

## 8. COMMISSION DE L'ASTRONOMIE MÉRIDIENNE

PRÉSIDENT: Sir FRANK DYSON. *Astronomer Royal of England, Director of the Royal Observatory, Greenwich, England.*

MEMBRES: MM. Aiginitis, Armellini, Bemporad, Boss, Carnera, de Sitter, Dneprovsky, Dodwell, Fayet, Gonnessiat, Gyllenberg, Hins, Jackson, Jeffers, Jones, Kopff, A. Lambert, Moreau, Morgan, Oom, Perrine, Stewart, Zimmer.

Since the last meeting of the International Astronomical Union, much attention has been given both in Germany and America to the systematic errors of the fundamental catalogues of Boss and Auwers. This is of special importance if the proper motions of any of the stars are to be used in the verification of the rotation in the plane of the Milky Way. The periodic errors in the proper motions, both in right ascension and declination, are of significance in this connection, while the motion of the equinox is required for the determination of precession, and the systematic correction to the proper motions of declination affects the position of the Solar Apex and the Vertices of the Star Streams.

By a discussion of the observations of the Sun, Moon, Venus and Mercury at a number of observatories, the correction to the equinox of Boss's Catalogue has been found by Morgan to be  $-0^{\circ}.042 - 0^{\circ}.007 (T - 1900)$  and by Kahrstedt to be  $-0^{\circ}.048 - 0^{\circ}.007 (T - 1900)$ , results which are in good agreement. For the declinations the agreement is not so good. Different authorities give corrections at the equator varying from  $+0''.2$  to  $+0''.5$ , with somewhat larger values at  $+30^{\circ}$  dec. and  $-45^{\circ}$ . The difficulties are in the multiplicity of corrections, latitude, flexure, refraction, differences between day and night and the personal difference of the observer whether near his zenith he looks North or South. Attention was drawn at the last meeting of the Union to the desirability of using the planet Vesta for this purpose: Leveau's Tables are good but not sufficient. It is satisfactory to learn that Mr Eckert is occupied with the computation of new tables using Cowell's method. The fact that Vesta at opposition is of magnitude 6.5 and to all appearances like a star makes it preferable to the Sun, Mercury and Venus, which have serious drawbacks. Another favourable case is presented by the planet Ceres for which computations have been started by Mr Subbotin in Russia.

It was stated that Newcomb's precession will continue to be used by the leading authorities in America, France, England and Germany.

The attempt to determine the position of the Equator by means of azimuth observations is being put into operation by Prof. de Sitter. Two observers, Dr Hins and Mr van Herk, sailed from Amsterdam on July 14, 1931, and set up their instrument near the railway station "Equator" in Kenya (Long.  $2^{\text{h}} 22^{\text{m}} 10^{\text{s}}$  E., Lat.  $-0^{\circ} 0' 43''.5$ ). The observations are made at zenith distance  $82^{\circ}$  to  $83^{\circ}$ , and the seeing and weather conditions have been found to be satisfactory. The results will be awaited with interest. The following Preliminary Report has been received from Prof. de Sitter on the expedition of the Leiden Observatory to the Equator for the determination of systematic corrections of our fundamental declinations.

The azimuth instrument constructed by Messrs Cooke, Troughton and Simms at York was received at Leiden in December 1930. The instrument was thoroughly investigated, the division errors of the horizontal circle were determined, and some additions and improvements were made in our workshop. The expedition consisting of Dr Hins and Dr van Herk sailed from Amsterdam on July 14, 1931, and reached Mombasa on August 15. The station selected is on a piece of government land adjoining "Canada Farm" near the railway station "Equator", its approximate co-ordinates being: longitude  $2^{\text{h}} 22^{\text{m}} 10^{\text{s}}$  E., latitude  $-43''.5$ , altitude 9150 feet.

The observers arrived at Equator on September 15. The building of the piers and huts for the azimuth instrument, zenith telescope, chronograph, wireless receiver and electrical installation, and of the living rooms took considerable time. The first wireless time signals (Bordeaux) were received on November 15 and the first astronomical observations were made on November 19.

The programme consists of two sets of about 240 stars, each containing one star in every hour of right ascension and every ten degrees of declination from  $-50^\circ$  to  $+50^\circ$ , supplemented by 24 equatorial stars (one in each hour), some of which also belong to the ordinary programme. Altogether there are 482 stars, and it is intended to observe each of these twice near the eastern horizon and twice in the west. These four observations of each star will thus give two series of 96 determinations of the systematic correction to Boss' declinations for each zone of  $10^\circ$ . The seeing is generally good practically down to the horizon (good pointings can often be made on Polaris), but to avoid clouds near the horizon, which often occur in some azimuths (especially S.W., over Lake Victoria), the regular observations are all made at an altitude of  $7^\circ.5$ . Although the clear nights are not nearly so numerous as we were led to expect from previous meteorological information, it seems probable that within the time at their disposal Drs Hins and van Herk will succeed in completing one of the two series of 240 stars, and the greater part of the second series, though some stars of the latter may finally have only one observation east or west.

A complete observation consists of three pointings of the eye-end micrometer, a reading of the circle by two microscopes (the preceding and following division being bisected in each) and a reading of the level in two positions, reversal of the whole instrument and repetition of the same readings. On good nights from twelve to twenty stars are observed, in addition to four or six of the equatorial stars.

There is a meridian mark, at a distance of about 300 metres, which is observed through a collimating lens fixed on the dew-cap, two or three observations being made on each night. The 24 additional equatorial stars are observed in pairs at an altitude of  $45^\circ$ , one east and one west, differing 6 hours in R.A. These observations are made with the special purpose of determining the zero of azimuth.

It is not yet possible to give any actual results. Dr Hins gives the following preliminary estimates of the mean errors of one observation:

Declination: $+10^\circ$ to $-10^\circ$	m.e. $\pm 0''.87$	}	$\pm 0''.76$
$\pm 10$ to $\pm 20$	$0''.74$		
$\pm 20$ to $\pm 30$	$0''.66$		
$\pm 30$ to $\pm 40$	$0''.90$	}	$\pm 1''.16$
$\pm 40$ to $\pm 50$	$1''.43$		

The stability of the instrument appears to be nearly perfect, but the determination of the collimation has revealed some as yet unexplained anomalies, which it is hoped will soon be traced to their source and remedied.

The present expedition is intended only to give the method a thorough test, and, so far as we can see now, this object will be fully attained. In order to arrive at a definitive *determination* of the systematic errors in our system of declination a much longer stay at an equatorial station would be necessary. For several reasons, of which the most important are of a financial nature, this must be deferred to a later occasion.

The success of the expedition in a trying climate, with many difficulties due to the great distance from inhabited centres, and with an entirely new method and instrument, is entirely due to the enthusiasm, perseverance and skill of Dr Hins with the very able assistance of Dr van Herk.

Observations of the Moon are sufficiently provided for at a few observatories, in view of the observations of occultations which the Wireless Time service has brought within the scope of amateur astronomers.

For the determination of the proper motions of faint stars in Kapteyn's Selected Areas, the co-operative scheme of the Union for the observation of reference stars has been completed. Observations made at Leiden, Bonn and Berlin-Babelsberg have been published, while those made at Paris and Strasbourg have been sent to Leiden and the reduction of those taken at Bordeaux is nearly completed.

During the present century a very large number of stars have been observed for the determination of the constants of the catalogue plates of the Astrographic Chart and other purposes. The Paris Observatory has recently published a catalogue of 16,000 stars for this purpose, and during the present century the Southern Observatories have made many thousands of observations from  $-30^{\circ}$  to  $-82^{\circ}$ . Probably this is the last occasion on which so large a number of faint stars will be observed by meridian instruments. The success attained by the wide-angle lenses introduced by Prof. Schlesinger in the zones  $-2^{\circ}$  to  $+1^{\circ}$ , and  $50^{\circ}$  to  $55^{\circ}$ ,  $55^{\circ}$  to  $60^{\circ}$  has shown that, with suitable reference stars, the positions of all stars of photographic magnitude  $9^m.0$  to  $10^m.0$  can be readily obtained. The German observatories are adopting this method for the re-observation of the stars in the catalogue of the Astronomische Gesellschaft. Photographs are being taken at Pulkovo, Hamburg and Bonn on plates covering 25 square degrees, and the reference stars are 13,755 taken from the two catalogues of Küstner. Each star is observed at three observatories, all of them at Hamburg and Berlin, while Breslau, Pulkovo, Bonn, Leipzig and Heidelberg are sharing the list of stars between them.

Prof. Schlesinger is using a telescope covering  $12^{\circ} \times 12^{\circ}$  on the same problem. On so large a field there are many more reference stars, and by use of a wire grating the diffraction images of brighter stars may be used. This avoids the meridian observation of the fainter stars which were placed in Küstner's Catalogue largely for the purpose of determining magnitude equation.

The observations at St Louis have been published in succession to those at Albany. The revision of Boss's *Preliminary General Catalogue* and its extension to all stars of  $7^m.0$  and brighter with some additional stars of fainter magnitude in sparse regions of the sky is in progress, and will, we may hope, be published before the next meeting of the Union. The *Preliminary General Catalogue* has been of great value in co-ordinating meridian astronomy. The hope may be entertained that continuous observations of these bright stars of the new catalogue will be made at many observatories. If this were done the fainter reference stars required for observations of Eros, for example, might be obtained from large-scale photographs, containing as much as  $5^{\circ} \times 5^{\circ}$ . Some of the reference stars in the last observations of Eros were beyond the limits of most meridian instruments, except under specially good conditions of seeing. It would seem to be quite feasible to keep 30,000 stars under observation; all meridian instruments would be able to contribute—some differentially, others fundamentally. It is suggested that meridian work may be confined to these brighter stars, and photography link up the stars down to magnitudes 9 or 10, and thus down to still fainter stars, such as the Selected Areas, etc.

The reference stars for the opposition of Eros last year have been observed at the observatories of Algiers, Babelsberg, Cincinnati, the Cape, Cordoba, Greenwich, Hamburg, Heidelberg, La Plata, Leiden, Lick, Padua, Uccle and Washington. The observations have been combined at the Rechen-Institut at Berlin, and a catalogue of 419 stars for 1930 with proper motions was published in the *Astronomische Nachrichten* in March, and a further catalogue of 402 stars was published in December 1931.

A catalogue of Zodiacal stars is under construction at Washington for the use of observers of occultations. It may be recalled to memory that in 1899 David Gill published a list of 2798 Zodiacal stars. These were observed in the early part of the century at eight observatories, but the observations were never collected into a single-catalogue. Along with more recent observations at the Cape, Washington, Heidelberg, and Pulkovo, this very desirable catalogue is being prepared.

The reduction by Dr Knox-Shaw and Dr Jackson of Hornsby's observations made at Oxford in the years 1774-1798 has been published. They consist of fundamental stars and many observations of the Sun, Moon and Planets. Dr Jackson is comparing the observations of Mercury with Newcomb's tables. There is a perfect agreement for the perihelion positions. It is desirable that similar comparisons be made for Venus.

In continuation of the reduction of earlier observations, the Paris observations from 1882-99 have been published for the first twelve hours. Oeltzen's observations, 26,060 stars observed in the years 1856-8, have been published by the late Prof. Hepperger. These stars all lie between  $14^{\circ} 57'$  and  $20^{\circ} 44' N$ . Dec.

The *Geschichte des Fixsternshimmels* has been published as far as  $16^h 0^m$ . A valuable addition to this work is *Index der Sternörter* by Dr Schorr which gives references to observations made in the first quarter of this century.

The *Geschichte*. The usefulness of these collections has been shown by the determination of many proper motions at the Hamburg Observatory.

The following suggestions have been put forward for discussion by the Commission.

(1) Que les Observatoires ayant un service méridien se mettent d'accord:

(a) Pour dresser et observer une liste d'étoiles, analogue en nombre et en répartition à la liste de Backlund-Hough, et devant servir de fondamentales nouvelles. Ces étoiles, choisies à mouvement propre faible, rattacheront les fondamentales classiques aux étoiles de magnitude 7 à 9 dont les positions très exactes sont nécessaires aux travaux de la Carte du Ciel.

(b) Pour dresser et observer une liste d'étoiles devant permettre, suivant un plan proposé par M. Mineur de l'Observatoire de Paris, de déterminer le mouvement propre d'étoiles très éloignées de la zone galactique.

Dans une première partie de ce travail très étendu, on se limitera à la portion centrale de la galaxie ( $\pm 1^{\circ}$  de latitude galactique), ce qui correspondra à une liste de 7000 étoiles environ (10 par degré carré). Le choix portera:

Sur les étoiles de repère du Catalogue photographique se trouvant dans la zone galactique.

Sur les étoiles de classe spectrale O et B, les géantes et les céphéides, qui sont dans l'ensemble les étoiles les plus éloignées.

Et, s'il est nécessaire pour atteindre le chiffre de 10 étoiles par degré carré, sur des étoiles dont on connaisse de bonnes positions méridiennes antérieures.

Ces observations sont destinées à connaître la position et surtout le mouvement propre des astres de la liste.

Ensuite, leur mise en œuvre suivant les procédés usuels, dans la comparaison de clichés photographiques pris à des dates différentes, permettra de calculer les mouvements propres des étoiles très éloignées, si nécessaires aux recherches contemporaines sur la galaxie. (Lambert.)

(2) The desirability of confining meridian observations to brighter stars. (Dyson.)

F. W. DYSON

*President of the Commission*