REPORT

OF

THE ASTRONOMER ROYAL

TO THE

BOARD OF VISITORS,

Read at the Annual Visitation of the Royal Observatory, Greenwich,
1854, *June* 3.

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THE present Report to the Board of Visitors may be understood as recording the general condition of the Observatory on 1854, May 26, and the transactions from 1853, May 22, to that time.

I. Grounds and Buildings.—I alluded in the last Report to the necessity for a new Fire-proof Room. The want of this became so evident that in the last autumn I submitted to the Lords Commissioners of the Admiralty a proposal for constructing one in the present year; and in consequence a sum of £550, applicable to that purpose, has been granted on the Navy Estimates. The plan has been arranged in concert with Lieut.-Colonel Greene, R.E., Civil Architect of the Admiralty; and its general features may be understood as follows:—The Eastern Buildings will be extended, preserving the same general breadth, to the boundary wall of the Observatory grounds. Access will be gained to the lower story by taking the breadth of a passage out of what is now the First Assistant's Room (the East Depôt being in future appropriated to the First Assistant), and to the upper story by an internal iron staircase. The stack of chimneys in the middle of the Library will be removed. Several preparations have been made for this work; but, at the present time, ground has not been actually broken.

The support of the quicksilver-trough for the Reflex Zenith Tube is not sufficiently steady: the proximity to the entrance gate rendering it liable to perpetual jars, and the hardness of the brickwork upon which its sand-bed is founded tending to propagate the tremors. I propose to construct a small building in the angle between the south-western part of the Transit-Circle Room and the south wall of the passage which leads from the Computing Room to the Transit-Circle Room.

These are all the remarks worthy the attention of the Visitors which relate to the interior of the Observatory inclosure. Exterior to it, the following particulars require notice.

The South-Eastern Railway Company declined to urge in the present session of Parliament their plan for carrying a railway through Greenwich Park. This resolution was taken, not in consequence of any representations on the part of the Observatory, but from considerations of private policy.

Four complete galvanic lines are now established from the Royal Observatory to the London Bridge Railway Station. Three of these are appropriated to specific uses; the fourth is reserved for contingencies.

II. Moveable Property.—No change of importance has been made; and I have no remark which calls for the attention of the Visitors, except that we are preparing a new Catalogue of the Instruments and Furniture of every kind.

III. Manuscripts.—The collection of Baily's Papers, to which I alluded in the last Report, has now been completed (or nearly so) by Professor De Morgan.

The manuscripts generally are in some disorder, from the mere want of space for arrangement. This, I trust, will be effectually remedied when more room is obtained in the proposed new building.

IV. Library.—Very little addition has been made to the Library. A large mass of pamphlets, which had accumulated in the course of several years, have been bound. The arrangement of these has occupied much of the attention of the First Assistant.

V. Astronomical Instruments.—The Transit Circle has not received or required any alteration. Its efficiency is perfect.

The new mounting of the quicksilver-trough, to which I alluded in the last Report, is in use, and is found advantageous, as I expected. It has required a new crane-cistern for the store of quicksilver. Troughs both of iron and copper are adapted to the mounting, and sometimes one and sometimes the other is employed, according as the observer

prefers to submit to the inconvenience of tremor with the iron trough, or loss of light with that of copper.

The Transit Circle for the Cape Observatory, at the last advices, had been safely received at the Cape, but was not mounted.

The Reflex Zenith Tube is in general good order, and is, generally speaking, perfectly efficient. Still I think that its efficiency will be improved, as regards both the number and the excellence of the observations, by transferring it to a site where it will be less subject to tremor.

The Altazimuth is in the same state as in the last years, and is completely efficient. Still I cannot deny that, with the experience that I have gained in the construction of the Transit Circle, I could now construct a better Altazimuth—better, however, rather in convenience than in accuracy. In the particular point which I mentioned in my last Report (the counterpoise friction-wheels of the horizontal axis), I still contemplate a change.

The Barrel-Apparatus for the American method of Transits has been practically brought into use: not, however, without a succession of difficulties, arising sometimes from causes very hard to discover. When the instrument was approaching to a serviceable state, there still remained an imperfection in the ill-defined form of the punctures on the paper. At this juncture, Lieutenant Maury, U.S.N., paid me a brief visit, and in the course of inspection of the instruments he alluded to this very defect, and to the method which had been used in America for its remedy. Although my apparatus did not admit of the same application, yet, possessed of the principle, I had no difficulty in embodying it in a form adapted to my wants; the prickers were mounted on springs, and now the punctures are perfectly round. The paper on which the punctures are to be made is folded in a wet state, upon a brass cylinder covered with a single thickness of tailor's woollen cloth, and has its edges united by glue.

The punctures, it will be remembered, are produced by two systems of prickers, which have nothing in common except that they are carried by the same travelling frame, which moves slowly in the direction of the barrel-axis while the barrel revolves beneath it. These require separate notice.

One pricker is driven by a galvanic magnet whose galvanic circuit is completed at every second of sidereal time. It was at first intended by me that the completion of the circuit should be effected by the same smooth-motion clock (regulated by a conical pendulum) which drives the barrel. I found, however, that I could not ensure such a constancy in

the radial arc of the pendulum as would make its rate sufficiently uniform to entitle it to be considered as the fundamental clock; and, moreover, there was a little difficulty in referring its indications to those of the transit-clock (which must be used in some cases). I, therefore, carried wires from the pricker-magnet to the transit-clock, connected there with springs whose contact is made at every second by the transit-clock. At first, the contact was made by the touch of a pin fixed in the pendulum-rod; and this construction for a time answered well. But it so happens that, in our transit-clock, the pendulum is carried by one frame, and the point of attachment of the galvanic springs by a different frame: it was impossible to maintain these in steady adjustment; and the rate of the clock was sensibly disturbed. I have now adopted the following construction, which promises to succeed better. A wheel of 60 teeth is fixed on the escape-wheel-axis, and the teeth of this wheel in succession make momentary contacts of the galvanic springs. The position of the springs is so adjusted that the effort of the wheel-tooth upon them occurs only when one escape-tooth has passed the sloping surface of the pallet, and the other escape-tooth is dropping upon its bearing; and thus the resistance of the springs does in no way affect the legitimate action of the train upon the pendulum.

The other pricker is driven by a galvanic magnet, whose circuit is completed by an arbitrary touch made by an observer's finger upon a contact-piece. Of contact-pieces there are three. One is upon the eye-end of the Transit Circle: it effects the contact of two brass rings which (by means of wires passing in the interior of the tubes) are connected with two other brass rings surrounding the axis and touched respectively by two springs on the pier leading to the galvanic wires. The other two contact-pieces are upon the rotating base-plate of the Altazimuth (one to be used with Vertical Face to the Right, the other with Vertical Face to the Left); the parts which they bring together carry springs which touch two large horizontal rings on the fixed base; and these rings are connected with branches of the same pair of wires which communicate with the Altazimuth. Thus Altazimuth observations are referred absolutely to the same time-record as Transit-Circle observations.

It is necessary to mark upon the revolving barrel the beginnings of some minutes and the numeration of some hours and minutes. This is done by arbitrary punctures given by the observer's touch, upon a simple system which scarcely merits detailed description.

In order to guide the eye through the multitude of dots upon the sheet, lines of ink are traced by means of a glass pen, which is attached to the same frame as that by which the prickers are carried.

Wires have been inserted in the wire plates, both of the Transit Circle and of the Altazimuth, at intervals adapted to the rapid observation by touch. The wires of the Transit Circle and the vertical wires of the Altazimuth are adapted to intervals of

about 42″ and 48″ of arc; the intervals of the horizontal wires of the Altazimuth do not exceed 24″ of arc. They are probably the smallest intervals that have ever been used. The old systems of wires are not disturbed, nor rendered confused; so that, with the Transit-Circle, either 7 wires may be observed by ear or 9 by touch; and with the Altazimuth (in either dimension) either 6 by ear or 6 by touch.

I have only to add that this apparatus is now generally efficient. It is troublesome in use; consuming much time in the galvanic preparations, the preparation of the paper, and the translation of the puncture-indications into figures. But among the observers who use it there is but one opinion on its astronomical merits—that, in freedom from personal equation and in general accuracy, it is very far superior to the observation by eye and ear.

The galvanic apparatus for giving time-signals, for dropping the time-ball, and for maintaining the movement of sympathetic clocks, is in the same state as at the last Report, with this addition only: that a separate battery, galvanic needle, and pair of contact springs, are appropriated to the wire on which the current is sent to drop the Time-Ball at Deal at 1^h (the contact being completed by the same movement of a galvanic magnet which drops our own Ball), and that the fall of our Ball-Tumbler then effects such a change in the connexions of the wires, that the galvanic needle is in a state fit to receive the return-signal given by the Deal Ball when it reaches the end of its fall.

The Hour-Circle Microscopes of the North or Shuckburgh's Equatoreal are in Mr. Simms's hands for alteration. In other respects, the equatoreals, micrometers, &c., are in their usual good state. Preparations have been made for attaching a photographic apparatus to the East or Sheepshanks' Equatoreal.

The old instruments of the Observatory have been preserved almost untouched since the last meeting of the Visitors.

VI. Observations.—The long-established plan of meridional observations is preserved unaltered in its essential points. The standard stars of the extended list, as well as those of the Nautical Almanac list, are observed (the latter twenty times in three years, if possible), and all the bodies of the solar system at every opportunity (the Moon only being observed on Sundays). The whole number of observations from 1853, May 22, to 1854, May 26, is nearly as follows (an observation of two limbs, or a duplicate transit by eye and by touch, being counted as two):—In the Transit Department:

Transits, 4802; Observations of Collimators, 317; Observations of Transit-wires by Reflexion, 317; Observations of one Collimator by the other, 53. In the Meridian-Circle Department: Observations of all kinds, 4590.

The intervals of transit-wires have been determined by collimator-observations when it appeared necessary.

The ordinary routine of transit-observations is the same as last year. Of clock stars and planets it is unnecessary to speak: the adjustment-observations are—weekly comparisons of collimators, daily observations of collimators with the transit-telescope and of the wires by reflexion, observations of circumpolar stars when possible. It has been necessary to add to these, comparisons of the transits by ear and by touch, as the ear-observation must be used still for the very slowly moving stars.

For the Circle Adjustments, there are weekly observations of runs of microscope-micrometers, daily observations of the wire by reflexion, and observations of stars by reflexion when practicable.

With the Reflex Zenith Tube, observations of γ Draconis have been obtained on 39 days. The principle of using quicksilver in a copper pan has not been adopted here.

The observations with the Altazimuth have been conducted as in the last two years. The number of days of complete observations of the Moon is 209, or 16·7 per lunation, against 117 with the Transit Circle, or 9·4 per lunation. Of the Altazimuth observations, 0 are when the Moon passed the meridian between 0^h and 1^h, 3 between 1^h and 2^h, 9 between 2^h and 3^h, 5 between 21^h and 22^h, 0 between 22^h and 23^h, 1 between 23^h and 24^h. There is only one corresponding observation on the Meridian, namely, between 2^h and 3^h. The whole number of separate observations of Moon and Stars with the Altazimuth is 976; and the whole number of separate observations of its collimator, 712.

The Equatoreals have been used for observing the third Comet of 1853, and the great Comet of 1854. The former observations do not, perhaps, possess any particular value. No observations have been made on the Solar Spots.

The Double-Image Micrometer has been used for measures of γ Virginis (two evenings), and of Saturn's rings (six evenings).

VII. Reduction of Observations.—Although our reductions are in a perfectly healthy state, quite complete in everything that demands judgment and recollection of the

circumstances under which the observations were made, and now requiring only masses of mechanical calculations, yet they are not so forward as I could wish. They are, however, almost more forward than I could expect; for very much time has been consumed in general galvanic arrangements, in the arrangements for the galvanic drop of a Time Ball at Deal, in the reducing to practical efficiency the American method for Transits, and in the operations for the longitude of Brussels; and very much time also in the reading of the great number of proof-sheets lately received. The maintenance of our computations, under these circumstances, in a forward state, is due almost entirely to the skilful and orderly arrangements and the unwearied personal attention of Mr. Main.

For Transits, the Clock Times of True Transits are formed to May 13; the Apparent Right Ascensions from Observation to May 12; the star-corrections are computed to May 20, and are applied to March 5. For the Circle Observations, the Concluded Circle Readings are completed to May 20; the Apparent Zenith Distances to May 6; and the North Polar Distances from Observation to April 1. The star-corrections are computed to April 1, but are not yet applied.

The observations with the Reflex Zenith Tube are reduced to May 19.

With the Altazimuth, the Zenith Distances are completely reduced to April 20, and the Azimuths to Feb. 22; the Tabular Computations of Zenith Distance and Azimuth are complete to March 17; and the Errors of Zenith Distance and Azimuth are converted into Errors of R.A. and N.P.D. to the end of 1853. The results are very satisfactory.

The observations with the Double-Image Micrometer are fully reduced.

For 1853, the means of the star-places in Ledger are completely or very nearly finished, but the star-catalogue is not commenced. No effective work is done to the Solar, Lunar, and Planetary reductions, beyond the formation of the separate Errors in R.A. and N.P.D.

As soon as the observations of 1853 shall be sufficiently reduced, I propose to prepare a new star-catalogue, based on the six years' observations from 1848 to 1853.

VIII. Printing of Astronomical Observations.—I stated in my last Report that the printing of the Observations for 1852 was scarcely commenced at the time of the last meeting of the Visitors. For a long time the printing went on so slowly that I almost despaired of ever again seeing the Observations in a creditable state. After a most harassing correspondence, the printers were at length persuaded to move more actively, and for some time the printing advanced at the rate of five sheets per week. This, of course, has contributed greatly to bring the press-work into proper condition; but the volume is still very much behind its usual time of publication.

The Astronomical part is (with the exception of a small part of the Introduction) finished. The Magnetic Results are printed as far as the month of May.

Two Appendixes are printed, which I trust the Visitors will regard with interest. One is, an elaborate description of the Transit Circle, illustrated with sixteen plates. The proofs of the plates have been received, but they are not finally passed for working off. The other is a statement of the Regulations, public and private, of the Royal Observatory. These were drawn up in consequence of an application of a Foreign State to the British Government; and the Lords Commissioners of the Admiralty ultimately decided that the paper should be printed for public reference.

A large quantity of the manuscript of observations and reductions for 1853 is prepared for the printer, and has recently been forwarded to him for printing.

IX. Magnetical and Meteorological Instruments.—No important change has been made in these instruments. For perfecting the insulation of the support of the Electric wire, attempts have been made to heat the glass cone, which is carried by the mast, by means of a gas lamp (in the same manner as that which is attached to the chimney above the Octagon Room); and, after some troublesome failures, I hope that we are now successful. Considerable additions have been made to the presses, trays, yellow windows, &c., which are required for the photographic operations.

The photographic registers of the barometer (formed by means of a large syphon-barometer, carrying a float, which is attached to the short arm of a lever, whose long arm carries the disk which casts a shadow upon the photographic paper) had long been a subject of anxiety to us. We could not always reconcile the apparent changes of this barometer with those of the standard barometer. It was at last conjectured that the fault probably arose from the omission of boiling the quicksilver in the barometer-tube (a rather hazardous operation in this case). Messrs. Negretti and Zambra, at my request, undertook to do this; and effected it most successfully. The quicksilver, as I understand, exhibited unequivocal signs of aqueous moisture. The changes of indication since that time have been so consistent with those of the standard barometer, that I propose now to combine the two (in the same manner as for the magnetic instruments), with the view of establishing a continuous register of atmospheric pressure.

X. Magnetical and Meteorological Observations.—The system of the last four years is continued without change. By photographic arrangements, the Magnetometers, Barometer, and Thermometers, continually register their changes of indication. Their

zeros are given by eye-observations. The wind and rain are registered by Whewell's and Osler's anemometers. Magnetic dips, deflexions, and vibrations, are observed by eye. Captain Sanders, R. N., reads thermometers suspended in the water of the Thames; and the Rev. G. Fisher registers the fall of rain at the Hospital Schools; and these results are communicated to me.

XI. Reduction of Magnetical and Meteorological Observations.—The translation of Declination observations into angle-measure, and of Horizontal Force observations into parts of the whole Horizontal Force, is completed to the present time. The Theodolite Zero is completed to the end of March, 1854. The Vertical Force observations are reduced in great measure to the present time, wanting the conversion into equivalents, which is complete to the end of 1852. The Dip observations are reduced, but not examined, to the end of March, 1854. The Deflexion observations are reduced and examined to the end of 1852. The daily Meteorological observations are reduced to the present time: Abstracts having been omitted for several years past.

The Photographic Sheets for Declination and Horizontal Force are completely prepared to the end of February, 1854; their time-scales being laid down to the end of March. For the Vertical Force and Barometer, the time-scales have been laid down to the end of March, and for the Thermometers to the end of January: no further reduction being yet attempted in these. Preparations, however, have been commenced for comparing the photographic indications of Barometer-height with those obtained by direct reading by eye, in order to make the continuous register of the Barometer perfectly efficient.

No further step has been taken for the digest of the Magnetical Results.

XII. Printing of Magnetical and Meteorological Observations.—The Magnetical Indications are printed to the end of May, 1852. No other part of this section is printed for 1852: the whole of the manuscript is in the printers' hands.

Under this head I may appropriately record the efforts that we have made for multiplying copies of our Photographic Registers. The subject had long been in our contemplation, and some apparatus, suggested by a gentleman to whom we are very greatly indebted for the efficiency of our photographic operations, had been long since prepared. For some time, perhaps, I trusted too much to the assistance which might be

obtained from persons extraneous to our own establishment. In the last winter, however, Mr. Glaisher took up the matter with his usual vigour. It was soon found that by the agency of the sun-light upon the back of an original photograph, whose face was pressed closely by means of a glass plate upon proper photographic paper below, there would be no difficulty in preparing negative and inverted secondaries, and, from them, positive and erect tertiaries. The process is so simple, and admits of repetition to such an extent, that it may be considered infallible; and all that was requisite was, that the primaries should be good. By diminishing the quantity of iodide of potassium in the preparation of the paper; by slightly touching the dark curves, as soon as they are brought out, with nitrate of silver; and by diminishing the quantity of hypo-sulphite of soda; very pure grounds with black lines are obtained. The sheets are fitted up with their apparatus of time-scales, base-lines, &c., and are then waxed: secondaries and tertiaries are taken from them; and the last, if the operation is properly conducted, are in every respect as good for ulterior uses as the originals. Beyond the trouble to ourselves (accompanied with some small expense) of making secondaries, and the expense of making tertiaries through the instrumentality of some professional person, I anticipate no difficulty in multiplying copies to any extent which the Visitors may desire.

XIII. Chronometers, Communication of Time, and Operations for Longitude.—The number of Chronometers now on hand is about sixty, of which sixteen are makers' chronometers on trial. The chronometers are rated daily or weekly; the trial-chronometers are rated in heat and in cold; the abstracts of rates are formed; and the repairs are superintended; as in former years.

The Normal Clock, with its small adjusting apparatus (described in last year's Report), has been in constant use, and has been found exceedingly convenient. It drops the Greenwich Ball and the Strand Ball, it sends daily signals along several railways, and it maintains in sympathetic movement several clocks, by galvanic currents. Among other clocks thus moved, one is in the Chronometer Room, one is at the Entrance Gate, and one is at the South-Eastern Railway Offices, London Bridge.

With the sanction of the Commissioners of Greenwich Hospital, it has lately been arranged by the Rev. George Fisher and myself that two wires shall be swung across the lower part of Greenwich Park, from the top of the Octagon Room of the Royal Observatory to the Observatory of the Hospital Schools, for carrying the galvanic currents which will maintain the movement of a sympathetic clock at the School Observatory.

I alluded, in my last Report, to the erection of a Time-Signal Ball at Deal, to be

dropped every day by a galvanic current from the Royal Observatory. The Ball has now been erected by Messrs. Maudslays and Field, and is an admirable specimen of the workmanship of those celebrated engineers. The galvanic connexion with the Royal Observatory (through the telegraph wires of the South-Eastern Railway) is perfect. The automatic changes of wire-communications are so arranged that, when the Ball at Deal has dropped to its lowest point, it sends a signal to Greenwich to acquaint me, not with the time of the beginning of its fall (which cannot be in error), but with the fact that it has really fallen. The Ball has several times been dropped experimentally with perfect success; and some small official and subsidiary arrangements alone are wanting for bringing it into constant use. I can scarcely convey to the Visitors how much I am indebted to the South-Eastern Railway Company and the Electric Telegraph Company, and to their principal Telegraph Officers, Charles V. Walker, Esq., and Latimer Clark, Esq., for the liberality and even the zeal with which they have assisted me in every step of these preparations. Without the cordial aid of Mr. Walker, in particular, it would have been impossible to complete the work. The best line of wires on the Railway has been devoted to this purpose, and the shifting connexions have been modified to diminish the resistance and remove the chances of disturbance as much as possible.

No step has yet been taken for the galvanic determination of the longitude of Oxford Observatory, although I believe that the preparations within that building are now complete.

The determination of the difference of longitude with the Paris Observatory had long been contemplated as one of the important uses of our galvanic connexions. In the last summer and autumn, I recommenced correspondence with Messrs. Arago and Laugier for this object; and one of my letters to M. Arago was addressed to him on the very day of his death. Deeply do I grieve that this operation was not finished in time for him to know the results: not a day, however, had been lost in pressing it forward. It was obviously impossible then to proceed with it; and I considered myself at liberty to take measures in concert with M. Quetelet for our difference of longitude with Brussels. The Submarine and European Telegraph Company, through an unusually protracted operation, gave their warmest assistance. A most able assistant from the Brussels Observatory, M. Bouvy, came to Greenwich, and Mr. Dunkin went to Brussels: when the operation was half finished, the observers returned to their original posts. The signals were continued every night (an hour each night) until three nights' signals had been obtained, accompanied with unexceptionable transits, in each part of the operation; and these alone were retained as available for longitude. Thus, about 3000 effective signals were made, but only 1000 of these were admissible for the fundamental objects of the operation. The result, I need scarcely remark, claims a degree of accuracy to

which no preceding determination of longitude could ever pretend. I apprehend that the probable error in the difference of time corresponds to not more than one or two yards upon the earth's surface.

One of the earliest steps taken by M. Le Verrier, after his appointment to the charge of the Observatory of Paris, had reference to the determination of our longitude-difference. All important preliminaries are now arranged, and I trust to be able to report orally to the Visitors the commencement, or probably the conclusion, of this long-desired operation.

The perfection of our galvanic connexion with Edinburgh having been fully established by the operations of last year, I had proposed to use it for the determination of the longitude of a more distant point. For checking the azimuthal accuracy of our great National Survey, as well as for giving (by interpolation) the error of longitude of every point of our coasts, I had intended to determine with the utmost accuracy the longitude of Lerwick, in Shetland. I proposed to establish a galvanic connexion with a comparing-observatory on the Granton Pier, and to transmit the time from that point to a selected station in the neighbourhood of Lerwick, by a large number of chronometers carried in the steamboat which plies between Granton and Lerwick. With the sanction of the Admiralty, a grant of money for defraying the expenses was inserted in the Navy Estimates; and other preparations were made. Unfortunately, the demand for chronometers caused by our large naval armament has been so considerable that I cannot reckon on having at my disposal a sufficient number to carry on this operation successfully; and I have, therefore, unwillingly deferred it to a more peaceful time.

XIV. Personal Establishment.—The number of Assistants is the same as for several years past; and, with one exception, the names of the individuals are the same as last year; Mr. Henderson having resigned, and the vacancy having been filled by the appointment of Mr. Charles Todd, formerly supernumerary computer, and lately Assistant at the Cambridge Observatory. The present list of officers is: — First Assistant: Rev. R. Main. Astronomical Assistants: Mr. Henry, Mr. Dunkin, Mr. Breen, Mr. Ellis, Mr. Todd. Magnetical and Meteorological Assistants: Mr. Glaisher, Mr. Downs. At the present time, five supernumeraries are also employed.

Mr. Breen partially superintends the staff of supernumeraries; and neither Mr. Breen nor his subordinates are usually employed in observing; although, when need requires, any one of the Assistants or Computers is required to observe, a corresponding alteration being made in the hours of attendance for computation.

Mr. Todd (succeeding to Mr. Henderson in that responsibility) has the charge of the galvanic apparatus.

Other officers are, a Labourer, Gate Porter, Watchman, and Carpenter, or Clerk of Works. The last mentioned, though not borne on the Admiralty Books, is practically a fixed officer of the Observatory.

XV. Extraneous Computations.—Supported by the approval of the Visitors at their last meeting, I applied for and obtained the sanction of the Board of Admiralty for the correction and completion of the Lunar Reductions (the correction being rendered necessary by Mr. Adams's detection of Burckhardt's error in the Lunar Parallax); and a sum of money has been granted on the Navy Estimates. Hitherto, however, no progress has been made in the work. Partly from the occupation of my time and thoughts by other pressing subjects, and partly from my not having found a fit superintendent, I have yet given little attention to the matter. I trust, however, that it will not be deferred much longer.

The only other astronomical work which has been executed at the Royal Observatory consists of the calculation of some chronological eclipses, scarcely meriting notice.

XVI. General Remarks.—The past year has, on the whole, been felt as a laborious one. This has arisen from a cumulation of several perfectly distinct causes. The order of our printing has been disturbed, and this has produced great disarrangement of all our ordinary daily work. The establishment of our galvanic system, and its application to American transits, to public time-signals, and more especially to the longitude-determination, has caused to the establishment in general, and to myself in particular, a great consumption of time. The preparation of the Observatory Regulations, and of the Description of the Transit-Circle, and the closing of the business of the Standard Commission, have required a great amount of writing which could be entrusted to no one but myself.

I may confidently hope that in the next following years several of these causes will not be in action. Still I am impressed with the feeling that the strength of our establishment is now loaded to the utmost that it can bear. A brief review of the progress of the science of Astronomy and of the arts related to it will shew that this must be expected. The number of known planets has been largely increased: and I cannot think that in this National Observatory the neglect of any one of the bodies of the Solar System is permissible. The American method of transits adds to our labours; but it appears likely to contribute to accuracy, and it will give facilities for the record of the observations made at other Observatories, upon our registering-barrels; and, if these advantages are established by experience, the method must be maintained.

The public dissemination of accurate time brings some trouble; but it is a utilitarian application of the powers of the Observatory so important that it must be continued. The galvanic determination of difference of longitude brings with it a mass of work in negotiations, in preparations, and in calculations; but it produces results of such unimpeachable excellence, and of such value to astronomy and geodesy, that it must in any wise be preserved as part of our system. Time is consumed in experiments for the improvement of our photographic process, and in measures for the multiplication of copies; but these are worthy objects of attention, which it would be wrong to neglect. All these are additions to the labours of the Observatory as they existed a few years ago, unbalanced by any corresponding subtraction.

This increase of labour has been met (or partially met), not by an increase of the number of the fixed Assistants, but by an increase of the number of supernumerary computers. And this is, in my opinion, the cheapest and the most efficient way of supplying our want. The position of the permanent Assistants is in some degree altered by this organization. Formerly they were simple observers and simple computers: now, without losing the responsibility of personal work, each of them has a subordinate computer whose work is placed almost entirely under his control. The admirable conduct of all the Assistants and Computers on the establishment justifies me in saying, that the characters of all parties rise under this arrangement.

I think it quite probable that I may desire from the Government an extension of the discretionary powers under which I have engaged these aids. But I do not at present foresee the necessity of any further increase of our fixed personal staff, or of any other source of important expense.

G. B. AIRY.

Royal Observatory, Greenwich,
1854, *May* 26.