

8. COMMISSION DE L'ASTRONOMIE MERIDIENNE

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8a. SOUS-COMMISSION POUR LES CATALOGUES PHOTOGRAPHIQUES D'ÉTOILES JUSQU'À LA 9^{ME} GRANDEUR

PRÉSIDENT: M. D. Brouwer.

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

Previous to the preparation of the present report I distributed in August 1954 a circular letter to all members of Commission 8 and the Directors of several observatories asking them to send me their communications about studies in meridian astrometry, carried out since the last General Assembly of the I.A.U. Data that were communicated by about thirty of my correspondents in answer to my request were taken as a basis for the present report. I use this opportunity to express my gratitude to all members of Commission 8 who have sent me their reports, as also to F. Becker, G. Demetrescu, J. Dick, E. Rybka, E. Paloque, G. Spigl, A. A. Yakovkin, V. P. Scheglov, V. V. Podobed, A. F. Bogorodsky, N. P. Barabashev and V. P. Tsesevich, who communicated with me about studies in astrometry carried out at their observatories. No replies were obtained from the following members of Commission 8: G. Armellini, I. Barney, B. Boss, L. Carnera, G. Fayet, G. Meyer, F. Moreau, J. Procházka, B. Strömngren and J. Verbaandert.

The survey of studies in meridian astrometry given below does not contain any mention of the activity of some observatories because of lack of information. These are Abbadia, Alger, Cincinnati, Copenhagen, Cordoba, Nice, Rome (Monte Mario), Trieste, and possibly some more.

STUDIES IN ACCORDANCE WITH RECOMMENDATIONS OF THE I.A.U. TAKEN IN 1948 AND 1952

At the Seventh General Assembly of the I.A.U. in Zürich (1948) and the Eighth Assembly in Rome (1952) decisions were taken in which the importance to astronomy of photographic observations of extragalactic nebulae and observations of the Catalogue of Faint Stars (Katalog Slabych Zvezd—K SZ) was pointed out. In accordance with these decisions I directed a circular letter to a number of observatories requesting them, on behalf of Commission 8, to take part in these observations. Several European observatories (that of France, in particular) and also observatories of the southern hemisphere (Cape, La Plata, Santiago, Perth, Sydney) answered in the affirmative. A short summary of the present state of K SZ studies is given below.

Meridian observations of FKSZ by means of absolute methods have been completed in Kazan, are being carried out at Pulkovo, Tashkent and Golosseyevo (near Kiev) and will be started in the very near future at Wroclaw and Cape.

Differential observations of the FKSZ stars in the FK 3 system have been terminated in Kazan, Tashkent, Odessa, Kiev, Golosseyevo and Wroclaw, and are continued at Pulkovo, in Moscow, Kharkov and Bucharest. In 1955 differential observations will be started at Nikolaev, the La Plata observatory, and also, possibly, at Santiago. Compilation of a preliminary normal catalogue of Faint Stars (FKSZ) in the FK 3 system, containing stars from the North Pole down to -20° , is planned, commencing in 1955–56,

at the Pulkovo Observatory, on the basis of about twenty-five observations for every star obtained by different observatories.

Observations for the large KSZ of the northern sky (for declinations down to -25°) will be started in 1955–56. A number of observatories of the U.S.S.R. and that of Bucharest will take part in that work. It is desirable that several other observatories, possessing meridian circles with apertures not less than 16 cm. (permitting accurate observation of stars as faint as $9^m.1$), should also participate in this programme. The list of 15355 KSZ stars between declinations $+90^\circ$ and -30° compiled in Moscow was partly revised at Pulkovo for the purpose of substituting some very faint stars (fainter than $9^m.1$ vis. and $10^m.5$ phot.) and including some stars, particularly those in the vicinity of extragalactic nebulae. (A list of additional reference stars located in the vicinity of the selected nebulae was prepared in Moscow and is published in the *Proceedings of the Eleventh Astrometric Conference of the U.S.S.R.*) The Cape Observatory consented to prepare the extension of the list of KSZ stars for the southern sky down to declination -90° . An interesting proposal was made by R. H. Stoy⁽¹⁾ who suggested making use of photographic observations with wide-angle astrographs for improving the positions of southern KSZ stars with respect to accidental errors.

Photography of selected extragalactic nebulae down to 13^m-14^m phot. is continued at Pulkovo, in Moscow, started at Golosseyevo, in Tashkent and Bucharest. Such observations are also planned for the future at the La Plata Observatory. A working list of more than 600 nebulae in 157 areas of the northern sky, with their astrometric characteristics, was prepared under the direction of A. N. Deutsch⁽²⁾ as a result of a study of 500 plates taken with the Pulkovo normal astrograph. It should be noted here that the Lick programme of the photographic survey of the sky with the 50 cm. astrograph independently solves the problem of referring the fundamental catalogue to the extragalactic objects. Thus the Lick programme is favourably extending the KSZ programme in so far as much fainter nebulae (about 16^m phot.) are measured on the Lick photographs.

The programme of photographic observations of ten selected minor planets suggested by N. S. Yakhontova (Institute for Theoretical Astronomy, Leningrad) was discussed and approved at the Eleventh Astrometric Conference of the U.S.S.R. at Pulkovo. The observatories of Leiden, Nanking (Purple Mountain), Sydney, La Plata, Cape, Copenhagen, Pulkovo, Moscow and Tashkent expressed their wish to take part in these observations to be commenced in 1955.

In accordance with the decisions of the Eighth General Assembly of 1952 in Rome (resolution no. 18 of Commissions 4 and 4a, approved by Commissions 7, 8, 8a, 17, 20, 20a and 31) the revision and improvement of FK 3 was started at the Heidelberg Astronomisches Rechen-Institut under the direction of Prof. A. Kopff and with the participation of K. Schaifers. In this work 57 catalogues with the epochs from 1918 to 1950 are used; 38 of them were obtained by the observatories of the northern hemisphere and 19 by those of the south. About half of these catalogues are absolute, i.e. they are referred to the systems of the instruments. The work includes two stages, just as was done for the compilation of FK 3. The first stage consists of improving the positions and proper motions of individual stars in the FK 3 system using *all* the catalogues. The second stage is an improvement of the fundamental system for which only absolute catalogues are used. Systematic differences: 'Catalogue—FK 3' are being derived for a number of catalogues. It was found that the differences $\Delta\alpha_\alpha$ and $\Delta\delta_\alpha$ depend appreciably upon declination. Hence their study will be carried out for different zones separately. The termination of the improvement of the FK 3 is planned for 1958, while the results for the northern sky will obviously be completed early in 1957.

The Catalogue FK 3, suppl., was prepared at the Heidelberg Astronomisches Rechen-Institut (with the participation of H. Nowacki and W. Ströbel) and published in the *Anhang des Astronom. Geodät. Jahrbuchs für 1954*. It contains 1987 stars with magnitudes similar to those of the FK 3. For stars north of declination -10° precise positions and proper motions referred to the FK 3 system are given. The same data for stars of the southern hemisphere will be published in the *Astron. Geodät. Jahrbuch* for 1956. The

Catalogue FK 3, suppl., can be applied to various astronomical and geodetical problems. The next task is an extension of the FK 3 by adding some faint stars (see the above-mentioned resolution no. 18).

In accordance with the decisions taken by the Seventh General Assembly of the I.A.U. in Zürich (resolutions nos. 6 and 7 of the Executive Committee), the Potsdam-Babelsberg Astronomisches Rechen-Institut continues the reduction of the Berlin Card Catalogue 'Geschichte des Fixsternhimmels'. Under the direction of J. Dick, the first part of the Catalogue for 23^{h} in α was completed and published. The second part for 23^{h} is in print. Part of the Catalogue containing 21^{h} and 22^{h} is in progress. It may be added that since 1941 till 1953 9 volumes of the southern part of GFH (from Vol. 6 to 10 and from Vol. 13 to 16) had been issued under the direction of J. Haas. The Hamburg-Bergedorf Observatory has been publishing since 1951 the valuable and extensive series of AGK 2 catalogues. Nine volumes containing zones from $+90^{\circ}$ to $+25^{\circ}$ were published before 1954. The whole series will consist of 15 volumes containing about 185,000 stars. It should be mentioned here, that the circumpolar zone AGK (from $+90^{\circ}$ to $+70^{\circ}$) was also observed at Pulkovo. Results were published by S. Belyavsky⁽³⁾ in 1947.

CONFERENCES

Several conferences at which problems of meridian astrometry were discussed have taken place in various countries since the preceding General Assembly of the I.A.U. The Tenth Astrometric Conference of the U.S.S.R. took place in December 1952 at Pulkovo. A volume containing the *Proceedings* of that conference was issued in 1954. It was devoted to a discussion of the activity of the Soviet observatories in astrometry. The conference adopted instructions for meridian observations of FKSZ and KSZ and photographic observations of extragalactic nebulae and approved the list of stars recommended for meridian observations. The list, suggested by P. P. Parenago, contains 551 B0-B5 type stars, Cepheids, supergiants and stars in the vicinity of T-associations in Taurus and Orion.

A conference on 'Problems in astrometry' took place at Evanston (U.S.A.) in September 1953. A number of astronomers of the U.S.A. and several astronomers of other countries took part in this conference. The main problem discussed was O. Heckmann's suggestion concerning a new photographic re-observation of the zone AG catalogues of the northern sky and the compilation of AGK 3. The preparation of a list of reference stars (containing about 14,000 stars from $6^{\text{m}}.5$ to $8^{\text{m}}.5$ vis.) was entrusted to Dr F. P. Scott (U.S. Naval Observatory, Washington). Attention was also paid at the conference to the necessity of intensifying the astrometric studies—both meridian and photographic—in the southern hemisphere. Proceedings of the Evanston Conference were published in *Ast. J.* **59**, no. 2, 1954.

I should like to mention the following in connexion with the decisions of the Evanston Conference. I admit the great importance of a re-observation of the AG zone catalogues, but cannot agree with the principles involved in choosing the reference stars recommended by the conference. The average photographic magnitude of the AG catalogue stars is about $9^{\text{m}}.5$, whereas the stars contained in Scott's list are about $1^{\text{m}}.5$ brighter, while the dispersion in their photographic magnitude reaches $4^{\text{m}}.0$. The application of gratings will certainly help the solution of the problem. But the dispersion in the magnitudes in this case will be still appreciable, which may affect the results. A list of fainter reference stars with a smaller range of photographic magnitudes would be much more proper and advisable. I should also like to make a comment concerning the opinion of some astronomers who consider it undesirable to include in the programmes of meridian observations stars fainter than $8^{\text{m}}.5$ vis., because of the lack of precision in their observations. Data from a number of observatories do not confirm this opinion. These data show that by means of meridian instruments with diameters of 12, 15 and 19 cm., stars to about $8^{\text{m}}.4$, $8^{\text{m}}.9$, and $9^{\text{m}}.4$ respectively (Harvard system) and even fainter can be observed with precision and certainty on ordinary clear nights.

The recommendation to re-observe the AG catalogues was also approved at the international conference in Vosbergen near Groningen (Holland), devoted to a co-ordination of galactic studies (June 1953), at the Pulkovo astrometric conference (see below) and the Tenth Assembly of the International Union of Geodesy and Geophysics in Rome (September 1954). One of the results of the Groningen Conference was the recommendation for meridian observations of a list of stars, prepared by A. Blaauw, containing 1151 O and B type stars and Cepheids north of -20° .

During the festivity of the opening of the restored Pulkovo Observatory in May 1954, the Eleventh Astrometric Conference of U.S.S.R. took place. Besides the Soviet astronomers, a number of astronomers from other countries also took part in these meetings. Various problems were discussed at the conference: improvement of instruments and methods of observation, programme for observations of selected minor planets for fundamental astrometry, selection of reference stars for astrographic observations and others. Proceedings of the conference are in print.

OBSERVATIONS AND DISCUSSIONS

The U.S. Naval Observatory at Washington has continued with the 6-inch transit circle the series of Sun, Moon, and planet observations started in 1925, and the Ceres, Pallas, Juno, and Vesta observations started in 1950. The stars now being observed, besides the FK3 stars and several PZT zones, include 3087 in the declination interval $+35^\circ$ to $+50^\circ$. This zone forms a part of the list with uniformly spaced stars described in the *Trans. I.A.U.* Vol. 8, p. 129. The results for the zone from $+50^\circ$ to the pole have appeared in Vol. 16, part 3, Publications of the U.S. Naval Observatory. As many as possible of the O and B type stars and Cepheids recommended by Drs Blaauw and W. W. Morgan for meridian observations are included in the programme. Dr H. R. Morgan is deriving proper motions for these. Morgan's 'Catalogue of 5268 Standard Stars, 1950.0', was published in 1952 as Vol. 13, part 3 of *Astr. Pap., Wash.* The catalogue is based on new fundamental normal positions entirely independent of previous work, for an epoch a little later than 1930.

Observations with the Airy transit circle were terminated at the Royal Greenwich Observatory on 30 March 1954, ending the series of observations which had commenced 103 years ago. The observations since 1952 have consisted of the Sun, Moon, planets, four minor planets, together with clock and azimuth stars. The results will be published in the annual volumes of *Greenwich Observations*. The catalogue of the positions of stars for observation with the new photographic zenith tube is in progress. The stars were observed with the Airy transit circle along with stars from the FK3 Catalogue in 1949-51. Progress has been made with the preparation of the 'First Greenwich catalogue of stars for 1950.0'. The first large programme of observations with the Cooke reversible transit circle will consist of the observations of reference stars for the repetition of the AG zones. Until this programme of observations is commenced, the instrument will be used for the observation of fundamental stars.

Work with the Gill reversible transit circle of the Cape Observatory has been confined to observations for the 'Second Cape Catalogue for 1950.0' and to the usual observations of the Sun, Moon, major planets, and the four minor planets. The working list for the catalogue includes all FK3 stars south of -20° , all GC stars brighter than 8.5 lying between -30° and -52° and between -80° and -90° , and a number of supplementary stars between -80° and -90° specially chosen to serve as reference stars for the reduction of that part of the 'Cape Photographic Catalogue for 1950.0'. The observations of the polar portion of this catalogue are now complete and it is hoped that the list will be completely observed by the end of 1956. In the next working list it is proposed to include all FK3 and FK3 supplement stars south of the equator, all the southern stars in FKSZ, a selection of FKSZ stars between 0° and $+30^\circ$, and such southern stars, observations of which may be requested by Dr Blaauw on behalf of the committee set up after the Groningen conference.

The present Ottawa programme consists of stars from the FK 3 catalogue and Dr Kopff's supplement to the FK 3 north of $-27^{\circ} 30'$. It is intended to add to this list a selection from Dr Scott's list of reference stars for the re-observation of the AG catalogue. These stars are being observed differently with the FK 3 in right ascension and fundamentally in declination. The printing chronograph, which records the transits of the stars, is now operated by a synchronous motor controlled by a crystal clock. The observing programme of 1950-53, which consisted of stars required for the Richmond, Florida, Greenwich and Ottawa P.Z.T.'s, along with the FK 3 stars in the zones near the zenith of these places, has now been completed. These results are at present being studied and prepared for publication. A catalogue containing the results of observations made at Ottawa with the reversible meridian circle during the years 1923-35 was published in 1952. It contained 1589 stars and the results of observations of the Sun, Mercury and Venus. A catalogue containing the re-observations of 1525 stars from the catalogue of 1923-35 is at present being printed. These observations were made during the years 1935-50 after an interchange of the eye and object glass ends of the telescope.

Regular observations of the Moon, major planets and the four minor planets referred to FK 3 stars are being carried out at the Tokyo Astronomical Observatory, under the direction of S. Nakano, with the 8-inch Gauthier meridian circle. The results of the observations for the years 1951-53 are published in *Tokyo Astr. Bull.* nos. 43, 50, 56, 59, 67 and 68. The (O-C) of the Moon's mean longitude seems to decrease at the rate of about $0''.36$ per year. This rate appears still to hold, at least to the epoch 1954.22. Observations of 621 zenith stars which have been commenced in 1951 will be completed in 1955. F. Fukaya made occasional observations of some planets with the 90 mm. Bamberg transit, which are regularly in use for time determinations. Results were also published in the above issues of the *Tokyo Bulletin*. Observations of the R.A. of equatorial stars was commenced in 1950 by K. Tuzi⁽⁴⁾ with the Repsold transit instrument of the Tokyo Astronomical Observatory. A survey of observations made with this instrument since 1935 has appeared⁽⁵⁾.

In the U.S.S.R. regular observations of the fundamental stars, the Sun, Moon and planets were continued at Nikolaev with the 11 cm. Freiberg-Kondratjev transit instrument and Repsold vertical circle. Catalogues of the FK 3 Zusatzsterne based on absolute observations carried out at Nikolaev by L. I. Semenov and G. K. Zimmermann in 1939-50 are ready for publication. The right ascensions of about 80 polar stars in the zone $+75^{\circ}$ to $+90^{\circ}$ with reference to the more southern stars, were determined with the Askania transit instrument of the Nikolaev time service. The stars were observed in two culminations, reversing the instrument during each observation. Similar observations are in progress at Pulkovo and in Moscow and have been started in Tashkent. The improvement of fundamental systems of stellar positions and motions in the circumpolar zone is the purpose of these observations.

Observations with the transit instrument and vertical circle were resumed at Pulkovo in 1954. The traditional programme of absolute observations carried out since the foundation of the observatory (1839, W. Struve's programme) was revised and the binaries excluded as far as possible to adapt the programme for photo-electric observations also. The actual programme contains 1046 stars, 515 of which belong to Struve's list while 531 are FKSZ stars north of declination -10° . The differential observations of FKSZ in the FK 3 system were started in the summer of 1954 with the Toepfer meridian circle. This instrument will be used in the future for observation of KSZ. A survey by A. A. Nemiro of the whole series of absolute observations with the large transit instrument carried out at the Pulkovo Observatory for a hundred years is near to completion. Similar investigations are carried out by B. A. Orlov in respect to the Pulkovo vertical circle observations. A test determination of the fundamental system of declinations was started at Pulkovo⁽⁶⁾, using Shaposhnikov's method of zenith symmetry. Star catalogues of Backlund-Hough's list, composed at various observatories of both hemispheres, are used for this work.

The declinations of 1758 FK 3 and FKSZ stars are being observed by V. V. Konin and

A. K. Korol at Golosseyevo (Central Observatory of the Academy of Sciences of the Ukrainian S.S.R.) with the 19-inch vertical circle of Wanshaff. The polarissima BD 89° 3 in its azimuth and some minor planets are also observed. Two series of differential observations were carried out by the same observers in 1952–53: (1) 67 stars of the Poltava observatory latitude programme (each observation was made in two positions of the instrument); (2) 588 FKSZ stars (observations were made in one position of the instrument, taking readings of the level). The mean errors of one observation in the zenith zone are $\pm 0''25$ and $\pm 0''38$, respectively.

Determinations of the co-ordinates of stars with the use of absolute methods, were continued at the Tashkent Observatory (right ascensions of FKSZ stars) and the Engelhardt Observatory near Kazan (declinations). A catalogue of absolute declinations of 536 FKSZ stars, based upon observations by L. D. Agafonova and A. I. Nefedjeva, has been published (7). Declinations of 131 stars of the Poltava and Kazan latitude programmes were determined during the last two years. A list of special pairs of stars intended for the study of refraction was observed at the Engelhardt Observatory with the meridian circle and zenith telescope.

Observations with the Repsold meridian circle of the Moscow observatory were resumed in the summer of 1953, after an interval of twelve years. The instrument was installed in a new pavilion. Co-ordinates of the FKSZ stars in the FK 3 system are determined. It is planned to observe the KSZ stars with this instrument in the future. The catalogue of 545 FKSZ stars and the catalogue of declinations of 180 zenith stars of the Poltava Observatory have been published (8). These catalogues are based upon observations by M. S. Zverev in 1940–41, interrupted by the war. Photography of extragalactic nebulae with the large astrograph ($D=38$ cm., $F=6.4$ m.) and a study of the photographs are in progress at the Sternberg Astronomical Institute. About 450 photographs have been obtained since 1940. The accuracy of measurement of these plates is no less than that of the Pulkovo normal astrograph (9).

Differential observations of the FKSZ stars were also obtained with transit circles of the observatories of the Kharkov, Kiev and Odessa universities. Observations carried out at Kiev, separately for each co-ordinate, are terminated. A catalogue of declinations, prepared from observations by A. A. Gorynia, is in print. A catalogue of right ascensions of 645 FKSZ stars in FK 3 system was prepared for print based on the Odessa observations by B. V. Novopashenny (1940–43). A catalogue of declinations of the same stars is in progress, observations for which were obtained by A. S. Tsesjulevich, who died in 1950. The Odessa meridian circle was used during the past two years for observations of about 250 red irregular variable stars, 80 Cepheids and 64 stars of the Kazan latitude programme. Two catalogues of declinations were published: 319 stars of the Pulkovo zenith-telescope programme observed by V. V. Konin in 1947–50 and 125 circumpolar stars observed by L. F. Tcherniev in 1950–51 (10). The reduction of the meridian observations of about 5000 stars of the Nikolaev AG zone (from -2° to $+1^\circ$) was continued. These observations were obtained in Odessa by B. V. Novopashenny in 1929–35. The reduction of declinations was terminated by G. G. Ermolaev, who also compared the Odessa catalogue with other catalogues of equatorial stars. He found systematic errors in the declinations of the photographic catalogue of the Yale observatory (11) and a magnitude error in declination in the GC.

Differential observations of FKSZ stars were also carried out at the Wroclaw Observatory with the Repsold 6-inch transit instrument and the vertical circle. A reduction of these observations is being terminated. The pavilion is at present being reconstructed and the instruments prepared for absolute observations of FK 3 and FKSZ stars, which will be commenced in the autumn of 1955.

With the Bucharest 19 cm. Prin meridian circle 224 variable stars from 5^m to 10^m were observed. This instrument has an automatically moving thread for transit registrations and a printing declination micrometer. In the summer of 1953 observations of FKSZ stars in the FK 3 system were started in co-operation with the U.S.S.R. observatories. Observations of KSZ stars in the equatorial zone are planned for the future in Bucharest.

At the Leiden Observatory the reduction of the former series of meridian observations was continued under the direction of Dr G. van Herk. The programme of 1941-47 (declinations of GC stars between $+24^\circ$ and $+32^\circ$) is ready for print. The programme of 1936-40 (positions and proper motions of narrow double stars) will be ready for print in 1955. The reduction of observations obtained by the azimuth expedition (programme of 1948-51 of FK 3 and GC stars from $+60^\circ$ to -50° on a station near the Earth's equator) is in progress. It will take another half year to finish the measurement and reduction of the films obtained with the azimuth instrument, containing the readings of the horizontal circle. A comparison of the observed and computed azimuth differences is being carried out at present. The observations made with the zenith telescope serving as a control have all been reduced.

In Lund Dr S. Cederblad⁽¹²⁾ has published a catalogue of positions of 1190 miscellaneous stars. A catalogue of proper motions of 5960 AG stars compiled by A. Reiz and reported in Vol. 8 of the *Trans. I.A.U.* is ready for publication.

At the Hamburg-Bergedorf and Heidelberg-Königstuhl observatories the compilation of the catalogue of 3342 faint stars, spaced uniformly from $+90^\circ$ to -5° , was completed (see the report by Dr Larink⁽¹³⁾ at the Astrometric Symposium during the Eighth Assembly of the I.A.U.). Meridian observations of these stars were made in 1948-52 by J. Larink at Bergedorf and A. Bohrmann in Heidelberg. Each star was observed at each observatory four times. The mean error of one observation in Bergedorf is $\pm 0^s.018$ sec. δ for right ascension and $\pm 0".38$ for declination. Observations of the two observatories gave only a very small ($0".05$) systematic difference in declination. Proper motions of these stars were calculated as follows: (1) by a comparison of the new observations (mean epoch, 1948) with the positions of the stars in AGK 2, in conjunction with AGK 2 A (mean epoch, 1930) and (2) by using, besides the above catalogues, the Küstner catalogue of 1900, Bonn X, referred to the FK 3 system (mean epoch of 1898). A comparison of the two methods of computation of the proper motions showed that Bonn X deviates systematically from the new catalogues.

The meridian astrometrists of France paid attention in recent years to the compilation of catalogues of reference stars for the zones of the *Carte du Ciel*.

A catalogue of 4000 reference stars in the zones $+34^\circ$ and $+35^\circ$ in the FK 3 system was completed in 1953 at the Paris Observatory. The mean epoch of the observations is about 1950. The GC stars were observed eight times each, all the other stars four times. The mean error of one observation is $\pm 0^s.019$ in right ascension and $\pm 0".29$ in declination. The catalogue is already in use in the reduction of measurements of plates. From a comparison of the Paris catalogue with the GC and AGK 2 A, J. Delhaye found that a system of proper motions of the GC, deduced from bright stars, requires systematic corrections for faint stars in the zone $+30^\circ$ to $+40^\circ$. His paper will appear in the *Bulletin Astronomique*. A catalogue of 1400 reference stars up to $9^m.5$ in the same zone (from $+32^\circ$ to $+35^\circ$) is being compiled at the Besançon Observatory on the basis of observations terminated in 1953. Meridian observations of the stars of that zone were also carried out at the Observatoire royal de Belgique in Uccle-Bruxelles. The meridian circle of the Paris Observatory was also used for the compilation of small catalogues of stars in associations: 16 stars in Perseus (results were published by J. Delhaye and A. Blaauw⁽¹⁴⁾), 32 stars in Lacerta and 39 stars in Orion. Determinations of the right ascensions of 172 zenith stars for the zenith transit circle programme were completed, but this instrument has not yet been mounted. Meridian observations of 1000 *étoiles galactiques* of Mineur's plan were resumed⁽¹⁵⁾. Observations of these stars were started in 1934, but were interrupted by the war. The time service of the Paris Observatory investigates the observations with two transit instruments obtained in 1940-54. They are aimed at determining the systematic errors in the FK 3.

The university observatory of Bordeaux continues meridian observations (in FK 3 system) of reference stars in the *Carte du Ciel* zone from $+11^\circ$ to $+17^\circ$. The work will be terminated in two years after obtaining eight observations for each star. The observatory will then be able to participate in the co-operative international programme.

The university observatory of Toulouse continued, under the direction of E. Paloque, the deduction of precise proper motions of about 10,000 reference stars in the zone from $+4^{\circ}$ to $+12^{\circ}$ (*Quatrième Catalogue de Toulouse*). Meridian observations of each star were repeated in Toulouse not less than seven times from 1891 to 1941. For the deduction of proper motions the AGK 1, the AGK 2 and the Yale Observatory catalogues were also utilized. New positions of these stars are determined with the $8^{\circ} \times 8^{\circ}$ astrograph.

The Askania meridian circle is being used in Uccle, according to the suggestion of Prof. G. Cecchini, the director of the Bureau of the International Latitude Service, to determine the declinations of 499 stars of the I.L.S.-programme. The observations are made differentially in the FK 3 system. The importance of such work was pointed out at the Tenth Assembly of the International Union of Geodesy and Geophysics (Rome, 1954).

The La Plata Observatory in Argentina is actively continuing its work in meridian astrometry. Catalogues of GC stars for zones from -47° to -82° and from -35° to -47° were completed and are ready for print. A re-observation of GC stars in the zone from -22° to -35° as also the La Plata catalogue of stars in the zone from -72° to -82° was continued. Observations for the study of refraction were carried out. A determination of the division errors of the Repsold meridian circle was finished and is in print. Dr S. Slaucajcs communicates that the La Plata Observatory will commence observations of FKSZ in 1955.

In concluding the present survey, it should be mentioned that the München and Bonn observatories are initiating a valuable work of meridian observations in the southern hemisphere. A large Askania vertical circle of the München Observatory has been moved to Australia and installed at the Mount Stromlo Observatory near Canberra. Absolute determinations of the declinations of the southern fundamental stars are carried out to obtain the system of declinations, based upon observations with the same instrument in two hemispheres (as is known, an analogous recommendation of the Pulkovo observatory, approved in 1932 at the Fourth Assembly of the I.A.U. in Cambridge, was not realized). The Repsold meridian circle of the Bonn Observatory was demounted, its utilization at Bonn not being advisable owing to the unfavourable location of the observatory. It is intended to modernize this instrument and to move it to some suitable place in the southern hemisphere, where it can take part in the international work.

I should also like to say that several large meridian instruments of various countries are not being used for scientific studies. The main cause is a lack of staff and means. These instruments are the large Pistor-Martins meridian circle at the Berlin-Babelsberg Observatory, the Repsold meridian circle in Kremsminster (Austria), the new large Askania instrument in Beograd and also the meridian circle of the observatories in Santiago, Perth and Sydney in the southern hemisphere. There is no doubt that participation of these instruments, and particularly of those in the southern hemisphere, would be most favourable in the present co-operative work in this field of research. It is my opinion that Commission 8 and the Executive Committee of the I.A.U. should render the observatories assistance and help to enable them to start regular use of these instruments.

INSTRUMENTS AND OBSERVATORIES

The ceremony of reopening the Pulkovo Observatory, totally destroyed during the war and erected now on a scale surpassing its pre-war dimensions, took place in May 1954. The partly modernized old Pulkovo instruments of W. Struve, the large transit instrument and the vertical circle, were mounted and investigated again (these instruments were used for over 100 years for absolute determinations of star co-ordinates). An interferometrical investigation of the pivots of the transit instrument and a detailed determination of the errors of the vertical circle diameters for each $10'$ were carried out. Thermal differences in the bodies of the instruments and in the surrounding air are being studied, as well as their influence upon the results of observations. Absolute determina-

tions of right ascensions and declinations of stars were resumed with these instruments after an interval of 13 years. The Toepfer meridian circle with an aperture of 19 cm., intended for differential observations, was also mounted and investigated. The old Pulkovo 6-inch Repsold meridian circle was moved to the Nikolaev branch of the observatory. Together with the Pulkovo meridian circle, the latter will be used for differential observations of faint stars. An experimental meridian instrument of a new design⁽¹⁶⁾ was constructed in the shop of the observatory. It consists of a flat mirror rotating on a horizontal axis and two fixed meridian collimators. Soukharev's instrument is at present being investigated and will soon start an experimental series of right-ascension determinations.

The pavilion to house the Cooke reversible transit circle at Herstmonceux has been completed and the installation of the instrument is in progress. The instrument itself and the two piers for the collimators (which are contained within the pavilion) are supported by one massive concrete foundation, which is stabilized by piles reaching to a depth of 34.5 ft. The instrument will be provided with azimuth marks. Cameras are being provided for recording the circle readings and alterations are being made to the micrometer eye-end. A photographic chronograph has been planned to eliminate the time-consuming work of reading chronograph tapes. A quartz optical square is under construction for the investigation of the flexure of the instrument in different positions. The pavilion for the Melbourne reversible transit circle will be generally similar to that for the Cooke instrument. The pavilion is to be started in the near future. This instrument will be used for differential observations. The pavilion to house the photographic zenith tube has been completed and the erection of the instrument has been commenced. Preliminary observations will be made for the purpose of smoothing the positions of the stars on the observing programme. Observations will be made in the evening and morning and will provide a control on periodic errors in the right-ascension system of the FK 3 for the declination corresponding to the zenith of Herstmonceux.

The new 7-inch transit circle of the U.S. Naval Observatory in Washington, constructed in the Naval Observatory shop, is being installed on new piers in the transit house formerly occupied by the 9-inch. The instrument is of steel construction, the circle graduations being engraved on a gold-silver alloy. The circles are divided to $0^{\circ}.05$ and the zenith distance micrometer and the measuring engine also utilize decimal parts of a degree. The avoidance of minutes and seconds of arc greatly facilitates the use of the punched-card machines in the routine computations. The final results are converted to the customary units before publication. The circles of the 6-inch have been regraduated on the same system and one circle of each instrument is now being investigated.

In Ottawa it is planned to build a mirror transit instrument similar to that of Soukharev (or to that by Dr Atkinson at the Greenwich Observatory). The intention is to use the 10-inch collimating lenses with 14-foot focal length and an 11-inch quartz mirror, and if possible to record transits photographically. Dr W. McClenahan hopes that with such an instrument it will be possible to observe the KSZ, or Larink's list of faint stars. The PZT is installed and is now used in Ottawa for the determination of clock errors. An automatic machine for operating the PZT and a new measuring engine were constructed and are put to work. With the latter both micrometer readings and star images are projected on a ground glass screen. Observations by means of PZT permitted the improvement of the co-ordinates of the programme stars, which produced a considerable increase of precision in time determinations. The probable error of a clock correction from an observation of one star has thus been reduced considerably and is now of the order of $\pm 0^{\text{s}}.014$.

Dr A. Reiz at the Lund Observatory constructed a photo-electric unpersonal micrometer for the Repsold meridian circle. A knife-edge prism is connected to a micrometer screw, the speed of which can be adjusted by means of a photo-electric balance device to maintain the coincidence of the object under observation and the travelling knife-edge. Laboratory tests have proved the micrometer to behave satisfactorily.

A new meridian circle recently constructed by Grubb-Parsons Co. was installed in

1953 at the San-Fernando Observatory. An investigation of the instrument was undertaken. Errors of graduation of the fixed circle are being determined. After the completion of its investigation the instrument will be used for absolute determinations.

Determinations of the graduation errors of the circles of the meridian instruments were also carried out at the observatories in Paris, Uccle, La Plata, Pulkovo, Golosseyevo and Odessa. Bruns's rosette method was used by the last three observatories for determinations of the errors in the degree diameters. For more detailed investigations the method recently proposed by V. V. Podobed (17) was applied, which is a modernized Zurhellen's method for the investigation of scale graduations. It was found at Golosseyevo that the Wanshaff vertical circle has a regular $5''$ -rate of diameter errors, reflecting the errors of the scale copied during graduating the circle. The Askania meridian circle in Uccle shows a slight displacement between the degree and the half-degree touches. It was caused by the systematic $1''$ periodic error with an amplitude of about $0''.4$. This error was found through an analysis of observations of fundamental stars. M. Lévy determined in Paris the corrections for all the diameters (for every $5''$) of the two circles of the large meridian instrument. An original method was applied by him, similar to that of Bruns, but securing a greater economy (a description of it will appear in the *Bulletin Astronomique*). A comparison with the old investigation (1907) showed a slight deformation of the circles (of $0''.04$ and $0''.09$, respectively).

Pivots were investigated at Pulkovo, Nikolaev, Kiev, Tashkent and Bergedorf. Pivots of the Bergedorf meridian circle were repolished, reducing their errors from $+2\mu$ to $+0.2\mu$. The micrometer of that instrument was reconstructed to adjust it for records with a printing chronograph, controlled by a quartz clock. The graduations of the circles became unfit for photography during the 50 years of use. Therefore it was decided to use in the future the visual microscope method and to photograph the micrometer readings. Cameras for this purpose were constructed by the Bergedorf Observatory shop.

A number of observatories carried out azimuth determinations with meridian marks. Regular observations of the azimuth mark of the Bouty transit instrument have been carried out since 1953 at the Paris Observatory to study seasonal variations of its azimuth. An interesting investigation was made by Dr G. van Herk and J. C. de Münck for the Netherlands Geodetic Committee. In order to test whether it would be practicable to get rid of lateral refraction influencing observations of meridian marks, they tried to test the possibility of using a vacuum pipe between the mark and the instrument. The result was encouraging and published by the Committee just mentioned.

It should be mentioned, in conclusion, that the building of the La-Leona Astrometrical Observatory in Argentina at a latitude of -50° is being continued. We do not doubt that this observatory, the most southern in the world, will play an important rôle in astrometry.

As can be seen from all the material reported above, activity in the domain of meridian astrometry has been considerable since the last Assembly of the I.A.U. The plan for a new photographic re-observation of the AG zone catalogues for the northern sky was advanced during this period. The meridian observations of the reference stars and the improvement of FK3, undertaken in Heidelberg, will play an important part in this plan. The compilation of the KSZ develops favourably. Closely allied to meridian astronomy is the useful work of the Cape and Yale Observatories, which are successfully compiling large photographic catalogues of stars. The Lick programme of proper motions of stars, as referred to extragalactic nebulae, is also in progress. The growing co-operation of the observatories of different countries in extensive programmes of observations is particularly welcome. It should also be pointed out that the bonds existing between meridian astrometry and other branches of astronomy are steadily being strengthened. Thus, for instance, the interesting work of the Leiden and Paris Observatories have confirmed the expansion of stellar associations, forecast by V. A. Ambartsumian. Of great importance for stellar astronomy and astrophysics are the studies of proper motions of stars, lists of which are recommended for meridian observations.

Considerable progress was also reached in the construction of new astrometric instruments, such as Danjon's *prism astrolabe*, horizontal mirror meridian instruments by Soukharev and Atkinson, new photographic zenith tubes and so on.

The most essential drawback of the present astrometric investigations, is, however, the insufficient observation of the southern sky.

The most important task of Commission 8 for the future is, in my opinion, a further strengthening and stimulation of international co-operation in the domain of astrometry, and a greater development of this branch of astronomy, especially at the observatories in the southern hemisphere.

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President of the Commission

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8a. SUB-COMMISSION ON PHOTOGRAPHIC CATALOGUES OF STARS BRIGHTER THAN THE NINTH MAGNITUDE

At the Rome meeting the President of Commission 8 recommended that a sub-commission be given the name 'Photographic Catalogues of Stars Brighter than the Ninth Magnitude' as better expressing the nature of its work than the original name. This makes it clear that the sub-commission is concerned with the repetition of photographic observations of AG stars in the northern hemisphere and its counterpart in the southern hemisphere and also the consideration of meridian-circle programmes required to support such projects.

The symposium on the astrometry of faint stars during the Rome meeting of the Union and the conferences on galactic structure at Groningen (1953), on problems in astrometry at Evanston (1953) and on astrometry at Pulkovo (1954) have shown how basic our subjects are to other fields of astronomical research. Especially closely related are the following:

- (a) The construction of a fundamental system of faint stars.
- (b) The determination of absolute proper motions of stars by measuring them against a background of extragalactic nebulae.

Of particular importance is the proposal made by O. Heckmann⁽¹⁾ at the Evanston Conference. This plan proposes that the northern hemisphere be reobserved photographically at Bergedorf and Bonn with the same instruments as were used for AGK 2.