

8. COMMISSION DE L'ASTRONOMIE MÉRIDienne

PRÉSIDENT: M. J. Jackson, *H.M. Astronomer, Royal Observatory, Cape of Good Hope.*

MEMBRES: MM. Armellini, Boss, Carnera, Mme Chandon, MM. Courvoisier, da Gama, Danjon, Dneprovski, Dyson, Fayet, Gyllenberg, Hins, Jeffers, Jones, Kopff, A. Lambert, Moreau, Morgan, Schorr, Stewart, Zimmer.

Since the last meeting of the Union, Sir Frank Dyson, who for forty years had devoted himself to the advancement of meridian astronomy, has resigned the position of president of the Commission. The Executive Committee have done me the honour of inviting me to fill the vacancy.

I have sent a circular letter to all members of the Commission asking for a report on the meridian astronomy being carried on in the institutions with which they are connected, and for suggestions of subjects which might be discussed in Paris. In some countries, particularly Germany and U.S.S.R., there are a number of observatories carrying on meridian astronomy but not represented on the Commission, and I have asked the representatives of these countries to send me details of the work of the various institutions in their countries. The following report is largely based on the replies I have received.

A most important subject is naturally that of fundamental stars. There is now general agreement as to the constants to be used in the reduction of meridian observations, precession, nutation, aberration and to a lesser extent refraction, but with regard to the positions and proper motions no such uniformity at present exists. It would be of the greatest service to astronomy if all observational catalogues could be on the same fundamental system—both for the use of astronomers who require occasional star places in the reduction of observations of comets etc. and in general work on the determination of proper motions. In the meantime the directors of the various national almanacs have been discussing the question of uniformity of adopted star places, and it is hoped to hold at Paris a joint meeting of Commissions 4 and 8 to discuss the matter. Now that the New Fundamental Catalogue has been revised at the Rechen-Institut and the *Albany General Catalogue* will soon be available, it should be possible to establish greater uniformity. Morgan has suggested that we “recommend that observational catalogues publish, if possible, in their introductions comparisons with the fundamental catalogues FK₃ and the new *Albany General Catalogue* (now in course of construction)—the comparisons to be grouped every five degrees and every three hours, more or less, and the motions of the fundamental catalogue to be used for difference in epoch and equinox”.

With regard to the stars to be used as fundamentals it will be necessary to retain the bright stars for daytime observations. Kopff urges that double stars with separation between 0".5 and 5".0 be abandoned, except for a very few stars which can be observed in daylight. Schlesinger wishes a list of fundamentals, not so bright as those generally used, to be established for use in determining accurate star places by photography. If an open grating is placed over the objective, measurable first order spectra are obtained for stars fainter than magnitude 5.5, but those of brighter stars are unsuitable for measurement. In this connection Kopff intends to set up a Fundamental Catalogue of Faint Stars, between the seventh and ninth magnitude. This catalogue will consist of about 3000 stars uniformly distributed over the sphere and should form a foundation for the reduction of star places, determined by photography, in a common system. Dneprovsky also writes that “a

programme of fundamental observations of faint and remote stars is being prepared at Pulkovo”.

At this stage we might refer to the actual scope of the Commission. Although it is called the Commission on Meridian Astronomy, it is generally considered as dealing with the determination of accurate positions and proper motions of the brighter stars, whether these depend on meridian observations or not, so long as the observations are reduced to right ascension and declination. But how bright should the stars be, or rather how many should there be? Or again at what point should visual observations give place to photographic? To a certain extent the answer must depend on the individual astronomer and the equipment at his disposal. Many members are inclined to the view that photography should take over as much as possible of the work, leaving the visual observers to do what cannot be done by photography, viz. the determination of the accurate positions of fundamental stars and as many stars as are necessary for the reduction of plates covering 25 square degrees or even more. This plan is recommended on grounds of economy both in money and observing time, and also on grounds of accuracy. It is of course a plan for mass production, and it would avoid the necessity for observing stars fainter than about magnitude 8.5 with meridian circles. The ideal seems to be to observe a system of fundamental stars, and then to tie on to these the reference stars required for the reduction of photographic plates, choosing stars bright enough to be clearly seen in the meridian instruments, but faint enough to give good measurable images on the photographic plates. On the other hand it has been suggested that there is a controversy as to whether stars of the eighth and ninth magnitude should be observed visually or photographically. It appears to me that this question can be left to settle itself. Any accurate visual observations which are available will be useful for reducing photographic plates, and it was largely because of the difficulty of getting accurate modern places that Schlesinger has developed the use of plates covering a very large field.

For myself I do not like the observation with the meridian circle of stars near the limit of visibility, which can only be clearly seen on very fine nights. The introduction of the self-registering micrometer has made it impossible to observe such faint stars as formerly. At the Cape there are many nights in summer, on which the sky looks wonderfully transparent, when the definition practically cuts out stars fainter than the eighth magnitude. Nevertheless some observers can go below the ninth magnitude. As examples we may note the programmes recently carried out on standard stars for the Kapteyn Selected Areas, and on Eros comparison stars. The results for 1200 standard stars in the northern Kapteyn Areas have a probable error of only $\pm 0''.10$ in the positions and $\pm 0''.007$ in the proper motions (*Annals of Leiden Observatory*, 15, pt 4). Hins suggests that these standard stars may be retained for reobservation with meridian circles in the future. As they are amongst the faintest stars which can be observed visually, and as they have been observed in the past this suggestion seems a reasonable one, if it is considered advisable to observe such faint stars with meridian circles in the future.

There is still plenty of work for the meridian circles in use—and their number does not tend to increase much if at all. Besides the observation of fundamental stars, of all stars down to 7.5 or 8.0, of fainter stars to give say one star per square degree, there are special stars not suitable for photography—double stars, red stars, variable stars. As indicated later in this report, several observatories are undertaking the visual observation of such stars. As examples of co-operation between visual and photographic observers we may mention that Berlin-Babelsberg has

undertaken the visual observation of all stars of the A.G. Catalogues which cannot be measured on the photographs (1616 stars) and that Lick Observatory is considering the observation of the A.G. stars in the Zone $+20^\circ$ to $+30^\circ$ which were not measured on the Yale photographs.

Use of Minor Planets. At previous meetings of the Union the possibility of using minor planets to determine corrections to the equator point and the equinox has been pointed out, together with the advantages they offer as compared with the bright inner planets. As a result of these discussions Vesta has been observed with meridian instruments at a number of observatories. This planet was considered the most suitable on account of its brightness and the fact that a general theory of its motion was available, although the latter comes nowhere near the accuracy required. For the computation of an accurate ephemeris numerical integration will be required and in this respect Vesta offers no advantages compared with other minor planets. Dneprovsky has considered the use of the four brightest of the minor planets and while pointing out the difficulties of observation with meridian circles, of getting adequate material in a reasonable time and of making the necessary calculations, he concluded that the work must be undertaken to solve the problem of the equator point. Further possibilities of the method were examined by Numerov who suggested the use of ten minor planets to be observed both visually and photographically for determining the systematic errors of the assumed star places in the form

$$\Delta\alpha = a + b \sin \alpha + c \cos \alpha + \dots$$

$$\Delta\delta = a' + b' \sin \alpha + c' \cos \alpha + \dots$$

The scheme has been critically examined at Yale Observatory where an actual plan of campaign has been drawn up, involving the observation of fourteen minor planets, photographically, over the ten years 1936-46 at two stations. The minor planets have been chosen as bright as possible, consistent with a fairly uniform distribution of the positions of opposition, in R.A. and Dec. throughout the zone from -30° to $+30^\circ$. The plan would involve the taking of about 2000 photographs at each station, for the determination of 164 unknowns (including, for both $\Delta\alpha$ and $\Delta\delta$, first and second harmonics with regard to α in each of six zones of declination). The scheme would undoubtedly involve a great deal of labour, but the problem is one of first-rate importance. "The observational programme is being actively considered. Observing will probably begin within a year. Constructive criticism will be welcomed" (Brouwer). (See Dneprovski, *Poulkovo Bull.* 112; Noumerov, *Bull. of Leningrad Astr. Inst.* 32; Brouwer, *A.J.* 1022.)*

* *Addendum.* Since the above was written a most important paper by N. Voronoff has appeared in *A.N.* 6092-3. In it the general theory of the motion of Vesta as developed by Leveau has been revised and extended to include perturbations of the second order of the mass of Mars and the third order of masses of Jupiter and Saturn. The theory is believed to be exact to $0''.01$ or $0''.02$ and has been compared with observations from 1807 to 1932. Corrections are found to the orbital elements of the Earth and Vesta, to the masses of Mars, Jupiter and Saturn and to Boss's system of Right Ascensions and Declinations. These latter corrections take the form:

$$\Delta\alpha = -0''.046 + 0''.000 (T - 1900) - 0''.001 \sin \alpha + 0''.002 \cos \alpha,$$

$$\Delta\delta = +0''.315 + 0''.166 (T - 1900) - 0''.019 \sin \alpha + 0''.016 \cos \alpha.$$

The residuals of Leveau's theory and the revised theory are given for each opposition.

The new residuals are small and after 1826 rarely exceed $0''.2$ and are generally under $0''.1$. Further details of this application of observations of a minor planet to derive corrections to a system of star places are awaited with interest.

Fundamental Catalogues. It has already been mentioned that the New Fundamental Catalogue (NFK) of Auwers (prepared by J. Peters, *Publication of the Astronomisches Rechen-Institut*, No. 33) has been revised at Berlin. For the derivation of the revised catalogue (to be known as FK3) see *A.N.* 244, p. 33, and 247, p. 213. It may be noted that Morgan (*A.J.* 987), from about 30,000 observations of the sun, moon and planets made at several observatories during the past 35 years, agrees with the equator point of FK3. There had been general agreement that the correction of about $-0^{\circ}.05$ to the equinox was required. (See Morgan, *A.J.* 969.)

A provisional publication of FK3 is given in the *Berliner Jahrbuch* for 1936 where the corrections to reduce NFK to FK3 are given for 1925.0, 1934.5, 1935.5 and 1936.5 as well as the positions and motions for 1950.0. FK3 will be used for the first time in the *Berliner Jahrbuch* for 1940, but for the intermediate years reduction from NFK to FK3 will be given. A complete publication with a detailed introduction is in preparation. It will give a comparison with other fundamental catalogues for the epochs 1925 and 1950.

An extension of FK3 is planned. It is intended to remove 52 unsuitable double stars, while it is proposed to introduce 630 additional stars not near the poles, and 16 additional stars within 9 degrees of each pole. These additional stars are given in the *Berliner Jahrbuch* for 1936. Several observatories have indicated their intention of observing them.

The completion of the *Albany General Catalogue* containing about 32,000 stars is expected soon and it is hoped that it will be in close agreement with FK3. In preparation for its publication a catalogue of 15,333 stars observed at San Luis in South America and another of 20,811 stars observed at Albany have been published (1928 and 1931). These catalogues contain all stars down to 7.0 supplemented by fainter stars selected for inclusion in the General Catalogue. There is a wide overlap in the observations made at the two stations, the observation of fundamental stars at Albany being extended southward to the zenith at San Luis.

Fundamental Stars. Fundamental observations and observations of fundamental and Boss stars are being carried out with meridian circles at many observatories including Berlin, Cape, Cordoba, Greenwich, La Plata, München, Ottawa, Strasbourg, Uccle, Washington (two instruments). In several cases series of observations are completed and nearly ready for publication. Generally the sun and planets are also observed.

In U.S.S.R. an extensive scheme of co-operation is being carried out with meridian circles, at Pulkovo, Moskva, Nikolayev, Kharkov and Kazan, Bamberg transits at Pulkovo, Tashkent and Kharkov and a zenith telescope at Kazan. Catalogues of fundamental declinations have been published from Pulkovo and Kazan Observatories and from the Astronomical Institute, Leningrad.

In addition to these observations with meridian instruments, observations to determine the systematic errors of our fundamental systems have been carried out with special instruments. The observations made with an azimuth instrument by observers from Leiden at a station very near the equator were finished in 1933. The reduction of the observations is nearing completion and it is hoped that the corrections to Boss's system will be available before the meeting. The mean error of the zero point in azimuth for an average night is $\pm 0^{\circ}.39$. It is intended to use the same instrument at stations near latitudes 35° North and South. At Berlin-Babelsberg observations are made with an instrument for measuring large angles, of stars 90° distant from α Herculis, near the solar apex.

Backlund-Hough Stars. Observations of these stars have been made at many

observatories, including those carrying out observations on fundamental stars, and many of the resulting catalogues have been published. A catalogue of right ascensions based on observations made at Pulkovo, Greenwich, Washington, Cape, Paris, Alger and Uccle has been formed at Pulkovo and is now in the press. *Annales d'Uccle*, 3ème série, Tome II, Fasc. 4, contains observations of 1339 Backlund-Hough stars. Another catalogue giving the right ascensions of 1903 Backlund-Hough stars north of Dec. -30° from observations made at Nicolajeff is in the press. Further observations of the Backlund-Hough stars are being made at Ottawa and Washington.

Zone Observations by Photography. As is well known, Schlesinger initiated the accurate determination of star places by photography using lenses covering a field of $5^\circ \times 5^\circ$ or more. So far the observations for the following A.G. zones have been published by him and his colleagues: -2° to $+2^\circ$, $+50^\circ$ to $+55^\circ$ and $+55^\circ$ to $+60^\circ$ from plates covering 25 square degrees and $+20^\circ$ to $+25^\circ$ and $+25^\circ$ to $+30^\circ$ from plates covering 140 square degrees. This method of determining star places in bulk and in particular of deriving modern places and proper motions of stars previously observed visually has commended itself to many astronomers. Under the auspices of the Astronomische Gesellschaft the German and Russian astronomers have undertaken the complete reobservation of all the A.G. zones north of declination -5° . The observations for the determination of the positions of some 13,700 reference stars have been completed at Berlin-Babelsberg, Bonn, Breslau, Hamburg, Heidelberg, Leipzig and Pulkovo, while those made at Berlin-Babelsberg have been published. The reduction and co-ordination to the system FK3 have been undertaken by the Rechen-Institut. Simultaneously with the meridian observations the photographs have been taken and considerable progress has been made with the measurement. As already noted, stars in the original A.G. catalogues which for any reason cannot be measured on the plates are being observed visually at Berlin-Babelsberg.

Schlesinger has undertaken the area from -2° to -30° and already the plates each covering 110 square degrees have all been taken and the measurement of those between -10° and -20° is nearing completion.

The Cape Observatory is dealing with the region south of -30° , using plates with an area of 25 square degrees. For -30° to -35° the plates have been taken and a commencement has been made with the measurement. At the same epoch as that of the photographs the positions of 1686 comparison stars were determined with the transit circle. Work on the zone -35° to -40° has been commenced, both visually and photographically. When this zone is completed it is proposed to take up the area south of -52° , as the region from -40° to -52° is well covered by the Cape Astrographic Zones. The R.A.'s and Decs. of over 40,000 stars in the C.A. zones have been determined from photographs taken near the beginning of the century and the proper motions from more recent photographs. The copy for press of these results is completed.

It is proposed to reduce the observations made with the wide-angle lenses to the equinox of 1950, although those previously published by Schlesinger were for the equinox of the original A.G. catalogues, 1875.

To simplify the derivation of Right Ascension and Declination from rectangular co-ordinates special tables have been prepared at Berlin and Hamburg. These tables are very suitable for use with plates covering an area $5^\circ \times 5^\circ$ and with the scale of 100" to the mm. The tables are: *Tafeln zur Verwandlung von rechteckigen Platten-Koordinaten und sphärischen Koordinaten ineinander*, von J. Peters.

Veröffentlichungen des Astronomischen Rechen-Instituts zu Berlin-Dahlem, No. 47 (1929) and *Formeln und Hilfstafeln zur Reduktion Photographischer Himmelsaufnahmen*. 2 Teil. *Sammlung von Hilfstafeln der Hamburger Sternwarte in Bergedorf*. H. (1934).

Zone Observations. The Zone from $+32^\circ$ to $+64^\circ$, including all stars down to magnitude 8.0, has been observed at Greenwich and the results published. Observations of stars for the region from the equator to $+24^\circ$, down to magnitude 7.5, are now being made there. At the Cape Observatory stars down to magnitude 7.5 have been observed from declination -30° to the south pole, while similar stars between the equator and -30° are now being observed.

The observation of 2000 stars in the Zone $+50^\circ$ to $+55^\circ$, for which only one position is given in the *Geschichte des Fixsternhimmels*, has been completed at Königsberg i/Pr. Meridian observations of double stars in the Zone $+50^\circ$ to $+60^\circ$ are now being undertaken there, while similar stars in the Zone -8° to -16° are being observed at München.

Vol. 41 of the *Publications of Poulkovo Observatory* is a Catalogue of 3396 stars for 1910 between declinations $+39^\circ$ and $+46^\circ$.

A catalogue of 784 reference stars for the Paris Astrographic Zone $+18^\circ$ to $+24^\circ$ has been published by Paris and Uccle, working in collaboration. It is proposed to continue the observation of stars for this Zone at Paris.

The results of a reobservation of reference stars for the Zone $+10^\circ$ to $+18^\circ$ have been published by Bordeaux Observatory.

Observations of reference stars for the Zone -10° to -20° have been completed at Washington and the results are ready for printing.

Extensive zone observations to magnitude 9.0 of the C.P.D. scale have been carried out at La Plata as follows:

- -47° to -52° . 4800 stars. Observations commenced.
- -66° to -72° . 4266 „ Catalogue to be published this year.
- -72° to -82° . 3578 „ Observations completed, but reduction will take a year.

Zodiacal Stars. A new catalogue of these stars is being prepared at Washington. In its preparation recent series of observations made with the two transit circles at the Naval Observatory, Washington and with the reversible transit circle at the Cape will be incorporated. A catalogue of 640 stars has been published from Kiev. Faint Zodiacal stars are being observed at Leiden.

Galactic Stars. At the meeting of the I.A.U. in 1932 a scheme was proposed by Mineur for the observation of distant stars near the galaxy for the purpose of determining their proper motions. This scheme was approved by the Commission. A first list of 4799 stars within $1\frac{1}{2}^\circ$ of the galaxy has been prepared by A. Lambert and distributed from the Paris Observatory. An additional list of 394 stars in Kapteyn Areas within 15° of the galaxy has been prepared by Stroobant. These stars refer to the part of the galaxy, observable from northern observatories, from Dec. -15° to $+64^\circ$. Relatively few stars are fainter than magnitude 9.0. Observations on this programme have been or soon will be commenced at Paris, Uccle, Besançon, Bordeaux, Rome and Strasbourg. So far no provision has been made for observations south of -15° , say between R.A. $7^h 13^m$ and $18^h 7^m$. It may be noted that the Cape Astrographic Zone (see Zone Observations by Photography, above) is traversed by the galaxy from $8^h 28^m$ to $9^h 32^m$ from $15^h 48^m$ to $16^h 52^m$ and covers about 32° of galactic longitude along the central line.

Eros Reference Stars. The positions of the first order reference stars for the opposition of Eros 1930–31, resulting from a combination of observations at many observatories, were published in *A.N.* 5781–2, 5852–3. The observations made at a number of observatories, Berlin-Babelsberg, Lick, Strasbourg, Washington, have been published separately.

The *Zweites Bergedorfer Sternverzeichnis* 1930·0 contains the positions of 4599 Eros reference stars of the second order derived from photographic plates.

Stars near the Poles. There is always a difficulty in determining the positions of stars near the poles. Hence the original A.G. Catalogue did not go north of Dec. +80°. At the Cape stars near the south pole have been observed by tapping off transits of the wire driven at equatorial speed over the star, and in addition observations of a selected list were made with the heliometer. The photographic plate offers the best solution of the problem but even then reference stars must be observed. It is possible to observe stars with the self-registering micrometer to a high declination (say 3° or even less from the pole) and this method which seems best to the writer is being followed at Ottawa, and has been used at Greenwich. Ten stars in the Kapteyn Area near the north pole are being observed at Berlin-Babelsberg in connection with the very close polars B.D. 89°, 3 and 89°, 37. Further observations of these close polars and B.D. 89°, 1 are planned there with the vertical circle at different hour angles. Stars in the Kapteyn Area and other stars near the pole are also observed at Leiden.

The fundamental programme at Pulkovo and Nikolayev includes additional polar stars. Observations of close polars have also been made at München.

Miscellaneous Observations. At Leiden the observation of a number of stars round θ Tauri has just been completed.

Mostly variable stars are being observed at Lund.

Danjon at Strasbourg proposes to observe early type stars (to A 5) over the northern sky in the R.A.'s not covered by the stars near the galaxy.

Red stars and stars of type O have been observed at Pulkovo and Kiev.

Stars of large proper motion from Van Maanen's list (*Ap. J.* 41) are observed at the R. Osservatorio Astronomico at Rome.

Publications. Besides those previously mentioned or indicated above, the following catalogues have been published:

- (1) Paris. *Catalogue complémentaire des Étoiles de Lalande* (2ème et dernier volume, 1933).
- (2) Uccle. *Catalogue of 784 reference stars for the Paris Zone +18° to +24°* (1932).
- (3) *Publications of the U.S. Naval Observatory, Washington*, 13. This volume contains the results of fundamental observations with the 9-inch transit circle of the sun, moon and planets, 1913 to 1925, and a catalogue of 10,571 standard and intermediary stars.
- (4) *Right Ascensions of 1334 stars from the 2nd to the 6th magnitude, together with 316 reference stars*—Pulkovo Publications, 39.
- (5) Francesco Porro. *Fondamenti delle Riduzioni per un Nuovo Catalogo di Stelle dedotto dalle Osservazioni di Giuseppe Piazzi a Palermo* (1792–1814).
- (6) Observatoire d'Abbadia. *Cinquième Catalogue comprenant 1275 Étoiles dont 669 Fondamentales de +45° à -26°*.

Geschichte des Fixsternhimmels, giving the positions of stars observed up to 1900 reduced to the equinox of 1875 has been published for the northern sky for 21 hours of R.A. This has been much used at Hamburg and elsewhere for derivation of proper motions.

New Instruments and Modifications. The new transit circle Askania-Bamberg (190 mm.—258 cm.) has been erected at Uccle. It has a motor-driven micrometer. There are two divided circles, one of platinum-palladium (20 per cent. *Pt*, 80 per cent. *Pa*) and the other of a nickel alloy (70 per cent. *Ni*, 29 per cent. *Cu*, 1 per cent. *Fe*). The readings of the 4 microscopes are registered photographically.

At Greenwich a new transit circle (178 mm.—244 cm.) by Cooke, Troughton and Simms is nearing completion. This instrument will have glass circles, the weights of which will be relieved by counterpoised lever arms to reduce the possibility of flexure of the circle in its plane. The travelling wire of the impersonal micrometer will be driven by a synchronous motor with variable speed gear. The recording will be on a tape chronograph using pen systems of small inertia.

A new pavilion of modern type is planned for the Pulkovo meridian circle. The instrument will be provided with azimuth marks of the Gill type.

The Pulkovo, Kazan and Odessa meridian circles have been provided with modern Zeiss object glasses. The 16 cm. objective of the Repsold meridian circle at Strasbourg is to be replaced by one of 19 cm. to increase the light grasp.

One of the Paris meridian instruments has been adapted for observations according to the scheme of Esclançon, to avoid errors due to the form of the pivots (see *Bull. Astr.* 6, Fasc. VI). The principle is that sometimes used for determining pivot errors—the use of horizontal collimators directed through the hollow axis of the transit which carries a lens at one end and a fiducial mark at the other. Irregularities in the form of the pivots cause the mark to move irregularly when the transit is moved in zenith distance.

Danjon announces that he has constructed and experimented with at Strasbourg a transit instrument on a new principle, so that the instrumental constants are better defined and more exactly determined (see *Bull. Astr.* 9, Fasc. II).

The director of the observatory at La Plata (Prof. Felix Aguilar) writes that he hopes to set up a Repsold Meridian Circle at the most southerly point possible in Patagonia (say Lat. 50° South) for the determination of fundamental positions especially declinations. Refraction will be studied with an instrument out of the meridian.

Experiments with a photoelectric cell as an automatic observer are being carried out at Cordoba.

At Ottawa two crystal clocks maintained outside the observatory can be compared with the Shortt standard clock.

Subjects for Discussion. As indicated in the first few paragraphs of this report, subjects for discussion suggested by several members of the Commission are:

- (1) Fundamental Stars and Fundamental Systems.
- (2) A recommendation for comparing observational catalogues with fundamental systems (Morgan).
- (3) The limitation of the scope of visual observations so as to eliminate work which can be suitably done by photography.
- (4) The retention of some faint stars on visual programmes.
- (5) Use of minor planets for determination of systematic errors.

In connection with the programme for the observation of distant stars near the galaxy A. Lambert writes:

- (6) Cette entreprise recommandée en 1932 par la Commission Méridienne présentant un incontestable intérêt scientifique et ne pouvant être menée à bien que par une large coopération dans les deux hémisphères, on propose que la question soit à nouveau soumise à l'attention de l'Assemblée de 1935.

Mme Chandon submits for discussion the following recommendations:

(7) Sur l'emploi d'une lunette coudée pour la mesure des déclinaisons des étoiles
(See *Journal des Observateurs*, 15, No. 10, p. 121).

(8) Sur l'utilisation des instruments de hauteurs égales pour l'amélioration des positions des étoiles.

J. JACKSON

President of the Commission

REPORT OF SUB-COMMISSION ON THE RE-OBSERVATION BY MEANS
OF PHOTOGRAPHY OF THE A. G. ZONES AND THE
OBSERVATIONS OF STANDARD STARS

This Sub-Commission of Commission 8 has been asked to report on comparison stars for plates covering approximately 25 square degrees. The choice of such stars should be governed by the results of two large pieces of work that are now in progress. The first of these is the compilation of the General Catalogue at Albany under the auspices of the Carnegie Institution and of the Dudley Observatory. This great undertaking, begun more than forty years ago, is near completion. The catalogue will contain about 32,000 stars whose positions at mean epoch will normally have probable errors averaging about $0''.15$ in each co-ordinate, though this accuracy will not be reached for many stars in high southern declinations. The average number of stars is 0.8 in a square degree. This is sufficient for the reduction of plates of 25 square degrees, as there would be 20 stars in this area. But there are naturally many regions in which the actual number falls far below the average, and for them many additional stars would be necessary, aggregating several thousand over the whole sky.

The second undertaking is the repetition of the *Astronomische Gesellschaft* Zones, originally observed around 1880, averaging about six stars in a square degree. At Yale Observatory the following three zones have been published, based upon plates of 25 square degrees: -2° to $+2^\circ$, $+50^\circ$ to $+55^\circ$, and $+55^\circ$ to $+60^\circ$; and two zones with plates of 140 square degrees: $+20^\circ$ to $+25^\circ$, and $+25^\circ$ to $+30^\circ$. Attention is now being concentrated upon the zones between -2° and -30° ; all the plates, 110 square degrees, have been secured; the measurement of those between -10° and -20° is nearing completion. The *Astronomische Gesellschaft* is re-observing all the zones north of -5° with plates of 25 square degrees. All the plates have been secured and their measurement is progressing rapidly. To reduce these plates 14,000 comparison stars have been observed six times each with various meridian circles, an average of 17 stars on a plate. South of declination -30° the Cape Observatory is taking plates of 25 square degrees; those for the zone -30° to -35° have been secured and are now being measured. The Cape Observatory is also observing the comparisons for this zone and for those farther south.

At Yale Observatory the experiment is being tried of reducing plates of 110 square degrees, using only those positions that will appear in the Albany General Catalogue, and with a diffraction grating in front of the objective that permits the measurement of first-order spectra and the use of brighter stars than would otherwise be advisable. If this experiment is successful, all the *Gesellschaft* stars, averaging six in a square degree, could be used as comparison stars on smaller plates.

In view of these circumstances your Sub-Commission is of opinion that a more intelligent choice of comparison stars can be made in the next triennium than in this. By that time the Albany General Catalogue will probably have been distributed, and the experiment at Yale Observatory just referred to will have been completed.

The Sub-Commission therefore recommends that it be continued for another period of three years and that the actual choice of comparison stars be deferred until after the Paris meeting.

F. SCHLESINGER, <i>Chairman</i>	
B. BOSS	J. JACKSON
H. SPENCER JONES	A. KOPFF
A. LAMBERT	F. MOREAU
H. R. MORGAN	