

R E P O R T
OF THE
ASTRONOMER ROYAL
TO THE
BOARD OF VISITORS
OF THE
ROYAL OBSERVATORY, GREENWICH.

Read at the Annual Visitation of the Royal Observatory, 1924 June 7.

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The Report here presented refers to the year from 1923 May 11 to 1924 May 10, and exhibits the state of the Observatory on the last-named day.

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

The external painting of the dome of the Thompson Equatorial was completed on May 23.

The Record room was cleaned and redecorated in the autumn.

Considerable repairs have been carried out on the roof of the Octagon room. A new floor has been provided for the wooden house of the Robinson Anemometer. The balustrade round the roof has been thoroughly overhauled and repaired. This work which involved some structural alteration is now completed. The building of the Magnetic Observatory at Abinger was commenced in January and has made good progress. It is dealt with in greater detail in Section III. of the Report.

The principal movable instruments are thus distributed :—

At Greenwich—

Transits B, C, D, and E.—Transit B is fitted with an impersonal Micro-meter.

Altazimuths D and E.

Equatorials (6-inch).—Cooke No. 2, Simms No. 1.

Photoheliographs Nos. 2 and 3 complete and the mechanical parts of Nos. 1 and 5.

Detached Telescopes (on tripod stands).—Three 4-inch (Simms Nos. 1 and 2 and R.O. No. 2).

Cooke 6-inch triplet Photographic Objective.

Two Hilger Chronographs.

A single-prism Spectroscope.

On loan—

Transit A, at the Cape Observatory.

Transit, with axis view, at the Science Museum, South Kensington.

Altazimuths.—A, at the Imperial College of Science and Technology, South Kensington; B, at the Cape Observatory.

Equatorials.—Simms No. 2 (6-inch), at the Imperial College of Science and Technology.

Two Heliotropes at the Science Museum, South Kensington.

Photoheliographs :—

No. 1. Object-glass at the Cape Observatory.

No. 5. Object-glass on loan to Professor Newall, Cambridge.

9-inch speculum flat by Hilger and a 9-inch speculum concave mirror by Herschel at University College, London.

Clocks.—Dent No. 1916 and Dent No. 2013, at the Cape Observatory; Dent No. 2011, at the Kew Observatory; Arnold 2, at the University Observatory, Oxford; Graham 2, for use in connection with the Time Ball at Rosyth.

Anemometer.—Whewell's Anemometer at the Victoria and Albert Museum, South Kensington.

On loan to the Royal Observatory—

The Cookson Floating Zenith Telescope from the Cambridge Observatory, for a second period of seven years from July, 1918.

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.

A Bendorff Electrometer, two Kelvin-White Multicellular Voltmeters, and a Flame Collector, from Dr. G. A. Carse, University of Edinburgh.

One seven-valve Amplifier and one C.W. Syntoniser, from the Royal Air Force.

A battery of 72 Leclanché cells, from the Director of Scientific Research of the Admiralty.

The Observatory is indebted to Mr. Witt Burnham, who has kindly presented the three-valve Amplifier which had been on loan from him.

Reference has been made in previous reports to the generosity of Lieutenant Commander R. T. Gould, R.N., in overhauling Harrison's first time machine and the chronometer which obtained the prize offered by the Board of Longitude. Commander Gould now has in hand the two machines made by Harrison subsequent to his first attempt, and expects to complete them in a few months.

The re-arrangement of the record room has been carried out, and the formation of a new catalogue will be taken in hand at the first opportunity.

The annual examination of the Library has been made as usual. Twelve books are reported missing, and cannot be accounted for at present, including six books reported missing last year. Two of the books missing last year have been found.

Additional shelving has been obtained for the West Library in which observatory publications and general astronomical books are kept. A run of about 150 feet of adjustable steel shelving has been obtained. This will meet immediate needs. There is room for another 100 feet and this will be added as required.

II.—Astronomical Observations :—

Transit Circle.—The Sun, Moon, major planets and fundamental stars have been regularly observed. The observation of all stars brighter than $8^m \cdot 0$ between the limits of declination $+32^\circ$ and $+64^\circ$, commenced in 1922, has been continued.

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

Transits	-	-	-	9,407	Circle Observations	-	-	-	8,378
Collimation	-	-	-	262	Nadir point	-	-	-	544
Level	-	-	-	598					

The Sun was observed on 132 days and the Moon on 102 days.

The observations of transits and zenith distances are reduced as far as apparent place to April 30. The reductions from apparent place to mean place 1925·0 have been computed as far as 1923 May 25. The planetary ledgers for 1923 are complete.

The first Greenwich Catalogue for 1925·0, consisting mainly of stars in the list prepared by Dr. Backlund and Mr. Hough, is completed. Revision of the proper motions of the stars, excluding those given in Boss' Preliminary General Catalogue, has been made. Comparisons with a number of other catalogues have been made. Copy for press is prepared for the printer, with the exception of the Introduction.

From 1923 Jan. 1, the tabular places of the Moon in the Nautical Almanac are derived from Brown's Tables. Those in the *Connaissance des Temps* are derived from the revision of Delaunay by Radau and Andoyer. Comparison with the means for each lunation are given below, after correction for a small term depending on the mean anomaly, arising from the mean error of tabular longitude.

Tabular Error of Moon's centre.

Extent,	No. of Obs.	Brown.		Delaunay.	
		Long.	E.N.P.D.	Long.	E.N.P.D.
		"	"	"	"
January 2–January 10	6	− 7·5	− 1·0	− 2·4	− ·2
January 20–February 10	7	− 6·9	− ·8	− 1·9	− ·8
February 21–March 6	7	− 7·6	− 1·1	− 2·7	− ·4
March 24–April 8	11	− 7·5	− ·5	− 2·7	+ ·1
April 24–May 4	7	− 7·5	− ·6	− 2·9	− ·5
May 22–May 24	2	− 7·6	·0	− 1·6	·0
June 22–July 6	9	− 6·8	+ ·5	− 2·4	·0
July 20–August 6	13	− 6·8	− ·2	− 2·2	− ·5
August 21–September 2	6	− 6·8	− ·3	− 2·6	− 1·0
September 16–October 3	8	− 6·6	− ·6	− 2·3	− ·7
October 15–November 3	9	− 7·2	− 1·0	− 3·1	− ·9
November 14–December 2	9	− 6·4	− 1·4	− 2·2	− 1·7
December 15–December 28	8	− 7·5	− ·8	− 3·6	− ·5

For the reasons given in the last Report the bearing of the pivots of the transit circle on the Y s was kept under close observation. At the beginning of October the pivots were found to be bearing very unevenly on the Y s in consequence of want of alignment caused by changes of level. This was remedied by altering the tin-foil packing under the blocks. It became clear that constant adjustment would be required if the pivots were to have a good bearing over the 5 inches in the length of the Y s. This pointed to the necessity of shorter bearing surfaces. If this were done more weight would need to be taken by the counterpoises. To insure that the counterpoises should not influence the position of the telescope it was thought advisable to substitute new friction rollers with ball-race bearings before making alterations of the Y s. The new friction rollers made by Messrs. Cooke, of York, were fitted on November 29. As these were found to be very satisfactory, the alteration of the Y s was proceeded with. After consultation with Mr. Gray, of Messrs. Cooke's, it was decided to make new bearing blocks of cast iron, into which four gun-metal plugs were to be fitted. These plugs of $1\frac{1}{2}$ inches diameter are concave in the plane perpendicular to the axis of the pivots, and very slightly convex in the horizontal direction. The centres of the bearing surfaces are 100° apart instead of 123° as in the old bearings. The new bearings were installed at the end of March, and show a very satisfactory bearing surface. They are being kept under close observation. It is too early to say whether these changes have improved the time-determinations.

A small alteration has been made so as to increase the illumination of the field. The opal reflector on the object glass has been replaced by a mirror with a piece of ground glass across the reflected beam.

Altazimuth.—Extra-meridian observations of the Moon have been discontinued for the present. The instrument has been used during the year in the prime-vertical for observation of transits of fundamental stars, to obtain a check on the declinations. A working Catalogue has been prepared of all the stars in Boss' Preliminary General Catalogue of magnitude $5^m.4$ or brighter between N. dec. $11^\circ 41'$ and 50° , *i.e.*, of stars which cross the prime vertical between zenith distances 75° and $11^\circ 0'$. There are 602 of these, and they are observed in the two positions East and West. The telescope is reversed on its Y s each week, when the collimation is determined. This is checked by comparison of the transits in the two positions of the instrument.

The number of transits observed in the year ending 1924 May 10 is 2,976. A preliminary discussion of the observations gives the following differences from Boss' "Preliminary General Catalogue":—

Limits of N. dec.	R.A.	Altazimuth—Boss.		Number of Observations.
		Dec. (1).	Dec. (2).	
$47\frac{1}{2}^{\circ} - 50^{\circ}$	- - - 0·11	+ 0·21	+ 0·34	92
$45^{\circ} - 47\frac{1}{2}^{\circ}$	- - - ·07	·00	+ ·13	172
$40^{\circ} - 45^{\circ}$	- - - ·02	+ ·17	+ ·30	313
$35^{\circ} - 40^{\circ}$	- - - ·01	+ ·25	+ ·37	439
$30^{\circ} - 35^{\circ}$	- - - ·01	+ ·30	+ ·41	368
$25^{\circ} - 30^{\circ}$	- - - ·00	+ ·19	+ ·30	458
$20^{\circ} - 25^{\circ}$	- - - ·00	+ ·41	+ ·50	433
$15^{\circ} - 20^{\circ}$	- - + ·01	+ ·38	+ ·45	387
$11\frac{1}{2}^{\circ} - 15^{\circ}$	- - + ·02	+ ·39	+ ·44	220

The columns (1) and (2) in the declination correspond to two different assumed values of the colatitude $38^{\circ} 31' 23''\cdot55$ and $23''\cdot42$, corresponding to the values $21''\cdot88$ and $21''\cdot75$ for the transit circle. Owing to the obliqueness of the transits above 45° dec., the corrections to the right ascensions of these stars have very little weight.

The Cookson Floating Zenith Telescope.—During the year, 227 photographs have been taken. The measurements are completed to the end of 1923, and the variation of latitude at Greenwich during the year has been published in the *Geophysical Supplement of the Monthly Notices of the Royal Astronomical Society*.

Equatorial Observations.—Both phases of the occultation of Aldebaran by the Moon were observed on October 27, and the disappearance on April 8. The transit of Mercury (egress) was observed by several observers on May 7.

The 28-inch Equatorial.—Observations of double stars have been continued during the year, and 669 observations of 391 stars have been obtained. The details are:—

34	double stars,	separation	$< 0''\cdot5$.
85	„	„	$0''\cdot5$ to $1''\cdot0$.
127	„	„	$1''\cdot0$ to $2''\cdot0$.
145	„	„	$> 2''\cdot0$.

These stars have for the most part been rarely observed in the past, and often consist of a bright star with a faint companion.

The results for stars which had been observed three times between the publication of the Greenwich Catalogue of double stars and the beginning of 1923 were given in the Volume for 1920.

A number of double stars which are being observed with an interferometer by Professor Maggini at Catania have been put on the observing list.

Thompson Equatorial.—With the 26-inch Refractor 1,010 photographs have been taken during the year for stellar parallax and 985 plates have been measured. The parallaxes of 46 stars have been determined, giving a total up to date of 241 stars.

Also 168 plates have been measured for proper motion of the parallax star in declination and 91 in right ascension. It is proposed to determine the proper motions of the stars in right ascension and declination with a probable error of $\pm 0''.002$, a few additional photographs being taken so as to have an interval of 6 or more years.

The parallaxes of 50 stars have been published in the *Monthly Notices* of the R.A.S.

The 30-inch Reflector has been used for the determination of the effective wave-lengths of stars in the Greenwich Astrographic Catalogue. 73 photographs have been taken since the date of the last Report and 56 have been measured, completing the area from the pole to declination 82° , whilst zone 81° is well advanced.

The usefulness of this method of colour classification would be increased, and the correlation of the results of different observers simplified, if they could be referred to an adopted sequence of standard stars similar to the Harvard North Polar sequence as used in stellar photometry. In accordance with a suggestion by MM. Bergstrand and Rosenberg a number of selected stars near the pole have been observed on 19 photographs taken for this purpose, and the resulting effective wave-lengths of 25 typical stars have been published in the *Monthly Notices* in a paper by Messrs. Davidson and Martin.

No photographs have been taken during the year with the prismatic camera and grating, but some progress has been made in setting up a carbon arc lamp on the roof of the octagon room to provide a comparison spectrum of a known temperature on the same plate with the stars. The photometer for the measurements of the photographs has now been completed.

Astrographic Equatorial.—The determination of proper motion by comparison of new photographs with those taken 25 to 30 years ago for the Astrographic Catalogue has been in progress throughout the year. The number of fields taken is 71 with centres at dec. 65° and 31 at 67° . Successful photographs of all the fields, with centres at dec. 65° , have been taken, with the exception of two, which were rejected when they came to be measured.

With these two exceptions the plates with centres in dec. 65° have all been measured. The measures between R.A. 6^h and 24^h have been reduced and those from R.A. 0^h to 6^h in part. The following table gives the number of stars with proper motions between certain limits in the second half of Zones 64° and 65° in the Astrographic Catalogue.

No. of Plates.	No. of Stars in Ast. Cat.	Centennial proper Motion.						
		5"-10"	10"-15"	15"-20"	20"-30"	30"-40"	40"-50"	>50"
39	10,192	533	87	38	20	7	3	1

The one star found with proper motion $>50''$ a century is of mag. $12^m \cdot 0$.

At the request of Dr. Kreiken, of the Leyden Observatory, three plates of the Pleiades have been taken, and others will be taken later for the determination of parallax of stars in this field.

Heliographic Observations.—In the year ended 1924 May 10, photographs of the Sun were obtained on 228 days. Of these 398 have been selected for preservation, including 15 with double images of the Sun for the determination of the zero of position angle. This has also been determined regularly by visual observations of the transit of the Sun's limb over the cross-wires of the Photoheliograph.

H.M. Astronomer at the Cape has reported that the Sun was photographed there on 329 days in the year 1923, and on 87 days in the first three months of 1924. The Director of the Kodaikanal Observatory has reported that plates were taken there on 317 days in the year 1923, and on 88 days during the first three months of 1924.

Photographs have been received from the Royal Observatory, Cape of Good Hope, to 1924 February 20. Photographs have been received from the Kodaikanal Observatory and also from Dehra Dun, through the Solar Physics Committee, to complete the series for 1922 and 1923.

The measurement of the combined series has been made from 1922 December 15 to 1924 January 10.

The reductions of positions and areas of spot groups and their principal components have been completed from 1922 July 1 to 1923 October 6.

During the period covered by this report, the sunspot activity has been near the minimum. A few spots belonging to the old cycle have been seen near the equator, whilst groups in higher latitudes are indicating the advance of the new cycle.

Two papers on solar faculæ have been communicated to the Royal Astronomical Society. The first deals with their occurrence and distribution in latitude; the second paper gives the sun's rotation period derived from the measurement of long-lived groups of faculæ.

III.—Magnetic Observations :—

The variations of magnetic declination, north force and vertical force have been observed photographically. Absolute observations of declination are made five or six times a week, of horizontal force twice a week, and of dip three times a week. The absolute observations and the photographic records are made in the two buildings in the Magnetic Enclosure.

The thermostat installed on 1922 April 7 continues to work satisfactorily.

The mean hourly ordinates of the declination, north force and vertical force are read off to the end of April with provisional base-lines. The reductions to the end of 1923 are completed and copy for press prepared.

The mean values of the magnetic elements for 1923 are given below, with previous years for comparison:—

	Dec. W.	Hor. Force.	Vert. Force.	Dip.
		(C.G.S. units.)		
1919 - -	14 18·2	0·18454	0·43242	66 53·3
1920 - -	8·6	· 454	· 249	53·6
1921 - -	13 57·6	· 449	· 218	53·0
1922 - -	46·7	· 447	· 176	52·3
1923 - -	35·1	· 452	· 187	51·9

In 1923 October Dr. Chree visited the Observatory for the purpose of making a comparison between the Kew and Greenwich instruments. A series of observations extending over a fortnight gave differences in the sense Greenwich—Kew of -9γ in horizontal force and $-0'15$ in dip. Comparison of the declination instruments was made subsequently through the intermediary of the new Magnetometer Casella 181 intended for use at Abinger. Declination observations were made with this instrument while it was being tested at Kew for certification, and a further series of observations was made at Greenwich. An instrumental difference of $-0'1$ in the sense Greenwich—Kew was found, with a probable error of twice this amount.

New Magnetic Observatory.—The approaching electrification of the railways in the neighbourhood of Greenwich made the removal of the magnetic observatory to another site necessary. In choosing a new site the conditions were laid down that it should be as near as possible to Greenwich, so that the new Observatory may be an out-station and kept in close touch with Greenwich by regular visits from the Superintendent of the Magnetic and Meteorological Department. It should also be sufficiently distant from existing railways to be unaffected should they be electrified, and in a place where, as far as can be foreseen, no extension of railways will be made. The site selected consists of 10 acres of land on the side of the valley known as Abinger Bottom, near Leith Hill, in Surrey. The geographical position is Lat. $51^{\circ} 11' 3''$ N., Long. $0^{\circ} 23' 12''$ W. The height above sea-level is 800 feet. The distance from the nearest railway line is $2\frac{3}{4}$ miles. The distance from Greenwich is 26 miles.

The land for the Abinger Observatory was acquired late in December, and building was commenced early in January. The suitability of the site for a

magnetic observatory was assured by observations made in September by Mr. Jones and Mr. Witchell. The buildings will be similar to those now in use at Greenwich, and consist of a wooden pavilion for absolute observations, and a house enclosing an inner chamber with thermostatic control for the magnetographs. In addition, there is a house for a resident observer, and one for the caretaker, and adjoining it an office room and a house for the dynamos and accumulators. The minimum distance from the dynamo room to the houses containing the instruments is 370 feet.

The machinery, which is required for pumping water, lighting and heating, consists of two direct-current dynamos driven by petrol motors, accumulators, and motor-alternators to transform power from the accumulators into alternating current, rendered necessary by its use in the Magnetograph and Absolute buildings. The dynamos are sufficiently far from the magnets to need but little shielding. The instruments will be similar to those now in use at Greenwich. In addition to these we hope to have a coil magnetometer of the Schuster-Smith pattern on loan from the National Physical Laboratory.

In order that simultaneous observations at Greenwich and Abinger should be commenced as early as possible, the Wooden Magnet House for the absolute instruments was built first. The instruments for declination and horizontal force were installed on March 24, and a dip-circle temporarily, pending the delivery of the dip-inductor. Since this date absolute observations have been made each day with the exception of Sundays and the Easter holidays. A preliminary comparison of the results obtained between March 24 and May 3 with those derived from the Greenwich photographic records shows the following mean differences for that part of the day (9^h to 17^h) over which the observations at Abinger usually extend:—

Abinger—Greenwich						
		Declination W.	Dip.	Hor. Force.		Vert. Force (deduced).
Difference	-	+ 7'·9	- 17'·1	+ 176γ		- 204γ
No. of observations	-	245	86	48		

Good progress is being made with all the buildings, and it is expected that the machinery and lighting and heating systems will be installed and the Magnetographs set up during the summer.

IV.—Meteorological Observations :—

The registration of atmospheric pressure, temperature of the air and of evaporation, pressure and velocity of the wind, rainfall, sunshine and cloudiness at night has been continuously maintained. A record of visibility has been kept since October at the request of the Meteorological Office and is forwarded regularly.

The potential gradient of atmospheric electricity has been registered with a radium collector and Kelvin-White Quadrant Electrometer. The sulphur insulators mentioned in last year's report continue to prove satisfactory, provided the house is kept warm and dry. Fine copper fuse wire is found to make a suitable suspension for the electrometer needle, as it maintains a steady zero.

The following details of the weather refer to the period ended 1924 April 30.

The mean temperature was $48^{\circ}\cdot7$, or $0^{\circ}\cdot8$ below the average of the 75 years 1841–1915. The highest temperature in the shade was $92^{\circ}\cdot2$, on July 11. The temperature exceeded 80° on 25 days, and exceeded 90° on 4 days. The lowest temperature was $21^{\circ}\cdot2$, on February 15. On 68 days the temperature fell as low as $32^{\circ}\cdot0$. June and November were cold months, being respectively $3^{\circ}\cdot7$ and $4^{\circ}\cdot7$ below the average for 75 years (1841–1915), while July was above the average by $3^{\circ}\cdot9$.

The mean daily horizontal movement of the air was 290 miles, which is 6 miles above the average of the 50 years 1867–1916. The greatest daily movement, 659 miles, was recorded on February 13, and the least, 42 miles, on November 26. The greatest pressure was 16·1 lbs. to the square foot on April 27. The greatest velocity in one hour, 44 miles, was registered on November 15. The duration of bright sunshine registered by the Campbell-Stokes instrument was 1,434 hours, out of a possible 4,471 hours, or 32·0 per cent.

The total rainfall was 23·90 inches, or 0·34 inch below the average for the period 1841–1915. The number of rainy days (0·005 inch or over) was 161. The wettest month was October, with 5·03 inches, and the driest month June, with 0·48 inch.

V.—Printing and Distribution of Greenwich Publications :—

The volumes for 1919 and 1920 and the separate results for these years have been distributed. In addition to the regular observations made during the year, the volume for 1920 contains ledgers of some of the double-star observations made during 1920–1923, and a comparison of the longitudes and ecliptic north polar distances of the Moon as observed, with Hansen's tables from 1851 Jan. 8 to 1922 Dec. 31.

The printing of the volume for 1921 is completed and the copy for 1922 is in the hands of the printers.

VI.—Chronometers :—

The number of chronometers and watches belonging to the Admiralty now at the Observatory is 2,896. Of this total 113 chronometers, 164 chronometer watches, 226 hack watches and 69 pocket watches are being rated. The remainder, consisting of 489 chronometers, 1,116 chronometer watches, 212 hack watches and 507 pocket watches, are kept in storage.

In addition to Admiralty chronometers there are 33 chronometers and 21 watches deposited at the Observatory for various reasons.

During the year ended 1924 April 30 a total of 2,127 chronometers and watches have been received and 2,299 issued. The number sent for repair was 1,342, namely, 1,315 for the Admiralty, 25 for the Indian, 1 for the Canadian and 1 for the New Zealand Governments.

The annual trials of chronometers and watches have not been reinstated.

VII.—Time Service :—

Two new sets of accumulators in banks of eighteen each were installed in 1923 October for use in the Time Service.

The gearing of the drums of the recording chronograph has been renewed.

The Standard Sidereal Clock Dent 1906 was cleaned during October 1923. The clock Dent 2 used as the controlled clock with the Cottingham Standard Clock is now under repair.

The Mean Time Clock Dent 2016 has been fitted with suitable control switches for the transmission of time signals to the British Broadcasting Company.

Signals can be sent to the Company's studio at 2, Savoy Hill, every half-hour, and are broadcast, usually, once during the afternoon and once during the evening. The broadcasting of time from the Royal Observatory commenced on February 5.

A precision clock of Riefler pattern, in air-tight case, and a clock with Graham Escapement, also in an air-tight case, were under test from 1923 February to 1924 March. These clocks, required for the Time Service at Mauritius, were tested at the request of the Crown Agents for the Colonies. Both clocks have given a satisfactory performance, and after inspection by Mr. Walter, the Director of the Royal Alfred Observatory, during his visit to England, were despatched for shipment to Mauritius.

Daily time signals have been sent to the General Post Office without failure. The Greenwich Time Ball has been dropped correctly at 13^h with six exceptions. On August 16 and September 15 the current failed to release the trigger apparatus; on September 16 and September 18 the ball was not raised owing to defects in the machinery; on January 9 it could not be raised owing to severe frost; and on April 7 an error was made in working the raising gear.

The Deal Time Ball was not raised owing to the violence of the wind on six days, November 10, November 15, February 13, February 14, April 2, April 3. On ten days the current from Greenwich failed to reach Deal. On these days the ball was released by hand except on two occasions. On two days, November 19 and April 24, the ball was released by hand on account of telegraphic interruptions on the line.

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

Error of Return Signal.	Portsmouth.	Portland.	Devonport.	Rosyth.	Westminster.
Not greater than 0 ^s .2 - - - -	253	239	273	164	77
0 ^s .3 to 0 ^s .5 - - - -	11	15	5	15	73
0 ^s .6 to 1 ^s .0 - - - -	1	4	1	4	70
Greater than 1 ^s .0 - - - -	0	0	0	0	72

The Westminster Clock was under repair during the periods May 18–May 30 and June 23–28. The error never exceeded $3^s\cdot 0$ on any of the 292 days on which signals were received. The clocks at Portsmouth, Portland, Devonport and Rosyth are corrected daily by the 10^h signal from Greenwich.

Wireless time signals have been received regularly from the Eiffel Tower, Nauen, Bordeaux and Annapolis, and from Moscow during the winter months. They are registered automatically on a syphon recorder operated by an oscillating valve relay system. The signals from Annapolis were recorded on 60 per cent. of the possible number of days during 1923.

The monthly means of the differences from Greenwich shown by the various wireless time-signals, using the final clock errors, and in addition correcting the Annapolis signals for lag on the land line from Washington to Annapolis, $0^s\cdot 02$ for time of travel, and $0^s\cdot 05$ for difference in the adopted right ascensions of the clock stars, are as follows:—

Month.	Rhythmic Time Signals.		Ordinary Time Signals.		
	Paris 10^h .	Bordeaux 20^h .	Paris $10^h\ 45^m$.	Nauen Noon.	Annapolis 17^h .
	s	s	s	s	s
January - - - -	+ 0·12	+ 0·14	+ 0·07	+ 0·07	+ 0·06
February - - - -	+ ·04	+ ·05	- ·03	+ ·02	·00
March - - - - -	+ ·02	+ ·02	- ·09	- ·02	·00
April - - - - -	+ ·02	+ ·03	- ·04	- ·01	+ ·01
May - - - - -	+ ·05	+ ·07	- ·02	- ·02	+ ·06
June - - - - -	+ ·02	+ ·06	- ·04	- ·09	·00
July - - - - -	+ ·08	+ ·12	+ ·02	·00	+ ·09
August - - - - -	+ ·12	+ ·12	+ ·02	·00	+ ·09
September - - - -	+ ·13	+ ·13	+ ·04	+ ·06	+ ·08
October - - - - -	+ ·13	+ ·15	+ ·08	+ ·02	+ ·11
November - - - - -	+ ·17	+ ·18	+ ·11	+ ·06	+ ·03 (3)
December - - - - -	+ ·14	+ ·15	+ ·09	+ ·08	+ ·04 (6)
Mean - - - - -	+ ·090	+ ·103	+ ·021	+ ·014	+ ·046
Number of comparisons - -	289	319	298	265	242

The sign + means late on Greenwich.

VIII.—Personal Establishment :—

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

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

Assistants.—Mr. Bowyer, Dr. Crommelin, Mr. Davidson, Mr. Witchell.

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

Junior Assistants.—Mr. Acton, Mr. Barton, Mr. Chamberlain, Mr. Cullen,
Mr. Finch, Mr. Jeffries, Mr. Martin, Mr. Newton, Mr. Rickett, Mr. Symms,
Mr. Wells.

Clerical Assistant.—Mr. Edney.

18 Computers, including 4 ladies, are employed at the Observatory.

Mr. Jones resigned the post of Chief Assistant on November 7 to take up his appointment as H.M. Astronomer at the Cape of Good Hope. He came to the Observatory on 1913 July 1, and has contributed largely to the progress of the Observatory by his instrumental skill as well as by his knowledge of mathematics and physics. He was succeeded on 1924 January 1 by Mr. Greaves, Fellow of St. John's College, Cambridge.

Mr. Wells was appointed on May 23 to fill the vacancy among the Junior Assistants. Mr. Finch was appointed on March 13.

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

Branch.	Established Staff.	Unestablished Staff.
<i>Transit Circle, Altazimuth and Zenith Telescope.</i>	Dr. Crommelin, Mr. Furner, Mr. Cullen, Mr. Acton, Mr. Symms.	Mr. Kinnear, Mr. Longley, Mr. Fellows, Mr. Davies, Mr. Stephens, Mr. Rood, Mr. Ware.
<i>Time Signals and Chronometers</i> -	Mr. Bowyer, Mr. Rickett. -	Mr. Scott, Mr. Alcock, Mr. Collings.
<i>Thomson Equatorial</i> - - -	Mr. Davidson, Mr. Martin -	Miss Faulkner, Miss Jeffries.
<i>28-inch Equatorial</i> - - -	Mr. Furner - - -	
<i>Astrographic Equatorial</i> - -	Mr. Melotte, Mr. Jeffries - -	Mr. Smith.
<i>Photoheliograph</i> - - -	Mr. Newton, Mr. Barton - -	Miss Crommelin.
<i>Magnetic and Meteorological</i> -	Mr. Witchell, Mr. Stevens, Mr. Wells, Mr. Finch.	Miss Clack, Mr. Oliver, Mr. Burridge.
<i>Secretariat and Library</i> - -	Mr. Edney, Mr. Chamberlain -	Mr. Cox.

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.

IX.—General Remarks :—

The Observatory was honoured by a visit from His Royal Highness Prince George on March 10.

In the course of the year a large number of persons have visited the Observatory, including the following astronomers :—Professors Abetti, Belopolsky, Hertzsprung, Hussey, de Sitter, Dr. Innes, Mr. Bamford, Professor Duffield, Mr. Knox-Shaw and Mr. Walter.

The establishment of the out-station at Abinger as a Magnetic Observatory will, it is hoped, secure an undisturbed site for many years for a base station in the South of England. It is with regret that the transference is being made from Greenwich, where there have been continuous observations since 1840, but there was no alternative. In the selection and acquisition of the site, and in the design and erection of the buildings and machinery, I have gratefully to acknowledge the constant help received from different departments of the Admiralty. But for this co-operation the transference of the Magnetic Observatory to Abinger could not have been carried out satisfactorily. Absolute observations are being made regularly, and it seems likely that by the end of the summer the variometers will be installed. Concurrent observations will be carried on till the railways in the neighbourhood of Greenwich are electrified.

The changes in the transit circle have only been made after serious consideration. The comparison by wireless of the determinations of time at different observatories showed differences of a quasi-systematic character which required explanation. As far as Greenwich was responsible for these differences, the most likely source of error appeared to be in the want of alignment of the long bearings of the transit circle. As the alterations were not completed till the end of March, and as some time elapses before the final determinations of clock error are received from other observatories, it is impossible as yet to say whether the anomalies have been reduced in amount.

In spite of very cloudy weather during the winter months, the number of observations has been well maintained, though a slight decrease in the number

of transit-circle observations and of photographs for stellar parallax was inevitable. All computations, except star corrections which have been kept back owing to preparation of the catalogue, as well as measures of photographs and registers, are practically up to date. In addition, arrears in the printing of the annual volume are being rapidly overtaken. It is only by the interest in their work and enthusiasm of the whole staff of the Observatory that these satisfactory results have been obtained.

F. W. DYSON.

Royal Observatory,
Greenwich.
1924 May 26