

REPORT

OF THE

THIRTY-EIGHTH MEETING

OF THE

BRITISH ASSOCIATION

FOR THE

ADVANCEMENT OF SCIENCE;

HELD AT

NORWICH IN AUGUST 1868.

LONDON:

JOHN MURRAY, ALBEMARLE STREET.

1869.

Report of the Kew Committee of the British Association for the Advancement of Science for 1867-68.

The Committee of the Kew Observatory submit to the Council of the British Association the following statement of their proceedings during the past year :—

The Meteorological Office, to which allusion was made in the last Report, continues in operation, Kew being the Central Observatory as arranged with the Meteorological Committee appointed by the Council of the Royal Society. In consequence of this arrangement there has been during the past year a considerable access of work to the Kew Observatory, and the duties undertaken by that establishment may, as in the last Report, for clearness' sake, be again considered under the two following heads :—

- (A) The work done by the Kew Observatory under the Direction of the British Association.
- (B) That done at Kew as the Central Observatory of the Meteorological Committee.

This system of division will therefore be adopted in this Report; but it ought to be mentioned that the financial statement appended to it refers only to the first of these divisions, since the work done at Kew for the Meteorological Committee has been paid from funds supplied by the Committee, and not in any way from money subscribed by the British Association.

(A) WORK DONE BY KEW OBSERVATORY UNDER THE DIRECTION OF THE BRITISH ASSOCIATION.

1. *New Instruments for Colaba Observatory.*—The Chairman of the Kew Committee, shortly after the Meeting at Dundee, received a communication from Mr. Chambers, the Superintendent of the Colaba Observatory, Bombay, requesting the support of the Kew Committee in his application to the India Board for a supply of Self-recording Magnetographs and other instruments required for his observatory. This was ultimately brought before the Council of the British Association; and in consequence of the steps taken, Sir Stafford Northcote, in a letter to General Sabine, dated 30 January, 1868, sanctioned the supply of new instruments for the observatory at Bombay, while General Sabine, on behalf of the Kew Committee, undertook to select the following instruments required :—

- (1) A set of Self-recording Magnetometers for registering by photography changes of Declination, Horizontal Force, and Vertical Force.
 - (2) Thomson's Electrometer, arranged for photographic self-registration.
 - (3) A Self-recording Barograph and Thermograph, of the pattern adopted by the Meteorological Committee (added afterwards).
 - (4) Apparatus for measuring and tabulating the curves given by the above-named instruments.
 - (5) Photographic apparatus, porcelain dishes, and boxes for paper and photograms.
 - (6) Moffat's Ozonometer, in box with clockwork and rotating cylinder.
 - (7) Beam-compasses, with steel points and tangent screw adjustment to measure 4 feet (for verification of distances in deflection experiments).
 - (8) Rotating frame with large glass jar for testing thermometers.
2. *Magnetic work.*—The Self-recording Magnetographs, ordered by the

India Board for Mr. Chambers, have been verified at Kew, and returned to the India Office, from which they have been doubtless despatched ere this to Bombay.

A Differential Declinometer (received from General Sabine's Office) has been verified at Kew for Dr. Lemström, who has gone out as physical observer with the Spitzbergen expedition.

A Unifilar has been received at Kew for Mr. Meldrum, of the Mauritius Observatory, and its constants are in progress of being determined.

Senhor Viegas, of Coimbra, and Lieutenant Ielagin, of the Imperial Russian Navy, have received magnetic instruction at Kew; and a Dip-circle has been prepared for the latter gentleman, who purposes making observations with it at the various European Observatories.

The usual monthly absolute determinations of the magnetic elements continue to be made by Mr. Whipple, magnetic assistant; and the Self-recording Magnetographs are in constant operation as heretofore, also under Mr. Whipple, who has displayed much care and ability in the discharge of his duties.

The photographic department connected with the Self-recording instruments is under the charge of Mr. Page, assisted by Mr. Foster, both of whom discharge their duties very satisfactorily.

An arrangement connected with the instrumental clock for shutting off the light every two hours, and thereby increasing the accuracy of the time-scale, originally devised by Mr. Beckley, in connexion with the self-recording meteorological instruments, has been adapted to the Kew, and also to the Mauritius and Bombay Self-recording Magnetographs, and the time-scale of the Kew Magnetographs has been made the same as those of the other instruments.

It was proposed in the last Report that the task of tabulating and reducing the magnetic curves produced at Kew subsequently to January 1865 should be performed by the staff at Kew working under the direction of Mr. Stewart. In accordance with this resolution 787 curves, being those of the declination from February 1865 to April 1867, have been measured for every hour, and the process of reduction of these measurements is well advanced.

The magnetical observations made at Ascension by Lieut. Rokeby, R.M., have been nearly reduced by Mr. Whipple, and it is proposed to communicate the results to the Royal Society.

A comparison of the Kew and Lisbon magnetic curves during the magnetic storm of February 20-25, 1866, made by Senhor Capello, of the Lisbon Observatory, has been communicated to the Royal Society, and will be found published in their Proceedings for May 28, 1868.

Mr. Stewart has likewise received from Senhor Capello a short paper, "On the reappearance of certain periods of Declination disturbance during two, three, or several days," which he proposes to communicate to the Royal Society.

The Rev. W. Sidgreaves and Mr. Stewart have been engaged in making inter-comparisons of simultaneous disturbances of the declination at Stonyhurst and at Kew, for both of which stations the instruments have the same scale. It would appear from these that during slow disturbances there is an absolute identity between the indications of the two instruments, even to their most minute features. On the other hand, the more abrupt disturbances appear to be exaggerated at Stonyhurst as compared with Kew to an extent which appears (at first sight) to depend upon the abruptness. Messrs. Sidgreaves and Stewart are investigating this phenomenon, which has clearly

a physical and not an instrumental origin, and purpose communicating their results in a joint paper to the Royal Society.

3. *Meteorological Work*.—The meteorological work of the Observatory continues in the charge of Mr. Baker, who executes his duties very satisfactorily.

Since the Dundee Meeting, 78 Barometers have been verified, and 71 are at present in hand; 1139 Thermometers have likewise been verified, and 14 Standard Thermometers have been constructed for the Thermographs of the Meteorological Committee. 32 Thermograph Thermometers have likewise been tested, 24 of these being for the Meteorological Committee and 8 for opticians.

The self-recording meteorological instruments now at work at Kew will be again mentioned in the second division of this Report. These are in the charge of Mr. Baker, the Photography being superintended by Mr. Page.

Mr. Robert Addams has kindly made a preliminary experiment with his apparatus for freezing carbonic acid, which is now at Kew, and has also left specific instructions regarding it, so that the operation can in future be performed without assistance. The point corresponding to the temperature of freezing mercury has been determined for two Thermometers belonging to the Meteorological Committee.

The Self-recording Barographs, Thermographs, and Anemographs for the six outlying Observatories of the Meteorological Committee have been verified at Kew. A Self-recording Barograph and Thermograph have likewise been verified for Messrs. R. and J. Beck, opticians; and the verification of another set for Mr. Chambers, of the Colaba Observatory, has been very recently completed.

The experiments made on Aneroids at Kew, by the request and at the expense of the Meteorological Committee, have formed the subject of a communication recently made to the Royal Society by that body.

4. *Photoheliograph*.—The Kew Heliograph, in charge of Mr. De La Rue, continues to be worked in a satisfactory manner. During the past year 224 negatives have been taken on 140 days. 90 pictures of the Págođa in Kew Gardens have likewise been taken, in the hope of being able by this means to determine accurately the angular diameter of the Sun.

Since the last Meeting of the Association, a series of solar researches, in continuation of the second series, has been published (the expense of printing having been defrayed by Mr. De La Rue), entitled “Researches on Solar Physics. Appendix to Second Series.—On the Distribution in Heliographic Latitudes of the Sun-spots observed by Carrington; by Messrs. De La Rue, Stewart, and Loewy.”

Two papers have likewise been communicated to the Royal Society by these gentlemen. The first of these is entitled “Researches on Solar Physics. Heliographical Positions and Areas of Sun-spots observed with the Kew Photoheliograph during the years 1862 and 1863.”

The second is entitled “Account of some Recent Observations on Sun-spots, made at the Kew Observatory.”

Sun-spots continue likewise to be numbered after the manner of Hofrath Schwabe; and a Table, exhibiting the monthly groups observed at Dessau and at Kew for the year 1867, has been communicated to the Astronomical Society, and published in their Monthly Notices.

The measurements of the Kew pictures for the year 1864 are approaching completion; when complete, they will be communicated to the Royal Society. It is intended to work up rapidly the back years, preparatory to a final discussion.

Mr. De La Rue has recently received a letter from M. Struve, in which it is stated that the arrival at Kew of M. Berg, of the Wilna Observatory, in order to practise with the Photoheliograph, may be shortly expected.

5. *Apparatus for Verifying Sextants.*—Several determinations have been made of the angular distances between the collimators of this instrument; but the result appears to indicate a greater want of fixedness in these than is desirable. Should, however, the apparatus come to be extensively employed for the verification of sextants, this may be overcome by means of frequent determinations of these angular distances by a theodolite.

6. *Miscellaneous Work.*—The time and attention of the Observatory Staff have been so much absorbed during the last year with the regular work of the Observatory, that little or no progress has been made in miscellaneous experiments.

The instrument devised by Mr. Broun for the purpose of estimating the magnetic dip by means of soft iron, remains at present at the Observatory, awaiting Mr. Broun's return to England.

The Superintendent has received grants from the Royal Society for special experiments; and when these are completed, an account will be rendered to that Society.

(B) WORK DONE AT KEW AS THE CENTRAL OBSERVATORY OF THE METEOROLOGICAL COMMITTEE.

This work may be divided into four heads, the first of these being the arrangement of self-recording meteorological instruments, their verification at Kew, and erection at the various stations; the second being the arrangement of a system of tabulating from the automatic records of these instruments; the third being the arrangement of a system by means of which the continued accuracy of the instruments themselves, and of their tabulated records, may be secured; while the fourth is the work done at Kew as being itself one of the Observatories of the Meteorological Committee.

1. *Arrangement, Verification, and Erection of Self-recording Instruments.*—In the last Report of this Committee a short account was given of the principles of construction of the system of self-recording meteorological instruments arranged at Kew, comprising the Thermograph, Barograph, and Anemograph. A more detailed account has since been given by the Meteorological Committee in their Report to Parliament for the year 1867, and it is therefore unnecessary to enter here into the subject. It ought, however, to be mentioned that the principle adopted in these instruments is to check the accuracy of their automatic records by means of reference to standards; and with this view the Kew Committee have constructed a Standard Wet and Dry Bulb Thermometer for each Thermograph, and has verified a Standard Barometer for each Barograph. When the various self-recording instruments had been completed by the opticians, they were sent to Kew, where they were examined and verified. They were then dispatched to their respective stations in charge of the observer, who had been previously instructed at Kew; and finally, Mr. Beckley, Mechanical Assistant at Kew, went to the various stations and superintended the erection of the instruments. By his aid this was accomplished in a very thorough and satisfactory manner.

2. *System of Tabulation.*—It is not proposed to discuss here the system of tabulation. This has already been done, to a certain extent, in the Report of the Meteorological Committee presented to Parliament; and the whole subject will, it is hoped, be fully treated of on some future occasion. Suffice

it to say, that the system of tabulation was arranged at Kew, and that the tabulating instruments were all verified there before being sent to their respective observatories.

3. *Verification of Records.*—It has already been mentioned that the competency of the observers at the various stations to undertake the charge of the self-recording instruments was secured by a course of instruction at Kew, where they became acquainted with the principles of construction of the various instruments, with the photographic process necessary to obtain curves, and with the system of tabulation. In addition to this, the instruments were erected at the various stations by Mr. Beckley, and each observer was thus well started. It is not, however, enough, in a project of this nature, to secure a good beginning; it is, moreover, indispensable to see that the standard of excellence is maintained.

For this purpose it is proposed by the Meteorological Committee that Mr. Stewart should personally visit all the Observatories every year; in addition to which, some one of the Kew assistants might occasionally visit some station, with a specific object in view. Mr. Stewart has already visited Stonyhurst, Glasgow, and Aberdeen; and, in addition to the preliminary visit to the various stations made by Mr. Beckley, Mr. Whipple has visited Falmouth.

Besides this inspection, it is also necessary to check at Kew the accuracy of the tabulated results that arrive there from the various stations. A close and constant scrutiny of these results is therefore made at Kew; and when any error is detected, it is brought before the notice of the observer who made it. All this involves a very considerable amount of labour, more especially at the commencement of the undertaking, and until the various observatories are in thorough working order. For the purpose of securing accuracy and uniformity in the reduction of the records of these instruments, it has been proposed that a set of rules should be drawn up under the sanction of this Committee.

4. *Work done at Kew as one of the Observatories of the Meteorological Committee.*—This consists in keeping the Barograph, Thermograph, and Anemograph furnished by the Meteorological Committee in constant operation. The Barograph is erected in the room which contains the Magnetographs, and which has a very small daily range of temperature. The outer part of the Thermograph is attached to the north side of the Observatory, towards the west, while the Anemograph has been erected above the centre of the dome, so as not to interfere with the Photoheliograph.

For the first two of these instruments traces in duplicate are obtained, one set being sent to the Meteorological Office, and one retained at Kew; as regards the Anemograph, the original records are sent, while a copy of these on tracing-paper is retained.

The tabulations from the curves of the Kew instruments, and the examination of the results forwarded to Kew from the outlying Observatories, so far as this last is not personally done by Mr. Stewart, are performed in a very satisfactory manner by Messrs. Whipple, Baker, and Page.

Mr. Steventon, a nephew of Captain Toynbee, of the Meteorological Office, has been in attendance at the Observatory for instruction for about twelve months, and latterly has given much assistance in the meteorological department of the Observatory, with the details of which he is now fully conversant.

J. P. GASSIOT, *Chairman.*