

REPORT

OF THE

THIRTY-FIFTH MEETING

OF THE



BRITISH ASSOCIATION

FOR THE

ADVANCEMENT OF SCIENCE;

HELD AT

BIRMINGHAM IN SEPTEMBER 1865.

LONDON:

JOHN MURRAY, ALBEMARLE STREET.

1866.

Report of the Council of the British Association, presented to the General Committee, Wednesday, September 6, 1865.

1. The Council has received a Report from the Treasurer, W. Spottiswoode, Esq., at each of its meetings, and his General Report for the year ending September 6, 1865, will be presented to the Committee this day.

2. The Report of the Parliamentary Committee has been received for presentation to the General Committee this day.

3. The Kew Committee has presented a Report to the Council at each of its meetings, and the Report for the year 1864-65 will be laid before the General Committee this day.

4. In addition to the Noblemen and Gentlemen elected at Bath, the Council propose the names of the Right Hon. the Earl of Dudley; the Right Hon. the Lord Lyttelton, Lord-Lieutenant of Worcestershire; A. Follett Osler, Esq., F.R.S.; and the Rev. Charles Evans, M.A., Head Master of King Edward's School, as Vice-Presidents of the present Meeting; and the Rev. G. D. Boyle, M.A., as Local Secretary.

5. The Council have added to the list of Corresponding Members the names of the following Foreign Men of Science, who have been present at Meetings of the Association:—M. E. Hébert, Dr. Arnold Moritz, Herr Neumayer, M. Vámbéry, Dr. Welwitsch.

6. The Council learn with deep regret that the prolonged illness of Mr. Hopkins renders him unable to continue his valuable services in the office of General Secretary.

7. The Council have been informed that invitations will be presented to the General Committee at its meeting on Monday, September 11, from Nottingham, for the year 1866; from Dundee, for the year 1867; and from Norwich and Southampton for an early meeting.

Report of the Kew Committee of the British Association for the Advancement of Science for 1864-65.

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

A short time before the Meeting at Bath, it had been decided by the Secretary of State for India, on the recommendation of the President and Council of the Royal Society, that pendulum observations should be made in India, and that the officer appointed to conduct this experimental investigation might receive instruction at Kew Observatory, which might form the base-station of the Indian series.

In consequence of this decision Captain Basevi, R.E., first assistant in the Indian Trigonometrical Survey, received instruction at Kew Observatory in the method of making and reducing pendulum observations, and in that of taking transits. Colonel Walker, R.E., Superintendent of the Survey, also attended, in order to make himself acquainted with the details of the apparatus and the method of observing.

The pendulums used were those marked No. 1821 and No. 4, used formerly by General Sabine in different parts of the globe. The former was also used by Mr. Airy in his Harton Colliery experiments.

A receiver, by means of which these pendulums might be vibrated *in vacuo*, was constructed by Mr. Adie, optician, London. A convenient room for pendulum observations was likewise fitted up in the Observatory, the expense being defrayed from the Government Grant Fund of the Royal Society;

and in this room the preliminary observations were made for determining the constants of the two pendulums about to be used in India. These observations were made by Mr. Loewy, and the results have been communicated to the Royal Society by the Superintendent, in conjunction with the observer. The pendulums and other apparatus were subsequently taken to India by Mr. J. Hennessey, and have arrived safely at the head quarters of the Trigonometrical Survey.

General Sabine has been informed by Mr. Meldrum, Director of the Mauritius Observatory, that the necessary funds have been voted by the Government of that colony for hourly meteorological and magnetical observations; and that he may shortly be expected in this country, in order to become acquainted with the working of the Kew instruments. In consequence of this communication, Mr. Adie has constructed a set of self-recording magnetographs, in readiness for Mr. Meldrum's arrival.

A Dip Circle and Unifilar have been verified at Kew, and will shortly be dispatched to Mr. Ellery, Director of the Observatory, Melbourne, Australia.

Two Dip Circles and two Unifilars, ordered by Colonel Walker, R.E., Superintendent of the Indian Survey, have been verified in the presence of Colonel Walker, who has received instruction in the method of observation with these instruments. They have since been sent to India, where they have safely arrived.

Three Dip Circles and three Unifilars, ordered by Colonel Strange, are being verified at the Observatory, and likewise one Dip Circle and one Unifilar recently ordered by Captain J. Belavenetz of the Russian Navy, for the Compass Observatory just built at Cronstadt.

Mr. E. Walker (who has received the Cambridge Adams prize for his essay on terrestrial magnetism) has been at Kew Observatory, receiving instruction in the use of magnetical instruments.

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

The meteorological work of the Observatory continues to be performed by Mr. Thomas Baker, who likewise takes charge of the photographic department connected with the self-recording instruments, and executes both offices very satisfactorily.

Since the Meeting at Bath, Senhor da Souza, of the University of Coimbra, has ordered a self-recording barograph and thermograph, an anemometer and electrograph, tubes for filling by Mr. Welsh's process in order to obtain a standard barometer, and a cathetometer. These instruments have been constructed by opticians, and forwarded to Coimbra.

During the past year, 88 barometers and 420 thermometers have been verified, and 6 standard thermometers have been supplied to men of science and opticians; 3 sets of measures of capacity have likewise been verified.

The Self-recording Barograph continues in constant operation, and traces in duplicate are obtained, one set of which has been regularly forwarded to the meteorological department of the Board of Trade.

At the request of Mr. Charles Cator, an anemometer of his construction has been tested at the Observatory, and the results communicated to him. Also, at the request of Professor Roscoe, the photographic action of total daylight is daily registered by an apparatus of his construction.

The Kew Heliograph, in charge of Mr. De la Rue, continues to be worked by a qualified assistant, who gives much satisfaction. During the past year 243 negatives have been taken, on 146 days, and four sets of positives

have been printed from each, some of which have been given to men of science interested in this branch of research.

The negatives are being reduced under the superintendence of Mr. De la Rue, and by means of an instrument of his own construction, which he has generously presented to the Kew Committee. Mr. B. Loewy has been engaged in the reduction, which he is executing satisfactorily.

It was mentioned in last Report that an addition to the Micrometer was in the course of construction, by means of which the proportion of the sun's disk obscured by spots might be conveniently measured. This arrangement is now completed; and the materials for measurement have been greatly increased through the kindness of Mr. Carrington, who has placed his original drawings, in which the size and appearance of the spots are delineated with great fidelity, at the disposal of the Kew Observatory. It may be desirable to state in a few words the proposed method of exhibiting the results of these reductions. In the progress of this branch of knowledge observers have been led to recognize certain laws which represent the average behaviour of sun-spots; but to all of these laws there are individual exceptions. In this state of things it is probable that our knowledge of the subject will ultimately be advanced, not only by a study of those groups which behave in a normal manner, but also by a study of those which are exceptions in their behaviour to the general rule; and on this account it has been thought desirable to publish the results in such a way that anyone may be able to study the appearance and behaviour—in fact the whole history—of any one group.

In order to accomplish this, a lens is being made by Dallmeyer, by means of which individual groups may be magnified to a scale on which the diameter of the sun will be equal in size to two feet.

The sun-spots continue to be observed after the method of Hofrath Schwabe, of Dessau.

As Kew is the first public institution which has taken up the subject of sun-spots, and as it is intended to continue the method of numbering groups so long and successfully adopted by Hofrath Schwabe, it was thought desirable to endeavour to procure, if possible, for this country the original drawings made by this eminent and assiduous observer during a course of about forty years. A joint letter by Mr. De la Rue and Mr. Stewart was consequently addressed to Hofrath Schwabe; and the following answer to it was soon received.

“GENTLEMEN,—The request contained in your letter, although in the highest degree honourable and complimentary to me, and although it gives me an opportunity to show the Royal Astronomical Society my gratitude for the Royal Medal granted to me, has still cost me some struggle before complying with it; for it is not easy to part with what has given me very often much pleasure and enjoyment as a compensation for the labour devoted to the work.

“But in complying with your desire I do so on one condition, viz. that you would grant me permission to obtain the observations back again at any time that I should be desirous of looking into them, during the short time of life still left to me. I do not think that I shall have an occasion to avail myself of the permission asked for; but permit me kindly to believe that it is in my power to do so. After my death you may consider the whole of the observations as the property of the Royal Astronomical Society.

“Please to write me if you are willing to agree to the above desire, and I shall then immediately send you my astronomical diaries, &c. from 1825 to the end of 1864.

“I remain, Gentlemen,

“Yours very faithfully,

“S. H. SCHWABE.”

In order to realize this generous bequest of Hofrath Schwabe, Mr. Loewy of the Kew Observatory went to Dessau, taking with him a selection of duplicate negatives and prints of the sun, which he presented, in the name of the Association, to that gentleman. After receiving Mr. Loewy most courteously, Hofrath Schwabe expressed his gratification at the high degree of perfection attained in photoheliography, which surpassed his most sanguine expectations; he also handed over to Mr. Loewy's trust not only his valuable collection of sun-drawings, but also all his astronomical observations. Some of these will be exhibited at the Association.

It has long been a desideratum in photoheliography, with the view of obtaining the apparent diameter of the sun's disk, to ascertain the *absolute* values in arc of the divisions of the measuring-instrument (Mr. De la Rue's Micrometer), and preliminary experiments were made with that object during the period that the Heliograph was at the Cranford Observatory. These were only partially successful. The mode of operation was this: a suitable object sufficiently distant was photographed by means of the Kew instrument, with the lenses in the same positions as when solar pictures were taken. Different portions of the object (windows, doors, &c. of a house, for example) were then carefully measured so as to ascertain their value in minutes and seconds of arc; and by measuring the pictures of these several portions with the arbitrary scale of the Micrometer, the value of the latter in arc could be calculated. The experiments did not succeed so well as could have been desired, in consequence of the disturbance of the images by the undulations of the atmosphere, none but very low objects coming within the desired range. More recently, however, the experiments have been taken up again with great promise, and excellent photographs of the Kew Pagoda have been obtained, which possess the requisite sharpness. The object itself, on account of its numerous galleries, is peculiarly fitted for such observations, as it will be possible to ascertain and allow for any optical distortion of the photographic image. Thus it is not improbable that the Pagoda will afford the means of ascertaining, photographically, with the greatest accuracy, the angular diameter of the sun, and will give data for correcting the assumed semidiameter of the moon, by the discussion of photographic pictures of solar eclipses.

M. Gussew has informed Mr. De la Rue that the Wilna Heliograph is now at work under his direction, during the absence, on account of ill health, of the Director, Prof. Sabler. At present he experiences some difficulty in obtaining perfect photographs, and he has been invited to receive instruction at the Kew Observatory. It is considered to be desirable on other accounts that M. Gussew should be able to avail himself of the advantage thus offered to him, as an arrangement might then be made for the division of the labour of reducing the Heliographic observations.

An apparatus will shortly be added to the Kew Observatory for the important object of the ready verification of sextants; the system of distant mirrors now in use, designed by Mr. Galton and erected at his own cost, being only available in steady sunshine.

The new apparatus has been designed by Mr. Thomas Cooke, the well-known optician. In principle, it consists of four collimators fixed radially, at various angles apart, round the table on which the sextant is to be laid for examination. The cross wires of the collimators in each of their combinations are to be brought successively into contact by the sextant. Then a comparison of its readings with the constant angles of construction of the apparatus determines the error of the sextant at various points of its arc. However, in practice, to avoid the cost of very large collimators, whose

object-glasses would suffice to include the rays proceeding both to the index and to the horizon-glasses of large sextants, Mr. Cooke employs *double* collimators of moderate size; and he adjusts each pair to strict parallelism by aid of a detached telescope.

The coloured shades of the sextant are readily examined by strongly illuminating the fields of two of the collimators, after contact of their cross wires has been made in the ordinary manner.

On the application of Mr. Galton, backed by the recommendation of the Kew Committee, the Council of the Royal Society has allotted £80 from the Government Grant, to defray the estimated cost of Mr. Cooke's apparatus, and its establishment in the Observatory at Kew.

The apparatus will be erected in the basement-hall of the Observatory; and when the arrangement is complete it is hoped that the Observatory will become a place where quadrants and sextants can be verified with great facility, and where scientific travellers or officers in Her Majesty's Service may receive instruction in the use of geographical instruments.

The solar spectrum is being mapped by the spectroscope belonging to the Chairman. All the measurements for the region between D and E have been made and carefully verified; and a map of this region, in accordance with these measurements, has been constructed by Mr. Loewy. Many more lines are exhibited in this map than in that lately made by Professor Kirchhoff. Observations made by this instrument have likewise brought out several new lines in the spectrum of ignited sodium.

At the joint suggestion of Professor Tait of Edinburgh and the Superintendent, an ingenious apparatus has been constructed by Mr. Beckley, by means of which a disk can be made to revolve *in vacuo* with great velocity; and a short description of some experiments performed by means of this instrument, with the view of ascertaining whether visible as well as molecular motion is dissipated by a medium pervading space, has been communicated to the Royal Society by the Superintendent in conjunction with Professor Tait.

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.

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.

It will be seen from the foregoing Report, that many other experiments and observations, of a nature to advance science, are made under the sanction of the Committee, besides those which form the ordinary work of the Observatory; it is, however, always stipulated that the cost of such experiments shall be defrayed by their promoters.

J. P. GASSIOT,
Chairman.

Kew Observatory,
31st August, 1865.

Accounts of the New Committee of the British Association from September 14, 1864 to September 6, 1865.

RECEIPTS.

	£	s.	d.
Received from the General Treasurer	600	0	0
" for the verification of Meteorological Instruments, from the Board of Trade ..	4	5	0
" from the Admiralty	10	15	0
" from Opticians	35	15	6
" for Barograph Curves sent to the Meteorologic Office, London	26	1	5
" for the verification of portable Magnetometers	20	0	0
" for the construction of standard Thermometers	3	5	0
Received by the Superintendent for time of the Observatory Staff occupied in preparing pendulum-room, making and reducing pendulum observations, &c.....	50	0	0
	—	150	1 11
			<u>£750 1 11</u>

PAYMENTS.

	£	s.	d.
Balance from last account	45	17	9
Salaries, &c. :—			
To B. Stewart, four quarters, ending 1st October, 1865	200	0	0
Ditto, allowed for petty travelling expenses.....	10	0	0
G. Whipple, four quarters, ending 18th September, 1865.....	85	0	0
T. Baker, four quarters, ending 29th September, 1865	60	0	0
R. Beckley, 51 weeks, ending 4th September, 1865, at 40s. per week	102	0	0
Ditto, gratuity allowed for travelling expenses	15	0	0
F. Page, 3 weeks, ending 3rd October, 1864, at 10s. per week.....	1	10	0
Ditto, 48 weeks, ending 4th September, 1865, at 12s. per week	28	16	0
			<u>502 6 0</u>
Apparatus, Materials, Tools, &c.	32	3	9
Ironmonger, Carpenter, and Mason	1	4	0
Printing, Stationery, Books, and Postage	29	17	8
Coals and Gas	47	11	1
House Expenses, Chandlery, &c.	29	4	8
Portage and petty expenses	16	12	4
Rent of Land to 10th October, 1865, and half payment for horse which fell into ditch	18	10	0
Balance.....	26	14	8
			<u>£750 1 11</u>

I have examined the above account and compared it with the vouchers presented to me.

The Receipts amount to.....	£700	1	11
And for expenses connected with Pendulum Observations.....	50	0	0
	750	1	11
Last Year's Balance.....	£ 45	17	9
Leaving a balance in hand amounting to.....	723	7	3
	£ 26	14	8

29th August, 1865.

R. HUTTON.