

## 8. COMMISSION DE L'ASTRONOMIE MERIDIENNE

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### SOUS-COMMISSION POUR L'OBSERVATION PHOTOGRAPHIQUE ET VISUELLE D'ÉTOILES JUSQU'À LA 9<sup>ME</sup> GRANDEUR

PRÉSIDENT: M. BROUWER.

MEMBRES: Mlle Barney, MM. Eckert, Lourens, Martinez, Scott, Shane.

During the short interval that has elapsed since the Zürich meeting appreciable progress has been made in the field of meridian astronomy. The following summary was prepared from information supplied by members of the Commission and other correspondents.

*Observing Programmes and Discussions.* At Leiden about 10,000 observations of the declinations of stars in the zone  $+24^{\circ}$  to  $+32^{\circ}$ , which were completed about 1947, are well advanced in their reductions. These were selected from the *Albany General Catalogue* and are referred to the FK 3 system. The reduction of a list of close double stars observed before the recent war is also well in hand. Dr van Herk is making differential azimuth observations at Timboroa (B.E.A.) of all FK 3 stars between  $+60^{\circ}$  and  $-50^{\circ}$  for declination determinations (*B.A.N.* 81 and *Leiden Annals*, 18, 1). It is proposed to observe each star twice near eastern and western elongation, the altitude of the stars at the time of observation being  $9^{\circ}$ . About 40% of these observations are completed. This programme is supplemented by a series of zenith telescope observations of FK 3 stars, with some additional GC stars needed to form more Talcott pairs; the latter are also included in the azimuth programme.

At Cordoba the catalogue of the AG zones  $-37^{\circ}$  to  $-47^{\circ}$  (Cordoba D, 1950.0) is finished and ready for publication. The catalogue Cordoba E, comprising the AG zones  $-82^{\circ}$  to  $-90^{\circ}$ , is completely observed and the reductions rather far advanced, so that it may be ready in 1953.

The present observing programme of the meridian circle at Bordeaux consists of the reference stars of the Bordeaux photographic catalogue, about 1500 in number.

At the Cape Observatory the observing list of the transit circle continues to include the Sun, Moon, and planets, in addition to the reference stars for photographic zone work (see report of the Sub-Commission). When modifications of the instrument are completed the star list will consist of 6638 stars and include all GC stars from  $-30^{\circ}$  to  $-52^{\circ}$  and from  $-80^{\circ}$  to  $-90^{\circ}$  and also all FK 3 stars between  $-20^{\circ}$  and  $-30^{\circ}$ . The *Second Cape Catalogue* for 1925.0 was published in 1949. The *Third Cape Catalogue* for 1925.0 and the *First Cape Catalogue* for 1950.0 (based on observations made between 1936 and 1944) are in press. Vol. 14, part 4 of the *Annals* has been published. It contains the results of the Sun, Mercury, and Venus observations, 1925–36.

The Askania transit circle of the Royal Observatory at Brussels (Uccle) has been engaged during the past two years on differential observations of a portion of the reference stars used in the photographic zones  $+33^{\circ}$ ,  $+36^{\circ}$ ; these stars are also being observed at Paris and Besançon.

The present observing programme for the transit circle at Ottawa consists of the lists of stars required for the photographic zenith tubes at Richmond (Florida), Greenwich, and Ottawa, along with FK 3 stars in zones near the zenith of these places. Reductions of Sun, planet, and star observations made during the period 1923–35 have been com-

pleted and are nearly ready for printing. Similar reductions for the period 1935–50 are being completed.

At Washington the 6-inch transit circle has continued its series of Sun, Moon, and planet observations. The star list, in addition to the zone stars mentioned in the report of the Sub-Commission, includes the FK 3 stars and various zones for zenith tubes, as well as the International Latitude Service stars. The asteroids Ceres, Pallas, Juno, and Vesta were added to the programme in 1950. Considerable attention has been given to the use of punched cards in the reduction of the meridian observations, but some of the operations are still to be adapted to this method. The reductions of the observations made during the period 1941–48 are well advanced. The results of observations made with the 9-inch transit circle, 1935–45, appeared in Vol. 15, part 5 (1948) of *Publ. U.S. Naval Observatory*, and those made with the 6-inch, 1925–41, in Vol. 16, part 1 (1949). The first of these, in addition to the Sun and planet results, includes a catalogue of 5446 stars for 1940.0. The second, with observations of the Sun, Moon, and planets, contains catalogues of 2383 stars for 1925.0 and of 1536 stars for 1950.0. Both volumes give individual corrections to the positions of the GC and FK 3.

At Greenwich the Airy transit circle, which, except for a period of idleness during the war, has completed its hundredth year of service, is in use for observations of the Sun, Moon, and planets. A list of PZT stars for the latitude of Herstmonceux has also been observed. Proper motions of the stars in the first *Greenwich Catalogue* for 1950 are being computed. The preparation of this catalogue has been delayed by shortage of staff.

The transit circle of the Paris Observatory has been devoted since 1945 to the observations of the reference stars of the Uccle-Potsdam photographic zone ( $+33^\circ$ ,  $+36^\circ$ ) and the FK 3 stars between  $+20^\circ$  and  $+50^\circ$ . This work, which involves some 30,000 observations of about 4000 stars, is being reduced by methods described in *Bull. Astr.* 13, 161 and 283 (1947–48). Regarding the large amount of material already accumulated bearing on the relative errors of the positions of the FK 3 stars in this list, Dr Lévy remarks that considerable systematic errors are indicated. He continues:

Je pense donc qu'un 'smoothing' du FK 3 serait désirable. En attendant qu'on puisse entreprendre le travail nécessaire de réobservation complète du FK 3, il serait facile de recueillir un grand nombre d'informations valables concernant les erreurs systématiques importantes de certaines étoiles du FK 3. On pourrait ensuite, provisoirement et surtout à l'intention des Services horaires, signaler ces étoiles comme douteuses; il n'y aurait pas d'inconvénient pour les usagers du FK 3 à les abandonner, à la condition essentielle que leur élimination ne modifie pas la système de base du FK 3, c'est-à-dire que la somme algébrique de leurs erreurs systématiques présumées soit nulle dans chaque région de la sphère céleste.

Le matériel que je propose de réunir pourrait s'obtenir aisément à partir du travail normal qui se fait dans beaucoup de Services méridiens et horaires, sans qu'un programme spécial leur soit imposé; (la réobservation du FK 3 en vue de la redétermination des mouvements propres et des positions, qui au contraire exige que les services intéressés s'y consacrent spécialement, pourrait ensuite ne porter que sur un nombre limité d'étoiles). Il va de soi que les éléments recueillis devraient avoir été obtenus dans des conditions qu'il y aurait lieu de préciser; je crains que les valeurs qui sont publiées de temps à autres sur les erreurs relatives du FK 3 ne soient souvent inutilisables faute d'une documentation suffisante sur leurs origines.

At the Tokyo Astronomical Observatory the series of Moon and planet observations started by S. Nakano in 1936 was interrupted by the war in 1944. The instrument used was the Gautier meridian circle. Much of the data of the period 1941–44 was destroyed by fire; it is thought that the remainder can be salvaged and the results published in the future. During the period 1945–48 Nakano observed these bodies in right ascension with a Bamberg transit instrument and in 1948 he resumed work with the meridian circle. The Sun and the minor planets Ceres, Pallas, and Vesta have been added to the programme; the results for 1949 have already appeared in *Tokyo Astronomical Bulletin*, No. 28. A programme of zodiacal star observations is projected.

A catalogue of the right ascensions of 3000 zodiacal stars (Gill's list) for 1950.0, with proper motions, was published in 1949 as Vol. 2, no. 1, of the *Annals of the Tokyo Observatory*. It is based on observations made by K. Tuzi with the Repsold transit instrument during the period 1937–42. The probable error of the catalogue positions, which are referred to the FK 3 system, is less than 0<sup>s</sup>.009. With a view to making future time determinations possible with a photographic zenith tube about 500 zenith stars were observed during the period 1945–48. The resulting catalogue appeared in the *Annals*, Vol. 2, no. 3 (1950). Since 1950 Dr Tuzi has been observing with this instrument a zone of equatorial stars ( $-5^{\circ}$  to  $+5^{\circ}$ ) in right ascension. The programme includes all stars brighter than the seventh magnitude and is expected to be completed in five years. With the object of determining the systematic differences between the equatorial and zenith zones he is also observing selected stars with the Bamberg transit instrument.

At Lund a catalogue of about 1190 miscellaneous stars is ready for publication. It is based on observations by Dr S. Cederblad, 1939–43, and is reduced to the system GC, of which it contains about 800 stars with weak proper motions. A catalogue now in the Press by Dr A. Reiz, 1943–47, contains nearly 6200 AG stars, mainly between  $0^{\circ}$  and  $+40^{\circ}$  declination, brighter than magnitude 8.7, and having but one or two positions in the *Geschichte des Fixsternhimmels*. It is referred to the system FK 3. The ultimate aim is to obtain accurate proper motions, and in this part of the work all new catalogues have been included. Prof. Gyllenberg has continued his work on systematic corrections and weights for existing star catalogues.

In the U.S.S.R. a list of 645 fundamental stars north of  $-30^{\circ}$  declination is being extensively observed, the purpose being to obtain about fifty observations in each co-ordinate for use with the catalogue of faint stars. Both absolute and differential observations are complete or in progress at Kazan, Kiev, Pulkovo, and Tashkent, differential observations are being furnished by the observatories at Kharkov, Moscow, and Odessa. The Wroclaw Observatory, Poland, will also take part in this work. The selection of a list of 15,320 faint stars north of  $-30^{\circ}$  has been completed under the direction of Prof. Zverev; these stars range in visual magnitude from 7.5 to 9.1 and have proper motions less than 4" per century.

A revised list of 302 extra-galactic nebulae, prepared by Kulikovskiy, Neuymin, and A. N. Deutsch, has been distributed by the Sternberg Institute. It is supplemented by a list of seventy-three faint long-period Cepheids which is recommended for inclusion in the programme. The nebulae have been photographed at Pulkovo (300 photographs in 1939–41 and 1949–51), at the Sternberg Institute (over 280), and at Tashkent (about 250). At Kiev similar operations have been started. Preliminary results of the work at Tashkent are given in *Tashkent Publ.*, Ser. 2, Vol. 1 (1950).

At Pulkovo N. V. Fatchikhin determined the proper motions of about 1500 stars in four areas with reference to thirteen extra-galactic nebulae, the difference in epochs being about forty years. The results will appear in the Pulkovo Publications. At the Sternberg Institute D. K. Karimova and P. P. Parenago have also derived similar proper motions using both photographic and visual measures.

At Pulkovo and the Sternberg Institute minor planets 1, 3, 4, 6, and 39 were photographed for reference use in preparing the catalogue of faint stars. The positions of these bodies were derived at Pulkovo from seventy plates obtained at Tashkent during the war years. This work is in the Press.

Vol. 63 (1949) of the Pulkovo Observatory Publications contains a catalogue by L. I. Semenov and G. K. Zimmerman of absolute right ascensions for 1930.0 of 674 FK 3 stars, the positions resting on fifteen or more observations; also catalogues by Nemiro containing absolute right ascensions for 1950.0 of over 400 Zusatz and circumpolar stars, and utilizing a new method of working up absolute right ascensions.

Measures of the azimuth of the meridian marks of the large transit instrument at Pulkovo have been utilized by B. A. Orlov for determinations of the co-ordinates of the pole (*Pulk. Bull.* No. 143).

At Nikolayev Semenov and Zimmerman have completed a series of observations in both co-ordinates of the Zusatz stars. The late I. P. Milstein made a series of observations with the vertical circle at this Observatory for a study of the astronomical refraction; and G. K. Zimmerman, by taking into account the effects of room refraction on observations of the Sun, derived an improved system of declinations (*Pulk. Bull.* No. 143). Special observations are also being made at Kiev for refraction studies. At Odessa V V Konin has completed a series of observed declinations of 225 zenith telescope stars for the latitude of Pulkovo, and B. V. Novopashenny is observing a list of red stars in both co-ordinates.

A catalogue of 615 FK 3 and Zusatz stars for 1950.0, based on observations made with the Repsold transit circle at Königsberg (mean epoch about 1938) was published in *Abh. Bayer. Akad. Wiss. Munich*, 1949.

New fundamental normal positions of the standard stars for an epoch a little later than 1930 have been derived by H. R. Morgan, who has used the places of over seventy recent catalogues based on observations made between 1920 and 1950 for this purpose. About one-third of these catalogues rest on fundamental or independent observations which determine the new system. The 4500 stars in the new catalogue are spaced and include the FK 3 and BH stars and other GC stars. The positions and the system are independent of other systems. Proper motions have been derived by comparing the new normal positions with others some thirty years earlier, as given in the *Albany General Catalogue* at their mean epochs; the latter positions were corrected for certain well-known systematic errors. The resulting proper motions are entirely independent of the GC motions. Provisional systematic corrections to the GC at the epoch 1930, as given by the new system for the equatorial half of the sky, were published in *A. J.* 54, 145, 1949, and the complete work will be published soon. It forms part of a project sponsored by the Office of Naval Research.

*Instruments and Observing Methods.* Two transit circles are being constructed in England by Messrs Grubb-Parsons for the Copenhagen and San Fernando Observatories. The first of these is to be provided with photographic circle microscopes, and with a mechanism for securing point images of stars and fiducial marks on photographic plates, the motion of which is accurately controlled. The second instrument will replace an older one.

A 7-inch transit circle nearing completion in the shop of the Naval Observatory, Washington, will serve as a replacement for the 9-inch, which was in service during the period 1865–1945. The new instrument will resemble in many respects the 6-inch as modified during recent years (*Publ. U.S. Naval Obs.* Vol. 16, part 2, 1950).

A mirror transit circle, following Dr Atkinson's design (*M.N.* 107, 291 and *Observatory*, 68, 98), is being constructed by Dr de Barros of Oporto and is now far advanced.

A horizontal transit instrument for right ascension work only is being developed for use at the Royal Greenwich Observatory by Dr Perfect. The flexure of the *E–W* axis of the Cooke reversible transit circle of this Observatory has been investigated in some detail by means of an autocollimation method utilizing a mirror which is rigidly attached to the end-face of the pivot. Atkinson remarks that an elliptical component in the axis flexure of a transit that is not symmetrically distributed between the east and west halves of the axis will introduce errors that are not all removed by reversal. These could be of the order of magnitude of the differences found between catalogues based on different instruments. A projected new building to house this transit circle will be sufficiently large to accommodate the two collimators also. Distant azimuth marks, for which space was not available at Greenwich, will be provided. This instrument will be used for fundamental observations; the Melbourne instrument, which will also be set up at Herstmonceux, will be used for differential work.

Improvements in the construction of the transit circle of the Cape Observatory have been in progress for some time. The instrument has been provided with cameras for photographing the circle, eliminating the visual use of the microscopes. Changes in the technique of right ascension observations are also being made.

Some details of the technique used in nadir determination at the Paris Observatory are furnished by Dr Lévy. He writes:

La détermination du nadir se fait à l'aide de l'oculaire nadiral de M. Danjon (*Bull. Astr.* 12 (1946), 415), qui nous permet d'effectuer des pointés dont l'écart à la valeur moyenne n'excède pas 0<sup>s</sup>,004; M. A. Couder nous a construit un bain de mercure à couche mince dont la cuvette, de 15 cm. de rayon (donc débordant largement l'objectif qui a 19 cm. de diamètre), a sensiblement une forme sphérique de 6 m. de rayon de courbure; la forme théorique de la surface libre a été étudiée dans le *Bull. Astr.* (14 (1949), 145); les images obtenues sont rigoureusement stables quelles que soient les circonstances atmosphériques.

Dr Sémirot writes of instrumental developments at the Bordeaux Observatory:

Des perfectionnements ont été apportés dans le chronographe modèle Prin. Une roue phonique alimentée par le mille périodes et fournie par l'horloge à quartz entraîne des rouages. La précision de l'enregistrement des instants de passages est donc accrue.

Des recherches sur la construction de nouveaux types d'instruments de passage ont été entreprises.

Dans un article qui paraîtra au Journal des Observateurs je montre que les principes établis par Noumerov sont pratiquement réalisables, et j'ai établi le principe d'un nouvel instrument.

Dr Reiz has designed a photographic time recorder, controlled by a quartz crystal clock, which he has utilized in the observation of meridian transits (*Arkiv for Astr.* 1, 199, 1950).

The Dominion Observatory, Ottawa, has equipped the microscopes of its meridian circle with cameras, visual reading of the circle microscopes having been discontinued. A motor drive has been mounted on the slow motion mechanism, replacing the hand control. For measuring the microscope films an instrument has been constructed at the Observatory which utilizes a projected image (*A.J.* 55, 174, 1950).

Dr Nemiro has proposed a new method of treating absolute observations of right ascensions and determining the azimuth of a transit instrument; G. K. Zimmerman has made an investigation of the flexure of the vertical circle at Nikolayev; L. A. Sukharev has discussed the effects of temperature changes on astrometric observations. The foregoing subjects are discussed in the *Pulkovo Bulletin*, No. 143. Some work has been done at Pulkovo by Sukharev toward the construction of a horizontal meridian circle; the design will include photographic circle microscopes and photoelectric registration of star transits.

At the Engelhardt Observatory, Kasan, the flexure of the transit circle has been investigated both by means of collimators and by comparison of observational results with those of the zenith telescope. At Tashkent, Kharkov, and Kiev the graduation errors of the transit circles have been investigated.

At the Tokyo Astronomical Observatory the Gautier meridian circle and the Repsold transit instrument, which were damaged during the war, have been reconstructed. The meridian circle has recently been equipped with photographic circle microscopes, which are now being tested.

*Recommendations.* Prof. Danjon proposes that the Commission consider an observing programme of fundamental stars planned with a view to improving the proper motions of the FK 3 and GC. He writes:

Il me paraît nécessaire de consacrer à ce travail un nombre important de grands cercles méridiens, une vingtaine, par exemple, ce qui paraît possible.

Chaque étoile devrait être observée un grand nombre de fois: plusieurs dizaines d'observations me paraissent nécessaires pour bien établir les positions relatives.

Le nombre des étoiles ainsi observées devrait être suffisant pour que l'on puisse les utiliser comme étoiles de repères pour la réduction de clichés à grand champ (80 × 80). Je pense, en effet, qu'il faut renoncer à observer directement au cercle méridien les étoiles de repère de magnitude 9 ou 9,5, comme on le fait actuellement pour la réduction des clichés de la Carte Photographique. La position d'une étoile difficilement visible dans un champ faiblement

éclairé, où l'on voit mal à la fois l'étoile et le fil n'est pas déterminée avec précision par une moyenne de 4 ou 5 observations.

Les observatoires qui possèdent un service méridien actif l'utiliseraient mieux en participant à la réobservation collective du GC, par exemple.

Bien entendu, ce programme devrait être complété par la détermination de l'équinoxe. Je propose que ce second point figure aussi au programme de la Commission 8.

The following recommendations accompany the report of Prof. Idelson and Dr Nemiro:

1. In view of the fact that the compilation of a new catalogue of faint stars according to the plan worked out in the U.S.S.R., which includes both meridian observations and the photography of extra-galactic nebulae and minor planets, is of great importance for astrometry and stellar astronomy, the General Assembly of the International Astronomical Union recommends the Observatories to take part in this work. Of especial importance is that the Observatories of the Southern Hemisphere should also take part in the work.

2. Taking into consideration the achievements in the U.S.S.R. in the registration by means of photo-electric cells of star transits, it is considered desirable to introduce this new method on a wide scale in meridian astronomy.

On the subject of intercomparisons among fundamental catalogues Dr Stoyko writes:

Je pense qu'en vue de l'utilisation et de la comparaison mutuelle des Catalogues fondamentaux qui sont référés à des équinoxes variés, ainsi que de l'identification des positions des étoiles contenues aux positions données dans des Catalogues d'observation antérieurs, il est nécessaire de disposer d'un répertoire fournissant la correspondance des Nos affectés aux étoiles dans les divers catalogues, qu'il s'agisse d'une No courant ou d'un No. B. D.

Il y a également intérêt à pouvoir disposer à propos des Catalogues fondamentaux de tableaux récapitulatifs dans lesquels les étoiles soient groupées à la fois par zones de déclinaison et subsidiairement par ascension droite. Il est utile de trouver une vue d'ensemble statistique, mais assez détaillée, portant sur le nombre d'étoiles de magnitude de type spectral donné.

Il est désirable que la Commission 8 de l'U.A.I. reprenne en considération l'existence d'un travail de cette nature, établi dès 1943, à l'Observatoire de Paris, par M. R. Brisse, astronome, qui en a déjà informé l'Union (page 96 des *Transactions, Assemblée de Zürich, 1948*) et que l'U.A.I. veuille bien apporter son appui à la publication du *Répertoire des Etoiles des Catalogues fondamentaux*, en émettant explicitement un vœu correspondant.

Le procédé d'impression par photozincographie paraît être le moins onéreux.

McClenahan suggests that the Commission consider and recommend types of observing programmes suitable for differential work. While the various photographic zenith tubes, now planned or under construction, will develop a need for observations of special lists of zenith stars, other differential programmes of comparable importance should be considered.

Dr Hins considers it desirable that the Commission recommend the re-observation in the near future of the nearly 1200 standard stars in areas 1-115 of Kapteyn's selected areas. The first set of observations of these stars (combined results of Leiden, Berlin-Babelsberg, Bonn, Paris, and Strasbourg), with proper motions, was published in *Leiden Annals*, Vol. 15, part 4. Hins continues:

I think it of the utmost importance that a number of well-determined meridian circle proper motions of stars at the limit of visual visibility will become available. Certainly there is an important and troublesome gap between the GC p.m.'s on the one side and the photographically determined proper motions like the Radcliffe and Pulkowa ones on the other side.

The mean epoch of the positions in *Leiden Annals*, Vol. 15, part 4, lies around 1924. The p.e. of one star place may safely be assumed as about 0".10 in each co-ordinate. It must be possible by co-operation of the same or some other observatories, where a fairly large-sized meridian circle operates, to establish around 1954 a second set of positions of at least the same accuracy. Even disregarding the great bulk of older positions a comparison between both

sets would result in a number of systematically well-determined p.m.'s with a p.e. of about 0".005. Including only the first-class older catalogue positions the amount of labour in deriving proper motions of an even better quality would be surmountable.

A proposal by Dr Atkinson, which will also be considered by Commission 4, would involve a change in the almanacs. He writes:

It is recommended that in all national ephemerides the 'Apparent Right Ascensions' of all bodies (Sun, Moon, planets, and stars) should be tabulated with the nutation of the equinox subtracted from them, and that the 'Sidereal Time at 0<sup>h</sup>', the 'Transit of the First Point of Aries', and the Independent Day Numbers, should be modified to correspond. The Besselian Day Numbers would remain as at present, but with a modified formula for their use in R.A. The 'Sidereal time at 0<sup>h</sup>' would become the 'Mean Sidereal Time' already tabulated in 'Apparent Places of Fundamental Stars', and the right ascensions of equatorial stars would become formally independent of nutation, as their clock-times of transit are in fact independent of it. It appears possible that with this arrangement it might become superfluous to tabulate the present variable sidereal time, and the nutation of the equinox (both long-period and short-period) altogether; those occasions when the position of the true equinox was required for formal transformations of co-ordinates, etc., would be adequately covered by the Besselian Numbers. The question whether the proposed new Right Ascensions, which are in fact the times of apparent transit on a local perfect sidereal-time clock, would nevertheless have to receive a new name to avoid confusion, and the question of what name should in that case be selected, would follow on the adoption of this proposal, but are essentially secondary.

C. B. WATTS  
*President of the Commission*

#### SUB-COMMISSION FOR THE PHOTOGRAPHIC AND VISUAL OBSERVATION OF STARS BRIGHTER THAN THE NINTH MAGNITUDE

The report by H. R. Morgan in *Trans. I.A.U.* vol. 7 covers in a section entitled Photographic Work (loc. cit. p. 93) the activities in this field early in 1948. Progress made since that time is as follows:

The Cape Observatory has continued its work on the preparation of photographic zone catalogues south of  $-30^\circ$ . The zone  $-40^\circ$  to  $-52^\circ$  from the Cape Astrographic plates was published previously. The copy for the catalogue  $-35^\circ$  to  $-40^\circ$  has been sent to the printers for photo-lithographic reproduction, the copy for the catalogue  $-30^\circ$  to  $-35^\circ$  is being prepared. The measurement of the plates covering the zones  $-52^\circ$  to  $-64^\circ$  has been completed, those in declinations  $-56^\circ$  to  $-60^\circ$  at Greenwich. The taking of the plates for the zones  $-64^\circ$  to  $-80^\circ$  was completed in 1948; the measurement of these plates is in progress.

The reductions for the Cape photographic zones are made with the aid of positions of reference stars furnished by the reversible transit circle of the Cape Observatory. From 1944 to 1949 this instrument was used for the observation of 5395 stars between declinations  $-56^\circ$  and  $-80^\circ$ . The observations have been completely reduced.

The Pulkovo Observatory published a volume, *Publ. Pulk. Astr. Obs. Ser. 2, Vol. 60* (1947), of photographic positions of 11,322 stars with declinations  $+70^\circ$  to  $+90^\circ$  for the epoch 1930. The reference stars used are those furnished by the Astronomisches Rechen-Institut in the catalogue of Anhaltsterne, *Veroff Kopern. Inst. No. 55* (1943).

The volumes containing the results of the photographic re-observation of AG stars at German observatories have not yet been published, but the preparation of the printer's copy for photo-lithographic reproduction is well advanced.

The Yale Observatory completed the publication of the catalogue volumes based on a re-observation by photography of AG stars in declinations  $+30^\circ$  to  $-30^\circ$ . A supplementary volume now in preparation by Dr Ida Barney, will furnish additional comparisons with the *General Catalogue* of the various zones and improved positions and proper motions of numerous stars for which incomplete data were given in the zone catalogues.

A new series of plates covering declinations  $+50^\circ$  to  $+90^\circ$  was taken at the Yale Observatory,  $+50^\circ$  to  $+60^\circ$  in 1948,  $+60^\circ$  to  $+90^\circ$  in 1950. The measurement of these plates will be made at the Watson Scientific Computing Laboratory as soon as the new measuring engine with automatic setting and recording equipment is ready for routine operation.

The reference stars for the reduction of these plates are to be taken from a catalogue of stars north of  $+50^\circ$  declination, uniformly spaced with eighty-three stars per one hundred square degrees, and observed with the 6-inch transit circle at the United States Naval Observatory during the years 1941–48.

The United States Naval Observatory is now selecting stars between declinations  $+50^\circ$  and  $-30^\circ$  according to the following precepts: the stars will range in magnitude from 5.5 to 8.5, with occasional fainter stars. They are spaced uniformly with about seventy-five stars per one hundred square degrees. Double stars with components differing by less than one magnitude in brightness and with separations from  $1''$  to  $10''$  are being avoided. An effort is being made to select stars with favourable observational histories. The references being consulted are GC, Zodiacal Catalogue, Anhaltsterne, Cape, Greenwich and Washington catalogues and the AG. The zone from  $+35^\circ$  to  $+50^\circ$  has been selected and is now being observed with the 6-inch transit circle. The selection will be completed by zones as needed to supply stars for the observing programmes. The selection of the stars north of  $+50^\circ$  for the observing programme in 1941–48 was made before all the criteria were formulated, but it does meet these requirements quite well.

The purpose of selecting this observing list is two-fold. It is expected that it will meet the requirements of photographic zone programmes with large plates as well as the Lick programme of obtaining proper motions of stars referred to a background of distant nebulae.

The programmes undertaken in the U.S.S.R. with similar scope were explained by Dr M. Zverev at the meeting of Commission 8 in Zürich (loc. cit. pp. 96–7).

In *Trans. Yale Obs.* Vol. 21, Dr Barney published the second photographic catalogue of the Nicolajew Zone of the AG,  $-1^\circ$  to  $+1^\circ$ . Since two photographic epochs 1914 and 1937 were available, it enabled her to free the proper motions from the effects of systematic errors in the visual AG observations. These results are most encouraging and illustrate the importance of obtaining a second photographic epoch of AG zones in other parts of the sky.

In this connection, it is of interest to refer to the work by O. Heckmann, W. Dieckvoss and H. Kox, *Sitz. Deutsch. Akad. Wiss. Berlin*, No. VII (1948). They made use of astrographic catalogue positions, newly reduced, combined with the German photographic repetition of the AG epoch 1930, to determine the systematic errors in the old visual AG positions.

DIRK BROUWER  
*President of the Sub-Commission*

## RAPPORT SUPPLÉMENTAIRE

### WORK CARRIED OUT IN THE U.S.S.R. DURING 1951

#### I. FOR THE CATALOGUE OF FAINT STARS

##### (a) *Fundamental Stars*

L. L. Matkevich has completed the preparation of the observations of the right ascensions of 645 stars of the Fundamental Catalogue KC3 with declinations from  $-30^\circ$  to  $+90^\circ$ , observed in Tashkent during 1940–45. The observations were made in the FK3 system by the differential method but with the determination of the absolute azimuth. The Catalogue, with the preface by A. A. Nemiro, has been sent to the Press.

The basic meridian instruments of the Pulkovo Observatory, the large transit instrument, the vertical circle, and the meridian circle, have been restored. The



programme of absolute observations with these instruments contains 1065 stars, with 534 bright stars of the programme of the 1930 Pulkovo Catalogue and 531 stars of the Fundamental Catalogue of Faint Stars.

(b) *Compilation of the Working Catalogue of Faint Stars*

An article by M. S. Zverev, V. A. Izvekov, A. G. Osborneva and L. M. Khommik concerning the list of 15,355 faint stars in the zone of  $-30^\circ$  declination to the North Pole compiled at the Sternberg Astronomical Institute has been published in the *Astronomical Journal*, no. 1, for the year 1952. The list consists of two parts: KC31, containing 5120 faint stars from North Pole to declination  $+30^\circ$ , and KC32, containing 10,235 stars in the equatorial zone  $\pm 30^\circ$ .

(c) *Extragalactic Nebulae*

Approximately 200 photographs with extragalactic nebulae were obtained in 1951 in Pulkovo and Moscow (the Sternberg Astronomical Institute) in accordance with the plan for the Catalogue of Faint Stars. A. N. Deutsch and his collaborators have prepared for publication a list of about 1000 nebulae, suitable for exact position measurements. The photographs of nebulae obtained will be partially utilized as first epochs for the derivation of absolute proper motions of the KC3 stars.

(d) *Minor Planets*

Minor planets, selected for the orientation of the Catalogue of Faint Stars, were continually and systematically photographed in Pulkovo on a standard astrograph. Over one hundred photographs have been obtained and seventy-eight exact positions of minor planets (3, 6, 18, 39 and 51) were published in the *News of the Main Astronomical Observatory of Pulkovo*, vol. 18, series 5, no. 146. The probable error of one position is  $\pm 0''.1$ . The positions of the six selected minor planets are also being observed at the Sternberg Astronomical Institute and at the Tashkent Observatory.

The preparation of the observations of these minor planets, particularly of Ceres and Juno, is being conducted in the Institute of Theoretical Astronomy of the Academy of Sciences of the U.S.S.R. An exact absolute theory of motion is being constructed for Ceres, and numerical integration of differential equations of motion in rectangular co-ordinates with consideration of the perturbations from the major planets is being conducted for Juno.

## 2. FOR THE CATALOGUES OF BRIGHT STARS

In Pulkovo, B. A. Orlov investigated the observations made with Ertel's large vertical circle from 1842 to 1928 (ten catalogues from 1845.0 to 1925.0). On the basis of this investigation, a number of conclusions was drawn. The zenith distances measured by means of Ertel's vertical circle were affected by an error of the form  $c \sin z$ , which is perhaps related to interchanges of the objective and the ocular. For the 1885 and 1915 catalogues the coefficient  $c$  proved to be  $-0''.71$  and  $-0''.56$  respectively, and for other catalogues about  $-0''.30$ . Furthermore, it has been shown that certain systematic deviations of the observations in the pavilion of the main building, attributed earlier to room refraction, are due to the error in the instrument proportional to  $\sin z$ . The refraction variation with an annual period obtained by Bonsdorff from the observations for the 1915 catalogue is fictitious, and is explained by the fact that in the computation of the refraction the value assumed for the coefficient of expansion of the atmosphere was too large. The mean latitude of Pulkovo during 83 years remained constant within the limits of  $0''.1$ .

A. A. Nemiro investigated the absolute catalogues of right ascensions for the years 1845, 1865, 1885, 1900, 1905, 1915, 1925 and 1930. As a result, certain systematic

errors were brought to light. In particular, it has been determined that the Pulkovo surroundings have oscillations not only of an annual period but also of a 24-hour period with an amplitude of the order of 0.01. On the basis of the preparation of a hundred-year series of observations of the North Star a number of values of the constant of aberration has been obtained in which a systematic difference depending on the registration method of the observations has been discovered. Thus, the constant of aberration determined according to the catalogues of the years 1845, 1865 and 1885, observed by eye and ear or with a key, resulted in 20"49, and according to the catalogues of the years 1905, 1915, 1925 and 1930 (registering micrometer), in 20"44.

### 3. INVESTIGATION AND MODERNIZATION OF INSTRUMENTS AND IMPROVEMENT OF MERIDIAN OBSERVATION METHODS

N. N. Pavlov proposed a new design of reversible transit instrument with a meniscus optical system developed by D. D. Maksutov (*News of the Main Astronomical Observatory in Pulkovo*, vol. 18, series 5, no. 146). N. N. Pavlov continued his work on the improvement of the photo-electric method of registration of the star transits. His article on the compensation of the input capacitance of an electrometer tube has also been published in the reference cited above.

M. S. ZVEREV

#### *Report of meeting of Commission 8 and 8a, 5 September 1952*

PRESIDENT · C. B. WATTS.

SECRETARY · Dr P LACROUTE.

After noting a small correction to be made in the Draft Report, the President requested and received the approval of the Report.

In considering the various proposals made by members, the Commission decided to defer discussion of two. These were the proposal of Idelson and Nemiro on the extension to the southern hemisphere of the programme on referring the positions of stars to the extra-galactic nebulae (deferred until the symposium on astrometry of faint stars), and that of Atkinson regarding the proposed omission of the nutation of the equinox from the right ascensions given in the national ephemerides (deferred to the joint session of Commissions 4 and 8).

Zverev discussed briefly the results obtained in the U.S.S.R. in the registration of star transits by photoelectric methods. The method has been used with stars down to magnitude 6.5 with an aperture of 80 mm., and is utilized in time services. The probable error of a single observation is found to be eight milliseconds. The method has not been extended to the determination of declinations with meridian instruments. The Committee by vote expressed its appreciation of this accomplishment. Further discussion of the second recommendation of Idelson and Nemiro was reserved for Commission 31.

The proposal of Stoyko regarding the future publication of the *Répertoire des Etoiles des catalogues fondamentaux* by R. Brisse was considered. The Commission by vote agreed that such publication is desirable.

In response to the suggestion of McClenahan that the Commission consider observing programmes suitable for differential work, Zverev suggested the following:

- (1) KC3, magnitudes 7.5 to 9.1.
- (2) 3332 stars, 8.0 to 10.0, selected by Larink, of which observations are in progress at Bergedorf and Heidelberg.
- (3) FK 3 supplementary stars, selected by Kopff.
- (4) Kapteyn's selected areas (also proposed by Hins).
- (5) The various photographic zenith tube zones (also suggested by McClenahan).

At the conclusion of the session the President announced that, with the approval of Dr Brouwer, he had recommended that the Sub-commission be given the name 'Photographic Catalogues of Stars Brighter than the 9th Magnitude' as better expressing the nature of its work than the original name.

*Second session of Commissions 8 and 8a, 12 September 1952*

Resolutions regarding the need for increasing the fundamental meridian circle work in the southern hemisphere, and the extension of the surveys of extra-galactic nebulae also to that hemisphere, were discussed and adopted.

At the suggestion of Prof. Kopff, the President of Commission 8 was requested to appoint a committee to draw up plans for a single catalogue of faint reference stars. In a communication from the Observatory at Eva Peron (formerly La Plata), Argentine, Dr Gratton indicated that that Observatory would be willing to take part in the programme of observations of nebulae proposed by Prof. Zverev, using for this purpose the astrographic telescope at the Cordoba Observatory. He also expressed a willingness to consider sharing a part of the work involved in connecting the faint reference stars with the FK 3.

Dr van Herk described his recent investigation at Leiden which indicates that the effect of atmospheric dispersion in changing the observed declinations of stars amounts, at 45° zenith distance, to  $0''.034 \pm 0''.0067$  per spectral class. The complete results will appear in the *B.A.N*. The President remarked that F. P. Scott at Washington had later to some extent duplicated this analysis, using the somewhat fainter stars of the Washington *Catalogue* for 1940, and had confirmed the existence of the effect in observations of such stars. Suitable methods of introducing corresponding corrections in the refraction tables were discussed.

Prof. Kopff described an article by Nowacki (to appear in *Veröff. Astr. Recheninstituts*) devoted to the improvement of the position and motion of 61 Cygni, treated as a double star.