

8. COMMISSION DE L'ASTRONOMIE DE POSITION

Report of Meetings

PRESIDENT: F. P. Scott.

SECRETARY: R. d'E. Atkinson.

First Meeting, 26 August 1964

The Commission met at 10^h 45^m under the chairmanship of the President Mr F. P. Scott.

The Draft Report was considered, and was adopted after a few alterations; especially (a) the addition of the Quito Observatory to the list of those that have been obtaining regular observations with a Danjon astrolabe; (b) the paper on refraction mentioned in Comment 7 was published in the proceedings of the German Geodetic Commission, Series D, no. 6, and not as previously noted in the Draft.

Resolution 17 of the IUGG meeting at Berkeley (1963) was noted with approval. (Endorsement of plans to improve the positions and proper motions of stars in the southern hemisphere.)

With reference to Resolution no. 1 of the previous IAU Assembly, De Barros reported that after some trials with his Mirror Transit Circle the large circular floats for counterpoising the axis had been replaced by mechanical bearings supported on floats; the resulting load on the pivots was appreciably more uniform. Various modifications in the mirror counterpoising had also been successfully adopted.

With reference to Resolution no. 2 of the previous IAU Assembly, Guinot reported on the present state of the astrolabe chain. (a) Stations that have already published star catalogues with places based on astrolabe work are Paris (+ 49°), Neuchâtel (+ 47°), and Curaçao (+ 12°). (b) Stations that have done a substantial amount of observing and are in the process of reducing and discussing their results are Pulkovo (+ 59½°), Potsdam (+ 52°), Herstmonceux (+ 51°), and Tananarive (− 19°). (c) Stations which have set up instruments and, in general, have started observing are Besançon (+ 47°), St Michel (+ 44°), Mizusawa (+ 39°), Algiers (+ 37°), Florida (+ 25°), Quito (0°). (d) Projected: São Paulo (− 24°), Santiago (− 33°), Cape (− 33°), Wellington (− 42°). It would of course be 3 or 4 years yet before definite results could be obtained from this last group, in the best of circumstances.

In reply to a question, Guinot stated that the stars observed would in all cases be FK₄ or (sometimes) FK₄ Supp. ones; many stations proposed to observe every FK₄ star within their range. Fricke recalled the emphasis that had been placed on the chain proposal of Dr Danjon at previous meetings, and expressed his satisfaction that it was now bearing fruit. The Commission adopted Resolution no. 1. Sandig reported that it was hoped to move the Potsdam astrolabe to a latitude near zero, but that no clear date for being able to do this could yet be given.

The President summarized the effort currently being devoted to the Bright Stars program. Eight observatories are involved, with a considerable fraction of the work described as 'fundamental'. The Commission considered that the requirements were on the whole adequately covered.

Note: The term 'fundamental' is definitely not used in the same sense at all observatories. It would seem desirable to adopt a definite terminology for future reports.

Fricke asked whether Munich would continue with fundamental work, definitely including

observations of the major and minor planets. Schmeidler replied that this had been done for many years and he hoped to be able to continue the work. Fricke strongly urged that this should be done if at all possible, and the Commission supported this view. Von der Heide stated that Bergedorf intended to observe all accessible bright stars from their new station at Perth. Slaucitajs stated that the observatory at La Leona (-50°) expected to be operational in a few months, and would be observing all FK4 stars from $+30^\circ$ to -90° fundamentally.

In connection with the extension to -90° of the list of double stars not suitable for measurement on photographic plates, the President appointed a committee consisting of Dieckvoss, Stoy, Zverev, and himself, to revise the provisional list.

The Comments (Draft Report, p. 46) were considered. Fricke urged the importance of no. 1 (machine-readable catalogues) and after some discussion on the relative merits of cards and tape, Resolution no. 2 was adopted, identical with that in the Comment. The President stated that *U.S. Naval Obs. Circular* 99 summarizes the work already done on getting old catalogues onto cards. The President announced a meeting of the Southern Reference Stars Committee, and all interested observers, for the coming evening.

Second Meeting, 28 August 1964

The second meeting was called to order at 14^h 00^m by the President.

It was announced that the President of the Commission, for the ensuing 3-year term, would be Dr R. H. Stoy, with Dr A. Nemiro as Vice-President, and that the Organizing Committee would consist of W. Fricke, J. Lévy, F. P. Scott, S. Slaucitajs, E. G. Woolsey, and M. S. Zverev. A list of new members of the Commission was displayed.

The Committee on Double Stars, appointed at the first meeting, presented a report of a meeting it had held. It recommended: (a) The double stars to be observed with Meridian Circles should be selected from the *Index Catalogue of Double Stars* recently published by the Lick Observatory; (b) The list of 2291 double stars from $+90^\circ$ to -30° selected at Pulkovo from Aitken's catalogue should be revised on the basis of the Lick Index Catalogue; (c) Meridian Circle observers should be encouraged to include as many of the selected stars ($+90^\circ$ to -90°) as possible in their observing programs. Zverev had called the Committee's attention to the fact that the criterion published in *Trans. IAU*, 10, 128, 1960, should be altered. The words 'combined magnitudes $6^{m.0}$ to $9^{m.0}$ (Harvard system)' should be replaced by 'magnitude of the brighter component $6^{m.0}$ to $9^{m.0}$ (*Index Catalogue of Double Stars*)'. This change reduces the number of stars in the Naval Observatory list (-30° to -90°) from 1589 to 1204. Other modifications, aimed at substantially reducing the whole working list, had also been discussed; the Committee felt it had no present basis for assessing their suitability, and recommended that it be kept in existence until an approved list can be settled by correspondence. This was agreed to.

The President then reported on a meeting of the SRS Committee. There had been a discussion of the problem involved in relating the SRS stars to the fundamental system, and of the methods in use. The Committee had agreed: (a) All Meridian Circle observers doing differential work should relate the Reference Stars to the FK4 system by their own methods, and should publish the results for both the Reference Stars and the Fundamental Stars, all of which should be reduced in the same way; (b) All Meridian Circle observers doing fundamental work may relate the Reference Stars to their own system provided they also relate the FK4 stars to the same system and publish their places also, so that a clear relation between that system and the FK4 can be established; (c) It would be desirable to make a complete photographic coverage of the sky from 0° to -90° as nearly as possible at the epoch of the reference star observations.

Two further 'addenda to the Draft Report' were presented. Zagar reported that the Ap 100

transit instrument of Brera-Milan has been observing FK₃ and FK₃ Supp. stars in R.A. since 1958, and has also observed planets and bright asteroids differentially against FK₃. Nemiro and Plugina, at Pulkovo, have studied a possible diurnal term in the 1954–61 results of the large Pulkovo transit, and they find that the amplitude of the diurnal term is small and the day-night difference practically zero.

The President reported on the status of the AGK₃R program.

(1) All observational commitments have been completed except that of Babelsberg; it is hoped that this one will also be completed in time to be included.

(2) All observational results have been received at USNO for Bergedorf, Bordeaux, Heidelberg, Nicolaiev, Ottawa, Paris, Pulkovo, Strasbourg, and Washington; the Herstmonceux results are in transit to Washington at the moment.

(3) Processing of the results is under way at USNO, but has been delayed in a few cases by failure of the observer to provide an adequate description of his observing and reducing methods, or by questions of interpretation.

(4) As a first step at USNO, three different methods are being tried for reducing all results to the FK₄ system. The first is a general reduction by means of condensed tables of the FK₄ – FK₃R differences. In the second, a constant correction is computed for each observing tour, using the FK₄ – FK₃R differences for the actual fundamental stars observed in that tour. In the third method, the FK₄ – FK₃R differences for the stars observed in any tour are used to derive corrections to the reduction constants themselves, and these are applied as nearly as possible according to the methods of the original observer. There are only slight systematic differences between the end results of the three methods, for any one observatory, but the third method is the most effective in diminishing both the nightly mean errors and the mean error of all results for any one star, at one observatory. (These conclusions are preliminary, since a complete study of all the data has not yet been made.) The reduction to FK₄ has been completed for the Bergedorf, Bordeaux, and Washington observations. In discussion of this report, Zverev asked when Pulkovo could expect to receive a copy of the results. The President stated that this might be done in about 12 to 15 months provided some late observations were omitted.

The President showed a table of the status, as of 1964 June, of the observational and reduction work on the SRS project, for the observatories: Abbadia, Bordeaux, Bucharest, Nicolaiev, San Fernando, Tokyo, Cape, and Santiago (Pulkovo). On the average about 38 per cent of the commitments have been completed. The two last lists are largest, and are the only ones going beyond – 30°; for them, the observations are, respectively, 25 per cent completed, (80 per cent reduced) and 40 per cent completed, (15 per cent reduced). The USNO has computed, on request from observers, 40 000 apparent places, 23 000 *m*, *n*, and *c* reductions, and 12 000 refractions. Further additions which may be made to the list of participating observatories are: Hamburg plans to send its Meridian Circle to Perth in 1965; La Plata intends to participate as soon as its instruments have been renovated and after completion of its present programs; Yale-Columbia Southern Observatory and USNO are considering installing the USNO 7-inch at El Leoncito for a cooperative SRS program; the San Juan Meridian Circle is still being installed; and the Perth instruments are being moved and future programs are under consideration.

At this point Dr D. Brouwer took the chair to lead the discussion of the photographic work.

Dieckvoss reported on the AGK₃ (photographic) work. The 1939 plates, + 90° to – 2°·5, have been measured and the results punched on cards, together with the original AGK₂ measurements. The systematic errors (magnitude and color coefficients) have been evaluated for the Bonn lens (*c.* 1930) and for the Bergedorf one (1930 and 1958); other systematic errors have also been included, and new AGK₂ places are being computed on the FK₄ system. In the

Bonn zone (south of $+22^{\circ}.5$) new plate constants have to be derived, as the lens errors were rather large. In addition, a fairly good approximation to a future AGK₃ is computed by several iterations using faint stars and an assumed mean proper motion. These results will be produced in machine-readable form, and they should represent the actual AGK₃ except for the final systematic relation to the Reference Stars. This program makes it possible to take advantage of the generous offer of Lacroute (Strasbourg) and Bacchus (Lille) to process the data by Lacroute's method of overlapping plate fields; this can greatly increase the weights of the plate-constants even when the reference-star places are moderately good. The almost final AGK₂ – AGK₃ differences which will result will permit the detection of chance errors in the Bergedorf measures without waiting for the AGK₃R results.

Lacroute spoke on his method of overlapping plates. It produces in effect a set of plates so self-consistent that it can be located as a whole, i.e. with a very large number of reference stars. The method can be extended to an entire hemisphere, or even to the complete sphere, and is practicable even if the epoch of the meridian work is different.

Brouwer reported on the present state of the southern photographic work. The reductions for the Yale Zone -30° to -40° , mean epoch 1956, are nearing completion by Dr Hoffleit; the -40° to -50° zone, mean epoch 1941, is in progress by Mrs Eckert at the Watson Computing Laboratory; the -60° to -70° zone, mean epoch 1941, is being reduced by Dr Klemola; and the -70° to -90° zone, mean epoch 1956, is being reduced by Drs Eichhorn and Jefferys. The Cape Zones -64° to -80° , mean epoch 1948, and -80° to -90° , mean epoch 1953, will be published shortly. New photographic work in progress or about to start consists of the Cape re-observation of the zone -40° to -52° , mean epoch 1962 (photographs completed); the Sydney repetition of the -51° to -65° zone of the astrographic with a mean epoch to be approximately equal to that of the southern reference stars; and the Yale repetition of the 0° to -30° zone to be taken up after the installation of the Yale-Columbia Southern Observatory. To this report should be added Lourens's report on the Cape Observatory's work. He stated that the Cape Observatory was committed to a photographic re-observation of the area of the sky between -30° and -90° . This area is being photographed in four zones in the following order: (1) -40° to -52° (mentioned above), (2) -30° to -40° , (3) -52° to -64° , and (4) -64° to -90° . Meridian circle determinations of the positions of the reference stars are planned to be made concurrently with the photographic work; those for the first zone are nearly completed. The new astrometric camera is used for the photographic work and plates overlapping in both right ascension and declination are being taken. The plates will be measured initially for the purpose of smoothing individual accidental errors of the meridian circle positions of the reference stars. This process may be used to improve the positions of poorly observed meridian stars. The plates will serve as a permanent memory record of nearly all stars to the eleventh magnitude. They will also serve as a repeat survey of the Cape photographic series for the improvement of proper motions. A fully overlapping series of plates concurrent with meridian circle positions of the southern reference stars will always contain a very great potential in astrometry.

Zverev reported on the KSZ program. 'Absolute' observations of the fundamental stars (FKSZ) of the Faint Star program have been completed in recent years at Pulkovo (α , δ), Golossejevo (δ), Kasan (δ), and Tashkent (α). Cape and Cerro Calan (Pulkovo) are extending this work to the southern sky. The observations will be discussed at Pulkovo along with those of the bright stars. Differential observations of the northern FKSZ stars (14 catalogues from 10 observatories) were used to compile a Preliminary Catalogue of Fundamental Faint Stars (PFKSZ) (1), and further observations were completed in Moscow (2). All (northern) FKSZ and KSZ stars are also included in the AGK₃R program, and in addition meridian observations of these were made at Bucharest ($+10^{\circ}$ to -10° , α and δ), Kazan ($+90^{\circ}$ to

+ 50°, δ), Kiev (+ 30° to + 10°, α and δ), Moscow (+ 90° to + 30°, α and δ), Nikolajev (− 5° to − 20°, α and δ), Odessa (− 5° to − 20°, α and δ) and Tashkent (− 5° to − 20°, α). All these observations have been completed and some catalogues have been published (3, 4, 5); general discussion of them can be started when the international AGK₃R results are received at Pulkovo. All southern KSZ stars are included in the SRS program. Photographic observations of selected minor planets (nos. 1, 2, 3, 4, 6, 7, 11, 18, 39, 40) Yachontova (6, 7) were started in 1954. More than 5000 observations were obtained at Bucharest, Pulkovo, Leiden, Moscow, Santiago, Zo-se, Sydney, Golossejevo, Cape, Tashkent, Nikolajev, and some others. Yale catalogue stars are used as reference stars. It has been decided to continue observing each minor planet until it has completed three revolutions; this will take until 1965 or 1969, depending on the planet. General discussion has started at the Leningrad Institute of Theoretical Astronomy. The photographic observations of galaxies are in charge of A. N. Deutsch. Working lists were published by Pulkovo (8), Tashkent (9) and Santiago (10); seven areas from − 68° to − 90°, photographed at the Cape, have been studied at Pulkovo. First-epoch plates have been completed at Pulkovo (157 areas) and Golossejevo (95 areas); observations are in progress at Bucharest (165 areas), Moscow, Tashkent, Zo-se, and Bordeaux, and they will be resumed (after an interruption) at Santiago and Perth. In addition, selected FKSZ stars are being photographed with objective grating at Bucharest, Golossejevo, Moscow, Pulkovo, Zo-se, and some other observatories (11), to obtain the connection between galaxies and fundamental stars. The connection must of course wait for second-epoch plates of the galaxies; Pulkovo and some other observatories, where the work was begun in 1939, may start with second-epoch plates very shortly.

REFERENCES

(The following references were taken from a manuscript provided by Dr Zverev).

1. *Trudy glav. astr. Obs. Pulkove*, 72, 1958.
2. *Trudy gos. astr. Inst. Sternberga*, 31, 1962.
3. *Izv. astr. Engel'gardt. Obs.*, 33, 1963.
4. *Cirk. Taškentsk. astr. Obs.* no. 314, 1961.
5. *Ibid.*, no. 319, 1962.
6. *Trudy 11. astrometr. Konf. SSSR*, 78, 1955.
7. *Ibid.*, 261, 1955.
8. *Izv. glav. astr. Obs. Pulkove*, 20, no. 154, 14, 1955.
9. *Cirk. Taškentsk. astr. Obs.* no. 302, 1959.
10. *Obs. Nacional Chile, Publ.* no. 4, 1961.
11. *Trudy 13. astrometr. Konf. SSSR*, 12, 1958.

Third Meeting, 1 September 1964

This meeting commenced at 10^h 45^m with the President presiding.

Fedorov reported for the Working Group set up at the previous Assembly to consider the accuracy-requirements in meridian observations of latitude stars. Different latitude stations have different $\Delta\delta_\alpha$, and these can only be unified by meridian circle work. The scatter of the different catalogues is such that about 10 independent ones are needed, if the non-polar variation is to be adequately investigated. The Commission adopted Resolution no. 3, as proposed by the Working Group.

The President referred to the suggestion, made at the first meeting by Sandig, that the Potsdam astrolabe might be moved to an equatorial station, and the Commission adopted Resolution no. 4.

The President opened a discussion on the improvement of meridian observations, and on

new methods of observing. Zverev presented a paper on a method used in analyzing determinations of Bessel's n made at Cerro Calan. Equatorial ($+40^\circ$ to -40°) values of n_0 were compared with values of n obtained by combining a few equatorial stars with stars in other parts of the sky. Considering pairs of stars of the same declination, one observed at upper and the other at lower culmination, relations can be set up which, with certain moderate assumptions, permit the exhibition of the $\Delta\alpha_\alpha$ and $\Delta\alpha_\delta \cos \delta$ corrections needed by the Fundamental Catalogue. An application of this method to the Cerro Calan meridian circle observations gave $\Delta\alpha_\delta \cos \delta$ corrections to the FK4 varying from $-0^s.012$ at -90° to $-0^s.028$ at -70° declination. Gliese gave somewhat similar results from an analysis of Cape observations of mean epoch 1936.5.

Guinot spoke on the agreement between different astrolabe catalogues. To date, only Neuchâtel and Paris can be compared (*Bull. Astr.* **23**, 343, 1962); small systematic differences $\Delta\alpha_\alpha$ and $\Delta\delta_\alpha$ are found, but none in $\Delta\alpha_\delta$ or $\Delta\delta_\delta$.

Zverev presented some work by Nemiro and Pavlov on the use of Time Service transit observations for improving Right Ascensions. (See *Izv. glav. astr. Obs. Pulkovo* **20**, no. 157, 1957; **21**, no. 161, 1958; **22**, no. 168, 1961.) Although the azimuth-stability of these instruments is relatively poor, their reversibility gives them some compensating advantages. A catalogue is being compiled from about 150 000 observations using as a reference system three catalogues based on more than 60 000 observations made with three photo-electric transits during 1957-59; some tours of duty ran up to 18 hours and many exceeded 12. The high latitude of Pulkovo means the altitude at lower culmination of zenith stars is the same as the altitude of the Equator; thus, if we can assume symmetry about the zenith the run of $\Delta\alpha_\delta$ from the zenith to the Equator can be well determined. In discussion Fricke agreed that time service observations can be valuable, and stated that they would be used in compiling FK5 if they were so presented that the compilers could in fact use them.

Gliese discussed the dispersion among the systems of absolutely-observed catalogues. He found that the average dispersion $\sigma \cos \delta$ among α_δ systems has remained at about $\pm 0^s.01$ for the last century, with the dispersion of any one instrument from its own mean only slightly less. The dispersion ($\sigma \cos \delta$) among α_α systems has fallen from about $\pm 0^s.006$ (1900-20) to $\pm 0^s.003$ (1920-50), for stars from $+50^\circ$ to $+80^\circ$. Similar results appear in δ ; the dispersion among the δ_δ systems has not decreased in the last century, while that among the δ_α systems is smaller and has decreased substantially. The dispersion among the Equator-point determinations, originally derived from solar observations only, has been decreased by the inclusion of planets and minor planets. In discussion, van Herk asked whether there was any physical explanation for the drop in dispersion among the α_α systems, and suggested that temperature-effects had been inadequately guarded against. Atkinson suggested that the α_δ dispersion seemed to arise primarily through changes in the procedure for determining azimuth. Gliese felt that these factors were not large enough.

Atkinson urged that northern and southern observatories should make combined analyses of their observations, down-weighting in each case the ones made at low altitudes, so that the Equator-point, obliquity, etc., could be derived almost entirely without these weak data. The President stated that USNO plans were now along these lines.

Fricke showed graphs of $\Delta(\mu_\delta)_\delta$ for FK3-NFK and FK4-FK3; the correction made in deriving FK3 was over-estimated.

Requière described a photo-electric observing system now under development at Bordeaux. A system of tracking by use of a knife-edge prism and Lallemand photomultiplier has been studied. The speed of the driving motor is corrected by the error signal from the photomultiplier. Early results show that the new automatic micrometer can be compared advan-

tageously with visual micrometers. Kozai remarked that a similar technique had been introduced on a transit instrument by Dr Tsubokawa of the Geographical Institute of Japan.

Høg reported on his photo-electric method of transit observations. He uses a fixed grid in the focal plane, with a pulse-counting photometer having a fast output on punched tape. Stars can be observed to 10^m , and planets and bright stars can be observed by day. Azimuth marks, and collimation, can also be reliably observed, so that the instrument can be truly fundamental. The focal length can be quite short, thus decreasing flexure troubles. A preliminary instrument has been tested on the Hamburg 9 cm transit, and study of the power-function of the image-motion indicates that a finite number of discrete counts, obtained with the slit-system in use, is about 80 per cent as efficient as a completely continuous ideal record would be.

RESOLUTIONS

(1) Commission 8 notes with satisfaction that the chain of astrolabes repeatedly recommended by this Commission is now being completed by the essential extension into the southern hemisphere. In view of the recognized value of a continuous astrolabe chain for the improvement of the fundamental system of star-places, and in view of the particularly great need for such improvement in the southern hemisphere, the Commission strongly recommends that all southern nations which are in a position to contribute to this work make every effort to bring their observational output up to the necessary level at a very early date.

(2) Commission 8 recommends that publishing institutions make their observations and other star catalogues available in machine-readable form, preferably on punched cards.

(3) Commission 8, having considered the report of the Working Group on the systematic accuracy in declination required for latitude stars, invites the attention of all observatories engaged in positional work to the conclusion that about 10 independent catalogues of the positions of these stars are desirable, if systematic errors in declination are to be eliminated sufficiently well to permit the study of non-polar terms in latitude variation.

(4) Commission 8 notes the suggestion that the Potsdam astrolabe might be removed to some station near the Equator, and cordially welcomes this proposal in view of the scarcity of such stations and the large number in northern latitudes.