

PROCEEDINGS

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OF THE

ROYAL SOCIETY OF LONDON.

*From January 18 to April 26, 1894.*

VOL. LV.

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MDCCCXCIV.

*Report of the Incorporated Kew Committee for the Year  
ending December 31, 1893.*

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The operations of The Kew Observatory, in the Old Deer Park, Richmond, Surrey, are controlled by the Incorporated Kew Committee, which is constituted as follows :—

Mr. F. Galton, *Chairman.*

Captain W. de W. Abney, C.B., R.E.	Prof. A. W. Rücker.
Prof. W. G. Adams.	Mr. R. H. Scott.
Captain E. W. Creak, R.N.	Lieutenant-General R. Strachey, C.S.I.
Prof. G. C. Foster.	General J. T. Walker, C.B.
Admiral Sir G. H. Richards, K.C.B.	Captain W. J. L. Wharton, R.N.
The Earl of Rosse, K.P.	

On February 9 the Kew Committee became registered under the Companies Acts, 1862 and 1867, as the "Incorporated Kew Committee of the Royal Society."

The Memorandum and Articles of Association are given in Appendix A.

It is with deep regret that the Committee have to report the decease of the late Superintendent of the Observatory, Mr. G. M. Whipple, B.Sc., which occurred on the 8th of February, after a serious illness of more than seven months. He had been connected with the Observatory in various capacities for thirty-four years, and had filled the office of Superintendent since 1876. Under his efficient management the work at the Observatory had been largely augmented in amount and variety, and the funds at its disposal for purchase of apparatus and extension of its premises had steadily increased. Mr. Whipple was the author of numerous papers on Meteorological and other subjects connected with the work of the Observatory, which appeared in the 'Proceedings of the Royal Society,' the 'Quarterly Journal of the Royal Meteorological Society,' and other scientific publications.

During the year there also occurred the death of Mr. H. McLaughlin, Librarian and Accountant, whose connexion with the Observatory had extended over twenty years.

The Committee having invited applications for the vacant post of Superintendent, selected from amongst the candidates Mr. Charles Chree, M.A., Fellow of King's College, Cambridge, Sixth Wrangler 1883, First Division Part III of the Mathematical Tripos, and First Class in Part II of the Natural Sciences Tripos, 1884. Mr. Chree entered on his duties on May 15.

During the earlier part of the year the work of the Observatory was carried out by Mr. Baker, the Chief Assistant, to the entire satisfaction of the Committee. They desire that his services should be specially recorded, and they are glad to state that the routine work of the Observatory has in no way suffered owing to the enforced absence of the Superintendent for the early months of the past year.

The work at the Observatory may be considered under the following heads:—

- 1st. Magnetic observations.
- 2nd. Meteorological observations.
- 3rd. Solar observations.
- 4th. Experimental, in connexion with any of the above departments.
- 5th. Verification of instruments.
- 6th. Rating of Watches and Marine Chronometers.
- 7th. Miscellaneous.

#### I. MAGNETIC OBSERVATIONS.

The magnetographs have been in constant operation throughout the year, and the scale values of all the instruments were determined in January.

The ordinates of the various photographic curves were then found to be as follows:—

Declinometer : 1 inch =  $0^{\circ} 22' \cdot 04$ . 1 cm. =  $0^{\circ} 8' \cdot 7$ .

Bifilar, January 18, 1893, for 1 inch  $\delta H = 0 \cdot 0274$  foot grain unit.

„ 1 cm. „ =  $0 \cdot 00050$  C.G.S. unit.

Balance, January 19, 1893, for 1 inch  $\delta V = 0 \cdot 0277$  foot grain unit.

„ 1 cm. „ =  $0 \cdot 00050$  C.G.S. unit.

The distance between the dots of light upon the Vertical Force cylinder having become too small for satisfactory registration, the position of the zero dot was altered on January 23.

The toothed wheel of the Declination cylinder being much worn,

a new one was obtained from Adie, London, and fitted to the cylinder on July 5.

On August 10 the clock was dismantled and cleaned.

As regards Magnetic Disturbances, no very large movements have been registered during the year. The principal oscillations that were recorded took place on the following days:—

February 4—5, March 14—15, April 26, June 18—19, July 16, August 6—7 and 18, November 1—2.

The hourly means and diurnal range of the magnetic elements for 1893, for the quiet days selected by the Astronomer Royal, will be found in Appendix I.

The following are the mean results for the entire year:—

Mean Westerly Declination . . . . .	17° 28'·8
Mean Horizontal Force . . . . .	0·18238 C.G.S. units.
Mean Inclination . . . . .	67° 26'·3
Mean Vertical Force . . . . .	0·43896 C.G.S. units.

The observations of Horizontal Force, Inclination, and Declination with the absolute instruments have been made in accordance with the usual practice.

Captain Schück visited the Observatory in July, and made a series of absolute magnetic observations in order to compare his own instruments with those of Kew, prior to his continuing his magnetic survey on the banks of the Elbe.

The temperature coefficients of the magnets employed by Captain Schück were determined at Kew.

The magnetic instruments have been studied and a knowledge of their manipulation obtained by Lieutenants Parry and Tancred, of the Royal Navy, who visited the Observatory from December 4 to December 20.

## II. METEOROLOGICAL OBSERVATIONS.

The several self-recording instruments for the continuous registration respectively of Atmospheric Pressure, Temperature of Air and Wet-bulb, Wind (direction 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 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.

A summary of the results for the year is given in Appendix II, Tables I, II, and III.

With the sanction of the Meteorological Council, data have been supplied to the Council of the Royal Meteorological Society, the Institute of Mining Engineers, the editor of 'Symons's Monthly Meteorological Magazine,' Dr. Rowland, and others.

Detailed information of thunderstorms observed in the neighbourhood during the year has been forwarded to the Royal Meteorological Society.

*Anemograph.*—The "worm" on the direction fan-spindle had become very thin through wear, causing considerable "back-lash;" a new one has been put in hand by Munro, and will be fitted up at an early date.

The new square-headed pricker, mentioned in the last Report, has been rather unsatisfactory in its action, and will be shortly replaced by a round one, made of specially hardened steel.

*Rain-gauge.*—The Willesden prepared papers have been in daily use on the self-recording Beckley gauge, and although the curves obtained are clear and distinct, yet the defect of the lengthening of the sheets in wet weather has not been entirely overcome.

Circular letters were sent to several prominent paper makers asking for samples of material, specially prepared, to be used in a very damp atmosphere; but of those thus obtained, only one sample (supplied by Messrs. Waterlow and Sons) showed no appreciable lengthening in the dampest atmosphere producible artificially. It has, however, some counterbalancing defects, which render its superiority to the Willesden paper for the purpose in view somewhat doubtful.

*Barograph.*—At the request of the Meteorological Office an investigation has been carried out as to the causes of fluctuations that present themselves in the value of the residual correction to the barograph readings, which is deduced by comparison of simultaneous readings of the barograph and a standard barometer.

An analysis was made of the value of the residual correction between May, 1892, and October, 1893, while numerous measurements were taken of the width of the temperature compensation to the barogram at different temperatures. The data obtained accounted for a very considerable part, at least, of the irregularities observed in the residual correction.

A report embodying an analysis of the results has been sent to the Meteorological Office.

*Electrograph.*—This instrument has been in regular action during the year, but its performance on the whole has been rather unsatisfactory. Early in the year the needle-suspension being accidentally broken, another was fitted without delay, and a new determination

made of the scale value. Subsequent re-determinations were carried out in May, July, and November.

It is intended to take advantage of the first spell of frosty weather to dismount and thoroughly overhaul the instrument, and to open out the scale, which has for some time past been too contracted.

*Inspections.*—In compliance with the request of the Meteorological Council, Mr. Baker visited and inspected the Observatories at Stonyhurst, Glasgow, Fort William, and Aberdeen, and the Anemograph Stations at Yarmouth, North Shields, Alnwick Castle, Deerness (Orkney), Fleetwood, and Holyhead; while Mr. Constable inspected the Observatories at Oxford and Falmouth.

### III. SOLAR OBSERVATIONS.

*Sun-spots.*—Sketches of Sun-spots have been made on 155 days, and the groups numbered, after Schwabe's method.

Particulars will be found in Appendix II, Table IV.

The marked exhibition of solar activity noted in last report has continued, and although no phenomenally large group of Sun-spots has appeared, yet no one observation has been recorded in which the Sun's surface was entirely free from spots.

*Time Signals.*—These have been regularly received from Greenwich through the G.P.O., with the exception of a few days, on which occasions supplementary signals were transmitted at later hours.

### IV. EXPERIMENTAL WORK.

*Richard's Anemo-cinemograph.*—This instrument, which has been at the Observatory since May, 1891, was at the end of the year returned to Mr. Casella, by request of the makers.

*Cloud Photographs.*—Operations connected with cloud photography have been suspended during the past year.

*Fog and Mist.*—The observation of a series of distant objects referred to in the last report has been continued. A note is taken of the most distant of the selected objects which is visible at each observation hour. An analysis of the results for the period May, 1892, to December, 1893, is at present being carried out.

During the thickest fog experienced in the past year, at one of the hours of observation the most distant object visible was only 12 feet off.

### V. VERIFICATION OF INSTRUMENTS.

The subjoined is a list of the instruments examined in the year 1893, with the corresponding results for 1892:—

	Number tested in the year ending December 31.	
	1892.	1893.
Air-meters .....	9	15
Anemometers .....	4	24
Aneroids .....	74	59
Artificial horizons.....	22	15
Barometers, Marine.....	74	98
,, Standard .....	61	50
,, Station.....	18	30
Binoculars .....	168	466
Compasses.....	28	12
Deflectors .....	20	4
Hydrometers.....	395	591
Inclinometers .....	1	2
Photographic Lenses .....	18	31
Magnets.....	1	3
Navy Telescopes .....	487	913
Rain Ganges .....	9	19
Rain Measures.....	13	37
Sextants.....	463	517
Sextant Shades .....	52	47
Sunshine Recorders.....	1	1
Theodolites .....	6	2
Thermometers, Arctic.....	50	44
,, Avitreous or Immisch's .....	71	54
,, Chemical .....	44	57
,, Clinical .....	16,850	14,682
,, Deep sea.....	31	69
,, Meteorological .....	1,875	2,246
,, Mountain .....	17	18
,, Solar radiation .....	1	2
,, Standard .....	79	88
Unifilars .....	1	1
Vertical Force Instruments.....	5	0
Total.....	<u>20,948</u>	<u>20,197</u>

Duplicate copies of corrections have been supplied in 19 cases.

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

Thermometers, clinical .....	57
,, ordinary meteorological.....	16
Sextants .....	109
Telescopes .....	119
Various .....	18

3 Standard Thermometers have been supplied during the year.

There were at the end of the year in the Observatory undergoing verification, 6 Barometers, 571 Thermometers, 18 Sextants, 45 Telescopes, and a Sunshine Recorder.

## VI. RATING OF WATCHES AND CHRONOMETERS.

A large increase has taken place in the number of watches sent for trial during the year, 1,521 having been received, as compared with 1,044 during the previous twelve months.

This increase, however, has been largely in watches entered for the class B test, and for various reasons a future falling off in the number of such watches is not unlikely.

It is a gratifying fact that the number of high-class movements attaining the distinction *especially good* has been greater than in any previous year.

The watches were entered for trial as below :—

For class A, 376; class B, 885; class C, 251; and 9 for the subsidiary trial. Of these 5 passed the subsidiary test, 299 failed from various causes to gain any certificate; 238 were awarded class C certificates, 722 class B, and 257 class A; of the latter, 34 obtained the highest form of certificate, class A, *especially good*.

In Appendix III will be found a table giving the results of trial of the 34 watches which gained the highest number of marks during the year. The first place was taken by Messrs. Stauffer, Son, and Co., London, with a keyless, going-barrel, chronometer-watch, No. 147,625, with the "tourbillon" escapement, which obtained 88·0 marks out of a maximum of 100.

The best performance of *lever* watches during the year was that of No. 33,884 by Jos. White and Son, Coventry, which gained 84·9 marks.

*Non-Magnetic Watches.*—Twelve watches thus designated have been examined during the year, both as to their ordinary time-keeping and also as to their non-magnetic properties, and although the trial to which they are submitted is severe—the movement being tested in an intense magnetic field, both in vertical and horizontal positions, and gradually approached to and removed from the poles, whilst its behaviour is critically watched—in the majority of cases the watches were found to perform very satisfactorily.

*Marine Chronometers.*—The Committee having been requested by the Naval Attaché to the Royal Italian Embassy to undertake trials for Marine chronometers on the Greenwich plan, Mr. Constable visited the Royal Observatory, Greenwich, by kind permission of the Astronomer Royal, and was afforded every facility to make himself

familiar with the system of rating chronometers carried on there for many years past.

The Greenwich trial lasts for twenty-nine weeks, the movements being tried during alternate periods of seven and four weeks at the ordinary temperature of the air, and in a hot room at temperatures of from about 75° to 100° Fahr. This gives a total of twenty-one weeks at atmospheric temperatures and eight weeks in the oven.

The difference, in seconds, between the greatest and least weekly rates of a chronometer during the trial being denoted by  $a$ , and the greatest difference, in seconds, between the rates of two successive weeks by  $b$ , the smallness of the quantity  $a + 2b$  has been adopted at Greenwich as the measure of the excellence of a chronometer.

At the request of the Italian Naval Attaché the test at Kew was to be directed to ascertain in which of the chronometers sent for trial the value of  $a + 2b$  did not exceed 38.

It was decided to utilise for the trial the Pendulum Chamber in the basement and the North room in the new wing. The former is constructed of wood, double walled, with a 6-inch air space all round, and having been originally designed with a view to reducing temperature variations to a minimum, it was admirably suited for conversion into a hot chamber.

A gas furnace, made of copper to avoid the risk of disturbing the magnetographs, was specially built by Messrs. Fletcher, Russell, and Co., of Warrington. It has given entire satisfaction, being perfectly under control, so that any desired temperature up to 100° Fahr. can be reached and regularly maintained. By means of two copper flues the products of combustion are taken into the outer air, and the atmosphere of the hot chamber is at all times pure and free from fumes, while the presence of several open vessels of water prevents undue desiccation.

The North room referred to above is used for the ordinary temperature tests, and in it temperatures as low as 37° Fahr. have been observed. In addition to the ordinary maximum and minimum thermometers a "Richard" thermograph is used, which supplies a continual record of the temperature.

Two sets of trials were started during the year: the principal—for which 30 chronometers were entered—commencing on June 1, while the subsidiary—for which there were 12 entries—commenced on November 1. Of the 30 chronometers sent for the first trial only 14 attained the limit prescribed by the Italian Government. A brief summary of their performance will be found in Appendix III, Table III.

During the year 10 chronometers have been received for the ordinary trials. Of these 1 obtained the A certificate and 3 B certificates, while 2 failed to pass and 4 are still under examination.

A mean time Astronomical Regulator has also been rated at temperatures of 40° to 80° Fahr., and a statement of its performance issued.

## VII. MISCELLANEOUS.

*Lens Testing.*—During the year 31 lenses have been tested; of these 13 received class A and 18 class B certificates. These numbers though small show a gratifying increase on the two previous years.

The testing apparatus has been the subject of a good deal of interest, several practical opticians of eminence and others interested in photography having inspected it and enquired into the details of the various tests.

*Library.*—During the year the library has received as presents the publications of—

26 Scientific Societies and Institutions of Great Britain and Ireland, and

108 Foreign and Colonial Scientific Establishments, as well as of numerous private individuals.

During the summer a partition was removed which used to divide the library into an outer and an inner portion. The conversion into a single room has greatly improved the appearance of the library, and has been found advantageous in various other ways.

*Loans, &c., Repaid.*—The Royal Society have been repaid half their loan of £400 made last year towards defraying the cost of the new building, and also the unspent balance—£117 1s. 7d.—of the pendulum account.

*Paper.*—Prepared photographic paper has been procured and supplied to the Observatories at Aberdeen, Oxford, Stonyhurst, Lisbon, Mauritius, St. Petersburg, Toronto, and through the Meteorological Office to Batavia, Fort William and Valencia. Plain Papier Saxe has been sent to Coimbra Observatory, anemograph sheets to the Hong-Kong and Mauritius Observatories, and blank forms for the entry of magnetic observations to the Observatories at Falmouth and Valencia, and to the Science and Art Department, London.

*House, Grounds, and Path.*—These have all been kept as usual during the year. In view of the increased and increasing extent to which the Old Deer Park is now allotted to athletic clubs and other associations having for their object the public amusement, negotiations have been entered upon with the Office of Her Majesty's Woods and Forests for the purpose of securing ampler protection to the Observatory.

Subjoined to this Report will be found a list of instruments, apparatus, &c., the property of the Incorporated Kew Committee, at present lent to various institutions and scientific men.

The balance sheet for the year, with a comparison of the expenditure for the two years 1892 and 1893 is also appended. It is subject to a further audit by the Royal Society if the President and Council should so require.

PERSONAL ESTABLISHMENT.

The staff employed is as follows:—

C. Chree, M.A., Superintendent.

T. W. Baker, Chief Assistant.

E. G. Constable, Observations and Rating.

W. Hugo, Verification Department.

J. Foster            "                "

T. Gunter            "                "

W. J. Boxall        "                "

E. Dagwell, Observations and Rating.

R. S. Whipple, Accounts and Library, and five other Assistants.

FRANCIS GALTON,  
*Chairman.*

*April 11, 1894.*



*Kew Observatory. Account of Receipts and Payments for the year ending December 31st, 1893.*

<i>Dr.</i>	<b>RECEIPTS.</b>	<b>Cr.</b>	<b>£ s. d.</b>	<b>£ s. d.</b>
To Balance from Year 1892 .....	£ 529 2 9		291 13 4	
Royal Society:— (Gassiot Trust) .....	486 9 2		148 18 0	
Meteorological Council:— Allowance .....	400 0 0		85 12 3	
Postages, &c. ....	7 18 5		278 19 10	
Researches .....	407 18 5		50 0 0	
Tests:— Verifications .....	6 16 2		855 3 5	
Rating .....	1131 1 8		340 18 5	
Lenses .....	718 1 10		63 17 5	
Gravity Survey Committee for Pendulums .....	15 19 9		404 15 10	
Commissions executed for Colonial and Foreign Institutions, &c. ....	1865 3 3		227 4 0	
	5 10 0		866 18 0	
	183 19 6		181 8 7	
			1048 6 7	
			146 2 7	
			200 0 0	
			117 1 7	
			317 1 7	
			357 16 2	
			112 10 0	
			8 10 0	
			7 9 1	
			486 5 3	
			£3484 19 3	

**PAYMENTS.**

By Administration:— Superintendent .....	291 13 4
Salaries, Wages, &c. ....	148 18 0
Rent, Fuel, and Lighting .....	85 12 3
Attendance, Cleaning, Repairs,* and Insurance .....	278 19 10
Donation to "Whipple" Fund .....	50 0 0
Normal Observatory:— Salaries—Observations, Tabulations, &c. ....	340 18 5
Incidental Expenses, Instruments, &c. ....	63 17 5
Researches:— Salaries—Observations, Reductions, &c. ....	227 4 0
Tests:— Salaries .....	866 18 0
Incidental Expenses—Instruments, Postages, &c. ....	181 8 7
Commissions for Colonial and Foreign Institutions, &c. ....	1048 6 7
Royal Society:— Partial repayment of Loan for Extension of Pre- mises .....	146 2 7
Payment of Balance of Pendulum Account .....	200 0 0
Balance:— Cash at Bank of England .....	117 1 7
" London and County Bank, Richmond .....	357 16 2
" Observatory (for Banking) .....	112 10 0
" " (Petty Cash) .....	8 10 0
	7 9 1
	486 5 3
	£3484 19 3

Examined and compared with the vouchers, and found correct.

January 31, 1894.

(Signed)

ROSSE, Auditor.

\* This includes "Extension of Premises."

ESTIMATED ASSETS.

By Balance as per Statement .....	£	s.	d.
Payments due:—			
Meteorological Council—Allowance, Postages, &c. ....	486	5	3
Test Fees.....	106	9	3
Commissions .....	494	16	11
	102	17	9
<b>Stock:—</b>			
Blank Forms and Certificates .....	48	16	10
Standard Thermometers .....	83	19	0
	182	15	10
	<hr/>		
	£	1323	5 0

February 2, 1894.

ESTIMATED LIABILITIES.

To Administration accounts—Gas, Repairs, and Contingencies.....	£	s.	d.
To Observatory accounts—A.G.B. Paper, Chemicals, &c. ....	33	4	8
To Tests accounts—Fittings, Printing, &c. ....	8	3	3
To Royal Society (Balance of Loan) .....	29	6	1
To Commissions .....	200	0	0
	98	17	10
General Balance .....	963	13	2
	<hr/>		
	£	1323	5 0

(Signed) CHARLES CHREE,  
Superintendent.

Comparison of Expenditure (excluding Commissions) for the twelve months ending December 31st, 1892, and December 31st, 1893.

Heads of Expenditure.	1892.	1893.	Increase.	Decrease.
<i>Administration—</i>	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Superintendent.....	400 0 0	291 13 4	..	108 6 8
Office .....	200 3 0	148 18 0	..	51 5 0
Rent, fuel, lighting, &c. ....	58 15 10	85 12 3	26 16 5	
Attendance and con- tingencies .....	184 12 10	219 3 1	34 10 3	
“Whipple” Fund ..	..	50 0 0	50 0 0	
<i>Normal Observatory—</i>				
Salaries .....	296 12 0	340 18 5	44 6 5	
Incidental expenses..	31 14 11	63 17 5	32 2 6	
<i>Researches—</i>				
Salaries .....	223 5 0	227 4 0	3 19 0	
Incidental expenses..	2 11 0	..	..	2 11 0
<i>Tests—</i>				
Salaries .....	858 17 7	866 18 0	8 0 5	
Incidental expenses..	183 15 2	181 8 7	..	2 6 7
Ordinary expenditure, showing an increase of £35 5s. 9d.	2,440 7 4	2,475 13 1	199 15 0	164 9 3
Repayment of Loan from Royal Society ..	..	200 0 0	200 0 0	
Payment of unex- pended balance of Pendulum Grant....	..	117 1 7	117 1 7	
Extension of Premises..	656 10 0	59 16 9	..	596 13 3
			516 16 7	761 2 6
Total expenditure.....	3,096 17 4	2,852 11 5	..	244 5 11

APPENDIX A.

MEMORANDUM OF ASSOCIATION.

1. The name of the Association is "THE INCORPORATED KEW COMMITTEE OF THE ROYAL SOCIETY."

2. The registered office of the Association will be situate in England.

3. The objects for which the Association is established are:—

1. The administration, under the direction of the Royal Society, of so much as shall be paid to them of the income of the Trust Fund founded by Mr. GASSIOT for maintaining the Kew Observatory and carrying on the magnetic, meteorological, and other physical observations there, but the Royal Society is not to be responsible for the acts or omissions of the Association, or for the Application of the income of the said Trust Fund when paid over to the Association, or for the misapplying of such income or for any debts or liabilities which may be incurred by the Association.

2. The maintenance and the management of an Institution for the supply, examination, and testing of instruments for scientific and other purposes, and the investigation and application of methods of measurement and observation.

3. The doing all such lawful things as are incidental or conducive to the attainment of the above objects.

4. The income and property of the Association, whencesoever derived, shall be applied solely towards the promotion of the objects of the Association as set forth in this Memorandum of Association; and no portion thereof shall be paid or transferred directly or indirectly, by way of dividend, bonus, or otherwise howsoever by way of profit, to the Members of the Association.

Provided that nothing herein shall prevent the payment, in good faith, of remuneration to any officers or servants of the Association, or to any Member of the Association, or other person, in return for any services actually rendered to the Association.

5. The fourth paragraph of this Memorandum is a condition on which a licence is granted by the Board of Trade to the Association in pursuance of Section 23 of the Companies Act, 1867.

6. If any Member of the Association pays or receives any dividend, bonus, or other profit, in contravention of the terms of the fourth paragraph of this Memorandum, his liability shall be unlimited.

7. Every Member of the Association undertakes to contribute to the assets of the Association, in the event of the same being wound up during the time that he is a Member, or within one year afterwards, for payment of the debts and liabilities of the Association contracted before the time at which he ceases to be a Member, and of the costs, charges, and expenses of winding up the same, and for the adjustment of the rights of the contributories amongst themselves, such amount as may be required not exceeding one pound, or in case of his liability becoming unlimited, such other amount as may be required in pursuance of the last-preceding paragraph of this Memorandum.

8. If upon the winding up or dissolution of the Association there remains, after the satisfaction of all its debts and liabilities, any property whatsoever, the same shall not be paid to or distributed among the Members of the Association, but shall be given or transferred to the President and Council of the Royal Society, and on any winding up the Association shall consent to the appointment of any liquidator who may be nominated by the said President and Council.

9. True accounts shall be kept of the sums of money received and expended by the Association and the matter in respect of which such receipt and expenditure takes place, and of the properties, credits, and liabilities of the Association; and, subject to any reasonable restrictions as to the time and manner of inspecting the same that may be imposed in accordance with the Regulations of the Association for the time being, shall be open to inspection of the Members and to the President and Council of the Royal Society. The accounts of the Association shall be submitted annually to the Royal Society for audit, or to any auditor or auditors to be appointed from time to time by the Royal Society, or by the Association acting under the authority of the Royal Society.

We, the several persons whose names and addresses are subscribed, are desirous of being formed into an Association in pursuance of this Memorandum of Association.  
Signed by Members of the Committee.

Dated the 31st day of January, 1893.

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### ARTICLES OF ASSOCIATION.

(1.) For the purposes of registration the number of the Members of the Association is declared not to exceed twelve.

(2.) These Articles shall be construed with reference to the provisions of the Companies Act, 1862, and the Companies Act, 1867, and terms used in these Articles shall be taken as having the same respective meanings as they have when used in those Acts.

(3.) The Association is established for the purposes and subject to the conditions expressed in the Memorandum of Association.

(4.) *Qualification of Members.*—The Association shall consist of such of the present Members of the Kew Committee of the Royal Society as consent to be Members.

(5.) *Admission of Members.*—Future Members shall be nominated from time to time by the Council, for the time being, of the Royal Society.

(6.) *Honorary Officers and their Elections.*—The Chairman shall be nominated by the Council of the Royal Society.

(7.) *Management of the Association.*—The business is to be managed by the Members of the Association.

(8.) *Meetings, Proceedings, &c.*—The First General Meeting of the Association shall be held within four months after the registration of the Memorandum of Association. A General Meeting shall be held at least once in each year, in accordance with Section 49 of the Companies Act of 1862. The Ordinary Meetings of the Association shall be held as the Committee shall direct, and their proceedings shall be regularly recorded. The Association shall submit yearly a Report of its proceedings to the Royal Society.

(9.) *Accounts, Audit.*—The annual statement of income and expenditure of the Association shall be sent to the President and Council of the Royal Society for audit, as provided by Section 9 of the Memorandum of Association.

(10.) A notice may be served by the Association upon any Member, either personally or by sending it through the post as a prepaid letter, addressed to such Member at his registered place of abode.

Any notice, if served by post, shall be deemed to have been served at the time when the letter containing the same would be delivered in the ordinary course of the post, and in proving such service it shall be sufficient to prove that the letter containing the notice was properly addressed and put into the Post Office.

Signed by Members of the Committee.

Dated the 31st day of January, 1893.

APPENDIX I.

MAGNETICAL OBSERVATIONS, 1893.

Made at the Kew Observatory, Richmond, Lat.  $51^{\circ} 28' 6''$   
 N. and Long.  $0^{\text{h}} 1^{\text{m}} 15^{\text{s}}.1$  W., height 34 feet above mean  
 sea-level.

The results given in the following tables are deduced from the magnetograph curves which have been standardised by observations of deflection and vibration. These were made with the Collimator Magnet K.C. I. and the Declinometer Magnet marked K.O. 90 in the 9-inch Unifilar Magnetometer by Jones.

The Inclination was observed with the Inclinator by Barrow, No. 33, and needles 1 and 2, which are  $3\frac{1}{2}$  inches in length.

The Declination and Force values given in Tables I to VIII 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 1893 which were selected by the Astronomer Royal, as suitable for the determination of the magnetic diurnal variations, and which have been employed in the preparation of the magnetic tables:—

January .....	7, 8, 15, 25, 26.
February .....	1, 11, 13, 26, 27.
March .....	10, 13, 18, 19, 20.
April.....	4, 9, 21, 22, 23.
May .....	2, 14, 17, 21, 28.
June .....	8, 13, 17, 22, 24.
July .....	5, 6, 10, 30, 31.
August.....	1, 9, 16, 17, 27.
September .....	4, 7, 13, 23, 24.
October.....	9, 11, 16, 21, 22.
November.....	7, 11, 15, 20, 21.
December.....	7, 13, 18, 21, 22.

Table I.—Hourly Means of Declination, as

Hours	Mid.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
(17° +) West. Winter.												
1893.												
Months.	'	'	'	'	'	'	'	'	'	'	'	'
Jan. ..	28·9	29·6	30·4	31·2	31·6	31·6	31·8	31·6	31·3	31·3	32·3	34·0
Feb. ..	31·3	31·2	31·1	31·2	31·0	30·8	30·5	29·9	29·4	29·8	31·6	34·1
March..	30·3	30·2	29·7	29·6	29·2	28·9	28·4	27·7	26·3	26·6	28·5	32·2
Oct. ..	25·1	25·1	25·0	25·1	25·1	25·1	24·4	23·7	22·9	22·7	24·4	27·8
Nov. ..	23·7	24·3	24·4	24·4	24·3	24·3	24·0	23·5	22·8	22·4	23·8	26·8
Dec. ..	25·2	25·6	26·1	26·1	25·9	25·6	25·6	25·3	25·2	24·5	25·2	26·4
Mean.	27·4	27·7	27·8	27·9	27·8	27·7	27·4	26·9	26·3	26·2	27·6	30·2
Summer.												
April..	30·4	30·3	30·3	30·1	29·9	29·5	28·1	27·0	25·4	25·7	27·5	31·9
May ..	28·7	29·0	29·1	28·6	28·0	26·1	24·9	23·7	23·4	24·7	27·9	32·3
June ..	29·4	28·7	28·6	28·3	27·4	25·5	23·9	23·8	23·6	24·8	27·6	30·7
July ..	26·2	26·1	25·8	25·6	24·9	23·5	22·1	21·2	21·4	22·9	25·8	29·6
Aug. ..	27·6	27·6	27·2	26·9	26·2	25·2	23·4	22·2	22·8	24·4	27·0	30·3
Sept. ..	26·0	25·9	26·1	25·2	24·6	24·6	23·7	23·0	22·2	23·8	26·8	30·6
Mean.	28·0	27·9	27·8	27·4	26·8	25·7	24·3	23·5	23·1	24·4	27·1	30·9

Table II.—Solar Diurnal Range of the Kew

Hours	Mid.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
Summer mean.												
	-0·8	-0·9	-1·0	-1·4	-2·0	-3·1	-4·5	-5·3	-5·7	-4·4	-1·7	+2·1
Winter mean.												
	-1·5	-1·2	-1·1	-1·0	-1·1	-1·2	-1·5	-2·0	-2·6	-2·7	-1·3	+1·3
Annual mean.												
	-1·1	-1·0	-1·0	-1·2	-1·5	-2·1	-3·0	-3·6	-4·1	-3·5	-1·5	+1·7

NOTE.—When the sign is + the magnet

determined from the selected quiet Days in 1893.

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Mid.
Winter.												
'	'	'	'	'	'	'	'	'	'	'	'	'
35.6	36.4	36.2	35.3	35.1	34.5	33.8	33.3	32.8	32.0	31.8	31.4	31.4
35.9	36.3	35.9	35.0	33.7	32.9	32.5	32.1	32.0	31.6	31.3	31.1	31.2
36.2	38.4	38.4	36.3	34.2	31.9	31.6	30.9	30.5	30.3	30.5	30.4	30.1
30.5	31.8	31.6	30.1	28.6	27.6	27.0	26.5	25.9	25.1	25.1	24.9	24.7
29.0	29.9	29.1	28.2	27.4	26.7	26.2	26.0	25.0	24.7	24.5	24.5	24.8
27.8	28.7	28.9	28.5	27.7	27.1	26.9	26.4	25.7	25.6	25.4	25.4	25.1
32.5	33.6	33.3	32.2	31.1	30.1	29.7	29.2	28.6	28.2	28.1	27.9	27.9
Summer.												
'	'	'	'	'	'	'	'	'	'	'	'	'
35.9	38.7	38.5	36.8	34.6	32.4	31.1	31.1	31.0	31.0	30.8	30.6	30.4
36.5	37.9	37.0	35.3	32.7	30.9	29.7	29.4	29.5	29.6	29.4	29.1	29.2
34.0	35.8	36.0	34.4	32.9	31.4	30.4	29.5	29.4	29.2	29.5	29.1	29.2
32.3	33.9	34.4	33.3	31.0	28.8	27.5	26.6	26.5	26.8	27.2	27.1	26.6
33.9	35.6	35.2	33.5	31.3	29.1	28.2	28.2	27.7	27.7	27.6	27.6	27.6
33.9	34.7	34.5	32.6	30.3	28.5	27.7	27.5	27.1	26.9	26.7	25.8	25.6
34.4	36.1	35.9	34.3	32.1	30.2	29.1	28.7	28.5	28.5	28.5	28.2	28.1

Declination as derived from Table I.

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Mid.
Summer mean.												
'	'	'	'	'	'	'	'	'	'	'	'	'
+5.6	+7.3	+7.1	+5.5	+3.3	+1.4	+0.3	-0.1	-0.3	-0.3	-0.3	-0.6	-0.7
Winter mean.												
'	'	'	'	'	'	'	'	'	'	'	'	'
+3.6	+4.7	+4.4	+3.3	+2.2	+1.2	+0.8	+0.3	-0.3	-0.7	-0.8	-1.0	-1.0
Annual mean.												
'	'	'	'	'	'	'	'	'	'	'	'	'
+4.6	+6.0	+5.7	+4.4	+2.7	+1.3	+0.5	+0.1	-0.3	-0.5	-0.5	-0.8	-0.9

points to the west of its mean position.

Table III.—Hourly Means of the Horizontal Force in C.G.S. units

Hours	Mid.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
0·18000 + Winter.												
1893. Months.												
Jan. ..	208	210	210	214	217	219	219	221	218	213	207	201
Feb. ..	235	235	234	235	236	236	236	235	231	219	213	210
March ..	230	228	228	227	227	227	227	225	217	203	196	194
Oct. ..	246	243	241	245	243	245	243	239	229	219	210	211
Nov. ..	236	237	238	236	239	239	239	238	234	222	211	209
Dec. ..	251	251	252	253	254	257	259	259	257	252	245	240
Mean.	234	234	234	235	236	237	237	236	231	221	214	211
Summer.												
April ..	246	245	245	245	246	247	250	249	241	227	209	199
May ..	244	244	244	246	245	242	238	231	218	208	205	209
June ..	247	243	242	243	243	241	236	228	221	214	212	212
July ..	255	254	252	253	253	253	248	239	230	222	218	220
Aug. ..	260	261	261	261	261	259	252	243	235	225	220	224
Sept. ..	250	249	250	247	248	245	241	236	226	219	212	216
Mean ..	250	249	249	249	249	248	244	238	228	219	213	213

Table IV.—Diurnal Range of the Kew

Hours	Mid.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
Summer mean.												
	+·00006	+·00005	+·00005	+·00005	+·00005	+·00004	·00000	-·00006	-·00016	-·00025	-·00031	-·00031
Winter mean.												
	+·00002	+·00002	+·00002	+·00003	+·00004	+·00005	+·00005	+·00004	-·00001	-·00011	-·00018	-·00021
Annual mean.												
	+·00004	+·00003	+·00003	+·00004	+·00004	+·00004	+·00002	-·00001	-·00008	-·00018	-·00024	-·00026

NOTE.—When the sign is + the

(corrected for Temperature), as determined from the selected quiet Days in 1893.

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Mid.
Winter.												
207	213	213	212	212	213	218	220	218	217	218	219	221
216	223	230	229	230	231	235	236	239	238	237	238	238
199	207	218	223	229	228	231	233	235	234	233	232	230
219	225	229	233	237	239	245	245	245	250	248	249	248
211	217	223	229	233	238	240	240	240	241	241	240	241
241	245	248	251	254	256	257	259	257	258	257	255	252
216	222	227	229	232	234	238	239	239	240	239	239	238
Summer.												
201	213	225	237	243	247	248	249	253	250	250	248	248
221	229	239	247	253	256	255	255	255	255	251	251	252
220	226	237	244	251	256	257	260	257	255	254	252	252
230	235	243	255	259	264	270	269	266	264	260	258	256
234	245	253	258	262	263	264	267	267	269	265	264	263
225	234	243	247	245	249	254	255	258	259	259	259	255
222	230	240	248	252	256	258	259	259	259	256	255	254

Horizontal Force as deduced from Table III.

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Mid.
Summer mean.												
-00022	-00014	-00004	+00004	+00008	+00012	+00014	+00015	+00015	+00015	+00012	+00011	+00010
Winter mean.												
-00016	-00010	-00005	-00003	00000	+00002	+00006	+00007	+00007	+00008	+00007	+00007	+00006
Annual mean.												
-00019	-00012	-00004	00000	+00004	+00007	+00010	+00011	+00011	+00011	+00009	+00009	+00005

reading is above the mean.

Table V.—Hourly Means of the Vertical Force in C.G.S. units (corrected)

Hours	Mid.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
0·43000 + Winter.												
1893. Months.												
Jan. ..	942	939	939	938	938	938	938	939	939	940	937	934
Feb. ..	956	956	955	955	955	955	955	955	956	955	951	950
March ..	902	902	902	903	904	906	906	909	909	905	900	893
Oct. ..	854	854	854	853	853	852	852	853	852	850	844	840
Nov. ..	901	901	899	900	900	900	900	900	901	899	895	894
Dec. ..	923	923	923	922	922	922	921	922	921	920	917	916
Mean ..	913	913	912	912	912	912	912	913	913	912	907	905
Summer.												
April ..	905	907	907	908	910	911	912	913	912	909	900	891
May ..	870	871	872	871	871	874	875	875	871	863	852	842
June ..	841	841	842	843	845	849	850	848	844	838	831	825
July ..	866	867	869	871	874	877	877	876	872	867	862	855
Aug. ..	924	925	925	926	927	929	930	930	925	919	912	908
Sept. ..	901	902	903	903	904	905	906	907	905	900	891	888
Mean ..	885	886	886	887	889	891	892	892	888	883	875	868

Table VI.—Diurnal Range of the Kew

Hours.	Mid.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
Summer mean.												
	+·00002	+·00003	+·00003	+·00004	+·00006	+·00008	+·00009	+·00009	+·00005	·00000	-·00008	-·00015
Winter mean.												
	+·00003	+·00003	+·00002	+·00002	+·00002	+·00002	+·00002	+·00003	+·00003	+·00002	-·00003	-·00005
Annual mean.												
	+·00003	+·00003	+·00003	+·00003	+·00004	+·00005	+·00006	+·00006	+·00004	+·00001	-·00006	-·00010

NOTE.—When the sign is + the

for Temperature), as determined from the selected quiet Days in 1893.

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Mid.
Winter.												
932	936	939	942	943	944	943	944	943	941	940	939	939
949	948	950	952	955	955	955	954	953	954	955	956	955
889	891	896	902	907	907	907	905	904	903	903	904	902
840	842	843	848	850	850	849	848	848	848	848	848	848
894	897	898	901	900	900	897	897	897	896	896	895	894
916	917	919	923	923	922	920	920	919	918	918	918	918
903	905	908	911	913	913	912	911	911	910	910	910	909
Summer.												
887	885	892	899	904	911	911	911	910	909	908	909	909
842	846	855	863	868	871	871	868	867	865	864	863	863
825	830	832	835	837	840	841	841	838	837	834	835	834
851	851	856	865	872	878	880	878	876	874	872	870	868
907	909	917	920	922	926	922	920	918	916	916	916	916
889	890	895	901	904	906	906	906	905	904	905	906	908
867	869	875	881	885	889	889	887	886	884	883	883	883

Vertical Force as deduced from Table V.

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Mid.
Summer mean.												
-00016	-00014	-00008	-00002	+00002	+00006	+00006	+00004	+00003	+00001	00000	00000	00000
Winter mean.												
-00007	-00005	-00002	+00001	+00003	+00003	+00002	+00001	+00001	00000	00000	00000	-00001
Annual mean.												
-00012	-00010	-00005	00000	+00003	+00005	+00004	+00003	+00002	+00001	00000	00000	00000

reading is above the mean.

Table VII.—Hourly Means of the Inclination, calculated

Hours.	Mid.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
67° + Winter.												
1893.												
Months.	'	'	'	'	'	'	'	'	'	'	'	'
Jan....	29·6	29·3	29·3	29·1	28·8	28·7	28·7	28·6	28·8	29·2	29·5	29·8
Feb....	28·2	28·2	28·2	28·1	28·1	28·1	28·1	28·1	28·4	29·2	29·5	29·7
March.	27·0	27·1	27·1	27·2	27·2	27·3	27·3	27·5	28·0	28·9	29·2	29·1
Oct....	24·6	24·8	24·9	24·6	24·8	24·6	24·7	25·0	25·7	26·3	26·7	26·5
Nov. . .	26·5	26·5	26·4	26·5	26·3	26·3	26·3	26·4	26·7	27·4	28·1	28·2
Dec....	26·2	26·2	26·1	26·0	25·9	25·7	25·6	25·6	25·7	26·0	26·4	26·7
Mean.	27·0	27·0	27·0	26·9	26·9	26·8	26·8	26·9	27·2	27·8	28·2	28·3
Summer.												
April..	26·0	26·1	26·1	26·1	26·1	26·1	25·9	26·0	26·5	27·4	28·3	28·7
May...	25·2	25·2	25·2	25·1	25·1	25·4	25·7	26·2	26·9	27·4	27·3	26·7
June ..	24·2	24·4	24·5	24·5	24·5	24·8	25·1	25·6	26·0	26·3	26·2	26·0
July...	24·3	24·4	24·6	24·6	24·7	24·8	25·1	25·7	26·1	26·5	26·7	26·3
Aug. . .	25·6	25·6	25·6	25·6	25·6	25·8	26·3	26·9	27·3	27·8	27·9	27·6
Sept. . .	25·6	25·7	25·7	25·9	25·8	26·1	26·4	26·7	27·3	27·7	27·9	27·5
Mean.	25·2	25·2	25·3	25·3	25·3	25·5	25·8	26·2	26·7	27·2	27·4	27·1

Table VIII.—Diurnal Range of the

Hours	Mid.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
Summer mean.												
	-0·3	-0·3	-0·2	-0·2	-0·2	0·0	+0·3	+0·7	+1·2	+1·7	+1·9	+1·6
Winter mean.												
	-0·1	-0·1	-0·1	-0·2	-0·2	-0·3	-0·3	-0·2	+0·1	+0·7	+1·1	+1·2
Annual mean.												
	-0·2	-0·2	-0·2	-0·2	-0·2	-0·2	0·0	+0·3	+0·7	+1·2	+1·5	+1·4

NOTE.—When the sign is +

from the Horizontal and Vertical Forces (Tables III and V).

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Mid.
Winter.												
'	'	'	'	'	'	'	'	'	'	'	'	'
29.4	29.1	29.1	29.3	29.3	29.3	28.9	28.8	28.9	28.9	28.8	28.7	28.6
29.2	28.7	28.3	28.4	28.5	28.4	28.1	28.0	27.8	27.9	28.0	28.0	27.9
28.7	28.2	27.6	27.5	27.2	27.3	27.1	26.9	26.7	26.7	26.8	26.9	27.0
26.0	25.6	25.4	25.3	25.1	24.9	24.5	24.5	24.5	24.2	24.3	24.2	24.3
28.0	27.7	27.3	27.0	26.7	26.4	26.2	26.2	26.2	26.1	26.1	26.1	26.0
26.6	26.4	26.3	26.2	26.0	25.8	25.7	25.5	25.7	25.6	25.6	25.8	26.0
28.0	27.6	27.3	27.3	27.1	27.0	26.8	26.7	26.6	26.6	26.6	26.6	26.6
Summer.												
'	'	'	'	'	'	'	'	'	'	'	'	'
28.5	27.6	27.0	26.4	26.2	26.1	26.0	26.0	25.7	25.8	25.8	26.0	26.0
25.9	25.5	25.1	24.8	24.5	24.4	24.5	24.4	24.3	24.3	24.5	24.5	24.4
25.5	25.3	24.6	24.2	23.8	23.5	23.5	23.3	23.4	23.5	23.5	23.7	23.6
25.6	25.2	24.8	24.3	24.2	24.0	23.7	23.7	23.9	23.9	24.1	24.2	24.3
26.9	26.2	25.9	25.6	25.4	25.4	25.3	25.0	25.0	24.8	25.0	25.1	25.3
27.0	26.4	25.9	25.8	26.0	25.8	25.5	25.4	25.2	25.1	25.1	25.2	25.5
26.6	26.0	25.6	25.2	25.0	24.9	24.8	24.6	24.6	24.6	24.7	24.8	24.8

Inclination as deduced from Table VII.

Noon.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	Mid.
Summer mean.												
'	'	'	'	'	'	'	'	'	'	'	'	'
+1.1	+0.5	+0.1	-0.3	-0.5	-0.6	-0.7	-0.9	-0.9	-0.9	-0.8	-0.7	-0.7
Winter mean.												
'	'	'	'	'	'	'	'	'	'	'	'	'
+0.9	+0.5	+0.2	+0.2	0.0	-0.1	-0.3	-0.4	-0.5	-0.5	-0.5	-0.5	-0.5
Annual mean.												
'	'	'	'	'	'	'	'	'	'	'	'	'
+1.0	+0.5	+0.2	-0.1	-0.3	-0.4	-0.5	-0.7	-0.7	-0.7	-0.7	-0.6	-0.6

the reading is above the mean.

APPENDIX II.—Table I.  
Mean Monthly Results of Temperature and Pressure,  
Kew Observatory.

Months.	Thermometer.				Barometer.*				Mean vapour-tension.
	Mean.	Means of—			Mean.	Absolute Extremes.			
		Max.	Min.	Max. and Min.		Max.	Min.	Date.	
		Date.	Date.	Date.					
1898.	°	°	°	ins.	ins.	d. h.	d. h.	in.	
Jan....	35·8	31·9	35·8	30·069	30·455	5 5 A.M.	19 9 A.M.	·184	
Feb....	41·7	36·7	41·8	29·726	30·441	6 8 "	5 11 "	·223	
March..	45·4	36·3	45·8	30·145	30·487	19 6 "	19 8 "	·224	
April...	50·8	40·9	51·7	30·163	30·529	14 5 "	8 9 "	·244	
May...	56·7	47·2	57·0	30·062	30·432	31 4 "	6 6 "	·310	
June...	61·1	51·1	61·1	30·012	30·416	1 4 "	6 10 "	·345	
July...	63·3	55·5	63·8	29·907	30·306	15 1 "	28 8 "	·403	
Aug....	65·0	56·1	65·3	30·037	30·341	29 5 "	29·627	·424	
Sept....	56·8	49·0	57·2	29·879	30·322	24 5 "	12 9 "	·340	
Oct.....	51·4	44·9	51·4	29·919	30·489	31 1 ?	23 10 P.M.	·304	
Nov....	42·2	36·9	42·0	29·997	30·465	1 6 "	21 10 "	·223	
Dec....	40·2	33·7	39·5	30·019	30·778	3 6 "	30 2 A.M.	·218	
Yearly Means	50·9	43·4	51·0	29·995	..	....	....	·287	

\* Reduced to 32° at M.S.L.

† From ordinary Min. Ther.; the thermograph trace was lost through stoppage of the clock.

This Table is compiled from "Hourly Means," vol. 1893, of the Meteorological Office.

Meteorological Observations.—Table II.  
Kew Observatory.

Months.	Rainfall.*		Weather. Number of days on which were registered						Wind.† Number of days on which it was											
	Mean amount of cloud (0=clear, 10=over-cast).	Total.	Maxi-mum.	Days	Rain. †	Snow.	Hail.	Thun-der-storms.	Clear sky.	Over-cast sky.	Days	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm
1893.		in.	in.																	
January.....	7.5	1.430	0.295	9	25	6	..	..	3	19	..	6	3	2	2	3	5	7	3	5
February.....	7.1	2.660	0.465	27	22	2	1	..	4	15	..	2	2	..	3	6	9	5	1	2
March.....	3.9	0.230	0.045	3	6	2	..	..	18	9	..	2	2	1	4	8	8	5	2	9
April.....	2.6	0.100	0.050	20	3	..	..	..	20	1	..	4	8	1	2	2	2	1	1	1
May.....	5.4	1.395	0.765	17	10	..	..	1	9	9	..	4	6	6	5	4	4	2	4	2
June.....	5.1	0.860	0.245	22	11	..	..	1	11	11	1	2	6	8	2	4	4	5	1	3
July.....	6.5	1.815	0.360	17	17	..	..	4	2	13	..	5	2	4	6	6	6	5	3	4
August.....	5.4	1.705	0.760	4	12	..	..	2	6	4	..	2	3	3	1	3	11	4	4	5
September...	5.7	0.995	0.175	26	9	..	..	2	8	9	..	2	4	3	..	1	6	10	4	6
October.....	6.7	4.115	1.205	9	14	..	..	1	5	11	..	4	1	2	..	2	12	9	1	9
November...	7.6	1.975	0.700	14	15	2	2	..	5	20	1	8	6	2	1	5	5	5	2	2
December...	6.1	2.220	0.425	8	18	1	1	..	8	10	4	3	3	..	1	6	13	6	2	8
Totals and means.....	5.8	19.500			162	13	4	11	99	131	9	44	43	48	12	41	85	64	28	56

\* Measured at 10 a.m. daily by gauge 1.75 feet above ground.  
 † The number of rainy days are those on which 0.01 inch rain or melted snow was recorded.  
 ‡ As registered by the anemograph.  
 Note.—For total rainfall, February, 1892, 0.495, read 1.405.

Meteorological Observations.—Table III.  
Kew Observatory.

Months.	Bright Sunshine.			Maximum temperature in sun's rays. (Black bulb <i>in vacuo</i> .)		Minimum temperature on the ground.		Horizontal movement of the air.*					
	Total number of hours recorded.	Mean percentage of possible sunshine.	Greatest daily record.	Date	Mean.	Highest.	Date. †	Mean.	Lowest.	Date. †	Average hourly velocity.	Greatest hourly velocity.	Date.
1893.													
January	h. m. 22 24	9	h. m. 5 0	15	deg. 56	deg. 82	28	deg. 26	7	5	miles. 9.8	miles. 27	29
February	63 18	23	7 6	28	77	99	19	31	17	6	13.3	42	10
March	157 12	42	10 36	31	100	118	31	28	16	19	8.9	33	1
April	243 48	59	12 24	26	109	134	20	32	19	14	11.0	33	22
May	205 24	43	13 42	10	120	130	29	39	28	11	9.9	30	5
June	206 24	42	14 12	18	124	139	19	43	29	1	9.6	35	28
July	174 48	35	13 30	7	126	138	21	50	39	23	9.9	31	9
August	225 18	50	12 42	16	126	138	11	48	32	29	9.2	33	22
September	151 54	40	9 36	{ 12 24	115	133	14	42	29	24	8.9	30	29
October	133 54	41	9 30	3	100	116	1	37	18	31	8.2	29	25
November	42 54	16	6 12	7	69	96	3	31	18	1 & 13	13.2	38	18
December	54 12	22	6 6	2	67	81	24	27	12	3	10.9	49	12
Totals and Means	1681 30	35	..	..	99	..	..	36	..	..	10.2	..	..

\* As indicated by a Robinson's anemograph, 70 feet above the general surface of the ground.

† Read at 10 A.M., and entered to previous day.

‡ Read at 10 A.M., and entered to same day.

Table IV.

Summary of Sun-spot Observations made at the Kew Observatory.

Months.	Days of observation.	Number of new groups enumerated.	Days apparently without spots.
1893.			
January .....	8	14	—
February.....	10	11	—
March.....	12	15	—
April.....	20	18	—
May.....	15	17	—
June .....	17	19	—
July.....	12	10	—
August .....	18	20	—
September.....	11	12	—
October.....	15	15	—
November.....	8	13	—
December .....	9	9	—
Totals for 1893 ....	155	173	—

APPENDIX III.—Table I.

RESULTS OF WATCH TRIALS. Performance of the 34 Watches which obtained the highest number of marks during the year.

Watch deposited by	Number of watch.	Balance spring, escapement, &c.	Mean daily rate.				Mean variation of daily rate. †	Mean change of rate for 10 F.	Difference between extreme gaining and losing rates.	Marks awarded for			Total Marks. 0—100.	
			Pendant up.	Pendant right.	Pendant left.	Dial up.				Dial down.	Daily variation of rate.	Change of rate with position.		Temperature compensation.
Stauffer, Son, & Co., London.....	147625	Single overcoil, g. b., "tourbillon" chronometer.....	+2.2	+1.8	+2.4	-0.6	+1.3	0.3	0.04	6.2	34.0	36.6	17.4	88.0
L. Rozat, Chaux-de-Fonds.....	2324	Single overcoil, g. b., "tourbillon" chronometer.....	+1.3	+1.2	+1.5	+2.0	+2.4	0.4	0.08	5.7	32.2	38.4	15.0	85.6
J. White & Son, Coventry .....	33884	Single overcoil, s. r., g. b. centre seconds, lever .....	+1.4	+0.4	+1.0	+0.5	+3.1	0.5	0.04	6.5	30.5	36.9	17.5	84.9
A. E. Fridlander, Coventry .....	13684	Single overcoil, s. r., g. b. ....	-1.6	-3.2	-1.6	-2.7	+3.0	0.4	0.03	7.2	32.6	33.2	18.2	84.0
J. White & Son, Coventry .....	34994	Single overcoil, s. r., g. b. centre seconds ..	-0.9	-0.7	+0.1	+1.2	+1.2	0.4	0.06	6.3	31.2	36.7	16.1	84.0
A. E. Fridlander, Coventry .....	13847	Single overcoil, s. r., g. b. centre seconds ..	-2.2	-2.0	-1.1	-1.4	+0.8	0.6	0.03	6.7	28.5	36.7	18.0	83.2
E. F. Ashley, London .....	04248	Single overcoil, s. r., fusee .....	-2.5	-0.7	-2.4	-0.4	-0.5	0.5	0.03	6.7	29.6	35.6	17.8	83.0
A. E. Fridlander, Coventry .....	52685	Double overcoil, d. r., g. b. ....	+3.2	+4.7	+4.8	+3.1	+4.1	0.6	0.03	5.2	27.4	37.3	18.3	83.0
J. White & Son, Coventry .....	34699	Single overcoil, d. r., g. b. ....	+0.8	+0.4	+1.8	+2.4	+1.2	0.5	0.07	4.7	29.9	37.5	15.5	82.9
J. White & Son, Coventry .....	34385	Double overcoil, d. r., g. b. ....	+2.3	+1.4	+3.6	+2.1	+3.6	0.5	0.06	5.2	29.8	36.8	16.0	82.6
Klean & Co., London .....	62112	Single overcoil, s. r., g. b. ....	+0.5	0.0	-1.7	+1.4	-1.0	0.5	0.07	5.3	30.7	36.2	15.8	82.2
Jos Player, Coventry .....	18074	Single overcoil, d. r., fusee .....	+5.1	+5.0	+4.2	+4.3	+4.2	0.6	0.06	6.7	28.0	38.4	15.7	82.1
J. White & Son, Coventry .....	34340	Single overcoil, d. r., g. b. ....	+0.9	-2.9	-0.2	-0.4	+0.6	0.5	0.06	6.0	30.0	36.0	15.8	81.8
Lancashire Watch Co. ....	979	Single overcoil, s. r., g. b. ....	+1.5	+1.6	-0.8	+1.7	+3.6	0.6	0.02	6.2	27.5	36.2	18.0	81.7
Stauffer, Son, & Co., London .....	124228	Single overcoil, s. r., g. b. ....	-0.4	-2.1	-2.9	-0.5	-0.2	0.5	0.06	5.0	29.8	35.8	15.9	81.5
A. E. Fridlander, Coventry .....	52578	Single overcoil, d. r., g. b., non magnetic ..	+3.0	+6.1	+4.9	+1.4	+4.3	0.6	0.01	6.5	27.5	34.4	19.3	81.2
A. E. Fridlander, Coventry .....	52791	Single overcoil, d. r., g. b. ....	+2.1	+3.0	+2.2	+4.0	+4.5	0.6	0.04	6.7	27.4	36.4	17.3	81.1
J. White & Son, Coventry .....	33906	Single overcoil, d. r., g. b., non-magnetic ..	-3.7	+2.8	-1.0	+4.1	+4.9	0.5	0.05	8.5	30.3	33.6	16.9	81.0
J. White & Son, Coventry .....	33906	Single overcoil, d. r., fusee .....	+0.4	+2.2	+1.2	+0.9	+0.6	0.5	0.09	6.8	29.3	37.4	14.3	81.0
Usher & Cole, London .....	26873	Single overcoil, s. r., g. b. ....	-0.9	-5.9	-2.4	-0.1	-3.9	0.5	0.03	8.5	30.2	32.7	18.0	80.9
J. White & Son, Coventry .....	32961	Single overcoil, s. r., g. b. ....	+3.7	+3.0	+1.6	+0.1	+2.1	0.5	0.09	8.2	30.6	35.9	14.3	80.8
A. E. Fridlander, Coventry .....	52794	Single overcoil, d. r., g. b. ....	-0.3	+2.6	+3.0	+1.6	+2.1	0.7	0.02	8.0	26.4	35.6	18.8	80.3
Rotherham & Sons, Coventry ..	97865	Single overcoil, s. r., g. b., chronograph.....	-2.0	+1.5	+1.2	+0.8	+0.8	0.7	0.02	7.7	26.5	36.0	18.3	80.3

Table I—continued.

Watch deposited by	Number of watch.	Balance spring, escapement, &c.	Mean daily rate.					Mean variation of daily rate. †	Mean change of rate for 1° F.	Difference between extreme gaining and losing rates.	Marks awarded for			Total Marks. 0—100.
			Pendant up.	Pendant right.	Pendant left.	Dial up.	Dial down.				Rate.	Change of rate with change of position.	Temperature compensation	
Rotherham & Sons, Coventry ...	13421	Single overcoil, s.r., g.b. ....	secs. +5.4	secs. +3.1	secs. +3.1	secs. +3.2	secs. +1.8	secs. 0.6	secs. 0.07	secs. 7.2	28.8	36.7	15.3	80.8
P. Cohen, Coventry .....	109013	Single overcoil, s.r., g.b. ....	-3.2	-3.0	-0.0	-4.3	+0.2	0.6	0.01	7.2	28.0	33.1	19.7	80.8
Usher & Cole, London .....	27754	Single overcoil, s.r., fusee .....	+0.5	+0.5	+3.2	-0.9	+0.6	0.5	0.05	7.7	29.6	34.2	16.9	80.7
Rotherham & Sons, Coventry ...	94692	Single overcoil, s.r., g.b. ....	+1.2	+0.4	-0.6	+2.7	+3.0	0.7	0.02	6.0	26.4	35.2	18.9	80.5
Little & Co., London .....	2250	Single overcoil, s.r., g.b. ....	+2.9	+6.2	+4.0	+4.0	+4.4	0.6	0.05	7.5	27.2	36.8	16.4	80.4
J. White & Son, Coventry .....	33447	Single overcoil, d.r., g.b. ....	+0.7	-1.0	-0.7	+0.7	+1.7	0.4	0.12	7.2	31.6	36.4	12.3	80.3
H. Golay, London.....	2087	Double overcoil, d.r., g.b., minute repeater and minute chronograph .....	+0.8	-0.8	-0.2	+1.2	-0.2	0.8	0.03	8.0	24.9	37.3	18.1	80.3
Rotherham & Sons, Coventry ...	95453	Single overcoil, s.r., g.b. ....	+0.4	+0.1	-0.7	-1.3	-0.6	0.7	0.05	7.5	26.2	37.8	16.3	80.3
Rotherham & Sons, Coventry ...	13414	Single overcoil, s.r., g.b. ....	+0.8	+0.1	-2.1	+0.1	+0.2	0.6	0.07	5.5	27.8	36.9	15.5	80.2
Pearson & Son, Coventry .....	71164	Single overcoil, s.r., g.b., centre seconds .....	+0.1	+2.4	-0.3	-3.2	-0.2	0.7	0.02	9.0	26.1	35.2	18.9	80.2
Rotherham & Sons, Coventry ...	97867	Single overcoil, s.r., g.b., chronograph.....	+2.7	+1.6	-1.4	+1.3	+1.8	0.6	0.06	5.7	28.6	35.8	15.7	80.1

In the above List, the following abbreviations are used, viz. :—s.r. for single roller; d.r. for double roller; g.b. for going barrel; † for gaining rate; - for losing rate.

## APPENDIX III.—Table II.

Highest Marks obtained by Complicated Watches during the year.

Description of watch.	Number.	Received from.	Marks awarded for			Total marks, 0—100.
			Variation.	Position.	Temperature.	
Minute and seconds chronograph and minute repeater.....	2087	H. Golay, London .....	24.9	37.3	18.1	80.3
” ” .....	4212	” ” .....	26.5	35.6	15.6	77.7
Minute and split seconds chronograph .....	74510	R. Roskell, Liverpool & London	25.7	35.8	16.5	78.0
” ” .....	74522	” ” .....	28.6	27.4	15.1	71.1
” ” .....	101—1892	S. Smith and Son, London.....	22.9	30.1	17.4	70.4
Minute and seconds chronograph .....	147472	Stauffer, Son and Co., London	26.1	34.4	18.9	79.4
” ” .....	13193	D. A. Nicole and Co., London.	27.3	32.4	18.1	77.8
” ” .....	2085	Weill and Co., London.....	26.6	35.3	12.0	73.9
Ordinary seconds chronograph .....	97865	Rotherham and Sons, Coventry	26.5	36.0	18.3	80.8
” ” .....	97867	” ” .....	28.6	35.8	15.7	80.1
” ” .....	92488	” ” .....	23.5	37.8	15.7	77.0
Minute repeater .....	31946	G. Carley and Co., London.....	24.8	38.0	13.4	76.2
” ” .....	2073	H. Golay, London .....	25.7	36.8	12.0	74.5
” ” and clock-watch.....	52851	A. E. Fridlander, Coventry ...	25.1	32.4	15.3	72.8
“Non-magnetic” watches.....	52578	A. E. Fridlander, Coventry ...	27.5	34.4	19.3	81.2
” ” .....	52844	” ” .....	30.5	33.6	16.9	81.0
” ” .....	13131	S. Smith and Son, London.....	23.1	34.3	19.0	76.4
” ” .....	13405	Rotherham and Sons, Coventry	27.2	33.1	16.0	76.3

APPENDIX III.—Table III.

Abstract of Performance of Chronometers on Trial for the Italian Government, from June 1 to December 21, 1893.

Name of maker.	Number of chrono- meter.	Whether 2-day or 8-day.	Description of balance, &c.	Least weekly sum.		Mean temperature for that week.		Greatest weekly sum.		Mean temperature for that week.		Difference between the greatest and least.		(y.) Greatest difference between one week and the next.		Mean temperatures for these two weeks.		Trial No. a + 2b.
				secs.	secs.	secs.	secs.	secs.	secs.	secs.	secs.	secs.	secs.	secs.				
V. Kullberg, London	5352	2	Auxiliary to balance; reversed detent	- 7.9	47.1	- 0.9	80.2	- 0.9	80.2	7.0	2.4	47.3-45.4	11.8	47.3-45.4	11.8			
J. E. A. Uhrig,	587	2	Continually acting auxiliary	- 1.8	71.8	+ 8.3	81.8	+ 8.3	81.8	10.1	2.2	67.1-63.7	14.5	67.1-63.7	14.5			
J. E. A. Uhrig,	601	2	"	- 6.2	63.6	+ 7.9	85.7	+ 7.9	85.7	14.1	4.3	80.2-47.3	22.7	80.2-47.3	22.7			
A. W. Webb,	5657	2	Ordinary balance	- 22.2	71.8	- 6.3	48.2	- 6.3	48.2	15.9	3.9	85.7-80.2	23.7	85.7-80.2	23.7			
A. W. Webb,	5656	2	"	- 10.9	69.0	+ 6.9	44.5	+ 6.9	44.5	17.8	4.0	92.5-96.9	25.8	92.5-96.9	25.8			
D. Buckney,	5635	2	Auxiliary to balance	- 7.6	96.9	+ 6.1	57.5	+ 6.1	57.5	13.7	7.3	81.8-92.2	28.3	81.8-92.2	28.3			
V. Kullberg,	5396	2	" reversed detent	- 16.1	47.1	- 4.0	81.8	- 4.0	81.8	12.1	8.6	57.5-81.8	29.3	57.5-81.8	29.3			
Kendal and Dent,	5651	2	Ordinary balance	- 11.4	45.4	+ 3.5	80.2	+ 3.5	80.2	14.9	7.4	80.2-47.3	29.7	80.2-47.3	29.7			
M. Klean and Co. "	1005	2	Auxiliary to balance	- 14.9	63.9	+ 2.4	73.4	+ 2.4	73.4	17.3	7.5	75.0-64.7	32.3	75.0-64.7	32.3			
Kendal and Dent,	8108	2	" acting in ex- tremes	+ 0.9	63.6	+ 21.4	45.4	+ 21.4	45.4	20.5	6.5	96.9-84.6	33.5	96.9-84.6	33.5			
V. Kullberg,	5320	2	Auxiliary to balance; reversed detent	- 9.6	96.9	+ 8.6	80.2	+ 8.6	80.2	18.2	8.2	96.9-84.6	34.6	96.9-84.6	34.6			
H. P. Isaac,	1920	2	" bright spring	- 16.3	45.4	+ 2.1	81.8	+ 2.1	81.8	18.4	8.7	80.2-47.3	35.8	80.2-47.3	35.8			
Kendal and Dent,	6587	2	" to balance, acting in ex- tremes	+ 4.3	65.0	+ 20.6	92.2	+ 20.6	92.2	16.3	9.9	66.1-85.4	36.1	66.1-85.4	36.1			
H. P. Isaac	1772	2	Auxiliary to balance, bright spring	- 3.8	96.9	+ 18.2	45.6	+ 18.2	45.6	22.0	7.5	80.2-47.3	37.0	80.2-47.3	37.0			

30 movements were sent for this trial, but only the performance of those whose trial-number did not exceed 38 secs. is given above.  
+ Rate gaining. - Rate losing.

The extreme range of temperature was from 37.8 to 101.2 F.