

REPORT OF THE ASTRONOMER ROYAL

TO THE

BOARD OF VISITORS,

Read at the Annual Visitation of the Royal Observatory, Greenwich, 1851, June 7.

THE Report which I have the honour now to present to the Board of Visitors is intended to convey an account of the state of the Royal Observatory on 1851, May 30; and of the proceedings in the Observatory from 1850, May 11, to that time.

I. Grounds and Buildings.—In previous communications to the Visitors I have pointed out the want of an Official Room for the Astronomer Royal, and the facility with which this could be supplied as soon as the Transit Instrument should be dismantled. This has now been done. At the beginning of the present year, as soon as the competency of the Transit-Circle for work was established, the Troughton's Transit was taken down, the piers were removed, the room was dismantled of all astronomical appurtenances, a doorway was pierced through the wall of the Computing Room (close to the south wall of the Transit Room, and opposite to an existing doorway leading into the Transit-Circle Room), and an east-and-west wall was built in the Transit Room, so near to its south wall as to leave only a passage equal in breadth to the doorways. This passage makes a communication between the Computing Room and the Transit-Circle Room; the remainder of the Transit Room forms the Astronomer Royal's Official Room. The doorways formerly existing give immediate access from it to the Computing Room on one side, and to the Transit-Circle Room on the other. The old observing-shutters were taken out and replaced by rough glass, and the room is now extremely well lighted.

The ground-floor room of the North Dome (formerly called the East Dome, and lately the North-east Dome) was for more than half a century useless, because it was used as a passage-room. A most insignificant alteration of doors and windows, effected about two years ago, made it available as a separate room, with a convenient access. For some time

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past it has been destined to contain the Galvanic Registering Apparatus to be employed on the American principle, for recording the Transits observed with the Transit-Circle and the Altazimuth; and in the last year the basement has been prepared (by inserting windows, paving the floor, and placing a ladder) for the Galvanic Batteries and other rough apparatus required in the American register. The rooms, however, are not yet occupied.

It will be necessary soon to increase our Library accommodation; and I have begun to make preparations for this extension, by removing the Chronometers from the room which they have many years occupied (adjoining the Library) to a room above the Computing Room, formerly used as an Assistant's sleeping-room, but for many years past nearly useless. The Old Chronometer Room is at present used for a temporary purpose, but I intend before long to fit it up with Library Shelves. The New Chronometer Room is somewhat larger than the old one, and it is furnished with an apparatus for warming a limited number of chronometers by the heat of gas-flames, copied from that established in the Liverpool Observatory. Adjoining to the Chronometer Room is a small room now used as Office for the transaction of Chronometer Business.

The Manuscript Room is becoming exceedingly crowded. Workmen are at the present time employed in erecting shelves and cabinets on the east wall of the Astronomer Royal's Room, which it is intended to appropriate to some of the Manuscripts, especially those of a more confidential class.

Gas illumination has now been introduced in all the buildings and on all the instruments, as far as I think it desirable to employ it.

On matters external to the observing buildings, I have only to record that the demand for open shelter has become more and more pressing, and I have therefore commenced the erection of a large Shed on the east side of the Magnetic Ground.

II. Moveable Property.—The moveable property of the Observatory has been altered in no important respect (except as regards Instruments, to be hereafter mentioned) since the last Visitation. In addition to Standard Bars formerly mentioned, the 10-feet Standard Bar of the East India Company is for the present lodged here, as also some valuable standard Thermometers made by the Rev. R. Sheepshanks.

III. Manuscripts.—No addition has been made to our manuscripts from any external source. But the system of arranging and binding our own papers has been gradually reduced into a more complete form, and the number of MS. books stowed in the Safe Room has greatly increased. So much are the shelves overloaded, that it has been found impracticable lately to maintain good order in the room. The pressure will, however, be very greatly relieved when the new shelves in the Astronomer Royal's Room shall be fitted

for the reception of books; and a better arrangement (commenced, as was stated in the last Report, about a year ago) may then be perfected.

IV. Library.—No particular effort has been made for the increase of the Library. Books, however, are added from various sources, and the room is now scarcely large enough. But I trust to obtain sufficient accommodation (as I have already mentioned) in time to avoid any confusion from want of space.

V. Astronomical Instruments.—The change which has been made in the principal Astronomical Instruments of the Observatory since the last meeting of the Visitors is perhaps greater than any that has been made in an equal interval of time since the commencement of Bradley's more accurate astronomy in 1750. I shall most clearly explain the history of our meridional instruments by beginning with those which last year were in use, and proceeding then to the Transit-Circle.

The collimation-error of the Transit had for a long time been so steady that I was in no anxiety to repeat the observations for its determination very frequently. Near the end of last year, however, as it was probable that the use of the instrument would soon cease, observations for collimation were made. To my great dismay, the collimation was found to be changed by $4\frac{1}{2}$ seconds. The current observations with the Transit had been closely reduced, and those with the Altazimuth had been brought to a forward state. The comparison of the clock-errors given by stars of small and great N.P.D., and the comparison of the zeros of azimuth of the Altazimuth, showed sufficiently that the error had lasted some time; but it was difficult to say whether it had arisen gradually or suddenly. It was, however, assumed that the whole error arose on a day when the symptoms of sudden change are the most distinct; and the observations were re-reduced. The results for clock-errors and for azimuth-errors in the latter part of the year now agree with those in the former part; but there is still a trifling irregularity about the time which was selected for the assumed change.

The zenith-point of the Mural-Circle, during the earlier part of 1850, had been (under a pressure of work) obtained exclusively from observations of the wire by reflexion. In the latter part of the year, commencing with May 30, there had been a proper mixture of observations of stars by reflexion. The observations were completely reduced, as far as the formation of star-catalogue and the investigation of planetary errors in longitude and E.P.D., and nothing remarkable was observed. The comparison of results from direct and reflexion observations of stars was made in our usual way, when a peculiarity in the law of their numbers was remarked, which at once convinced me that the zenith-point obtained by the wire was sensibly different from that obtained by the stars. An investigation was directed expressly to this point, and it was found that the error of zenith-point by the wire was fully

$1\frac{1}{2}$ second (the mean of those by stars being assumed to be correct). The whole of the results have been corrected for this error.

Upon forming the corrected values of the difference of star-results by direct and by reflexion observations, they appear, for the first time during many years, to follow a distinct law, with a coefficient of appreciable value (about $\frac{9}{10}$ second). I have not thought myself justified in making any other supposition than that this error is equally shared by direct and by reflexion observations. But it is worthy of remark that the reflexion-observations, treated alone, give results for elevation of pole and polar distances of stars more accordant with those of former years than the direct observations treated alone.

I had learned by former experience the liability of the old instruments to the errors which I have now described, but never before had I been so much troubled by them. It was therefore with great satisfaction that I looked to the approaching erection of the Transit-Circle.

In the latter part of August, 1850, the principal parts of the Transit-Circle were brought from Messrs. Ransomes and May's factory at Ipswich, and measures were immediately taken for mounting it under the personal superintendence of their able assistant, Mr. G. A. Biddell. On October 2 the instrument was delivered up to me by Messrs. Ransomes and May. Much was yet to be attached to it by Mr. Simms; this was completed on November 23. Some carpenters' and draftsmen's work was next finished, and then the values of all the micrometer scales, and the intervals of the wires, were found by independent operations, for which the structure of the Transit-Circle and the use of collimators give great facilities; the errors of graduation of the circle were examined down to every single degree (the operation being suspended there only because there appeared no necessity for carrying it further); the form of the pivots was scrutinised; and the flexure of the telescope, both the real curvature of tube and the relative or noxious drop of the two ends, were ascertained. It is needless to describe in this Report the methods by which these determinations were effected, as the Visitors will be enabled personally to see all, and as it is intended that a full description shall appear in the Greenwich Observations (a skilful draftsman having been already employed on plans of the whole instrument, or rather system of instruments). At the end of 1850 all was ready, and on the first observing day of 1851, January 5, the first observation was made.

It will be remembered that the ground upon which I suggested the intercession of the Board of Visitors with the Government for provision for this instrument was the want of telescopes of greater light. This, I need not observe, is sufficiently secured by the use of a good object-glass, whose aperture exceeds 8 inches, the full effect of which is made available by an apparatus (perhaps worthy the attention of the Visitors) by means of which the ordinary illuminating-light is used, when required, to illuminate the wires in a dark field. But the collateral advantages obtained in the new construction are scarcely inferior in value. The general structure of the instrument, of its piers, and of its microscopes, is firm beyond

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anything previously known. The telescope (as in the German transit-circles) is free to take its own natural flexure, and that flexure is measured; the circle is unconstrained by connexion with the telescope, and its errors are ascertained. The error of collimation and the error of level are ascertained with ease once at least every day, and the same operation gives a severe check on the constancy of the error of azimuth.

As an evidence of the firmness peculiar to the principle on which I have mounted the micrometers of this Instrument and of the Altazimuth, I will mention that, a short time since, all the micrometers of the Transit-Circle were taken off to be cleaned; and, on replacing them, it was found that the readings were not altered by a perceptible fraction of a second.

One idea, the following out of which would have made the instrument almost theoretically perfect, occurred to Mr. Simms, only too late to be adopted without remaking the instrument. In order to verify the position of one collimator upon the other, it is necessary, with the construction actually adopted, to raise the instrument. Mr. Simms suggested that this trouble might have been avoided by piercing the central cube of the instrument, so that, by simply placing the object-glass upwards or downwards, one collimator might view the other through that hole. It was not without considerable chagrin that I recognised the impossibility of now modifying the instrument in this manner.

To this notice of the Transit-Circle I have only to add that I believe that its superiority over the old instruments is recognised by every person who uses it.

As soon as the Transit-Circle was brought into use, the object-glass of Troughton's Transit was placed in Mr. Simms' hands, for mounting in a Reflex Zenith Telescope, to be constructed on principles formerly explained to the Visitors. At the time of writing this Report the instrument is not quite completed, but is so near to that state that it may probably be mounted by the day of the Visitation.

The only changes made in the Altazimuth are the following:—By a peculiar arrangement of jointed tubes, gas is supplied to the illuminating-lamp in all positions of the instrument. And, as it is found that reliance cannot be placed on the efficiency of the metallic reflectors by which light is conveyed to the divisions under the microscopes, I am preparing a new system of illumination for them. I cannot omit expressing my regret that at the time of planning the Altazimuth I was not possessed of the principle which I have now used for the Transit-Circle; namely, of throwing the light in a direction slightly inclined to the axis of the microscope, and so bevelling the surface of the limb that its normal makes equal angles with the incident light and with the axis of the microscope; a principle which gives an illumination to which I have seen nothing comparable.

In the last Report I alluded to the mounting of a Collimator as a reference-mark for the Altazimuth. The use of this mark does not give positive information on the stability of the azimuth-circle, because the collimator itself may be unsteady; but it gives probable

information, of an indirect kind, which may be treated by the Calculus of Probabilities. In a memoir communicated to the Royal Astronomical Society, I have discussed in this manner the results of the Collimator observations, and the zeros of azimuth as determined from February, 1850 (when the Collimator was mounted), to the end of the year. The result is, that the probable error of the assumption that the Azimuth-Circle is immoveable, or that of the assumption that the Collimator is immoveable, is insignificantly small; and that the observed unsteadiness of azimuth zeros depends almost entirely upon the errors in obtaining time by the meridian observations, transmitting it to the Altazimuth, and using it with the Altazimuth. It is believed that, since the use of the Transit-Circle has commenced, the unsteadiness of azimuth zeros has sensibly diminished, but I am unable yet to speak positively to this point.

The forms of the pivots of the Vertical-Circle have been lately examined by the rigorous microscopic process; as before, they have been found sensibly free from error.

Both the Transit-Circle and the Altazimuth are fitted up with galvanic wires and contact-apparatus for making a galvanic register of transits in the American manner, and the wires are led into the ground-floor story of the North Dome. The reading-barrel and the registering apparatus, however, are not yet mounted. I may state to the Visitors that I hope to mount an apparatus which shall cause a barrel to revolve with Astronomical uniformity, using a mercurial pendulum revolving in a cone of about two degrees' radius, which is resisted only by the air, and introducing in the machinery which acts upon this a modification of the Chronometric Governor, applicable to the regulation of machines driven by weights. I have tried this carefully in experiment, and have reason to believe that it will act very well. The clockwork for the new machinery containing this principle is completed by Mr. Dent; but the barrels and galvanic apparatus are not yet completed by Mr. Henley, to whom that part of the work is intrusted.

The two Equatoreals are in their usual order. The new double-image micrometer is found to bear well a high power. The number of detached Telescopes is sensibly diminished, one having been fixed on a pier as Collimator for the Transit-Circle, and another having been sent to the Observatory of Quebec; no inconvenience, however, has yet been felt from this transfer. The other small instruments are in their usual state.

The ancient instruments of the Observatory are preserved as usual; they are all collected, as far as possible, and are fixed on the walls of the Transit-Circle Room. Troughton's Transit (deprived of its object-glass), and Troughton's Mural-Circle, are now added to the collection. Jones's Mural-Circle, however, is still in a packing-box on the Magnetic Ground.

VI. Observations.—No alteration has been made in the general principle of arrangement of our Meridional observations. Each standard star is to be observed in each

element, 20 times in three years. The observation of the Catalogue of Stars including those of the 4th magnitude has been steadily maintained. Stars culminating with the Moon, Stars occulted by the Moon, and Stars insufficiently observed in former years, are also observed. The Moon is observed whenever she is visible on the meridian; the Sun and Planets when visible, except on Sundays, and except on a monthly holiday (a relaxation which, as regards observations, will now be discontinued). The number of observations from 1850, May 11, to 1851, May 30, is nearly the following:—Transits 4334, Zenith Distance Observations 4420.

The introduction of the Transit-Circle, in lieu of the Transit and the Circle, has made some difference in the details of observation. One observer only is now appointed for each day's observations (unless when a number of closely-following stars is to be observed, or when the upper and lower limbs of the Moon are to be observed, in which cases a second observer is appointed to read the Circle-Microscopes: this assistance is always given for the observation of the Sun). Every evening's work is thus more laborious than formerly; but the reduction, to little more than one-half, of the evenings employed, is a very great relief, and one of which the want had been much felt. The observer on duty is now required to attend about sunset, whatever be the state of weather, and at once to make those observations of the Collimator, of the Transit wire by reflexion, and of the Zenith-Distance wire by reflexion, by which the line of collimation, the level-error, and the zenith-point, are determined. Stars are also to be observed by reflexion if the weather permits. Once in each week the instrument is raised, and the correspondence of the two Collimators, by which the line of collimation is ascertained, is verified. I think I may boldly say that it is impossible that our observations can be affected with any error depending on faults of adjustment of the instrument.

The Altazimuth has been used in the same manner as is described in last year's Report. The whole number of days of complete observation of the Moon with the Altazimuth, for 13 lunations, is 228, against 121 with the Meridional Instruments. Of these 228, 3 are on days when the Moon's time of passage was between 1^h and 2^h, 6 when between 2^h and 3^h, and 10 when between 3^h and 4^h; the last-mentioned class of days is the first on which meridional observation appears, and with that the Moon has been obtained but once. Between 21^h and 22^h there are eight observations with the Altazimuth, and between 23^h and 24^h there is 1; there are none with the Meridional Instruments. The determined places appear very good.

The Equatoreals have been used only for Transits of the Moon's diameter.

The Double-image Micrometer has been employed on measures of γ Virginis, and measures of the diameter of Jupiter.

VII. Reduction of Observations.—The reductions are nearly as forward as it is possible

to maintain them, and are much more advanced than could be anticipated by any person, who knows how much time was consumed in the observations and computations for determining the micrometer values, for verifying the circularity of pivots, and, above all, for ascertaining the errors of graduation of the Transit-Circle. All apparent R. A. from Transits are completed to May 15, and all apparent N.P.D. from Circle Observations (including the effect of errors of graduation, &c.) to May 1. The star-corrections (which alone are wanted to complete the reductions) are only a few days in arrear. The Helio-centric errors, &c., of Planets were completed to the end of 1850, but have not yet received the final correction for the alteration of zenith-points to which I have alluded.

The reductions of the observations with the Altazimuth are absolutely complete (to the stage of Moon's Errors in Longitude and Ec. N.P.D.) to March 26, and are nearly complete (even in the stage of Errors in R.A. and N.P.D.) to April 25. The daily reductions are kept close to the Observations. All Equatoreal computations, and all computations of double-image observations, are complete.

The reduction of Occultations is very nearly complete for 1850.

The Catalogue of Stars from the 1850 Observations is ready for the printer.

VIII. Printing of Astronomical Observations.—The volume for 1849 has been published several months.

In the volume for 1850 the Transits and their immediate reductions are printed to October 15, and the Circle Observations and Reductions to July 4. In my last Report to the Visitors I stated that the printing of the Transits was in the volume for 1849 reduced to one page, containing the same number of observations as were formerly contained in two. In the volume for 1850 the Circle Observations also are reduced to one page, containing, however, not quite so many Observations as were formerly contained in two. The section containing the Results of Meridian Observations is not yet begun. The Observations of Azimuth with the Altazimuth are complete to the end of the year, the Observations of Zenith-Distance to September 30. The section of Tabular Comparisons is not begun.

The new type, to which allusion was made in the last Report, has been adopted in the 1850 volume; it is, in my opinion, much clearer than the type formerly used.

IX. Magnetical and Meteorological Instruments.—The instruments are all in perfectly good order. No change has been made in them, except such petty alterations or repairs as instruments constantly in use require. The Vertical Force Magnetometer still exhibits proofs of its extreme delicacy, and is still liable occasionally to shew, in the dislocations of its curves, evidence of abnormal disturbance. The action of the mechanism connected with the Barometer is not quite satisfactory. The Photographic Registration is still per-

fectly successful. I had hoped before this time to have been in possession of some efficient method of producing multiplied copies of the Photographs, but have not yet succeeded. The other Magnetic Instruments and the Meteorological Instruments require no special remark, except that we have had the advantage of comparing our thermometers with some original standards made with the greatest care by Mr. Sheepshanks.

X. Magnetical and Meteorological Observations.—Eye-observations of the declination-magnetometer (by theodolite), of the other magnetometers (by telescope), and of the barometer and wet-bulb and dry thermometers, are made four times every day; these observations are intended only to give zero-points for the photographic registers. Magnetic Dip is observed three times on one day of each week. Absolute measures of magnetic horizontal force by deflexions are made at no regular intervals, but about once in five or six weeks. In these intervals a few observations of horizontal force by vibrations are made. Self-registering instruments are read daily.

XI. Reduction of the Magnetical and Meteorological Observations.—The Observations for 1850 are completely reduced, and the entire manuscript for press is in the printer's hands.

For 1851, the Theodolite-Readings for eye-observations of Declination Magnetometer are ready to the present time, and those for the Astronomical Meridian nearly ready; but no absolute declinations are formed. The Horizontal Force eye-observations are completely reduced. Those of Vertical Force, for the present year, are not begun. The Dips are completely and the Deflexions partially reduced. The Meteorological observations are completely reduced (to the state in which they are printed in the new form) up to the present time.

In the Photographic sheets, the time-scales are laid down within three weeks of the present time; the new base-lines are laid down for the Horizontal Force sheets to the end of January, but no others are yet prepared for 1851. None of the dislocated curves of the Vertical Force have been retraced for 1851.

These reductions, it will be perceived, are (relatively) much in advance of the reductions as described in the last year's Report. They would have been brought up still closer to the observations, but for the occupation of Mr. Glaisher (with my sanction) in the troublesome office of Juror in the Great Exhibition.

XII. Printing of Magnetical and Meteorological Observations.—In the last Report I described the form which I had adopted for printing the Magnetical and Meteorological Observations for 1848, then nearly ready for publication. The Observations for 1849 have been published since that time. The form adopted for them is precisely that adopted for

1848, with this difference only, that, instead of selecting a limited number of days, for which the numerical equivalents of the photographic sheets should be recorded, a record (such as the circumstances seem to require) is made for every day. It is unnecessary for me to go into details in describing the form adopted for the printed Meteorological Register; it may suffice to state that I have endeavoured to give, in a compendious form, the mean and the extremes (for every day, if the nature of the observation permits) of all the principal subjects of Meteorological observations, together with some extraordinary observations.

The printing of the Magnetical and Meteorological Observations for 1850 is proceeding in the same form; but only one sheet, containing the magnetical results to the end of January, has yet been worked off.

XIII. Chronometers.—The chronometers are compared as is described in last year's Report, some every day and some once a week, as the object of their comparison appears to require; their rates are reported every week to the Admiralty; and an Abstract of the rates of those on trial for purchase, is circulated among chronometer-makers and others, and is attached to the volume of Observations. The repairs of Government chronometers are made entirely under my superintendence. The expenses of repairs are digested for our own reference, but are not printed. The number of chronometers now on hand is 96.

Since the commencement of the present year, the gas-heating apparatus has been employed for those chronometers which were to be tried in elevated temperatures.

The signal-ball is dropped at one o'clock every day by one Assistant, another Assistant being employed at the same time to observe and register the time of its fall. I am thus in a condition to exhibit the absolute error in the time of its drop; it is usually a very small fraction of a second of time.

XIV. Personal Establishment.—The personal establishment remains in all respects the same as last year. It consists of the following persons:—First Assistant, Mr. Main; Astronomical Assistants, Mr. Henry, Mr. Ellis, Mr. Rogerson, Mr. Dunkin, Mr. Breen; Magnetical and Meteorological Assistants, Mr. Glaisher, Mr. Henderson. During the greater part of the year three Supernumeraries have also been employed.

I have thought it prudent to withdraw Mr. Breen generally from observations (the arrangements of the Transit-Circle permitting this), and to place him as immediate Superintendent of the Supernumerary Computers.

XV. Extraneous Computations.—The only extraneous computations which have been made in the past year relate to the approaching Total Eclipse of the Sun, which had

been computed very imperfectly in the best Astronomical Ephemerides, and of which (from circumstances beyond my control) no immediate computation could be procured elsewhere.

Maskelyne's Ledgers of Stars had been written out some years, but it was impossible to exhibit them as in a state proper for publication until they should have undergone an examination such as no mechanical computers could give. My own incessant employments have prevented my taking them up, but I have now requested Mr. Main to examine them at his leisure, and I fully anticipate from his discussion a valuable addition to the Astronomy of the last century.

XVI. General Remarks.—The Visitors are fully aware of the views which I have long entertained as to the direction in which the powers of this Observatory ought to be turned, and I understand that, in acting on these views, I have their entire sanction. The first subject is, Standard Meridional Astronomy of the highest class, the bodies of the Solar System being distinctly included in the subjects of observation. With this, the observation of stars of historical importance, as γ Draconis, may be considered as connected. The second is Lunar Astronomy, and with this may be associated a general attention to chronometers. Other astronomical subjects are not to be neglected, but are not to be put in competition with those which I have mentioned.

As regards Meridional Astronomy, our equipment may now be considered complete. As I have stated above, an improvement might yet be made in our Transit-Circle; nevertheless, I do not hesitate to express my belief that no other existing meridional instrument can be compared with it. This presumed excellence has not been obtained without much thought on my part and much anxiety on the part of the constructors of the instrument (Messrs. Ransomes and May, and Mr. Simms); above all, on the part of Mr. May, to whose unremitting attention its admirable workmanship is mainly due. But it would be very unjust to omit the further statement, that, in the mechanical difficulties which have successively arisen and been vanquished, the expense of the construction has considerably exceeded the original estimate, and that this excess has been most liberally defrayed by the Government. I am confident that the Visitors will appreciate with me the unquestioning promptitude with which the Board of Admiralty and the Lords of the Treasury made provision for the liquidation of the whole expense, and that they will also accept the expression of my feeling on this transaction as a pledge that, though serious outlay may sometimes be required for the proper maintenance of the Observatory, no large expense will be lightly incurred by me. Reverting, however, to the character of the instrument, I have to state that it appears to me probable that, for some time, no alterations, except in petty details, will be required. Of these the greatest is that of the American method of observing and registering transits; on the capabilities of which, as applied to the wants of an Observatory in incessant work, I

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hope in no long time to be able to form an opinion. Still, as compared with the erection of the Transit-Circle, this is but a small matter.

The observation of γ Draconis will, I trust, be provided for by the Reflex Zenith Telescope. If, however, it should be found necessary to provide for it a larger object-glass, still I cannot but think that the experience of a short time will have sufficiently overcome every practical difficulty, and that the system of observations referring to this point may be considered as settled.

The observation of the Moon has been amply, and I think myself fully entitled to say successfully, provided for by the Altazimuth.

For other observations we are provided, not so well as some observatories especially devoted to those observations, but perhaps sufficiently well for our wants.

On the whole, I regard our equipment as approaching to a normal and quiet state more completely than it has been for several years past. I still bear in mind the distant galvanic connexions to which I alluded in my last Report, and I anticipate occasional changes in the subordinate parts of our instruments; but I think it likely that, for a long time, we shall have no change so extensive as those which have been made.

G. B. AIRY.

Royal Observatory, Greenwich,
1851, June 2.