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# REPORT

OF THE

TWENTY-SEVENTH MEETING

OF THE



# BRITISH ASSOCIATION

FOR THE

## ADVANCEMENT OF SCIENCE;

HELD AT DUBLIN IN AUGUST AND SEPTEMBER 1857.

LONDON:

JOHN MURRAY, ALBEMARLE STREET.

1858.

The Principal and Professors of Owens College.

VI. The Council has this day received letters of invitation to the Association to hold its Meeting in 1858 in Leeds, from—

The Mechanics' Institution and Literary Society.

The School of Practical Art.

VII. The Council have also this day been informed of an invitation to be presented from the Literary and Philosophical Society of Newcastle-on-Tyne and the Fine Arts Society of the North of England, to hold an early meeting at Newcastle.

VII. The General Committee will receive full information, in the sub-joined Report from the Kew Committee, of the proceedings of that establishment during the past year; and the Council are persuaded that the General Committee will see with pleasure the evidences of the still increasing public utility of that institution, and of the credit thereby accruing to the British Association.

*Report of the Kew Committee of the British Association for the  
Advancement of Science, for 1856-57.*

Since the last Meeting of the British Association, the works necessary for lighting the Observatory with gas have been executed at a cost of £250, which has been defrayed by a Grant from the Wollaston Fund by the President and Council of the Royal Society.

Soon after the last Meeting of the Association, the Board of Works commenced the external repairs of the Observatory. These were completed in November last. The Chairman having represented to the Chief Commissioner of Works the necessity for considerable repairs to the interior of the Building, the Board of Works agreed to execute such repairs as soon as the necessary funds should be voted by Parliament. The Committee understand that the requisite vote has been passed, and that the works will be proceeded with in the course of the present summer.

The following memorandum relative to the re-establishment of self-recording magnetic instruments at the Kew Observatory was submitted to the Committee by General Sabine on July 22, 1856:—

“1. The decennial period in the solar magnetic variations, and its coincidence with a similar period in the frequency and amount of the solar spots, appear to be highly deserving of attention in an observatory established, as Kew is, for physical researches.

“2. There is reason to suppose that the permanency and regularity in the occurrence of the decennial period in the magnetic variations, and its coincidence with the periodic variation of the solar spots, might be effectually and satisfactorily tested by observations of both classes of phenomena at the alternate periods of maximum and minimum, say for example, in 1857 and 1858 as the anticipated period of maximum, and in 1863 and 1864 as the anticipated period of minimum, and so forth.

“3. The apparatus constructing under the superintendence of Mr. De la Rue will, it is hoped, fully meet the requirements of the research in respect to the solar spots.

“4. Since the time when the magnetic self-recording instruments belonging to the Kew Observatory were constructed under the direction of Mr. Ronalds, very considerable improvements have been made in the art of Photography, and the six months' trial which was made by Mr. Welsh of Mr. Ronalds' instruments, has led in several other respects to suggestions for improvements which could not but be expected to be required in instruments

of so novel a kind, while at the same time the six months' trial referred to has placed beyond doubt the sufficiency of a properly conducted research by means of self-recording instruments for the examination of the solar magnetic variations."

The Committee authorized Mr. Welsh to proceed with the construction of the instruments, which have now been completed at an expense not exceeding £250, this sum being defrayed from the funds supplied by the Government Grant through the Council of the Royal Society, the instruments remaining at Kew at the disposition of the Council of the Royal Society.

With the assistance of apparatus lent from General Sabine's department, the observatory is now possessed of the means of determining with great accuracy the various constants required in magnetic observation. Some alterations in the method of manipulation have, it is believed, added considerably to the accuracy of observation of the absolute value of the Magnetic Force.

At the request of the Foreign Office, Magnetical and Meteorological Instruments have been prepared at the Observatory for Mr. Lyons M'Leod, Consul at Mozambique. Mr. M'Leod attended on several occasions in order to make himself acquainted with their manipulation.

The following correspondence has taken place relative to an application from the Austrian Government to be supplied with Magnetical Instruments, to be employed in the scientific voyage undertaken by His Imperial Majesty's Frigate "Novara."

(Copy.)

"Admiralty, 31st December, 1856.

"DEAR GENERAL SABINE,—The Austrian Consul, Baron Rothschild, has written a pressing note to the Admiralty to ask where the enclosed list of instruments can be procured, and for any assistance we can give in ensuring their being the best. Will you be so good as to say what answer shall be sent? would it be too much to ask you to see that they are properly sent, and as nearly as you can, will you name the time the instruments could be ready?"

"Yours faithfully,  
(Signed) "JOHN WASHINGTON."

*"Memorandum of Instruments required by His Imperial Majesty's Frigate 'Novara.'*

"a. The Azimuth Compass.

"b. The Unifilar Magnetometer.

"c. Mr. Fox's apparatus for observing the magnetic force and inclination.

"d. Mr. Barrow's Circle for observing the magnetic inclination.

"To the apparatus *b* belongs also a peculiar apparatus for its erection and use on board ship.

"For the further use of these instruments and for taking the observations made thereby, it is desired that they may be delivered with the indication of their respective constants, as the moment of inertia, the temperature, coefficients, &c. &c.

"The Consulate-General will apply to the British Admiralty, who will, no doubt, kindly give the names of the makers who supply the British Admiralty, as it is desired that they be the same instruments as those on board Her Majesty's ships of war."

"London, 29th December, 1856."

(Copy.)

“13, Ashley Place, London,  
January 7th, 1857.

“SIR,—I have received from Mr. James Yates a copy of the letter which you addressed to him on the 26th of last month, describing the scheme of the scientific voyage of circumnavigation about to be undertaken by His Imperial and Royal Majesty's Frigate ‘Novara,’ and requesting to be furnished with any suggestions which may assist you in carrying out the objects for which this voyage has been undertaken. I have deemed, therefore, that it may be agreeable to you to be informed, that in consequence of an application from Baron Rothschild to the British Admiralty, I have been requested to undertake, and have undertaken, to prepare the following instruments named in Baron Rothschild's letter for the magnetical observations to be made during the voyage, viz.—

- “1. A Standard Azimuth Compass for the Declination.
- “2. A Barrow's Inclinometer for the Inclination.
- “3. A Fox's apparatus with Gimbal Stand for Inclination and Magnetic Force at sea.
- “4. A Unifilar Magnetometer for observations of the Absolute Horizontal Magnetic Force on land.

“These instruments will be examined and their constants determined at the Kew Observatory of the British Association for the Advancement of Science, and will be ready by the end of February or beginning of March, together with instructions for the use of each of the instruments, and blank forms for the convenient record of the observations to be made with them. It is most desirable, however, that the physicist who is to be charged with the observations should have some previous practice with the instruments, and I would therefore beg leave to suggest that the gentleman who may be appointed to that duty should be directed to proceed in the first instance to London, so as to arrive there about the third week in February, and after having made himself familiar with the use of the instruments, should take them with him to Gibraltar, and there await the arrival of the ‘Novara’ on the passage from Trieste to Rio Janeiro.

“I have the honour to remain, Sir,

“Your obedient Servant,

(Signed) “EDWARD SABINE,  
*Major-General.*”

“P.S. Several of the instruments above mentioned will be ready by the end of the present month. Baron Rothschild's letter does not say anything about Marine Meteorological instruments. Should instruments of this description, such as are now furnished to the British Navy, be desired, they could be supplied by the Kew Observatory, and might accompany the magnetical instruments to Gibraltar.”

“Dr. Karl Scherzer, Vienna.”

The Magnetical Instruments for this Expedition have been prepared, and the Constants determined at the Observatory. Dr. Hochstätter, of Vienna, who has undertaken the superintendence of the Magnetical Observations to be made during the voyage, visited the Observatory in the end of February and beginning of March, to receive instructions in the use of the various instruments.

A letter has been received by General Sabine from the Archduke Ferdinand Maximilian, expressing his thanks, as Chief Officer of the Austrian  
1857.

Navy, for the assistance afforded to Dr. Hochstätter, who writes that he had commenced his observations:—Dr. Hochstätter's letter is dated Gibraltar, 21st May, 1857.

In consequence of an application from the Hydrographer of the Admiralty, Dr. Baikie and Lieut. Glover, who have recently sailed on an expedition to Africa, were furnished with Magnetical Instruments, whose Constants had been previously determined at the Observatory. Dr. Baikie and Lieut. Glover visited the Observatory, when detailed instructions were communicated to them by Mr. Welsh, as to the practical use of the instruments.

Application having been made to the Royal Society by Her Majesty's Secretary of State for the Colonies, relative to a supply of Magnetical Instruments for an expedition to British North America, under the direction of Mr. Palliser, Lieut. Blakiston, R.A., who accompanies the Expedition, attended for some time at the Observatory for the purpose of manipulating with the Magnetical Instruments, which have been prepared under the direction of Mr. Welsh for the use of the Expedition. The Constants of these instruments were determined as in the other instances already referred to in this Report.

At the request of the Council of the Royal Society, Mr. Welsh has prepared the Magnetical Instruments required in the North Polar Expedition, which has been fitted out at the expense of Lady Franklin: the cost of preparation of these instruments is defrayed by the Royal Society. The instruments themselves have been supplied from Major-General Sabine's establishment at Woolwich.

General Sabine having communicated to the Committee that £200 had been placed at his disposal by the Admiralty, for the purpose of conducting the Magnetical Survey of Scotland, in connexion with the general Magnetic Survey of the British Islands, as recommended at the last Meeting of the Association, the Committee have arranged that Mr. Welsh shall undertake such survey in the course of the present and following summer.

Sir James Clark Ross has already commenced the Survey of England, taking Kew as his base station.

A new method, proposed by Dr. Lloyd, of determining the absolute total magnetic force by means of the Dip Circle, will be employed in this Survey. Dip Circles adapted for this method have been supplied to Sir James C. Ross and Mr. Welsh, also to Lieut. Blakiston for his Survey in North America.

#### PHOTOHELIOGRAPH.

On the 20th of May, 1854, Benj. Oliveira, Esq., F.R.S., placed the sum of £50 at the disposal of the Council of the Royal Society, to be appropriated during that year in any manner the Council might consider most in harmony with the interests of Science. Mr. Oliveira further stated, that he might probably in future years offer a similar sum if the mode of its disposal appeared to him eligible; and an application having at the same time been made by the Kew Committee for the sum of £150, in order to erect a Photographic Apparatus for registering the position of the spots in the Sun's disc, as suggested by Sir John Herschel, the Council of the Royal Society devoted to this purpose the donation of Mr. Oliveira, and proposes, should it be continued, to apply it for the next two years in replacement of the sum of £100 which the Council in the mean time advanced from the Donation Fund of the Royal Society, in order that the undertaking might not be delayed. This arrangement was approved by Mr. Oliveira, and the apparatus has, under the direction of Warren De la Rue, Esq., F.R.S., been completed by Mr. Ross at the cost of about £180.

The object-glass of this instrument is  $3\frac{4}{10}$  inches aperture and 50 inches focal length; it is not corrected for achromatism in the ordinary manner, but so as to produce a coincidence of the visual and photogenic foci. The secondary objectives for magnifying the image produced by the principal object-glass are of the Huyghenian form. They are three in number, producing respectively images of the sun 3, 4, and 8 inches in diameter. Between the two lenses of each of these secondary object-glasses is inserted a diaphragm-plate carrying the fixed micrometer wires, which are of platinum; these wires are four in number, two at right angles to the other two. One of the wires of each pair is in such a position that they may both be made tangential to the sun's image, while the other two cross at a point situated near the sun's centre. By means of these wires, the distance in arc between each pair having been once for all ascertained astronomically for each secondary object-glass, it will be easy to determine all the data necessary for ascertaining the relative magnitudes and positions of the sun's spots. These micrometer wires are under the influence of springs, so as to preserve a tension upon them when expanded by the sun's heat, and thus to keep them straight.

The principal and secondary object-glasses are not mounted in an ordinary cylindrical tube, but in a pyramidal trunk square in section, 5 inches in the side at the upper end, which carries the principal object-glass, and 12 inches in the side at the lower end, which carries the photographic plate-holder and the usual ground glass screen for focusing.

This trunk is firmly supported by a declination axis of hard gun-metal  $2\frac{1}{2}$  inches in diameter; it is furnished with a declination circle 10 inches in diameter, reading to one minute of arc, and has a clamp and screw motion for fine adjustment in declination.

The declination axis works in Y-bearings at the top of the polar axis, which is 12 inches long; it is 4 inches diameter at its upper end and  $1\frac{1}{2}$  inch at its lower end. The lower end fits with a slight taper into a brass collar up to a shoulder, the friction being reduced by a steel spring plate pressing against a hardened steel hemisphere at the end of the axis.

It will be seen by the above description, that every precaution has been taken to secure stiffness in the telescope combined with freedom in the motion of the polar axis. The polar axis is driven by a clock driver, which answers perfectly, and is easy of regulation to the greatest nicety, so that the sun's limb remains for a long period in contact with the tangential wires. Near the lower end of the polar axis is fixed the hour-circle, which, like the declination circle, is 10 inches in diameter; it is graduated to read to 2 seconds of time. An endless screw, making about two revolutions in one minute, geers into the hour-circle and connects it with the clock. As it is generally necessary to make small corrections in right ascension after the tangent screw has been geered with the driving clock, in order to bring the sun's image in position with respect to the micrometer wires, a sliding plate is provided which carries the bearings of the tangent screw; this is acted upon by a second fine screw parallel with the tangent screw; so that by rotating the second screw, the sliding plate and the tangent screw are moved through a small space, and the hour-circle thus caused to rotate to the extent necessary for bringing the sun's image in position.

The clock is driven by two weights, one pulling upwards over a pulley, the other downwards, thus suspending the barrel and equalizing the pull and avoiding friction on its bearings. By causing the click of the winding lever to abut on the ratchet-wheel of the going part of the clock during the period of winding, the clock goes at its normal speed while it is being wound.

The mode of regulating the clock is extremely simple and efficacious; it is

effected by approaching to, or withdrawing from, a hollow cone over a small wheel, on which are attached, by means of flat springs, two small weights, which expand by centrifugal force and come in contact with the inside of the hollow cone.

The polar axis of the telescope is carried by a dial-plate, which fits on the top of a hollow column of cast iron, the section of which is a parallelogram. This column is securely fastened to the stone foundation. The instrument is mounted within the rotating dome of the Kew Observatory, which has been repaired and put in order for that purpose. The photographic dark room is at present too distant from the telescope, but it is contemplated to construct one close to it, as serious inconvenience has been already experienced in the preliminary experiments in consequence thereof.

The telescope and its mechanical appliances may be said to be perfect so far as they go, but experience will undoubtedly suggest several minor alterations and additions before the telescope is brought practically to work. The photographing of such minute objects as the sun's spots will require at all times the utmost skill and care of an accomplished photographer, even when the telescope has been fairly started. The difficulties yet to be mastered must occupy some considerable time. The first attempts have been confined to the production of negative photographs, but in consequence of the imperfections always existing in the collodion film, it has been deemed advisable to make attempts to produce positive pictures, and recourse may ultimately have to be made to the Daguerreotype process.

The verification of Meteorological Instruments has been continued on the same plan as in previous years. The following are the numbers of instruments which have been verified since the last meeting of the Association :—

	Baro- meters.	Thermo- meters.	Hydro- meters.
For the Admiralty . . . . .	127	840	605
For the Board of Trade . . . . .	86	360	140
For Opticians and others . . . . .	65	324	6
Total . . . . .	278	1524	751

Mr. Stewart having left the Observatory, as mentioned in the last Annual Report, the Committee in October last engaged Mr. Charles Chambers of Leeds, on the recommendation of the Council of the Society of Arts. The Committee report very favourably of the intelligence and assiduity with which he has discharged his duties.

JOHN P. GASSIOT,  
*Chairman.*

*Accounts of the Kew Committee of the British Association from Aug. 6, 1856, to Aug. 26, 1857.*

RECEIPTS.

	£	s.	d.
Balance from last account .....	260	4	6
Received from the General Treasurer .....	350	0	0
” for the verification of Instruments—£ s. d.			
from the Board of Trade .....	52	10	0
from the Admiralty .....	66	15	0
from Opticians and others.....	22	0	0
	141	5	0

PAYMENTS.

	£	s.	d.	£	s.	d.
Salaries, &c.:—						
To Mr. Welsh, one year, ending Aug. 27....	200	0	0			
Ditto, allowed for petty travelling } expenses .....	10	0	0			
Mr. J. V. Magrath, one year, ending } Aug. 14.....	50	0	0			
Mr. C. Chambers, three quarters, } ending July 6 .....	37	10	0			
Mr. Beckley, 55 weeks, ending Aug. 24	96	5	0			
Mr. Stewart, Sept. 1—15, 1856.....	3	10	0	397	5	0
Apparatus, Materials, Tools, &c. ....				28	10	7
Plumber's and Bricklayer's work .....				33	11	2
Stoves, Ironmongery and Carpentry .....				32	18	2
Printing, Stationery, Books, Postage.....				24	9	8
Coals and Gas .....				19	0	2
House Expenses, Chandlery, &c. ....				17	10	4
Porterage and petty expenses.....				5	19	3
Rent of Land, one year ending Oct. 10, 1857				21	0	0
Balance in hand .....				171	5	2
				£751	9	6

I have examined the above account and compared it with the vouchers presented to me, and find the Balance to be One Hundred and Seventy One Pounds Five Shillings and Twopence.  
17th July, 1857.

R. HUTTON.