

REPORT

OF THE



THIRTY-SECOND MEETING

OF THE

BRITISH ASSOCIATION

FOR THE

ADVANCEMENT OF SCIENCE;

HELD AT CAMBRIDGE IN OCTOBER 1862.

LONDON:

JOHN MURRAY, ALBEMARLE STREET.

1863.

the General Committee at its Meeting on Monday, October 6, from Newcastle-on-Tyne, Birmingham, Bath, Nottingham, and Dundee.

11. That the Vice-Chancellor of the University of Cambridge and the Rev. Professor Challis be elected Vice-Presidents for the next year.

October 1, 1862.

WILLIAM FAIRBAIRN,
President.

*Report of the Kew Committee of the British Association for the
Advancement of Science for 1861-1862.*

The Committee of the Kew Observatory submit to the Association the following Report of their proceedings during the past year.

Deeming it desirable that the instrumental arrangements and scientific processes at use in the Observatory should be represented at the International Exhibition, application was made to the Commissioners for space.

This was granted in the nave of the building, where the following instruments are at present exhibited :—

1. A set of Self-recording Magnetographs.
2. An instrument for tabulating from the traces furnished by the Magnetographs.
3. A Unifilar.
4. A Dip Circle.
5. A Self-recording Anemometer.
6. Barometers.
7. An instrument for testing Thermometers, also a Kew Standard Thermometer.
8. Sun Pictures, taken by the Kew Heliograph.

The Committee have the pleasure to inform the Association that a Medal has been awarded to the Kew Observatory for excellence and accuracy of construction of instruments for observing terrestrial magnetism; and that two Medals have likewise been awarded to Mr. R. Beckley, Mechanical Assistant at Kew, for his Registering Anemometer, and for his Photographs of the Sun.

It is proposed that application be made to the Government Grant Committee of the Royal Society for the expenses incurred through this exhibition.

At the time when the last Report was made to the Association, the Staff at Kew were occupied with the verification of a set of magnetic instruments belonging to Prof. De Souza, of the University of Coimbra, a gentleman who was present at the Meeting at Manchester. The examination of these was shortly after completed, and the instruments, consisting of a set of Self-recording Magnetographs, a tabulating instrument, a Dip Circle, and a Unifilar, have since been safely received at Coimbra.

The following letter was addressed to the Chairman by Prof. De Souza shortly before his departure :—

“ London, 26th October, 1861.

“ MY DEAR SIR,—I cannot leave England, where I have been exceedingly favoured by the Committee of the Kew Observatory of the British Association, without expressing to you my hearty thanks for the help I have experienced from the Committee in the construction and verification of the Magnetic and Meteorologic instruments for the University of Coimbra, as well as for the valuable instruction which I have received, guided by the Director of the Kew Observatory, and the kindness which the British Asso-

ciation has shown me in their magnificent Meeting. I shall never forget the help afforded to me in so many different ways, and I desire earnestly to put it in immediate contribution towards *the advancement of science*.

“The Observatory of Coimbra must have in its library, as a memorial, the valuable collection of Transactions of the British Association, and I hope that you may be so kind as to put me in the way of obtaining these volumes.

“I remain, dear Sir,

“Sincerely yours,

“J. P. Gassiot, Esq.”

“JACINTHO A. DE SOUZA.”

The request of this letter has been complied with by the Council of the Association, and a complete set of the Transactions has been dispatched to Coimbra.

The Director of the Lisbon Observatory has since requested the Committee to superintend the construction of a set of self-recording Magnetographs. The Committee, in complying with his request, have made arrangements for the instruments at present exhibited in the International Exhibition, and these will afterwards be mounted at the Kew Observatory for inspection and verification.

A Differential Declinometer for the Government Observatory at Mauritius has been verified and forwarded to Prof. Meldrum, who has received it in safety.

Lieut. Rokeby, of the Royal Marines, already favourably known by a meteorological register very carefully kept at Canton during its occupation by the British troops, has received instruction at Kew in the use of magnetical instruments, and has been furnished with a Dip Circle, a Unifilar, a Bifilar, and a Differential Declinometer, of which the constants have been determined at the Observatory. Lieut. Rokeby proposes to employ these instruments at the Island of Ascension during his term of service at that station. He has also been furnished by Admiral FitzRoy with a complete equipment of the meteorological instruments supplied by the Board of Trade. The importance of Ascension as a magnetical station has long been recognized. Situated very nearly on the line of no magnetic dip, the determination of the periodical variations and of the secular changes of the three magnetic elements cannot fail to possess a high value; and as a meteorological station, a rock in the mid-ocean, within 6° of the Equator, presents an almost unrivalled locality for an exact measure of the amount of the lunar atmospheric tide, and of the variations in direction and force of the trade-wind. The Admiralty, apprised of Lieut. Rokeby's meritorious purposes, have sanctioned the appropriation of the officers' quarter at the summit of the Green Mountain, known as the “Mountain House,” as an observatory; and the department of the Board of Trade, under Admiral FitzRoy's superintendence, has authorized the expenditure of £50 in providing the additional accommodation required for the instruments. Lieut. Rokeby has arrived at Ascension with the instruments uninjured, and writes in strong terms of the support he receives from Captain Barnard, the commander of the troops on the island.

On June 19th the Chairman received a letter from the Astronomer Royal, in which he stated that he was very desirous of comparing the Greenwich records of the vertical-force magnet with those at Kew; and that, if agreeable to the Committee, he would request Mr. Glaisher to endeavour to arrange a meeting with Mr. Stewart for that purpose.

The Chairman immediately replied, offering every facility, and Mr. Glaisher has since visited the Observatory, where the comparison has been made.

The usual monthly absolute determinations of the magnetic elements continue to be made, and the self-recording magnetographs are in constant operation under the zealous superintendence of Mr. Chambers, the Magnetical Assistant.

Major-General Sabine, Pres. R.S., has laid before the Royal Society a paper entitled "Notice of some conclusions derived from the Photographic Records of the Kew Declinometer in the years 1858, 1859, 1860, and 1861."

The exceedingly good definition which the labours of the late Mr. Welsh procured for the magnetic curves, has also enabled the Superintendent, Mr. Stewart, to discuss the disturbance-curves by a peculiar method, depending on such definition; and he has presented a paper to the Royal Society "On the forces which are concerned in producing the larger magnetic disturbances."

The Committee are at present engaged in investigating the best means of multiplying copies of these curves, and exhibit to the Association two prints from such—one kindly taken by Sir Henry James by his process, and the other taken by that of Mr. Paul Pretsch.

The expense incurred by Mr. Pretsch has been defrayed by £25 obtained from the Government Grant through the Royal Society.

The Chairman of the Balloon Committee having applied to the Superintendent for the instruments used by the late Mr. Welsh in his ascents, these were delivered over to Mr. Criswick on the 12th of March last, having been previously verified at the Observatory.

The Meteorological work of the Observatory continues to be performed in a satisfactory manner by Mr. George Whipple, and each Member of the Staff of the Observatory seems much interested in the duties he is called upon to discharge.

During the past year 184 Barometers and 282 Thermometers have been verified; and, to give an idea of the amount of this kind of work which has been accomplished since first the subject was commenced in the year 1854, it may be stated that no fewer than 1185 Barometers and 6429 Thermometers have been verified up to this date.

Rear-Admiral FitzRoy having been informed of the existence at the Observatory of a Barograph invented and used by Mr. Ronalds, the following letter was addressed by him to the Chairman:—

(Copy.)

"Board of Trade (and Admiralty) Meteorological Department,
2 Parliament Street, London, S.W., 7th April, 1862.

"SIR,—I have the honour to address you as Chairman of the Kew Committee of the British Association for the Advancement of Science, on behalf of this branch department of the Board of Trade and the Admiralty.

"I am authorized to request that you will allow us to endeavour to benefit by your regular photographic self-registration of the Barometer at the Kew Meteorological and Magnetical Observatory during at least one complete year of continuous record, by causing this office to be furnished with copies of photographic tracings, or their results, in *full detail*.

"The objects specially in view here, are:—

"Such accurate and indisputable continuous delineation of atmospheric pressure, or (rather) tension, as can only be obtained by perfectly reliable means; and

"Such details of *occasional* oscillations, or pulsations (so to speak), as can best be obtained photographically.

“For practical daily purposes, a self-registering Barometer, on the Milne principle, may be sufficient; but for elaborate analysis of atmospherical conditions and changes, in connexion with the numerous influences operating, some occasionally, some frequently, others *always*, in the air and its ever-restless currents, such an apparatus as that now available at Kew would appear to be indispensable.

“Besides ordinary meteorological peculiarities, the direction of magnetic earth-currents, the occurrence of magnetic storms, the differing electrical conditions of various currents of air, the phenomena of earthquakes, and their ‘lightnings’*, seem to be more or less in certain relations to atmospheric tension, and therefore to require a close and unbroken barometrical registration. Towards some additional expense incurred by the Kew Observatory in complying with this request, I am authorized to say that this department will contribute, on principle similar to that of verification of instruments.

“I have the honour to be,

“Sir,

“Your obedient Servant,

(Signed)

“ROBERT FITZROY, *R. Adm.*”

“P.S. Probably *two* scales of tracing, analogous to ‘Sailing Charts’ and ‘Particular Plans,’ would be convenient.”

“John Peter Gassiot, *Esq., F.R.S.,*
Chairman of the Kew Committee of the
British Association.”

To which the Chairman shortly afterwards replied in the following terms:—

(Copy.)

“Kew Observatory, 23rd April, 1862.

“SIR,—I have the honour to acknowledge receipt of your letter of 7th inst., addressed to me as Chairman of the Kew Committee of the British Association.

“On behalf of this Committee, I may state in reply that it will afford us much satisfaction to furnish your department with Photographic Self-registrations of the state of the Barometer at Kew Observatory.

“I am informed by Mr. Stewart, our Superintendent, that we have in our possession an instrument well calculated, with some slight alterations, to produce the results you desire.

“It possesses a compensation for temperature; besides which, it will be placed, when finally in action, in a room where the daily range of temperature is not more than half a degree Fahrenheit.

“This instrument is not yet, however, in working order, and two months may perhaps elapse before it is quite ready. As you seem to think it desirable to obtain occasionally curves on an enlarged scale, it will be matter for our consideration whether this can be managed, and how. You will be duly informed of our resolution; but, in the mean time, I may state that it would be somewhat more than two months before such additional curves could be ready. In conclusion, without binding ourselves to any specified time (which, indeed, would not be desirable in a matter of this nature), I beg to assure you that we shall do all in our power to hasten the desired result; and, as we hope to have things ready in the course of two or three months,

* Secchi and Palmieri, 1862.

we shall then also be prepared to reply to you with respect to remuneration for the additional work which the Observatory would thus undertake.

“ I have the honour to be,

“ Sir,

“ Your obedient Servant,

(Signed) “ J. P. GASSIOT.”

“ *Rear-Admiral FitzRoy, F.R.S., &c.*”

The Mechanical Assistant being engaged at the Exhibition, it was found impossible to complete the alterations alluded to quite so soon as anticipated; but a curve was procured about the middle of August, which was sent to Admiral FitzRoy, and approved of by him.

The Barograph has since received some further alterations, with a view to increase its stability and general efficiency. These are now completed, and the instrument will be henceforth kept in constant operation. One of the curves from this instrument is presented to the Association.

Arrangements were made for recording photographically, by means of the Heliograph, the transit of Mercury which took place on the 12th of November last, but the weather proved unfavourable. This instrument was also in readiness for the partial eclipse of the sun which took place on the 31st of December last; but, owing to the unfavourable state of the sky, only two imperfect pictures were obtained. A very good series of sun-pictures was obtained by Mr. Beckley during the months of November and December.

The Heliograph was sent from Kew at the beginning of January to Mr. De la Rue's Observatory, and Mr. Beckley attended at Cranford to assist in erecting and adjusting it to focus; but the weather was so unfavourable during the remainder of that month that no pictures of the sun could be obtained. It had somewhat improved about the 7th of February, when the first photograph was taken, and since then others have been obtained by Mr. Reynolds (Mr. De la Rue's assistant) on every day on which this has been possible. Altogether, up to the 12th of September inclusive, 177 photographs have been taken on 124 days, namely:—

In the Month of	Number of working days.	Number of photographs procured.
February	7	13
March	10	17
April	17	31
May	17	26
June	23	28
July	20	27
August	21	26
Up to September 12 .	9	9
	<hr/> 124	<hr/> 177

From February 7th to September 12th inclusive there are 218 days; so that on the average one photograph was procured for 1.77 day. Nearly half of the pictures have been obtained by taking advantage of breaks in the clouds, and many have been taken through haze. In several of the photographs, owing to the unpropitious state of the atmosphere, there is a want of that beauty and perfection which the Heliograph is capable of affording; but all the pictures are sufficiently perfect for measurement by means of Mr. De la Rue's Micrometer. Many of these are extremely perfect, and all would have been so had the state of the atmosphere permitted.

During the month of August Dr. Sabler, Director of the Observatory of Wilna in Russia, resided at Cranford, and received instruction in Astronomical Photography. A Photoheliograph is being constructed for him under Mr. De la Rue's superintendence by Mr. Dallmeyer, and a Micrometer by the Messrs. Simms. This Heliograph will embody all the optical and mechanical improvements suggested by the experiments with the Kew instrument; and it is expected that the Wilna apparatus will be in operation in the spring of 1863. In the event of the Kew Heliograph being worked continuously, Sir John Herschel's suggestion that daily records of the sun should be taken by means of photography will therefore be carried out both in England and Russia; if this were done in one or two other localities, a considerable amount of information would be obtained respecting physical changes continually occurring on the sun's surface.

The experience obtained during the past year has been such as to lead Mr. De la Rue to recommend that photographic records should be continued for a series of years at some public Observatory. The Committee have had in consideration whether this could be done at Kew without interfering with the other work, and have come to the conclusion that the Heliograph might be worked at an annual expense of £200, which sum would cover the cost of an additional Assistant, who might at the same time do the other photographic work of the Observatory.

The old dome formerly used for the Heliograph is so inconveniently situated as to be quite unfit for such work, and it will be necessary to make some addition to one of the present out-buildings in order to contain the instrument. The cost of this structure is estimated at £100.

The Committee strongly recommend that the General Committee of the Association take such steps as they may consider advisable for carrying this desirable object into practical effect.

The self-recording Electrometer of Prof. W. Thomson continues in constant operation.

Mr. Francis Galton having made arrangements in the Observatory Park for testing sextants, the Observatory is now prepared to receive such instruments for examination, and to issue certificates to such as may fulfil the conditions of any of the following classes:—

A. Sextants of the highest order of workmanship for lunar observations and general service, on shore as well as at sea.

B. Sextants for naval surveys and for the determination of altitudes with as much precision as is available at sea.

C. Quadrants or sextants to be used without telescopes, for the determination of altitudes with an exactness equal to the requirements of general navigation.

The charges for examination under classes A and B will be 5s., under class C, 1s.; and the minute constant errors of instruments under class A will be determined, when desired, at an additional charge of 5s.

Eight sextants have been verified at Kew since the last Meeting of the British Association.

The Observatory has been honoured with a visit from the following distinguished men of science, who had visited this country in consequence of the International Exhibition:—

Professors Dove, Magnus, and Quincke, of Berlin; Professor Förchhammer, of Copenhagen; Professors Bunsen, Kirchhoff, and Eisenlohr, of Heidelberg; Professors Kraft and Pisko, of Vienna; Professor Govi, of Turin; Professor Donati, of Florence; Professor Bolzani, of Kasan; Professor Lapschine, of

Accounts of the Kew Committee of the British Association from September 4, 1861 to October 1, 1862.

RECEIPTS.		PAYMENTS.	
	£ s. d.		£ s. d.
Received from the General Treasurer	500 0 0	Balance from last account	79 3 7
" for the verification of Instruments— £ s. d.		Salaries, &c.:—	
from the Board of Trade	18 11 0	To B. Stewart, four quarters, ending	200 0 0
from the Admiralty	15 18 0	1st October, 1862	
from Opticians	29 10 0	Ditto, allowed for petty travelling ex-	10 0 0
" for standard thermometers	63 19 0	penses	
" for time expended by Mr. Beckley in making	5 0 0	C. Chambers, four quarters, ending	100 0 0
apparatus for which a separate grant was		6th October, 1862	
provided	9 0 0	G. Whipple, four quarters, ending 18th	50 0 0
Balance	182 2 6	September, 1862	
		R. Beckley, 56 weeks, ending 29th	112 0 0
		September, 1862, at 40s.	
		T. Baker, 56 weeks, ending 29th Sep-	33 12 0
		tember, 1862, at 12s.	
		Apparatus, Materials, Tools, &c.	505 12 0
		Ironmonger, Carpenter, and Mason	44 16 4
		Printing, Stationery, Books, and Postage...	8 6 0
		Coals and Gas	30 2 9
		House Expenses, Chandlery, &c.	42 13 0
		Portage and petty expenses...£16 2 11 }	17 9 11
		Ditch, &c. 4 15 0 }	20 17 11
		Rent of Land to 10th October, 1862	11 0 0
	<u>£760 1 6</u>		<u>£760 1 6</u>
		Balance	182 2 6

I have examined the above account and compared it with the vouchers presented to me. I find that the amounts expended exceed those received by the sum of £102 18 11
 To which must be added the excess of expenditure over income for the previous year, 1861, consisting of five quarters..... 79 3 7

Making the present balance of expenditure beyond receipts for the last two years and a quarter amount to £182 2 6

17th September, 1862. R. HUTTON.

Kharkof; Professors Clausius and Wartmann, of Geneva; Captain Belavenetz, Russian Navy; and Captain Skariatine, Russian Marines.

A reference to the annexed financial statement will show that, although the expenditure has exceeded the income, the Observatory has been conducted with the utmost regard to economy; and the Committee recommend that for the ensuing year a sum of £600 should be granted, which, with other amounts to be received, will, it is expected, meet the necessary requirements.

JOHN P. GASSIOT,
Chairman.

Kew Observatory,
Sept. 29th, 1862.

Report of the Parliamentary Committee to the Meeting of the British Association at Cambridge, October 1862.

The Parliamentary Committee have the honour to report as follows:—

The Bishop of Oxford, in furtherance of the resolution adopted at Liverpool in 1854, must be deemed to have vacated his seat in this Committee, but we recommend that he should be re-elected.

Your Committee have also to report that Mr. James Heywood has not found it necessary to call upon them to interfere in the matter referred to them at Manchester by the General Committee.

WROTTESELEY, *Chairman.*

Sept. 14, 1862.

RECOMMENDATIONS ADOPTED BY THE GENERAL COMMITTEE AT THE
CAMBRIDGE MEETING IN OCTOBER 1862.

[When Committees are appointed, the Member first named is regarded as the Secretary of the Committee, except there be a specific nomination.]

Involving Grants of Money.

That the sum of £600 be placed at the disposal of the Council, for maintaining the Establishment of Kew Observatory.

That the sum of £100 be placed at the disposal of the Council, for the purpose of making an addition to the out-buildings at Kew Observatory, to receive the Photoheliograph, now in the hands of Mr. De la Rue.

That the cooperation of the Royal Society be requested for the purpose of completing and proving the instruments devised for obtaining Photographic registration of the physical aspect of the Sun.

That the Committee, consisting of Professor Williamson, Professor Wheatstone, Professor W. Thomson, Professor W. H. Miller, Dr. A. Matthiessen, and Mr. Fleeming Jenkin, appointed at the Manchester Meeting, be requested to continue their Report on Standards of Electrical Resistance, and to extend it to other Electrical Standards; and that Dr. Esselbach, Sir C. Bright, Professor Maxwell, Mr. C. W. Siemens, and Mr. Balfour Stewart be added to the Committee; and that the sum of £100 be placed at their disposal for the purpose.

That the Committee to report upon Standards of Electrical Resistance, be