REPORT OF THE ASTRONOMER ROYAL

to the Board of Visitors of the Royal Greenwich Observatory

Read at the Annual Visitation of the Royal Greenwich Observatory, 1954 June 12.

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OF THE ROYAL GREENWICH OBSERVATORY

Read at the Annual Visitation of the Royal Greenwich Observatory, 1954 June 12.

The Report here presented refers to the period from 1953 May 1 to 1954 April 30 and exhibits the state of the Observatory on the last named day.

I. GROUNDS AND BUILDINGS.

(a) Greenwich. The Octagon Room, which had been handed over to the National Maritime Museum as described in last year's Report, was formally opened by H.R.H. the Duke of Edinburgh on May 8. It has been accessible to the public at regular Museum hours, warders being provided by the Museum. Halley's Transit and Bradley's Zenith Sector are displayed in this room, together with copies of various old prints of the Observatory. Some important old manuscripts in the possession of the Observatory were exhibited for most of the year. The Airy Transit Circle has been shown to visitors, subject to not being in use for observation at the time.

The workshop, staircase, "museum" floor, and exterior of the New Building have been painted, and downpipes which suffered war damage are being replaced. The hot-air furnaces have been overhauled. In the old buildings, repair and maintenance work has been done on the battery room and toilets, the vinery, and the cold house. Boundary fences have been repaired and strengthened. A new boiler has been installed for heating the Record Rooms and Time Department Office.

The Time Ball has been dropped regularly, exceptions being made (on account of high winds) on January 15, March 1, and March 2.

(b) Abinger. At Feldemore, an additional flat has been provided, as the requirements for hostel accommodation had decreased. A new septic tank has been installed, serving the drainage system of the stables block. The cold water supply pipe from the pump house to Feldemore has been replaced.

(c) Herstmonceux. In connexion with the maintenance of the external fabric of the Castle by the Ministry of Works, the replacement of portions of the stonework of the south gateway, which were badly weathered, has been completed. Repairs to the west tower of this gateway are in progress.

The Meteorological Enclosure, including the building to house the anemograph recorder, has been completed. Regular meteorological observations were commenced on November 1.

In the Meridian Group, the Control Building for the Photographic Zenith Tube has been completed. The pavilion for the Cooke Reversible Transit Circle was erected for tests at the makers' works in July. Some modifications to the gear for operating the roof-shutters were found to be required. After these changes had been made, the structure was dismantled and sent to Herstmonceux. The concrete

foundations for the building and the massive pier to carry the instrument and collimators had meanwhile been constructed by Departmental labour. The base casting of the instrument was placed in position before the erection of the pavilion was commenced. The pavilion was completed in March, except for external painting and the provision of the entrance steps.

The foundations for the Photographic Zenith Tube Pavilion are under construction and the manufacture of the pavilion is well in hand at the works of the contractors. The plans for the pavilion to house the Bamberg Small Transit are nearing completion. It had been expected that both of these buildings would have been completed during the year, but there have been further delays. It is hoped that both buildings will be erected by the end of July 1954. The pavilion which housed the Cooke R.T.C. at Greenwich is to be modified to house the Melbourne R.T.C., together with its two collimators, at Herstmonceux. The drawings of the modifications are in hand.

Work on the Equatorial Group was started in October. The whole of the steelwork for the Laboratory Block is complete and the foundations and walls for the domes are in hand. The details of the designs for the domes have been settled. The building contract for the group is due to be completed by July 1955.

The details of the design of the building to house the Nautical Almanac Office, Time Department, workshops and associated buildings have been under discussion. The Consulting Architect has not made the progress expected on the working drawings and the commencement of the work on site has accordingly been delayed. It is hoped, nevertheless, that an early start will be made on this building.

Works on roads, drains and landscape gardening has continued by Departmental labour.

II. INSTRUMENTS, APPARATUS, AND LIBRARY.

The following instruments are on loan to the Royal Greenwich Observatory:-

A printing micrometer, from the Imperial College of Science.

A 13-foot spectrohelioscope, complete with coelostat, but without grating, from the Mount Wilson Observatory.

A 7-inch prism of 40° angle, from the Joint Permanent Eclipse Committee.

A 16-inch coelostat, from the Royal Astronomical Society.

A position micrometer for measuring solar photographs, from the Solar Physics Observatory, Cambridge.

A Schuster-Smith coil magnetometer for measurement of horizontal intensity, from the National Physical Laboratory.

A coil magnetometer designed by the late Dr. D. W. Dye, F.R.S., for measurement of vertical intensity, from the National Physical Laboratory.

Three potentiometers, with standard cells and resistances for measuring current supplied to the coil magnetometers, from the National Physical Laboratory.

A small transit instrument, of the broken type, with stand, by Bamberg, from the Royal Observatory, Edinburgh.

A 30° prism from the Royal Society.

Two 35-mm. cinema cameras, from the Admiralty Research Laboratory.

Several other smaller instruments are also on loan to the Royal Observatory.

The following instruments have been lent by the Royal Greenwich Observatory:-

To the Royal Observatory, Cape of Good Hope:-

Clocks, Dent 1916 and Dent 2013.

To the Imperial College of Science and Technology:-

6-inch equatorial, Simms No. 2.

To the Cavendish Laboratory, Cambridge:-

Shortt clock No. 16, with slave.

To the National Maritime Museum:-

Harrison's Time Machines, Nos. 1,2,3 and 4 and the copy of No.4 by Larcum Kendall.

To the Science Museum:-

A number of astronomical instruments of historical interest.

To the Cambridge University Observatory:-

A gravity drive clock and five plate-holders.

A comparison image micrometer.

To Messrs. Kelvin & Hughes Ltd.:-

An equatorial mounting with adjustable head.

The Cookson Floating Zenith Telescope, which has been on loan from the Cambridge Observatory since 1911, has been dismantled preparatory to its return to Cambridge. Return has been delayed, but will shortly take place.

The 4-inch portable refraction telescope which was on loan to the Observatory from Mr. Harry D. Oppenheimer, President of the Oppenheimer Casing Company of Chicago, has been presented to the Observatory by the Oppenheimer family as an outright gift, following the death recently of Mr. Harry D. Oppenheimer.

A valuable gift of solar equipment has been made to the Royal Greenwich Observatory by Mr. J. Evershed. It includes 3 large liquid prisms figured to the high accuracy of 1/20th wave-length of light, a 15-inch coelostat, solid glass prisms and a spectroheliograph movement.

Airy Transit Circle.

Observations with the Airy Transit Circle were terminated on March 30, and staff of the Maritime Museum are being instructed in its care and maintenance. The formal transfer of responsibility will take place shortly. The original Airy chronograph, with conical-pendulum control, will also be left in situ.

Cooke Transit Circle.

The instrument was dismantled on June 17. The base casting of the instrument was removed to Herstmonceux on June 25; it was adjusted for azimuth and level and was then grouted in. The azimuth-plate and level-plate were added on July 8, and about 80 gallons of oil were poured into the trough; the whole was then covered

over, pending erection of the pavilion. Since the completion of the pavilion, the erection of the piers and of the telescope has been in progress and is nearing completion.

New supports for the collimators are necessary, to provide room for viewing the azimuth marks. The supports and supports for the azimuth-mark lenses have been made in the Workshop. Azimuth-mark lenses have been ordered; the marks themselves will not be located until the lenses arrive, since their very long focal lengths may not come out quite as expected. Owing to pressure of other work, including eclipse preparations, the cameras for photographic recording of the circles have not yet been fully adapted for operation. Tests to ascertain the necessary exposure times, with the illumination as planned, are in progress. An essential accompaniment is the provision of automatic recording for the Z.D. micrometer; this has been very materially advanced by the receipt, on indefinite loan from the Imperial College, of a printing micrometer which can be suitably adapted with very much less effort and delay than would be involved in designing and making a new one. The loan is most gratefully acknowledged. A photographic chronograph, which will eliminate the present time-consuming work of reading tapes, has also been planned, in conjunction with the staff at Abinger. It will have a graduated and numbered disk, permanently rotating on the seconds spindle of a 1000-cycle sidereal phonic motor, and the disk will be photographed by a flash whenever the micrometer contact closes. The sidereal time of each contact can thus be read off directly from the photographs.

The barrel-chronograph, formerly used with the Altazimuth, has been reconditioned; it will be provided with an electric drive and will be used at Herstmonceux as standby and filing-summary for the Cooke T.C.

A quartz "optical square" of four inches' clear aperture has been ordered from Messrs. Cox, Hargreaves & Thomson and is now nearly complete. It will be used for investigating the flexure of the Cooke T.C., and of other meridian instruments. The method seems well suited in principle for separating refraction and flexure.

Lyot Monochromatic Filter.

Delivery of this birefringent monochromatic filter from the firm of Optique et Précision de Levallois is expected shortly. Two subsidiary lenses, required for mounting the filter on the 6¼-inch Newbegin telescope in the Solar Dome, have been ordered from Messrs. Wray. In addition, a commercial camera body using 35-mm. film and two 3-inch quartz flats have been purchased. The image will be 22 mm. in diameter and exposure times of the order of ½-second should be possible. The adaptation to the telescope will include devices for visual observation at a magnification of x100, for photography of limited regions of the Sun's disk and of prominences, and for the standardization of the photographic film.

Solar Spectrographs.

Mr. J. Evershed has presented to the Observatory the principal parts of the solar spectrographs from his private observatory at Ewhurst. These included a coelostat for a 15-inch mirror, a train of three large liquid prisms and many accessory items. A pair of large solid glass prisms of 45° angle and a 21-foot collimator lens had previously been presented by Mr. Evershed; the loan to him from the Royal Society of a large reflecting prism of 30° angle has been transferred to the Observatory.

The coelostat has been modified in the Workshop to take a 16-inch mirror and the base has been fitted with wheels to permit east-west traversing on rails, without change of azimuth or level. A mounting for a 16-inch secondary mirror, which will be linked with the carriage of the coelostat so that it rotates as the coelostat is traversed east or west, is being constructed. The secondary mirror will move vertically to take up the varying declination of the Sun and the 10½-inch objective will lie directly below the secondary mirror. Two 16-inch quartz flats for the coelostat have been obtained, together with a 12-inch quartz flat which is required for turning the vertical beam into either one of the two horizontal spectrographs eight feet below ground level.

The train of three large glass prisms has been received back from Messrs. Hilger and Watts, who reported very favourably upon their homogeneity and who were able, with the help of a large interferometer, to improve their figure appreciably by local polishing. The prisms have been set up in a temporary prism-box insulating them from the concrete surface of the prism-table and from the small variations in the temperature of the air in the spectrograph room. They show a quality of definition approaching the theoretical maximum. More accurate control of the temperature of the air will eventually be provided, and provisional equipment has been constructed. Precise tests of instrumental line-profile, to show how much benefit will be derived from this more accurate control, are to be made.

Some tests of the liquid prisms have been made but as yet satisfactory definition has not been achieved without periodic stirring of the liquid. The deterioration after such stirring is more rapid than could be tolerated. It seems highly desirable that this stirring should be eliminated, so that reliance can be placed upon the instrumental profile.

Total Eclipse of 1954 June 30.

The Field Equatorial belonging to the Joint Permanent Eclipse Committee has had its centre section bored out to take the centre section of the 21-ft. telescope, of 7 inches aperture, which had been used with a coelostat at some previous eclipses. On this occasion it is intended to use it for studying the Einstein effect; the increased scale and the smaller aperture-ratio, compared with those of the Carte du Ciel lens for which the mounting was designed, should be advantageous. The Equatorial was designed for latitudes up to 30°; a large pedestal has been constructed of angle-iron to convert it for use in latitude 59°. The thrust-supports for the polar axis have been strengthened, as the load on them is very much increased. The cable-release motor has been moved so as to shorten the cable as much as possible, with a view to reducing the whip. A new rotary exposing shutter, over the object glass, has been made and operates so smoothly as to be without visible effect on the stability of the images. The instrument was erected in November in the Thompson dome, whose dome-motor had been re-wound and re-mounted for this purpose, and the performance of the lens was found to justify the use of 15-inch plates covering 3½°. A new double plate-holder has been made to facilitate a quick change of plates during the eclipse. A light framework hut, of tubular scaffolding, large enough to cover the telescope completely in the positions in which it will be used, was erected at Herstmonceux and covered with waterproof canvas; it will serve both as a windbreak during actual observations (the instrument being somewhat lacking in rigidity), and also for protection from the weather, especially during the months that it will have to stay in position after the eclipse if the eclipse results themselves are satisfactory. It is intended to obtain during the eclipse two plates, on each of which is photographed the eclipse field and a selected nearby comparison field; the same fields will subsequently be photographed on comparison plates, if successful observations are made during the eclipse. The comparison

field will provide a determination of the difference of scale, which will then be used for the reduction of the eclipse field. The mounting and tent were both dismantled at the end of April for packing and shipment to Sydkoster, (Sweden). The observing party will consist of Mr. Gold, Dr. Hunter, and two volunteers, Mr. Bastin and Dr. Sciama from Cambridge University.

Two of the cine camera assemblies used for the 1952 eclipse have been overhauled; one will be used by Mr. Pope for the Atkinson method, just outside the zone of totality at Simrislund on the Swedish mainland, and the other by Dr. Atkinson for the Banachiewicz method, near the central line at Persnäs (Öland). A direct comparison of the two methods, both as to ease of reduction and as to final accuracy, will be valuable. The camera mechanisms have been carefully reconditioned and readjusted, to eliminate a fault which had given some trouble before; they have then to be squared on afresh. Unmounted gelatine filters, close to the focal plane, are being substituted for glass-mounted ones immediately outside the fiducial-mark lenses, as this arrangement should in principle be slightly preferable.

A visit was paid to Sweden by Mr. Gold, who selected sites for the three expeditions and made various local arrangements.

York Memorial Clock.

Dr. Atkinson was appointed to design the mechanism of an "Astronomical Clock", which is to be the central feature of a Memorial to the air personnel from Northern Commands who lost their lives in the War. The exterior is being designed by Professor A. E. Richardson, R.A. The construction of the mechanism, for which drawings have been made by the Foreman of the Observatory, is being undertaken in the Observatory Workshop, on a voluntary overtime basis. The principal feature of the Clock will be a planisphere rotating behind a fixed horizon once in a sidereal day, and carrying a "Sun" which will advance along a circular "Ecliptic", at the proper rate to take account of the Equation of Time. As the south pole, and not the north one, has been projected to the centre of rotation, the horizon is convex instead of concave; it is sensibly circular, so that the impression will correspond as far as possible to that of an airman immediately above York; the "Sun" will rise and set at the correct times and azimuths for York every day, and will also reach all other "azimuths" and "altitudes" at the correct times, taking full automatic account of leap years and of precession as well as of the Equation of Time. There will in addition be a circumpolar dial, and various smaller subsidiary ones, but no representation of the Moon and planets, since it is hardly practicable to attain a comparable accuracy in their case.

Library.

The removal of the Library from Greenwich to Herstmonceux was completed in August, 1953, with the exception of the collection of rare books for which a suitable bookcase is being made. It is, however, expected that this collection will be at Herstmonceux within the next few weeks.

The recataloguing and re-arrangement of the Library has been begun, and, in connexion with this work, a complete check of the book stock is being made.

III. ASTRONOMICAL AND RADIO OBSERVATIONS.

Airy Transit Circle.

Observations with this instrument were terminated on March 30, thus ending a series of observations begun 103 years ago and almost unbroken except during the

war. In the present staffing situation it seemed to be more useful to overtake arrears of reductions during the transitional period of the removal of the Meridian Department to Herstmonceux and before regular observations are started with the Cooke R.T.C., than to devote further effort to the Airy T.C., which has continued in operation for much longer than was expected when the Cooke was first authorized. Observations from May 1 to March 30 were as follows:

Sun	129	Mars	1	Neptune	8
Moon	87	Jupiter	17	Ceres	1
Mercury	8	Saturn	12	Pallas	3
Venus	45	Uranus	9	Juno	6
				Vesta	16

Transits for the determination of clock and azimuth errors number 2571.

During the summer a series of observations was made of double transits of azimuth stars with concurrent measures of the azimuth of a survey beacon lamp mounted on the long-disused meridian mark obelisk at Chingford, eleven miles north of Greenwich. The lamp was supplied and maintained by the Director of the Ordnance Survey. It is hoped that an accurate value of the azimuth of this mark, in conjunction with a survey triangulation from Greenwich to the new site of the Cooke R.T.C. at Herstmonceux, and a determination of the deflexion of the vertical at the two stations from gravity anomalies, will lead to values of the astronomical latitude and longitude of the new site, for comparison with those obtained by the classical astronomical methods.

This appears to be the first occasion on which an azimuth mark has been observed with the Airy T.C. The data obtained are being analysed; it is apparent that, apart from the information sought on the azimuth of the mark, some interesting facts on the variations of the azimuth error of the instrument itself are shown by the figures. The error correlates with the temperature in the pavilion, with a mean diurnal range of three-quarters of a second of arc for a mean diurnal range of temperature of 6°F. On days when the range of temperature is large the azimuth error inferred from observations of the mark may range over three seconds.

Shortage of staff has continued to delay the completion of the 1st Greenwich Catalogue for 1950.0. The determination of the proper motions of the stars not contained in the Boss General Catalogue has been practically completed. Considerable work has been done on an investigation into a suitable method of using punched-card machines to determine the proper motions of the G.C. stars contained in the catalogue.

The observed places of FK3 stars from the following series of observations have been communicated, in advance of publication, to Professor Kopff for use in the revision of the FK3 system, which is being undertaken by the Astronomisches Rechen-Institut.

(a) FK3 stars contained in Parts I and II of the 1st Greenwich Catalogue for 1950.0.

(b) FK3 stars in the fifteen-degree zenithal belt observed in conjunction with the PZT stars, 1949-51.

(c) FK3 stars observed in R.A. only with the Cooke R.T.C., 1937-40.

Astrographic telescope.

Systematic observations of the brightest four minor planets for position have been continued. Photographs of Ceres, Pallas, Juno and Vesta were secured on 9, 12, 10 and 14 occasions respectively. That the total of plates taken is little more than half the figure in last year's Report is due partly to less favourable apparitions of the first three planets and partly to an extremely cloudy winter. Measuring and reduction are well up-to-date.

A possible occultation of an 8th magnitude star by Pallas (itself at 7th magnitude) was predicted for the morning of April 7 over N. America. Accurate prediction of the track depends on precise determinations of the position of the planet made as recently as possible before the event, preferably from plates showing simultaneously the planet and the star concerned. Preliminary observations indicated that the drop in brightness could be seen with ease if an occultation did occur, and arrangements were made for cabling any information secured by April 6 to the U.S. Naval Observatory, to assist observers. A photograph obtained some 26 hours before occultation showed that the relative positions of planet and star were such as to throw the occultation track off the area predicted from the ephemeris place of Pallas into the Pacific Ocean and daylight.

Amongst the other fields taken during the year are 48 showing other minor planets and 2 showing Comet 1953a. Measurement of the special series of plates taken at large hour angles has proceeded far enough to make it clear that the systematic error mentioned in the last Report is too small to affect the minor planet programme appreciably. It seems possible, however, that whenever large hour angles are involved such a systematic error may demand "control" experiments if high accuracy is to be attained; in particular, the displacements now found with this telescope may account for the very low value of the solar parallax, deduced from the observations with this instrument in the Eros parallax programme. Control plates have continued to be taken, and 15 further exposures on the same test field (dec. +27°) have been secured, many with the instrument reversed. The dependence of the effect on declination is being evaluated by systematic photography of a circumpolar field and an equatorial field, on which 35 and 24 exposures respectively have been made.

Lunar occultations have again been observed with the ten-inch guiding telescope when their times of occurrence were conveniently related to the photographic duties: six observations have been communicated to the Nautical Almanac Office.

Yapp 36-inch reflector

Observations of the standard stars of the Yerkes Atlas have been continued with the single-prism spectrograph: 86 spectra of 74 stars have been secured. The instrument was, however, out of use between October 30 and April 26 whilst the 21-ft. eclipse telescope was under test.

Four occultations were observed with the 7-inch guiding telescope during photographic duties.

During the early part of January the instrument was used in an attempt by Mr. F. J. Hargreaves to televise Jupiter and its satellites. The spectrograph was removed from the telescope and a B.B.C. television camera installed in its place in a timber cradle. The lens of the camera was removed and its photocathode was put at the Cassegrain focus. A Barlow lens just inside the focus increased the

magnification at will by up to 6 diameters. A successful public transmission at the end of broadcasting on January 13 included excellent views of the planet and its Galilean satellites, and of the Moon; but the following night, on which the full-scale programme was scheduled, was cloudy and a stand-by programme, using photographs and models, had to be substituted.

Solar Eclipses, 1948 November 1 and 1952 February 25.

The difficulties reported last year, in connexion with the zero of position angles, were partly resolved (as had been expected) by the receipt of several small corrections, at different dates, from Dr. Watts of the U.S. Naval Observatory. However, it became clear on both sides that correspondence was not the best method for resolving the question completely, and the Naval Observatory invited Dr. Atkinson to Washington for direct conferences. A very full joint study of the apparatus and the reductions employed in Dr. Watts' lunar profile work produced a few trivial additional corrections, but these were not material; both parties were finally convinced that no further substantial correction could be expected. The net effect of all known corrections, though in the right direction, still left a discrepancy of two or three tenths of a degree between the two position-angle systems, and it was thus necessary to re-examine that of the eclipse results. This had never been altogether satisfactory; the "diurnal track" provided by the south limb of the Sun originally showed a violent scatter, and although it had proved possible to assign this to a specific fault in the camera, and to correct for it, there then remained a marked systematic change of direction at one point. This had been dealt with by adopting a compromise direction. It was now found that when the final values of all known corrections were applied, the remaining discrepancy could be almost totally removed if the second part of the run only, instead of a compromise between both, were assumed to show the true diurnal path. The resulting corrections to the Moon's place then also fell into satisfactory agreement with those based on occultations, with which they had previously conflicted. The assumption implies that during the first part of the run the camera bench tilted slowly through about 10″, which is perhaps not unlikely in view of the rather exceptional way in which it had to be mounted at Mombasa. If this is really what happened, the difficulty should not recur. The reductions have now been completed on this basis, and the internal probable errors of the corrections obtained to the Moon's place are ±0″.012 in longitude and ±0″.015 in latitude. These figures do not include the uncertainty in the zero itself, nor that in the Sun's place, but they are directly comparable with (and considerably smaller than) the internal probable errors of all previous methods. If the zero can be as well determined in future, as now seems possible, its uncertainty will cause a negligible increase in the final probable errors. The method thus seems able to give the Moon's place with very high accuracy. The place obtained is, of course, a single one, but comparison of such eclipse places at both nodes should give a very reliable correction to the longitude of the node. A paper describing the apparatus in detail, and the work at Mombasa, is in print, and the final reductions and discussion are nearly ready for press.

No further progress has as yet been made in the reduction of the films obtained at the eclipse of 1952 February 25.

Cosmic Ray Observations.

Recording with the Cintel apparatus has been continued throughout the year. Some of the data obtained were found to be unreliable and showed that a certain amount of modification of the apparatus was necessary. Some of this has been done.

The records are kept in a card index system, which is very suitable for statistical work. The barometric and mean atmospheric temperature corrections applicable to this particular set have been derived.

The investigations of the atmospheric cosmic ray Čerenkov effect have been discontinued here as the slit in the solar dome was found to be too narrow for a satisfactory arrangement.

Some consideration has been given to the project of high energy shower recording at Herstmonceux.

Photoheliograph.

The Sun was photographed on 302 days, a second photograph being taken on all but 18 days. The improved conditions for solar work at Herstmonceux are reflected in this number as well as in the quality of the definition, which continues to be maintained.

Thirty-two plates with double images were taken for determining the zero of position angle, which was also regularly checked by a visual method. From reports received from H.M. Astronomer at the Cape and the Director of the Kodaikanal Observatory, India, all days are represented in the combined series for 1953.

Consignments of solar negatives have been received from the Cape in duplicate from 1953 January 1 to December 31.

Measurement of the combined series has been completed from 1952 October 1 to 1953 December 31. Computations of sunspot positions and areas have been made from 1952 January 30 to 1953 December 31.

The MS. copy of the "Greenwich Photoheliographic Results" for 1949 and 1950 has been completed during the year. The copy for 1951 and 1952 is well advanced. Varityper copy for the years 1942, 1943, 1944 and 1946 has been sent for reproduction.

Daily sunspot numbers based on the Zürich system of counting have been sent to the Director of the Federal Observatory, Zürich, for inclusion in the Quarterly Bulletin on Solar Activity. Monthly mean values have been sent to several radio centres in this country. The mean daily sunspot number for the twelve months covered by this report is 10, as compared with 27 for the preceding twelve months.

The Sun is now nearing the minimum of the sunspot cycle. On about 190 days no sunspots were recorded, January being a completely spotless month. Two small high-latitude spots of the new cycle were recorded on the Herstmonceux photographs, on February 10 and March 1 - 4 respectively. A possible earlier spot associated with a small but definite patch of faculae was recorded on July 21 in latitude 27° south. A tiny, short-lived spot in abnormally high latitude (52°N), reported by the McMath-Hulbert Observatory on August 13, was not shown on the Herstmonceux photographs.

In spite of the lessening solar activity, there were two spots which attained a maximum area of about 500 millionths of the Sun's hemisphere. Their respective times of central meridian passage were August 17.2 (latitude 11°N) and March 17.1 (latitude 9°S).

During the year, small short-lived flecks of faculae have continued to appear in the Sun's polar regions.

Summaries of the mean daily areas and mean heliographic latitudes for the years 1949 and 1950 are being published in the Monthly Notices of the R.A.S. A paper dealing with the frequency distribution of great and small geomagnetic storms and the sunspot cycle has been completed and will appear shortly in the Journal of Geophysical Research.

The preparation has been commenced of an appendix to the Greenwich Photo-Heliographic Results which will contain:- (1) A catalogue of sunspots whose areas exceeded 500 millionths of the Sun's hemisphere, 1874-1954. (2) Monthly mean daily areas of sunspots and faculae, 1874-1954. (3) A catalogue of (a) great geomagnetic storms, 1874-1954; (b) small storms for the same period, and (c) great storms 1840-1874.

Spectrohelioscopes.

Observations of the Sun's disk in $H\alpha$ were made on 128 days, but on 50 days observations were restricted to a few minutes. Only four solar flares were observed, and these were of minor importance.

The S.E.A. recorder working on 27 kc/s has been in operation throughout the year. Four flares and a possible fifth were indicated. One of these on August 11 was synchronous with one of the above four flares observed at Herstmonceux. The continued decrease in the number of flares is a further indication of the impending sunspot minimum.

Although sunspots and solar flares were infrequent, the past year was quite active in solar particle radiation. The chief feature was a distinctive 27-day M-region sequence of geomagnetic disturbance extending for up to a week during each solar rotation, from May to November.

Reports of solar flares, their times of occurrence, positions and highest intensity observed with a wedge photometer were sent quarterly to Meudon for subsequent inclusion in the Zürich Quarterly Bulletin. Copies of these lists are sent to the usual radio research centres and to the Director, Meteorological Office, Air Ministry, London.

The Greenwich Photo-Heliographic Results for 1944 (now awaiting publication) contains a list of 476 flares observed at Greenwich from 1930 to 1944.

Besides following the progress of solar flares, 37 measures of line-of-sight motions of dark hydrogen flocculi on the disk were obtained. Similar measures were also made on patches of normal bright flocculi around sunspots, but these rarely show significant line-of-sight motions. Nine photometer measures were made on patches of normal bright flocculi, in addition to 4 sets on solar flares. Seventeen prominences were examined at the Sun's limb.

The helpful co-operation has been continued by the Joint Radio Propagation Bureau (Admiralty) in the telephonic distribution of current solar data issued from Herstmonceux for use at a number of radio research centres.

Time Service.

At Abinger the Bamberg broken transit instrument was in use throughout the year, 204 observations being obtained on 121 nights. At Greenwich, Transit B was withdrawn from service on September 16, on the completion of the parallel tests

mentioned in the previous report. Transit C was in use in the Courtyard dome until July 18; it was then transferred to the Altazimuth dome, but was returned to the Courtyard dome on January 1. Transit B was transferred from the Altazimuth dome to the Courtyard dome on July 18. Transit B was adopted as the standard Greenwich instrument until June 30, and Transit C from July 1. The number of observations at Greenwich used for controlling the clocks was 196, obtained on 152 nights. In addition, for the parallel comparison between Transits B and C there were 69 observations on 69 nights, between 1953 March 25 and September 15.

The pivots of Transit B have been chromium plated, and the instrument is being re-conditioned in the workshop at Greenwich. The figure of the pivots of the Bamberg instrument, which had been in continuous operation for some six and a half years, was examined. Wear had occurred at the parts of the pivot which are in contact with the supporting Y's and the pads of the hanging level, but the departure from circularity nowhere exceeded 1 micron and has no significant effect on the determined time.

The application of observer corrections to the time observations was discontinued on July 1, with the exception of a significant personal correction retained for one observer (AC). It was found that the personal equations of the observers, with this one exception, are much smaller than the fluctuating difference between the two stations, Abinger and Greenwich.

The series of morning observations undertaken at Abinger was discontinued on May 1; no significant differences of a systematic nature were detected between the morning and evening observations. A similar series was commenced at Greenwich on January 31, after Transit C had been finally mounted in the Courtyard dome.

The determinations of time have been corrected for the effects of polar motion, based on current latitude observations communicated regularly by the U.S. Naval Observatory. After this correction, they have been compared with several selected quartz clocks and analysed to derive the apparent annual fluctuation in the rotation of the Earth. The fluctuation is in close agreement with those observed in the past two or three years.

During the summer of 1953, the time determinations indicated an increasing systematic departure of the standard clocks from the performance predicted on the basis of the observations of the previous 6 to 12 months. Clock inter-comparisons gave no reason to suspect that the clocks had suffered any change, and the divergence was attributed to a change in the rate of rotation of the Earth. The magnitude and form of the change could not be precisely evaluated because of the considerable scatter in the time determinations and because of some uncertainty about the rate of frequency drift of some of the clocks. The change was represented at first as a simple decrease of 1.3 milliseconds in the length of the day, occurring in 1953 March, but subsequent evidence suggests that it was more complex, and may have occurred as early as 1952 December.

Clocks.

The Time Service has been based on clocks employing silk-supported ring crystals, together with an experimental clock employing a GT-cut plate crystal, which has been included because of its excellent performance. Two new ring crystals have been obtained from the Post Office Radio Branch, and installed as B5 and B6. The performance of B6 has been good, but B5 showed variations which correlated with changes of atmospheric pressure, and it has been returned for examination. The oven

temperature of oscillator C6 was readjusted in August; oscillator C5 was taken out of service in March for overhaul and modification. Oscillators E5 and E6 have run throughout the year. Additional buffer amplifiers are being fitted in the 100 kc/s outputs of the ring crystal oscillators to minimize the possibility of variations in the output load causing changes in frequency. Oscillators B4, C4 and E4, of the GT-cut plate type, have been employed as working standards.

Three oscillators of the pattern developed by the Electronics Laboratory have been installed in D cellar. Oscillator D6 has been provided with a four-point supported GT-cut plate crystal: D4 and D5 are awaiting suitable crystals.

At Greenwich, two oscillators, similar in design to B4, C4 and E4, have been installed in a newly prepared clock room. They have been designated H1 and H3, and incorporate the GT-cut plate crystals previously used in oscillators A1 and A3. Their power supplies are obtained direct from the A.C. mains, but an alternative supply is provided by battery-driven rotary converters, which automatically start up when a mains failure occurs.

The Observatory has continued to receive information on the Post Office quartz clocks at Dollis Hill and Banbury, those of the National Physical Laboratory at Teddington, of the B.B.C. Receiving Station at Tatsfield, and of the Research Division, Marconi's Wireless Telegraph Company Ltd.

Experimental Clocks.

The second experimental oscillator G2 which, as reported last year, attained a high standard of short-term stability, has now been in operation for over 18 months. During the year 1953 its rate approximated closely to an exponential curve: when this is allowed for, the performance of the clock becomes comparable with that of the ring-crystal oscillators. The experimental oscillator G3 has continued in operation, but its performance is erratic. The rebuilding of oscillator G1 was completed, and oscillator G4, which contains a slightly sub-standard ring crystal, has commenced its first test run. These clocks have not as yet attained the high standard of performance of G2.

Some of the experimental clocks have been equipped with special long-life valves. For the best results, it is essential that the low-tension supply should be held within closer limits of voltage than are needed for conventional valves. The L.T. supply to the experimental group has accordingly been fitted with a voltage-stabilized rectifier. Similar long-life valves are being fitted in some of the operational clocks, and constant voltage devices are being obtained for installation in the operational power supplies.

Work has proceeded on the development of a high-precision frequency comparator. The first experimental model gave an accuracy of a few parts in 10^{10}, and construction is in progress on a new design which is expected to give still higher accuracy.

Control Room Equipment.

The rotary beat counters in the Control Room at Abinger have been augmented by the installation of two additional groups, enabling the experimental oscillators to be investigated in the same way as the operational clocks. The beat counter dials are photographed automatically at the same time each day.

The 100 kc/s to 1 kc/s regenerative dividers referred to in last year's Report have performed satisfactorily. The circuit has been modified to permit adjustment in steps of 0.01 and 0.001 seconds as well as in steps of 0.1 seconds. A prototype pulse divider employing Dekatron counting tubes has been designed and constructed and is undergoing tests. This type of divider has the advantage of consuming only one-third of the power required by the thermionic dividers. Two 1 kc/s phaseable transformers are under test: they have been designed to permit phase adjustment of the 1 kc/s input to the pulse dividers, thereby enabling the output pulses to be set to an accuracy of 0.0001 seconds. A contract has been placed for two 1 kc/s phaseable transformers, to be driven continuously by suitable gearing from a phonic motor and to provide an output of 1,000 cycles per sidereal second.

Cold-cathode trigger tubes possess advantages for many time service applications, and various experiments have been carried out. An automatic sender for the morse preamble which precedes the radio time signal has been constructed using these tubes, and a time signal switching clock is being built.

The precision of the signal pulses obtained from the drum contacts of the phonic motors has been affected by the transfer of material from the positive drum to the negative wiper arm, causing craters in the leading edges of the rotating contact segments. The contact drums have been insulated from their spindles so that the polarities can be reversed.

With the co-operation of the Post Office, tests have been made of various types of circuits for the control of the Rugby transmitters by direct land-line from Abinger. The system at present in use consists of a 3-channel V.F. line from London to Rugby, keyed at London by direct current pulses from Abinger. Promising results have been obtained with a private telephone line from Abinger to Rugby, the signal taking the form of keyed pulses of 1 kc/s tone. By this system, which is essentially a single channel wide-band V.F. circuit, the erratics have been reduced by one half.

At Greenwich a signal forming unit similar to that at Abinger has been installed. The phonic motor circuits are being modified to work with this unit, and the various selector contacts are being aligned. The installation of electronic send relays has been completed. Serious variations in mains supply voltage have given cause for concern, and discussions are in progress with Electrical Engineering Manager, Chatham, regarding the provision of a constant voltage device to ensure adequate stability in the supplies to essential equipment.

Time Signals.

The international time signals, the six-pips time signals, and the hourly signals used by the Post Office for the control of the Speaking Clock, have been controlled by the phonic motor transmitters at Abinger. The reserve service of hourly and six-pips signals available from Greenwich has twice been called upon during the period under review. At the request of the Radio Research Station, Slough, several special time signals were transmitted: these consisted of 20-millisecond pulses at intervals of one-tenth of a second, the pulses being lengthened to 40 milliseconds at the exact seconds, and to 60 milliseconds at the exact minutes.

The transmissions of the international time signals from Rugby on both long and short waves have been monitored at the Observatory, but propagation conditions sometimes cause the reception of the short-wave time signals to be uncertain.

Routine measurements are made of the carrier frequencies of MSF (60 kc/s) and Droitwich (200 kc/s), together with the reception times of the seconds pulses superimposed on the MSF transmissions on 60 kc/s and $2\frac{1}{2}$ Mc/s. Radio time signals have been received throughout the year from Argentina, Australia, Canada, France, Germany, Russia, and the United States.

The Time Service Circular and the Monthly Frequency Estimates have been distributed at the middle of each month. The Time Service Bulletin, with its various supplements, has been published in quarterly instalments. Proof-reading of copy for the Time Service Section of the volume of Greenwich Observations for the years 1941, 1942, and 1943 has been completed or is in progress.

Miscellaneous.

Experimental work on the automatic recording of star transits with photoelectric equipment has been continued. A number of transits have been observed; it appears that the system now being investigated may form the basis of a practicable instrument.

The optical and mechanical design of the photoelectric measuring machine for the P.Z.T. stellar plates has been in abeyance owing to the prolonged illness of the officer concerned. The electronic equipment has been constructed and preliminary tests have been made with a temporary bench arrangement in the laboratory. The results give some promise that the desired accuracy may prove capable of achievement.

Experiments have been carried out with an electron-beam counter tube which may have applications in frequency dividers and decimal counters working at high frequencies.

A prototype unit for the cathode ray tube display of chronometer and watch ticks has been constructed, and a quartz crystal controlled drive circuit is under construction for the Bèlin drum chronograph.

Measurements have been made to determine the level of the radio interference emanating from overhead power lines at Herstmonceux. As a result, the S.E. Electricity Board has been asked to re-route one of its proposed new lines so that it will be at a safe distance from the site selected for the time signal reception aerials.

Shortt 49 free pendulum and slave have been dismantled and transferred to the Chronometer Department at Herstmonceux.

IV. MAGNETIC OBSERVATIONS.

Regular observations of declination, horizontal intensity and vertical intensity have been made throughout the year for the determination of the base-lines of the magnetograms. During this period the variometers have maintained an unbroken record.

The potentiometers used with the coil instruments for the measurement of horizontal and vertical intensities have undergone the normal annual check at the National Physical Laboratory. The dimensions of the Schuster-Smith coil were re-measured on April 13 by Mr. L. O. C. Johnson of the National Physical Laboratory to check whether any secular changes had occurred. A series of measurements across the check studs inserted into the marble were made with the coil in situ. These

measurements have shown that no significant changes in the dimensions of the coil have occurred since the previous check in November 1931. The re-measurements of the dimensions of the Dye coil are to be made, but as this coil is not provided with check studs, it will be necessary for the re-measurement to be made at the Laboratory. The opportunity will be taken, while the coil is there, of having check studs inserted, so that future checking of the dimensions can be made on the coil in situ.

The Earth inductor, which had been giving unsatisfactory results, is being modified in the workshop to simplify dismantling when examination of the bearings or the fitting of new bearings becomes necessary.

Two Broca galvanometers have been sent for renovation to the Cambridge Instrument Company. Three standard resistances, which are at present undergoing certification at the National Physical Laboratory, have been purchased from the Cambridge Instrument Company. A high precision potentiometer has been ordered from Messrs. H. Tinsley and Company.

Various improvements are being made in the observing arrangements. A hut has been constructed alongside the battery hut to house the oscillators, referred to in the previous Report, for use with the vertical intensity coil. All electrical current (except from the mains) required for instrument use will be fed from this hut; two earthenware ducts have been laid about two feet underground connecting it with the Magnetic Pavilion. Points have been fitted at appropriate positions on the floor of the pavilion from which galvanometer and illuminating lamps can be fed. A rack containing control panels for regulating current supplied to the magnetometer coils is under construction.

A floor-level pier has been constructed in the pavilion to facilitate the mounting of the B.M.Z., the Q.H.M., and other portable instruments. A second pier of non-magnetic lime bricks has been built in the pavilion to take the earth inductor galvanometer. In its old position, mounted from the wall, the heating of the wall by the Sun and vibration in strong winds were troublesome. A similar lime-brick pier has been built in the large Test Hut for mounting the galvanometer.

In the Recording Room, the wiring to the trace and time-signal lamps has been renewed, and three boxed units designed and constructed in the department have been installed. These units are so arranged that by means of switches and resistances any desired condition of illumination for normal or adjustment purposes can be rapidly obtained.

The results of the spherical harmonic analysis of the Earth's magnetic field, mentioned in the previous Report, have been used, together with some further data subsequently received, to revise the first draft of the world magnetic charts of declination and horizontal intensity for epoch 1955.0. A second analysis has been made and the preparation of the charts in their final form has been completed. These charts cover the seven elements declination, inclination, horizontal, vertical and total intensities; north and east components, together with their secular variations.

The following table contains the mean annual values of the magnetic elements determined at Abinger during the period 1950-53 with estimated values for 1954.

Year	Declination (West)	Horizontal Intensity	Vertical Intensity	Inclination
1950	9° 19'.7	0.18628	0.43288	66° 43'.0
1951	9 12.2	0.18648	0.43305	66 42.1
1952	9 4.7	0.18671	0.43316	66 40.9
1953	8 57.5	0.18697	0.43321	66 39.3
1954	8 50.0	0.18725	0.43331	66 37.7

Classifying as "storms" and "great storms" disturbances having a lower limit of range of 150γ and 300γ respectively in H or 30′ and 60′ in D, 9 "storms" have occurred during the twelve months covered by this report, but no "great storm".

V. METEOROLOGICAL OBSERVATIONS.

Full scale meteorological observations were commenced at Herstmonceux on November 1, after a series of preliminary routine observations had been made. Observations are made daily at 0900 and 2100 U.T. and, as a further check upon the recording instruments, at 1500 on working days. Some trouble was experienced at first owing to poor drainage of the site, but this has been largely overcome by the construction of trenches containing drainage pipes and gravel.

The instruments in regular use on the site comprise a Dines Pressure-tube Anemograph; the distant recording dry and wet bulb thermograph by Negretti and Zambra, formerly in use at Greenwich; two 5-inch rain gauges and an M.O.-type recording rain gauge; the Newman 64 standard barometer; and the usual thermometers employed in routine meteorological observations which, with the exception of the solar radiation thermometer, the two grass minimum thermometers and the deep-sunk thermometers, are mounted, in a new standard double Stevenson screen, together with the elements of the distant recording thermometer.

Before bringing the standard barometer, Newman 64, into use at Herstmonceux it was sent to the National Physical Laboratory, where it underwent an empirical check. On its return simultaneous observations were made over several weeks with this instrument and with Casella 3290, which was mounted alongside for convenient comparison. The latter barometer had previously been overhauled by the makers and received a normal calibration at the National Physical Laboratory.

No significant change in the constants of Newman 64 was found to have occurred, since the earlier calibrations in 1866 and 1877.

The recording barometer, transferred from Greenwich to a compartment in the cellar of the Castle, has shown some instability in the deduced values of the recorded base-line. The trouble was eventually traced to defective centring of the float within the glass tube, and has been corrected.

A series of comparisons has been effected between night-sky records obtained with the Herstmonceux plate camera and with the M.O.-type camera referred to in the previous report. From simultaneous records taken on 251 nights during the period 1953 April - 1954 February the following comparisons have been obtained:-

	Polaris	δ Urs. Min.
	h m	h m
M.O.	1014 16	838 56
Herstmonceux	991 28	868 17
Difference	+ 22 48	- 29 21
Excess of M.O.	+2.3%	-3.4%

There are considerable differences between the two cameras; in particular, the M.O. camera has a much lower focal ratio and uses film with a more rapid emulsion. The general agreement between the results is satisfactory, though considerable discrepancies occur in the results for individual nights.

Experience with the use of the M.O. camera does not warrant its substitution for the existing camera at Herstmonceux.

The duration of bright sunshine recorded at Herstmonceux over the twelve months covered by this report was 1826.8 hours. This figure represents 0.408 of the total possible duration. The sunshine total for January was higher than that of any other station in the British Isles reporting to the Meteorological Office. There were 59 entirely sunless days during the 12 months and 6 days on which the record exceeded 90 per cent of the possible duration. The Herstmonceux night-sky camera gave unbroken trails of δ Ursae Minoris on 43 nights. On 87 nights no trace of this star was recorded, while on a further 34 nights not more than 10 per cent of the amount possible was recorded.

During the whole six months during which observations were taken the temperature of the air never reached 60°.0F. The maximum temperature reached was 58°.9F on April 12; the next highest maximum was 58°.7F on December 6. The lowest minimum temperature was 18°.0F on January 28, on which day a minimum temperature on the grass of 15°.6F was recorded. There were 28 days on which the temperature fell below 32°F. The mean temperature of the air for the six months was 42°.9F.

During the period November 1 - April 30 the number of "rainy" days (.005 inches or more) was 67. The total rainfall was 10.79 inches. The total rainfall during the 24 consecutive days April 7-30 was only 0.02 inches, while during the period of 43 days from November 9 to December 21 it was 0.42 inches. The latter period included a spell of 18 days, November 26 to December 13, during which no rain fell.

The highest gust of wind recorded by the anemograph was on January 15, this gust corresponding to a wind velocity of 57 knots, or 66 m.p.h. The mean velocity over the whole period was 7.4 knots.

VI. CHRONOMETERS.

The number of Admiralty chronometers and watches on charge to the Royal Greenwich Observatory, exclusive of those in the hands of outworkers for repair, is 14875. Of this total 96 chronometers (Pattern HS1), 399 chronometer watches (HS2), 1217 deck watches (HS3), 5 dashboard watches (HS4), 39 pocket watches (HS5), 1460 wrist chronographs (HS9) and 389 wrist watches (HS10 and HS11) are rating or ready for issue. There are 26 Pattern HS1, 21 HS2, 165 HS3, 1 HS5, and 562 HS9 undergoing repair in the Chronometer Workshop. Chronometers and watches in use throughout the

Observatory number sixteen. The remainder, consisting of 647 HS1, 2546 HS2, 4946 HS3, 772 HS4, 355 HS5, 414 HS6, 101 HS7, 105 HS8, 286 HS9 and 307 HS10/11, are held in store awaiting overhaul and rating. In addition to the foregoing, 177 chronometers and watches are deposited in the Chronometer Department for various reasons.

During the year a total of 7403 Admiralty chronometers and watches was received and 8213 issued. These figures include the following non-routine items:

(a) 113 obsolete chronometer watches sold.

(b) 1 chronometer sold to University of St. Andrews, Fife.

(c) 1 chronometer watch transferred to New Zealand Government.

(d) 3 deck watches sold to British Overseas Airways Corporation.

The total number of chronometers and watches repaired and adjusted was 4243, including two for the Canadian Government, five for the Ministry of Supply, and four for the Ministry of Civil Aviation. Of the total number repaired 63 chronometers, 61 chronometer watches, 515 deck watches, 13 dashboard watches and 2054 wrist chronographs were dealt with in the Chronometer Workshop.

The 8-day chronometer Dent 30254 belonging to Her Majesty the Queen was thoroughly overhauled in the Chronometer Workshop and subsequently issued to the Royal Yacht "Britannia".

Six chronometers and two watches, selected to form a representative collection of British horological production over the past 150 years, were loaned to the Birmingham City Museum for exhibition over the period October 1953 to March 1954.

All computing and notation of record cards has been completed to a current date. At the Annual Audit in April all chronometers and watches on charge to the Royal Greenwich Observatory were accounted for.

The sidereal Free Pendulum Shortt No. 40 used as the standard in the department has been running throughout the year and has been checked daily against the Rugby Rhythmic Signals. A subsidiary clock keeping solar time is corrected as necessary, after comparison with the sidereal standard, and signals are distributed to the chronometer rating rooms and also to the Solar, Magnetic and Cosmic Ray departments for the calibration of recording apparatus.

In addition to the normal repair work, of which it now undertakes the major part, the services of the Chronometer Workshop have been made available to other Admiralty and Observatory departments for repair and construction of equipment of a mechanical nature. A seconds impulse dial, fitted with multi-contact switches, was constructed for use with the Cosmic Recorder Unit; the movement of the Riefler clock at the Royal Observatory, Edinburgh, and the movement of Free Pendulum Clock No. 16 on loan to Cambridge University were overhauled during the year.

Extensive trials of the watch movement modified for use as a portable current integrating meter measuring very minute currents indicated that isochronous changes were appreciably greater than the rate variations it was hoped to achieve magnetically and tabulate. Work on this project has therefore been discontinued. Work on the specialized clockwork mechanism, undertaken for D.R.E. Admiralty, has been continued and it is expected that practical trials will be made shortly.

The approved complement of watchmakers was attained during the year by the engagement of two journeyman watchmakers to fill the remaining vacancies.

The number of watches dealt with by the Chronometer Department on behalf of the Air Ministry again shows a considerable increase, due mainly to arrivals of new watches from Switzerland and to the extension of the number of types of watches being handled by the department.

During the year 22491 Air Ministry watches were received and 13814 issued. The number sent for repair was 3603 made up of 32 Patt. 6B/60, 2005 Patt. 6B/159 and 1566 Patt. 6B/346.

Watches of various types belonging to the Air Ministry at present on charge to the Royal Greenwich Observatory total 14258 and comprise 102 6B/60, 895 6B/234, 3662 6B/346, 2563 6B/542 and 58 6B/551 rating or ready for issue, with 98 6B/60, 3945 6B/159, 1616 6B/234, 1043 6B/346, 201 6B/542 and 75 6B/551 awaiting repair.

Representatives of the Air Ministry Audit Department checked the departmental records and stocks in July 1953 and April 1954. Subsequent reports expressed satisfaction with the standard of the accounting.

VII. H.M. NAUTICAL ALMANAC OFFICE.

The routine calculation and proof-reading involved in the preparation and printing of the publications for which the Office is responsible have been continued throughout the year.

The work of the Office is still in a state of transition, in regard both to the continued change-over to punched-card methods and to the changes in the ephemerides to be introduced as from 1960. Much of this transition has now been completed, and it is hoped that the Office will gain the benefit of it in future years. There is still a vacancy for a Scientific Officer.

The Nautical Almanac.

The Almanac for 1955 was published in April. The first part of the Nautical Almanac for 1957, containing the fundamental ephemerides of the Sun, Moon and planets, has been distributed to at least one observatory in each interested country.

In the Almanac for 1955 a list of observatories, restricted generally to those whose work demands a knowledge of accurate values of the geographical co-ordinates, is given for the first time since 1941. Information about Standard Times is being omitted from the Almanac, as it is not required for any purely astronomical purpose. No other change has been made in the contents or presentation of the Almanac.

The first part of the Almanac for 1960 has been completely redesigned to meet the recommendations of the International Astronomical Union made at the Eighth General Assembly in Rome in 1952. Many changes have been made after detailed investigations and after consultations with other ephemeris offices. The introduction of Ephemeris Time has enabled the fundamental ephemerides of the Sun, Moon and planets to be given throughout on a gravitationally consistent basis. Preparation of copy for 1960 will shortly be started.

General Astronomical Work.

Considerable progress has been made in the calculation, from the appropriate tables, of the ephemerides of the Sun and planets for the years 1960-1980. The equatorial rectangular co-ordinates for the Sun have been completed; the heliocentric equatorial co-ordinates of Venus and Mars are being formed; and the true geocentric equatorial co-ordinates of the five outer planets have been completed.

In connexion with the third volume of Planetary Co-ordinates, the work on the illustrative examples, referred to in last year's Report, has been continued. Encke's method has been completed, Hansen's method is nearly finished, and some progress has been made with the method of Variation of Elements and with Herrick's method of Variation of Parameters.

The Office share of the work on the Joint Supplement to the Nautical Almanac and the American Ephemeris, which gives an improved ephemeris of the Moon for 1952 - 1959 calculated directly from Brown's theory, has been completed. This has consisted of the conversion from longitude and latitude to right ascension ($0^s.001$) and declination ($0''.01$), and subtabulation to every hour during the eight years; in addition, copy has been prepared on the card-controlled typewriter for the 279 pages of tabular matter, for which positive transparencies are being sent to U.S. Naval Observatory. Although this is but a small portion of the total computation involved in this project, it has taken an appreciable fraction of the machine time available and has necessarily involved postponing other work. The Supplement, which will also contain a full account of the method of calculation of the Moon's position, will be printed in U.S.A. and will be given a wide distribution.

The calculation of the nutation from the new series, referred to in last year's Report, has been completed for the whole of the twentieth century. Values for 1952 - 1959 have been incorporated into the improved ephemeris of the Moon in the Joint Supplement, and have been included in the supplement. For 1900 - 1960 inclusive, values of the nutation in longitude and in obliquity (including short-period terms) will be published in a Supplement to "Greenwich Observations" for some convenient year. From 1960 onwards, they will be published year by year in the Nautical Almanac.

Calculations have been made of the day numbers, on the new basis, for 1954 and later years for use in the calculation of the apparent places of P.Z.T. stars; values have been obtained on the punched-card machines for every half-hour of sidereal time, and these have been made available to those interested. By special arrangement, the apparent places of the stars required for the P.Z.T. programme at Neuchâtel have been calculated on a repayment basis.

Predictions for 1954 of occultations of stars by planets have been published in the B.A.A. Handbook. An article was also published in "Sky and Telescope" calling attention to a possible occultation of a star by Pallas. Unfortunately the minor planet was a long way (about 5") from its ephemeris position and no occultation was observable; many negative observations, giving micrometric measures of closest approach, have been received.

Occultations.

Of the 2391 conjunctions during 1956 of stars with the Moon examined by means of the occultation machine, 1161 were discarded as the resulting occultations were not observable under suitable conditions. Preliminary times and position angles

were recorded for 69 stations for the remaining 1230 conjunctions. After computation, using the punched-card machines, a further 145 conjunctions were rejected, and the apparent places of stars for the remaining 1085 conjunctions will be published in the Nautical Almanac for 1956. Copy has been prepared for 68 stations (the additional station having been used for checking purposes only), involving a total of 5443 predictions.

Of 2320 conjunctions during 1957 examined by means of the occultation machine, 1044 were discarded, and preliminary times and position angles were recorded for 71 stations (three of these for checking purposes) for the remaining 1276 conjunctions.

1560 observations of occultations for 1951 and 1390 observations for 1952 were reduced by the punched-card machines. 74 observations, which were received when the computation was almost finished, have been reduced by hand and are being included in the analysis. The discussion of the occultations observed in 1949 and 1950 has been published in the Astronomical Journal.

The punched-card methods of calculation for both predictions and reductions have been improved and are now satisfactory; but the inevitable errors in the observations (in times or positions of the observers) continue to be a source of difficulty.

The numbers of observations of occultations in 1951, 1952, 1953 and 1954 received during the year were 36, 348, 936 and 82 respectively. Since the last Report, it has proved possible to observe only 3 occultations at Herstmonceux.

The Star Almanac.

The Star Almanac for 1954 was published in October. A minor change in content has been made by including short paragraphs giving an indication of the visibility of the five brighter planets. The edition for 1955 should be published in June.

Although it took some little time to become known, the Star Almanac is now an established success; reprints have been necessary in both 1953 and 1954 in spite of printing increased numbers.

Apparent Places of Fundamental Stars.

The volume for 1954 was published in August. The machine sheets of the volume for 1955 have been received and read; publication should therefore take place in the scheduled month of May. No changes have been made in the content or in the allocation of the computations.

Copies of the mean places of the stars for 1957 have been distributed to the several offices responsible for the computation of apparent places.

The apparent place pages of the volumes for 1956 and subsequent years will be printed by photolithographic methods from copy prepared on the card-controlled typewriter; after 1957 the mean place pages will be prepared in the same way. It has been possible to design a lay-out on the typewriter that will involve only very minor changes of presentation.

The whole of the apparent places for 1956 have been punched on cards, and checked, in a form suitable for the typewriter; final details of design of the printed form on which they will be typed are now being decided. Acknowledgment is

gratefully made to Statistical Branch, Admiralty, for hand-punching the actual positions; it would have been a major undertaking for the Office, which has no trained, or full-time, punch operators. The differences were calculated and punched, and the whole subjected to absolute checks on the machines.

The Abridged Nautical Almanac.

The Abridged Nautical Almanac for 1955 was published in March. Only trivial alterations have been made to the content and presentation.

As mentioned in last year's Report, an experimental quarter-bound edition of the 1954 Almanac was put on sale, at a higher price. The evidence available indicated that there would be a continued demand for the bound edition, so that the present arrangement of two editions is being continued.

The Air Almanac.

During the year the three parts of the Air Almanac for 1954 have been published. No change has been made in the content or presentation.

General navigation work.

The work on the "Sight Reduction Tables for Air Navigation", A.P. 3270, has been completed by the publication of Volumes 2 and 3, and on H.D. (Hydrographic Department Publication) 486 by the issue of Volumes III and VI. The restriction on the sale of the last-named publication has now been lifted, and copies may be purchased through the Hydrographic Supplies Establishment of the Admiralty.

Various methods for the reduction and plotting of astronomical observations at sea and in the air have been investigated during the year.

Many observations appertaining to the accuracy of astronomical observations at sea have been received by the Office, both directly and on behalf of the Working Party of the Institute of Navigation. Some of these have been reduced and analysed. So far about 2000 individual observations have been received in response to the Institute's appeal; these are being transferred to cards for analysis.

Although no large-scale computing has been done for the hyperbolic lattices of the Decca Navigator system, many minor requests have been filled; there is still much interest in methods of calculation and the Office has been called upon for advice in several connexions.

The Office continues to supply the Royal Navy and Royal Air Force with special astronomical and related data, and has been frequently consulted during the year on various problems.

Proof-reading.

During the year 2527 pages of first proofs and 2154 pages of stereo proofs or machine sheets, depending on whether the publication is printed from stereo plates or movable type, have been read for the normal publications of the Office. The proofs of the photolithographic reproduction of the Air Almanac are treated as first proofs and read in duplicate.

No other proof-reading has been done during the year except for the introductions and auxiliary tables of the navigational publications H.D. 486 and A.P. 3270.

Although this is the least number of readings for many years, it is a heavy burden on the reduced staff. Some relief will be forthcoming when the apparent places of stars are reproduced from typed copy; but this involves the equivalent of a proof-reading in the examination of the copy before photography. On balance it is hoped that the typewriter will eventually lead to a reduction of this burden.

Machines.

Apart from the inevitable periods when the machines are being serviced or are waiting for mechanical attention, the punched-card installation has been in almost full-time use throughout the year. The Tabulator and 602A Calculating Punch have been in operational use for nearly 80 per cent of the available time (excluding the period of "overtime" for the 602A during the last three months of 1953); they have been idle for less than 5 per cent of the time. The major pieces of work completed during the year are referred to in various sections above; by far the largest job has been the calculation of the Moon's R.A. and Dec. for 70,000 dates. On the whole the machines have functioned well; their increasing efficiency is largely due to the increasing experience of the staff of the Machine Section. It is perhaps relevant to remark that the "operational use" of these machines, in circumstances which are not favourable to high output, is exceptionally high by the standards of commercial and other installations.

Members of the Section gave a talk on the operation of the machines at the Cambridge Mathematical Laboratory on March 25.

The card-controlled typewriter has been largely used experimentally during the year. The Joint Supplement provided the opportunity for a full trial of the auxiliary procedures and material required; the exacting requirements of the Office publications cannot be met without the exercise of the greatest care in the choice of materials, in the skill of the operators and the "pasters" (who have to paste dates, page numbers etc., on the pages), and at all stages of the photographic reproduction. Many difficulties have been met but, thanks to the co-operation of H.M. Stationery Office, most of these have now been overcome. The typewriter proved its reliability in typing all the 279 pages of the Supplement in less than a month.

The typewriter will be brought into regular use for the Office publications in June or July for the Apparent Places of Fundamental Stars; and it will later be extended to other publications. It offers the possibility of some overall saving in proof-reading as well as a substantial saving in the cost of composition.

Miscellaneous.

A new, and much enlarged, edition of "Interpolation and Allied Tables", originally included in the explanation to the Nautical Almanac for 1937, is being prepared in co-operation with the Mathematics Division of the National Physical Laboratory. The tables will appear as one, or more, of the volumes of the new N.P.S. series of Mathematical Tables.

VIII. PUBLICATIONS.

Preparation of varityped copy for "Greenwich Observations" has continued at an accelerated rate with the recruitment of the third varityper operator mentioned in last year's Report. Printing and binding have not been carried out at such a satisfactory rate and consequently the number of publications outstanding with H.M. Stationery Office has more than doubled since last year. It is expected, however, that several of these will be published shortly.

The following were published during the year:-

"Greenwich Astronomical Results" 1939.

"Greenwich Photo-Heliographic Results" 1941.

"Greenwich Magnetic and Meteorological Observations" 1940 and 1945.

The above mentioned publications, together with the "First Cape Catalogue of Stars for the Equinox of 1950.0", were distributed during the year.

Varityped copy for the following publications has been sent to H.M. Stationery Office for printing, and the completed books are awaited. That marked with an asterisk was typed over a year ago.

"Greenwich Observations" 1939*, 1940, 1941 and 1945.

"Greenwich Astronomical Results" 1940, 1941 and 1945.

"Greenwich Photo-Heliographic Results" 1942, 1943, 1944 and 1946.

"Greenwich Magnetic and Meteorological Observations" 1941.

Preparation of copy for the following publications is in hand:-

"Greenwich Observations" 1942.

"Greenwich Astronomical Results" 1942.

"Greenwich Photo-Heliographic Results" 1947.

"Greenwich Magnetic and Meteorological Observations" 1942, 1943, 1944 and 1946.

The following other publications have appeared during the year:

Royal Greenwich Observatory. Mean Areas and Heliographic Latitudes of Sunspots in the year 1948. M.N. **113**. 262.

Nautical Almanac Office. Planetary Occultations and Appulses. Handbook of the B.A.A. 1954.

H. Spencer Jones. Greenwich Meridian Observations. Ast. Journ. **59**. 49.

The Mountains of the Moon. Proc. R.I. 35. pt. III.

Continuous Creation. Penguin Science News. **32**. 19.

H. Spencer Jones and P. J. Melotte. The Harmonic Analysis of the Earth's Magnetic Field for epoch 1942. M.N. Geophys. Suppl. **6**. 409.

R. d'E. Atkinson and J. D. Pope. Cinematography of Partial Solar Eclipses. Pt. II. M.N. **113**. 635.

D. H. Sadler. Margetts's Horary Tables. J. Inst. Nav. **6** No. 4.

An Improved Astrograph. J. Inst. Nav. 6 No. 4.

The Precision of the Air Almanac and the Sight Reduction Tables, A.P. 3270. J. Inst. Nav. **7** No. 1.

Continuous Plotting of Astronomical Position Lines Using A.P. 3270. J. Inst. Nav. **7** No. 2.

D. H. Sadler (with E. W. Anderson). The Genesis of the E.A.N.T.s. J. Inst. Nav. **6** No. 4.

D. H. Sadler (with R. B. Michell, E. W. Anderson, E. Fennessy). Methods of Air and Surface Navigation. (III - Astronomical Navigation). J. Inst. Nav. **7** No. 2.

F. M. McBain. Discussion of Occultations Observed in 1949 and 1950. Ast. Journ. **58.** 7.

J. G. Porter and D. H. Sadler. The Accurate Calculation of Apparent Places of Stars. M.N. **113.** 4.

A. Hunter. Photography in Astronomy. Photographic J. **92A.** 89.

H. W. Newton. Solar Activity (Council Note). M.N. **113.** 382.

H. W. Newton and H. F. Finch. Solar Activity and Geomagnetic Storms. Observatory **74.** 44.

L. S. T. Symms. Observations of the Old Meridian Mark at Chingford. Observatory **73.** 250.

P. A. Wayman. Coronal Observations and Magnetic Storms. Observatory **73.** 202.

E. G. Martin. Light and Instruments. (Chapter in "Astronomy for Everyman", ed. M. Davidson, Dent.)

W. A. Scott (with R. L. Duncombe). Computing the Revised Edition of H.O. 249 (A.P. 3270). J. Inst. Nav. **6** No. 3.

G. A. Harding. The Accuracy of Astronomical Observations at Sea. J. Inst. Nav. **7.** No. 2.

P. S. Laurie. Flamsteed's Magnetic Observations. Observatory **73.** 104.

B. J. Harris. "Standard Co-ordinates". Observatory **72.** 73.

E. A. Whitaker. A Spherical Co-ordinate Converter. Journ. B.A.A. **63.** 145.

G. E. Taylor. Occultations of Stars by Minor Planets 1954. Handbook of B.A.A. 1954,

An Occultation of a Star by Pallas. Sky & Telescope **13.** 5.

IX. PERSONAL ESTABLISHMENT.

The total non-industrial complement of the Royal Greenwich Observatory and the Nautical Almanac Office remains at 113.

The following officers have joined during the year:- D. R. Palmer, Experimental Officer; Miss V. A. J. Papworth, Miss V. Pessell, Miss R. E. Sare, P. Sykes and R. F. Wallis, Temporary Assistants (Scientific); and Mrs. H. L. Halloran, Temporary Clerk.

The following officers have left during the year:- A. Jones, K. A. Miller and Mrs. B. G. Tucker, Assistants (Scientific); J. D. Winter, Temporary Assistant (Scientific); and Mrs. L. E. Nicholls, Clerical Assistant.

A. E. Carter, Experimental Officer, has been promoted to Senior Experimental Officer.

L. J. Bates, Assistant Experimental Officer, and H. G. Gill, Senior Assistant (Scientific), have been promoted to Experimental Officer.

D. C. Smith has been established in the grade of Assistant Experimental Officer and Miss V. E. Terry has been established in the grade of Assistant (Scientific). Miss J. A. Pumfrey has been established as Typist Grade I.

Dr. D. S. Perfect is being invalided on pension from 1 May next.

The staff of the Royal Greenwich Observatory is now constituted as follows.

(a) Royal Greenwich Observatory.

Chief Assistants as Senior Principal Scientific Officers	- R. d'E. Atkinson, M.A., Ph.D., T. Gold, M.A.
Principal Scientific Officers	- H. F. Finch, B.Sc., A. Hunter, Ph.D., B.Sc., A.R.C.S., H. W. Newton, D. S. Perfect, M.A., D.Phil., H. M. Smith, B.Sc., M.I.E.E., F.Inst.P., L. S. T. Symms.
Senior Scientific Officer	- G. B. Wellgate.
Scientific Officer	- P. A. Wayman, M.A., Ph.D.
Temporary Scientific Officer	- P. J. D. Gething, Ph.D., M.Sc.
Senior Experimental Officers	- H. H. J. Barton, E. A. Chamberlain, E. G. Martin, P. L. Rickerby, G. W. Rickett, G. F. Wells.
Experimental Officers	- L. J. Bates, K. C. Blackwell, A. E. Cordwell, H. G. Gill, W. G. Grimwood, C. C. Harris, P. S. Laurie, B. R. Leaton, B.Sc., D. R. Palmer, Miss C. J. A. Penny, B.Sc., J. D. Pope, B.Sc., A.M.I.E.E., J. L. Rudd, A. Shortland, R. H. Tucker.
Head of Royal Greenwich Observatory Workshop	- A. C. S. Wescott, B.E.M.
Head of Chronometer Repair Shop	- D. W. Evans, F.B.H.I.
Assistant Experimental Officers	- A. M. Allen, P. M. Corben, B. J. Harris, B.Sc., A. P. Lamb, C. A. Murray, M.A., A. S. Milsom, D. C. Smith, E. A. Whitaker.
Senior Assistant (Scientific)	- Miss F. E. A. Jeffries.
Assistants (Scientific)	- Miss H. Howe, C. M. Lowne, Miss P. M. Morris, Miss M. Newman, N. P. O'Hora, Miss D. E. Pankhurst, N. S. C. Rhodes, Miss C. M. Ryall, R. W. Teague, Miss V. E. Terry.
Assistants (Scientific) Temporary	- B. T. Archer, Miss W. Barton, D. R. A. Christie, Miss B. A. Crowley, R. G. Lorton, Miss M. A. Jeffrey, Miss V. A. J. Papworth, Miss J. H. Phillips, Miss R. E. Sare, G. E. Satterthwaite, E. Shepherd, Miss S. W. Slater, P. Sykes, R. F. Wallis, P. J. Willmoth.

(b) Nautical Almanac Office.

Superintendent as Senior Principal Scientific Officer	- D. H. Sadler, M.A.

Principal Scientific Officers	- Miss F. McBain, M.A., J. G. Porter, B.Sc., Ph.D.
Scientific Officer	- G. A. Wilkins, Ph.D.
Senior Experimental Officers	- A. E. Carter, H. W. P. Richards, B.Sc., W. A. Scott, B.Sc.
Experimental Officers	- G. A. Harding, Miss M. R. Rodgers, E. Smith.
Assistant Experimental Officers	- M. P. Candy, Miss M. McI. S. Gibson, B.Sc., D. Harragan, Mrs. A. M. Jarrett, B.Sc., Miss P. V. Knight.
Senior Assistant (Scientific)	- G. E. Taylor.
Temporary Senior Assistant (Scientific)	- J. H. Barry.
Assistants (Scientific)	- Miss A. B. Grogan, Miss E. J. M. Grove, Miss A. J. Nevell.
Assistants (Scientific) Temporary	- Miss A. M. Crisford, Miss V. Pessell, Mrs. I. M. Rhodes.
(c) Secretariat.	
Secretary and Cashier as Higher Executive Officer	- H. G. Barker.
Higher Clerical Officers	- H. P. C. Cook, J. H. Whale.
Clerical Officers	- Miss S. M. Billenness, F. A. Everest, Miss J. E. Perry.
Librarian as Temporary Assistant	- W. P. Preston.
Clerical Assistants	- Miss B. E. Carey, Miss J. A. Morris.
Established Shorthand Typists Grade I	- Miss A. R. Hewerdine, Miss C. V. Hewerdine.
Established Varityper Operators as Typists, Grade I	- Miss S. K. Page, Miss R. Weakley.
Established Typist Grade I	- Miss J. A. Pumfrey.
Temporary Shorthand Typists	- Mrs. V. Hyde, Miss E. M. Swanborough.
Temporary Varityper Operator	- Miss V. Kemp.
Temporary Clerk Grade III	- Mrs. H. L. Halloran.
Hostel Wardens	- Mrs. E. M. P. Marples, Miss O. Marshall.

The industrial staff employed at Greenwich, Herstmonceux, and Abinger total 88 including Hostel staff, who, although not borne on the Observatory Vote, are attached to the Establishment for administration and pay.

The various grades are as follow:- fourteen watchmakers, two watchmaker apprentices, six laboratory mechanics, one mechanic, one fitter, two storehouse assistants, one head gardener, one forester, five messengers, two packers, three boiler attendants, three drivers, five skilled labourers, four night-watchmen, one caretaker, six gardeners, six labourers, two switchboard attendants, ten part-time cleaners and thirteen Hostel domestic staff.

X. ISAAC NEWTON OBSERVATORY.

Professor W. E. Curtis was renominated by the Council of the Royal Society as a member of the Board of Management of the Isaac Newton Observatory to serve for a further period to 31 December 1957.

Professor W. H. McCrea was nominated by the Council of the Royal Astronomical Society as a member of the Board of Management, to succeed Professor W. M. Smart, who retired on 31 December 1953.

Expenditure of preliminary expenses amounting to £11,500 has been approved for the current financial year.

The broad features of the design of the mounting of the Isaac Newton 98-inch telescope have been decided. It will be an offset fork mounting with polar axis in the form of an inverted and truncated cone. Further consideration has been given to the details of the optical design and to the spectrograph requirements.

The figuring of the 98-inch disk has reached the stage at which further work is dependent upon the results of optical tests. Preliminary tests have shown that the figure is reasonably satisfactory; these tests were made with the mirror in a vertical position and there was some trouble from flexure of the mirror in the vicinity of the supports and from stratification of air in the testing tunnel. Further figuring has been suspended until further tests are made during the works holiday period in August, when there will be an absence of vibration from heavy machinery. The mirror will then be tested in a horizontal position, using a 25-foot high staging; the mirror will be supported by air cushions so as to be free from strain.

A design has been prepared for a model mechanism to test the proposal by Mr. B. N. Wallis, F.R.S., of the method of artificial stiffening of structures, referred to in last year's Report. A contract for the manufacture of the mechanism has been placed with the Engineering Laboratory of the University of Cambridge.

XI. GENERAL.

Dr. S. Herrick, Professor of Astronomy at the University of California, who had spent a year at Herstmonceux on being awarded a Guggenheim Fellowship, returned to Los Angeles in August. His visit provided an opportunity for a valuable exchange of ideas on methods of orbit calculation and special perturbations. Dr. Herrick's assistant, Mr. C. G. Hilton, spent a year in the Nautical Almanac Office, working mainly on the orbit of Icarus. The Office benefited considerably from the impact of the different methods and techniques of computation.

Dr. F. Gondolatsch, of the Astronomisches Rechen-Institut in Heidelberg, spent a week in the Nautical Almanac Office discussing the many matters of common interest, particularly in regard to the co-operation of the Institut and the Office.

Mr. S. S. Sundaram, Chief Cartographer of the Indian Hydrographic Office, spent a few days in the Nautical Almanac Office studying methods of computing hyperbolic lattices.

During the year a number of astronomers and geophysicists visited the various establishments of the Royal Greenwich Observatory, among them the following:-

Dr. W. S. Adams, late Director, Mount Wilson Observatory.
Mr. G. J. Bell, Hong Kong Observatory.
Prof. S. Chandrasekhar, Yerkes Observatory, Williams Bay.
M. B. Decaux, Laboratoire national de Radioélectricité, Paris.
Mr. Gebhardt, U.S. Coast and Geodetic Survey, Washington.
Mr. W. D. George, National Bureau of Standards, Washington.
Prof. E. Guyot, Director, and M. J. Rossel, Cantonal Observatory, Neuchâtel.
Mr. Hashmie, Deputy Director, Map and Survey Department, Pakistan.
Mr. S. Q. Hassan, Map and Survey Department, Pakistan.
Mr. F. Heegaard, Chief Engineer, Danish State Radio.
Dr. R. V. Hesketh, Falkland Islands Dependencies.
Dr. E. Hubble, Mt. Wilson and Mt. Palomar Observatories.
Mr. F. Hoyle, University of Cambridge.
Mr. E. Julstrud, Assistant Chief Engineer, Norwegian State Radio.
Dr. S. L. Malurkar, Colaba and Alibag Observatories, Bombay.
Mr. A. Maxwell, Jodrell Bank Experimental Station.
Dr. J. Nassau, Director, Warner and Swasey Observatory, Cleveland.
Dr. Thornton Page, Yerkes Observatory, Williams Bay.
Dr. W. R. Piggott and Mr. R. Naismith, Radio Research Station, Slough.
Dr. T. Riketaki, Tokyo University.
MM. B. Sevarlic and M. Turajlic, Technical University, Belgrade.
Mr. S. Dayal Sinvhal, Lucknow University.
Dr. R. H. Stoy, H.M. Astronomer, Royal Observatory, Cape of Good Hope.
Mr. Z. Suemoto, Tokyo University.
Dr. F. Sherwood Taylor, Director, Science Museum, South Kensington.

Other visitors included Sir Henry Dale, former President, Royal Society; Dr. Hans Ehard, Minister President of Bavaria, Dr. Schwerd, Head of Chancellery and Mr. P. J. Summerscale, Consul General, Munich; Lt. A. Penyapol, Royal Thai Navy; Squadron Leader D. F. H. Grocott, Air Ministry; Brigadier S. T. Divers, Controller, Ministry of Health, Newcastle-upon-Tyne.

Two parties of Navigating Officers from Royal Naval College, Greenwich, and one from H.M.S. Dryad have visited Herstmonceux during the year.

Dr. E. Holmberg, Admiralty Research Laboratory, Dr. W. R. Piggott and Mr. R. Naismith, Radio Research Station, Slough, have given lectures to staff colloquia.

The Astronomer Royal and Lady Spencer Jones received Her Majesty's Command to be present in Westminster Abbey at her Coronation on 2 June.

The Astronomer Royal has been elected Master of the Worshipful Company of Clockmakers for the year 1954. He has also been awarded the Lorimer Medal of the Astronomical Society of Edinburgh.

Mr. D. H. Sadler has been elected President of the Institute of Navigation.

The Astronomer Royal attended the Conference on Co-ordination of Galactic Research, held at Vosbergen, near Groningen, Holland, in June; the meeting of the American Astronomical Society, held at Boulder, Colorado, in August; and the Conference on Problems in Astrometry, held at Northwestern University, Evanston, Illinois, in September. He also visited the U.S. Naval Observatory and the U.S. Coast and Geodetic Survey, Washington, for the discussion of various problems relating to the work of the Observatory.

On the invitation of the Royal Swedish Academy of Science the Astronomer Royal attended in September the commemoration of the bicentenary of the foundation of the Stockholm Observatory and gave an address on International Co-operation in Astronomy.

The Astronomer Royal attended in February a small Conference in Paris, arranged by the Association of Geodesy of the International Union of Geodesy and Geophysics, for the discussion of problems relating to the organisation and observing programme of the International Latitude Service.

Dr. R. d'E. Atkinson visited the U.S.A. in October, on the invitation of the U.S. Office of Naval Research in connexion with the Naval Observatory's Moon Survey Programme, and to discuss matters arising from the Eclipse Expedition of 1948. He also visited the Dominion Observatory, Ottawa, to discuss details of the Mirror Transit Circle, planned for that Observatory.

Mr. A. C. S. Wescott has been awarded the Medal of the Order of the British Empire (Civil Division).

Dr. J. G. Porter gave one of the Juvenile Lectures at the meeting of the British Association at Liverpool in September.

Coronation Medals have been awarded to the Astronomer Royal, Mr. E. A. Chamberlain and Mr. G. H. Pearce.

Mr. B. J. Harris, Assistant Experimental Officer, has gained the B.Sc. degree.

Mr. Anthony Edwards has been working as a volunteer helper in the Solar Department since January 20.

In the course of excavating a trench for the laying of drainage pipes from the Equatorial group of telescopes, six Roman burial urns were uncovered in October. They were handed to the Curator of the Sussex Archaeological Society for study. Five of the vessels contained cremated human bones; the sixth was a food vessel. The Curator has reported that the vessels date from an early period of Roman culture in Britain, possibly prior to the Roman occupation in A.D. 43. Some of them are of the "Asham" type, having a small neck with an out-turned rim, a wide body and a flat base; one has the eye-brow pattern, fixing it into the local Belgic culture known as "South-Eastern B". Two of the vessels are of a finer buff ware, well-turned on a lathe after drying but before firing; they are in the best first century A.D. Roman tradition, and are thought to have been imported from the Continent. The urns have been permanently loaned to the Sussex Archaeological Society for Exhibition in Lewes Museum.

Substantial progress in the further stage of the removal to Herstmonceux has been made during the year. The delays in the construction of the meridian group of buildings have been disappointing, however. It was expected a year ago that the installation of the Cooke Reversible Transit Circle and of the Photographic Zenith Tube would before now have been completed. The Transit Circle building can not yet be used, while the Photographic Zenith Tube building is only at the foundation stage.

Observations at Greenwich with the Airy Transit Circle have been terminated. Until the Cooke R.T.C. can be brought into use at Herstmonceux, meridian observations will be suspended. The opportunity will be taken to reduce some of the arrears of reductions, which have accumulated as consequences both of the large amount of time that has had to be spent on the detailed investigation of the Cooke R.T.C. and of shortage of staff.

The Admiralty has decided that no official houses for observing staff will be provided at Herstmonceux. This decision increases the need for close co-ordination between the building programme at the Observatory and the provision of houses for the staff through the local Rural District Council. The Consulting Architect's delay in completing the plans for the building to house the Time Department, the Nautical Almanac Office and the workshops is regrettable, and will inevitably cause a still further delay in the completion of the removal.

The year 1957-58 is to be observed as an International Geophysical Year, during which special observations will be made in a variety of fields of geophysical investigation in many parts of the world. The International Council of Scientific Unions has constituted a Special Committee for the International Geophysical Year (CSAGI), of which the Astronomer Royal is a member, to co-ordinate the programmes of observation in the various fields of investigation and in different countries. The plans include a worldwide programme of determinations of longitude and latitude, including the investigation of the seasonal variation in the rate of rotation of the Earth and of the movements of the Earth's poles. It is most important that Herstmonceux should be tied into the worldwide network of observing stations during that year. As the transfer from Abinger to Herstmonceux of quartz clocks, control panels, and other ancillary equipment of the Time Department will require considerable time, and as the quartz crystal oscillators will require some months to settle down to a steady performance after moving, it is of great importance that the new building to house the Time Department at Herstmonceux should be completed not later than the end of 1956, and preferably some months earlier.

The removal of the Magnetic Observatory from Abinger, where observations are disturbed by the local electric railways, to a site near Hartland in North Devon has been approved in principle by the Board of Admiralty. A number of sites were tested a few years ago for magnetic suitability and one particular site was selected as best meeting all requirements. After the buildings for the magnetic observations have been erected on the new site, an overlap in the observations at this site and at Abinger, extending over not less than one year, will be required. It is desirable that this period of overlap should include the International Geophysical Year; the magnetic data for that year would then include results from two observatories in the south of England, together with results from the northern observatories at Eskdalemuir and Lerwick. The transfer of the Magnetic Observatory from Abinger to Hartland was temporarily deferred while the removal of the astronomical work to Herstmonceux was in progress. The plans that have been formulated for the International Geophysical Year now require, for the most effective British participation in magnetic observations during that year, that the buildings on the new site should be started sufficiently early for observations to begin not later than the middle of the year 1957.

H. SPENCER JONES
Astronomer Royal

ROYAL GREENWICH OBSERVATORY,
HERSTMONCEUX.

1954 May 18.

C.B.H. 30170 - Wt. 4620 - Dd. - 259 - 4/58