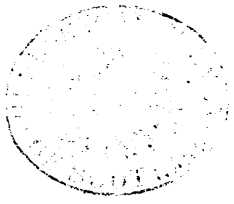
REPORT

OF THE

THIRTIETH MEETING

OF THE



BRITISH ASSOCIATION

FOR THE

ADVANCEMENT OF SCIENCE;

HELD AT OXFORD IN JUNE AND JULY 1860.

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1861.

2. The continuance of Magnetic Observations, at stations indicated by the General Committee at the Leeds Meeting, has engaged the attention of H.R.H. the President, and of the Council; and they have had the advantage of co-operation on the part of the President and Council of the Royal Society. Every means has been adopted for pressing the subject on the favourable attention of the Government, but, it is to be regretted, hitherto without success.

3. The importance of telegraphic communication between sea-ports of the British Isles, has been the subject of much attention since it was urged on the General Committee by the Aberdeen Meeting. The Council are happy to find that Admiral FitzRoy has been authorized to proceed in bringing to a practical issue the recommendations offered on this subject to the scientific department of the Board of Trade; and they congratulate the Association on the share they have taken in a cause so dear to humanity.

4. The expedition suggested by the Royal Geographical Society, and concurred in by the General Committee of the British Association, is on its way; Capt. Speke, under the direction of the Admiralty, with his assistant, Capt. Grant, having sailed from Zanzibar. Sir R. I. Murchison, in reporting on this subject, expresses the obligation which is felt by the promoters of this great step for the exploration of Africa, to Lord John Russell, Secretary of State for Foreign Affairs.

The Report of the Parliamentary Committee is received for presentation to the General Committee this day.

5. At the Meeting this day, in pursuance of the Notice placed in the Minutes of the General Committee at Aberdeen, it will be proposed—"That a permanent distinct Section of Anatomy and Physiology be established, in addition to that of Zoology and Botany."

The Council are informed that Invitations will be presented to the General Committee at its Meeting on Monday, July 2, to hold the next Meeting in Manchester; on behalf of the Literary and Philosophical Society of Manchester, and other Institutions and Public Authorities of that city, from whom Invitations were received at previous Meetings.

Invitations will also be presented to hold an early Meeting in Newcastle, on behalf of the Council and Borough of Newcastle-upon-Tyne, and to hold a Meeting in Birmingham in 1862, on behalf of the Birmingham and Midland Institute.

Report of the Kew Committee of the British Association for the Advancement of Science for 1859–1860.

Since the last Meeting of the British Association, the self-recording magnetographs have been in constant operation under the able superintendence of Mr. Chambers, the magnetical assistant.

A description of these instruments has been given by Mr. Stewart, the Superintendent, in a Report which is printed in the Transactions of the British Association for 1859. The drawings for the plates connected with this Report were made with much skill by Mr. Beckley, the mechanical assistant at Kew.

It was mentioned in the last Report of this Committee, that a set of self-recording magnetic instruments, designed for the first of the Colonial Observatories which have been proposed to Her Majesty's Government, had been completed and set up in a wooden house near the Observatory.

Shortly after the meeting at Aberdeen, the Chairman received a letter from Dr. P. A. Bergsma, Geographical Engineer for the Dutch possessions in the

Indian Archipelago, requesting that the Committee would assist him in procuring a set of self-recording magnetic differential instruments similar to those at Kew, the Dutch Government having resolved to erect such at their Observatory at Java.

In consequence of this application, and as the instruments which had been completed were not immediately required for a British Observatory, it was resolved that they should be assigned to Dr. Bergsma; this gentleman has since arrived, and has for the last few weeks been engaged at the Observatory in the examination of his instruments.

The usual monthly absolute determinations of the magnetic elements continue to be made.

Application having been made through Padre Secchi, of the Collegio Romano, for a set of magnetic instruments, for both differential and absolute determinations, for the Jesuits' College at Havanna, the whole to cost 600 dollars, or about £150, General Sabine obtained, at a reasonable price, the three magnetometers that had formerly been employed at Sir T. Brisbane's Observatory at Makerstoun, and also an altitude and azimuth instrument. With these instruments it is expected that the application from Havanna Observatory can be met within the sum named; the instruments are now in the hands of the workmen, and will be ready early in July.

Two unifilars, supplied by the late Mr. Jones, for the Dutch Government (one for Dr. Bergsma, and the other for Dr. Buys Ballot), have had their constants determined. Observations have also been made with two 9-inch dip-circles belonging to General Sabine, which have been repaired by Barrow, and with two dip-circles and a Fox's instrument designed for Dr. Bergsma.

A set of magnetical instruments, consisting of a dip-circle, an azimuth compass, and a unifilar, previously used by Captain Blakiston, have been re-examined, and have been taken by Colonel Smythe, of the Royal Artillery, to the Feejee Islands.

As it was feared that the Kew Standard Barometer might have been injured by the workmen who some time since were repairing the Observatory, a new one has been mounted. The mechanical arrangements of this instrument have been completed in a very admirable manner by Mr. Beckley; and the mean of all the observations made shows that the new Barometer reads precisely the same as the old. This result is satisfactory, not only as showing that no change has taken place in the old Barometer, but as confirming the accuracy of the late Mr. Welsh's process of constructing these instruments. The height of the cistern of the new Barometer above the level of the sea is 33·74 feet.

Mr. Valentine Magrath having quitted the Observatory, at his own request, on the 14th of February last, Mr. George Whipple has taken his place as Meteorological Assistant, and has given much satisfaction.

On the 12th of March, Thomas Baker was engaged at the weekly salary of 8*s*., to be raised to 10*s*. in six months if he gave satisfaction, which has hitherto been the case.

Since the last meeting of the Association, 173 Barometers and 222 Thermometers have been verified at the Observatory.

Professor Kupffer, Director of the Russian Magnetical and Meteorological Observatories, visited the Observatory, and was presented with a standard thermometer.

Mr. J. C. Jackson, Lieutenant Goodall, R.E., and Mr. Francis Galton, F.R.S., have visited the Observatory, and received instructions in the manipulation of instruments.

Mr. Galton has made some experiments at Kew Observatory, to determine

the most practicable method of examining sextants, and other instruments for geographical purposes. Considering that these instruments, after having been once adjusted, are liable to two distinct classes of error, the one *constant* for any given reading, and the other *variable*, it is an object to form Tables of Corrections for the constant errors of instruments sent for examination, and also to ascertain the amount of variable errors which might affect their readings.

As a groundwork for examination, it is found that small mirrors may be permanently adjusted, at the distance of half a mile, so that when the rays of a mirror of moderate size, standing by the side of an assistant, are flashed upon them, they may re-reflect a brilliant star of solar light, towards the sextant under examination.

By having four permanently fixed mirrors of this description, separated by intervals of 20°, 60°, and 40° respectively, and by flashing upon them with two looking-glasses of moderate size, it is possible, by using every combination of these angles, to measure every twentieth degree, from 0° up to 120°.

The disturbing effects of parallax are eliminated without difficulty, by mere attention to the way in which the sextant is laid on the table, or, in the case of a zero determination, by a simple calculation.

Moreover, the brilliancy of the permanent mirrors is perfectly under control, by the interposition of gauze shades in front of the looking-glasses that flash upon them. This renders an examination of the coloured shades a matter of great ease and certainty.

Based upon these principles, Mr. Galton has drawn up a system for the thorough examination of sextants. Each would not occupy more than two hours in having its constant errors tabulated, and its variable errors determined; nor would an outlay of more than £30 be required for the establishment of fixed tables and permanent marks. Difficulty is, however, felt in setting the system in action, owing to the absolute need of an assistant having leisure to undertake it.

The sum of £179 12*s*. 6*d*. has been received from the Royal Society, to defray the expense of erecting a model house for the reception of the instruments for Colonial Magnetic Observatories.

The Photoheliograph has been an occasional source of occupation to the mechanical assistant; but before daily records of the sun's disk can be obtained, it is absolutely requisite that an assistant should be appointed to aid Mr. Beckley, because his duties are of such a nature as to prevent his devoting attention at fixed periods of the day to an object requiring so much preparation as is the case with photoheliography. Unfortunately, the funds at the disposal of the Committee are quite inadequate for this purpose; and unless a special grant be obtained, the Photoheliograph will remain very little used.

At present Mr. Beckley is preparing the instrument, under Mr. De la Rue's direction, for its intended trip to Spain, for the purpose of photographing the eclipse which takes place on July 18th. The expenses of these preparations, and of the assistants who will accompany Mr. De la Rue, will be defrayed out of the grant of the Royal Society for that object.

The requisite preparations are somewhat extensive; for it has been deemed necessary to construct a wooden observatory, and to make a new iron pillar to support the instrument, adapted to the latitude of the proposed station: both the observatory and iron pillar may be taken to pieces to facilitate their transport.

The wooden house is 8 feet 6 inches square, and 7 feet high; it is entirely open at the top, except that portion divided off for a photographic room.

The open roof will be covered by canvas when the observatory is not in use; and when in use, the canvas will be drawn back, so as to form an outer casing at some little distance from the wall of the photographic room; and, in order to keep this room as cool as possible, the canvas will, in case of need, be kept wetted.

The chemicals and chemical apparatus will be packed in duplicate sets, so as to provide as far as possible against the contingency of loss, by breakage or otherwise, of a part of them.

Mr. Downes, of the firm of Cundall and Downes of Bond Street, has promised to accompany the expedition; Mr. Beckley will also go; and Mr. De la Rue has engaged Mr. Reynolds to assist in the erection of the observatory in Spain, and in the subsequent photographic operations.

The Admiralty, on the representation of the Astronomer Royal, have provided a steam-ship to convey this and other astronomical expeditions to Bilbao and Santander. It is proposed that the Kew party should land at Bilbao and proceed to Miranda. Mr. Vignoles, who is constructing the Tudela and Bilbao railway, has kindly promised his aid and that of his staff of assistants, to promote the objects of the expedition, and promises, on behalf of the contractors, the use of horses and carts for the conveyance of the apparatus. The expedition will sail from Portsmouth on the 7th of July; and, should the weather prove favourable, there is reasonable hope that the various phases of the eclipse will be successfully photographed. Whether the light of the corona and red prominences will be sufficiently bright to impress their images, when magnified to four inches in diameter, is a problem to be solved only by direct experiment.

Professor William Thomson (of Glasgow) having expressed a desire that the practical utility of his self-recording electrometer should be tried at Kew, his wish has been acceded to and the instrument received, and it is expected that it will shortly be in operation under his direction.

A Report has been completed by the Superintendent on the results of the Magnetic Survey of Scotland and the adjacent islands in the years 1857 and 1858, undertaken by the late Mr. Welsh. This Report is printed in the Transactions of the British Association for 1859.

The following correspondence has taken place between General Sabine and the Rev. William Scott, Director of the Sydney Observatory:—

"Observatory, Sydney, March 2, 1860.

"Sir,—The great interest which you take in the promotion of Magnetical Science encourages me to address you on the subject of the establishment of a Magnetical Observatory at Sydney. The report which I send you by this mail will explain to you the character and position of the Astronomical Observatory under my direction.

"I am convinced that an application to our Government, from influential persons at home, for the establishment of magnetical observations on not too expensive a scale, would be readily attended to. I am not practically acquainted with any magnetical observatory, with the exception of that at Greenwich, and am ignorant of the cost of a set of instruments, and the exact amount of space required for working them; but I believe we could find sufficient room in the observatory without any additional building; they would be under my own supervision, and all that would be required would be an additional assistant, to share with myself and my one assistant in observing and computing. The Governor-General, Sir W. Denison, would, though powerless as regards public money, exert his influence in favour of such an object.

"Trusting that you will take the matter into consideration, and excuse the liberty I have taken in addressing you,

"I am, Sir,
"Your obedient Servant,
(Signed) "W. Scott,
"Astronomer for N. S. Wales."

"*Major-General Sabine.*"

"13 Ashley Place, London, May 8, 1860.

"Sir,—I lose no time in replying to your letter of March 2, received this day. The self-recording magnetical instruments at Kew have been in action nearly two and a half years—a sufficient time to test their merits or defects. I have myself completed the analysis and reduction of the first two years (1858 and 1859) of the Observations of the Declinometer, and can therefore speak of my own knowledge of their performance, as far as that element is concerned. The Photographic Traces, recording both the zero line and the actual movements of the magnet, can be measured with tolerable confidence to the third place of decimals of an inch, the inch in the Kew instrument being equivalent to 22 minutes of arc. The reading is consequently made to the 1000th part of 22 minutes of declination. The record is of course continuous; but, for the purpose of computing the results, *hourly* readings have been tabulated. In the first year the trace failed in 107 out of 8760 hours, chiefly from failure in the supply of gas, which is brought by pipes from Richmond, a considerable distance off. This inconvenience has been remedied by the construction at the Observatory itself, at a small expense, of a water regulator, through which the supply from Richmond passes, and there is now no reason why the trace should ever fail. I have now in course of analysis and reduction the same years of the observations of the horizontal and vertical force magnetographs, and have no reason hitherto to believe that the record of those two elements will be inferior to that of the declination. The three instruments, with the clock which keeps the registering papers in revolution, together with reading telescopes placed for eye observation, either to accompany or to be independent of self-registry, occupy an interior space of about 16 feet by 12, including a passage round for the observer. The cost of such a set of instruments, complete in every respect, is £250; and four months must be allowed for making them from the date of the order, as well as an additional month for their careful verification at Kew (should that be desired), where a detached building has been erected for this particular purpose, in which they may be kept in work in comparison with the Kew instruments. A detailed description of these instruments is now in the press, and will be published in June in the volume of Reports of the British Association. The results of the first two years of the Declinometer observations, showing what are deemed at present to be the most useful modes of eliciting the results, will be printed in the 'Proceedings of the Royal Society' in the present summer, and the first two years of the horizontal and vertical force magnetographs in the same publication later in the year. A small adjoining room is requisite, opening if possible into the instrument-room, which should contain suitable troughs for the preparation of the paper to receive the traces, and to fix them. It is important to diminish as much as possible the changes of temperature in the Observatory itself, exclusive of the effect of the instrument cases, which have adaptations for that purpose. So far in regard to differential instruments. For absolute determinations and secular changes a small detached house is required, say 12 feet by 8, in which equality of temperature need not be regarded, but which must be at a sufficient distance from other

buildings containing iron, and have copper fittings. The instruments required for these purposes are an inclinometer and a unifilar, the latter having provision for the experiments of deflection and vibration, as well as for the absolute declination: the cost of the first is £30, and of the second £45; both may be verified, if desired, at Kew. The little work which is sent to you by the same post as this letter contains a full description of these instruments, and directions for their use. In addition to the charges named above, making in all £325, the cost of packing, freight, and insurance will have to be taken into the account.

"One assistant will suffice, as you suggest, for keeping the magnetometers in action, and for tabulation. The absolute values, and the calculation of the results of all the instruments, would be, I presume, the work of the Director of the Observatory himself. Provision must also be made for a supply of chemicals, stationery, and gas. Should it be thought desirable that the instruments should be prepared and verified under the superintendence of the Committee of the Kew Observatory, a request to that effect, transmitted by yourself through the Governor of the Colony to the Chairman of the Committee of the Kew Observatory, Richmond Park, London, S.W., would, I am sure, meet immediate attention. That such an institution at the head-quarters of our Australian dominions would be as honourable to those who should be instrumental in its establishment as it would be beneficial to magnetical science, must be a matter of general recognition, and it would, I am persuaded, find a warm supporter in your present most excellent Governor.

"I remain, Sir,

"Your obedient Servant,

(Signed) "EDWARD SABINE."

"*The Rev. W. Scott.*"

From the following correspondence which has taken place between Her Majesty's Government and the President of the Royal Society, it will be seen that the establishment of a Magnetical Observatory at Vancouver Island is postponed, in consequence of the war with China precluding the establishment at present of a corresponding observatory at Pekin:—

"Treasury Chambers, 16th May, 1860.

"SIR,—I am directed by the Lords Commissioners of Her Majesty's Treasury to acquaint you that My Lords have had under their further consideration the establishment of an Observatory at Vancouver Island, and the insertion in the Estimates of this year of a vote for that service.

"My Lords are fully sensible of the importance of obtaining a series of accurate Magnetical Observations at the stations recommended by the Council of the British Association, and it would give them great pleasure to assist without further delay in forwarding objects so interesting for the cause of science.

"The numerous and pressing claims, however, on the public finances in the present year make it imperative upon My Lords to submit no fresh estimate to Parliament which is not of a very urgent character, and where the total limit of expense to be incurred has not been accurately ascertained.

"In the present instance My Lords must observe that you appear to be under some misapprehension in supposing that any engagement was entered into by the late Government to establish a Magnetic Observatory at Pekin or elsewhere. On the contrary, the letter of this Board of 6th December, 1858, to Lord Wrottesley states that, 'whatever may be the public advantages to be derived from the proposed new establishments, the object would not,

it appears, be sacrificed by postponement, and, looking to the extent of the other claims upon the public finances already existing, My Lords have thought it right to defer the consideration of the question until next year.'

"The letter then further states, that the three Magnetical Observatories at the Cape of Good Hope, St. Helena, and Toronto, which were originally sanctioned in an estimate of about £3000 for three years, had in fact cost £11,000 for that period, and, in all, had put the country to an expense of nearly £50,000. This consideration alone suffices to show the necessity for very careful investigation by the Government before any step is taken which might commit the country to further expense. The circumstances referred to in the letter in question continue in full force; and an important further argument against undertaking the proposed Observatory at Vancouver Island at the present moment is furnished by the political events which have since occurred in China. In General Sabine's able letter of the 1st January, 1859, it is stated that, 'without entering into the comparative scientific value of Vancouver Island and Pekin as magnetic stations,—both being highly important,—this much is certain, that, whatever might be the value of either, that value would be greatly enhanced—far more than doubled—by there being a simultaneous and continuous record at both stations; and Sir John Herschel remarks that the importance of a five years' series of observations at one of the proposed stations without the others would be grievously diminished, and the general scope of the project defeated.'

"As the present state of things in China precludes the establishment of a Magnetic Observatory at Pekin, or any point in the Chinese Empire sufficiently to the north to correspond with a station at Vancouver Island (though there is reason to hope that this state of things may be of short duration), it would appear desirable even in the interests of science to postpone the consideration until something more certain can be ascertained as to the possibility of meeting what Sir John Herschel and General Sabine consider such an essential requisite, viz. the commencement and continuance of simultaneous observations at Vancouver Island and at a point in China nearly in the same parallel of latitude. The interval which must elapse until the political state of affairs in China may render such an establishment possible may be usefully employed in obtaining the most accurate estimate possible of the actual cost of founding and maintaining each station for the period requisite for the complete attainment of the scientific objects in view, so as to enable Her Majesty's Government, when the proper time shall arrive, if they shall decide on doing so, to submit a vote to Parliament with confidence as to the amount of expense which they may ask the nation to defray in the interests of science.

"I am, Sir,
"Your obedient Servant,
(Signed) "GEO. A. HAMILTON."

"*The President of the Royal Society.*"

"May 23rd, 1860.

"MY DEAR SIR,—In Mr. Hamilton's letter (returned herewith) he has referred to Sir Charles Trevelyan's communication to Lord Wrottesley of the 6th December, 1858, expressing the desire of the Lords Commissioners of the Treasury to postpone to the following year the consideration of the establishment of the Colonial Magnetic Observatories which had been recommended by the Royal Society and the British Association for the Advance-

ment of Science; but Mr. Hamilton has omitted altogether to refer to the interview which took place between the President of the British Association and Sir Charles Trevelyan subsequent to that communication, viz. on the 18th of December, 1858, when Sir Charles Trevelyan stated that 'if a single station for magnetical and meteorological observations were applied for [intimating Pekin as its locality] by the Joint Committee of the Royal Society and the British Association, My Lords would be disposed to comply with such application.' (See Report of the Council of the British Association, September 1859.)

"Political events which became known shortly after that interview made it manifestly unadvisable to apply for a station in China; but the scientific importance of procuring systematic magnetical researches at other stations which had been named in the original application from two Societies, in parts of the globe which were conveniently accessible and under British dominion, remained as before. In these respects Vancouver Island was unobjectionable, and was therefore substituted for 'a station in China' in the application, which, consistently with Sir Charles Trevelyan's communication of the 18th December, 1858, was made by the Joint Committee of the two Societies. The confident expectations thus founded being known in the United States by the publications of the Reports of the Joint Committee of the Royal Society and British Association, the Government of the United States authorized the establishment of Magnetical Observatories at a station on the east side of the United States, and at another on the south coast, both designed to cooperate with the British Observatory to be established on Vancouver Island; the three stations being obviously remarkably well selected for systematic researches over that large portion of the globe. The two observatories of the United States' Government have been established, and commenced their work at the beginning of the present year.

"In reference to the aggregate amount of expenditure incurred by the magnetical researches recommended to Government by the Royal Society and British Association in the last twenty years, it may be remarked that, the researches being altogether of a novel character, the continuance of the Observatories, when first asked for in 1839, was for a very limited period. It was, in fact, an experiment, and their longer continuance would not have been recommended had not the experiment proved eminently successful, and such as to justify the prosecution of the researches. The subject was therefore brought afresh under the consideration of Government in 1845 and again in 1849, and the further expenditure to be incurred received the sanction of the Treasury on both occasions, as have also, on other occasions, the magnetic surveys connected with the Observatories. It is possible that the aggregate amount of expenditure thus sanctioned and incurred may not be overstated at £50,000. It is an average amount not exceeding £2500 a year for this great branch of physical science.

"I am not myself the proper authority to say whether the gain to science, and to the estimation in scientific respects in which this country is held by other nations, be, or be not, an equivalent for this expenditure; but I may be permitted to refer to the opinion expressed by the Joint Committee of the two Societies, consisting, as is well known, of persons holding high places in public estimation for their general knowledge and good judgment, as well as possessing the highest scientific eminence:—'Your Committee, looking at this long catalogue of distinct and positive conclusions already obtained, feel themselves fully borne out in considering that the operation, in a scientific point of view, has proved, so far, eminently remunerative and successful, and that its results have fully equalled in importance and value, as real accessions

to our knowledge, any anticipations which could reasonably have been formed at the commencement of the inquiry.'

"Believe me, my dear Sir,
"Faithfully yours,
(Signed) "EDWARD SABINE."

"*Sir B. C. Brodie, Bart., P.R.S.*"

Mr. Hamilton to the President of the Royal Society, in reply to his letter of 2nd June (not given here).

"Treasury Chambers, June 14, 1860.

"SIR,—In reply to your letter of the 2nd inst., with its enclosure from General Sabine relative to the establishment of Colonial Magnetic Observatories, I am directed by the Lords Commissioners of Her Majesty's Treasury to state that, without entering into the question what verbal assurances may have been given in December 1858 by the then Assistant Secretary, Sir Charles Trevelyan, of which no record was made, their Lordships observe that the main ground of their letter of the 16th May, 1860, remains unaffected, viz. that, in the opinion of the highest scientific authorities, whatever might be the value of observations at Vancouver Island, that value would be greatly increased by simultaneous observations at some station in the North of China, and, on the other hand, would be 'grievously diminished' if no station in China was established. Under these circumstances, their Lordships thought it desirable to postpone for a short time the consideration of the question, in the hope that it might be considered under a different state of things in China, rendering possible the attainment of the greatest amount of scientific advantage from the expenditure of public money, in case that expenditure should be decided upon.

"I am, Sir,
"Your obedient Servant,
(Signed) "G. A. HAMILTON."

General Sabine has written the following letter to Dr. Bache, who had intimated to him that, in the event of Her Majesty's Government declining to establish a magnetical observatory at Vancouver Island, it was the wish of the United States' Government to establish one in Washington Territory, in the vicinity of Vancouver Island:—

"May 22, 1860.

"DEAR BACHE,—I waited to reply to yours of April 13th until we should have received the reply of our Government regarding the Vancouver Island Observatory. Mr. Gladstone has availed himself of some expressions in Sir John Herschel's letters and mine (to the effect of the far greater importance of having observations on the Chinese as well as on the American side of the Pacific to having either separately) to postpone a decision regarding Vancouver Island until our relations with China shall enable our Government to consider the question of establishing both simultaneously. Our proposition, therefore, has fallen to the ground, and it is quite open to your Government to occupy the field which you were willing to concede to us in consideration of the forward part which our Government has hitherto taken in magnetic researches.

"Now in regard to the instruments, which, as you are probably aware, have been prepared at my own risk, in order that, should our Government accede to the recommendation made by the Royal Society and British Asso-

ciation, the time might be saved which must otherwise have been lost in their preparation. They have been made on the model of those which have been in use at the Kew Observatory since January 1858. An account of these is in the press, and will be published in the volume of Reports of the British Association for 1859–1860, which must be in circulation next month. I have thoroughly examined and computed the *declination* results for 1858 and 1859, by means of tabulated hourly values, and am now engaged in the same calculation of the Bifilar and Vertical Force Magnetometers. The Declination Report will be presented to the Royal Society, and printed in the 'Proceedings' in the course of the summer, as well as the results of the Force Magnetometers for the same two years, as soon as I am able to draw up the report in due form and order. But I am able to say, regarding all the three elements, that the instruments are *eminently* successful. Independent of the *continuity* of the record (which is of course a great thing in itself), the hourly tabulations are far more consistent and satisfactory than were the eye-observations at any of our observatories.

"In preparing a second set of instruments, therefore (which we have done for the proposed Netherlands Observatory in Java), we have had very few improvements to introduce, except the addition of reading-telescopes for each instrument—so that we may always retain the power of eye-observation, either in addition to or substitution for photographic records. Dr. Bergsma, the Director of the Java Observatory, is now at Kew, observing with his instruments, in comparison with those in our own Observatory (as we have a separate building for the instruments on trial), and will take them away towards the end of June. These of course will be paid for by the Netherlands Government, having been ordered expressly for them. There will then be the third set, which have been prepared for Vancouver, and which are ready to succeed the Java instruments in the experimental house. A few *very* trifling improvements have been introduced in these—none worthy of being noticed here. They at present stand as mine, and I shall be indebted £250 for them. The decision of Government, as communicated to the President of the Royal Society, makes no reference to my responsibility on their account. I am, therefore, to say the least, quite free to dispose of them as I may please. Now I am not rich enough to offer them as a *loan* to your 'Washington Territory' Observatory; but if you desire to have differential determinations there in addition to absolute determinations, I am persuaded that you could not have better instruments than these would be; and I consider myself as quite free to offer you the refusal of them, asking only in return that you will give me as early a reply as may be convenient, because I have some reason to expect that I may receive an application from the Sydney Observatory to obtain a duplicate of the Kew instruments; in which case, if you had not claimed them in the meantime, I should direct these to be sent to Sydney.

"Sincerely yours,

(Signed) "EDWARD SABINE."

"*Dr. Bache, F.R.S., Director of the Coast Survey of the United States.*"

The reply to this letter has not yet been received; but in the meantime the following application has come for a set of magnetical instruments for absolute determinations from Dr. Smallwood, Professor of Meteorology at McGill College in Montreal, Canada:—

"St. Martin, Isle Jésus, May 21, 1860.

"SIR,—I duly received yours of the 16th of July last, in reference to the

establishment of a Magnetic Observatory here, in connexion with observations on meteorology and atmospheric electricity, and deferred writing until I was in a position to acquire the instruments necessary.

"You said in your communication that '£80 or thereabouts was required;' and you were kind enough to add, with a spirit of generosity I could not expect, 'that every care should be taken to superintend the construction of such instruments, to verify them, and to determine their constants, and have them carefully packed and sent out.'

"The object of the present letter is to ascertain, 1st, the exact cost (if possible); 2nd, to whom the amount shall be forwarded; 3rd, when the instruments would probably be ready; 4th, a short list of what are to be sent.

"I feel that I am asking too much from you; but a knowledge of your devotion to a science which you have so much extended, makes me feel less diffident, and I have thrown myself upon your kindness.

"I have also to acknowledge the receipt of a Book of Instructions, &c., with thanks.

"So soon as I get a reply from you, I will at once transmit the amount with the order, and submit a plan of the building.

"Believe me to remain, with great consideration and respect,

"Yours faithfully,

(Signed) "C. SMALLWOOD."

"*General Sabine, London.*"

Instruments to meet this request are in preparation.

The Committee have thought that it might not prove uninteresting to the members of the British Association, if, in this Report, a short description were given of the Kew Observatory, and of the nature and amount of work which is accomplished therein.

The Observatory is situated in the middle of the old Deer-park, Richmond, Surrey, and is about three-quarters of a mile from the Richmond Railway Station. Its longitude is 0° 18′ 47″ W., and its latitude is 51° 28′ 6″ N. It is built north and south. The repose produced by its complete isolation is eminently favourable to scientific research. In one of the lower rooms a set of self-recording magnetographs, described in the Report of the last meeting of this Association, is constantly at work. These instruments, by the aid of photography, furnish a continuous record of the changes which take place in the three magnetic elements, viz. the declination, the horizontal force, and the vertical force. The light used is that of gas, in order to obtain which, pipes have been carried across the Park to the Observatory, at an expense of £250, which sum was generously defrayed by a grant from the Royal Society.

Attached to this room is another, of a smaller size, in which the necessary photographic operations connected with magnetography are conducted.

In the story above the basement, the room by which the visitor enters the Observatory is filled with apparatus. Much of this is the property of the Royal Society, and some of the instruments possess a historical value; for instance, the air-pump used by Boyle; and the convertible pendulum designed by Captain Kater, and employed by him, and subsequently by General Sabine, in determining the length of the pendulum vibrating seconds.

An inner room, which opens from this one, is used as a library and sitting-room, and in it the calculations connected with the work of the Observatory are performed. In this room dipping-needles and magnets, which it is necessary to preserve from rust, are stored. Here also the MS. of the British Association Catalogue of Stars is preserved.

A room to the east of this contains the standard barometers, and the appa-

ratus (described by Mr. Welsh in the 'Transactions' of the Royal Society, vol. 146. p. 507) for verifying and comparing marine barometers with the standard. This room has also accommodation for the marine barometers sent for verification. In the middle of the room is a solid block of masonry, extending through the floor to the ground below. To this an astronomical quadrant was formerly attached; it is now used as a support for the standard barometers. This room contains also a Photographic Barograph invented by Mr. Francis Ronalds, which, though not at present in operation, may serve as a model for any one who wishes to have an instrument of this description. It is described by Mr. Ronalds in the Report of the British Association for 1851.

In a room to the west of the Library, thermometers for the Board of Trade, the Admiralty, and opticians, are compared with a standard thermometer by means of a very simple apparatus devised by the late Mr. Welsh.

The Observatory also possesses a dividing-engine by Perreaux, by means of which standard thermometers are graduated. It was purchased by a grant from the Royal Society.

In this room the pure water required for photographic processes is obtained by distillation; and here also a small transit telescope is placed for ascertaining time. The transit instrument is erected in a line between two meridian marks—one to the north and the other to the south of the Observatory; so that, by means of suitable openings, either of these marks may be viewed by the telescope.

In a higher story is the workshop, containing, among other things, a slide-lathe by Whitworth, and a planing machine by Armstead, both of which were presented to the Kew Observatory by the Royal Society.

In the dome is placed the Photoheliograph for obtaining pictures of the sun's disk; attached to the dome there is a small chamber in which the photographic processes connected with the photoheliograph are conducted. This chambe is supplied with water by means of a force-pump. A self-recording Robinson s anemometer is also attached to the dome.

In addition to the rooms now specified, there are the private apartments attached to the Observatory.

On the north side of the Observatory there is an apparatus similar to that used at the Toronto Observatory for containing the wet- and dry-bulb, the maximum and the minimum thermometers.

The model magnetic house, elsewhere alluded to in this Report, stands at a distance of about 60 yards from the Observatory; and the small wooden house in which the absolute magnetic observations are made, at a distance of about 110 yards. These houses are within a wooden paling, which fences them off from the remainder of the Park, and encloses about one acre of ground attached to the Observatory.

The work done may now be briefly specified. In the first place, the self-recording magnetographs, as already mentioned, are kept in constant operation, and record the changes continually occurring in the magnetic elements.

The photographs are sent to General Sabine's establishment at Woolwich, to undergo the processes of measurement and tabulation.

In the model magnetic house there is at present a set of magnetographs which Dr. Bergsma will take to Java. When this set is removed another will supply its place, in readiness for any other Observatory, colonial or foreign, at which it may be required.

In the house for absolute determinations, monthly values of the declination, dip, and horizontal magnetic force are taken, and magnetic instruments for foreign or colonial observatories have their constants determined.

RECEIPTS.

	£	s.	d.
Balance from last account	8	9	8
Received from the General Treasurer	500	0	0
„ for the verification of Instruments— £ s. d.			
from the Board of Trade 20 14 0			
from the Admiralty 62 19 0			
from Opticians 32 16 8			
	116	9	8
„ for standard Thermometers	3	8	0
„ from the Royal Society to defray the expense of erecting a wooden house in which to receive and examine Magnetographs for Foreign or Colonial Observatories ...	179	12	6
„ from the Royal Society in part payment of the Kew Magnetographs	150	0	0
	£957	19	10

PAYMENTS.

	£	s.	d.	£	s.	d.
Salaries, &c.:—						
To B. Stewart, three quarters, ending June 30, 1860	150	0	0			
Ditto, allowed for petty travelling expenses	10	0	0			
C. Chambers, three quarters, ending July 6, 1860	75	0	0			
J. V. Magrath, six months, ending Feb. 14, 1860	35	0	0			
R. Beckley, 41 weeks, ending June 25, 1860, at 35*s.*	71	15	0			
G. Whipple, 40 weeks, ending June 18, 1860, at 12*s.*	24	0	0			
T. Baker, 15 weeks, ending June 25, 1860, at 8*s.*	6	0	0			
				371	15	0
Apparatus, Materials, Tools, &c.				64	6	1
Ironmonger, Carpenter, and Mason				32	19	9
Printing, Stationery, Books, and Postage				22	3	6
Coals and Gas				39	16	6
House Expenses, Chandlery, &c.				17	6	7
Porterage and petty expenses				11	5	4
Rent of Land	10	10	0			
Ditto, undercharged in last account	10	10	0			
				21		0
Cost of building a Wooden House in which to receive and examine Magnetographs for Foreign or Colonial Observatories				179	12	6
Optician's account for the Kew Magnetographs				186	6	2
Balance in hand				11	8	5
				£957	19	10

I have examined the above account and compared it with the vouchers presented to me, and find that the Balance in hand is Eleven pounds Eight shillings and Fivepence.

18*th June*, 1860.

R. HUTTON.

In the meteorological department, all the barometers, thermometers, and hydrometers required by the Board of Trade and the Admiralty have their corrections determined; besides which, similar instruments are verified for opticians. Standard thermometers also are graduated, and daily meteorological observations are made, an abstract of which is published in the 'Illustrated London News.'

Instruction is also given in the use of instruments to officers in the army or navy, or other scientific men who obtain permission from the Committee.

All this amount of work, it is believed, can be executed by the present staff, consisting of the superintendent, three assistants (magnetical, mechanical, and meteorological), and a boy; but the expense attending it is greater than the present income of the Observatory, furnished by the British Association, will support.

In the resolution of the British Association of the 14th September, 1859, it was recommended to Government, at the instance of the joint committee of the Royal Society and British Association, that the sum of £350 per annum should be placed at the disposal of the general superintendent of the magnetical observations; this sum was intended to have defrayed the expenses attending the magnetical department of the Observatory and the observations of the sun's spots. It will be seen, however, from the correspondence contained in an earlier part of this Report, that this source of income is not yet available.

JOHN P. GASSIOT,
Chairman.

June 18, 1860.

Report of the Parliamentary Committee to the Meeting of the British Association at Oxford in June 1860.

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

No subject of sufficient importance to require any especial notice has occupied their attention during the past year, nor indeed was there any matter referred to them at the last Meeting of the Association.

There are now either two or three vacancies in that portion of the Committee which represents the House of Commons, according as it shall be determined whether the vacancy caused in that Section by Lord de Grey's taking his seat in the House of Lords is or is not to be filled up.

WROTTESLEY, *Chairman.*

May 28, 1860.