

*Report of the Kew Committee for the Year ending  
October 31, 1879.*

The Kew Committee has been increased by one new member, Lieutenant-General Sir J. H. Lefroy, K.C.M.G., during the past year, and is now constituted as follows:—

General Sir E. Sabine, K.C.B., *Chairman.*

Mr. De La Rue, *Vice-Chairman.*

Prof. W. G. Adams.

Capt. F. Evans, C.B.

Prof. G. C. Foster.

Mr. F. Galton.

Lieut.-Gen. Sir J. H. Lefroy,  
K.C.M.G.

Vice-Adm. Sir G. H. Richards.

The Earl of Rosse.

Mr. R. H. Scott.

Lieut.-General W. J. Smythe.

Lieut.-Gen. R. Strachey, C.S.I.

Mr. E. Walker.

*Magnetic Work.*—No change has been made in the Magnetographs, which have worked continuously during the year. The curves obtained have been, as a rule, devoid of interest, no disturbance of note having been registered for some time.

Owing to wear, the vertical force cylinder bearing has become loose in its seat, and it will be necessary shortly to make a new fitting for it.

In consequence of the illness of some of the members of the Subcommittee mentioned in the last report, as appointed to consider the best means of utilising the accumulated records of the Magnetographs, no decision has yet been arrived at in the matter.

At the request of Professor Balfour Stewart the absolute diurnal range of the declination needle has been determined for every day for the period 1858 to 1873.

The scale values of all the instruments were re-determined in January, in accordance with the usual practice.

The monthly observations with the absolute instruments have been made regularly by Mr. Figg, and the results are given in the tables forming Appendix I of this report.

The magnetic instruments have been studied and a knowledge of their manipulation obtained by Mr. D. Gill, the Astronomer Royal at the Cape of Good Hope, and Mr. H. I. Bell, the recently appointed Assistant to the Royal Alfred Observatory, Mauritius.

Information on matters relating to terrestrial magnetism and various data have been supplied to the Hydrographic Office, Dr. E. Van Ryckevorsel, Dr. Atkinson, Dr. Thorpe, Mr. Elliott, Mr. Fleming, and Mr. Gordon.

To the last-named gentleman the Committee also lent illustrations of the magnetographs and other magnetic instruments employed at Kew for use in a work he has in preparation upon Electricity and Magnetism.

The following is a summary of the number of magnetic observations made during the year:—

Determinations of Horizontal Intensity .....	29
„ Dip .....	123
„ Absolute Declination .....	25

*Meteorological Work.*—The several self-recording instruments for the continuous registration respectively of atmospheric pressure, temperature, humidity, wind (direction and velocity), and rain have been maintained in regular operation under the care of Mr. T. W. Baker, assisted by Mr. J. Hillier.

The standard thermometer (No. 379) for eye observations of the temperature of evaporation was accidentally broken in September whilst re-covering the thermograph tube with new muslin. A spare thermometer (No. 473) of the same construction was at once set up in its place, so that no loss took place in the registrations.

The standard eye observations made five times daily, for the control of the automatic records, have been duly registered through the year, together with the daily observations at 0 h. 45 m. P.M. in connexion with the Washington synchronous system.

An additional daily observation has been made since July 1st at 6 h. 45 m. P.M., to be used in a second synchronous system organised by M. Mascart, Directeur du Bureau Central Météorologique, Paris.

The tabulation of the meteorological traces has been regularly carried on by Mr. Hawkesworth, and copies of these, as well as of the eye observations, with notes of weather and cloud, have been transmitted weekly to the Meteorological Office.

The following is a summary of the number of meteorological observations made during the past year:—

Readings of standard barometer .....	2270
„ dry and wet thermometers .....	5818
„ maximum and minimum thermometers .....	976
„ radiation thermometers .....	1670
„ rain and evaporation gauges .....	830
Cloud and weather observations .....	2607

Measurements of barograph curves . . . . .	9202
„ dry bulb thermograph curves ..	9202
„ wet bulb thermograph curves ..	9119
„ wind (direction and velocity)..	18492
„ rainfall curves . . . . .	8760
„ sunshine traces. . . . .	2393

Instruction in the use of meteorological instruments has been afforded to the Rev. Clement Ley, Inspector of English Observing Stations, and Mr. H. I. Bell.

In compliance with a request made by the Meteorological Council to the Kew Committee, the Observatories at Aberdeen, Armagh, Falmouth, Glasgow, Stonyhurst, and Valencia, have been visited and their instruments inspected by Mr. Whipple during his vacation.

Mr. Baker, also in consequence of a request of the Meteorological Council, visited Stonyhurst Observatory in January last, and re-adjusted the thermograph, which had accidentally been deranged during the frost.

With the concurrence of the Meteorological Council, weekly abstracts of the meteorological results have been regularly forwarded to and published by the "Times,"\* "Illustrated London News," "Mid-Surrey Times," and "Torquay Directory," and meteorological data have been supplied amongst others to the editor of "Symons' Monthly Meteorological Magazine," Professor B. Stewart, Dr. Rowland, Mr. Greaves, C.E., and the Institute of Mining Engineers.

Copies of selected photographic curves have been made and supplied to M. Mascart.

*Electrograph.*—This instrument has been in continuous action through the year under the care of Mr. Constable.

It was found necessary in August to dismount and clean the instrument in order to restore its power of keeping a full charge of electricity, which had become somewhat impaired.

On consideration it was deemed inadvisable to alter the bifilar suspension as suggested in last year's report, but the Mascart insulating stands were fixed for the support of the water-dropping cistern, and the action of the instrument has been greatly improved by their adoption, so that strong charges of electricity are now registered even in the dampest weather.

Some trouble was experienced in maintaining a constant flow of water from the jet during the severe frosts of last winter, but it was not considered necessary to make special arrangements for heating the

\* A detailed investigation was made in the month of January into the accuracy of the weekly meteorological records published in "The Times." The result on the whole was very favourable, the principal difference being found in the rainfall, which is usually given in excess of the true amount.

water in the cistern, a spare jet kept in readiness being screwed on when the other was observed to be frozen.

*Photo-heliograph.*—The re-examination of the measurements of the Kew sun-pictures, as noticed in the last report, was completed in January, and the preliminary reductions of  $\frac{r}{R}$  have been steadily carried on throughout the year by Mr. Whipple, assisted by Mr. McLaughlin, who has been temporarily engaged for this purpose. It is expected that the above reductions will be completed by the end of the present year, or early in 1880.

Mr. Marth is still engaged on the reduction to heliocentric elements of the pictures from January, 1864, to April, 1870, inclusive.

All these operations have been conducted under the direction and at the expense of Mr. De La Rue.

The eye observations of the sun, after the method of Hofrath Schwabe, as described in the report for 1872, have been made on 151 days, in order to maintain for the present the continuity of the Kew records of sun-spots. The sun's surface was observed to be free from spots on 113 of those days.

*Transit Observations.*—Seventy-eight observations have been made of sun-transits for the purpose of obtaining correct local time at the Observatory. Eighty-six clock and chronometer comparisons have also been made. This work is performed by Mr. Constable.

*Extra Observations.*—The four solar-radiation thermometers and one terrestrial-radiation were observed daily until the 3rd of August, when all, with the exception of one black bulb thermometer, were completely destroyed by the great hailstorm which occurred on that date. Since then only one, the remaining black bulb, and a new terrestrial radiation thermometer have been daily observed.

The Campbell sunshine recorder, described in the Report for 1875, continues in action, and the improved form of the instrument, giving a separate record for every day of the duration of sunshine, has been regularly worked throughout the year, and its curves tabulated.

Two papers based upon these records have been read by the Superintendent before the Meteorological Society, and published in their Quarterly Journal. The first, "On the Relation between the Duration of Sunshine, the amount of Solar Radiation, and the Temperature indicated by the Black Bulb Thermometer," printed in vol. v, p. 142, shows that these three phenomena are intimately connected with each other, the curves resulting from the plotting down of the daily values given by the three instruments rising and falling together almost all through the year.

The second paper, published in vol. v, p. 213, on "The Duration of Sunshine, Extent of Sky clouded, and the Height of the Barometer," proves that at the Kew Observatory the amount of cloud varies

inversely as the barometric pressure between the limits of 29·0 and 30·3 inches, the variation being most rapid between 29·8 and 30·1 inches. Also that above 30·3 inches cloud increases with increasing pressure, attaining the mean about 30·5 inches, and rising above it at 30·6 inches.

Various experiments have been made with the sunshine-recorder from time to time with the view of improving its efficiency, and new instruments with certain modifications of the Kew pattern have been submitted for approval by Messrs. Beck and Mr. Casella.

*Wind Component Integrator.*—The numerous adjustments and electrical contacts, altogether 190 in number, of this instrument, render it particularly subject to derangement in this country, the damp atmosphere causing frequent failures in the electrical actions, and the high winds constantly shaking the screws loose. The continual necessity for readjustment causing a greater demand upon the time of the Observatory staff than the Committee feel themselves justified in bestowing upon it, they have reluctantly decided upon dismounting it, and it will shortly be returned to South Kensington, to be again set up in the Loan Collection of scientific apparatus.

*Photo-nephoscope.*—At the request of the Meteorological Council this instrument, which was mentioned in the last Report, was, in March, placed in the hands of Captain Abney, R.E., F.R.S., that gentleman having kindly offered to make some experiments with it.

*Exposure of Thermometers.*—Experiments have been for some time in progress at the Observatory with the view of determining the relative merits of different patterns of thermometer screens. For this purpose there have been erected on the lawn a Stevenson's screen, of the ordinary English pattern, and a large wooden cage, containing a Wild's screen, of the pattern employed in Russia. Each of these screens contains a dry and wet bulb thermometer, and a maximum and minimum, all of which are read daily at 9 A.M. and 9 P.M., their indications being compared with those of the thermograph at the same hours. A third portable metal screen, designed by Mr. De La Rue for use on ship-board, which contains a dry bulb thermometer only, is also carried out by the observer, and read at the same time as the fixed instruments.

The cost of these experiments is borne by the Meteorological Council.

*Glycerine Barometer.*—Mr. J. Jordan, having obtained a grant from the Government Fund of the Royal Society for the construction of a glycerine barometer, applied to the Committee for permission to erect it in the Observatory. This they willingly granted, and they also undertook to read it regularly for one year. It has accordingly been set up in the building, but owing to its great length, thirty feet, some difficulty was experienced in finding a suitable situation for it. Eventually it was decided to fix the cistern (which was first ascertained to be constructed of non-magnetic materials), in the magneto-

graph room, to lead the tube of composition metal up through the entrance hall, and to put up the upper part of glass, with the verniers and divided scales, in the north library in a convenient position for reading.

It was successfully filled, by Mr. Jordan, with glycerine (coloured red), and has since its erection been read five times daily, simultaneously with the standard mercurial barometer.

*Bogen's Barometers.*—Mr. F. Bogen has deposited two of the patent standard cistern siphon barometers, described by him in the "Quarterly Journal Met. Soc.," vol. v, p. 137, in the Observatory, with the request that comparisons might be made between the disk reading and the ordinary method of reading barometers. Mr. Bogen visited the Observatory, on several occasions, to give instructions as to the proper method of filling, setting up, and reading his instruments.

Mr. Bogen has also submitted for trial an improved Artificial Horizon.

*The De La Rue Evaporation Gauge.*—The Vice-Chairman of the Committee has devised a small evaporation gauge, by means of which the water given off from a continually-wetted sheet of vegetable parchment is measured daily. Two of these instruments, constructed by Messrs. Negretti and Zambra, are now at Kew, and their indications have been noted every day, at 10 A.M., for the past six weeks.

*The De La Rue Anemograph.*—The Meteorological Council, having now in use Thomson's Harmonic Analyser, instructed the Superintendent to again test the anemograph designed by Mr. De La Rue, for the purpose of indicating at once, without replotting, the horizontal movement of the wind from hour to hour.

The instrument, when tried at the Observatory in 1872, was found to be somewhat defective in its working, as, owing to the mechanical arrangements for returning the pencil to zero, its indications were left unrecorded for intervals varying from three to four minutes every hour. An electrical attachment has now been substituted for part of the mechanism, so as to reduce the time lost to about twenty seconds hourly, and the instrument is at present working in the experimental house.

*The spare Barograph,* belonging to the Meteorological Office, is also erected in the experimental house, for the purpose of trying various photographic processes suggested from time to time as desirable substitutes for those now employed in the preparation of the curves for the registering instruments.

At the request of Professor Stokes, a series of comparisons has been made between a Hodgkinson's Actinometer, returned to England for repair by Mr. Hennessey of Calcutta, and the three standard instruments retained in this country for reference.

*Pendulum Observations.*—The Committee have had their attention directed to an ambiguity in a paper by Messrs. B. Stewart and Loewy,

on the corrections to be applied to Pendulum Observations printed in the "Proc. Roy. Soc.," vol. xvii, p. 488.

It is there stated, on p. 489, that the observations were made with a *reversible* pendulum, and on p. 497, with Kater's *invariable* pendulum.

After a careful investigation the Committee find that only one pendulum was employed throughout the whole series of experiments, and that pendulum was Kater's *convertible* pendulum, designated in the Royal Society Catalogue of Scientific Apparatus as "the basis of the present system of British Weights and Measures."

The original observations stated in the paper to be preserved at the Kew Observatory cannot at present be found, and the authors are unable to afford the Committee any information as to what has become of them.

*Verifications.*—The following magnetic instruments have been verified, and their constants have been determined:—

A Dip-circle, by Barrow and Co., for the Austro-Hungarian Government.

A Dip-circle, by J. Dover, for Dr. Guido Schenzl, Budapest.

A pair of Dipping-needles for Professor Smirnow, Kasan.

There have also been purchased on commission and verified:—

A Unifilar, Dip-circle, and Fox Circle, together with the apparatus for the determination of temperature and induction co-efficients of Magnets, for Professor Greene, Bureau of Navigation, Washington.

A Unifilar for Professor Houzeau, Brussels Observatory.

A Unifilar and Dip-circle for Professor Young, Princetown, United States.

A Unifilar for Senhor Capello, Lisbon Observatory.

A Bifilar for Captain Wille, Norwegian Navy.

A Dip-circle for Lieutenant van Hasselt, Utrecht.

A pair of Dipping-needles for Professor Ferrari, Rome.

And a Tabulator for Don Cecilio Pujazon, San Fernando.

There are at present undergoing verification a Dip-circle for Dr. Mielberg of Tiflis, and a Dip-circle for Mr. Casella.

Although there has been a slight falling off in the total number of barometers verified as compared with last year, yet as regards thermometers the result is highly satisfactory, the number of these instruments having considerably increased. This is due to the great demand for verified clinical thermometers.

The branch still continues under the charge of Mr. T. W. Baker, who is assisted by Messrs. J. Foster, T. Gunter, and C. Taylor. The following are the numbers of instruments examined:—

Barometers, Standard .....	68
,, Marine and Station .....	77
Aneroids.....	51
	<hr/>
Total.....	196
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Thermometers, ordinary Meteorological ....	1286
,, Standard .....	67
,, Mountain .....	43
,, Clinical .....	3405
,, Solar radiation .....	27
	<hr/>
Total.....	4828
	<hr/>

Besides these 53 Deep-sea Thermometers have been tested, the greater number of which were subjected in the hydraulic press, without injury, to strains exceeding three and a-half tons on the square inch.

8 Thermometers have been compared at the freezing point of mercury.

Duplicate copies of corrections have been supplied in 54 cases.

12 Standard Thermometers have been calibrated and divided, a set of three being specially constructed for the experiments on Air Thermometers now in progress under Dr. Thorpe at Leeds.

2 Thermograph Tubes were examined for the Zi-Ka-Wei Observatory, Shanghai.

A pair of special Thermometers have been selected, verified, and forwarded to the Royal Observatory, Naples.

The following miscellaneous instruments have also been verified:—

Hydrometers.....	120
Anemometers.....	2
Rain Gauges .....	6
Sextants .....	4
Theodolites.....	5

There are at present in the Observatory undergoing verification, 26 Barometers, 400 Thermometers, and 4 Rain Gauges.

The comparison of Messrs. Hottinger's Aneroids being completed, the Superintendent drew up an account of the instruments and their performance, which he read before the Meteorological Society.

The paper was published in the "Quarterly Journal," vol. v, p. 189, and the Aneroids were transferred to the care of Mr. Hicks, whom Messrs. Hottinger have appointed their agent in this country.

Several attempts made to verify Thermometers at high temperatures having failed, it is intended to construct a special apparatus

when its pattern shall have been definitely decided upon. Experiments for this purpose are still in progress.

The Committee finding that the "Hall Mark" for Thermometers was not adopted by opticians, owing to the fact that a charge was made for engraving it, decided, in December, to mark all Thermometers verified at the Observatory free of cost.

This resolution having been advertised in the leading scientific journals, and a special assistant, H. Clements, having been engaged for the purpose, the K. O. monogram and register number have been etched upon every Thermometer tested since the beginning of the present year.

As the "Hall Mark" advertisements caused numerous inquiries to be made respecting the verification of instruments, the Committee took advantage of the opportunity to issue a new and revised scale of fees chargeable for this service.

*Air Thermometer.*—The construction of the Standard Air Thermometer has been delayed, in order that the Committee might be enabled to adopt certain improvements which have been suggested by Professors Thorpe and Rücker, who are at present engaged in making an elaborate and accurate comparison between the mercurial and air thermometers.

At the invitation of Professor Thorpe, Mr. Whipple recently visited the Yorkshire College of Science, Leeds, in order to witness the experiments in progress.

The difference between the old Royal Society Standard Barometer and the Kew standards having been well determined, the daily comparisons were brought to a close in March last. The former instrument is to be shortly returned to Burlington House, and again set up in the apartments of the Royal Society.

Owing to an accident to the Galton Thermometer-testing apparatus, and the increased risk incurred in marking the Thermometers, the breakage of Thermometers has been slightly larger than usual during the past year, but it has only amounted to about one-half per cent. of the total number verified.

Some very old Standard Thermometers having been recently tested, the Superintendent has been instructed to draw up an account of the changes in their indications, for presentation to the Royal Society.

A new form of thermometer has been designed by Mr. Whipple, and constructed by Mr. Hicks, for the purposes of conveying indication of temperature to a distance by means of electricity without the necessity of employing intervening clockwork. Professor W. G. Adams has kindly consented to make a set of experiments with this apparatus in the laboratory of King's College.

*Waxed Paper, &c., supplied.*—Waxed paper has been supplied to the following Observatories:—

Bombay, Mauritius, Montsouris, San Fernando, and four Observatories of the Meteorological Council.

Anemograph sheets have also been sent to the Mauritius Observatory, and blank forms for the entry of magnetic observations to the Horton Observatory, the Bureau of Navigation, Washington, and the Owens College.

*Loan Exhibition.*—With the exception of the Hodgkinson's Actinometer and the three instruments mentioned in last year's report, the instruments specified in the Report for 1876 still remain in charge of the Science and Art Department, South Kensington.

*Anemometer Testing.*—The Committee have had before them the question of the desirability of erecting a suitable apparatus for the testing of Anemometers and Air-meters; but in the opinion of Dr. Robinson it will be better to postpone its erection for a time.

*Mauritius Observatory.*—The Earl of Carnarvon, Secretary of State for the Colonies, having requested the Committee to nominate a suitable person to the appointment of First Assistant at the Royal Alfred Observatory, Mauritius, they eventually selected Mr. Herbert Irving Bell, Laureate of the Royal College of Mauritius in 1875, from amongst a number of candidates.

The Crown Agents having approved of their choice, Mr. Bell went through a course of training in observatory work, both at the Kew Observatory and at the Royal Observatory, Greenwich, before he sailed for Mauritius on October 6th.

*Workshop.*—The several pieces of Mechanical Apparatus, such as the Whitworth Lathe and Planing Machine, procured by Grants from either the Government Grant Funds or the Donation Fund for the use of the Kew Observatory, have been kept in thorough order, and many of them are in constant, and others in occasional, use at the Observatory, but the funds of the Committee do not at present allow of the employment of a mechanical assistant, although one is much needed.

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

11 English Scientific Societies and Institutions,

46 Foreign and Colonial Scientific Societies and Institutions.

A large number of scientific works have also been presented to the Library by General Sir E. Sabine, and duplicate copies of works already in the Observatory have been presented to

Dr. Hinrichs.

Professor Karlinski.

The Observatory, Pekin..

Mr. Rundell.

The Society of Telegraph Engineers.

The Committee have also received back from the Council of the British Association, a number of works on Meteorology originally presented to the Observatory, but transferred to the Library of the British Association at Albemarle Street in 1871, when the control of the Observatory was placed in the hands of the Royal Society.

It is in contemplation to make a complete catalogue of all the scientific works in the Library, which now number about 8,000.

*Ventilation Experiments.*—The tubes, cowls, and appliances used by the Sanitary Institute of Great Britain in their experiments on the ventilating power of cowls of different form, still remain fitted up in the experimental house, but no use has been made of them for some months. As, however, there is no immediate necessity for their removal, the Institute has not yet been called upon to dismount them.

*Observatory and Grounds.*—The buildings and grounds have been kept in repair, but owing to the great outlay caused in replacing the windows and skylights, which were broken in the hailstorm of August 3rd, 1879, Her Majesty's Commissioners of Woods and Forests have not repainted the Observatory this year, although it is greatly needed both internally and externally.

The Workshops have been painted externally, and partially whitened inside.

Application was made to the Commissioners to repair the path across the Park, which had become impassable in the long-continued wet weather; as however they did not accede to the request of the Committee, it has been found necessary to adopt temporary measures for facilitating the approach to the Observatory.

*Staff.*—The Staff employed at Kew is as follows:—Mr. G. M. Whipple, B.Sc., Superintendent; T. W. Baker, First Assistant; J. Foster, J. W. Hawkesworth, H. McLaughlin, F. G. Figg, E. G. Constable, T. Gunter, J. Hillier, C. Taylor, A. Dawson, H. Clements, and J. Dawson.

Mr. R. W. F. Harrison resigned his appointment in December, and two Junior Assistants, C. Taylor and A. Dawson, were then engaged in his stead.

*Visitors.*—The Observatory has been honoured by the presence, amongst others, of:—

The President, Officers, and Members of the Council of the Meteorological Society.

Dr. Abbe.

Captain I. du T. Bogle, R.E.

Mr. Gill.

M. Hagemann.

Captain Maxwell, R.N.

Abstract. *Kew Observatory Receipts and Payments Account from November 1, 1878, to October 31, 1879.*

Dr. RECEIPTS.

To Balance from 1877-78	£	s.	d.
Royal Society (Gassot Irons)	2246	16	7
"	248	17	5
Meteorological Office	110	8	4
"	100	0	0
"	100	0	0
"	100	0	0
Meteorological Office, for Postages, &c.	410	8	4
Payment for Instruments on Commission	14	15	3
Sale of Waxed Paper	461	14	7
Verification Fees, Magnetic Instruments	75	9	2
" Opticians, &c.	29	18	6
" Meteorological Office	64	9	0
"	311	0	1
Sale of Standard Thermometers	7	12	0
Payments for Copying Registers	66	17	6
Mr. De la Rue for Sun-work	469	17	1
Sanitary Institution of Great Britain	104	1	3
Professor Balfour Stewart	10	4	1
	4	6	3

PAYMENTS.

By Salaries	£	s.	d.
Extra Payments	4983	9	0
	110	12	4
	1094	1	4
Rent of Land	11	11	0
Fuel and Gas	66	1	9
Furniture and Fittings	16	2	9
Chandlery, &c.	10	3	5
Painting and Repairs	27	13	6
Maintenance of Path and Fence	16	6	8
Printing and Stationery	147	19	1
Postages	45	17	8
Library	14	14	7
Messenger and Housekeeper	14	3	8
Advertisements	61	14	0
Portage and Contingencies	16	14	0
	16	19	5
Instruments purchased on Commission	170	3	4
Postages and Payments on behalf of Meteorological Office	468	13	10
Purchase of Waxed Paper, Packing ditto, &c.	29	4	3
" Chemicals	63	2	0
" Tubes for Standard Thermometers	28	15	10
Verification Department Expenses (Ice, Carbonic-Acid Gas)	3	18	0
Repair of Instruments, and Purchase of New	12	2	7
Carpenter's Work and Sundries	17	17	2
	4	3	9
Sun-work expenses	66	17	4
Construction of Instruments for Experiments	102	0	0
Payments in behalf of Sanitary Institution of Great Britain	4	11	0
" Professor Balfour Stewart	2	13	1
" Mr. Jordan	4	6	3
Balance—Bank of England	437	16	3
London and County Bank	60	0	0
Cash in hand	14	9	4
	512	5	7
	£2657	2	7

November 13, 1879.

Examined and compared with the Vouchers, and found correct.

(Signed) WARREN DE LA RUE, Auditor.

ASSETS.

By Balance as per Statement	£	s.	d.
Meteorological Office, Allowances and Sundries	512	5	7
Commissions	54	3	0
Waxed Paper sold	158	3	6
" in stock	2	5	0
Blank Forms	21	0	0
Verification Fees due	3	3	0
Standard Thermometers sold	76	15	0
Sanitary Institution of Great Britain	5	0	0
Mr. Jordan	90	11	6
	2	13	1
	1	5	6

LIABILITIES.

To Gas, Fuel, and House Account	£	s.	d.
Apparatus and Chemicals	15	1	1
Commissions	5	9	2
Balance	156	18	6
	749	16	5

## APPENDIX I.

*Magnetic Observations made at the Kew Observatory, Lat. 51° 28' 6" N., Long. 0<sup>h</sup> 1<sup>m</sup> 15<sup>s</sup>.1 W., for the year October 1878 to September 1879.*

The observations of Deflection and Vibration given in the annexed Tables were all made with the Collimator Magnet marked K C 1, and the Kew 9-inch Unifilar Magnetometer by Jones.

The Declination observations have also been made with the same Magnetometer, Collimator Magnet N E being employed for the purpose.

The Dip observations were made with Dip-circle No. 33, the needles 1 and 2 only being used; these are 3½ inches in length.

The results of the observations of Deflection and Vibration give the values of the Horizontal Force, which, being combined with the Dip observations, furnish the Vertical and Total Forces.

These are expressed in both English and metrical scales—the unit in the first being one foot, one second of mean solar time, and one grain; and in the other one millimetre, one second of time, and one milligramme, the factor for reducing the English to metric values being 0.46108.

By request, the corresponding values in C.G.S. measure are also given.

The value of  $\log \pi^2 K$  employed in the reduction is 1.64365 at temperature 60° F.

The induction-coefficient  $\mu$  is 0.000194.

The correction of the magnetic power for temperature  $t_0$  to an adopted standard temperature of 35° F. is

$$0.0001194(t_0 - 35) + 0.000,000,213(t_0 - 35)^2.$$

The true distances between the centres of the deflecting and deflected magnets, when the former is placed at the divisions of the deflection-bar marked 1.0 foot and 1.3 feet, are 1.000075 feet and 1.300097 feet respectively.

The times of vibration given in the Table are each derived from the mean of 12 or 14 observations of the time occupied by the magnet in making 100 vibrations,\* corrections being applied for the torsion-force of the suspension-thread subsequently.

No corrections have been made for rate of chronometer or arc of vibration, these being always very small.

The value of the constant P, employed in the formula of reduction

$$\frac{m}{X} = \frac{m'}{X'} \left( 1 - \frac{P}{r_0^2} \right), \text{ is } -0.00179.$$

In each observation of absolute Declination the instrumental readings have been referred to marks made upon the stone obelisk erected about a quarter of a mile north of the Observatory as a meridian mark, the orientation of which, with respect to the Magnetometer, was determined by the late Mr. Welsh, and has since been carefully verified.

The observations have all been made and reduced by Mr. F. G. Figg.

\* A vibration is a movement of the magnet from a position of maximum displacement on one side of the meridian to a corresponding position on the other side.

## Observations of Deflection for Absolute Measure of Horizontal Force.

Month.	G. M. T.	Distances of Centres of Magnets.	Tempe- rature.	Observed Deflection.	Log $\frac{m}{X}$ Mean.	Observer.
1878.	d. h. m.	foot.				
October .....	28 12 24 P.M.	1.0	50.3	15 37 12		F.
		1.3	....	7 2 38		"
	2 28 "	1.0	52.2	15 36 1	9.13057	"
		1.3	....	7 2 10		"
November.....	25 12 28 P.M.	1.0	54.9	15 35 14		F.
		1.3	....	7 1 47		"
	2 24 "	1.0	52.9	15 35 18	9.13014	"
		1.3	....	7 1 48		"
December.....	23 12 37 P.M.	1.0	28.2	15 37 54		F.
		1.3	....	7 2 54		"
	2 36 "	1.0	31.0	15 37 50	9.12967	"
		1.3	....	7 2 48		"
1879.						
January.....	28 12 17 P.M.	1.0	34.6	15 39 6		F.
		1.3	....	7 3 29		"
	2 19 "	1.0	34.2	15 38 36	9.13046	"
		1.3	....	7 3 16		"
February.....	25 12 27 P.M.	1.0	40.3	15 37 41		F.
		1.3	....	7 2 49		"
	2 27 "	1.0	40.4	15 38 5	9.13043	"
		1.3	....	7 3 10		"
March.....	26 12 25 P.M.	1.0	37.0	15 37 51		F.
		1.3	....	7 3 0		"
	2 22 "	1.0	37.1	15 37 2	9.13001	"
		1.3	....	7 2 33		"
April.....	28 12 17 P.M.	1.0	52.7	15 35 22		F.
		1.3	....	7 1 42		"
	2 26 "	1.0	56.2	15 34 7	9.12988	"
		1.3	....	7 1 12		"
May.....	26 12 22 P.M.	1.0	63.9	15 33 20		F.
		1.3	....	7 0 53		"
	2 28 "	1.0	61.9	15 33 25	9.12994	"
		1.3	....	7 1 9		"
June.....	25 12 30 P.M.	1.0	61.4	15 33 15		F.
		1.3	....	7 0 52		"
	2 33 "	1.0	65.6	15 32 7	9.12962	"
		1.3	....	7 0 24		"
July.....	28 12 24 P.M.	1.0	72.3	15 31 32		F.
		1.3	....	7 0 7		"
	2 13 "	1.0	72.7	15 31 8	9.12961	"
		1.3	....	6 59 50		"
August.....	28 12 28 P.M.	1.0	65.4	15 32 49		F.
		1.3	....	7 0 37		"
	2 27 "	1.0	66.8	15 32 5	9.12974	"
		1.3	....	7 0 37		"
September.....	26 12 29 P.M.	1.0	62.7	15 33 11		F.
		1.3	....	7 1 0		"
	2 36 "	1.0	64.9	15 32 38	9.12974	"
		1.3	....	7 0 27		"

Vibration Observations for Absolute Measure of Horizontal Force.

Month.	G. M. T.	Temperature.	Time of one Vibration.	Log $mX$ . Mean.	Value of $m$ .*	Observer.
1878.	d. h. m.		secs.			
October.....	28 11 38 A.M.	48°9	4·6328			F.
	3 2 P.M.	53·4	4·6317	0·31198	0·52634	„
November.....	25 11 43 A.M.	53·4	4·6367			F.
	3 0 P.M.	51·3	4·6366	0·31128	0·52567	„
December.....	23 12 5 P.M.	26·1	4·6258			F.
	3 8 P.M.	32·3	4·6293	0·31162	0·52558	„
1879.						
January.....	28 11 34 A.M.	33·3	4·6335			F.
	2 53 P.M.	34·0	4·6317	0·31093	0·52564	„
February.....	25 11 48 A.M.	38·3	4·6317			F.
	3 1 P.M.	39·4	4·6334	0·31118	0·52578	„
March.....	26 11 37 A.M.	35·1	4·6328			F.
	2 58 P.M.	37·3	4·6328	0·31096	0·52539	„
April.....	28 11 33 A.M.	50·2	4·6382			F.
	3 8 P.M.	56·1	4·6372	0·31107	0·52539	„
May.....	26 11 37 A.M.	62·1	4·6419			F.
	3 2 P.M.	61·2	4·6401	0·31094	0·52534	„
June.....	25 11 55 A.M.	62·8	4·6403			F.
	3 35 P.M.	68·5	4·6415	0·31137	0·52540	„
July.....	28 11 32 A.M.	72·3	4·6418			F.
	2 55 P.M.	73·9	4·6408	0·31181	0·52567	„
August.....	28 11 40 A.M.	64·5	4·6452			F.
	3 4 P.M.	67·6	4·6456	0·31061	0·52501	„
September.....	26 11 44 A.M.	61·6	4·6406			F.
	3 13 P.M.	68·1	4·6410	0·31138	0·52548	„

\*  $m$  = magnetic moment of vibrating magnet.

## Dip Observations.

Month.	G. M. T.	Needle.	Dip.	Observer.	Month.	G. M. T.	Needle.	Dip.	Observer.
			North.					North.	
1878.	d. h. m.	No.			1879.	d. h. m.	No.		
Oct.	29 2 59 P.M.	1	67° 43' 09	F.	Apl.	29 3 16 P.M.	1	67° 42' 09	F.
	2 59 "	2	42' 88	"		3 16 "	2	42' 81	"
	30 3 3 "	1	42' 72	"		30 2 59 "	1	42' 87	"
	3 2 "	2	42' 59	"		2 59 "	2	42' 37	"
	Mean..	....	67 42' 82			Mean..	....	67 42' 53	
Nov.	27 3 9 P.M.	1	67 42' 50	F.	May	28 3 5 P.M.	1	67 42' 25	F.
	3 7 "	2	42' 03	"		3 5 "	2	42' 56	"
	28 3 1 "	1	42' 94	"		29 3 0 "	1	42' 03	"
	3 1 "	2	43' 24	"		3 1 "	2	42' 06	"
	Mean..	....	67 42' 68			Mean..	....	67 42' 22	
Dec.	30 2 55 P.M.	1	67 42' 62	F.	June	27 3 11 P.M.	1	67 43' 12	F.
	2 58 "	2	41' 94	"		3 9 "	2	42' 75	"
	31 3 3 "	1	43' 56	"		30 3 6 "	1	41' 88	"
	3 2 "	2	43' 31	"		3 6 "	2	41' 18	"
	Mean..	....	67 42' 86			Mean..	....	67 42' 23	
1879.					July	29 3 6 P.M.	1	67 42' 62	F.
Jan.	29 3 1 P.M.	1	67 42' 93	F.		3 8 "	2	41' 68	"
	3 2 "	2	42' 68	"		30 3 3 "	1	42' 43	"
	31 2 53 "	1	43' 00	"		3 5 "	2	42' 18	"
	2 52 "	2	42' 87	"		Mean..	....	67 42' 23	
	Mean..	....	67 42' 87						
Feb.	26 3 2 P.M.	1	67 43' 06	F.	Aug.	28 3 51 P.M.	1	67 42' 75	F.
	3 2 "	2	42' 37	"		3 51 "	2	42' 25	"
	27 3 8 "	1	42' 43	"		29 3 16 "	1	41' 68	"
	3 8 "	2	41' 19	"		3 14 "	2	41' 50	"
	Mean..	...	67 42' 26			Mean..	....	67 42' 04	
Mar.	28 4 27 P.M.	1	67 42' 99	F.	Sept.	29 2 55 P.M.	1	67 42' 87	F.
	4 25 "	2	42' 75	"		2 55 "	2	42' 75	"
	31 3 7 "	1	42' 87	"		30 3 10 "	1	42' 87	"
	3 7 "	2	41' 62	"		3 10 "	2	42' 93	"
	Mean..	....	67 42' 56			Mean..	....	67 42' 85	

Month.	Declination.		Magnetic Intensity.																	
	Mean of Observations.		English Units.				Metric Units.				C. G. Measure.									
	X, or Horizontal Force.	Y, or Vertical Force.	Total Force.	X, or Horizontal Force.	Y, or Vertical Force.	Total Force.	X, or Horizontal Force.	Y, or Vertical Force.	Total Force.	X, or Horizontal Force.	Y, or Vertical Force.	Total Force.								
1878.		West.																		
October . . . . .	19 10 3		3.8967	9.5076	10.2752	1.7967	4.3838	4.7377	0.1797	0.4384	0.4738	3.8967	9.5076	10.2752	1.7967	4.3838	4.7377	0.1797	0.4384	0.4738
November . . . . .	19 8 57		3.8956	9.5036	10.2712	1.7962	4.3820	4.7359	0.1796	0.4382	0.4736	3.8956	9.5036	10.2712	1.7962	4.3820	4.7359	0.1796	0.4382	0.4736
December . . . . .	19 9 37		3.8992	9.5139	10.2821	1.7978	4.3867	4.7409	0.1798	0.4387	0.4741	3.8992	9.5139	10.2821	1.7978	4.3867	4.7409	0.1798	0.4387	0.4741
1879.																				
January . . . . .	19 8 29		3.8925	9.4977	10.2646	1.7948	4.3793	4.7328	0.1795	0.4379	0.4733	3.8925	9.4977	10.2646	1.7948	4.3793	4.7328	0.1795	0.4379	0.4733
February . . . . .	19 8 9		3.8938	9.4960	10.2634	1.7954	4.3784	4.7323	0.1795	0.4378	0.4732	3.8938	9.4960	10.2634	1.7954	4.3784	4.7323	0.1795	0.4378	0.4732
March . . . . .	19 11 14		3.8947	9.5006	10.2679	1.7958	4.3806	4.7343	0.1796	0.4381	0.4734	3.8947	9.5006	10.2679	1.7958	4.3806	4.7343	0.1796	0.4381	0.4734
April . . . . .	19 6 51		3.8958	9.5032	10.2707	1.7963	4.3818	4.7357	0.1796	0.4382	0.4736	3.8958	9.5032	10.2707	1.7963	4.3818	4.7357	0.1796	0.4382	0.4736
May . . . . .	19 8 57		3.8949	9.4986	10.2662	1.7959	4.3797	4.7336	0.1796	0.4380	0.4734	3.8949	9.4986	10.2662	1.7959	4.3797	4.7336	0.1796	0.4380	0.4734
June . . . . .	19 7 54		3.8983	9.5067	10.2750	1.7974	4.3834	4.7376	0.1797	0.4383	0.4738	3.8983	9.5067	10.2750	1.7974	4.3834	4.7376	0.1797	0.4383	0.4738
July . . . . .	19 5 7		3.9003	9.5117	10.2804	1.7984	4.3857	4.7401	0.1798	0.4386	0.4740	3.9003	9.5117	10.2804	1.7984	4.3857	4.7401	0.1798	0.4386	0.4740
August . . . . .	19 10 21		3.8943	9.4955	10.2631	1.7956	4.3782	4.7322	0.1796	0.4378	0.4732	3.8943	9.4955	10.2631	1.7956	4.3782	4.7322	0.1796	0.4378	0.4732
September . . . . .	19 5 41		3.8978	9.5104	10.2783	1.7972	4.3851	4.7391	0.1797	0.4385	0.4739	3.8978	9.5104	10.2783	1.7972	4.3851	4.7391	0.1797	0.4385	0.4739

APPENDIX II.

Meteorological Observations.—Table I.

Kew Observatory.

Longitude 0<sup>h</sup> 1<sup>m</sup> 15<sup>s</sup>.1 W. Latitude 51° 28' 6" N. Height above sea-level = 34 feet.

Mean Monthly results from the continuous Records for the Twelve Months ending September 30th, 1879.

Months.	Thermometer.*				Barometer.†				Pressure.	
	Extreme maximum.		Extreme minimum.		Extreme maximum.		Extreme minimum.		Means.	
	Date.	Ther.	Date.	Ther.	Date.	Bar.	Date.	Bar.	Vapour-tension.	Dry air.
	d. h.	°	d. h.	°	d. h.	inches.	d. h.	inches.	inches.	inches.
1878. October . . . . .	5 2 P.M.	70.8	31 6 A.M.	31.3	13 10 A.M.	30.314	26 { 9 A.M. } 10 "	28.989	.315	29.471
November . . . . .	25 11 A.M.	52.4	29 midt.	29.0	19 9 P.M.	30.447	15 5 P.M.	29.167	.209	29.546
December . . . . .	30 noon	53.6	24 10 P.M.	14.7	24 8 "	30.345	19 6 A.M.	29.121	.175	29.552
1879. January . . . . .	1 2 A.M.	51.3	12 7 A.M.	21.0	27 8 "	30.417	3 9 "	29.310	.153	29.881
February . . . . .	9 1 P.M.	52.5	24 ?	20.8	1 1 A.M.	30.142	10 6 P.M.	28.797	.208	29.389
March . . . . .	19 2 "	62.9	2 7 "	25.8	8 7 "	30.592	27 4 P.M.	29.527	.209	29.782
April . . . . .	26 2 "	60.0	12 1 "	28.9	29 1 P.M.	30.299	7 7 A.M.	28.897	.228	29.468
May . . . . .	21 6 "	66.0	10 4 "	31.2	4 8 A.M.	30.489	28 1 "	29.505	.259	29.752
June . . . . .	14 1 "	69.7	{ 4 4 " 5 4 "	43.0	18 { 9 P.M. } 10 "	30.128	3 6 "	29.369	.379	29.433
July . . . . .	29 2 "	77.0	11 3 "	48.0	10 A.M. } 11 " } 1 P.M. }	30.141	20 8 P.M.	29.265	.399	29.406
August . . . . .	15 4 "	74.7	31 midt.	45.3	31 midt.	30.295	27 6 "	29.428	.425	29.418
September . . . . .	3 4 "	68.1	26 6 A.M.	40.3	1 9 P.M.	30.459	24 5 A.M.	29.259	.375	29.598
Means . . . . .	....	..	....	..	....	..	....	..	.278	29.554

The above Table is extracted from the Quarterly Weather Report of the Meteorological Office, by permission of the Meteorological Council.

\* The thermometer-bulbs are 10 feet above the ground.

† Readings reduced to sea-level.

Meteorological Observations.—Table II.

Kew Observatory.

Months.	Mean amount of cloud (0=clear, 10=overcast).		Rainfall*.		Weather †. Number of days on which were registered							Wind ‡. Number of days on which it blew.								
	Total.	in.	Maxi-mum.	Date.	Rain.	Snow.	Hail.	Thun-derstorms.	Clear sky.	Over-cast sky.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.		
1878.																				
October ..	6.5	2.110	0.445	9	16	1	1	..	4	11	1	..	6	2	7	6	6	3	3	
November	7.9	2.515	0.400	27	16	..	1	..	1	17	11	5	1	..	1	2	4	6	6	
December	7.8	1.315	0.200	31	16	6	..	..	3	20	7	2	3	1	2	9	3	4	4	
1879.																				
January..	7.6	2.705	1.030	1	10	4	..	..	3	19	1	15	4	2	1	3	4	1	1	
February.	8.6	4.125	0.890	20	22	8	..	..	1	21	4	2	5	1	2	9	3	2	2	
March...	7.1	0.950	0.355	30	13	3	..	1.	6	17	4	4	3	1	3	8	5	1	1	
April....	8.1	3.045	0.510	9	18	2	..	1.	..	20	7	4	3	2	6	3	3	2	2	
May.....	7.2	3.945	1.785	28	19	..	2	1	2	18	9	2	3	1	3	8	2	3	3	
June.....	7.5	4.180	0.610	24	23	..	..	2	..	18	..	..	2	1	10	12	3	2	2	
July.....	8.4	4.105	1.260	19	21	..	..	1	..	17	..	1	2	1	3	13	8	3	3	
August..	7.6	4.880	0.850	19	20	..	1	3	1	17	..	1	3	1	6	15	2	2	2	
September	7.0	2.865	1.135	23	16	..	1	1	2	15	4	3	5	1	2	9	5	1	1	
Totals...		36.740			210	24	7	10	23	210	49	41	40	14	46	97	48	30	30	

\* Measured daily at 10 A.M. by gauge 1.75 feet above surface of ground. † Derived from observations made at 10 A.M., noon, 2, 4, and 10 P.M.

‡ As registered by the anemograph.

Meteorological Observations.—Table III.

## Kew Observatory.

Months.	Sunshine.*		Maximum temperature in sun's rays.†			Horizontal movement of the Air.‡		
	Total number of hours.	Number of hours Sun was above the horizon.	Mean.	Highest.	Date.	Average daily Velocity.	Greatest Movement in a day.	Date.
1878.								
October .....	h. m.	h. m.	deg.	deg.		miles.	miles.	
October .....	112 54	328 53	98.1	121.8	8	208	510	10
November .....	52 6	264 29	71.2	91.1	8	254	604	10
December .....	19 48	243 3	57.7	83.3	18	201	632	31
1879.								
January .....	22 30	258 50	51.9	80.0	15	291	737	8
February .....	43 12	277 18	76.6	106.4	21	266	463	9
March .....	94 18	366 19	90.6	119.2	29	278	585	23
April .....	81 0	414 2	106.2	120.4	26	218	473	11
May .....	110 48	481 45	115.2	129.5	12	227	402	15
June .....	121 30	494 18	125.6	134.6	9	254	428	21
July .....	98 36	497 18	120.6	141.0	29	255	490	8
August .....	153 54	450 1	119.1	137.1	14	250	456	27
September .....	117 30	378 10	108.4	123.5	10	177	402	9

\* Registered by the Sunshine-recorder.

† Derived from the means of the indications of four black-bulb thermometers in vacuo, read daily at 10 A.M., excepting for the last two months, when a single thermometer only was read.

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