8. COMMISSION DE L'ASTRONOMIE MERIDIENNE

PRÉSIDENT: M. S. Zverev

MEMBRES: MM. Armellini†, Atkinson, R. Baillaud, Barros, Bohrmann, Brouwer, Carnera, Danjon, Demetrescu, Dick, Dyukov, Gordon, J. Jackson, Spencer Jones, Kopff, Lacroute, Larink, Lévy, Lourens, McClenahan, Maître, Meyer, Moreau, H. R. Morgan†, Nakano, Mme Nefedieva, M. Nemiro, Mlle Nowacki, MM. B. A. Orlov, Pilowski, Planelles, Podobed, Reiz, Schmeidler, Scott, Sémirot, Slaucitajs, Spigl, Stoy, Stoyko, Symms, Tuzi, van Herk, Verbaandert, Watts, H. W. Wood, Woolsey, Xanthakis, Zimmerman.

8*a*. SOUS-COMMISSION DES CATALOGUES PHOTOGRAPHIQUES D'ÉTOILES JUSQU'À LA 9-ME GRANDEUR

PRÉSIDENT: D. Brouwer

MEMBRES: Mlle Barney, MM. A. N. Deutsch, Dieckvoss, Eckert, Fatchikhin, Kox, Lourens, Scott, Vasilevskis, von der Heide, H. W. Wood.

We note with much regret the death on 11 June 1957 of H. R. Morgan. An eminent authority on meridian astrometry, he devoted over thirty-five years to observations with the 9-inch transit circle of the U.S. Naval Observatory at Washington. He was President of this Commission from 1938 to 1948.

The present report is based on more than sixty letters from members of the Commission and directors of observatories in answer to my circulars of December 1956 (about new urgent programmes of meridian observation) and of August 1957. I wish to record my gratitude to those members of Commission 8 who have sent me their reports, and also to E. Paloque, P. Naur, J. Hopmann, E. Martin, E. Rybka, M. F. Bykov, A. A. Gorynia, N. P. Barabashev, A. K. Korol, J. G. Kolchinski and B. V. Novopashenny, who communicated with me about the activities of their observatories. No replies were received from members of this Commission: Armellini (Rome, Monte Mario), R. Baillaud, V. Maître (Besançon) and G. Meyer (Alger). Hence the information on the activities of the respective observatories is missing in this report.

I should greatly appreciate having my attention called to any inaccuracies, omissions or errors in this report. Due corrections or additions will be made if the relevant information is available before the close of the General Assembly of the I.A.U. in Moscow (1958).

STUDIES IN ACCORDANCE WITH RECOMMENDATIONS OF THE I.A.U. AND OTHER INTERNATIONAL ORGANIZATIONS

The Revision of FK 3

This work is in progress at Heidelberg under the supervision of A. Kopff.

The first stage of the work has been brought to a close: systematic corrections of the observational catalogues to the system FK 3 were derived and taken account of; subsequently the individual corrections to both co-ordinates and proper motions of stars were computed on the original system. These corrections designated as 'FK 3R' have been published[1]. They are intended both for the observers of AGK 3 reference stars and for a preliminary discussion of observations made on the I.G.Y. programme. At present Kopff is engaged in systematic improvement of FK 3 and the derivation of a new system FK 4.

FK 3 *supp.*

Accurate positions and proper motions of FK 3 supp. stars on the FK 3 system were published in appendices to *Astr.-Geodät. Jahrbuch* for 1954 and 1956 for the northern and

southern sky respectively. Meridian observations of FK 3 supp. stars have been carried out in Ottawa since 1954 and at the U.S. Naval Observatory at Washington since 1956. In the near future observations of these stars are to be commenced at Cape and probably at some other observatories to meet the requirements of the 'programme of bright stars' (see 'propositions').

KSZ

The preparation of the *Preliminary General Catalogue of Fundamental Faint Stars* (PFKSZ) has recently been completed at Pulkovo. This catalogue was compiled on the basis of fourteen catalogues obtained in the course of the past fifteen years from the observations of ten observatories (Bucharest, Golosseievo, Kazan, Kiev, Moscow, Odessa, Pulkovo, Tashkent and Wroclaw). The system of PFKSZ is close to that of FK 3. The proper motions of stars were computed on the FK 3 system, use being made of the GC, AGK 2, Yale, and some other catalogues. The average mean errors of positions and centennial proper motions are:

$$\epsilon_\alpha \cos\delta = \pm 0^s.0068, \qquad \epsilon_\mu \cos\delta = \pm 0^s.029;$$

$$\epsilon_\delta = \pm 0''.127; \qquad \epsilon_\mu = \pm 0''.50.$$

The catalogue is in press.

Absolute determinations of co-ordinates of FKSZ stars are in progress at Pulkovo, Golosseievo (Dec. only) and at Cape, and have been completed at Tashkent (R.A. only). Differential observations of these stars on the FK 3 system are continued in Moscow and La Plata as also at the observatories participating in the programme of AGK 3R (this programme includes all the KSZ stars north of $-5°$).

Since 1956, meridian observations of the large KSZ programme have been carried on at the observatories taking part in the AGK 3R programme; moreover, the KSZ stars north of $-20°$ have been observed at Bucharest and at six observatories of the U.S.S.R. (Kazan, Kiev, Moscow, Nikolaiev, Odessa and Tashkent). The urgent task at present is to stimulate the meridian observations of KSZ in the southern sky (a list of these stars is prepared at the Cape Observatory).

The progress of photographic observations of selected extra-galactic nebulae on the Pulkovo programme [2] is reported from Bucharest, Golosseievo, Moscow, Pulkovo, Tashkent and Zo-Sé (near Shanghai). On the request of the Pulkovo Observatory due to the kind assistance on the part of Dr P. Couderc, President of Commission 23, Toulouse, San Fernando and some observatories of the southern hemisphere (Cordoba, Perth and Santiago) have also agreed to take part in these observations. The latter three observatories must begin their work by taking test photographs for choosing suitable galaxies, i.e. to extend the Pulkovo list to the southern sky.

The observatories at Santiago, Copenhagen, Cape, Pulkovo, Sydney, Golosseievo, Rome, Bucharest, Madrid and others participate in the observations of the ten minor planets proposed by N. S. Yakhontova in relation to the KSZ project (planets nos. 1, 2, 3, 4, 6, 7, 11, 18, 39 and 40). In 1955–57 the largest bulk of material was secured at Santiago, Copenhagen and Pulkovo. It should be added to this that the first four asteroids are on the meridian programmes of Cape, Golosseievo, Munich, Tokyo and Washington.

AGK 3R

In accordance with the resolution of the astrometric conference at Brussels [3] and the I.A.U. Dublin General Assembly, meridian observations of AGK 3R stars have been actively commenced; see the report by F. P. Scott under Sub-commission 8*a*.

Latitude and PZT stars

In accord with Prof. Cecchini's recommendation approved at the Brussels session of the I.U.G.G. in 1951, the Uccle Observatory has carried out the determination of declinations for 500 stars on all the I.L.S. programmes. About twelve observations of each star were obtained in 1952–56 with an Askania meridian circle. The catalogue is in

press. Declinations of latitude stars for the Poltava and Kazan Zenith-telescope programmes have recently been determined in Odessa and Kazan (Engelhardt-Observatory).

For some years meridian observations of the PZT stars were made at Greenwich (with Airy T.C., PZT stars for Herstmonceux) and Ottawa (for Herstmonceux, Richmond-Florida and Ottawa). Observations are being continued at Bergedorf (for the PZT of the Hydrographic Institute in Hamburg), in Tokyo (for the PZT of Tokyo and Mizusawa) and at the U.S. Naval Observatory.

Giants of early spectral types, Cepheids and others. (The lists by Blaauw and Parenago)

Meridian observations of these stars were recommended at the conferences in Brussels [3] and Groningen [4]. The U.S. Naval Observatory has completed the observations of 978 stars on Blaauw's list and is planning the observation of some stars on Parenago's list. At present, stars of Blaauw's list are observed in Ottawa (207 stars marked *p*) and in Munich.

The southern hemisphere

The recommendations of the eighth and the ninth Assemblies of the I.A.U. emphasized the importance of developing astrometric research in the southern hemisphere. G. van Herk has completed the discussion of declinations derived from the azimuth measurements made by the Leiden expedition in 1948–51 (*Ann. Sternw. Leiden*, **18**, part 5, 1957). F. Schmeidler has succeeded in realizing Prof. N. Dneprovsky's idea [5]; with a vertical circle he made absolute determinations of FK3 stars first in Munich, then on Mount Stromlo (Australia) and then in Munich again. The results of the observations in Australia will be published shortly.

Among the observatories of the southern hemisphere the intense and useful activity of the Cape Observatory in meridian astrometry is quite noteworthy. As to other observatories their activity is far from sufficient, although meridian observations are made at La Plata and are expected at Perth (West Australia). In accordance with the recommendation of the Dublin meeting a letter was addressed to the General Secretary of the I.A.U. with a request to support, before the Australian Government, the efforts of the Perth Observatory in the field of fundamental astronomy. As far as photographic astrometry is concerned, the activities of southern observatories have been more effective (Sydney, Santiago and others). As an achievement, the co-operation of Sydney and Yale Observatories in the extension of the Yale photographic zone catalogues to the southern sky is to be mentioned. Unfortunately I have no information about the progress of the astrometric observatory at La Leona (Argentina, latitude $-50°$).

Considering the great importance of the problems facing fundamental astrometry at its present stage, one cannot but admit that the extension and development of astrometric research in the southern hemisphere still continues to be a pressing and urgent task. The problem will be solved radically, provided the activities of established observatories in the southern hemisphere are intensified. Meanwhile expeditions organized by northern observatories, as well as the transportation of their instruments to the southern hemisphere, should be encouraged by every means. It is the duty of the I.A.U. to render all possible assistance to enterprises of this kind.

Geschichte des Fixsternhimmels

The work at the southern part of GFH is proceeding partly at Babelsberg and partly at Bonn. Under the direction of J. Dick (Berlin, Astronomisches Recheninstitut) the publication in 1955 of Catalogues for 23^h R.A. was followed by the first parts of the volumes for 22^h and 21^h. The second parts of these volumes are now in print. The work on the volumes for 20^h and 19^h continues, while for 18^h and 17^h it has only just started. Under the direction of J. Haas (Kommission für die GFH of the former Prussian Academy of Sciences) the volumes for 10^h, 11^h and 16^h have been published, thus completing the series of volumes 1–17 of Abteilung II.

OBSERVATORIES; OBSERVATIONS AND DISCUSSIONS

The U.S. Naval Observatory at Washington has continued with the 6-inch transit circle the series of observations of the Sun, Moon, planets, and fundamental stars started in 1925, and the observations of the asteroids Ceres, Pallas, Juno and Vesta, started in 1950. Six observations each of 3087 stars in the zone $+35°$ to $+50°$, and four observations each of 978 O- and B-type stars and Cepheids of Blaauw's list, were completed in 1955. Observations of 1409 of the FK 3 supp. stars between $+90°$ and $-30°$, and 7544 stars of the AGK 3R list were commenced with the 6-inch transit circle in 1956. The remaining AGK 3R stars, the stars of the PZT lists, and certain stars of the Parenago list will be observed with the 7-inch transit circle.

Since the beginning of 1954 the Ottawa Meridian Circle has been observing the 1142 FK 3 supp. stars of the northern sky, the 207 stars marked p from Blaauw's list which were not in the FK 3 supp., and 144 Ottawa PZT stars along with all the FK 3 stars north of $-27° 30'$. It is intended to obtain at least six observations on each star. It is hoped to finish this observing programme as soon as possible after 1960. In February 1956 a list of 3754 AGK 3R stars was added. The results of observations made during the years 1950 to 1953 are at the printers.

Observations with the Gill reversible transit circle for the *Second Cape Catalogue for* 1950·0 have proceeded steadily at the Cape Observatory and are nearing completion. The working list containing approximately 7000 stars was described in the report of R. H. Stoy at the Dublin meeting [7]. The reductions of these observations are well in hand and some attention has been given to the preparation of a new working list. A general outline of the proposed composition of this list was given in the report just mentioned.

A. A. Nemiro at Pulkovo completed the discussion of a centennial series of absolute observations of Struve's bright stars made with the Pulkovo large transit instrument, and compiled a new fundamental catalogue of the R.A. of 325 stars Puα1. This is the first fundamental catalogue based on the observations made with one and the same instrument. The comparison of the new system with FK 3, GC and N 30 has revealed appreciable systematic errors $\Delta\mu_\alpha$ and $\Delta\alpha_\alpha$ in these fundamental catalogues. Puα1 is in print.

Absolute determinations in R.A. and Dec. of 1046 bright and faint fundamental stars (515 W. Struve's and 531 FKSZ stars) started in 1954 have been carried on at Pulkovo with the large transit instrument and the vertical circle. Since 1955 the observations of the Sun (in spring and autumn) were also added to this programme. Observations with a Toepfer meridian circle to be used for determining R.A. of 580 FKSZ stars down to $-15°$ on the FK 3 system, were terminated in 1955, and since 1956 intense observations of the AGK 3R stars have been in progress. A catalogue of right ascensions of 203 Pulkovo Time Service stars distinguished for high accuracy was prepared by P. M. Afanassieva on the basis of photo-electric observations with a Zeiss transit instrument. R.A. determinations of about 120 bright circumpolar stars (Dec. $>70°$) effected with a prototype of Sukharev's horizontal meridian instrument have been commenced. For the past few years observations of circumpolar stars followed by a careful investigation of instruments were also made in Moscow, Nikolaiev and Tashkent and started in Kiev and Kharkov. As a result of this work seven new catalogues of right ascensions of circumpolar stars will soon be available. All of them contain the FK 3 stars, while some include the FKSZ stars as well.

Meridian observations of the Sun, Moon, major planets and fundamental stars with the Nikolaiev transit instrument and vertical circle have proceeded steadily. To these in 1957 absolute observations of 625 Struve's bright stars from the north pole to declination $-30°$ [6] were added. Since the war the old Pulkovo meridian circle (Repsold) has been installed at Nikolaiev in a new pavilion. In 1956 after a careful investigation of the instrument, regular observations of AGK 3R stars (from $+25°$ to $-5°$) and those of KSZ (down to $-20°$) were started. In 1955 the reduction of 'Zusatzsterne' observations carried out from 1939 to 1951 with the Nikolaiev transit instrument (L. I. Semenov) and the vertical circle (H. K. Zimmerman) was concluded (*Pulkovo Publ.* **71**, 1958).

Absolute determinations of declinations with a Wanschaff vertical circle are also regularly made at Golosseievo (near Kiev). The programme covers 1181 FK 3 and Pulkovo [6] stars down to $-31°$ as well as 611 FKSZ stars down to $-25°$, *Polarissima* BD $+89°3$, Vesta and Pallas. Every night the horizontal flexure is determined (it varies with time). In the nineteen-thirties *Polarissima* was much observed by I. A. Dyukov at Engelhardt Observatory (near Kazan). Now his monograph 'Applications of *Polarissima* to the determination of declinations of 192 stars' is being prepared for print.

In 1955 the Askania vertical circle was brought back from Australia to Munich and from the middle of 1956 F. Schmeidler resumed absolute determinations of the declinations of the FK 3 stars. At the same observatory W. D. Heintz is observing some double stars and the stars of Blaauw's list with the meridian circle. Both instruments are also used for the observations of major planets and the first four asteroids.

At the Bureau International de l'Heure (Paris Observatory) Mrs Stoyko computes R.A. corrections of the FK 3 stars from transit instrument observations. She also derives systematic $\Delta\alpha_\delta$ corrections of FK 3 from a comparison of co-ordinates of the Pole, computed by the Bureau International de l'Heure with the data of the I.L.S. The Bureau is planning the determination of $\Delta\alpha_\alpha$ and $\Delta\alpha_\delta$ corrections to FK 3 from a discussion of observations in the course of the I.G.Y. An analogous problem is set by the Time Services of the U.S.S.R. For this purpose a single list of stars composed at Pulkovo was adopted for transit instrument observations during the I.G.Y. On the basis of the great bulk of observations to be accumulated the compilation of an independent absolute catalogue of the R.A. of these stars is planned. Most observations concerned with this project are made by a photo-electric method.

In the Tokyo Astronomical Observatory under the direction of S. Nakano, the 8-inch Gautier Meridian circle was used, as also during the previous period, for the relative observations of the Moon, planets and some stars including PZT stars of Tokyo and Mizusawa. The results of observations of the Moon and planets for the years 1955 and 1956 have been published [8]. The provisional (O–C) values of the mean longitude of the Moon were $-3''12$ and $-3''23$ for the years 1955·513 and 1956·492 respectively. It seems that the rate of decreasing of (O−C) is becoming smaller. The observations of zenith stars of Tokyo were already finished. The observations of some 250 stars, including the PZT stars for Mizusawa, will also be completed in 1957. The observation of the R.A. of equatorial stars, which was commenced in 1950 by K. Tuzi with the Repsold transit instrument, has been continued, and preliminary results have been published [9]. In the near future the above results will be published as a star catalogue.

Two meridian programmes are being observed in Bordeaux: (*a*) part of the reference stars of the Bordeaux zone Photographic catalogue, and (*b*) the AGK 3R international programme. Since it was impracticable to have all the reference stars of the photographic catalogue observed with a meridian circle, 2024 stars conveniently distributed in R.A. and Dec. were selected, each being observed on seven nights by the differential method on the FK 3 system. The catalogue is ready for the printer. The discussion (O−C) of fundamental stars has shown fair agreement with the new corrections derived by Prof. Kopff. The positions of the rest of the reference stars are determined photographically in respect to the 2024 selected stars. For zones 17°, 16°, 15°, 14° and 13° this work has been completed, while the determinations for 12° are in progress. The observations of AGK 3R stars commenced in March 1956 have proceeded steadily.

Meridian observations at Toulouse have been interrupted for some time on account of urgent investigations in other fields. The Strasbourg Observatory, after having completed a detailed scrutiny of its instrument, proceeded to the observation of AGK 3R stars. Since 1956 observations on this programme have also been regularly made in Bergedorf and Heidelberg and are shortly to begin in Babelsberg. In Bergedorf, all the FK 3 stars north of $-15°$ were also included on the programme.

At the Leiden Observatory no more meridian work is being carried out. Van Herk has finished the reductions of the Kenya azimuth observations (*Ann. Sternw. Leiden*, **18**, pt. 5, 1957). The meridian observations of the close double stars taken during the years 1936–40

are published in *Leiden Ann. Sternw.* **18**, part 4, 1957. The observational work at the Lund Observatory has been interrupted since 1955 for a thorough reorganization of the meridian department. It is expected that regular observations of the AGK 3R stars will begin early in 1958. The proper motions of 5959 faint AG Stars, derived by A. Reiz, have been published in 1957 by the Swedish Academy of Sciences.

P. Naur at Brorfelde Observatory near Copenhagen has discussed 750 photographic observations of the minor planet 51 Nemausa, made in the years 1943–54, and derived a correction to equatorial declinations on the FK 3 system of $+0''.10 \pm 0''.04$ (mean error). The results were published in 1957.

La Plata Observatory has proceeded with the meridian observations of the zone $-72°$ to $-82°$. In 1955 observations of the FKSZ stars were also commenced. It is intended to obtain at least three observations of each star in either position of the instrument.

As mentioned above several observatories were engaged in observing FKSZ and KSZ programmes. The catalogues of FKSZ stars compiled at Wroclaw by P. Rybka (R.A.) and J. Kubikowski (Dec.) appeared in the publications of the Polish Academy of Sciences in 1956.

INSTRUMENTS

Installation of the Cooke Transit Circle at Herstmonceux is complete. A magnitude screen has been fitted. Cameras for photographic recording of the circle readings have been installed. A 4-inch pentag has been experimentally mounted on a framework independent of the telescope tube for determining tube flexure [10]. A full study of the second-order errors has been undertaken. A single-screw measuring machine for measuring the films from the circle-reading cameras has been adopted for recording the measures directly on to punched cards by the addition of a digitizer. This apparatus is in process of final adjustment. Prototype apparatus for recording the times of contact of the right ascension micrometer of the telescope directly on punched cards has also been designed and constructed. This prototype is proving useful in the development of a definitive model, which is now at an advanced stage of design.

The new 7-inch transit circle of the U.S. Naval Observatory at Washington has been brought into operation after correction of a number of minor faults. The work on improvement of auxiliary equipment has been continued. A digitizing counter has been installed on the microscope of the film-measuring engine so as to punch the measures directly on to cards. This has resulted in a saving of considerable time in the processing of observational data. Plans are under way to install similar counters on both transit circles so that the readings of the micrometer screws may be automatically recorded. All routine transit circle reductions are now being done on a high-speed electronic calculator.

Work with the new Grubb-Parsons 7-inch meridian circle of the Copenhagen Observatory at Brorfelde has been concentrated on the design and construction of auxiliary equipment for the instrument: (*a*) an automatic machine for the measurement of the photographs of the circle, based on the design used at the U.S. Naval Observatory, Washington, has been completed; (*b*) a new set of cameras for the circle is being constructed; (*c*) a device for the photographic recording of star transits, including a moving photographic plate, is nearing completion; (*d*) a system for aligning the north and south collimators by a photo-electric method has been constructed; (*e*) a new nadir mercury trough has been constructed.

The determination of the graduations of the new Grubb-Parsons meridian circle of the San Fernando Observatory has been completed. This instrument is actually working for the time service.

A new mirror transit instrument is under construction at the Dominion Observatory in Ottawa. Many parts have been completed; a building to house the instrument is under construction and should be completed before the end of 1957. Testing of component parts will commence during 1958 and it is hoped that the instrument will be completed by the end of 1960. The main features are: an 11-inch fused quartz mirror which is rotated so that the mirror surface is in the axis of rotation; two 10-inch collimator telescopes of 14-feet focal length for observing.

Installation of a large meridian circle (aperture 180 mm, focal length 240 cm) constructed in Leningrad for the Moscow University has begun lately at the new observatory of the Sternberg Institute on Leninskiye Gori. The R.A. wire of the eye-piece micrometer is motor driven. Varying the speed of the motor and using a mechanical switch, stars up to Dec. 89° 20′ can be observed with this device. Both the micrometer and the circle readings are recorded photographically. The instrument is provided with horizontal, vertical and axial collimators. Automatic reversing is readily done. This meridian circle is intended for absolute determinations of co-ordinates.

At Pulkovo a micrometer similar to that just described was mounted in 1955 on a Toepfer meridian circle. The main Pulkovo instruments, the large transit instrument and Struve vertical circle, are regularly tested (pivots, flexure). Photo-electric equipment for recording star-transits with the large transit instrument by N. N. Pavlov's method is under construction; this involves a mirror grating with two photo-multipliers, an amplifying device and moving azimuth-mark lenses. A prototype of Sukharev's horizontal instrument is employed to advantage for determining the right ascensions of circumpolar stars. In the astrometric laboratory directed by L. A. Sukharev, the design of a large horizontal meridian circle with a 300 mm mirror and two collimators (aperture 190 mm, focal length about 4 m) is in progress. The design provides for a glass circle which would facilitate the use of a photo-electric method for circle reading. The idea of such a method was independently suggested by P. Sémirot [17] and J. Dick [11]. An original photo-electric method for circle registration is now being worked out by A. A. Efimov and promises to yield far-reaching results. G. Platonov and V. Sukhov have constructed an electronic counter for automatic recording of averaged times of electric impulses; the counter will be employed for registering star-transits instead of a chronograph. They are also engaged in designing a new type of transit instrument which is expected to possess high stability of the optical axis, controlled by a photo-electric wedge micrometer, with an accuracy of the order of 0″02. The laboratory is also testing a gravimetric pendulum in which a mirror is used for artificial horizon. A computing laboratory equipped with punched-card machines has also been established at Pulkovo with D. D. Polozhentsev at the head. It is chiefly concerned with the reduction of meridian observations and the compilation of star catalogues.

An electronic chronograph for recording meridian observations was designed and constructed by G. Possoshkov at Kharkov Observatory. An apparatus for measuring graduated circle films was also mounted and tested there. At Nikolaiev the Repsold meridian circle, moved from Pulkovo, has been installed in a new pavilion; its pivots have been repolished and subsequently tested; the graduation errors of the main circle B have been redetermined, slight changes being found as compared to the results obtained by V. A. Elistratov in 1940 [12]. Testing of component parts of meridian circles was also made at the Engelhardt (circle) and Tashkent (pivots) Observatories.

At Lund the work on meridian astronomy has now been thoroughly reorganized. The Repsold meridian circle has been completely overhauled. A new time service based on the quartz clock at the Physical Institute is in regular operation. The electronic computer at the Theoretical Physics Division is used for the reduction of the observations.

At the Tokyo Astronomical Observatory some modifications were made in the 8-inch Gautier meridian circle; J. Matsumoto improved the motor driving device of the R.A. micrometer, bearing parts for the pivots, and the printing chronograph.

An improvement of micrometric design has been undertaken in Bordeaux. It is planned that the R.A. wire will be driven by a motor connected with frequency generator. The horizontal wire settings will be recorded with the aid of a small selsyn motor (téléaffichage). Experiments with a prototype apparatus of normal size have yielded fair results. A new determination of circle division errors was obtained, following J. Lévy's method [13]. These errors having been allowed for in the observations of the FK 3 stars, the results showed a fair agreement with the new corrections to FK 3 declinations recently published by A. Kopff. A careful investigation of the graduated circle by the symmetrical method has also been carried out at Strasbourg.

Technical improvements of observational procedure have been reported from Hamburg-Bergedorf. J. von der Heide prepared a Cardan for the mercury horizon, and constructed a simple device preventing the warmer air from moving upward around the mercury trough. This allowed nadir observations to be made at any time of the day and decreased the mean error of a single determination of inclination and collimation down to $\pm 0^s.002$. An apparatus for circle-reading has been mounted enabling successive settings with all four microscopes to be made together; the reading of the four micrometers and the position of the circle can be recorded on the same film. This has permitted the time spent on reading to be reduced by half without loss in accuracy. Instead of the conventional two or three settings for each star the averaged reading of micrometer wire settings made during 10 sec is now readily obtained with the aid of an integrating device; a considerable gain in accuracy is secured thereby. For recording star-transits printing chronographs are used, the mean error of a single time-replica being $\pm 0^s.0012$. Photographic recording of the micrometers, preserving visual settings at the circle, is used at Heidelberg. The photo-camera is mounted close to the pivot axis and the readings of all the micrometers are recorded on the same film.

New 2′ divisions have been engraved on silver-palladium alloy of one of the circles of the Pistor-Martins meridian instrument at the Berlin-Babelsberg Observatory. This work was done by the Feinmess-Dresden firm (former Heyde). According to the suggestion of F. Wünschmann the long visual microscopes were replaced by the short ones equipped with the photographic object-glasses and cameras. The new photographic method of circle reading gives much higher accuracy as compared with the previous visual method. The observation of stars with this instrument will be made with double wires, which will enable loss of accuracy to be avoided when observing the faintest stars.

K. Pilowski at Hannover has continued W. Schaub's experiments [14] with a small portable meridian circle as applied to accurate determination of the declinations of bright stars. For this purpose a glass vertical circle, 20 cm in diameter, is fitted to a small broken-type transit instrument (aperture 5 cm, magnification 75). The circle readings will be made automatically. Special regard is given to the elimination of flexure effect [15].

URGENT PROGRAMMES OF MERIDIAN OBSERVATIONS

In a circular letter of 31 December 1956 I proposed to organize co-operative meridian observations for two programmes: (*a*) bright stars, and (*b*) latitude stars (declinations only). In the numerous replies from members of Commission 8 and other astronomers, most approved the proposed programmes and some have already confirmed the agreement of the respective observatories to participate in the observations. They urged, however, that the period suggested by me for the accomplishment of this project (1958–1962) is not realistic, as many observatories are already heavily engaged in fulfilling their commitments concerned with the I.G.Y., along with their observational activity on other urgent programmes.

A number of letters contain valuable suggestions and remarks. G. van Herk (Leiden) has called attention to the necessity of including, in the programme of meridian observations, some *double stars* for which photographic observations offer certain difficulties and cannot give reliable results. Prof. P. Bourgeois (Uccle) pointed out that the meridian determinations of declinations on I.L.S. programmes had been suggested more than once (first by Prof. Kimura in 1925), but the Uccle Observatory alone carried out these observations in past years. J. Lévy (Paris) believes that co-operative meridian observations of the AGK 3R stars should be repeated from time to time, while in the intervals observations of bright stars are to be undertaken. It seems advisable that the bright stars be divided into groups of 1000 stars or so, and that each observatory be charged with the observation of one or several groups according to a plan similar to that available at present for the AGK 3R stars. Lévy considers that such a project would provide for a reasonable utilization of all the meridian instruments now in use, and would satisfy all

needs and requirements. For my part I agree with the above suggestions and think that all of them should be heeded.

Considering the above in addition to the previous recommendations of the I.A.U. and those of other bodies made during the past few years, I should think it advisable that co-operative meridian observations on the following programmes be undertaken for the next 5–10 years (the number of stars on the programmes is for the northern sky, Dec. $+90°$ to $-10°$):

(1) *The programme of bright stars*, containing about 3700 stars, and covering *all* stars brighter than $6^m.01$ (in the GC they number 2584 north of Dec. $-10°$) and about 1100 fainter stars, added so that the programme may cover entirely the stars of FK 3, FK 3 supp. and those of the Backlund-Hough list, and hence 'The Catalogue of Geodetical stars' (*Pulkovo Publ.* vol. **61**, 1948). The list of these stars has already been compiled at Pulkovo.

(2) *Giant stars*. 1012 stars from A. Blaauw's [4] and P. Parenago's (240 giants from the second and the third parts [16]) lists.

(3) *Double stars*. Some 2000 stars from $6^m.0$ to $9^m.0$, the distance between the components ranging from 2″ to 15–30″, and difference in magnitude less than 4 (the upper limit of distances, depending on the magnitudes of components, may be given by a special table).

(4) *Latitude stars*. Determination of declinations of about 2000 stars contained on the zenith telescope and zenith tube programmes of various observatories. The composition of this list is in progress at the Sternberg Institute (Moscow) in co-operation with the Poltava Observatory under the supervision of the President of Commission 19, E. P. Fedorov.

(5) *PZT stars*. In so far as the zenith tube observers need to know right ascensions as well as declinations, PZT stars for different observatories can be placed on a separate programme probably containing 1000 stars.

It should be pointed out that meridian observations of many stars covered by these programmes are being carried out, or have been recently completed, at some observatories. This, however, does not render new observations of these stars less important. Personally I am of the opinion that *all* bright stars down to $6^m.0$, and not only those contained in fundamental catalogues, must be observed with meridian circles. It can be added to this that about 1200 stars of the northern sky brighter than $6^m.01$ are covered neither by FK 3 nor by FK 3 supp., 190 of them being brighter than $5^m.01$.

Programmes (4) and (5) are of particular importance as many observatories located in different latitudes now carry on regular latitude observations and due consideration should be given to their being reduced to a single system.

Programme (2) is inconvenient for meridian observations because the distribution of stars in R.A. is extremely non-uniform, hence it is expedient that the 'giant stars' be added to some other programme. Probably the best results might be achieved by combining all the above programmes, with the exception of (4), into a single programme which would cover about 7500 stars, the fundamental ones included. It seems desirable that co-operative meridian observations of these stars be carried out during the years 1960–65. I believe that some observatories of the U.S.S.R., Pulkovo among them, would willingly take part in this project.

CONCLUSIONS

From the above outline of meridian astronomy for 1955–57 the following conclusions can be drawn.

(*a*) About twenty observatories of different countries have taken an active part in meridian observations, their principal tasks being: the absolute determination of co-ordinates of fundamental stars and differential observations of faint reference stars on co-operative plans. To this can be added photographic work related to the problems of meridian astronomy (such as compilation of zone catalogues, observations of selected asteroids and galaxies) successfully carried out by several observatories.

(*b*) Improvement and testing of the existing instrumental equipment, as well as the design and construction of new instruments, automatic devices, and auxiliary apparatus, are in progress at most observatories. This work is of greatest importance for the development of astrometry.

(*c*) Unfortunately at some places the observations have been delayed for various reasons. Moreover at some observatories instruments which seem to be in good order have been kept out of operation for many years.

(*d*) Up to the present, astrometrical work at the observatories of the southern hemisphere (with the exception of Cape) has remained quite inadequate.

Hence the following desiderata suggest themselves.

(1) It is desirable that the instruments of the following observatories be put into operation as soon as possible, so that they may participate in co-operative projects: Abbadia, Belgrade, Copenhagen–Brorfelde, Kremsmünster, Moscow, Porto, San-Fernando and some others.

(2) It is essential to encourage by all means the construction of modern meridian instruments, notably of horizontal meridian circles (Herstmonceux, Ottawa, Pulkovo), and also the application of electronic and other automatic techniques to meridian observations and their reduction.

(3) It is also necessary to promote in every possible way meridian work in the southern hemisphere, such as organization of meridian observations at Perth and Santiago; development of astrometric activity at La Plata; completing the construction of the southernmost observatory in the world at La Leona. Careful consideration should also be given to the observatories of the northern hemisphere desiring to move their astrometrical instruments to the southern hemisphere.

RECOMMENDATIONS

(*a*) A. Reiz (Lund) proposes to discuss reports concerning new types of transit instruments and accessories which may be under development at various observatories. He writes: 'I feel it would be of great value, particularly for the members of Commission 8, to know about the projects being developed in this field, and what experience astronomers have met in using the instruments. . . .'

I agree with Dr Reiz and think it would be advisable to discuss this problem at a special meeting of Commission 8.

(*b*) A. Bohrmann (Heidelberg) urges that a plan for the southern sky similar to that for AGK 3 be adopted by the I.A.U. He believes that the instruments of the northern observatories (meridian circles, astrographs) moved to the southern hemisphere might be used for carrying out this plan.

(*c*) It is recommended that Commission 8 should discuss the question of co-operative meridian observations to be carried out on the following urgent programmes during the next few years (for details see above—Urgent Programmes of Meridian Observations):

(1) bright stars; (2) giant stars; (3) double stars; (4) latitude stars (determination of Dec.); (5) PZT stars. This programme is supported by the President of Commission 19.

M. S. ZVEREV

President of the Commission

REFERENCES

[1] Kopff, A. *Veröff. Astr. Recheninst. Heidelb.* nos. 6 and 7, 1957.
[2] Deutsch, A. N., Lavdovski, V. V. and Fatchikhin, N. V. *Pulkovo Bull.* no. 154, 14, 1955.
[3] *Commun. Obs. Belg.* no. 85, 1955.
[4] Symposium 1 of the I.A.U., Groningen, 1953.
[5] Dneprovsky, N. *A.N.* **241**, 219, 1931.
[6] *Trans. of the 11th Astrometrical Conference U.S.S.R.* 94–106, 1955.
[7] Stoy, R. H. *Trans. I.A.U.* **9**, 717, 1957.

[8] Nakano, S. *Tokyo Astr. Bull.*, second series, nos. 79, 85, 1956; 98, 100, 1957.
[9] Tuzi, K. *Tokyo Astr. Bull.*, second series, nos. 72, 1955; 78 and 81, 1956.
[10] Atkinson, R. d'E. *M.N.* **115**, 427, 1955.
[11] Dick, J. *Wissenschaftliche Annalen*, **6**, Heft 11, 746, 1957.
[12] Elistratov, V. A. and Gordon, J. E. *Pulkovo Bull.* no. 150, 31, 1953.
[13] Lévy, J. *Bull. Astr.* **20**, 35, 1955; Delhaye, J. *Bull. Astr.* **20**, 101, 1956.
[14] Schaub, W. *A.N.* **275**, 176, 1947.
[15] Pilowski, K. *Mitt. Astr. Gesellschaft*, 1955, 115, Hamburg, 1956.
[16] Parenago, P. *Trans. of the 10th Astrometrical Conference U.S.S.R.*, 263–7, 1954.
[17] Sémirot, P. *Commun. Obs. Belg.* no. 85, 23, 1955.

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

A beginning was made with the observing programme for the second repetition of the Astronomische Gesellschaft Catalogues with the designation AGK 3, although the project is not being carried out under the auspices of the Astronomische Gesellschaft. The project consists of two parts: observations of selected reference stars with meridian circles (AGK 3R) and the photographic re-observation of the entire catalogue (AGK 3). Concerning the programme of observation of the reference stars, a report by F. P. Scott reads:

The AGK 3R star list agreed upon at the Brussels Conference on Astrometry was distributed to the participating observatories during January 1956. In accordance with the revised commitments announced at the Dublin Meeting of the I.A.U. each observatory offered to contribute the following observations to the programme:

Observatory	No. stars	No. observations
Bergedorf	12 124	2 each
Bordeaux	1 593	2 each
	2 972	4 each
Heidelberg	4 324	2 each
Nicolaiev	9 994	2 each
Ottawa	3 754	2 each
Paris	1 781	2 each
	3 551	4 each
Pulkovo	11 511	2 each
Strasbourg	1 608	2 each
	1 169	4 each
U.S.N.O. 6-inch	7 544	2 each
Babelsberg	5 111	2 each
R.G.O. (Herstmonceux)	13 813	2 each
Lund	7 658	2 each
U.S.N.O. 7-inch	11 326	2 each

Observations of the reference stars were commenced at the first nine of the above observatories within ten months after the distribution of the star list. On the basis of the observations reported to date these observatories are well on schedule and, if the present rate of progress continues, they will complete their commitments on time. The delay in taking up the AGK 3R work at the four remaining observatories is due to difficulties encountered in getting their instruments into operation.

The Naval Observatory is gratified with the excellent response to its offer to provide the observers with the reduction from apparent place to mean place 1950·0 for all AGK 3R, FK 3 and FK 3 supp. stars observed during the programme. As of 1 October 1957, over 67 000 such reductions had been completed and returned to the observers.

W. Dieckvoss reports for the Hamburg-Bergedorf Observatory that the Bonn and

Bergedorf Observatories have agreed that all of the plates for AGK 3 from declination $-2°$ to $+90°$ will be taken at Bergedorf. For AGK 2 the 1219 fields in declinations $+20°$ to $+90°$ were photographed at Bergedorf, the 720 fields in declinations $-2°$ to $+20°$ at Bonn. The positions obtained for the AGK 2 with the Bonn objective were affected by an appreciable colour-magnitude error. By not using this objective for the AGK 3 this difficulty will be avoided; yet the differential method of reduction can be employed. Between the beginning of the observing programme in August 1956 and October 1957, 677 new plates were taken; 597 in the Bergedorf zones, eighty in the Bonn zones. Of this plate material, 160 plates have already been measured, and the measurements have been used for obtaining provisional proper motions.

The measurement of plates in the zone $+50°$ to $+60°$ taken at the Yale Observatory in 1947 was completed at the Watson Scientific Computing Laboratory. Definitive positions and proper motions have been derived and the final steps toward the preparation of the catalogue volumes are now in progress.

The Royal Observatory at the Cape of Good Hope published *Cape Annals*, vols. **17**, **18**, and **19**, containing catalogues in declination zones $-30°$ to $-35°$, $-35°$ to $-40°$ and $-52°$ to $-56°$, respectively. The zones between declinations $-56°$ and $-64°$, which will form vol. **20**, are ready for photolithographic reproduction. The positional part for the zones between $-64°$ and $-72°$ is complete and the corresponding photometric work is nearly complete. The positional measurements for the next zone, $-72°$ to $-76°$ have been started.

The Yale Observatory secured in 1955/56 with a Yale camera at the Sydney Observatory new photographs on 10° by 10° fields of the zone $-30°$ to $-40°$ and of the area south of $-70°$. This undertaking was possible through the generous co-operation of Mr Harley Wood, Director of the Sydney Observatory, and the members of his staff. This plate material is now at the Yale Observatory, awaiting measurement and reduction.

The Gaertner measuring engine with which all of the large plates for the published Yale zone catalogues have been measured was dismantled in 1956 when the Yale Observatory offices were moved to a new location. It has been reassembled, but a digitizer and, probably, a photo-electric setting device will be installed before the instrument is again used for the measurement of a photographic zone.

S. Vasilevskis reports for the Lick Observatory that since the Dublin Meeting the main activity has been the planning of future work, particularly of an automatic engine for measuring the photographic plates for the Lick programme of stellar proper motions with reference to galaxies. Plans for the design of this measuring engine are now far advanced.

A special blink-comparator will be used for simultaneous examination of both epoch plates and for selection of objects (stars and galaxies) to be measured. The position of the microscope cross-wire, relative to a zero-point of the plates, will be continuously transmitted to a recording device, and recorded if necessary by pushing a button. Approximate co-ordinates of objects selected, recorded while inspecting the plates, will be used as input data in the automatic engine.

These input data will guide automatically a rotating photo-electric scanner to the position of the object until the scanner 'sees' the image. The servo-systems are then actuated only by error signals from the scanner until the balance position is reached. Then both rectangular co-ordinates, taken from two electronic scales, are automatically recorded, and the process repeats itself for each of the next objects selected, until the measurement of a plate is completed. In addition, photometric data for each object are also measured and recorded automatically during the positional measurement.

By the time the automatic engine becomes available, it is hoped in about three years, a partial repetition of 100–200 plates will be made for the purpose of a thorough investigation of instrumental and other observational errors, and for the detailed planning of the final repetition, particularly where measurement and reduction are concerned. These prior investigations will make it possible to avoid delaying unnecessarily the availability of proper motions at the time of the final repetition, which will probably start by 1967, i.e. with epoch-difference of twenty years.

The extension of the Lick programme to the southern hemisphere remains one of the urgent needs in this branch of astronomy. A site survey under the auspices of the observatories of Columbia and Yale Universities is in progress in Australia with the object of locating a suitable site on the Australian continent for a southern astrograph. This survey is being supported with funds granted by the National Science Foundation in Washington. Funds for the construction of an instrument similar to the 20-inch Carnegie astrograph of the Lick Observatory have not yet been secured. It is hoped, however, that such an instrument will become a reality within the next three or four years. The observatories of Columbia and Yale Universities are prepared to assume joint responsibility for extending the Lick programme to the south pole. The Lick Observatory has offered to make available the automatic measuring engine, if it is constructed as planned, for the measurement of plates taken for the southern programme.

A. Deutsch reports on progress with the project of using astrographs of the Carte du Ciel type for the absolute measurement of proper motions of stars in fields that contain suitable galaxies. At the Pulkovo Observatory three first-epoch plates of each of 157 areas in declinations $-5°$ to $+90°$ have been secured. A programme of photographing fields centered on KSZ fundamental stars has been started. Similar observations in these declinations are in progress at Moscow, Kiev, Tashkent and Toulouse (France).

The project is being extended to southern declinations as follows: in declinations $-5°$ to $-25°$ observations are in progress at Tashkent and are to begin at San Fernando (Spain), in declinations $-25°$ to $-90°$ observations will be undertaken at Santiago (Chile), Cordoba (Argentina) and Perth (Australia). At Bucharest (Roumania) and at Shanghai (China) certain areas with galaxies and fundamental stars in declinations $+90°$ to $-35°$ are being photographed.

A critical examination of the relative merits of the plan of using small-field photographic refractors against that of using fast large-field astrographs was written by S. Vasilevskis [1]. His conclusions from the measurements of Lick astrograph plates strongly favour the large-field astrographs.

The reports for Commission 8 and Sub-Commission 8*a* prepared for the Dublin meeting both concluded with remarks expressing the need for increased astrometric activity in the southern hemisphere.

Two items of progress may be noted: (1) The Sydney Observatory has acquired an astrographic camera constructed by Taylor, Taylor and Hobson. The aperture is 9 in., the scale 1 mm = 115″, and the images are perfect at full aperture over a field 6° by 6°. The Director of the Sydney Observatory reports that he is examining the possibility of undertaking with this instrument photographic zone observations for which his observatory has most of the resources. (2) The prospect of acquiring a 20-inch astrograph for the southern hemisphere is brighter than three years ago.

Other aspects of the problem remain unchanged. The Sub-Commission may well discuss during the Moscow meeting the total needs of astrometry in the southern hemisphere and attempt to formulate a realistic programme for the immediate future.

DIRK BROUWER

President of the Sub-Commission

REFERENCE

[1] Vasilevskis, S. *Astr. J.* **62**, 126, 1957.

ASTRONOMIE MERIDIENNE

Report of Meetings. 14 and 19 August 1958

CHAIRMAN: M. S. Zverev.

INTERPRETERS: A. A. Nemiro, Mrs S. Gossner.

SECRETARY: J. Larink.

First Meeting. 14 August

After some small corrections the *Draft Report* was approved.

Prof. A. Danjon requested members of the Commission to make proposals for a change in the name of the Commission to correspond to its wider scope.

The following proposals were made: Astronomie des positions fondamentales; Astronomie méridienne et extraméridienne; Astrométrie; Positions des étoiles.

Dr W. Fricke recommended the appointment of a small committee, consisting of Danjon (Chairman), Zverev and Symms, to make a definitive proposal. Fricke was asked to be a fourth member of this committee. This was agreed.

Dr F. P. Scott presented his report on the work on AGK 3R (Appendix 1); practically 35% of the required observations have been made. Scott added that he intends to collect all observations into the definitive catalogue AGK 3R. In addition, the results of observations of the single observatories are to be published (Appendix 2). In reply to a question by Symms as to which places are to be used for the reduction of the AGK 3 plates, Scott replied that his general catalogue composed of all the meridian circle observations is to be used.

Guinot reported on the derivation of the systematic errors of FK 3 with the help of the 'Astrolabe à prisme'; his report will be published elsewhere. In the discussion of Guinot's report, Danjon proposed that a series of astrolabes be put into operation (see Resolution no. 14); by this means a first-class Fundamental Catalogue could be available in a few years. It is a pity that minor planets are too faint for observation with the astrolabes.

Dr J. von der Heide spoke on the systematic errors of the FK 3, derived from observations with two broken Askania transits and the Repsold meridian circle of Hamburg-Bergedorf Observatory, in connexion with crystal clocks at the Observatory and at the Hydrographic Institute at Hamburg, compared with a crystal clock at the Physikalisch-Technische Bundesanstalt at Braunschweig (Appendix 3).

Prof. M. S. Zverev reported on Pavlov's photo-electric transit observations. Nemiro remarked that the $\Delta\alpha_\alpha$ derived in this way by Pavlov are in good agreement with the values obtained by Guinot.

Dr A. A. Nemiro asked for a more detailed discussion of Danjon's proposal above. Dr A. Schmitt, now at Strasbourg, reported on the observatory at Quito (Ecuador, $\phi = -0° 13'$); Ecuador is not a member of the I.A.U. At the observatory there is an 'Astrolabe à prisme', but at present no observer. Schmitt proposed a recommendation, to be sent by the I.A.U. to the government of Ecuador, stressing the utmost importance of the observatory of Quito, situated as it is on the equator at an altitude of nearly 3000 m (Appendix 4). In the discussion Fricke, who is engaged on the work for the revision of FK 3, strongly supported Schmitt's proposal.

Second Meeting. 19 August (*Joint Meeting of Commissions* 8 *and* 19)

Dr M. M. Thomson reported on the declination errors of the Ottawa P.Z.T. catalogue (Appendix 5).

Prof. Zverev spoke on future meridian programmes (see *Report*, p. 122), and recommended observation of the following groups of stars:

(*a*) Bright stars.

(*b*) Selected double stars as a supplement to AGK 3.

This programme contains about 2000 double stars north of declination $-30°$, with combined magnitudes in the range $6^{m}0$ to $9^{m}0$ (Harvard system) and the difference of magnitude less than $4^{m}0$. The lower limit of the separation is 2″, and the upper limit depends on the magnitudes as in the table below:

—	6^{m}	7^{m}	8^{m}	9^{m}	10^{m}	11^{m}
6^{m}	30″	28″	26″	24″	22″	20″
7	—	26	24	22	20	18
8	—	—	22	20	18	16
9	—	—	—	19	17	15
10	—	—	—	—	15	13

The separations in the table correspond to the distances between the limbs of star images on the Bergedorf AGK 3 plates equal to 0·07 mm.

Dr E. P. Fedorov recommended that meridian observations be made of the Latitude and P.Z.T. stars (Appendix 6).

The Resolutions (nos. 13 to 18 on p. 73–4) were then discussed and agreed.

Closing the meeting the President expressed his thanks to the interpreters and secretary.

An unofficial discussion concerning meridian work in Australia took place in Moscow with the participation of Dr B. J. Bok, Dr H. J. Abraham, Dr A. A. Nemiro and Prof. M. S. Zverev. Bok spoke about the efforts of the Australian astronomers in the organization of meridian observations at the Perth Observatory. It was agreed that Pulkovo Observatory should undertake the completion of the reduction of the last series of meridian observations made at the Melbourne Observatory in 1928–41 and should publish the resulting catalogue Me 5. All the materials connected with these observations are shortly to be sent to Pulkovo from the Mount Stromlo Observatory.

APPENDICES TO REPORT OF MEETINGS

1. *Report of the* AGK 3R. The distribution of the star list among the observers is described in the *Draft Reports*. At the time they were prepared the observers at Bergedorf, Bordeaux, Heidelberg, Nicolaiev, Ottawa, Paris, Pulkovo, Strasbourg, and the Naval Observatory Six-inch Transit Circle had already started their AGK 3R work. Since then the observers at Babelsberg, Greenwich, and the Naval Observatory Seven-inch Transit Circle have started and those at Lund are about ready to start.

From replies to a questionnaire recently sent to all observers the status of the AGK 3R observing programme as of 30 June 1958 is approximately as follows:

Observatory	Commitment No. obs.	No. of observations completed R.A.	Decl.	Ratio FK 3/AGK 3R
Babelsberg	10 222	1 419	1 419	0·35
Bergedorf	24 248	8 220	8 220	0·53
Bordeaux	15 074	7 461	7 461	0·40
Greenwich	27 626	4 376	4 376	0·41
Heidelberg	8 648	6 853	6 853	0·33
Lund	15 316	0	0	
Nicolaiev*	19 988	11 547	11 547	0·70
Ottawa	7 508	5 563	5 563	0·66
Paris	17 766	10 717	10 717	0·27
Pulkovo	23 022	12 279	11 907	0·56, 0·43
Strasbourg	7 892	7 980	7 980	0·34
U.S.N.O. 6-inch	15 088	6 384	6 384	0·30
U.S.N.O. 7-inch	22 652	2 117	2 117	0·28
Total	215 050	(84 500)		

* Nicolaiev report compiled from Naval Observatory records and includes all observations to 18 June 1958.

Allowing for the fact that some of the observations reported are in one co-ordinate only and that others will have to be rejected for various reasons it is estimated that the AGK 3R work is now about 35% completed. This figure does not reflect the situation at all observatories because some of them have completed as much as 70% of their work while others have just commenced.

The overall progress on this programme is quite satisfactory. The late starters are urged to do all they can to recover as much lost time as possible.

Techniques are now being worked out for assembling the final results of observation into a catalogue with the IBM 650 magnetic drum calculator.

Babelsberg, Greenwich, Ottawa, and the Naval Observatory Six-inch Transit Circle, are observing the FK 3 Supp. stars.

Including the AGK 3R, FK 3 and FK 3 Supp. stars the Naval Observatory has computed over 118,000 apparent places for this programme.

F. P. SCOTT
Chairman, AGK 3R *Committee*

2. *Recommendations regarding the catalogue of positions of the* AGK 3R *stars.* At Brussels it was agreed that the AGK 3R observers would send the mean observed positions of the stars in Zverev's list to the Pulkovo Observatory and those of the stars in Scott's list to the Naval Observatory.

It was also agreed that the Pulkovo Observatory and the Naval Observatory would form separate catalogues from the observations sent them and transmit their respective catalogues to Bergedorf for use in the reduction of the AGK 3 plates.

It is quite possible that the two resulting catalogues might differ from one another in a systematic manner due to differences in the methods used in discussing the observational material. Thus the introduction of two catalogues of reference stars into the reduction of the AGK 3 plates is likely to bring about unnecessary complications. Therefore to insure strictly homogeneous reference star positions for the AGK 3 work it is recommended that the agreements made at Brussels be modified to read as follows:

1. The AGK 3R observers should send the mean observed positions of all reference stars now on their programmes to the Naval Observatory.
2. The Naval Observatory will compile a catalogue giving the positions of all the 21,500 reference stars now under observation.
3. The Naval Observatory will send to the Pulkovo Observatory a list of the mean observed positions of each of the stars in Zverev's list exactly as reported by the observers.

F. P. SCOTT

3. *On the* $\Delta\alpha_\alpha$ *of the* FK 3. In the years 1950–54 I have made numerous time determinations at the Bergedorf Observatory with a broken transit. These observations were made

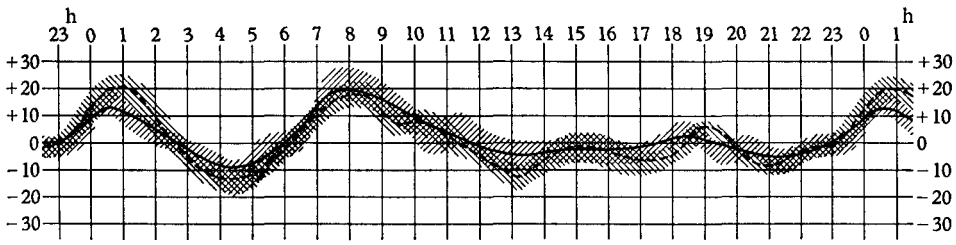

Fig. 1

during the whole night up to 14^h and up to six time determinations, each containing about twenty stars. The $\Delta\alpha_\alpha$ (in $0^s.001$) derived from these observations are given in Fig. 1 as a broken curve, the hatched area giving the mean error.

Our observatory participates in the observations for AGK 3R. One series of observations contains up to twenty-five FK 3 stars. All these stars are used for time determinations. The German Hydrographic Institute at Hamburg is engaged in the International Geophysical Year and for this reason numerous time determinations are made with a broken Askania transit.

Both institutes derive the clock corrections of a very good quartz clock at the Physikalisch-Technische Bundesanstalt at Braunschweig. The resulting $\Delta\alpha_\alpha$ from more than 400 time determinations with 6000 stars are shown in the diagram. The coincidence of the two curves is as good as one would expect from these simple observations thanks to the very good quality of the crystal clock.

J. VON DER HEIDE

4. *Informations au sujet de l'Observatoire de Quito* (*Equateur*). Sur la demande du Gouvernement de la République de l'Equateur Mr A. Schmitt a été chargé en Octobre 1955, en qualité d'expert de l'Unesco dans le programme d'aide aux états membres de la direction, de la réorganisation et de l'amélioration de l'Observatoire National de Quito.

Un projet de réorganisation de l'Observatoire approuvé par le Gouvernement de l'Equateur et par l'Unesco a été formulé pour établir à Quito un Observatoire d'Astronomie de Position avec comme programme principal:

1. Détermination de l'heure et de la latitude au moyen de l'Astrolabe à prisme système Danjon.

2. Etablissement d'un catalogue de déclinaisons d'étoiles fondamentales au moyen du cercle méridien Repsold existant à l'observatoire.

La mission de Mr Schmitt a pris fin en avril 1958 après 2½ années de séjour, l'Unesco ne pouvant plus prolonger la mission de l'expert par suite de difficultés d'ordre administratif entre le Gouvernement de l'Equateur et l'Unesco au sujet de l'accord spécial qui liait ces deux parties.

A la fin de la mission de Mr Schmitt le projet se trouve dans l'état suivant:

Séjonction des Services Météorologiques et Astronomiques;

Etablissement d'un budget personnel et fonctionnement de l'Observatoire Astronomique;

Réparation aux bâtiments et coupoles;

Création d'un atelier de Mécanique de précision grâce à l'aide fournie de l'Unesco;

Acquisition d'un chronographe Omega avec des fonds de l'Unesco;

Acquisition de 2 centrales horaires (horloges à quartz) de la maison Ebauches avec les fonds de l'Unesco et de l'Equateur; la moitié d'une centrale CH 1 payée par l'Unesco; le reste à payer sur les fonds de l'Equateur. L'autorisation de contrat à ce sujet se trouve à la signature du Président de la République de l'Equateur après avoir été approuvée par des instances administratives préliminaires;

Acquisition d'un micromètre impersonnel et d'un oculaire nadiral à la maison Bonty Paris avec les fonds de l'Equateur; l'autorisation de contrat à ce sujet se trouve à la signature du Président de la République après avoir été approuvée par les instances administratives préliminaires;

Acquisition de l'Astrolabe à prisme système Danjon avec les fonds de l'Equateur;

Initiation technique du personnel aux observations et réductions par cours et travaux pratiques de l'expert;

Obtention d'une bourse du Gouvernement français d'une année pour un jeune membre du personnel scientifique de l'Observatoire;

Attribution probable d'une bourse de 6 mois par l'Unesco pour l'actuel chargé de la direction de l'Observatoire de Quito;

Projet de décret pour l'adhésion de la République de l'Equateur à l'U.A.I. à l'étude et à la signature des autorités intéressées.

Pour 1957 et 1958 l'Equateur avait inséré au budget de l'Observatoire et du Comité National pour l'A.G.I. dont Mr Schmitt était président exécutif les sommes suffisantes pour le personnel et l'équipement ci-dessus mentionné, mais la mise en marche des

observations astrolabe et méridien exige encore la présence à Quito d'un technicien étranger. Il ne semble pas que l'Equateur veuille ou puisse prendre à sa charge les frais de mission de ce technicien.

Il résulte d'ailleurs de l'expérience faite par les anciens directeurs étrangers de l'Observatoire de Quito que leur action est d'autant plus efficace qu'ils sont moins dépendant du Gouvernement de l'Equateur et qu'ils peuvent compter davantage sur le soutien moral et matériel d'autorités internationales ou nationales comme l'Union Astronomique Internationale, l'Unesco ou les Ministères des Affaires Étrangères d'autres pays.

A. SCHMITT

5. *A Note on the declination errors of the Ottawa P.Z.T. Catalogue.* Ottawa P.Z.T. time and latitude results from 1952 to the present have been referred to three catalogues. The first provisional catalogue, provided through U.S. Naval Observatory, was based on the best available positions of suitable stars reduced to FK 3. This was used (with only a few of the largest residuals corrected by observation) during 1952 and 1953. Concurrent meridian circle observations were combined with these results to form a first revised catalogue used in 1954 and 1955. The 1954 P.Z.T. observations alone were then used to obtain the second revised catalogue in use since 1956·0. New proper motions were derived, using P.Z.T. places for the present epoch and all suitable catalogues back to AGK for earlier places.

In forming the catalogue no use was made of the observed differences between the two two-hour star groups usually observed. However from five to twenty plates per year are available for each pair of groups after rejecting those on which more than one-third of the stars of a group are missing. The group differences in latitude have been collected for the three years 1954–56 inclusive, and are shown in Table 1, in units of 0″01, in the sense of the correction to be applied to the declinations.

Table 1

	Year				
Group	1954	1955	1956	1957	1958
2–1	+10	+11	−1	+7	—
3–2	0	+1	+6	+8	—
4–3	+8	+9	+1	+4	—
5–4	−7	−10	−5	−3	—
6–5	+7	+9	+7	+5	+3
7–6	−1	−5	+2	+4	+7
8–7	−5	−4	−12	−9	−8
9–8	−20	−27	−4	0	0
10–9	+2	0	−3	+7	—
11–10	−7	−3	−4	−5	—
12–11	−11	−12	−4	+2	—
1–12	0	+3	0	+3	—

The mean error of the figures quoted, from the number of observations and their concordance, ranges from one to seven units, averaging three. This leads to great uncertainty in the declination corrections for any one year. However several years of observation on the current catalogue, reinforced by special observations covering three to six groups per night, should eventually produce reliable values for a definitive revision. No changes will be made during I.G.Y.

Meanwhile it is of interest to compare these preliminary results with other indications of a $\Delta\delta_\alpha$ error. Removal of the closing error leads to the group corrections shown in Table 2.

The values for 1956 are compared with AGK 2, using the Ottawa proper motions for the interval. The agreement is fair.

To make a comparison with I.L.S. (or S.I.L.) the corrections are smoothed 1–2–1 and applied to the appropriate time of year. The mean result for the three years is shown under $\Delta\delta$ in Table 3.

Table 2

Group	Year 1954	1955	1956	1957	AGK 2
1	−15	−14	−6	−6	−8
2	−3	−1	−6	+1	−10
3	−1	+2	+2	+5	+4
4	+9	+14	+4	+7	+2
5	+4	+6	0	+3	+4
6	+13	+17	+9	+6	+7
7	+14	+15	+12	+8	+10
8	+11	+13	+2	−3	+9
9	−7	−12	−1	−5	+8
10	−3	−10	−3	0	+6
11	−8	−10	−5	−7	+4
12	−17	−20	−8	−7	−1

Table 3

Decimal of year	$\Delta\delta$	z (Ott.)	$\Delta\delta$ (56)	$\Delta\delta+z$	$\Delta\delta$ (57) $+z$	z (Rich)
0·00	+1	+6	0	+7	+2	+6
0·05	+4	+2	+2	+6	+4	+7
0·10	+6	−2	+3	+4	+9	+7
0·15	+7	−4	+4	+3	+12	+6
0·20	+10	−6	+6	+4	+10	+6
0·25	+11	−8	+8	+3	+6	+4
0·30	+12	−9	+9	+3	0	−1
0·35	+8	−10	+5	−2	−4	−4
0·40	+3	−10	+2	−7	−9	−8
0·45	−3	−8	−1	−11	−10	−9
0·50	−5	−4	−2	−9	−8	−8
0·55	−7	0	−3	−7	−3	−7
0·60	−8	+3	−5	−5	−1	−7
0·65	−10	+5	−6	−5	+3	−6
0·70	−12	+7	−7	−5	−3	−4
0·75	−12	+8	−7	−3	−7	−1
0·80	−11	+9	−7	−2	−5	+2
0·85	−9	+8	−6	−1	−4	+5
0·90	−6	+7	−5	+1	−2	+5
0·95	−2	+6	−2	+4	+1	+6

The next column z (Ott.) shows Stoyko's z term for Ottawa. The agreement is fair. Values for 1956 above are given also, as being roughly applicable to present observations. The last two columns illustrate the interesting fact that our catalogue, corrected for $\Delta\delta_\alpha$, has nearly the same z term as that given by Stoyko for Richmond, indicating, presumably, the agreement of the catalogues. Finally, it may be noted that the P.Z.T. observations give a mean latitude in the international system 0″20 below the value assumed from meridian circle observations. M. THOMSON

6. *Liste d'étoiles pour le programme des latitudes à observer aux cercles méridiens.* L'observatoire de Moscou a élaboré avec la participation de l'observatoire de Poltava une liste d'étoiles des programmes de latitudes pour l'hémisphère nord pour la réobservation de ces étoiles aux cercles méridiens ou verticaux, afin d'obtenir des coordonées en le système FK 3 et d'en déduire des mouvements propres nouveaux.

On achève actuellement la vérification de la liste, après quoi elle sera multipliée sous forme de tabulogramme et pourra être envoyée à tous les observatoires qui exprimeront le désir de prendre part aux observations.

La liste se compose de deux parties.

ASTRONOMIE MERIDIENNE

1. *Etoiles du programme des lunettes zénithales et des zénith-télescopes flottants*

Les déclinaisons seules de ces étoiles doivent être observées. La liste contient les étoiles des programmes actuellement en action et celles des vieux programmes du S.I.L., de Poulkovo et de Greenwich (zénith-télescope flottant).

Liste des stations:

1. Belgrade	158	7. Kazan	64
2. Blagovechtchensk	192	8. Mizusawa (z.-t. flottant)	182
3. Borovetz	192	9. Moscou	272
4. Gorki	70	10. S.I.L.	436
5. Greenwich (z.-t. flottant)	198	11. Poltava	89
6. Irkoutsk-Poznan	65	12. Poulkovo	336

Le nombre général des étoiles est 1888.

Si cette liste pouvait être observée par 10 cercles méridiens ou verticaux (deux observations dans chaque position de l'instrument), les erreurs accidentelles du catalogue uni ne dépasseraient pas 0″.1.

2. *Liste des étoiles pour les tubes zénithaux photographiques*

Les deux coordonnées des étoiles de cette liste doivent être observées. La liste contient les programmes de tous les instruments en action excepté celui de Neuchâtel, que nous n'avons pas encore reçu. Le programme du tube zénithal de Washington qui est à notre disposition demande à être précisé.

Liste des stations:

1. Washington	64	5. Richmond	105
2. Mizusawa	90	6. Tokyo	119
3. Ottawa	285	7. Herstmonceux	249
4. Poulkovo	96		

Le nombre général des étoiles de cette liste est 972.

Nous profitons de cette occasion pour exprimer nos remerciements sincères à tous les observatoires qui nous ont envoyé les listes des étoiles de leurs programmes.

E. P. FEDOROV, J. I. PRODAN, D. N. PONOMAREV

INSTRUMENTAL DISCUSSION

An 'instrumental discussion' was held on 19 August when the following papers were presented and briefly discussed. Fuller versions of these papers will appear in a separate brochure which is being published by the Academy of Sciences of the U.S.S.R.

1. *On the use of a pentag with a transit circle* (R. d'E. Atkinson). In this paper are considered all the second-order errors which may be introduced by imperfections of adjustment of a pentag, or by the observational procedure employed with it; easy methods are given of determining the essential ones. Pictures of the mounting actually used at Herstmonceux were shown. (The complete version of this paper is expected to appear in *M.N.R.A.S.*)

2. *On the precision and permanence of transit-circle divisions* (R. d'E. Atkinson). It is desirable that the probable error of determining one difference from nadir (so far as the circle is concerned) should not exceed the probable error of the mean of two star-bisections. This means that the probable error of one circle position (mean of six, or four, microscopes) should not exceed $\pm 0''.071$, including the probable error of the division error itself. If the division errors (mean of six, or of four, as before) have not been determined for every division, one must substitute the scatter, from a smooth curve, of those which have been determined; this may greatly limit the attainable accuracy. The divisions of the Cooke

transit circle at Herstmonceux are extremely straight and uniform; as photographed (6:1 magnification), they can be read with a p.e. of $\pm 0''.092$ for one division on one film. Allowing $\sqrt{2}$ for the division-minus-index difference, and $1/\sqrt{6}$ for six microscopes, the p.e. of one circle reading is thus $\pm 0''.053$, and combining this with $\pm 0''.029$ (the p.e. of the worst-determined division errors, mean of six as before) we have $\pm 0''.060$ for the p.e. of one circle position. This is sufficiently below $\pm 0''.071$. However, more ragged divisions give much larger probable errors, and these will also add to the uncertainty of the division errors; even if photo-electric reading is employed, very special precautions will be needed if the results are to be relied on. In particular, variations as small as 10μ in the limits of that portion of the division which is actually used may cause serious changes in the effective division error. On permanency, it is shown that no systematic changes with time, varying from one declination-zone to another, should reach $0''.01$ at any epoch between the dates when the division errors are redetermined; displacements of a twentieth of a wave-length are thus relevant, and even the most gentle cleaning may be inadmissible. The divisions of the Cooke transit circle are etched on glass, silvered, varnished over the silver, and viewed through the glass; they cannot be cleaned at all, and do not need it. Where an existing metal circle must continue in use, it is suggested that systematic changes should be monitored by redetermining the division errors for (say) the whole degrees every few years. This requires only a modest effort, even to reach probable errors of $\pm 0''.01$.

3. *Some improvements introduced on the Repsold transit-circle of Bergedorf Observatory* (J. Larink).

(*a*) A printing-chronograph has been made, to a design by Von der Heide. Three type-wheels, driven continuously by a crystal clock, carry the digits for the minutes, seconds, and hundredths of seconds respectively. An electric contact from the instrument operates a hammer which strikes the paper from behind, forcing it against the wheels only momentarily (*Jahrbuch der Deutschen Gesellschaft für Chronometrie*, Bd. 5). The mean error of one printing is much smaller than that of the R.A. observation itself.

(*b*) The pivots have been examined by Von der Heide and relapped. The departures from a cylindrical form are now below $\pm 0{\cdot}2\mu$, instead of up to $\pm 3\mu$ ($0''.5$).

(*c*) The division errors of both the silver and the palladium circles were determined by Kox and Larink in 1955 (*A.N.* **283**, 168, 1956) and these are now applied.

(*d*) A mechanical averaging device has been designed by Von der Heide for the Z.D. micrometer; this is arranged to average the readings over a period of 10 sec, if the observer follows the star's oscillations in Z.D.

(*e*) The fields of view of the four circle microscopes, and of the pointer microscope, are all now brought into one eyepiece, by suitable optical trains, so that they can all be seen by the observer in one position. When the micrometers have been set, the five micrometer heads can also all be photographed on one frame, having been brought together by a second set of optical trains.

4. *Remarks on the photo-electric recording of star transits* (N. N. Pavlov). Photo-electric registration of transits offers the advantages of eliminating personal errors, and allowing the observer to be further away from the instrument. The mirror gratings facilitate observation during twilight, in 'white nights', and also through thin cloud. The work can be done more quickly, and with less strain, and observations of long duration become practicable even on cold nights. A comparison of the internal mean accidental errors with the external errors shows that the errors of the best photo-electric transit instrument of Pulkovo Observatory are of about the same order as the corresponding errors of the Washington P.Z.T.

A new transit instrument of special type is under construction at Pulkovo. It is expected that it will be better in some respects than a conventional transit instrument. It is to be installed in a pavilion with special ventilation.

5. *The new meridian circle of the Sternberg Astronomical Institute* (V. V. Podobed). A description of the new quick-reversal meridian circle of the Sternberg Institute. (See *Transactions of the 12th U.S.S.R. Astrometrical Conference*, pp. 190–3.)

6. *A photographic impersonal transit-circle micrometer* (A. Reiz, now at the Copenhagen Observatory, Denmark, and N. Hanson). The impersonal character of the photographic micrometer, built for the renovated Repsold meridian circle of the Lund Observatory, has been achieved by removing the observer from the eyepiece end and placing a photographic plate in the focal plane of the transit circle, which thus has been converted from a visual to a photographic astrometric instrument. The compensation for the diurnal motion during a short exposure, 15–20 sec, say, has been accomplished in the following way: the stellar image is kept stationary with respect to the photographic plate by introducing, in front of this, a plane parallel glass plate, which is brought to rotate round an axis parallel with the meridian plane, and normal to the collimation axis. By adjusting the rotational

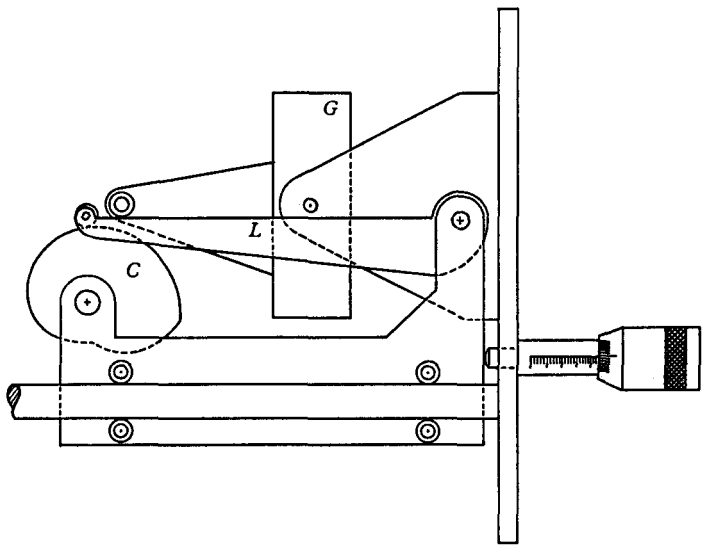

Fig. 2

speed of the glass plate according to the declination of the star, the stellar image is displaced with the proper speed so as to compensate for the diurnal motion. This technique has been developed for the Lund meridian circle; it has also been applied by W. Markowitz (*Astr. J.* **59**, 69, 1954) in his dual-rate Moon camera for holding the Moon fixed relative to the stars during exposure, and has further been suggested by Y. Väisälä (*Astronomisch-Optisches Forschungsinstitut der Universität Turku*, 1955) for similar purposes.

With the new micrometer the observations are performed diametrically different to the classical transit observations. Instead of recording the moments of the moving star's transits across the vertical wires, one keeps by means of the slowly rotating glass plate the stellar image fixed on the photographic plate, and by means of a graticule in near contact with the emulsion, time marks can be impressed at certain pre-selected positions of the glass plate. The position of the star can then be defined relative to these marks. Three to five independent exposures, each of about 17 sec duration, will be made, and the reference line will be impressed at the instant the glass plate is normal to the collimation axis. This moment can be determined with an accuracy of a few milliseconds.

The collimating error is determined in the following way. The collimator slits, about 20μ wide, in the north and south collimator telescopes are photo-electrically adjusted for coincidence, and the transit circle directed towards the collimators and the slits photographed with the glass plate in its zero or normal position.

The construction of the micrometer is indicated in Fig. 2. The rotation of the cam C (operated by a synchronous motor from a frequency of high stability) is transmitted to the glass plate G via the lever L. In order to make possible variation in the rotational movement, that is for covering a sufficiently wide declination zone, the cam C and lever L, which are fixed relative to each other, can be displaced along a slide. This movement is accomplished by means of the micrometer screw, visible to the right in the figure. The cam C has been shaped so that for one revolution the lever L is moved from one extreme position to the other, in 17 sec, after which time the glass plate is brought back to its starting position.

On the basis of observations of a number of FK stars, carried out over four nights, we have tried to form a preliminary estimate of the accuracy of the micrometer. The external probable error for one night for a time determination is close to 10 milliseconds, or about the same accuracy as for photo-electric registration (*Report* of Commission 31, p. 488). It is likely that with the introduction of definitive arrangements, an improvement in accuracy should be feasible.

Exposures of 17 sec length with Ilford HP 3 plates have yielded well-measurable images of stars of visual brightness 9^m5–9^m7.

7. *The Reduction of transit-circle observations using high-speed computing machinery* (F. P. Scott). The routine transit-circle reductions at the Naval Observatory are now done mostly by high-speed computing machinery. The only computations still done by hand are those related to the reduction of the instrumental constants.

The observer at the telescope works from a deck of cards containing one card for each observation anticipated at the beginning of the programme. This card is pre-punched with the star number, right ascension, declination, magnitude, circle setting, zenith distance micrometer setting, and the division correction. These quantities are also printed across the top of the card. When a star has been observed the card is removed from the main deck and set aside. At the end of each tour the date, observer and seeing conditions are punched on these cards. The only clerical work done by the observer is in recording the temperature, barometric pressure, and humidity.

The cards set aside during each tour furnish the star number, date, observer, etc., to be used in making up other decks of cards that are required at later stages of the reductions.

The first deck required is for the computation of the apparent place. For this purpose a deck containing the star number and date is compared with master cards containing the 1950·0 positions, precessions, secular variations and proper motions. The comparison is done with a collator which inserts a master card directly ahead of each card or group of cards containing the same star number. The combined tour and master cards are then run through the high-speed computer, which makes the reduction from 1950·0 to the apparent place at the rate of 2500 per hour. The computer used for these reductions has a memory capacity large enough to contain the entire programme of instructions as well as the A, B, C, D's for six months. The star constants, a, a', b, b', etc., are computed internally for each star as the reduction is being made.

The other decks required for the reductions are:

1. The microscope deck, made up from the output cards of the automatic measuring machine.
2. The bisections deck, containing the zenith distance bisections and the temperature.
3. The right ascension deck, containing the readings of the right ascension micrometer screw made at 4 sec intervals during the course of an observation.

The above decks of cards are combined with the apparent-place cards and arranged according to date with cards containing the instrumental constants placed before all other cards related to each tour of work. These cards are passed through the computer, which completely reduces the observations in both right ascension and declination. The output is in the form of (O − C). By inserting a special instruction when loading the computer the reductions can be confined to the FK 3 stars only. This is always done on the first run because at that time the clock corrections and night errors (zone corrections) are not known. These quantities are computed by hand from the output of the first run and

punched on cards so that they may be read into the machine and applied to all stars on the second run. The output of the second run gives the final reduction for all stars observed during each tour. The complete reduction of an observation in both right ascension and declination is accomplished in about 1·6 sec.

In addition to the regular results for each star the output contains several quantities which may be used in evaluating the performance of the instrument.

8. *The new seven-inch reversible transit circle of the U.S. Naval Observatory* (F. P. Scott). The mechanical details of this instrument may be inferred from a description of the six-inch transit circle given in *Publications of the U.S. Naval Observatory*, vol. XVI, part II.

Both instruments are equipped with a reversing prism, photographic microscopes, motor-driven travelling threads and photographic recording for the micrometer screws.

The seven-inch transit circle was constructed at the Naval Observatory and was put into service during December 1957. From a preliminary discussion of the observational results to date it appears that the performance of this instrument is quite satisfactory, the internal mean errors of a clock correction and a declination determination being $0^s{\cdot}018$ and $0''{\cdot}33$, respectively.

Equipment is being developed to record the instrumental readings directly on punched cards. A part of this task was accomplished by installing a digitizer on the measuring engine used to measure the microscope films. Further automation will be achieved when experiments with a synchro-system for transferring the micrometer readings to cards are completed.

9. *L'Amélioration de la lunette méridienne de l'Observatoire de l'Université de Bordeaux* (P. Sémirot). La lunette méridienne date de 1880 et notre effort de modernisation a porté sur les points suivants: (1) Construction d'un micromètre; (2) entraînement de la vis d'ascension droite; (3) enregistrement des pointés de déclinaison; (4) lecture automatique des cercles.

10. *Recent instrumental developments at Pulkovo* (L. A. Sukharev).

(*a*) The prototype Sukharev horizontal meridian instrument was used during 1957–58 to obtain the R.A.'s of 120 circumpolar stars; about four observations of each star, in each culmination, were obtained. Instrumental constants were investigated regularly; the root mean square error of one determination of collimation is $\pm 0''{\cdot}04$ and the actual values varied from $0''{\cdot}10$ to $0''{\cdot}46$. The experience gained was used in the design of a full-size instrument (300 mm mirror, 190 mm lens aperture, 4 m focal length) which is now under construction.

(*b*) An artificial horizon has been developed, consisting of a horizontal mirror mounted on the top of a reversible pendulum; the true horizon is the mean of the two mirror positions when the system is rotated 180° about a vertical axis. Laboratory tests showed that the error of adjustment does not exceed $0''{\cdot}01$ to $0''{\cdot}02$. The device has been used with the prototype horizontal transit, for latitude-variation work.

(*c*) A filter has been made, for meridian observations of the Sun, consisting of a plane-parallel glass plate aluminized on both sides so as to transmit about 10^{-4} of the incident light. It has been used on the large transit instrument and will shortly be used on the vertical circle also.

(*d*) An electronic counting device has been made for timing transits; it gives the mean time for ten micrometer-contacts. (*A. Zh.* **34**, 609, 1957.)

(*e*) A photo-electric method for measuring the linear interval between two division-marks has been worked out, and has been used in an experimental device for circle-reading. The mean error of one reading is $\pm 0{\cdot}05\mu$, and depends only slightly on the quality of the divisions.

11. *The Ottawa mirror transit circle* (M. M. Thomson). The instrument is housed in a new building, the whole of which, except for east–west extensions, divides at the centre and moves off to the north and south far enough to permit observations down to 15° elevation. The two horizontal 'collimators' are of 10 in. aperture and 14 ft focal length. The mirror is of fused quartz, 11 in. in diameter and 2 in. thick, flat to one-tenth of a wave at $\lambda 5500$. It is retained in a cell of massive design by three leaf-springs which oppose three pads

spaced 120° apart in the 'floor' of the cell. The reflecting surface is in the axis of rotation, and for stars up to 45° elevation the objectives are filled by the mirror; vignetting at greater elevations is symmetrical about the centre-line of the objective, and causes no serious loss of light even beyond the zenith. Rotation of the axis is controlled to one minute of arc, by servo-mechanism, and is measured on a circle, graduated to 3 min of arc, by the conventional four microscopes. Small mirrors are cemented to the east and west flanks of the main mirror so that their central normals are nominally in the axis of rotation. They are viewed through the pivots by auto-collimating telescopes of 3 in. aperture and 6 ft. focal length, in order to detect motions of the mirror in its cell.

At the prime focus of each collimator is a reticle with cross lines etched on the side opposite to the objective. The lines are illuminated by a flash lamp. They are fixed, and form a fundamental reference position in both co-ordinates for observation, collimation, and auto-collimation.

Carried on the right ascension slide, movable together in declination, and in order as one gets further from the main O.G., it is proposed to have: (1) another reticle with etchings *facing* the O.G. and about 0·002 in. (0·05 mm) from those on the first reticle. (These etchings are a double cross for the usual Besselian bisection in both co-ordinates used for visual observations.) (2) A transporting lens working with equal conjugates of about 4 in. (100 mm) which forms the image of star and both reticles at a secondary focus, and (3) a camera used for photographic registration (the emulsion side of the film is at the secondary focus) with a compound eyepiece integral for visual work.

For photographic registration of constants and transits the first mentioned (fixed) reticle only is used. The assembly of transporting lens, camera, etc., is fixed in declination but is moved in right ascension by a synchronous motor and a ball-disk integrator set to give the proper slide velocity for exact tracking. At equal intervals and at exact clock times the glow lamp is flashed; and the final photograph of a transit will be a point image of the star with several imprints of the reticle cross. The vertical etch images will be side by side and equally spaced providing an automatic check on the consistency of tracking velocity. For visual observations the fixed reticle is flashed at some convenient rate greater than the persistence of vision and at low intensity. It becomes then a field-identification grid. The other reticle carried on the slide assembly is illuminated. Tracking and bisection are performed in the accustomed fashion.

In lieu of conventional azimuth marks the three close circumpolars of the *Berliner Astronomisches Jahrbuch* will be observable at all times, and one or other of the two close polars of the FK 3 most of the time, thus furnishing a continuous check on the short-term stability of the instrument.

Report of Meeting of Sub-Commission 8a. 18 August 1958

PRESIDENT: D. Brouwer.

Prof. A. N. Deutsch reported on the progress of the photography of the galaxies according to the KSZ plan. Each of the 300 selected fields is to be photographed three times at three or more observatories; thus more than 2700 plates will be secured for the whole sky. Plate constants are to be determined using reference stars. (N. Fatchikhin has shown that such a method is more suitable than by means of the galaxies themselves.)

Prof. D. Brouwer, referring to the recommendation by Dr A. Bohrmann (see p. 123), raised the question of the organization of meridian and photographic observations for the southern hemisphere similar to those for AGK3. The speakers emphasized the importance of stimulating astrometric work for the southern sky. Dr R. H. Stoy reported that the Cape Observatory had compiled a list of reference stars for the southern hemisphere, including stars selected according to the KSZ criteria. After a short discussion it was decided to set up a small committee to work out a plan of astrometrical observations in the southern hemisphere (see Resolution no. 18).