REPORT

OF THE

ASTRONOMER ROYAL

TO THE

BOARD OF VISITORS

OF THE

ROYAL OBSERVATORY, GREENWICH.

Read at the Annual Visitation of the Royal Observatory, 1932 *June* 4.

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The Report here presented refers to the year from 1931 May 11 to 1932 May 10, and exhibits the state of the Observatory on the last-named day.

I.—New Instruments :—

The new transit circle sanctioned by the Admiralty and the 36-inch Reflecting telescope presented by Mr. W. Johnstone Yapp will be erected in the grounds of the former Magnetic Observatory, with the approval of the Office of Works.

The buildings of the transit circle and Johnstone Yapp Equatorial have been designed by the Civil Engineer-in-Chief, in accordance with the requirements of the Astronomer Royal and of the Contractors for the instruments. Previous experience at the Cape Observatory has afforded useful guidance in the building for the transit circle.

An isolation trench 3 feet deep has been constructed around the transit circle to prevent moisture soaking through to the foundations of the instrument. The soil has proved to be extremely firm, so that the block of concrete for the foundation did not need to go below the depth of 9 feet. The base is 15 feet square, 3 feet thick, and surmounted by a block 12 feet by 9 feet with supporting struts.

The building above the axis of the instrument will be of semi-cylindrical form, and the opening will be 8 feet.

The collimators are at a distance of 50 feet from the centre of the instrument. The houses are nearly completed and are of sufficient size to allow of efficient ventilation.

The construction of the instrument is in the hands of Messrs. Cooke, Troughton and Simms, who have great experience in this kind of work. The instrument will be reversible

with an objective of 7 inches aperture and 8 feet focus. The collimator object glasses will be of the same dimensions. The three objectives are already made. The adjustments for level and azimuth will be made from a base-plate supporting two iron piers as in the Cape Transit Circle. The micrometer will be motor driven. The contract is made for delivery in $2\frac{1}{2}$ years to be anticipated as far as possible, and the contractors report that all the heavy castings are made and they are progressing well with the machining and fitting. They are giving particular attention to the graduated circles and hope that it may be possible to construct one of glass of 24 inches diameter, material which has been found to be very useful in smaller instruments. Messrs. Cooke, Troughton and Simms are in the hope of exhibiting the instrument, as far as it is constructed, at the meeting of the British Association in York next September.

The Johnstone Yapp Equatorial will be mounted in a 34-foot dome. The dome of steel framework will have a layer of Agasote five-sixteenths of an inch thick with an external covering of copper. The building, which is of pleasing design, will include a silvering room for the mirror. The dome will be over a basement 7 feet high and will be reached by a flight of steps from the east side. The mounting is of the modified English type. The north and south piers have been erected, and considerable progress has been made with the brickwork. The support for the north end of the polar axis will be steel girders so constructed as to give a free passage for the mirror and cell to the silvering room.

The instrument and dome are being constructed by the firm of Sir Howard Grubb, Parsons and Co. The structural work of the dome is completed and the covering partly fitted, and the turning gear is under construction. All the heavier mechanical parts of the telescope mounting are finished. The sidereal circle, driving circle, driving screw and declination circle, are completed and many other parts nearly finished. The first attempt at casting a glass disc was not satisfactory but the Parsons Optical Glass Company reported on April 20 that the 36-inch disc had been successfully remoulded. The cooling has been in progress since March 25 and on April 28 the temperature was still about 350° C. It is hoped to deliver the disc by the end of May. The two smaller quartz mirrors are ground, edged, polished and partly figured.

A slitless spectroscope, following in the main the design of the existing spectroscope on the 30-inch reflector, is under construction by Messrs. Adam Hilger, Ltd. A parallel beam will be sent through the central opening of the large mirror by a parabolic Cassegrain mirror.

II.—Buildings and Grounds, Movable Property, and Library :—

The woodwork of the front court and the shutters of the transit circle were repainted during the year.

The room adjoining the Upper record room has been greatly improved by the removal of a large obstruction in the centre of the room which contained three disused chimney flues, and by the addition of a window in the roof. The room has been fitted up for the reception of wireless signals. The smaller room formerly used for this purpose has been repainted and converted into a store for stationery.

The small waiting room for visitors has been re-decorated.

The internal and external painting of the Thompson Dome was carried out during August and September, and the instrument was repainted at the same time. Opportunity was afforded by the scaffolding erected for the painters to renew the top rollers which carry the shutter of the dome. Gun metal rollers were substituted for the existing iron ones, which were much worn, with a considerable improvement in the running of the shutter.

At Abinger, a pavilion, 20 feet square, has been erected on the north side of the enclosure. This will be found very useful for the testing and standardisation of coil magnetometers and other magnetic instruments.

A concrete pillar, 10 feet in height, and distant 290 feet from the observing pier has been erected to carry an azimuth mark for the observations of declination.

The following instruments which are in regular use have been lent to the Royal Observatory :—

The Cookson Floating Zenith Telescope, from the Cambridge Observatory, for a third period of seven years from July, 1925. Application has been made for a renewal of the loan.

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 Position Micrometer for measuring solar photographs, from the Solar Physics Observatory, Cambridge.

Schuster-Smith Coil Magnetometer for measurement of Horizontal Intensity, from the National Physical Laboratory.

A Coil Magnetometer, designed by the late Dr. W. D. Dye, F.R.S., for measurement of Vertical Intensity, from the National Physical Laboratory.

The following instruments have been borrowed for observation of the Solar Eclipse of 1932 August 31.

16-inch Coelostat and two spectroscope slits from the Royal Astronomical Society.

Two 16-inch Coelostats, one 12-inch Coelostat, a 6-inch 45° Prism, a 15-inch concave mirror and a 4-inch concave grating from the Joint Permanent Eclipse Committee.

A 6-inch lens of 45-feet focus, from J. H. Worthington, Esq.

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

The following instruments have been lent by the Royal Observatory :—

To the Royal Observatory, Cape of Good Hope—
Transit A : Altazimuth B : Object glass of Photoheliograph No. 1 : Clocks. Dent 1916 and Dent 2013.

To the University Observatory, Oxford—
Clock Arnold No. 2.

To the Solar Physics Observatory, Cambridge—
Photoheliograph object glass No. 5.
9-inch Speculum flat mirror.
19-foot Telescope tube and four dark slides.

To the Imperial College of Science and Technology—
6-inch Equatorial, Simms No. 2 : Altazimuth A.

To the Meteorological Office—
Three variometers, one recording apparatus and a Dip Inductor for use at Fort Rae, N.W. Canada, during the Polar Year 1932–33.

To the Science Museum—
Harrison Time machine No. 2, and a number of other instruments of historical interest.

A suggestion was made by Commander Gould to complete his work on Harrison's Time Machines by restoring the first machine. He had already cleaned it and prevented further deterioration but had not restored it to going order. The proposal is to replace some missing parts which will be carefully marked as not original. Sanction was given by the Admiralty on June 22 and the instrument placed in Commander Gould's hands on October 2. The work is difficult and complicated but it is anticipated that the restoration will be completed by the end of the year.

The annual examination of the Library has been made. Five books are reported missing and cannot be accounted for at present. These were missing last year.

III.—Astronomical Observations :—

Transit Circle.—The Sun, Moon, planets and fundamental stars have been regularly observed.

The total number of observations made during the year is as follows :—

Transits	10,359	Zenith distances ..	9,792
Collimation	287	Nadir point	553
Level	580		

A motor-driven Assmann Psychrometer has been introduced to give the temperatures used in the calculation of refraction.

The Sun was observed on 116 days and the Moon on 74 days.

Transits are reduced as far as apparent place to April 30 and Zenith Distances to April 11. The planetary ledgers are reduced to 1931 December 31.

The observations of the Moon referred to Newcomb's Equinox show a regular decrease in the correction to the longitude given by Brown's Tables which were introduced into the Nautical Almanac in 1923.

	Longitude.		Latitude.		No. of observations.	
	Limb.	Mösting A.	Limb.	Mösting A.	Limb.	Mösting A.
	″	″	″	″		
1923 ..	+ 6·99	+ 7·47	— 0·56	— 0·63	101	60
1924 ..	+ 7·21	+ 7·14	— 0·82	— 0·59	87	54
1925 ..	+ 6·61	+ 6·71	— 0·87	— 0·75	90	52
1926 ..	+ 6·40	+ 6·55	— 0·68	— 0·92	93	66
1927 ..	+ 6·20	+ 6·24	— 0·70	— 0·91	80	43
1928 ..	+ 5·51	+ 5·88	— 0·93	— 0·66	97	60
1929 ..	+ 5·20	+ 5·89	— 0·78	— 0·80	108	67
1930 ..	+ 5·08	+ 5·40	— 0·93	— 0·83	82	47
1931 ..	+ 4·76	+ 4·87	—10·82	— 0·71	69	46

The observations of the Second Greenwich Catalogue for 1925 (1922–30) have been ledgered and the means taken. This catalogue contains all stars brighter than $8^{m}\cdot0$ between the limits of declination +32° to +64°, in addition to fundamental stars.

Proper motions of 1950 stars contained in Boss' Preliminary General Catalogue have been revised, using the most recent catalogues of Greenwich, the Cape and Pulkovo. Work is in progress on the remaining 9,000 stars in the zone $+32°$ to $+64°$.

Cookson Zenith Telescope.—During the year, 258 plates were taken for latitude variation, and 7 for determination of scale. The results for 1931 are published in the *Monthly Notices* for 1932, March. The measurement of the photographs, as anticipated, has been largely accelerated by the new micrometer.

28-*inch Equatorial.*—During the year, 462 observations of 311 double stars were made. These consist of :—

55	double stars,	with	separation	$< 0''\cdot 5$.
87	,,	,,	,,	$0''\cdot 5$ to $1''\cdot 0$
101	,,	,,	,,	$1''\cdot 0$ to $2''\cdot 0$
68	,,	,,	,,	$> 2''\cdot 0$

Thompson Equatorial.—With the 26-inch refractor, 1,223 plates have been taken for stellar parallax. Of these, 123 were rejected mainly on account of poor meteorological conditions. In the year 1,128 plates have been measured and the parallaxes of 37 stars determined. As usual, an annual publication of results has been made in the *Monthly Notices* for November.

With the 30-inch Reflector 39 pairs of spectra for the intercomparison of the Standard Stars have been taken. On 8 nights, comparisons of Standard Stars and the Acetylene Flame were secured. The programme outlined in the last Report has now been completed and a volume containing the absolute colour temperatures of 25 Standard Stars and 38 other stars is in the press. The observatory is indebted to the National Physical Laboratory for a careful and extensive series of determinations of the colour temperature given by the Kodak Acetylene Burner employed in this work.

Astrographic Equatorial.—During the year 106 photographs have been taken. The same number of plates has been measured in comparison with the photographs taken about 30 years ago for the Astrographic Catalogue or Chart. This completes the programme for the determination of the proper motions of stars from 64° dec. to the North Pole. The proper motions of all the stars of the Bonn Durchmusterung in Vol. II of the Astrographic Catalogue have been determined, and also of the fainter stars in the Astrographic Catalogue whose proper motion exceeds $3''$ a century. The greater part of the copy for press has been prepared and will shortly be sent for publication.

It is proposed to commence the measurement of the photographs of Eros as soon as the work on proper motions is concluded.

Heliographic Observations.—Photographs of the Sun were obtained on 261 days with either the Dallmeyer 4-inch photoheliograph or the Thompson 9-inch. The number of photographs selected for preservation is 496, including 28 with double images of the Sun for the determination of the zeros of position angle. The zeros of position angle have also been determined regularly by visual observations.

H.M. Astronomer at the Cape has reported that the Sun was photographed there on 333 days in the year 1931, and on 86 days in the first three months of 1932. The Director of the Kodaikanal Observatory has reported that plates were taken there on 327 days in the year 1931 and on 89 days during the first three months of 1932.

Photographs have been received from the Royal Observatory, Cape of Good Hope, to 1932 February 3. Photographs have been received from the Kodaikanal Observatory to complete the series for 1931.

The measurement of the combined series has been made from 1931 January 3 to 1932 January 27. The reductions of positions and areas of spot groups and their principal components have been completed from 1930 June 22 to 1932 January 1.

Sunspot activity has continued to diminish, and the minimum of the cycle may be expected within the next year or two. There were, however, three large groups of spots whose areas reached 500 millionths or more of the sun's hemisphere; their respective times of central meridian passage were, May 20·5, November 26·9 and April 25·4.

Observations in Hα light were made of the sun's disc with the Spectrohelioscope on 154 days during the year; on about 25 days, observation of the disc was possible only for a few minutes. A summary of measures of radial velocities made during 1931 of bright and dark Hα flocculi has been communicated to the Royal Astronomical Society.

Photographic prints of solar negatives for each day from 1930 January 1 to 1931 December 31 have been supplied to the Solar Physics Observatory, Cambridge.

Daily spot-numbers, both for the whole disc and for a central zone of the Sun, based on Wolf's method of counting, have been supplied quarterly to Zürich for incorporation in the *Bulletin for Character Figures of Solar Phenomena*, published under the auspices of the International Astronomical Union. Spot-numbers for the central part of the disc have also been supplied retrospectively for the years 1918–23 inclusive.

The Council of the Royal Astronomical Society has kindly presented about 200 prints of solar photographs taken at Kew during the years 1863 to 1873.

Eclipse of the Sun.—Two observers, Dr. Jackson and Mr. Davidson, will be sent to observe the solar eclipse of 1932 August 31. They propose to erect their instruments at

Parent on the Canadian National Railway, a station also selected by the observers from the Dominion Observatory, Ottawa. The programme they hope to carry out consists of :—

(1) Direct photographs of the Corona with a 6-inch lens of 45-feet focus, kindly lent by Mr. Worthington.

(2) Objective-prism spectra of the Chromosphere and Corona with a 7-inch lens of 21-feet focus and a 6-inch 45° prism.

(3) Comparison of the intensity of the H and K lines of calcium with the infra-red triplet. A 15-inch concave mirror of 29-feet focus will form an image on the slit of a prism spectrograph.

(4) Spectra of the Chromosphere and Corona between the limits of λ 5000–λ 9000. A 9-inch mirror of 10-feet focus will be used in conjunction with a slit-spectrograph employing a 4-inch concave grating of 1 metre focus.

IV.—Magnetic Observations.

Regular magnetic observations have been made at Abinger throughout the year. The variations of declination, horizontal and vertical force have been recorded photographically. Absolute observations of declination, of horizontal force with the *Schuster-Smith* coil magnetometer, and of vertical force with the *Dye* coil magnetometer are made every week-day. The measurements both of the horizontal and vertical components of magnetic force are now dependent upon electrical standards, but observations of horizontal force with the unifilar magnetometer and of Dip with the earth inductor have been taken frequently, for purposes of comparison.

The Observatory is indebted to the National Physical Laboratory for periodical re-measurement of the electrical constants of the potentiometers which are essential accessories to the coil-magnetometers.

In November 1931 the dimensions of the marble cylinder of the *Schuster-Smith* magnetometer were examined. For this purpose fine lines had been engraved on platinum pegs fixed in the cylinder at certain points at the time of the original measurement. The Director of the National Physical Laboratory kindly arranged for a re-measurement of the distances separating these lines to be made at Abinger so that minimum interference with the routine use of the instrument was incurred. Small differences were found to have arisen since the original measurement, but the effects largely cancelled one another as regards the " constant " of the coil. The total effect computed from the new dimensions was a change of only one part in a million.

As regards the reduction of observations, the mean hourly ordinates of all the traces have been read off to date. The reduction of absolute observations is complete to 1931 December 31, and with provisional constants to the present time.

The tabulation of results for 1931 and the preparation of copy for press are nearly complete and await only the receipt of the final list of " quiet " and " disturbed " days in 1931 from the International Committee.

The mean values of the magnetic elements at Abinger for the year 1931 are given below. The values for 1929 and 1930 are given for comparison.

	Decl. W.	Hor. Force.	Vert. Force.	Dip.
1929	12° 35′·8	0·18555	0·42918	66° 37′·2†
1930	12 24·6	0·18542	0·42924	66 38·2†
1931	12 13·7	0·18544	0·42923	66 38·1†

The weekly report of mean hourly values of declination has been sent regularly to several offices for publication or information—a service maintained in conjunction with Eskdalemuir Observatory.

Three coil-magnetometers of the Smith portable type have been tested, and certificates of the determination of the constant of the coils have been issued. One Kew-pattern unifilar magnetometer, one replacement collimator magnet for a similar instrument, two dip circles and one earth inductor have also been tested and certificates issued. In addition, a portable magnetometer for measuring changes of the vertical component of the earth's field was examined for the determination of its constants.

During the month of October 1931, a precise astronomical determination of the latitude and longitude of the magnetic observatory was carried out, the site chosen being approximately central to the group of buildings. The instrument employed was a 45° Prismatic Astrolabe, kindly lent by the Hydrographer of the Navy.

The separate results are given below :—

Date.	Latitude.	Longitude W.	No. of Stars observed.
October 14	51° 11′ 5″·49	0° 23′ 11″·86	21
19 ($\frac{1}{2}$ weight) ..	5 ·14	11 ·08	10
20	4 ·65	12 ·78	19
24	5 ·37	12 ·03	20
Mean	51° 11′ 5″·17	0° 23′ 12″·06	

The Ordnance Survey has kindly supplied the geodetic position as Lat. 51° 11′ 5″·28 ; Long. 0° 23′ 11″·40. No corrections for personal equation have been applied to the longitude observations.

† These values are deduced from observations with the Coil-magnetometer.

In connection with the Magnetic Survey of the British Isles by the Ordnance Survey Department, Mr. H. L. P. Jolly visited the Abinger Station before the commencement and after the conclusion of his surveying programme in 1931 for the purpose of comparing his instruments with the Abinger standards.

The quinquennial revision of the Admiralty charts of magnetic declination was carried out in the autumn of 1931, and isogonals for the epoch 1932·5 were furnished to the Hydrographic Office.

V.—Meteorological Observations :—

The registration of atmospheric pressure, temperature of the air and of evaporation, the direction, pressure and velocity of the wind, the amount of rainfall, sunshine, and cloudiness at night, has been continuously maintained, as well as estimates of visibility made by eye at definite hours.

Registration of the electric potential gradient of the atmosphere with a radium collector and a Kelvin-White quadrant electrometer was maintained until building operations necessitated the removal of the recording hut at the end of October 1931. The apparatus has been re-erected in the south-east angle of the former magnetograph house and will be brought into use again as soon as the buildings are completed.

It has also been necessary to remove the thermograph and the standard thermometer screen to temporary sites. The thermograph was moved on January 15 and the thermometer screen on March 29. Fresh permanent sites will be chosen when the new conditions can be studied as a whole from the point of view of meteorological suitability.

The tabulation of results for 1931 is complete and the copy for press is in the printer's hands.

The following details of the weather refer to the period of twelve months ended 1932 April 30 :—

The mean temperature was 49°·5 which is just equal to the average of the 75 years 1841–1915. The highest temperature in the shade was 81°·2, registered on July 12. July 12 was also the only day in the year on which the temperature exceeded 80°. The lowest temperature was 20°·6 on December 31. Temperatures of freezing point or below were recorded on 49 days. The mean daily horizontal movement of the air was 281 miles, which is 4 miles below the average for 50 years 1867–1916. The greatest daily movement was 691 miles recorded on December 4 ; the least daily movement was 129 miles on November 30. The greatest motion in one hour, 41 miles, was recorded on December 4. The foregoing data relating to wind have been derived from a formula modifying the direct

readings of the anemometer. The formula was supplied by the late Mr. W. H. Dines as the result of experiments with the anemometer, and considerably reduces the total when velocities recorded are high. The greatest pressure reached was 25·8 lbs. to the square foot, on January 6. The duration of bright sunshine recorded was 1,180 hours or only 26·3 per cent. of the possible total. There were 87 entirely sunless days, of which 21 occurred in December. There were 17 entirely cloudless nights, that is nights on which an unbroken trace of Polaris was obtained by the Night-Sky Camera. The total rainfall was 23·89 inches, that is 0·35 inch less than the average for 75 years 1841–1915, and measurable rain fell on 158 days. The wettest month was August with 6·27 inches, 2·20 inches of which fell during a thunderstorm on August 5. The driest month was February with 0·29 inch.

VI.—Printing and distribution of Greenwich Publications :—

The volumes for 1929 and 1930 and their separate parts have been distributed as has also a small volume of Photographic Magnitudes of Stars brighter than $14^{m}\cdot0$ in Kapteyn's Selected Areas. Part of the MSS. of the volume for 1931 is in the hands of the printers. The printing of another small volume, Observations of Colour Temperatures of Stars, is completed.

VII.—Chronometers :—

The number of chronometers and watches belonging to the Admiralty now at the Observatory is 3,063. Of this total, 257 chronometers, 226 chronometer watches, 331 hack watches and 55 pocket watches are being rated. Four are in regular use in the Observatory. The remainder, consisting of 359 chronometers, 1,001 chronometer watches, 189 hack watches and 641 pocket watches are kept in storage.

In addition to Admiralty chronometers there are 43 chronometers and 25 watches deposited at the Observatory for various reasons.

During the year ended 1932 April 30, a total of 1,654 chronometers and watches have been received and 1,559 issued. The number sent for repair was 849, viz. : 813 for the Admiralty, 29 for the Indian, and 6 for the New Zealand Governments, and 1 for the Royal Air Force.

During the year 11 chronometers, 38 chronometer watches, and 1 hack watch have been sold out of surplus stock.

VIII.—Time Service :—

The Time determinations have been made throughout the year by means of the reversible transit instrument " B " fitted with impersonal micrometer. When possible,

observations are made at intervals of not more than 5 days. In the year 1931 May 11–1932 May 10, observations have been made on 63 nights.

The Clock Shortt No. 3 was used as Standard Sidereal Clock until February 18 when No. 11 was substituted. Comparisons between the two clocks have been made regularly throughout the year.

A new pendulum of invar with a 14-lb. invar bob and a steel suspension spring has been fitted to Shortt No. 3.

The service of Rhythmic Time Signals at 10^h and 18^h transmitted through the Post Office Wireless station at Rugby, and also the daily time signals to the General Post Office and the British Broadcasting Corporation, have been transmitted regularly. The Free Pendulum Clock, Shortt No. 16, controls the mean time clocks used for the Post Office and Broadcast signals, in addition to the Rhythmic signal transmitter.

A short series of warning signals before the Rugby Rhythmic signals was introduced in June last. The apparatus used is automatically controlled and transmits in morse during the minute preceding the Rugby series the code signal " G.B.R. G.B.R. Time " repeated four times. In the construction of the automatic morse signal apparatus we are indebted to the Telegraph Section of the Engineer-in-Chief's Department of the General Post Office.

The corrections to the transmitted times of the rhythmic signals for adjustment to the final time determinations are published and distributed periodically by the Hydrographer of the Navy in " *Notices to Mariners.*"

The Time Ball was not raised on account of snow on the mast on two occasions, viz., February 10 and 11. On October 7 the Ball did not drop correctly at 13^h owing to faulty manipulation of the lifting gear, and on December 29 the Ball did not drop at 13^h owing to accumulation of snow holding it at the top of the mast.

The performance of the time balls at the Admiralty Signal stations and also the Westminster Clock is shown by the following table of the errors of the return signals.

Error of Return Signal.	Portsmouth.	Portland.	Devonport.	Westminster.
Not greater than $0^s{\cdot}2$	213	173	214	121
$0^s{\cdot}3$ to $0^s{\cdot}5$	3	10	9	98
$0^s{\cdot}6$ to $1^s{\cdot}0$	1	3	7	111
Greater than $1^s{\cdot}0$	0	0	10	9

The clocks at the Admiralty stations are corrected daily by the 10^h signal, but the Westminster Clock is not so corrected.

Wireless time signals are received regularly from the Eiffel Tower, Nauen, Bordeaux and Annapolis. These are registered automatically, and the corrections found for the Nauen, Bordeaux and Annapolis signals are published monthly for distribution in "*Notices to Mariners*," together with the corrections to the Rugby signals.

The following table gives the monthly means of the differences from Greenwich shown by the various time signals, using the final clock errors derived from observations made with the small reversible transit instrument "B" at Greenwich, and the corrections for final time determinations published by Paris, Hamburg and Washington Observatories.

The Annapolis signals have been corrected for lag of land line to Washington and by $0^s \cdot 02$ for time of travel.

1931.	Paris $9\frac{1}{2}^h$ Rhythmic.	Nauen 12^h Rhythmic.	Annapolis 17^h.	Bordeaux 20^h Rhythmic.
	s.	s.	s.	s.
January	+·018	−·003	+·011	+·030
February	+·002	+·039	+·050	+·015
March	+·006	+·055	+·047	+·024
April	+·004	+·036	+·038	+·013
May	+·047	+·053	+·050	+·056
June	+·052	+·049	+·047	+·063
July	+·050	+·033	+·063	+·062
August	+·007	+·029	+·012	+·012
September	−·028	+·037	+·006	−·022
October	−·007	+·030	+·020	−·003
November	−·033	+·012	−·020	−·035
December	−·028	−·001	−·021	−·025
Mean	+·007	+·031	+·026	+·015
Number of comparisons ...	299	296	346	338

The sign + means late on Greenwich. The reference point for all comparisons is the commencement of the signals. The Nauen times have been referred to the Eichelberger system of star places.

IX.—Personal Establishment :—

The permanent staff at the present time is constituted as follows :—

Chief Assistants.—Mr. Greaves, Dr. Jackson.

Assistants.—Mr. Bowyer, Mr. Davidson, Mr. Furner, Mr. Witchell.

Junior Assistants (Higher Grade).—Mr. Acton, Mr. Cullen, Mr. Melotte, Mr. Stevens.

Junior Assistants.—Mr. Barton, Mr. Chamberlain, Mr. Finch, Mr. Jeffries, Mr. Martin, Mr. Newton, Mr. Rickerby, Mr. Rickett, Mr. Symms and Mr. Wells.

Clerical Assistant.—Mr. Edney.

21 Computers, including 5 ladies, are employed at the Observatory.

The present arrangement of the staff under the general superintendence of the Chief Assistants is as follows :—

Branch.	Established Staff.	Unestablished Staff.
Transit Circle, Altazimuth and Zenith Telescope.	Mr. Furner, Mr. Cullen, Mr. Acton, Mr. Symms.	Mr. Slator, Mr. Blackwell, Mr. Malyon, Mr. Diston, Mr. Larkin, Mr. Grimwood, Mr. Stockwell, Mr. Deeks.
Time Signals and Chronometers ...	Mr. Bowyer, Mr. Rickett	Mr. Harris, Mr. Shortland, Mr. Rudd.
Thompson Equatorial	Mr. Davidson, Mr. Martin ...	Miss Jeffries, Miss French.
28-*inch Equatorial*	Mr. Furner	
Astrographic Equatorial	Mr. Melotte, Mr. Jeffries, Mr. Finch	Miss Bonnett, Miss Cumberledge.
Photoheliograph	Mr. Newton, Mr. Barton	Mr. Carter, Mr. Howes.
Small Transit	Mr. Finch	
Magnetic and Meteorological ...	Mr. Witchell, Mr. Stevens, Mr. Wells, Mr. Rickerby.	Miss Clack, Mr. Reece, Mr. Harrild.
Secretariat and Library	Mr. Edney, Mr. Chamberlain ...	Mr. Dennis.

The staff of workmen now employed consists of a foreman of works, two joiners, a mechanic, a boy assistant mechanic, a gate porter, two messengers, a night watchman, a gardener, three labourers, and a charwoman. There is also a mechanic at Abinger who has charge of the engines and acts as caretaker.

X.—General Remarks :—

We had the pleasure of a visit from the Overseas Surveyors of the British Empire on July 16, when a discussion was held on the Wireless Time Service.

Capt. J. C. Willis and Mr. E. C. Bullard made Gravity observations at Greenwich on August 31–September 2 and again on September 23–25.

In connection with a re-survey of S.E. London, observations were made from the trigonometrical point on the Octagon Room in September. On this occasion the

Director-General of the Ordnance Survey kindly had a point in the magnetic enclosure fixed relatively to the transit circle.

Mr. Narliker, Isaac Newton Student of Cambridge University, worked at the Observatory in August.

Mr. J. A. Madeira of Coimbra Observatory has studied since April 11 different branches of the work at Greenwich.

As this is the last Report I shall have the honour of presenting to the Board of Visitors, I venture to review the work of the Observatory since my appointment in 1910.

The regular determination of the positions of Sun, Moon, Planets and brighter stars has been carried on continuously. As far as possible systematic errors have been avoided. The new reversible instrument which is now under construction will, it may be hoped, help to eliminate these very troublesome errors. The practice of my predecessor in adding largely to the number of stars observed has been continued. The determination of proper motions of many stars has been made, and it is expected that some 10,000 more determinations will be made in the forthcoming catalogue.

The Reflex-Zenith tube has been replaced by the Cookson instrument, kindly lent by the University of Cambridge. Variation of latitude has been observed regularly, and determinations of the constants of aberration and nutation made with this telescope.

The 28-inch Equatorial, as previously, has been used in the measurement of double stars. Occasionally it has been used by amateur astronomers in observations of Mars and in the magnitude determinations of various Novæ, which had become too faint for smaller telescopes.

The Astrographic Catalogue published in 1908 gave the co-ordinates and measured diameters of the stars. In 1914 the right ascensions and declinations of the reference stars were published and compared with the meridian observations made at Greenwich, and with the catalogues of the *Astronomische Gesellschaft*. In addition, photographic magnitudes were determined by a special series of plates in which fields were compared with Pickering's North Polar Sequence. For the brighter stars where a larger field was necessary, a 6-inch triplet was used.

Shortly before his death, in 1912, Mr. Franklin-Adams presented to the Observatory his collection of 206 plates, covering the whole sky in areas of 15 degrees square. Photographic copies of these plates were published and sold at cost price. At the same time the number of stars of different magnitudes were counted. To obtain the scales of magnitudes photographs of various areas were compared with the North Polar Sequence,

using first the 30-inch reflector and afterwards the 26-inch refractor. The scarcity of nights when sufficiently long exposures could be made, made it necessary to use a coarse wire grating, and by means of diffraction images magnitudes were stepped down. This method also led to a verification of the standard magnitudes.

The magnitudes of stars in 40 of Kapteyn's Selected Areas were determined by comparison with the Polar Sequence. The 26-inch refractor was used for this purpose, and three or four plates were used for each of the areas.

A direct determination of the scale of photographic magnitudes of the North Polar Sequence was made with the Astrographic telescope, using a wire grating. The results agreed closely, as far as $13^{m}\cdot4$ with those at Mount Wilson.

In 1923 the rephotographing of the alternate zones of the Astrographic Catalogue was commenced for the determination of proper motions by direct comparison with the earlier plates. The area from dec. 64° to dec. 72° was published in 1929, and the remainder as far as the Pole is now ready for the press.

The 26-inch refractor has been used very largely for the determination of stellar parallax. The parallaxes of 250 stars have already been published, and an equal number will be completed by the end of the year. With the 30-inch reflector the effective wave-lengths of the stars from 80° to the North Pole have been determined to the limit of $10^{m}\cdot5$ by the use of a grating. The extension of this work was suspended to enable the reflector to be used for the determination of the Absolute Colour Temperatures of Stars. This difficult work has been in progress since 1926, and the results are being printed.

In the solar photography, measurements for each day of the year have been made, and the results discussed with reference to the solar rotation, movement of spots and the relationship between solar activity and magnetic storms. In the autumn of 1930 a spectro-helioscope was lent by the Mount Wilson Observatory and is in use on every fine day.

A number of expeditions have been sent out to observe total solar eclipses. Sometimes they failed owing to cloud. Fortunately the expedition to observe the Einstein Shift in 1919 was a brilliant success. The expeditions to Giggleswick in 1927 and Malaya in 1929 obtained good photographs of the prominences—that to Russia in 1914 of the corona and flash spectrum, and that to Sumatra in 1926 gave substantial additions to the spectrum of the chromosphere.

A new house for the continuous record of the magnetic elements was constructed in 1913–14 adjacent to the Magnetic Pavilion in the enclosure in the park. Instruments of improved design were obtained, particularly in the case of vertical force, to which a