1·0
						Annual Means.						
	′ −1·0	′ −0·9	′ −1·0	′ −0·9	′ −1·0	′ −1·2	′ −1·9	′ −2·3	′ −2·9	′ −2·4	′ −1·2	′ +1·0

NOTE.—When the sign is + the magnet
,, ,, − ,,

Quiet Days in 1909. Mean for the Year = 16° 10′·8 West.

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Midt.	Succeeding noon.
Winter.													
′	′	′	′	′	′	′	′	′	′	′	′	′	′
15·5	16·2	15·9	15·1	14·4	14·2	13·9	13·7	13·6	13·2	12·8	12·7	12·2	15·4
15·5	15·8	15·5	14·9	14·3	14·5	14·3	14·1	13·4	13·5	13·2	13·2	12·9	15·3
16·2	17·4	17·4	16·4	14·7	13·7	13·2	12·8	12·3	12·1	11·5	11·5	10·8	16·6
13·2	13·8	13·4	12·2	10·8	9·9	9·3	8·6	8·2	7·9	7·9	7·8	7·7	13·9
11·2	11·8	11·5	11·1	10·3	9·9	8·9	8·6	8·2	7·9	7·7	7·8	7·9	10·6
8·7	9·4	9·0	8·4	7·8	7·5	7·2	6·7	6·6	6·5	6·0	6·0	6·1	7·7
13·4	14·1	13·8	13·0	12·0	11·6	11·1	10·8	10·4	10·2	9·8	9·8	9·6	13·2
Summer.													
′	′	′	′	′	′	′	′	′	′	′	′	′	′
16·6	19·4	19·3	17·6	15·5	13·8	12·7	12·6	12·1	12·2	12·0	12·1	11·4	18·2
14·9	15·6	15·6	14·4	13·7	12·6	11·8	11·4	11·2	11·0	10·8	10·4	9·9	15·2
14·3	14·9	15·0	14·4	13·6	12·7	11·9	11·7	11·5	10·9	10·9	10·6	10·1	13·2
13·0	14·8	15·5	15·1	13·9	12·8	11·5	11·1	10·7	10·6	10·0	9·5	9·1	11·9
15·1	16·1	15·3	14·3	12·3	11·3	10·3	10·1	10·1	10·0	9·7	9·2	9·0	15·8
12·5	13·5	13·5	13·0	11·8	10·8	9·9	9·7	9·0	8·9	8·6	8·2	8·0	12·7
14·4	15·7	15·7	14·8	13·5	12·3	11·3	11·1	10·8	10·6	10·3	10·0	9·6	14·5

Kew Declination as derived from Table I.

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Midt.
Summer Means.												
′ +3·8	′ +5·1	′ +5·1	′ +4·2	′ +2·8	′ +1·7	′ +0·7	′ +0·5	′ +0·1	′ 0·0	′ −0·3	′ −0·6	′ −1·1
Winter Means.												
′ +2·4	′ +3·1	′ +2·8	′ +2·1	′ +1·1	′ +0·7	′ +0·2	′ −0·2	′ −0·6	′ −0·8	′ −1·1	′ −1·1	′ −1·3
Annual Means.												
′ +3·1	′ +4·1	′ +4·0	′ +3·1	′ +2·0	′ +1·2	′ +0·5	′ +0·1	′ −0·2	′ −0·4	′ −0·7	′ −0·9	′ −1·2

points to the West of its mean position.
,, ,, East ,, ,,

Table III.—Hourly Means of the Kew Horizontal Force in C.G.S. Units in 1909. (Mean for the

Hours	Preceding Noon.	Mid^{t}.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
	·18000+					Winter.							
1909. Months.													
Jan.	490	504	501	499	500	502	507	509	510	507	501	501	499
Feb.	499	505	504	502	500	501	504	506	508	507	506	506	505
March ...	491	511	508	505	507	507	510	513	513	510	499	497	494
Oct.	468	491	489	482	484	484	487	489	486	477	468	463	465
Nov.	489	500	498	494	495	496	499	502	502	500	496	493	491
Dec.	497	504	502	499	498	500	502	505	505	505	504	500	500
Means ...	489	503	500	497	497	498	502	504	504	501	496	493	492
						Summer.							
April	488	513	511	507	508	506	510	513	515	512	498	488	485
May	505	517	512	508	507	508	509	509	506	501	496	493	494
June	489	515	515	508	509	508	508	506	502	493	486	486	494
July	493	521	518	515	515	518	518	517	515	509	505	500	498
Aug.	492	517	517	511	510	510	509	504	498	490	484	483	485
Sept.	503	517	515	512	512	512	514	513	511	502	494	490	491
Means ...	495	517	515	510	510	510	511	510	508	501	494	490	491

Table IV.—Diurnal Inequality of the Kew

Hours.	Mid^{t}.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
						Summer Means.						
	+·00005	+·00003	−·00002	−·00002	−·00001	·00000	−·00001	−·00004	−·00010	−·00018	−·00022	−·00020
						Winter Means.						
	+·00002	·00000	−·00004	−·00003	−·00002	+·00001	+·00003	+·00003	·00000	−·00005	−·00007	−·00008
						Annual Means.						
	+·00003	+·00001	−·00003	−·00002	−·00002	00000	+·00001	·00000	−·00005	−·00011	−·00015	−·00014

Note.—When the sign is + the

(Corrected for Temperature) as determined from the Selected Quiet Days Year = ·18506).

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Mid^{t}.	Succeeding Noon.
Winter.													
499	501	505	508	507	508	510	510	510	510	509	510	507	503
506	508	508	507	504	506	509	510	509	508	507	506	507	517
495	496	503	506	509	513	514	514	512	510	509	510	508	494
469	475	481	485	484	484	485	487	486	486	487	489	489	469
492	493	495	496	499	503	504	507	506	504	504	503	503	496
503	506	508	508	509	511	511	510	510	507	505	504	504	503
494	497	500	502	502	504	506	506	506	504	504	504	503	497
Summer.													
490	498	506	512	516	521	520	519	520	520	519	519	517	491
498	501	507	510	516	520	528	526	527	523	523	520	518	500
500	505	511	515	515	518	523	528	528	524	522	520	518	500
503	506	511	519	525	532	536	535	540	533	532	533	531	505
497	505	512	516	521	520	521	522	525	523	522	520	520	492
501	508	509	512	515	518	519	523	521	520	519	521	519	504
498	504	509	514	518	522	525	526	527	524	523	522	521	499

Horizontal Force as derived from Table III.

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Mid^{t}.
Summer Means.												
−·00013	−·00008	−·00002	+·00002	+·00006	+·00010	+·00013	+·00014	+·00015	+·00012	+·00011	+·00011	+·00009
Winter Means.												
−·00007	−·00004	−·00001	+·00001	+·00001	+·00004	+·00005	+·00006	+·00005	+·00004	+·00003	+·00003	+·00002
Annual Means.												
−·00010	−·00006	−·00001	+·00002	+·00004	+·00007	+·00009	+·00010	+·00010	+·00008	+·00007	+·00007	+·00006

reading is above the mean.

Table V.—Mean Monthly Values of Kew Inclination and Vertical Force during the Year 1909.

1909.	Mean time of Observation. p.m.	Inclination Observed.	Inclination reduced to the mean value for the day.	Vertical force (mean value for the day.)
	h. m.	° ′	° ′	
January	2 50	67 0·2	67 0·0	·43596
February	2 47	67 0·1	67 0·0	·43597
March	2 54	67 0·3	67 0·2	·43607
April	2 53	67 0·3	67 0·3	·43617
May	3 34	66 59·9	67 0·2	·43615
June	3 18	66 59·6	66 59·9	·43604
July	3 22	66 58·9	66 59·2	·43601
August	3 53	66 58·5	66 58·7	·43559
September	3 38	66 59·1	66 59·2	·43583
October	3 20	67 0·2	67 0·1	·43542
November	3 4	67 0·1	66 59·9	·43576
December	2 13	66 59·3	66 59·1	·43563
Mean for year	...	...	66° 59′·7	·43588

APPENDIX Ia.

Mean Values, for the years specified, of the Magnetic Elements at Observatories whose Publications are received at the National Physical Laboratory.

Place.	Latitude.	Longitude.	Year.	Declination.	Inclination.	Horizontal Force, C.G.S. Units.	Vertical Force, C.G.S. Units.
	° ′	° ′		° ′	° ′		
Pawlowsk.........	59 41 N.	30 29 E.	1906	1 4·2 E.	70 36·6 N.	·16528	·46963
Sitka (Alaska)...	57 3 N.	135 20 W.	1906	30 3·3 E.	74 41·7 N.	·15502	·56646
Katharinenburg	56 49 N.	60 38 E.	1906	10 31·0 E.	70 49·5 N.	·17664	·50796
Rude Skov	55 51 N.	12 27 E.	1908	9 43·3 W.	68 45 N.	·17406	·44759
Eskdalemuir ...	55 19 N.	3 12 W.	1909	18 30·1 W.	69 38·9 N.	·16835	·45385
Flensburg	54 47 N.	9 26 E.	1903	11 28·0 W.	68 12·5 N.	—	—
Barth	54 22 N.	12 45 E.	1903	9 52·9 W.	67 37·6 N.	·18261	·44363
Stonyhurst	53 51 N.	2 28 W.	1908	17 35·6 W.	68 44·2 N.	·17434	·44801
			1909	17 28·6 W.	68 42·8 N.	·17424	·44722
Hamburg	53 33 N.	9 59 E.	1903	11 10·2 W.	67 23·5 N.	·18126	·43527
Wilhelmshaven	53 32 N.	8 9 E.	1907	11 59·4 W.	—	·18215	—
			1908	11 54·1 W.	67 31 N.	·18171	·43905
			1909	11 46·8 W.	67 30 N.	·18129	·43767
Potsdam	52 23 N.	13 4 E.	1907	9 24·0 W.	66 19·0 N.	·18866	·43010
			1908	9 18·4 W.	66 19·1 N.	·18853	·42988
			1909	9 10·6 W.	66 20·0 N.	·18834	·42971
Seddin	52 17 N.	13 1 E.	1908	9 19·9 W.	66 16·1 N.	·18891	·42975
			1909	9 12·1 W.	66 17·0 N.	·18872	·42958
Irkutsk...........	52 16 N.	104 16 E.	1905	1 58·1 E.	70 25·0 N.	·20011	·56250
de Bilt (Utrecht)	52 5 N.	5 11 E.	1907	13 19·0 W.	66 49·9 N.	·18559	·43366
Valencia (Ireland)	51 56 N.	10 15 W.	1909	20 50·3 W.	68 15·1 N.	·17877	·44812
Kew	51 28 N	0 19 W.	1909	16 10·8 W.	66 59·7 N.	·18506	·43588
Greenwich	51 28 N.	0 0	1908	15 53·5 W.	66 56·3 N.	·18528	·43518
Uccle (Brussels)	50 48 N.	4 21 E.	1908	13 36·7 W.	66 1·6 N.	·19061	·42867
Falmouth.........	50 9 N.	5 5 W.	1909	17 48·4 W.	66 30·6 N.	·18802	·43266
Prague	50 5 N.	14 25 E.	1908	8 20·9 W.	—	—	—
Cracow	50 4 N.	19 58 E.	1908	5 44·6 W.	—	—	—
			1909	5 35·1 W.	64 18 N.	—	—
St. Helier (Jersey)	49 12 N.	2 5 W.	1907	16 27·4 W.	65 34·5 N.	—	—
Val Joyeux (near Paris)	48 49 N.	2 1 E.	1907	14 45·9 W.	64 46·5 N.	·19740	·41900
			1908	14 39·6 W.	64 44·6 N.	·19735	·41831
			1909	14 32·9 W.	64 43·9 N.	·19727	·41792
Munich............	48 9 N.	11 37 E.	1906	9 59·5 W.	63 10·0 N.	·20657	·40835
O'Gyalla (Pesth)	47 53 N.	18 12 E.	1909	6 43·9 W.	—	·21094	—
Pola	44 52 N.	15 51 E.	1908	8 43·2 W.	60 6·8 N.	·22207	·38640
Agincourt (Toronto)	43 47 N.	79 16 W.	1906	5 45·3 W.	74 35·6 N.	·16397	·59502
Toulouse	43 37 N.	1 28 E.	1905	13 56·3 W.	60 49·1 N.	·22025	·39439
Perpignan	42 42 N.	2 53 E.	1907	13 4·4 W.	—	—	—
Tiflis..............	41 43 N.	44 48 E.	1905	2 41·6 E.	56 2·8 N.	·25451	·37799

APPENDIX 1A—*continued.*

Place.	Latitude.	Longitude.	Year.	Declination.	Inclination.	Horizontal Force, C.G.S. Units.	Vertical Force, C.G.S. Units.
	° ′	° ′		° ′	° ′		
Capodimonte (Naples)	40 52 N.	14 15 E.	1903	8 56·5 W.	56 17·6 N.	·24171	·36234
			1906	8 40·3 W.	56 13·5 N.	—	—
			1909	—	56 14·4 N.	—	—
Tortosa	40 49 N.	0 30 E.	1907	13 42·8 W.	58 4·8 N.	·23274	·37362
Coimbra	40 12 N.	8 25 W.	1906	16 56·5 W.	59 3·2 N.	·22924	·38232
			1907	16 51·6 W.	59 0·7 N.	·22935	·38188
			1908	16 46·2 W.	58 57·3 N.	·22946	·38120
*Mount Weather (Virginia)	39 4 N.	77 54 W.	1908	3 39·4 W.	—	—	—
Baldwin (Kansas)	38 47 N.	95 10 W.	1906	8 30·1 E.	68 45·1 N.	·21807	·56081
Cheltenham (Maryland)	38 44 N.	76 50 W.	1906	5 21·5 W.	70 26·9 N.	·20044	·56438
Athens	37 58 N.	21 23 E.	1904	5 20·2 W.	52 9·1 N.	·26275	·33691
			1905	5 18·2 W.	52 9·5 N.	·26140	·33598
			1906	5 10·4 W.	52 11·9 N.	·26099	·33604
			1907	4 59·8 W.	52 7·3 N.	·26016	·33477
			1908	4 52·9 W.	52 11·7 N.	·26197	·33613
San Fernando	36 28 N.	6 12 W.	1908	15 25·6 W.	54 48·4 N.	·24829	·35206
Zi-ka-wei	31 12 N.	121 26 E.	1906	2 32·0 W.	45 35·3 N.	·33040	·33726
Dehra Dun	30 19 N	78 3 E.	1907	2 38·3 E.	43 36·1 N.	·33324	·31736
Helwan	29 52 N.	31 21 E.	1908	2 55·7 W.	40 39·4 N.	·30033	·25793
Havana	23 8 N.	82 25 W.	1905	2 58·0 E.	52 57·4 N.	·30531	·40452
Barrackpore	22 46 N.	88 22 E.	1907	1 9·9 E.	30 30·2 N.	·37288	·21967
Hong Kong	22 18 N.	114 10 E.	1908	0 3·9 E.	31 2·5 N.	·37047	·22292
Honolulu (Hawaii)	21 19 N.	158 4 W.	1906	9 21·7 E.	40 1·8 N.	·29220	·24545
Toungoo	18 56 N.	96 27 E.	1907	0 39·3 E.	23 0·7 N.	·38754	·16461
Alibag (Bombay)	18 39 N.	72 52 E.	1908	1 2·2 E.	23 21·8 N.	·36857	·15922
Vieques (Porto Rico)	18 9 N.	65 26 W.	1906	1 33·2 W.	49 47·7 N.	·28927	·34224
Manila	14 35 N.	120 59 E.	1904	0 51·4 E.	16 0·2 N.	·38215	·10960
Kodai-Kanal	10 14 N.	77 28 E.	1907	0 40·7 W.	3 27·2 N.	·37431	·02259
Batavia	6 11 S.	106 49 E.	1906	0 54·1 E.	30 48·5 S.	·36708	·21889
Dar-es-Salaam	6 49 S.	39 18 E.	1903	7 35·2 W.	—	—	—
Mauritius	20 6 S.	57 33 E.	1908	9 14·3 W.	53 44·9 S.	·23415	·31932
Rio de Janeiro	22 55 S.	43 11 W.	1906	8 55·3 W.	13 57·1 S.	·24772	·06164
Santiago (Chile)	33 27 S.	70 42 W.	1906	14 18·7 E.	30 11·8 S.	—	—
Melbourne	37 50 S.	144 58 E.	1901	8 26·7 E.	67 25·0 S.	·23305	·56024
Christchurch (N. Z)	43 32 S.	172 37 E.	1903	16 18·4 E.	67 42·3 S.	·22657	·55259

* From first 6 months only of year.

APPENDIX II.—Table I.

Mean Monthly Results of Temperature and Pressure for Kew Observatory.

1909.

Months	Thermometer.									Barometer.*					Mean vapour pressure.
	Mean.	Means of—			Absolute Extremes.				Mean.	Absolute Extremes.					
		Max.	Min.	Max. and Min.	Max.	Date.	Min.	Date.		Max.	Date.	Min.	Date.		
	°	°	°	°	°		°		ins.	ins.		ins.			in.
January ...	38·7	42·5	34·5	38·5	50·6	15th 2 A.M.	23·9	29th 6 A.M.	30·172	30·741	4th 10 A.M.	29·072	15th 3 A.M.		·197
February ...	37·3	43·6	31·9	37·8	55·2	4th 2 P.M.	22·7	23rd 7 ,,	30·144	30·586	14th 0·15 ,,	29·388	10th 2 P.M.		·169
March	39·9	44·7	35·3	40·0	58·4	29th 1 ,,	17·0	5th 7 ,,	29·527	30·003	12th NOON.	29·011	7th 4 A.M.		·201
April	49·1	58·3	40·2	49·3	68·0	9th 5 ,,	30·0	2nd 6 ,,	29·988	30·535	2nd 8 & 11 P.M.	29·568	24th 6 P.M.		·246
May	53·3	62·8	43·6	53·2	80·7	21st 4 ,,	35·0	2nd 5 ,,	30·105	30·460	3rd 9 A.M.	29·456	26th 2 ,,		·268
June	54·7	61·3	48·8	55·1	72·0	21st 6 ,,	41·0	11th 3 ,,	29·966	30·385	18th 11 ,,	29·350	24th 7 A.M.		·328
July	60·5	68·1	54·0	61·1	75·2	18th 5 ,,	45·4	1st 4 ,,	29·939	30·299	19th 11 P.M.	29·441	25th 5 P.M.		·392
August	62·1	70·4	54·1	62·3	83·4	12th 5 ,,	46·7	3rd 5 ,,	30·003	30·319	11th 8 A.M.	29·426	18th 10 A.M.		·423
September	55·2	61·6	48·9	55·3	68·6	6th 2 ,,	40·0	2nd 6 ,,	30·035	30·327	14th 9 P.M.	29·643	7th 7 A.M.		·355
October......	53·1	58·1	47·0	52·6	65·4	1st 3 ,,	31·0	30th 3 ,,	29·814	30·310	9th 9 & 10 A.M.	29·347	26th 11 P.M.		·341
November...	42·0	46·9	36·8	41·9	54·9	3rd 2 ,,	28·5	9th 7 ,,	30·030	30·449	23rd 9 P.M.	29·307	29th, 10 & 11 ,, 30th 1 A.M.		·223
December...	40·8	45·4	35·9	40·7	53·7	28th 8 A.M.	22·9	21st 8 ,,	29·681	30·454	30th 9 A.M.	28·505	3rd 4 ,,		·215
Means	48·9	55·3	42·6	49·0	...	...	...	...	29·950	...	...	...	...		·280

* Reduced to 32° at M.S.L., but not to lat. 45°.

This table has been compiled at the Meteorological Office from values intended for publication in the volume of "Hourly Means" for 1909.

APPENDIX II.—Table II.

Kew Observatory.

Months.	Mean amount of cloud (0=clear, 10=overcast).	Rainfall.* Total.	Rainfall.* Maximum.	Rainfall.* Date.	Weather. Number of days on which were registered: Rain. ‡	Snow.	Hail.	Thunder storms	Clear sky.	Overcast sky.	Gales.§	Wind.† Number of days on which it was: N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.‖
1909.		ins.	ins.																	
January	7·2	0·785	0·195	10	11	0	1	1	4	19	2	2	6	3	0	2	9	5	4	10
February	6·0	0·340	0·120	28	6	3	0	0	5	12	1	5	5	3	4	1	2	4	4	3
March	8·2	2·680	0·520	6	23	9	1	0	1	22	2	4	4	2	4	6	6	2	3	2
April	5·0	1·815	0·420	19	12	0	2	1	7	5	1	1	2	6	1	4	8	6	2	2
May	4·8	1·545	0·740	24	10	0	0	0	7	7	0	4	3	6	2	3	8	3	2	0
June	8·3	3·420	0·480	1	18	0	1	1	0	22	0	10	4	2	1	3	3	3	4	4
July	7·4	2·690	0·950	27	16	0	0	2	0	15	0	3	0	0	0	2	12	8	6	1
August	5·6	1·320	0·340	24	12	0	0	1	9	12	0	4	2	2	1	3	7	6	6	9
September	7·0	2·585	0·400	28	18	0	0	1	0	14	2	6	6	3	2	2	4	4	3	9
October	7·6	3·525	0·880	28	20	0	0	0	1	18	0	2	2	1	0	8	11	6	1	3
November	6·0	0·720	0·300	29	8	0	0	0	6	12	2	5	9	0	0	2	5	6	3	8
December	7·5	2·325	0·400	2	21	1	0	0	3	20	1	1	3	4	1	3	9	8	2	3
Totals and Means	6·7	23·750			175	13	5	7	43	178	11	47	46	32	16	39	84	61	40	54

* Measured at 10 A.M. daily by gauge 1·75 feet above ground. † As registered by the Robinson anemograph.

‡ The number of rainy days are those on which 0·01 inch rain or melted snow was recorded.

§ In a "gale" the mean wind velocity has exceeded 25 miles an hour in at least one hour of the twenty-four } using the factor 2·2.

‖ In a "calm" the mean wind velocity for the twenty-four hours has not exceeded 3·7 miles an hour }

THE NATIONAL PHYSICAL LABORATORY.

REPORT OF THE OBSERVATORY DEPARTMENT FOR THE YEAR 1909.

The following corrected values should be substituted for those given in the Report of the Observatory Department for 1909 in the column in App. II., Table II., p. 22, headed "Gales," and in the two last columns (headed respectively "Greatest hourly velocity" and "Date") of App. II., Table III., p. 23.

	Gales.	Greatest hourly velocity.	Date.
January	0	24	14
February...........	2	26	5
March	0	23	18, 24 & 25
April	1	25	5
May	4	30	7
June.................	1	26	3
July	0	21	25
August	0	16	8, 17, 18, 19 & 20
September	0	19	6
October	0	24	15
November	0	22	12
December	3	32	3

APPENDIX I.I.—Table IV.

Measurements of Solar Radiation, with the Ångström Compensation-Pyrheliometer.

1909.

Month.	Days of Observation.	Mean Value. *	Maximum.			Minimum.		
			Value. *	State of Atmosphere.	Direction of Wind.	Value. *	State of Atmosphere.	Direction of Wind.
January	10	0·737	1·018	Clear	W.S.W.	0·382	Smoky mist	N.
February	7	0·812	1·030	Hazy	S.E.	0·602	Smoky mist	S.E.
March	6	0·983	1·221	Clear	S.W.	0·789	Hazy	S.W.
April	14	1·064	1·290	Clear	S.	0·661	Hazy	E.N.E.
May	12	1·086	1·265	Clear	W.	0·769	Clear	N.N.E.
June	4	1·056	1·254	Clear	S.W.	0·939	Hazy	N.W.
July	10	1·126	1·304	Very clear	S.W.	0·904	Hazy	N.
August	5	1·027	1·169	Extreme visibility	N.W.	0·799	Hazy	S.W.
September ...	5	1·071	1·277	Clear	W.	0·861	Hazy	N.N.E.
October.........	8	1·050	1·200	Extreme visibility	W.	0·961	Clear	W.
November ...	8	0·758	0·894	Clear	S.W.	0·586	Misty	N.E.
December.....	4	0·722	0·934	Clear	W.S.W.	0·670	Misty	N.W.

* Expressed in gramme-calories per sq. cm. per minute.

Measurements taken between 11.30 a.m. and 0.30 p.m., and observations omitted when sun's radiation was intercepted by any visible cloud.

APPENDIX II.—Table V.

Earth Thermometers. 1909.

Month.	1 foot Thermometer. Arithmetic Mean of Readings at 10 a.m. and 10 p.m.					1 foot Thermometer. Mean Excess of Temperature.		4 foot Thermometer. Arithmetic Mean of Readings at 10 a.m. and 10 p.m.				
	Mean.	Max.m.	Date.	Min.m.	Date.	10 p.m. over 10 a.m.	4 p.m. over 10 a.m.	Mean.	Max.m.	Date.	Min.m.	Date.
January	38·4°	41·5°	19	34·3°	31	−0·03°	+0·04°	44·1°	45·1°	1	42·2°	31
February	36·0	42·1	5	33·8	27	+0·15	+0·22	41·6	42·3	8 and 9	40·4	28
March	38·8	46·0	30	33·9	1, 2, 3, 5 and 6	+0·64	+0·33	40·7	43·1	31	39·9	7, 8 & 9
April	47·9	52·4	27	42·7	5	+1·49	+0·90	45·4	48·1	30	43·2	1
May	53·2	59·8	31	49·2	2	+1·50	+1·11	49·4	51·7	31	48·2	1, 2, 3, 4 and 5
June	56·6	59·6	20	53·0	12	+0·83	+0·61	52·9	54·1	27, 28, 29 and 30	52·0	1 and 2
July	60·8	64·2	19	56·7	1	+0·79	+0·48	55·8	57·2	25, 26, 27 28 & 29	54·1	1
August	62·8	66·2	15	59·9	3	+0·83	+0·65	58·4	59·3	21, 22 & 23	57·1	1
September	57·1	59·9	6	55·2	29	+0·60	+0·56	57·0	58·8	1	56·1	25, 26, 27 28, 29, 30
October	54·2	58·2	4 and 5	44·6	31	+0·15	+0·20	55·3	56·0	1, 5, 6, 7 8 and 9	53·1	31
November	42·9	49·1	4 and 5	37·3	24	+0·12	+0·11	49·5	52·5	1	46·1	29 & 30
December	40·0	44·0	28	36·2	21	−0·01	+0·10	45·0	46·2	1, 2, 3, 4 and 5	44·0	27 & 28
Yearly Means and Extremes	49·1	66·2	Aug. 15	33·8	Feb. 27	+0·59	+0·44	49·6	59·3	Aug. 21, 22 & 23	39·9	March 7, 8 and 9

APPENDIX II.—Table VI.—Hourly Means of Atmospheric Electric Potential on selected "Quiet"
19

Month.	Midt.	1 h.	2 h.	3 h.	4 h.	5 h.	6 h.	7 h.	8 h.	9 h.	10 h.	11 h.
January	225	214	208	196	176	167	173	198	212	231	245	248
February	257	228	211	177	166	169	177	207	258	286	283	277
March	166	133	117	108	109	125	149	187	222	247	223	184
April	242	231	220	195	185	198	202	213	240	257	252	235
May	170	165	153	147	149	166	189	210	225	225	205	179
June	104	94	86	77	75	81	96	108	126	130	127	125
July	125	114	93	87	94	103	110	124	135	121	110	99
August	144	123	109	106	119	132	151	180	199	203	182	161
September ...	136	123	117	111	103	98	104	125	160	177	168	163
October.........	115	108	103	100	103	116	136	155	162	165	149	123
November ...	217	197	179	165	158	166	170	209	229	244	248	232
December......	212	195	179	173	178	181	177	197	226	266	288	272

APPENDIX II.—TABLE VII.—Diurnal Inequality of Atmospheric Electric
19

Month, &c.	1 h.	2 h.	3 h.	4 h.	5 h.	6 h.	7 h.	8 h.	9 h.	10 h.	11 h.	Noon.	1 h.
January	−12	−18	−29	−46	**−55**	−51	−31	−20	− 6	+ 5	+ 7	+ 3	0
February	−30	−43	−70	**−78**	−76	−69	−45	− 3	+19	+18	+13	− 6	− 8
March	−35	−50	**−59**	**−59**	−46	−26	+ 7	+37	**+58**	+36	+ 1	−13	−22
April	+ 2	− 7	−29	**−38**	−27	−24	−15	+ 7	+21	+16	+ 2	− 3	−17
May	− 8	−18	−24	−23	− 9	+10	+27	+40	+39	+21	− 1	−25	**−41**
June	−19	−25	−32	**−33**	−29	−18	− 9	+ 4	+ 7	+ 4	+ 3	− 4	− 2
July	+ 2	−15	**−20**	−13	+ 2	+ 1	+12	+22	+11	+ 2	− 7	−12	−11
August	−25	−37	**−40**	−28	−17	0	+25	+42	**+46**	+27	+ 9	− 4	− 5
September ...	−17	−24	−29	−37	**−41**	−36	−18	+13	+27	+19	+13	+ 9	+ 1
October.........	−22	−26	**−29**	−25	−12	+ 9	+27	+35	**+38**	+24	− 2	−15	−14
November ...	−22	−41	−55	**−62**	−54	−50	−11	+10	+25	+29	+13	− 9	−15
December......	−38	−55	**−63**	−59	−58	**−63**	−45	−18	+21	+41	+24	+ 4	− 0
Winter	−26	−39	−54	**−61**	**−61**	−58	−33	− 8	+15	+23	+14	− 2	− 6
Equinox	−18	−27	−37	**−40**	−32	−19	0	+23	**+36**	+24	+ 4	− 5	−13
Summer	−12	−24	**−29**	−24	−13	− 2	+14	+27	+26	+14	+ 1	−11	−15
Year	−19	−30	−40	**−42**	−35	−26	− 6	+14	+26	+20	+ 6	− 6	−11

*Principal maxima and

(in volts) from the Self-recording Kelvin Water-dropping Electrograph
Days (10 each month).
09.

Noon.	1 h.	2 h.	3 h.	4 h.	5 h.	6 h.	7 h.	8 h.	9 h.	10 h.	11 h.	Midt.
244	242	276	284	272	267	268	284	299	295	278	254	252
252	249	256	276	294	309	336	335	330	319	302	279	244
169	160	170	174	175	195	213	233	245	239	239	212	190
231	215	208	215	219	230	251	270	282	284	273	256	256
152	134	135	149	149	152	169	202	231	247	225	203	186
115	118	133	128	126	138	150	159	170	164	149	127	105
92	92	92	88	80	83	85	98	122	132	127	124	112
147	145	132	124	131	137	146	161	165	177	183	174	144
158	149	144	142	146	158	167	174	185	191	182	163	146
109	109	106	110	114	135	151	146	142	120	101	100	102
211	205	216	228	245	242	238	243	249	249	259	254	219
254	252	269	296	287	299	313	313	298	291	292	269	250

Potential Gradient near the Ground in volts per metre of height.*
09.

2 h.	3 h.	4 h.	5 h.	6 h.	7 h.	8 h.	9 h.	10 h.	11 h.	Midt.	Range of inequality.	Monthly and seasonal mean absolute values.
+27	+33	+22	+17	+17	+29	**+41**	+37	+22	+ 1	− 2	96	200
− 2	+14	+29	+42	**+63**	**+63**	+59	+51	+38	+20	− 7	141	208
−14	−12	−12	+ 5	+20	+37	+47	+40	+40	+16	− 5	117	162
−23	−18	−15	− 6	+11	+27	+36	**+38**	+28	+13	+13	76	199
−40	−29	−30	−27	−14	+13	+38	**+51**	+31	+13	− 3	92	154
+ 9	+ 5	+ 4	+12	+21	+27	**+35**	+31	+20	+ 4	−11	68	87
−11	−13	**−20**	−17	−15	− 3	+17	**+26**	+22	+20	+10	46	88
−17	−24	−18	−12	− 5	+ 9	+12	+23	+28	+20	− 6	86	133
− 4	− 6	− 3	+ 7	+14	+20	+30	**+35**	+27	+ 9	− 6	76	130
−17	−22	− 8	+14	+29	+25	+22	+ 1	−18	−18	−16	67	123
− 4	+ 9	+26	+23	+18	+23	+29	+29	**+40**	+35	− 1	102	226
+16	+41	+31	+41	**+53**	+52	+35	+27	+26	+ 2	−19	116	250
+ 9	+24	+27	+31	+38	**+42**	+41	+36	+32	+15	− 7	—	221
−14	−14	− 9	+ 5	+19	+27	+34	+29	+19	+ 5	− 3	—	154
−15	−15	−16	−11	− 3	−11	+26	**+33**	+25	+14	− 2	—	116
− 7	− 2	+ 1	+ 8	+18	+19	**+34**	+33	+25	+11	− 4	—	164

minima are in heavy type.

APPENDIX II.—Table VIII.

"Electric Dissipation" (with Elster and Geitel apparatus).

Months. 1909.	Number of Days of Observation.	Mean Value.			Greatest Value.			Least Value.			$\frac{\Sigma a_-}{\Sigma a_+}$
		a_+	a_-	$\frac{a_-}{a_+}$	a_+	a_-	$\frac{a_-}{a_+}$	a_+	a_-	$\frac{a_-}{a_+}$	
January ...	11	0·307	0·371	1·24	0·539	0·787	2·14	0·189	0·185	0·62	1·21
February ...	11	·264	·412	1·61	·392	·672	2·54	·139	·194	0·88	1·56
March ...	8	·313	·429	1·52	0·615	1·034	3·41	·090	·162	0·64	1·37
April ...	10	·538	·684	1·35	1·034	1·369	1·90	·147	·256	0·84	1·27
May ...	14	·421	·649	1·60	0.720	1·178	2·35	·240	·342	1·00	1·54
June ...	13	·531	·712	1·46	1·138	1·742	2·89	·183	·341	0·72	1·34
July ...	13	·742	1·087	1·46	1·201	2·391	2·22	·352	·366	0·87	1·46
August ...	12	·568	0·901	1·65	0·929	1·764	2·40	·176	·394	1·07	1·59
September ...	10	·490	·719	1·58	·913	1·072	2·29	·283	·417	1·08	1·47
October ...	9	·469	·914	2·05	·874	1·345	3·89	·237	·228	0·96	1·95
November ...	14	·460	·602	1·38	·891	1·003	2·17	·170	·275	0·84	1·31
December ...	10	·499	·582	1·22	·921	1·148	2·20	·222	·265	0·55	1·17
Total, Means, and Extremes.	135	·467	·672	1·51	1·201	2·391	3·89	·090	·162	0·55	1·44

APPENDIX III.—Table I.

Register of principal Seismic Disturbances. 1909.

No. in Kew register.	Date.	Commencement.	Time of Maximum.	Maximum Amplitude.	Duration.	Remarks.
		hr. min.	hr. min.	mm.	hr. min.	
884	Jan. 23	2 57·2	3 16·9	7·0	1 48	Earthquake, Persia.
886	Feb. 9	11 37·2	11 49·2	1·0	28	
900	Mar. 12-13	23 44·8	0 14·8	1·5	1 25	
901	,, 13	14 58·0	15 20·5	1·5	55	Times somewhat approximate.
910	April 10	20 7·3	20 18·5	1·5	1 17	
913	,, 23	17 45·8	17 47·5	2·2	40	Earthquake, Portugal.
915	,, 27	13 40·5	14 1·4	1·0	43	
928	May 17	8 16·0	8 25·6	1·5	2 13	
938	,, 30	6 23·5	6 31·0	1·0	19	
944	June 3	19 0·8	19 47·3	3·6	3 40	,, Sumatra-Java.
948	,, 8	6 11·4	6 50·9	3·7	2 12	,, Sumatra
950	,, 11	21 11·0	21 11·3	1·3	18	,, S. France.
969	July 7	21 38·3	22 0·0	6·0	2 9	,, N. India.
971	,, 15	0 48·0	0 50·7	1·0	18	
974	,, 30	11 4·6	11 45·0	6·6	2 57	,, Mexico.
975	,, 31	19 41·8	20 10·4	2·0	1 21	
983	Aug. 14	7 14·5	7 29·2	1·6	40	
984	,, 16	7 27·2	7 47·7	2·6	1 0	
1011	Oct. 20-21	23 59·1	0 20·6	6·5	1 23	
1015	,, 31	10 45·3	11 13·5	1·5	1 3	
1017	Nov. 10	6 25·8	7 4·8	2·4	2 4	
1019	,, 21	8 18·8	8 34·4	1·6	41	

The times recorded are G.M.T., midnight = 0 or 24 hours.

The figures given above were obtained from the photographic records of a Milne Horizontal Pendulum; they represent E—W displacements.

The scale value has been 1 mm. = 0″·55 from January to April.

,, ,, ,, = 0″·54 from April to July.

,, ,, ,, = 0″·55 from July to December.

APPENDIX IV.—Table I.

Results of Watch Trials. Performance of the 50 Watches which obtained the highest number of marks during the year 1909.

Name.	Number of watch.	Escapement, balance spring, &c.	Mean daily rate. Pendant up.	Pendant right.	Pendant left.	Dial up.	Dial down.	Mean variation of daily rate. ± Unit 0·01 second.	Mean change of rate for 1° F. Unit 0·001 second.	Difference between extreme gaining and losing rates.	Marks awarded for Daily variation of rate.	Change of rate with change of position.	Temperature compensation.	Total Marks.
											0—40	0—40	0—20	0—100.
			secs.	secs.	secs.	secs.	secs.			secs.				
Vacheron & Constantin, Geneva	344762	D.r., g.b., d.o., Bar lever	+2·9	+3·4	+3·5	+3·4	+3·2	19	15	2·0	36·2	39·3	19·0	94·5
Patek Philippe & Co. ,,	132657	D.r., g.b., s.o., Bar lever	−2·6	−2·3	−1·6	−3·0	−2·3	17	31	2·25	36·5	38·5	18·0	93·0
Golay, Fils & Stahl ,,	28119	D.r., g.b., s.o., Bar lever	−1·3	−2·0	−1·9	−1·9	−1·4	26	15	2·25	34·8	39·0	19·0	92·8
Dent, London	56423	D.r., g.b., d.o., Tourbillon lever	+1·0	+1·6	+1·8	+0·7	+0·9	21	29	4·0	35·8	38·4	18·1	92·3
Vacheron & Constantin, Geneva	343543	D.r., g.b., s.o., Bar lever	−3·3	−2·7	−3·0	−2·4	−3·2	25	24	3·25	35·0	38·6	18·4	92·0
Chas. Frodsham & Co., London	12166 / 09269	D.r., fusee, s.o., Tourbillon lever	+2·9	+1·5	+1·6	+2·0	+2·6	24	22	3·75	35·3	38·0	18·5	91·8
Nicole Nielsen & Co ,,	12169	Dr., fusee, s.o., Tourbillon lever	+1·4	+1·9	+1·1	+0·5	+0·3	29	9	2·75	34·2	38·0	19·4	91·6
Patek Philippe & Co., Geneva	143287	D.r., g.b., s.o., Bar lever	−2·4	−2·5	−2·1	−1·5	−1·7	30	13	2·75	34·0	38·5	19·1	91·6
,, ,, ,,	146890	D.r., g.b., s.o., Bar lever	−1·5	−1·2	+0·1	+0·1	+0·4	25	9	3·0	35·0	37·0	19·4	91·4
Usher & Cole, London	31052	D.r., fusee, s.o.	+3·8	+4·9	+3·7	+2·5	+2·6	26	7	3·25	34·8	36·9	19·5	91·2
Patek Philippe & Co., Geneva	143302	D.r., g.b., s.o., Bar lever	−0·9	−0·6	+0·2	−0·2	−0·6	30	21	3·0	34·0	38·6	18·6	91·2
Vacheron & Constantin ,,	339582	D.r., g.b., s.o., Bar lever	−6·3	−4·0	−5·0	−5·6	−4·8	28	12	3·25	34·5	37·4	19·2	91·1
S. Smith & Son, London	302—10	D.r., fusee, s.o., Tourbillon lever	+1·6	+1·1	+1·6	+0·9	+3·1	23	30	3·75	35·3	37·7	18·0	91·0
Robert Milne, Manchester	1506	S.R., g.b., s.o., Rotary lever	+0·6	+1·7	+1·8	−0·5	+2·2	26	6	3·75	34·9	36·5	19·6	91·0
Patek Philippe & Co., Geneva	143289	D.r., g.b., s.o., Bar lever	−0·8	−1·5	−1·7	−0·6	−1·9	28	25	3·25	34·5	38·1	18·3	90·9
,, ,, ,,	146794	D.r., g.b., s o., Bar lever	−0·2	−0·6	−0·3	−1·4	+0·3	35	5	3·0	33·0	38·3	19·6	90·9
,, ,, ,,	146797	D.r., g.b., s.o., Bar lever	+0·8	+1·2	+0·8	+0·6	+3·3	26	12	4·0	34·8	36·8	19·2	90·8
Golay, Fils & Stahl ,,	29375	D.r., g.b., s.o., Bar lever	+0·5	+1·4	+1·7	+1·4	+2·1	33	16	3·0	33·4	38·4	18·9	90·7
Vacheron & Constantin ,,	343349	D.r., g.b., s.o., Bar lever	−3·6	−4·2	−4·0	−3·4	−4·9	25	39	3·0	34·9	38·2	17·4	90·5
Patek Philippe & Co. ,,	125409	D.r., g.b., s o., minute and second chronograph	−3·0	−3·3	−2·4	−2·6	−1·5	34	13	3·25	33·2	38·1	19·2	90·5
,, ,, ,,	146806	D.r., g.b., s.o., Bar lever	−0·5	+0·7	+0·4	−0·3	+2·0	25	27	3·5	35·1	37·1	18·2	90·4
,, ,, ,,	133300	D.r., g.b., s.o., Bar lever	−0·5	−0·3	−0·2	+0·2	−0·6	29	46	2·75	34·2	39·1	17·0	90·3
,, ,, ,,	132654	D.r., g.b., s.o., Bar lever	+3·1	+5·3	+4·0	+4·2	+4·0	29	31	3·5	34·3	38·0	17·9	90·2
Golay, Fils & Stahl ,,	28926	D.r., g.b., s.o. Bar lever	+0·6	+1·0	+1·3	+1·0	+2·3	35	16	2·75	33·0	38·2	18·9	90·1
,, ,, ,,	29386	D.r., g.b., s.o., Bar lever	−1·7	−0·5	−1·6	−2·3	−1·3	29	35	3·25	34·2	38·2	17·6	90·0
,, ,, ,,	29387	D.r., g.b., s.o., Bar lever	−0·8	+0·2	+0·3	−0·1	+0·7	28	46	3·0	34·5	38·3	16·9	89·7
Vacheron & Constantin ,,	343802	D.r., g.b., d.o., Bar lever	+1·6	+0·9	+0·5	+1·2	+2·8	32	20	3·0	33·5	37·5	18·6	89·6
Patek Philippe & Co., ,,	146800	D.r., g.b., s.o., Bar lever	−1·5	−1·4	−2·7	−1·4	−1·6	39	17	3·75	32·3	38·4	18·9	89·6
Vacheron & Constantin ,,	344765	D.r., g.b., d.o., Bar lever	−2·5	−2·1	−2·9	−0·1	−0·9	30	16	5·0	34·0	36·2	19·0	89·2

TABLE I.—*continued.*

Name	Number of watch.	Escapement, balance spring, &c.	Mean daily rate. Pendant up.	Pendant right.	Pendant left.	Dial up.	Dial down.	Mean variation of daily rate. ± Unit 0·01 second.	Mean change of rate for 1° F. Unit 0·001 second.	Difference between extreme gaining and losing rates.	Marks awarded for Daily variation of rate. 0—40	Change of rate with change of position. 0—40	Temperature compensation. 0—20	Total Marks. 0—100
			secs.	secs.	secs.	secs.	secs.			secs.				
Golay Fils & Stahl, Geneva	29390	D.r., g.b., s.o., Bar lever	−3·3	−3·2	−2·5	−3·9	−3·0	35	40	3·0	33·1	38·6	17·3	89·0
Carley & Clemence, London	51607	D.r., g.b., s.o., Tourbillon (annular)	−1·9	−1·8	−1·8	+0·8	−1·1	29	31	3·75	34·3	36·7	17·9	88·9
Patek Philippe & Co., Geneva	146897	D.r., g.b., s.o., Bar lever	0·0	0·0	−0·7	−0·5	+1·3	34	37	3·5	33·2	37·9	17·5	88·6
Jos. Player & Son, Coventry	33498	S.r., g.b., s.o., Karrusel	−5·2	−5·4	−5·3	−4·9	−6·8	36	34	3·75	32·8	38·0	17·8	88·6
Patek Philippe & Co., Geneva	132656	D.r., g.b., s.o., Bar lever	+1·7	+2·3	+3·0	+1·8	+1·5	35	40	3·25	33·1	38·1	17·3	88·5
Newsome & Co., Coventry	151391 130858	S.r., g.b., s.o., Karrusel	+0·3	−1·2	−1·1	0·0	+2·7	28	26	5·25	34·4	35·5	18·3	88·2
Hamilton Watch Co., U.S.A.	752521	D.r., g.b., s.o.	−5·0	−8·7	−4·9	−6·3	−4·5	28	28	5·25	34·5	35·6	18·1	88·2
W. Richardson & Son, Coventry	2019	S.r., g.b., s.o., Karrusel	−1·6	−0·6	−1·8	−0·7	−3·5	32	37	4·25	33·6	36·8	17·5	87·9
Patek Philippe & Co., Geneva	146808	D.r., g.b., s.o., Bar lever	+5·0	+4·9	+3·5	+6·1	+5·3	39	30	4·5	32·3	37·6	18·0	87·9
,, ,, ,,	125299	D.r., g.b., s.o., Bar lever	−1·7	−1·0	−1·6	−2·2	−0·7	27	77	4·75	34·6	38·2	14·9	87·7
,, ,, ,,	125408	D.r., g.b., s.o., minute and seconds chronograph	+0·9	−1·4	−1·1	−1·5	+0·4	32	31	4·0	33·7	36·1	17·9	87·7
Carley & Clemence, London	51385	S.r., g.b., d.o., Karrusel	−1·4	−0·1	−0·5	−3·1	−1·1	40	16	5·75	32·0	36·8	18·9	87·7
Longines Watch Factory (Baume & Co.). St. Imier	2041290	D.r., g.b., s.o.	+0·9	+1·6	−1·7	+3·6	+1·4	32	18	7·0	33·6	35·0	18·8	87·4
Jos. Player & Son, Coventry	30661	D.r., g.b., s.o.	−0·8	−0·2	+1·6	+0·1	+0·5	35	43	4·5	32·9	37·4	17·1	87·4
Patek Philippe & Co., Geneva	138629	D.r., g.b., s.o., Bar lever	+1·4	+0·2	+1·2	+2·2	+3·5	27	55	4·75	34·7	36·3	16·3	87·3
W. Ehrhardt, Ltd., Birmingham	494608	S.r., g.b., s.o., "Non-magnetic"	+0·7	+0·7	−0·1	+0·1	+1·1	47	25	3·75	30·7	38·3	18·3	87·3
Robert Milne, Manchester	1512	S.r., g.b., s.o., Rotary lever	+0·8	−0·1	+0·2	+2·6	−0·8	39	25	5·5	32·2	36·2	18·8	87·2
Carley & Clemence, London	12211	D.r., g.b., s.o.	+1·7	−1·2	−1·3	+0·2	+0·7	30	44	5·0	34·1	35·8	17·1	87·0
A. Lange & Söhne, Glashütte	60272	D.r., g.b., s.o.	−3·0	−4·2	−2·5	−0·5	−1·2	24	55	4·25	35·2	35·4	16·3	86·9
R. Gardner, London	43140	S.r., g.b., s.o., Deck	+0·7	+0·9	+1·3	+0·7	−2·4	22	68	4·5	35·6	35·8	15·4	86·8
Patek Phillippe & Co., Geneva	146849	D.r., g.b., s.o., Bar lever	−3·7	−2·4	−4·6	−1·8	−3·7	44	15	5·0	31·2	36·4	19·0	86·6

d.r. = double roller. s.r. = single roller.
d.o. = double overcoil spring. s.o. = single overcoil spring. g.b = going barrel.

APPENDIX IV.—TABLE II.

Highest Marks obtained by "Complicated" Watches during the year.

Description of watch.	Number.	Name.	Marks awarded for			Total Marks.
			Variation.	Position.	Tempera-ture.	
			0—40	0—40	0—20	0—100
Minute and split seconds chronograph................................	214569	Stauffer, Son & Co., London ...	31·2	36·8	18·4	86·4
	203147	,, ,, ...	30·0	37·5	18·5	86·0
	203148	,, ,, ...	31·3	36·4	17·9	85·6
Minute and seconds chronograph	125409	Patek Philippe & Co., Geneva...	33·2	38·1	19·2	90·5
	125408	,, ,, ...	33·7	36·1	17·9	87·7
	125406	,, ,, ...	27·3	38·2	17·1	82·6
Minute repeater..	12337/1732	John Lilley & Son, London......	26·8	35·6	18·8	81·2
"Non-Magnetic"..	494608	W. Ehrhardt, Ltd., Birmingham	30·7	38·3	18·3	87·3
	188—261	S. Smith & Son, London	28·2	35·0	19·1	82·3

APPENDIX V.

MAGNETIC OBSERVATIONS FOR THE YEAR 1909, FALMOUTH OBSERVATORY.

Latitude 50° 9′ 0″ N. Longitude 5° 4′ 35″ W. Height, 167 feet above mean sea level.

Photographic curves of magnetic Declination and of Horizontal and Vertical Force variations have been regularly taken during the year.

The scale values of the instruments were determined on the 20th February, 1909. The following values of the ordinates of the photographic curves were then found :—

Declination, 1 cm. = 0° 11′·7.
Bifilar, 1 cm. δH = 0·00053.
Balance, 1 cm. δV = 0·00064.

The sensibility of the Vertical Force Magnet was increased, and a second series of deflections made, the result being :—

Balance 1 cm. δV = 0·00050.

Deflections of the Vertical Force Magnet were also made on 7th July, when the scale value was found to be :—

1 cm. δV = 0·00048.

On 20th August the position of the Vertical Force Trace was altered, and a series of deflections were again made, the result being :—

Balance, 1 cm, δV = 0·00054.

The scale values of the Instruments were again tested on the 15th October, the resulting values being —

Bifilar, 1 cm. δH = 0·00055.
Balance 1 cm. δV = 0·00050.

The principal variations of the Magnetic Curves that were recorded took place on the following dates :—

January 3, 29 ; May 14, 18 ; September 25, 30 ; October 19.

Observations with the Absolute Instruments have been made four times a month, of which the following is a summary :—

Determinations of Horizontal Intensity, 48.
Determinations of Inclination, 48.
Determinations of Declination, 48.

The mean values of the Magnetic Elements for the year 1909 are as follows:—

Declination, 17° 48'·4 W.; Horizontal Force, 0·18802 C.G.S.; Vertical Force, 0·43266 C.G.S.; Inclination 66° 30'·6 N.

The results in the following Tables, Nos. I, II, III, IV, V, VI, are deduced from the magnetograph curves which have been standardized by the absolute observations. These were made with the Collimator Magnet 66A and the Mirror Magnet 66C in the Unifilar Magnetometer No. 66, by Elliott Brothers, of London, and with the Inclinometer No. 86, by Dover, of Charlton, Kent, employing needles 1 and 2, which are 3½ inches in length.

The effects of temperature on the Horizontal Force Curves are very small and have been neglected, but a temperature correction has been determined and applied to the Vertical Force Curves.

From the hourly means of Horizontal Force in Table III, and the corresponding Vertical Force in Table V, hourly values have been calculated for the Inclination. These and the corresponding diurnal inequalities appear in Tables VII and VIII.

The tables are prepared in accordance with the suggestions made in the Fifth Report of the Committee of the British Association on comparing and reducing magnetic observations. The time given is Greenwich Mean Time, which is 20 minutes 18 seconds earlier than local time.

The results are derived from the "quiet" days selected by the Astronomer Royal, mentioned on page 13 above.

The results are printed in the Royal Cornwall Polytechnic Society's Annual Report, and in the Annual Report of the National Physical Laboratory.

The whole of the instruments have been maintained in good order; and the Magnetic Chamber in the Observatory Building and the Magnetic Hut in the garden have been kept in a thoroughly satisfactory condition.

EDWARD KITTO,

Superintendent and Magnetical Observer.

REPORT ON THE MAGNETIC INSTRUMENTS AT THE FALMOUTH OBSERVATORY, OCTOBER 14—16, 1909, BY MR. T. W. BAKER, CHIEF ASSISTANT, OBSERVATORY DEPARTMENT.

The magnetic instruments were inspected during October 14—16, by Mr. Baker, who reported as follows:—

Since the last inspection (October, 1907), the magnetographs have been in constant operation.

I examined the photographic curves up to the middle of October. The photography was very good till the end of August, but since then it has not been so uniformly good.

The curves will admit of accurate tabulation.

There are, however, still numerous disturbances during the day time in the Declination and Horizontal Force traces, and to a less extent in the Vertical Force. These disturbances are chiefly due to the passing of heavy traction engines along the boundary road, but partly to people moving about during office hours.

I noticed that the trace dot of the Horizontal Force was too close to the zero line. Before altering it, I determined the scale value, and found it to be 1 cm. = ·00053 C.G.S., in close agreement with Mr. Kitto's value determined in February.

By a very slight twist of the torsion head, the curve dot was brought into a suitable position for safe registration, after which the scale value was found to be 1 cm. = ·00055.

The Vertical Force scale value was determined by myself on October 15, the results being in very fair agreement with Mr. Kitto's last determination.

The Richard thermograph appeared to be working satisfactorily.

The Absolute instruments were all found to be in good order.

I made a complete set of Absolute Observations on October 14, which on reduction were found to be in good agreement with the latest observations taken by Mr. Kitto.

I re-determined the meridian reading of the Dip Circle, the result being in satisfactory agreement with the value in use.

T. W. BAKER.

Table I.—Hourly Means of Declination at Falmouth on Five selected Quiet Days in each Month, 1909.

Hours	Midt.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Noon
	(17° + West.)				Winter.								
1909.	′	′	′	′	′	′	′	′	′	′	′	′	′
January	50·6	50·9	51·4	51·4	51·4	51·2	51·2	50·7	50·5	49·8	50·7	52·2	53·6
February	49·6	50·2	49·5	49·8	49·7	49·4	49·2	49·2	49·4	49·7	50·7	51·4	51·9
March	49·9	50·3	50·5	50·1	50·0	50·5	49·7	49·8	48·7	48·5	49·8	51·6	54·5
October.........	43·2	43·3	43·7	44·0	43·5	43·4	42·8	42·1	41·1	40·9	42·4	45·3	48·2
November......	44·3	44·6	44·8	44·8	44·7	44·5	44·2	43·6	43·7	43·4	44·2	46·0	47·5
December......	43·7	43·9	44·4	44·2	44·2	44·0	43·9	43·8	43·8	43·3	43·5	45·0	46·2
Means	46·9	47·2	47·2	47·2	47·2	47·2	46·8	46·5	46·2	45·9	46·9	48·6	50·3
					Summer.								
1909.	′	′	′	′	′	′	′	′	′	′	′	′	′
April	50·1	50·5	50·4	50·5	50·1	50·0	49·4	47·9	46·2	45·6	47·5	50·3	54·1
May	49·6	49·5	49·4	49·7	49·1	48·3	47·1	45·9	45·1	45·2	47·0	49·7	52·6
June	47·6	47·6	47·7	48·0	46·7	45·8	44·7	44·3	44·2	45·0	46·4	49·1	51·2
July	47·8	47·9	47·9	48·2	47·7	47·1	45·9	45·1	44·4	44·7	45·3	47·9	51·1
August	46·0	45·8	46·0	46·1	45·9	44·7	44·0	43·0	43·0	43·8	46·7	49·4	51·7
September ...	46·4	46·5	46·7	46·8	46·8	46·7	46·5	46·0	44·8	44·6	45·8	48·0	51·3
Means	47·9	48·0	48·0	48·2	47·7	47·1	46·3	45·4	44·6	44·8	46·5	49·1	52·0

Table II.—Diurnal Inequality of the Falmouth

Hours	Midt.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Noon
					Summer Means.								
	′	′	′	′	′	′	′	′	′	′	′	′	′
	−1·0	−0·9	−0·9	−0·7	−1·2	−1·8	−2·6	−3·5	−4·3	−4·1	−2·5	+0·1	+3·1
					Winter Means.								
	′	′	′	′	′	′	′	′	′	′	′	′	′
	−1·0	−0·7	−0·6	−0·6	−0·6	−0·7	−1·0	−1·3	−1·7	−1·9	−1·0	+0·7	+2·5
					Annual Means.								
	′	′	′	′	′	′	′	′	′	′	′	′	′
	−1·0	−0·8	−0·8	−0·7	−0·9	−1·3	−1·8	−2·4	−3·0	−3·0	−1·7	+0·4	+2·8

Note.—When the sign is + the magnet
When the sign is − the magnet

Observatory, determined from the Magnetograph Curves
(Mean for the year = 17°48′·4 W.)

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Midt.
Winter.											
′	′	′	′	′	′	′	′	′	′	′	′
54·4	54·6	53·5	52·7	52·2	52·0	51·7	51·6	50·9	50·7	50·4	50·6
52·3	52·3	51·6	50·6	50·4	50·5	50·3	50·1	49·4	49·1	49·3	49·4
56·0	56·7	55·7	54·0	52·4	51·8	51·2	50·7	50·3	49·7	49·5	48·7
49·3	49·3	48·1	46·7	45·5	44·9	44·1	44·1	43·7	43·7	43·9	44·0
48·3	48·1	47·3	46·1	45·8	44·7	44·5	44·3	44·1	43·8	44·3	44·4
47·3	46·7	45·8	45·2	44·7	44·4	44·0	44·0	43·9	43·6	43·5	43·5
51·3	51·3	50·3	49·2	48·5	48·1	47·6	47·5	47·1	46·8	46·8	46·8
Summer.											
′	′	′	′	′	′	′	′	′	′	′	′
57·0	58·0	56·5	54·4	52·8	51·4	50·8	50·7	50·5	50·3	50·2	50·2
53·9	54·4	53·5	52·9	52·1	51·0	50·5	50·4	50·3	50·0	49·6	49·5
52·6	53·1	53·0	52·1	51·1	50·3	49·6	49·3	48·7	48·8	48·4	48·4
52·7	54·4	54·2	53·4	52·2	50·7	49·7	49·5	49·4	48·9	48·5	48·1
53·1	52·9	52·0	50·2	48·8	47·9	47·4	47·1	47·0	46·9	46·5	46·3
52·6	52·5	51·9	50·6	49·3	48·0	47·6	46·9	46·8	46·9	46·5	46·4
53·6	54·2	53·5	52·3	51·1	49·9	49·3	49·0	48·8	48·6	48·3	48·2

Declination as deduced from Table I.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Midt.
Summer Means.											
′	′	′	′	′	′	′	′	′	′	′	′
+4·7	+5·3	+4·6	+3·4	+2·1	+1·0	+0·4	+0·1	−0·1	−0·3	−0·6	−0·8
Winter Means.											
′	′	′	′	′	′	′	′	′	′	′	′
+3·4	+3·4	+2·5	+1·4	+0·6	+0·2	−0·2	−0·4	−0·8	−1·1	−1·0	−1·1
Annual Means.											
′	′	′	′	′	′	′	′	′	′	′	′
+4·1	+4·4	+3·5	+2·4	+1·4	+0·6	+0·1	−0·2	−0·5	−0·7	−0·8	−0·9

points to the west of its mean position.
points to the east of its mean position.

Table III.—Hourly Means of Horizontal Force at Falmouth
Five selected Quiet Days in each Month, 1909.

Hours	Midt.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Noon
0·18000 + (C.G.S. units).						Winter.							
1909.													
January	795	794	796	796	798	799	800	801	799	794	789	788	788
February	800	802	802	800	801	800	801	802	802	800	798	798	798
March	798	796	795	796	797	797	799	797	796	796	782	777	778
October	798	798	795	797	797	798	798	796	787	777	770	770	771
November ...	793	792	792	793	793	794	796	794	794	789	784	780	781
December ...	780	780	782	782	782	783	784	783	784	781	775	772	772
Means.........	794	794	794	794	795	795	796	795	794	789	783	781	781
						Summer.							
1909.													
April	813	812	812	813	812	813	815	815	812	801	788	785	786
May	817	816	813	813	812	812	810	807	802	796	792	792	794
June	819	821	819	818	816	815	813	807	798	791	791	796	801
July	819	819	818	817	819	818	816	814	807	801	795	796	802
August	820	819	818	817	815	813	810	801	793	785	·783	788	792
September ...	817	817	816	816	816	816	815	813	806	797	790	790	798
Means.........	817	817	816	816	815	814	813	809	803	795	790	791	796

Table IV.—Diurnal Inequality of the Falmouth

Hrs.	Midt.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Noon
						Summer Means.							
	+ ·00005	+ ·00005	+ ·00003	+ ·00003	+ ·00002	+ ·00002	·00000	– ·00003	– ·00010	– ·00017	– ·00023	– ·00021	– ·00017
						Winter Means.							
	+ ·00002	+ ·00002	+ ·00002	+ ·00002	+ ·00003	+ ·00003	+ ·00004	+ ·00003	+ ·00002	– ·00003	– ·00009	– ·00011	– ·00011
						Annual Means.							
	+ ·00003	+ ·00003	+ ·00002	+ ·00002	+ ·00002	+ ·00002	+ ·00002	·00000	– ·00004	– ·00010	– ·00016	– ·00016	– ·00014

Note.—When the sign is + the

Observatory determined from the Magnetograph Curves on
(Mean for the year = 0·18802).

1.	2.	3.	4.	5	6.	7.	8.	9.	10.	11.	Midt.
Winter.											
790	795	796	795	797	801	800	801	801	800	799	798
800	802	802	799	798	801	804	802	801	800	800	801
778	784	786	791	794	796	800	799	797	798	796	795
780	787	791	791	792	792	794	795	794	796	798	796
784	785	787	789	792	795	798	797	796	797	796	795
777	780	782	785	788	789	787	786	784	783	782	782
785	789	791	792	794	796	797	797	796	796	795	794
Summer.											
794	801	808	816	821	821	820	820	821	820	820	818
799	803	808	816	820	827	826	828	824	823	822	820
807	811	818	818	822	825	832	834	828	827	824	823
801	807	817	823	830	834	836	839	833	832	831	829
802	806	812	819	818	819	823	825	825	822	822	822
805	807	811	815	818	819	824	821	821	820	821	819
801	806	812	818	821	824	827	828	825	824	823	822

Horizontal Force as deduced from Table III.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Midt.
Summer Means.											
− ·00011	− ·00007	·00000	+ ·00005	+ ·00009	+ ·00012	+ ·00014	+ ·00015	+ ·00013	+ ·00011	+ ·00011	+ ·00009
Winter Means.											
− ·00007	− ·00003	− ·00001	·00000	+ ·00001	+ ·00004	+ ·00005	+ ·00005	+ ·00003	+ ·00004	+ ·00003	+ ·00002
Annual Means.											
− ·00009	− ·00005	− ·00001	+ ·00002	+ ·00005	+ ·00008	+ ·00010	+ ·00010	+ ·00008	+ ·00007	+ ·00007	+ ·00006

reading is above the mean.

Table V.—Hourly Means of Vertical Force at Falmouth
Five selected Quiet Days in each Month

Hours	Midt.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Noon
0·43000 + (C.G.S. units).						Winter.							
1909.													
January	284	285	285	287	287	287	287	286	284	284	282	280	279
February	266	265	265	266	265	265	264	264	263	261	261	262	263
March	255	256	256	257	257	257	257	257	257	254	250	244	241
October	298	298	299	299	299	299	299	298	299	296	292	287	286
November	265	265	264	264	263	263	263	262	262	260	258	255	255
December	217	216	216	215	215	215	214	214	213	213	212	211	210
Means............	264	264	264	265	264	264	264	264	263	261	259	257	256
						Summer.							
1909.													
April	263	263	263	263	263	263	263	263	263	262	258	253	251
May...............	269	268	268	268	268	268	268	269	267	265	261	254	253
June	298	298	297	297	297	298	298	298	297	295	292	288	284
July...............	251	250	250	251	253	255	256	254	253	249	246	241	236
August	297	297	297	298	300	300	301	300	299	294	288	282	279
September	249	249	250	250	250	249	249	249	249	247	242	238	234
Means	271	271	271	271	272	272	272	272	271	269	264	259	256

Table VI.—Diurnal Inequality of the Falmouth

Hrs.	Midt.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Noon.
						Summer Means.							
	+ ·00001	+ ·00001	+ ·00001	+ ·00001	+ ·00002	+ ·00002	+ ·00003	+ ·00002	+ ·00001	− ·00001	− ·00005	− ·00011	− ·00014
						Winter Means.							
	+ ·00002	+ ·00002	+ ·00002	+ ·00003	+ ·00002	+ ·00002	+ ·00002	+ ·00002	+ ·00001	− ·00001	− ·00003	− ·00005	− ·00006
						Annual Means.							
	+ ·00002	+ ·00001	+ ·00002	+ ·00002	+ ·00002	+ ·00002	+ ·00002	+ ·00002	+ ·00001	− ·00001	− ·00004	− ·00008	− ·00010

Note.—When the sign is + the

Observatory, determined from the Magnetograph Curves on during 1909. (Mean for the Year = 0·43266).

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Mid^t.
Winter.											
280	283	286	286	286	284	282	281	281	280	279	280
264	265	269	269	268	268	268	266	266	266	265	266
243	246	251	255	258	257	257	256	255	254	253	253
290	295	297	300	300	300	298	298	297	296	295	294
257	259	261	261	261	259	258	257	257	257	257	257
211	212	213	214	214	212	212	211	211	211	211	211
258	260	263	264	264	263	263	262	261	261	260	260
Summer.											
251	256	263	268	271	271	270	270	268	267	267	267
256	261	266	270	271	273	273	272	271	270	270	270
286	289	295	299	301	302	303	302	301	299	298	297
236	242	248	255	261	262	262	262	259	257	256	255
283	290	295	298	301	304	302	299	297	294	292	292
236	240	244	248	250	251	250	248	247	246	246	245
258	263	268	273	276	277	277	276	274	272	272	271

Vertical Force as deduced from Table V.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Mid^t.
Summer Means.											
− ·00012	− ·00007	− ·00001	+ ·00003	+ ·00006	+ ·00007	+ ·00007	+ ·00006	+ ·00004	+ ·00002	+ ·00002	+ ·00001
Winter Means.											
− ·00004	− ·00002	+ ·00001	+ ·00002	+ ·00003	+ ·00001	+ ·00001	·00000	− ·00001	− ·00001	− ·00002	− ·00002
Annual Means.											
− ·00008	− ·00004	·00000	+ ·00003	+ ·00004	+ ·00004	+ ·00004	+ ·00003	+ ·00002	+ ·00001	·00000	·00000

reading is above the mean.

Table VII.—Hourly Means of Inclination at Falmouth Observatory, (Mean for the

Hours	Midt.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Noon
(66° +) Winter.													
1909.	′	′	′	′	′	′	′	′	′	′	′	′	′
January	31·7	31·8	31·7	31·7	31·6	31·5	31·5	31·4	31·4	31·8	32·0	32·1	32·0
February	30·8	30·7	30·7	30·8	30·7	30·8	30·7	30·6	30·6	30·7	30·8	30·9	30·9
March	30·7	30·8	30·9	30·9	30·8	30·8	30·6	30·8	30·9	30·8	31·6	31·7	31·6
October	31·9	31·9	32·1	32·0	32·0	31·9	31·9	32·0	32·7	33·2	33·6	33·5	33·4
November ...	31·3	31·3	31·3	31·3	31·2	31·2	31·0	31·1	31·1	31·4	31·7	31·9	31·8
December......	30·8	30·7	30·6	30·6	30·6	30·5	30·4	30·5	30·4	30·6	30·9	31·1	31·1
Means.........	31·2	31·2	31·2	31·2	31·2	31·1	31·0	31·1	31·2	31·4	31·8	31·9	31·8
Summer.													
1909.	′	′	′	′	′	′	′	′	′	′	′	′	′
April	29·9	30·0	30·0	29·9	30·0	29·9	29·8	29·8	30·0	30·7	31·4	31·5	31·3
May	29·8	29·8	30·0	30·0	30·1	30·1	30·2	30·5	30·7	31·1	31·2	31·1	30·9
June	30·5	30·4	30·5	30·5	30·7	30·8	30·9	31·3	31·9	32·3	32·2	31·7	31·3
July	29·1	29·1	29·2	29·3	29·2	29·3	29·5	29·6	30·0	30·3	30·0	30·4	29·8
August	30·4	30·5	30·5	30·6	30·8	31·0	31·2	31·8	32·3	32·7	32·6	32·1	31·8
September ...	29·2	29·2	29·3	29·3	29·3	29·3	29·3	29·5	29·9	30·5	30·8	30·7	30·1
Means.........	29·8	29·8	29·9	29·9	30·0	30·1	30·2	30·4	30·8	31·3	31·4	31·2	30·9

Table VIII.—Diurnal Inequality of the Falmouth

Hours	Midt.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Noon
Summer Means.													
	′	′	′	′	′	′	′	′	′	′	′	′	′
	−0·2	−0·2	−0·1	−0·1	0·0	0·0	+0·1	+0·4	+0·7	+1·2	+1·3	+1·2	+0·8
Winter Means.													
	′	′	′	′	′	′	′	′	′	′	′	′	′
	−0·1	−0·1	0·0	0·0	−0·1	−0·1	−0·2	−0·2	−0·1	+0·2	+0·5	+0·6	+0·6
Annual Means.													
	′	′	′	′	′	′	′	′	′	′	′	′	′
	−0·1	−0·1	−0·1	−0·1	−0·1	−0·1	−0·1	+0·1	+0·3	+0·7	+0·9	+0·9	+0·7

calculated from Tables III and V, for each month, 1909.
Year = 66° 30′·6).

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Midt.
Winter.											
′	′	′	′	′	′	′	′	′	′	′	′
31·9	31·7	31·7	31·8	31·6	31·3	31·3	31·2	31·2	31·3	31·3	31·4
30·8	30·7	30·8	31·0	31·0	30·8	30·6	30·7	30·8	30·8	30·8	30·8
31·6	31·3	31·3	31·1	31·0	30·9	30·6	30·6	30·7	30·6	30·7	30·8
32·9	32·6	32·3	32·4	32·4	32·4	32·2	32·1	32·1	32·0	31·8	31·9
31·6	31·6	31·6	31·4	31·2	31·0	30·7	30·8	30·9	30·9	30·9	30·9
30·8	30·6	30·5	30·3	30·1	30·0	30·1	30·2	30·3	30·4	30·4	30·4
31·6	31·4	31·4	31·3	31·2	31·1	30·9	30·9	31·0	31·0	31·0	31·0
Summer.											
′	′	′	′	′	′	′	′	′	′	′	′
30·8	30·5	30·2	29·8	29·6	29·6	29·6	29·6	29·5	29·5	29·5	29·7
30·6	30·5	30·3	29·9	29·7	29·2	29·3	29·1	29·4	29·4	29·5	29·6
31·0	30·8	30·5	30·6	30·4	30·2	29·8	29·6	30·0	30·0	30·2	30·2
29·9	29·7	29·2	29·0	28·7	28·5	28·3	28·3	28·4	28·4	28·5	28·6
31·2	31·1	30·9	30·5	30·7	30·7	30·4	30·1	30·1	30·2	30·1	30·1
29·6	29·6	29·5	29·3	29·2	29·1	28·8	28·9	28·9	28·9	28·9	29·0
30·5	30·4	30·1	29·9	29·7	29·6	29·4	29·3	29·4	29·4	29·5	29·5

Inclination, as deduced from Table VII.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Midt.
Summer Means.											
′ +0·5	′ +0·3	′ 0·0	′ −0·2	′ −0·3	′ −0·5	′ −0·7	′ −0·8	′ −0·7	′ −0·7	′ −0·6	′ −0·5
Winter Means.											
′ +0·4	′ +0·2	′ +0·1	′ +0·1	′ 0·0	′ −0·2	′ −0·3	′ −0·3	′ −0·3	′ −0·3	′ −0·3	′ −0·2
Annual Means.											
+0·4	′ +0·2	′ +0·1	′ −0·1	′ −0·2	′ −0·3	′ −0·5	′ −0·5	′ −0·5	′ −0·5	′ −0·4	′ −0·4

APPENDIX VI.

MAGNETIC OBSERVATIONS MADE AT THE VALENCIA OBSERVATORY CAHIRCIVEEN, 1909.

Latitude, 51° 56′ N. Longitude, 10° 15′ W.

The observations of Declination, Inclination and Horizontal Force have been made twice a month throughout the year, as heretofore; the secular change in each element being in close accord with that of last year. The values are:—

Declination	$-5'\cdot4$.
Inclination	$-1'\cdot2$.
Horizontal Force	$+\cdot00007$ C.G.S.
Vertical Force	$-\cdot00029$,,
Total Force	$-\cdot00024$,,

The monthly results call for no comment, except that they show the effects of the remarkable magnetic disturbance in September.

J. E. CULLUM,

Observer.

Table I.—Declination at Valencia Observatory, Cahirciveen, 1909.

(Dover Unifilar 139.)

Date.		Declination, West.	Monthly Mean.	Remarks.
		° ′	° ′	
January	7 ...	20 54·1		
,,	21 ...	20 54·6	20 54·3	
February	9 ...	20 55·4		
,,	22 ...	20 55·4	20 55·4	
March	8 ...	20 51·8		
,,	23 ...	20 51·2	20 51·5	
April	7 ...	20 49·7		
,,	21 ...	20 49·9	20 49·8	
May	7 ...	20 47·4		
,,	21 ...	20 51·3	20 49·3	
June	7 ...	20 45·6		
,,	22 ...	20 47·3	20 46·5	
July	7 ...	20 43·8		
,,	21 ...	20 47·8	20 45·8	
August	9 ...	20 50·3		
,,	21 ...	20 50·6	20 50·5	
September	7 ...	20 49·7		Auroral display and large magnetic disturbance in September.
,,	21 ...	20 48·5	20 49·1	
October	8 ...	20 50·7		
,,	21 ...	20 47·2	20 48·9	
November	8 ...	20 54·8		
,,	22 ...	20 51·4	20 53·1	
December	7 ...	20 48·7		
,,	27 ...	20 49·2	20 49·0	
Mean	...	at 10 a.m., G.M.T.	20 50·3	

Table II.—Inclination at Valencia Observatory, Cahirciveen, 1909.

(Dover Circle 118.)

Date.	Mean of two needles.	Monthly Mean.	Remarks.
	° ′	° ′	
January 7 ...	68 15·6		
,, 21 ...	68 15·5	68 15·6	
February 9 ...	68 14·7		
,, 22 ...	68 14·9	68 14·8	
March 8 ...	68 14·9		
,, 23 ...	68 15·3	68 15·1	
April 7 ...	68 14·8		
,, 21 ...	68 14·7	68 14·8	
May 7 ...	68 13·9		
,, 21 ...	68 14·1	68 14·0	
June 7 ...	68 15·5		
,, 22 ...	68 15·0	68 15·3	
July 7 ...	68 14·3		
,, 21 ...	68 14·2	68 14·3	
August 9 ...	68 15·1		
,, 21 ...	68 14·6	68 14·8	
September 7 ...	68 14·0		
,, 21 ...	68 15·3	68 14·7	
October 8 ...	68 18·1		
,, 21 ...	68 18·1	68 18·1	
November 8 ...	68 15·4		
,, 23 ...	68 14·4	68 14·9	
December 7 ...	68 14·9		
,, 27 ...	68 13·9	68 14·4	
Mean ...	at 1 p.m., G.M.T.	68 15·1	

Table III.—Magnetic Force (C.G.S.) at Valencia Observatory, Cahirciveen, 1909. (Dover Unifilar 139, and Circle 118.)

Date.	H.F.	Mean.	V.F. H.F. × Tan. Dip.	T.F. H.F. × Sec. Dip.
January 7	0·17866			
,, 21	0·17873	0·17870	0·44814	0·48245
February 9	0·17902			
,, 22	0·17866	0·17884	0·44822	0·48258
March 8	0·17877			
,, 23	0·17870	0·17873	0·44803	0·48236
April 7	0·17879			
,, 21	0·17883	0·17881	0·44812	0·48247
May 7	0·17876			
,, 21	0·17856	0·17866	0·44744	0·48179
June 7	0·17875			
,, 22	0·17893	0·17884	0·44837	0·48271
July 7	0·17881			
,, 21	0·17904	0·17893	0·44822	0·48261
August 9	0·17882			
,, 21	0·17882	0·17882	0·44815	0·48250
September 7	0·17874			
,, 21	0·17896	0·17885	0·44818	0·48255
October 8	0·17859			
,, 21	0·17851	0·17855	0·44871	0·48293
November 8	0·17892			
,, 22	0·17886	0·17889	0·44835	0·48273
December 7	0·17842			
,, 22	0·17889	0·17865	0·44751	0·48189
Mean	at Noon, G.M.T.	0·17877	0·44812	0·48246

REPORT ON THE WORK OF THE ESKDALEMUIR OBSERVATORY FOR THE YEAR ENDING DECEMBER 31st, 1909, MADE BY THE SUPERINTENDENT TO THE DIRECTOR.

POSITION OF OBSERVATORY.—In January, Mr. Gay, Clerk of Works, was instructed by the Office of Works to determine the levels from the fixed bench mark at Davington. He was assisted by Mr. Gendle. The results were :

Height above mean sea level of floor of main building					=	775 ft.
,,	,,	,,	,,	magnet house	=	786 ft.
,,	,,	,,	,,	East hut	=	823 ft.
,,	,,	,,	,,	West hut	=	829 ft.

AZIMUTH OF FIXED MARK.—The time signal was successfully introduced in July, and during that month we obtained six determinations, each involving the four possible positions of mirror, of the azimuth of the fixed mark from the centre pier in the East hut, and one determination for the West hut. The results agreed well and the final values obtained were :

Azimuth of mark from pier of			East hut	=	8° 12′·5 W. of S.
,,	,,	,,	West hut	=	4° 36′·2 W. of S.
			Difference	=	3° 36′·3.

The difference obtained by direct observation in 1908 from the mark itself, using the unifilar circle, was 3° 36′·5.

The observational work may be dealt with under the following heads :—

I. Magnetic Observations.
II. Meteorological Observations.
III. Seismology.
IV. Other Observational and Experimental Work.
V. Miscellaneous.

I. MAGNETIC OBSERVATIONS.

Absolute observations have been carried on in the East hut throughout the year. Improvement of the determination of horizontal force has been the subject of much experiment and careful consideration. After consultation with the Director and Dr. Chree, it was decided to add a balancing ring to collimator magnet 60A, so that the magnet when balanced horizontally for the vibration experiment was also magnetically symmetrical for the deflexion experiment. This change was made in October, and determination of the new moment of inertia was at once carried out. The change appears to have been largely successful. The elimination of small residual errors due to mechanical asymmetry of the instrument is still under consideration.

Tables of the mean monthly values of Horizontal Force, Declination and Inclination for 1909 are given in Appendix I. (pp. 52, 53).

In the early part of the year the magnetograph house gave some promise of improvement as regards dampness, and the Eschenhagen recorders were set up in the West room. Their behaviour there was far from satisfactory, there being frequent evidence of sticking which could not be traced to imperfection of adjustment or interference of spiders. The Adie magnetographs were also set up in the East room in June; but this had no sooner been done than water in considerable quantity made its appearance in the passages, and the humidity rose almost to saturation.

The instruments were therefore removed and the Eschenhagen recorders replaced in the seismograph room, where their behaviour at once improved.

An improvement of the optical arrangements in the Adie magnetographs was carried out in the summer, and the results now seem to be quite satisfactory. Several schemes for drying the magnet house were tried by the Office of Works, and in October the observations showed a marked reduction in the humidity. This, however, was not long maintained; but the condition remaining constant, though at a somewhat higher humidity, in December the Director agreed again to make trial of the place. The recorders have accordingly been installed, but adjustment to suitable sensitiveness and elimination of temperature coefficient will take several weeks at least to complete. The behaviour so far promises well, and in particular it is gratifying to know that within a day after the apparatus had been set up the vertical force magnet had ceased to show any drift. The condition of the magnetograph house is, however, very far from satisfactory, and unless the humidity can be greatly reduced, its permanent occupation is impossible.

II. Meteorological Observations.

It may be said that the whole of our ordinary equipment is now in regular working order. The barograph has been in use the whole year, and the thermograph since February. The great exposure in the thermograph shed rendered necessary special casings to protect the clock and the gas jets and also to prevent rain and snow from drifting into the recording mechanism. We have had a few failures of trace owing to the lights being blown out in high winds. The meteorological tables will be found in Appendix II. (pp. 54-60).

Dr. Shaw suggested that the difference observed last year between the Beckley recorder and the check rain gauge in high winds would be diminished by constructing suitable screens. Accordingly, in the spring, two turf dykes were built, each 4 feet radius and each 2 feet higher than the top of the enclosed gauge. Substantial agreement was now obtained. A comparison between the results obtained from the protected gauges and from a check gauge freely exposed is now in progress.

In connection with our meteorological work an interesting circumstance may be referred to. The late Richard Bell, Esq., of Castle O'er, which is situated half way between the Observatory and Langholm, had from 1888 to 1908 made daily eye observations of atmospheric pressure with a "station" barometer (Kew pattern), and of maximum and minimum temperatures in a Stevenson screen. He also had a Richard barograph in action from 1902 to 1908. A short time before his death, which occurred early this year, he very kindly placed these records at the disposal of the Laboratory. The instruments used have been compared with our own and the thermometers were tested at Kew. The reduction of the observations is in progress, and it is hoped to publish them, with a discussion, in due course.

III. Seismology.

The drifting observed in the Milne seismograph, and referred to last year, suggested examination of the pier, and the slate slab was found to have cracked away from the top of the pier. It was removed and the instrument placed directly on the pier. The drifting, however, continued for a time, but has now become very small.

A Wiechert horizontal seismograph was purchased and delivered here in October. Now that the Eschenhagen recorders have been removed we have made a start with its installation on the experimental pier. A casing is in course of construction, and preparations have been made for applying similar artificial disturbances to the Milne and the Wiechert seismographs.

The register of seismic disturbances is given in Appendix III. (pp. 61, 62).

IV. Other Observational and Experimental Work.

Atmospheric Electricity.—Ebert's ionisation apparatus has been in use since February. The instrument is placed on a small stone pier in the open, and observations taken whenever time and favourable conditions could be obtained. As a full determination of ionisation and conductivity takes over an hour, wind, rain and cold seriously reduce the number of occasions on which observation is possible. We hope to arrange for more systematic observation when magnetic work is fully in order. For recording electrical potential a water-tank with sprayer was fitted up in March, the insulation being carried out with moulded sulphur, which has given most satisfactory results. The recording mechanism was not delivered till the end of September. The electrograph was completed in October. A novel feature of the installation was the introduction of a Dolezalek electrometer (by Bartels, Göttingen). The needle was hung by a phosphor bronze strip so as to give a suitable scale on the paper when a single Weston cadmium cell was connected across the quadrants. The scale obtained was 1 cm. = 200 volts. This appears to be ample sensitiveness for the larger movements which we get during wind and rain, and will be retained for the present. It was foreseen, however, that two scales of sensitiveness would probably be required and so the chronograph was fitted with two cylinders driven by the same clock. It is now intended to fit up, in addition to the Dolezalek instrument, a recording voltmeter with zinc and copper quadrants soldered together so as to dispense with a battery. This has been tested and works quite well for steady potentials. The behaviour of the Dolezalek has proved very good up to 600 or 700 volts on the needle, but at higher potentials and especially when these change rapidly, the needle tends to fly to the side and discharge. We have already experienced very large and rapid fluctuations during wind and rain, and as these are frequent conditions here we have on trial reduced the distance of the jet from the wall to 30 cms.

The ratio of the rate of natural leakage of the system to the rate of collection by the jet is of importance in interpreting the record. Measurements show that the amount of leakage through the sulphur is very small compared with that due to the natural conductivity of the air, and thus the rate of leakage must vary considerably under different meteorological conditions. Systematic observation of the time constants of the system will be made with a view to finding a satisfactory criterion of a reliable record. The same point arises in the eye readings of potential in the open which are also in progress, using a Wulf high potential electrometer and elevated fuse. Investigation of the various sources of error is being made and will be continued. Some details will be found in Appendix II.

Solar Radiation.—The Ångström Pyrheliometer has been used throughout the year (see Appendix II., Table V., p. 60). The observations are not very numerous, partly because other matters claimed first attention, but chiefly because the sun was so seldom available. Several points of importance have, however, appeared. It has struck me as remarkable that a brisk wind was generally favourable to steadiness of the reading, while a calm day was often marked by unsteadiness. Again, one sometimes noticed that a reading near noon was actually less than one taken later or earlier in the day. This seems to be accounted for by the late Dr. Pernter's hypothesis of "invisible clouds," and here the hills are so saturated with moisture that a hot sun generally brings on a fine haze about the middle of the day.

V. Miscellaneous.

Library.—We gratefully acknowledge contributions of magnetic reports from Stonyhurst, Helwan, the U.S. Coast and Geodetic Survey Department, the Royal Observatory, Potsdam, and the Royal Observatory, Uccle, also seismological reports from Dr. Milne and the State Laboratory, Hamburg. Prince Galitzin most kindly sent a complete set of his publications on seismology and continues to send copies of his papers as they appear. Various memoirs on Meteorology have been sent by the Meteorological Office.

General.—Numerous readings of temperature and humidity, and special experiments connected with the magnetograph house have taken up a considerable amount of time. These do not appear in tables, but they form a very important contribution to the progress of the magnetograph house which is of vital importance to our work.

The Superintendent desires to record his appreciation of the cordial support of all members of the staff in carrying on the work of the Observatory.

GEORGE W. WALKER,

Superintendent.

APPENDICES TO THE REPORT OF THE SUPERINTENDENT OF ESKDALEMUIR OBSERVATORY.

APPENDIX I.

MAGNETIC OBSERVATIONS, 1909, ESKDALEMUIR OBSERVATORY.

Horizontal Force (*Appendix I., Table I.*).—The three observers each took observations once a week until the end of July. In the deflection experiment the distances used were 22·5, 30, and 40 cms. Since the magnet was not symmetrical, a double setting mark on the magnet carriage was used, in order to make the deflection angles on reversal of the magnet nearly equal. It was then decided to rebalance the magnet so that the single setting mark would give angles sufficiently agreeing to admit of averaging without error. The change was made in October, and the new moment of inertia forthwith determined.

Further, it was decided that the Superintendent should continue a weekly observation, using the distances 22·5, 30, and 40 cms., in order to obtain the P and Q corrections. The assistants now alternately take a weekly observation, but use only distances 30 and 40 cms.

It has been thought desirable to change from 22·5 cms. to 25 cms.; as further there is some evidence that individual observations at 40 cms. are subject to larger observational error than at shorter distances, it is proposed to investigate whether 35 cms. will give more consistent results from day to day. Thus in the new year the Superintendent will use four distances, viz., 25, 30, 35 and 40 cms., until sufficient evidence is forthcoming.

Declination and Inclination (*Appendix I., Tables II., III.*).—The observations are now made by the two assistants.

The observations are always made in the East Hut. In the case of Horizontal force and Declination Magnetometer Elliott No. 60 is used on the centre pier, while the observations of Inclination are made with Inclinometer Dover No. 74, with needles 1 and 2 on the adjoining east pier.

APPENDIX I.—Table I.

Mean Monthly Values of Horizontal Force (Absolute). (All Observers).

1909. Month.	Time h. m.	Hor. Force.	Mag. Moment at 0°C.	No. of Obvs.
January	12 24 P.M.	·16845	911·4	11
February	12 8 P.M.	46	·6	11
March	12 0 NOON	40	·7	12
April	11 53 A.M.	31	·6	12
May	11 57 A.M.	41	·2	13
June	12 6 P.M.	44	·6	13
July	12 27 P.M.	49	·4	8
August	12 3 P.M.	33	910·8	6
September ...	12 2 P.M.	35	911·1	4
October 1-8 ...	11 41 A.M.	01	·4	3
Means	12 4 P.M.	·16837	911·4	
October 8-31...	12 29 P.M.	·16808	911·8	6
November......	11 53 A.M.	·16816	911·8	9
December	12 4 P.M.	·16829	911·8	9
Means	12 9 P.M.	·16818	911·8	
Means for year	12 5 P.M.	·16835	911·5	

APPENDIX I.—TABLE II.

Mean Monthly Values of Declination (Absolute).

1909. Month.	Mean Time. a.m.	Declination W.	No. of Obvs.
	h. m.	° ′	
January	11 29	18 32·1	11
February	11 24	32·8	12
March...........	11 11	32·4	14
April	11 5	30·0	13
May..............	11 12	29·6	13
June	11 24	29·9	13
July..............	11 43	29·0	8
August	11 40	33·0	5
September......	11 44	30·0	4
October	11 41	28·7	4
November	11 21	28·4	5
December	11 22	25·3	4
Means	11 26	18° 30′·1	

APPENDIX I.—Table III.

Mean Monthly Values of Inclination (Absolute).

1909 Month.	Mean Time. p.m.	Inclination N.	No. of Obvs.
	h. m.	° ′	
January	2 55	69 39·8	11
February	2 54	39·6	12
March...........	2 51	39·0	14
April	2 57	38·3	13
May..............	2 31	38·0	13
June	2 41	37·2	13
July..............	2 25	37·4	8
August	3 1	37·8	5
September......	2 51	39·8	4
October	2 47	40·5	4
November	2 41	40·5	5
December	2 42	39·4	4
Means.........	2 46	69° 38′·9	

APPENDIX II.—METEOROLOGICAL OBSERVATIONS, 1909, ESKDALEMUIR OBSERVATORY.

The photographic barograph is situated in the east room of the Magnet House. The cistern is 788 feet above sea level.

The eye reading standard barometer is situated on the ground floor of the office and the cistern is 778 feet above sea level.

The photographic wet and dry bulb thermograph is enclosed in a shed 11ft. by 9ft. and 9ft. high. Thorough ventilation is secured by louvered boards and a top lobster-back chimney, and the shed is removed from all buildings.

The Stevenson screen is situated a little to the west of the thermograph shed, and is also freely exposed.

The head of the Dines pressure tube anemometer is 50 feet above the ground floor of the office and 14 feet clear of the top of the tower.

The Campbell Stokes sunshine recorder is some distance north of the office and is set on a stone pier 5 feet high, the general level of the ground there being about 800 feet above sea level. The hills generally slightly diminish the theoretical possible amount of sunshine. The chief obstacle is Fedling Hill, situated rather near to the east. It does not interfere at the summer and winter solstices, but towards the equinoxes it cuts off part of the morning sunshine by an amount which I estimate at half an hour.

The Beckley recording rain gauge has a diameter of 11¼″, and the rim stands 22 inches above the ground. It is protected by a circular turf dyke, 4 feet radius and 2 feet above the level of the rim.

The protected check rain gauge stands 24½ feet east of the Beckley recorder. The diameter is 8″ and height of the rim 8″. The dyke is 4 feet radius and 2 feet above the rim.

A check gauge freely exposed is placed 28 feet east of the protected check gauge. The diameter is 8″ and height of rim 11″.

The protecting dykes were built during March and April, while the exposed gauge was set up on August 14th.

The two protected gauges agree well on the whole, although occasional small differences occur. The exposed gauge, however, frequently collects more than the others, and the evidence so far is that this generally occurs in high winds. An enquiry is in progress, and it is sufficient at present to state that from August 14th to December 31st the quantities collected were, Beckley recorder, 22 inches; protected check gauge, 22·5 inches; exposed check gauge, 27·7 inches. The total collected for the year in the check gauge, which was exposed until April and protected since then, was 51·2 inches.

Atmospheric Electricity.—Table IV gives the results obtained by the use of Ebert's Ionisation Apparatus. Since the number of observations is small, individual determinations are given, as an average of only a few readings a month is not representative. It may be explained that a zero result simply implies that using the six-minute interval the quantities were too small to be measurable. A number of ions less than 30 per cc. cannot be determined, and the smallest measurable conductivity is about 7×10^{-27} absolute electromagnetic units. When either no positive or negative ions have been indicated, the corresponding specific velocity experiment does not necessarily fail, but the result is of very doubtful significance.

Atmospheric Electrical Potential.—Concurrently with the start of the electrograph, preparations for eye readings of potential gradient in the open were made; a space removed from all buildings was selected and a circle of 6 feet radius was levelled. A stone pier, 2½ feet high, carries the apparatus, which consists of a Wulf high potential electrometer and the collector. The present arrangement is provisional only and consists of a telescopic arrangement of brass tube carried vertically on a sulphur plug and holding a burning fuse at the top. The fuse can be elevated to a height of 3 metres from the ground.

Investigation of the sources ef error has been made and will be continued.

Errors arise from

(1) Presence of the pier and observer.
(2) Natural leakage of the insulated system.
(3) Presence of the insulated system.

(1) The pier, electrometer and observer *in situ* roughly resemble a half of a prolate spheroid, and so the disturbing effect can be computed. It is found that at three metres above the ground the potential is reduced by about 1 % of its true value. This error could be entirely removed by observing inside a pit covered with a flat metal plate, through which a connection to the fuse would pass.

(2) Recovery to a steady potential is nearly exponential, and the effects are simply expressed in terms of the time constants T_1 and T_2, when the fuse is and is not acting. The true potential is reduced by a fraction $\frac{1}{2}\,T_1/T_2$ of its value. Now T_2 depends almost entirely on the air conductivity and is therefore very variable. Thus determination of the time constants is most important. Experiments in the open have been found a little uncertain owing to inductive action of changing potential gradient, but some guide is afforded by experiments indoors. T_1 is found to be about ½ min., while T_2 has frequently been about 1 hour, but as has been said, T_2 might fall to ½ hour or even less. Good insulation is a *sine quâ non*, and a simple and conclusive test of this is proved by observing that outside the system acquires a very considerable potential in the course of an hour even when the fuse is not acting. This could not happen if leakage through the support was at all comparable with the surface action of air conductivity. It is desirable to keep the surface as small as possible, and compensation of the air conductivity might be secured by attaching the fuse half way up instead of at the top.

(3) Any practical system may be expected to disturb the true potential at the fuse. Investigation is being made as to what arrangement would give least disturbance and whether it is possible to compute the effect.

Solar Radiation.—Table V.—The number of occasions on which the sun was available between 11 a.m. and 1 p.m., as prescribed by International Regulations, was extremely small. It has therefore been thought desirable to give all readings obtained, but without any deduction as to the value of the "solar constant."

APPENDIX II.—Table I.

Barometric Height from Photographic Recorder, corrected to 32° F. at latitude 45° and mean sea level.

1909. Months.	Mean from Hourly Readings.	Absolute Extremes.			
		Max.	Date.	Min.	Date.
	inches.	inches.		inches.	
January ...	30·045	30·712	4 10.30 A.M.	28·635	14 11.0 P.M.
February...	30·107	30·626	13 9.50 A.M.	29·291	9 11.15 P.M.
March	29·562	30·173	12 1.50 A.M.	28·984	25 1.0 A.M.
April	29·902	30·534	2 8.25 A.M.	29·292	13 9.45 P.M.
May	30·090	30·454	6 9.15 P.M.	29·364	26 7.0 P.M.
June.........	29·996	30·390	17 9.45 P.M.	29·252	22 6.50 P.M.
July		30·230*	19 10.0 P.M.	29·182†	25 10.15 P.M.
August......	29·973	30·307	5 10.0 P.M.	29·545	31 2.35 A.M.
September	30·067	30·440	14 NOON	29·319	7 0.50 A.M.
October ...	29·641	30·347	31 11.30 P.M.	28·980	5 0.15 P.M.
November	29·981	30·399	23 9.0 A.M.	28·868	30 3.5 P.M.
December	29·617	30·651	14 11.0 A.M.	28·121	3 2.5 A.M.
Mean for the year	29·907				

* Barograph not working from 1st to 13th. Richard Barograph shews equal max. on 1st at 10 p.m.
† Correct.

APPENDIX II.—Table II.

Monthly Mean Results of Temperature at Eskdalemuir Observatory from the Photographic Recorder.

1909. Months.	Dry Bulb. Mean of Hourly Readings.	Dry Bulb. Means of Daily Max.	Dry Bulb. Means of Daily Min.	Dry Bulb. Means of Daily Max. and Min.	Dry Bulb. Absolute Extremes. Max.	Date.	Min.	Date.	Wet Bulb. Mean of Hourly Readings.	Wet Bulb. Means of Daily Max.	Wet Bulb. Means of Daily Min.	Wet Bulb. Means of Daily Max. and Min.	Wet Bulb. Absolute Extremes. Max.	Date.	Min.	Date.
	F.	°F.	°F.	°F.	°F.		°F.		°F.	°F.	°F.	°F.	°F.		°F.	
Jan.* ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Feb. ...	34·5°	40·0°	28·0°	34·0°	50·0°	3 1 P.M.	19·7°	13 Midt.	33·1°	37·3°	27·5°	32·4°	44·6°	2 2 P.M.	20·6°	13 Midt. (Bulb Frozen).
March	33·2	37·8	28·6	33·2	51·9	22 3 P.M.	17·1	17 2 A.M.	32·0	36·3	27·1	31·7	44·2	22 1 P.M.	8·6	5 6 A.M.
April ...	41·5	49·8	32·5	41·2	59·3	19 4 P.M.	24·4	10 6 A.M.	39·2	44·8	33·1	38·9	50·8	8 3 P.M.	23·8	10 6 A.M.
May ...	45·6	54·5	35·6	45·0	63·2	24 4 P.M.	18·3	16 5 A.M.	42·2	47·2	34·6	40·9	58·0	22 4 P.M.	19·6	16 4 A.M. (Bulb Frozen).
June ...	50·0	59·1	39·3	49·2	67·4	13 3 P.M.	30·0	13 4 A.M.	46·4	52·0	38·9	45·5	57·7	14 1 P.M.	28·8	13 4 A.M.
July ...	52·6	59·5	46·2	52·8	67·5	12 4 P.M.	35·2	12 4 A.M.	50·3	55·0	44·2	49·6	66·8	12 4 P.M.	34·8	12 5 A.M.
Aug. ...	55·0	62·8	45·7	54·2	74·3	8 3 P.M.	38·6	31 Midt.	52·3	57·6	45·0	51·3	66·1	12 3 P.M.	35·1	3 5 A.M.
Sept. ...	48·5	56·8	40·4	48·6	63·4	17 2 P.M.	29·5	2 6 A.M.	46·5	51·5	39·9	45·7	57·2	24 2 P.M.	29·4	2 6 A.M.
Oct. ...	44·1	49·6	38·8	44·2	59·6	4 Noon	24·4	31 7 A.M.	43·5	48·3	37·6	43·0	57·1	3 2 P.M.	17·8	30 7 A.M.
Nov. ...	36·1	43·4	28·0	35·7	57·6	3 3 P.M.	16·3	14 1 A.M.	35·1	39·9	27·9	33·9	54·1	3 3 P.M.	17·1	14 1 A.M. (Bulb Frozen).
Dec. ...	34·9	39·2	28·7	34·0	49·0	28 3 A.M.	11·2	8 9 A.M.	33·2	37·1	27·3	32·2	48·6	10 7 A.M.	11·2	8 9 A.M.

* The Thermograph was not working normally until the beginning of February.

APPENDIX II.—TABLE III.

Wind Velocity by Dines Pressure Tubes.

1909. Months.	Horizontal Movement of the air.				Bright Sunshine.			
	Means of Hourly Readings. Miles per hour.	Highest Gust.			Total Number of Hours recorded.	Mean Percentage of Possible Sunshine	Greatest Daily Record.	Date.
		Miles per hour.	Date.	Hour.				
					h.	%	h.	
January	12·3	78·0	16	1.20 P.M.	40·6	17	5·6	8
February	10·4	61·0	2	9.10 P.M.	76·3	29	9·0	20
March	11·5	47·5	11	9.50 A.M.	80·1	22	10·1	16
April	11·1	61·5	12	1.5 P.M.	158·3	38	11·9	5
May	11·1	44·5	6	3.25 P.M.	200·1	40	14·9	8
June	9·4	40·0	20	4.25 P.M.	178·7	35	16·0	15
July	12·8	50·0	23	0.20 P.M.	150·9	29	15·3	8
August	10·5	46·5	31	2.15 A.M.	154·3	34	14·2	9
September	8·0	39·0	1	9.25 A.M.	118·9	32	11·5	15
October	14·6	74·0	14	7.25 P.M.	74·3	23	7·9	28
November	10·1	71·0	12	10.30 P.M.	86·8	36	7·9	15
December	10·3	56·0	3	5.50 A.M.	43·7	20	6·4	21
Mean for the Year ...	11·0	78 0	Jan. 16	1.20 P.M.	1363·0*	31**	...	...

*Total for year.

**This figure applies to the total possible for the year; it is not the arithmetic mean of the monthly readings.

APPENDIX II.—TABLE IV.

Atmospheric Ionisation and Electrical Conductivity, using Ebert's apparatus.

Date.	Mean Time.	Positive Ions.		Negative Ions.		Air Conductivity in Absolute Electro-Magnetic Units.
		Number per cc.	Velocity for 1 volt per cm.	Number per cc.	Velocity for 1 volt per cm.	
1909.	h. m.		cms. per sec.		cms. per sec.	
Feb. 16...	3 24 P.M.	180	1·68	30	·50	$·35 \times 10^{-25}$
,, 18...	11 54 A.M.	210	1·47	120	·80	·45
,, 22...	12 4 P.M.	450	1·16	510	·29	·74
March 4...	10 50 A.M.	1170	·00	990	1·0	1·09
,, 8...	2 38 P.M.	240	·98	0	1·5	·26
,, 16...	11 30 A.M.	510	1·43	60	·29	·82
,, 22...	12 20 P.M.	510	1·1	60	1·9	·74
,, 23...	2 48 P.M.	300	.69	120	·55	·30
April 5...	11 58 A.M.	390	·58	450	1·40	·94
,, 6...	11 12 A.M.	150	·79	60	·00	·13
,, 8...	11 7 A.M.	90	·82	0	2·20	·08
,, 13...	11 31 A.M.	810	·55	690	1·0	1·25
,, 19...	11 37 A.M.	480	·80	270	·34	·52
,, 27...	11 17 A.M.	360	Failed (Rain)	510	1·3	—
,, 29...	10 56 A.M.	840	2·2	810	·66	2·67
May 4...	2 41 P.M.	90	1·4	120	·66	·23
,, 8...	11 23 A.M.	510	·6	360	1·2	·81
,, 10...	12 14 P.M.	750	·76	390	·82	·98
,, 24...	12 30 P.M.	540	Failed	390	Failed	—
June 1...	11 19 A.M.	600	·71	450	·24	·59
,, 3...	11 28 A.M.	390	.·60	330	·00	·24
,, 7...	12 29 P.M.	150	1·24	180	1·29	·46
,, 14...	2 49 P.M.	270	·84	390	·99	·67
July 1...	12 2 P.M.	510	1·29	420	1·1	1·23
,, 26...	11 54 A.M.	180	·90	210	1·28	·47
Aug. 3...	12 32 P.M.	270	·34	120	1·2	·26
,, 11...	12 26 P.M.	330	1·28	150	·37	·53
Oct. 4...	11 49 A.M.	900	1·03	450	·16	1·10
Nov. 3...	2 37 P.M.	900	·73	150	·82	·86
,, 18...	11 43 A.M.	660	1·29	360	1·20	1·41
Dec. 4...	12 28 P.M.	360	·00	0	—	·00
,, 27...	12 18 P.M.	1170	·98	0	·44	1·26

APPENDIX II.—TABLE V.

Measurement of Solar Radiation by Ångström's Pyrheliometer.

Date.		Mean Time.		Temp. C.	Cosine Zenith Dist.	Radiation in calories per sq. cm. per min.	
1909		h. m.					
Jan.	12	2 40	P.M.	2°	·130	·558	
,,	19	11 40	A.M.	3·5	·217	·855	
,,	27	12 50	P.M.	7	·275	·881	
Feb.	5	10 0	A.M.	4	·211	·910	
,,	5	12 0	NOON	5	·316	1·105	
,,	13	12 0	NOON	6	·358	1·138	
,,	16	12 0	NOON	8	·375	·883	
,,	19	12 0	NOON	6·2	·392	·935	
,,	20	11 45	A.M.	9	·396	1·017	
March	4	11 45	A.M.	6	·463	1·133	
,,	5	11 50	A.M.	8	·471	1·209	
,,	8	1 45	P.M.	6·5	·460	·877	
,,	16	12 30	P.M.	—	·542	1·015	
April	5	2 20	P.M.	14	·570	1·098	
,,	6	10 0	A.M.	11	·559	1·184	
,,	6	12 0	NOON	15·8	·655	1·236	
,,	7	12 30	P.M.	16	·660	·866	
,,	8	11 50	A.M.	16·8	·666	·850	
May	5	12 20	P.M.	17	·775	1·252	
,,	6	10 45	A.M.	17	·741	1·281	
,,	6	10 45	A.M.	17	·741	·062	Through blue shade
,,	6	10 45	A.M.	17	·741	·103	,, green ,,
,,	6	10 45	A.M.	17	741	·846	,, water ,,
,,	8	10 5	A.M.	16	·706	1·336	
,,	8	12 5	P.M.	26	·784	1·330	
,,	10	10 40	A.M.	16	·750	1·295	
,,	10	10 40	A.M.	16	·750	·060	Through blue shade
,,	10	10 40	A.M.	16	·750	·105	,, green ,,
,,	10	10 40	A.M.	16	·750	·857	,, water ,,
June	3	12 15	P.M	18·5	·838	1·181	
,,	7	12 20	P.M.	18	·842	1·147	
,,	7	1 40	P.M.	18	·803	1·279	
,,	15	1 50	P.M.	18·5	·802	·045	Through water + blue shades
,,	15	1 55	P.M.	18·5	·797	·050	,, ,, + green ,,
,,	15	2 35	P.M.	19·5	·751	1·316	
,,	30	1 40	P.M.	18	·805	1·284	
July	1	10 45	A.M.	16·5	·806	1·308	
,,	1	12 40	P.M.	24	·844	1·299	
,,	1	5 5	P.M.	26	·429	1·100	
Aug.	6	11 58	A.M.	20	·780	1·273	
,,	9	10 25	A.M.	21	·709	1·295	
,,	9	11 56	A.M.	21·5	·771	1·284	
,,	9	12 20	P.M.	23	·774	1·300	
,,	9	2 5	P.M.	23	·716	1·265	
,,	9	3 0	P.M.	24	·572	1·210	
,,	9	4 25	P.M.	23·5	·484	1·093	
Oct.	25	11 55	A.M.	8	·386	1·206	
Nov.	15	12 15	P.M.	6·5	·278	1·085	
,,	23	11 20	A.M.	7·5	·242	1·060	
Dec.	21	11 54	A.M.	3	·194	·989	

APPENDIX III.

SEISMOLOGICAL OBSERVATIONS, 1909, ESKDALEMUIR OBSERVATORY.

In accordance with Dr. Milne's advice a standard determination of sensitiveness was made when the period of the booms was 18 seconds. Weekly determination of the period has been made, and the sensitiveness calculated from the standard value.

Table I gives the record of disturbances in which the amplitude was not less than 1 mm. on the photographic trace. A complete record of all movements since 1st July has been sent to Dr. Milne. The absolute times before that date are somewhat uncertain, since no time signal was available.

APPENDIX III.—TABLE I.

Principal Disturbances recorded on Milne Twin-boom Seismograph.

Date.		P.T. Commence.		Max. at.		Duration.		Max. Ampt. mms.	Scale Value 1 mm. =	Direction of Displacement.
1909.		h.	m.	h.	m.	h.	m.		"	
January	23	2	58	3	17·5	1	58	10·0	0·44	E.W.
,,	23	3	5	3	16·5	1	56	10·+	·44	N.S.
February	26	17	9	17	36	1	1	1·0	·39	E.W.
,,	26	17	8	17	36	1	1	0·3	·38	N.S.
March	12-13	23	42·5	0	19·5	1	50	1·2	·39	E.W.
,,	12-13	23	42·5	0	18	1	50	1·3	·39	N.S.
,,	13	14	42·5	15	20	3	26	2·2	·39	E.W.
,,	13	14	42·5	15	26·5	3	25	2·0	·39	N.S.
April	10	5	52	6	49	2	19	1·9	·39	E.W.
,,	10	5	52	6	51	2	21	1·3	·39	N.S.
,,	10	18	48	19	17	?		0·9	·39	E.W.
,,	10	18	48	19	19	?		1·0	·39	N.S.
,,	10	?		20	21	?		1·5	·39	E.W.
,,	10	?		20	32	?		1·7	·39	N.S.
,,	14	20	17	20	50	0	58	0·9	·39	E.W.
,,	14	20	17	20	51	0	58	1·0	·39	N.S.
,,	23	17	47	17	49	0	29	6·2	·39	E.W.
,,	23	17	47	17	47	0	26	2·8	·39	N.S.
,,	27	13	12	13	59	1	10	1·9	·40	E.W.
,,	27	13	12	13	59	1	10	2·0	·39	N.S.
May	17	8	16	8	25	2	27	1·4	·39	E.W.
,,	17	8	16	8	26	2	31	1·5	·39	N.S.
,,	30	6	21	6	27·5	0	43	1·9	·39	E.W.
,,	30	6	21	6	27·5	0	46	1·2	·39	N.S.
June	3	18	56	19	40	2	43	5·5	·39	E.W.
,,	3	18	59	19	39	2	45	5·2	·39	N.S.
,,	8	6	0	6	46	2	37	3·7	·39	E.W.
,,	8	6	0	6	39	2	42	2·5	·39	N.S.

Note.—The times recorded in this table are G.M.T., midnight = 0 or 24 hours.

TABLE I.—continued.

Date.		P.T. Commence.		Max. at.		Duration.		Max. Ampt. mms.	Scale Value. 1 mm. =	Direction of Displacement.
1909.		h.	m.	h.	m.	h.	m,		″	
June	11	21	6·5	21	7·5	0	23·5	1·5	0·39	E.W.
,,	11	21	7	21	8·5	0	23	1·0	·39	N.S.
July	7	21	43·5	21	56·5	3	45	6·4	·38	E.W.
,,	7	21	43·5	21	56	3	41	9·3	·38	N.S.
,,	30	11	4	11	42·5	4	54	7·5	·37	E.W.
,,	30	11	4	11	42	5	1	2·3	·37	N.S.
,,	31	19	31	20	9·5	2	29	2·3	·37	E.W.
										N.S. (not working).
August	16	7	22	7	44	0	59	1·9	·37	E.W.
,,	16	7	21	7	47	1	0	1·1	·37	N.S.
October	20-21	23	59	0	19	1	31	5·6	·37	E.W.
,,	20-21	23	59	0	20·5	1	31	11·5	·36	N.S.
,,	30-31	21	4	11	14	16	2	1·5	·39	E.W.
,,	30-31	21	1	11	20	16	5	1·5	·38	N.S.
November	10	6	25	7	1	2	40	2·5	·38	E.W.
,,	10	6	25	7	2	2	40	2·6	·36	N.S,
,,	21	?		8	33	?		1·8	·36	E.W,
,,	21	?		8	33	?		2·3	·37	N.S.
December	9	15	55	16	55	?		0·8	·39	E.W.
,,	9	15	55	16	55·5	?		1·0	·37	N.S.
,,	10	?		0	29	?		0·9	·39	E.W.
,,	10	?		0	31·5	?		1·4	·37	N.S.