

COMMISSION 24: PHOTOGRAPHIC ASTROMETRY (ASTROMÉTRIE PHOTOGRAPHIQUE)

Report of Meetings, 15, 16 and 18 August 1979.

PRESIDENT: C. A. Murray

SECRETARIES: A. R. Klemola
F. V. Prochazka

Business Meeting (15 August 1979)

The President welcomed members of the Commission and announced the appointment of A. R. Klemola and F. V. Prochazka as secretaries. Brief mention of the preparation and distribution of the Reports on Astronomy was made. He thanked all who contributed. The contribution from the Yerkes Observatory by K. Cudworth and E. Vilkki, which failed to arrive in time for inclusion in the Report, is given here.

The modern Yerkes parallax program with the 40-inch refractor is continuing with 75 stars currently under observation and 67 parallaxes having been determined. Most of these have average standard errors of ± 0.006 from measurements on the Yerkes photoelectric image bisector but the last 14 stars have been measured by van Altena (now at Yale) on a PDS microdensitometer and have standard errors of ± 0.004 . We expect that future measurements will be made with a new PDS at the planned mid-west facility in Madison, Wisconsin. Moreover, Cudworth is continuing his proper motion work in globular clusters to determine membership and, usually, internal motions. Studies of M3, M5, M13, M92 and M15 are completed and some observations have been made on M2, M22 and M71.

As one of the main items of business, the President recalled the two resolutions passed at the IAU Colloquium No. 48 in Vienna in September 1979. These resolutions, concerning the improvement of the stellar reference frame and the call for support for the ESA Astrometry Satellite and the NASA Space Telescope astrometry programs, form the basis of joint discussions with other Commissions and are described later in this report. The texts of the resolutions passed at Vienna appear in Information Bulletin No. 41. The President also recalled the establishment of a Working Group on the identification of Radio/Optical Astrometric Sources. The recommendations of the Working Group appear later in this report.

The President reported the composition of the Officers and Organizing Committee for the triennium 1979-1982:

President: H. K. Eichhorn
Vice President: W. Gliese
Organizing Committee: Chr. de Vegt, L. W. Fredrick, G. Gatewood,
R. S. Harrington, C. A. Murray, H. I. Potter and A. R. Upgren.

The President presented lists of individuals seeking membership in the Commission. Following a brief discussion, unanimous approval was given to the proposed list of new members of the Commission:

G. F. Benedict, J. W. Christy, P. Connes, T. E. Corbin, K. Cudworth, C. C. Dahn,
F. W. Fallon, I. V. Gavrilov, R. B. Hanson, J-L Heudier, H. Jahreiss,
I. I. Kanaev, I. G. Kolchinskij, R. S. Le Poole, P. K. Lu, T. E. Lutz,
V. S. Matiagin, H. A. McAlister, D. D. Polozhentsev, N. G. Rizvanov,

J. L. Russell, K. Sims, C. A. Smith, J. D. Stock, L. H. Wasserman and, as consultant, E de Graeve.

The recent death of H. U. Sandig who had been proposed for membership, was noted with regret.

Gliese reported briefly the work of Commission 5 on the previous day concerning the nomenclature of stellar and non-stellar objects. It was noted that the decision was made to leave the matter of designation to the relevant Commissions to the extent that particular classes of objects fall within their domain of interest. It was announced that Gliese would continue to represent the interests of this Commission in such deliberations.

The President then brought up the question of approval of the Rules of the Commission. Vasilevskis pointed out that during his term of presidency a mail ballot was held with the following results: 25 approvals, 6 rejections and one abstention. Several members revived the matter of possible inconsistency of the name of the Commission with regard to the expanding range of astrometric work now being carried out.

In a brief note to the Commission Upgren called for the establishment of a Working Group on Parallax Calibration Fields. This was discussed at greater length in a later session.

Scientific Meeting (15 August 1979)

In introductory remarks Gliese, as organizer of the session on proper motion programs, mentioned three groups of programs.

a) Large proper motions measured relative to slowly-moving distant stars. Comparison of Luyten and Lowell motions reveal systematic differences amounting to several hundredths arcsec per year. But the comparison of Luyten and USNO parallax program (98 stars in common) shows agreement: $\langle \Delta\mu \rangle = +0.027$ per year.

b) Determination of proper motions relative to extragalactic objects.

c) Proper motions in photographic catalogues referred to the system of stars observed with meridian instruments. If given in the FK4 system these require correction due to change in precession and motion of the FK4 equinox according to values given by Fricke.

Scientific reports were then presented as follows:

1) W. J. Luyten: New Catalogue of Large Proper Motions. After a brief description of earlier work in identifying stars of large proper motion, it was announced that a new version of the earlier LTT catalogue was in progress. Since then over 800 Palomar Sky Survey plates have been hand-blinked or machine processed. The new catalogue, denoted NLTT, will contain between 55,000 and 60,000 stars. All relative motions of 0.180 or more per year are included in order to be sure that no absolute motions of 0.2 are omitted. Volume I ($+90^\circ$ to $+30^\circ$) has been published, Volume II ($+30^\circ$ to 0°) should be issued before December, 1979, Volume III (0° to -30°) should be ready early 1980, and Volume IV (-30° to -45° , -45° to -90°) should be ready by July, 1980. Data for approximately 250,000 stars found in the Minnesota surveys are being put on to magnetic tape for eventual transfer to NASA where they will be available to interested users. Charts for about 3000 stars are being prepared for distribution. The speaker emphasized the consequences of the significant systematic zero-point difference, reaching as much as 0.07 per year, found in the comparison of the Lowell and USNO motions.

2) B. F. Jones: Status of Lick Northern Proper Motion Program. After a brief summary of the early history and scope of the proper motion program with respect to galaxies, the current status of the work was presented. Second-epoch plates have been secured for 17 per cent of the 1246 fields. Measurements are complete for the declination band 0° to $+45^{\circ}$ for the sky outside the zone of avoidance. Comparison of the Lick motions with the AGK3, the Russian program and the Yale zones is in progress.

3) W. F. van Altena: Status of the Yale Southern Proper Motion Program. The first-epoch phase is essentially complete for the sky from -20° southward. In addition plates for about one-half of the fields at -15° have been obtained. A small program consisting of about 100 fields is in progress. One part consists of a small pilot program for the measurement and study of stellar motions in a region near the south galactic pole. Supplementary first-epoch plates are also being taken for isolated areas as far north as $+25^{\circ}$ for eventual comparison with the Lick northern program. It is anticipated that the second-epoch phase for the southern sky will begin in a few years.

Joint Meeting on Space Astrometry (16 August 1979). Chairman: G. Westerhout

A discussion of space astrometry and its impact on astronomy and astrophysics was organized by G. Westerhout at the request of the Presidents of Commissions 24 and 33 and with the cooperation of several other Commissions. The purpose of the discussion was to examine work which would be needed in other fields of astronomy and astrophysics to enable full potential of the astrometric data to be realized. The first pair of papers, by Høg and by Jefferys, provided brief technical descriptions, accuracy, and proposed plans of the European Astrometry Satellite and the U.S. Space Telescope, respectively. The remaining papers provided a description of the probable impact of the expected space astrometry data and the associated possible requirements for further ground- and space-based astrophysical observations.

The following papers were presented:

- 1) E. Høg: Hipparcos, The European Space Astrometry Satellite.
- 2) W. H. Jefferys: The U.S. Space Telescope: Astrometric Capabilities.
- 3) B. Pagel: Astrophysical Applications of a Large Increase in Number and Accuracy of Stellar Parallaxes.
- 4) C. Jaschek: Spectroscopy: What are the needs once Space Astrometry has given us a new data base?
- 5) A. D. Code: The Impact of new astrometric data on ground-based and space-based photometric studies.
- 6) P. O. Lindblad: The Impact of faint-star parallaxes and very accurate proper motions on galactic structure and dynamics studies.
- 7) J. Andersen: The needs in the radial velocity area in view of the impending space astrometry projects.
- 8) J. Dommanget: Double stars: interactions of ground-based and space observations.

A brief discussion was held concerning a Joint Resolution indicating support by the IAU for the European Astrometry Satellite and the U.S. Space Telescope programs.

Joint Meeting on Nutation and FK5 (16 August 1979)

The report for this session, organized by V. K. Abalakin and held in cooperation with Commissions 4, 7, 8, 19 and 31, appears elsewhere in the Proceedings.

Scientific Meeting (18 August 1979) Chairman C. A. Murray

The President reviewed progress on the Joint Resolution concerning IAU support of the astrometric space programs. Support was expressed either in writing or verbally by twelve Commissions for the following text:

"The IAU strongly supports the independent and complementary astrometric programmes proposed for the ESA Astrometry Satellite and the NASA Space Telescope".

The President then introduced the scientific session by inviting K. J. Johnston as Chairman of the Working Group on the Identification of Radio/Optical Astrometric Sources to present his report. Other speakers included R. S. Harrington and A. N. Argue.

The primary objective of this working group was to select a preliminary list of suitable celestial sources that may be employed as a benchmark in establishing an inertial reference frame. Radio sources with suitable optical counterparts were selected forming a primary list of eighty-two and a secondary list of thirty-two extragalactic sources. These two lists were deemed necessary as the complete radio/optical structure of a large number of sources is not yet known. Extensive additional observations are required to definitely establish these sources, and the list of sources presented will serve as a starting point in this direction. In addition a core list of nineteen sources was established in order to have a small number of sources which will be put on all astrometric programs in order to precisely evaluate systematic errors in radio/optical positions. The working group made the following recommendations:

- 1) The objects on the primary list should receive the maximum possible optical and radio attention, to ensure the highest-quality positions and information on structure, which will therefore make these objects suitable as an inertial reference frame at the milli-arc-second level for space astrometry.
- 2) That the publication of radio catalogs contain clear references to the radio frequency, epoch of observation, the equator and equinox and the values of the principal astronomical constants used in the reduction process.
- 3) The objects on the secondary list should continue to be surveyed, both to improve knowledge of structure and to improve positional, and therefore identification, information. These objects may become of quality to be on the primary list.
- 4) Additional objects should be observed for radio structure and optical counterparts as facilities permit, for possible later inclusion on either of the lists.
- 5) The core list should be observed as intensively as possible by all groups carrying out either optical or radio astrometry of these sources, to make possible a complete analysis of the systematic errors present before the space astrometry programs go into operation.

In addition it was proposed that the life of the Working Group be extended in order to revise and extend the source list. The report was accepted by the Commission; copies may be obtained from K. J. Johnston, Code 7134, Naval Research Laboratory, Washington, D.C. 20375.

The following membership of the Working Group was confirmed: A. N. Argue, (Chairman), B. Elsmore, J. L. Fanselow, R. S. Harrington, P. Hemenway, K. J. Johnston, I. Kumkova, Ch de Vegt, H. Walter, A. Witzel.

Hemenway reported that the University of Texas Radio Astronomy Observatory

is surveying the sky from declination -36° to $+70^{\circ}$ at about 360 MHz. Based on preliminary data it is expected that more than 2000 stellar-like objects brighter than magnitude 18 will be found from among the more than 50,000 sources expected from the program. Positional accuracies of $\pm 1''0$ and $\pm 1''5$ are expected for the strong and weakest sources, respectively. Finding charts will be provided for all radio sources, with radio position indicated.

The session continued with the discussion of topics associated with the proposed revision of the parallax catalogue under W. F. van Altena. The emphasis of the speakers was upon the study of errors and problems of combining parallaxes measured at different observatories. The reports are summarized briefly.

1) R. S. Harrington: Because of the demonstrated very high precision of the USNO parallaxes, now approaching one milli-arcsec, all parallaxes have been re-reduced using tighter algorithms. These will be published to 0''0001, and should replace the previously published values.

2) T. E. Lutz (with A. Marcus and W. Nicholson): Methods of modern statistical analysis have been applied to the comparison of parallaxes obtained at different observatories. Tests for significance show that most differences are not significant. Bias existing in the data available in the literature is an important factor in these comparisons. Inter-observatory corrections should not be applied.

3) R. B. Hanson: The frequency distributions of trigonometric parallaxes determined by the four major General Catalogue observatories (Allegheny, McCormick, Cape, Yale) have been used to study their absolute zero points, systematic differences, and external errors. The method is to fit the observed distributions by convolving power-law space distributions with Gaussian observational errors. The zero point of the General Catalogue parallaxes is confirmed to within $\pm 0''001$, without systematic observatory differences generally found from comparisons using multiple observations. The external error estimates agree with the General Catalogue precepts and other recent determinations. The systematic apparent magnitude effect in the Allegheny parallaxes in the blue magnitude range 2 to 8 has been confirmed by comparing Allegheny with cluster, spectroscopic, and Yale parallaxes. The effect is related to the use of very narrow sector openings to produce large magnitude reductions for the bright stars in the early Allegheny program.

4) A. R. Uggren: Spectroscopic parallaxes obtained from MK classes for more than 3000 stars in the GCTSP and Supplement were compared with the trigonometric parallaxes for each observatory separately and also for the mean parallax. A multivariate analysis of the data (with L. A. Breakiron) was made to measure the dependence of the differences π (tr) minus π (sp) on ten independent variables: $\sin RA$, $\cos RA$, Dec, zenith distance, b , M_V , V (or B) magnitude, $B-V$, π (sp), and internal error in π (tr). Few significant dependences of either systematic or external errors on any of these were found. Partial confirmation of the magnitude effect in the Allegheny parallaxes, already noted by Hanson's work, was found. From the variation between internal and external errors in the parallaxes of the four observatories with the most parallaxes, those of Allegheny and Yale appear to have some correlation whereas Cape and McCormick have none. Problems of calibrating parallax errors could be greatly reduced in the future by having each telescope observe some standard stars and regions. The relatively high weight of the parallaxes observed since the GCTSP and of the programs now in progress should be of great concern in the creation of a new parallax catalogue and plans to reduce or control systematic parallax errors should now be made with care. At least four new parallax programs are beginning or planned at latitudes not now covered by one of the current programs: Pulkovo (P) at $60^{\circ}N$, La Palma (R) in the Canary Islands at $28^{\circ}N$, CIDA (Cv) in Venezuela at $9^{\circ}N$, and Bosscha at Lembang (L) in Indonesia at 7° .

5) J. W. Stein: Allegheny trigonometric minus spectroscopic parallax differences ($\Delta\pi$) were compiled for 35 stars with spectroscopic parallaxes less than 10 milli-arcsec in RA zones 4^h , 14^h , and 21^h . This rather small data set shows no obvious correlation between $\Delta\pi$ and sector opening, exposure times, start and end year of the plate series, time interval covered by the series, or Allegheny publication number. Statistical testing indicates that for this data set the relationship between $\Delta\pi$ and B magnitudes is best described by a weak step function not very different from the Allegheny correction given in the Jenkins Catalogue.

A Working Group on Parallax Calibration Fields was established with the following membership: R. B. Hanson, R. S. Harrington, P. A. Ianna, S. L. Lippincott, T. E. Lutz, H. I. Potter, A. R. Upgren (Chairman), and W. F. van Altena.

Joint Meeting on Coordination of Astrometric Position Work (21 August 1979)

The report for this session, organized by H. K. Eichhorn and held in cooperation with Commission 8, appears elsewhere in the Proceedings.