

Royal Observatory, Edinburgh
(Director, Professor W. M. H. Greaves, F.R.S., Astronomer Royal for Scotland)

This report covers the period 1945 May to 1946 February.

The participation of the Observatory in the Greenwich Time Service was terminated at the end of 1946 January. The signals radiated from Rugby at 10^h U.T. originated from the quartz clock A1 at Edinburgh up to 1945 December 22, after which date these signals were operated from Abinger. The accuracy of signal transmission referred to in the previous report was maintained, and, in fact, somewhat improved, the mean absolute measured departures of the 10^h signals from the times by the clock A1 at which it was intended to transmit them being ± 0.25 , ± 0.24 and ± 0.25 milliseconds for the months of October, November and December respectively. These figures include relay errors of feeding the signal on to the line to Rugby, errors of line transmission, errors of radio transmission at Rugby and errors of radio reception and chronographic measurement at Edinburgh. The corresponding contribution to the mean absolute error of individual 24-hour intervals defined by successive signals at 10^h U.T. would be $\sqrt{2}$ times the above figures, giving a mean of ± 0.35 milliseconds as against the value ± 0.5 milliseconds quoted in the previous report. To these errors in individual 24-hour intervals must be added the errors of general trend for which the mean absolute value quoted in the previous report was ± 0.6 milliseconds.

During the latter half of 1945 it was noticed that the clock A1 at Edinburgh and the three quartz clocks at the Post Office Radio Branch Laboratories at Dollis Hill all appeared to change their rates, as determined from transit observations, at Edinburgh and Abinger, by about the same amount (about 4 milliseconds per day) at about the same time (the middle of September). This is obviously a matter requiring careful investigation, and is receiving such at Greenwich. It is understood that the same phenomenon has been noticed at other observatories.

An investigation of the errors which affect determinations of time with the Edinburgh Transit Circle has been carried out by Mr. Symms (whose services were on loan from the Royal Observatory, Greenwich) and Miss Penny. They find a marked correlation between the individual clock errors determined on various nights and the measures of collimation error. This shows that erroneous measures of collimation contribute materially to the total probable error of a determination of time. The total probable error of a single night's time determination (using the mean of ten stars) with the Transit Circle is ± 20 milliseconds when personal equations are applied to the results from the several observers. But that part of the whole probable error not due to errors in measuring collimation and level is ± 10 milliseconds or less, this figure including the contribution due to erroneous star places. The impersonal micrometer attached to the Transit Circle is hand driven.

The Time Service equipment was dismantled and returned to Greenwich during February.

The spectrophotometric programme of the measurement of line intensities in early-type spectra, which was suspended at the end of 1940, was resumed in August. The plates are taken with the 36-inch reflector and Hilger spectrograph; they are calibrated with a multiple slit spectrograph and are measured with a Moll-type microphotometer. 39 spectra were secured during the period covered by this report.

Royal Observatory, Cape of Good Hope
(Director, Dr. J. Jackson, F.R.S., H.M. Astronomer)

Reversible Transit Circle.—The observation of standard stars for the zone -56° to -64° begun in 1944 was continued on the same plan. During the year, 6818 transits

and 6748 zenith distances were observed. The following observations were made of bodies in the solar system :—

Sun	148	Ceres	11	Jupiter	17
Moon	35	Pallas	11	Saturn	13
Mercury	74	Vesta	15	Uranus	9
Venus	118			Neptune	11

The reduction of these observations is practically up to date. The preparation of a catalogue based on the observations of 5373 Boss and Backlund-Hough stars made in the years 1936–1944 has been continued. The final positions for 1950.0 have now been obtained by application of the necessary corrections for E–W differences, flexure and pivot errors. The calculation of precession and secular variation is well in hand.

Zone Observations.—The work on the reduction of the measures for the zone -35° to -40° was restarted in July. The final positions for the first 4380 stars, i.e. up to $9\frac{1}{2}$ hours of R.A., have been computed; proper motions have also been computed for these stars.

No further work has been done for the zone -52° to -56° , but a good deal of work has been done for the higher zones in bringing up the early positions to the epoch 1950.0. As already noted the observation of standard stars for the zones -56° to -64° is being carried out. In the photographic work with the wide-angle lens 40 plates were taken for the zone -56° to -60° and 30 for the zone -60° to -64° . The Astronomer Royal has kindly undertaken to have the plates for the zone -56° to -60° measured at Greenwich.

Dr. G. G. Cillié of Stellenbosch has completed the spectral classification of as many stars as possible for the zone -30° to -35° on plates taken at the Harvard branch station at Bloemfontein. About half of the spectrum plates for the zone -35° to -40° have been taken and forwarded to this Observatory.

Victoria Telescope.—During the year 2642 plates were taken for parallax and 21 for proper motion on 237 nights. 1822 plates were measured for parallax, 54 for proper motion in declination and 20 for orbital motion. More than 7000 plates remain to be measured. A list of a hundred parallaxes has been published by the Society, and with those in hand the number of stars for which the parallax has been determined since 1926 is now 1431. Papers have been prepared on the selection of stars for parallax determination and on the motions and parallaxes of M-type stars. A paper by Dr. Stoy and Mr. Cormack has been published by the Society on the use of parallax plates for photometry. This includes the determination of the photographic magnitudes of 150 of our parallax stars.

Photometry.—During 1945 co-operation with the Radcliffe Observatory has been continued. The plates required to complete the programme for the zone -35° to -40° as outlined in the last annual report were all obtained by Dr. Redman at Pretoria before the end of May. Measurement of these plates is more than two-thirds complete. Towards the end of the year Dr. Redman started observing for a new and slightly longer programme than that just completed. This will provide plates from which the magnitudes of stars in the three zones from -52° to -64° can be derived. It will also include more plates of the E regions, the Pleiades and Southern Eros Stars. These latter plates are intended to clear up outstanding points in the derivation of standard magnitudes and in the reduction of these magnitudes to the International System.

During 1945 Dr. Redman obtained about 90 pairs of plates with the Cape cameras attached to the unfinished 74-inch reflector.

In addition to the routine work on the zone stars, a considerable effort has been expended on improving the existing sequence of standard magnitudes in the E regions. A system of photographic magnitudes based entirely on material obtained at Pretoria has been derived. This system is in excellent agreement with that of the former Cape

magnitudes after the curvature in their scale introduced by the use of diffraction gratings has been corrected in the manner suggested by Dr. Seares in his discussion of the Mount Wilson, Yerkes and Cape Observations of the Southern Eros Comparison Stars. The close agreement between the two systems gives us some confidence that we are now not far from a magnitude system that can be taken as definitive for the range with which we are concerned in the zone work and, thanks to Dr. Seares's work, that this system is not very different from the International System. The photovisual system has still to be investigated.

The Fabry disk photometer attached to the astrographic telescope has been reconstructed to render it suitable for observing bright stars and has been fitted with a number of rotating sectors to reduce the apparent brightness of the brightest stars. A new and improved tube sensitometer to standardize the plates has also been constructed. After a certain amount of experimentation a programme to determine the photographic magnitudes of all stars south of the equator whose HR magnitude is brighter than 5.0 was started in June. The observing is being done by a local amateur astronomer, Mr. H. C. Davies, who volunteered to carry out this very desirable piece of work. To simplify the observing, all stars between declinations -4° and -64° are being observed at a standard altitude of 60° . It is hoped to obtain at least four observations of each star, two when the star is east of the meridian and two when it is west. So far 241 of the 813 stars have been observed. The scale for these magnitudes is determined partly by the reduction constants of the rotating sectors and partly from calibration with the tube photometer. The zero is based on the homogeneous system of visual magnitudes that Dr. Knox-Shaw has developed from the Harvard catalogues, suitably corrected for colour by the application of the colour index appropriate to the spectral type.

The rotating sectors were calibrated under conditions similar to those in which they are used, in a series of laboratory experiments made by Mr. Cousins of Durban during a three-weeks visit to this Observatory in July and August. The values he obtained from two different methods agreed closely with the values derived by calculation from the geometric figures, combined with the assumption that the sectors rotate quickly enough to be regarded as cutting down the incident light rather than the exposure time.

The modified Schilt photometer has been in constant use and has given no trouble whatever. During 1945 just over 74,000 images were measured with it.

Photoheliograph.—The Sun was photographed on 290 days; in all 501 plates were taken including 20 for the zero of position-angle. Generally speaking two plates were taken daily throughout the first three and last three months of the year. Of the 75 days on which no plates were taken 56 were in the interval June 26 to August 20 when no plates were available. All the plates which were retained at the Cape because of risk at sea have now been forwarded to Greenwich.

Occultations.—The effort to observe all the predicted occultations has been continued. There were in all 113 observations of 58 phenomena. These include 19 observations of 9 stars on October 12 when the Moon passed in front of the Trifid Nebula. Rather more than half of these observations were made at the Observatory by amateur astronomers. The results have been forwarded to the Nautical Almanac Office together with 25 observations made by other amateur observers in South Africa.

There has again been close co-operation with other astronomers in South Africa, both amateur and professional. The co-operation has been specially important in photometry for the determination of standard sequences and in our zone work. Also the determination of spectral types for stars in our zones should add considerable value to the results. Mr. de Kock has continued the active observation of long-period variables in the southern hemisphere, making 3872 observations of 105 stars. Mr. W. P. Hirst has observed double stars with the 7-inch refractor now mounted in the heliometer dome.

Four members of the staff who were away on duties connected with the war returned to the Observatory during the year. The staff is still four short of the full complement.