

## 8. POSITIONAL ASTRONOMY (ASTRONOMIE DE POSITION)

PRESIDENT: E Høg

VICE PRESIDENT: K N Tavastsherna

ORGANIZING COMMITTEE: C A Anguita, G Billaud, S Debarbat,  
W Fricke, J A Hughes, B L Klock, J A Lopez,  
I Nikoloff, G Teleki, R H Tucker, H Yasuda,  
Luo Ding-jiang, Y S Yatskiv

### I. INTRODUCTION

The present report covers mainly the period 1979 - June 1981.

As in the last Report, the following will contain three further sections:

II. Reports from observatories and Commission members presented under national headings.

III. Other reports: from the working groups on  
a) astronomical refraction,  
b) astrolabes, and  
c) horizontal meridian circles. Furthermore on the  
d) theory of nutation,  
e) SRS project, and on the  
f) HIPPARCOS satellite.

IV. Late reports.

We commemorate two well-known positional astronomers deceased since the last Report:

J Haas (Bonn), G K Zimmermann (Nikolayev).

The following have notified their retirement from the Commission:

N Hansson, J Larink, J R Levy, T Okuda, R W Rhuynsburger,  
A C Scheepmaker, T Tsubokawa, K Tuzi, J von der Heide.

After consideration by the Organizing Committee the following will be regarded as retired from the Commission:

J Gay, W Schuler, S Slaucitajs, E G Woolsey.

New members according to IAU By-law 21 are:

Xu Tong-qi (Shanghai), Luo Ding-jiang (Beijing),  
Li Dong-ming (Beijing), Hu Ning-sheng (Nanjing), Ye Shu-hua (Shanghai),  
L V Morrison (Herstmonceux), P T Wallace (Epping, Australia).

## II. REPORTS FROM OBSERVATORIES AND COMMISSION MEMBERS

a) Australia

Second epoch plates for the Perth Astrographic Catalogue Zone  $31^{\circ}$  to  $41^{\circ}$  south have been obtained to a 75% completion. For southern fields of galaxies and supporting fundamental stars in the zone of avoidance 50% of the first epoch plates have been achieved.

The semiautomatic meridian circle on loan from the Hamburg Observatory has been used since completion of the SRS observing programme in 1972. Up to 1976 the FK4 and FK4 Supp. stars south of  $+37^{\circ}5'$  obtained about 60 000 observations and the catalogue, Perth 75, is in press.

In August 1976 observations started of 1738 reference stars for southern areas of galaxies and of 153 fundamental stars in the zone of avoidance as proposed by A N Deutsch and M S Zverev. Later, 177 suspected population II stars proposed by E H Olsen, Copenhagen, were included. The results of 360 nights are being compiled.

In August 1980 an observing programme of 14702 stars set up in consultation with E Høg and E H Olsen was commenced. It contains the following stars south of  $+37^{\circ}5'$ : All 1156 FK4 stars in upper culmination, 75 FK4 stars in lower culmination, all further 11500 stars of  $m_V < 7.0$ , 22 certain and 246 suspected radio stars, 148 pulsating variables of  $m_V < 10$ , and 1801 suspected population II stars.

Regular observations of the five major outer planets and the four brighter minor planets have been carried out. (I Nikoloff).

At Sydney the photography of the sky from  $-38^{\circ}30'$  to the South Pole has been nearly completed. The measurement of the zones centred at  $-53^{\circ}30'$  and  $-56^{\circ}$  has been finished and more than half of the zone centred at  $-58^{\circ}30'$ . The plates are being reduced with references from the Perth 70 catalogue. The measurements are now transferred directly from the measuring machine to the calculator and a greater output is obtained. (W H Robertson).

b) Chile

At Santiago the following observing programmes with the Repsold meridian circle are in progress. 651 FKSZ stars and 1217 FK4 stars are being observed with the quasi-absolute method in the zone  $+40^{\circ}$  to  $-90^{\circ}$ , 367 double stars and 25 galactic objects recommended by Commission 24. During the recent 2.5 years three observers obtained a total of 12 123 observations on 239 series of differential observations.

A catalogue of observations of 7610 stars of the SRS and BS Programmes in the zone  $-25^{\circ}$  to  $-47^{\circ}$  is in press.

Results have been presented in (25.041.046, 25.002.013, 25.041.056, and 25.041.057). (G Carrasco).

Observations have been obtained with the Danjon Astrolabe (ESO/University of Chile) for a catalogue containing 358 FK4 stars and 164 FK4 Supp. stars. Uranus was observed on 107 double transits with the astrolabe. Three FK4 radio stars are being observed. (20.041.024, 25.101.013, 27.044.001, 27.012.052). (F Noë1).

c) Denmark

The Carlsberg Automatic Transit Circle (CATC) has been in fully automatic operation since 1981 at Brorfelde. The telescope is set automatically and the circle readings and transits are recorded using moving-slit micrometers with photoelectric detectors. The instrumental calibrations are also made automatically and observations are reduced on-line to the right ascension and declination system of the instrument. Meteorological data are recorded automatically with each

transit. All operations are made under the control of two computers, one of which controls the acquisition of data, whilst the other reduces and analyses these data. The instrument is capable of observing 80-90 transits an hour. A test programme of FK4 stars, polar stars, and PZT stars was started and results are promising.

The instrument will be moved to La Palma during 1982 in accordance with a tripartite agreement between the observatories of Copenhagen, Herstmonceux, and San Fernando and will be run by a joint management committee. About 25% of the time will be devoted to fundamental work, which will include the FK4/5 and about 4000 other fundamental stars, the sun, the major planets and about 20 minor planets. The very first differential programmes will be limited in scope in order to demonstrate the high accuracy attainable by the instrument as soon as possible. These programmes will probably include the AGK3R and SRS, and faint reference stars in the fields of selected radio sources. (L Helmer).

Feasibility studies have been carried out of the glass meridian circle, cf. Section IIIc. Contributions were made to the realization of the ESA astrometry satellite HIPPARCOS (25.041.057, 28.032.540, 28.051.007, 28.041.040). An Anglo-Danish-Swedish team of scientists have been formed for the reduction of data from HIPPARCOS. Assistance was given to set up a new observing programme for Perth and to complete a catalogue Perth 75 (in press). (E Høg).

d) Federal Republic of Germany

(i) At Heidelberg progress has been made in the work on the construction of the FK5. A great number of catalogues of observations have been investigated. Most of the catalogues have presented differential observations with respect to the FK4. About 35 catalogues have given results of absolute or quasi-absolute observations of FK4 stars in either both or one coordinate; these observations will yield systematic corrections to the positions and proper motions of the FK4 as functions of the position in the sky and of the magnitude. In addition, there are differential observations available which fulfill the conditions for the determination of magnitude equations of the FK4. All determinations of systematic differences (Cat-FK4) made from absolute and differential observations have been performed by means of the methods (analytical and numerical) described by Bien et al. (25.041.067). The transformation of the system of the FK4 to the FK5 will be formulated by analytical expressions developed by Schwan (publication in preparation) and tested in a pilot programme in application to all Washington 6" TC catalogues. The final transformation of the FK4 to the FK5 will include the results of the determination of the equator and equinox of the FK5 carried out by Fricke (29.043.008). Status reports which include preliminary results for the equator and equinox were presented by Fricke (28.041.012; 28.043.001). According to the final result for the time-dependent correction to all right ascensions of the FK4, the transition from the FK4 to the FK5 equinox is achieved by the following operations

$$\alpha_{FK4} + 0^{\text{S}}035 = \alpha_{FK5} \text{ at } 1950.0 \qquad (\mu_{\alpha})_{FK4} + 0^{\text{S}}085 = (\mu_{\alpha})_{FK5}, \text{ per century.}$$

Observations of relevance to the improvement of the equator have not indicated a significant correction to the FK4 equator. Hence, no change of the FK4 equator will be made in the FK5. The system of the FK5 is intended to be completed in 1983 and ready for introduction at 1984.0. The completion of the individual corrections to the positions and proper motions of the FK4 stars and the extension of the fundamental catalogue to fainter stars can be expected in 1985.

Preparations have begun in Heidelberg for the participation in the compilation of the observing programme for the Astrometry Satellite HIPPARCOS of the European Space Agency and for the reduction of the satellite data. (W Fricke).

(ii) At the Hamburg Observatory the programme of precise optical positions of

radio sources has been continued. (25.031.567, 25.141.079, 25.141.080, 26.041.014). Source positions have been derived now for 30 quasars on the northern hemisphere. Part of the material has been obtained from a joint observation program with F Prochazka, Vienna Obs. A detailed investigation of optical - and radio positions for 3C273B has been finished (A & A 1981). The work on optical and radio reference system with the IAU working group has been continued.

The project of a photographic reference star catalogue for the reduction of PZT-observations and the connection of neighbouring PZT-stations has been started with the zone astrograph as a contribution to MERIT. The catalogue will cover a closed belt of  $5^{\circ}$  width, centered at decl.  $+52^{\circ}.5$  with fourfold overlap. The area of the 4 PZT-stations Herstmonceux, Calgary, Potsdam, and Hamburg will be fully included.

Reductions of the Cape astrometric Survey (CPC2), zone  $-42^{\circ}$  to  $-52^{\circ}$ , has been started in collaboration with C A Murray and W Nicholson/RGO. (C de Veegt).

(iii) At Hannover the work on an absolute stellar geographical fundamental system was continued (22.041.076, 25.041.043, 28.041.016). (K Pilowski).

#### e) France

At Bordeaux the automatic meridian circle has been used since 1980 for routine differential observations of NPZT stars. About 8000 positions have been obtained during 10 months which confirm the claimed mean errors of  $0''.10$  in  $\alpha$  and  $0''.13$  in  $\delta$ . However, the automatic setting will be in service only by October 1981 and the determination of the division errors and the extension up to  $m_V = 12.5$  will not be carried out before 1982. The instrument is proposed to observe 15 000 faint HIPPARCOS stars and for specific high accuracy programmes. (25.032.036, 28.032.008). (Y Requième).

At Grasse the prototype photoelectric astrolabe has obtained a satisfactory precision of 5 to 5 ms on a transit time in the first vertical. (G Billaud).

Results from the Paris astrolabe have been published and analysed for Mars (25.097.036, 26.097.026), A & A 96 (1981) 193 and for Saturn (22.041.005, 22.041.025). Previously discussed discrepancies about Mars have been explained (25.097.047, 25.041.015, 25.097.019).

Synthesis paper about planetary astrolabe observations (27.041.034). Bibliography on astrolabe literature (21.002.061).

Contribution to the celestial reference frame can possibly be made through observations of bright counterparts of radiosources, and an international cooperation for astrolabes has been started, see IAU Coll. No. 56, Varsovie, 1980. The first five systematic campaigns at the Paris astrolabe for beta Persei have appeared in A & A Supp. Ser. 44 (1981) 189. (S Debarbat).

#### f) Great Britain

All observations of FK4 stars made at Herstmonceux in 1957-1981 have been reduced on the Herstmonceux system, and the results sent to the ARI at Heidelberg for inclusion in the FK5 catalogue. In addition, these observations have been transferred to the FK4 system, in order that they may be published on both systems.

On the Cooke Transit Circle at Herstmonceux, regular observations of Sun, Moon, major and minor planets, and fundamental stars are continuing. The Electronic Circle Reading system has been delivered and installed. Some modifications have been made, and the equipment has shown that it can provide real-time circle readings of the required accuracy. The delivery of the apparatus gave a natural opportunity for termination of the programmes of observations of zodiacal stars and NPZT stars.

Work continues on clearing the arrears of publication of meridian catalogues, starting with the Greenwich Airy TC observations of 1942-1954.

Morrison has succeeded Tucker as RGO Project Leader of the Carlsberg Automatic

Transit Circle. The main data-reduction computer for the CATC was tested at Herstmonceux, transported to Brorfelde, and successfully linked to the computer dedicated to control of the telescope. Efforts are being made to reduce the estimated cost of the CATC building on La Palma to bring it within the approved financial provision. (R H Tucker).

g) Italy

At Cagliari observations were started 1981 with the new Danjon astrolabe. A new photoelectric micrometer for the 12 cm transit instrument is planned for meridian observations of stars, planets and the Moon. Researches in the field of diurnal refraction deduced from observations of solar disk and anomalous refraction are pursued: A Poma, E Proverbio, and S Mancuso in W Fricke and G Teleki (eds), Sun and planetary system, Reidel Publ. C. (in press), and E Proverbio, S Uras in Mem. SAIt, Vol. 53 (in press). (E Proverbio).

h) Japan

At Mizusawa the International Latitude Observatory derived corrections to the declination of ILS latitude stars. It also continues to derive corrections to the positions of FK4 stars. C Sugawa and N Kikuchi showed the characteristics of astronomical refraction in the northern hemisphere (26.082.049), and S Takagi and Y Goto showed the formula applied to calculate the astronomical refraction at Mizusawa (26.082.050).

At the Tokyo Astronomical Observatory, regular observations of the Moon, planets and the four bright minor planets referred to the FK4 system have been continued. The results of the observations of solar system bodies from 1974 to 1977 were published by Yasuda et al. (21.041.035). The meridian observations of O and B stars north of  $-30^{\circ}$  have been completed by the end of 1979, and the observational catalogue of them is being compiled. Yasuda proposed a method with a new statistical approach to Brosche's model for catalogue comparison (21.041.011). M Miyamoto derived a method suitable for the computer analysis of division errors. A correction term to the refraction table is derived in an analytical expression by Yasuda and R Hukaya (26.082.043). Y Niimi determined the equinox and equator corrections to the FK4 system from meridian observations made during the period from 1935 to 1976.

At Tokyo the compilation of 1179 Northern PZT Stars Catalogue has been completed by Yasuda and K Hukurawa. It is based on comparative meridian circle observations at Abbadia, Beograd, Bordeaux, Bucharest, Copenhagen, Herstmonceux, Moscow, Pulkovo, San Fernando, and Tokyo Observatories. The average epochs of the catalogue in R.A. and Dec. are about 1974. The 95% of mean errors of catalogue positions is less than  $\pm 0.0060$  (m.e.  $\cos \delta$ ) and  $\pm 0.131$  in R.A. and Dec. respectively. The determination of proper motions of NPZT stars is going on by Yasuda.

An automatic photoelectric meridian circle is currently being manufactured by Carl Zeiss Oberkochen, and will be set up at Mitaka campus of the Tokyo Astronomical Observatory at the middle of 1982. This instrument can observe the Sun, the Moon, planets and stars brighter than 13.0 visual magnitude. It permits the preliminary observed minus computed position of a star to be produced on-line by PDP 11/34 and HITAC E-800 computers. (H Yasuda).

i) Romania

The Bucharest SRS catalogues were published in 1979. Observations of the Cagliari PZT stars were completed in 1979, and those of Prague PZT stars were started in 1980. The O-C differences for all FK4 stars of the Bucharest KSZ programme (1955-1962) will be computed and some of them have already been sent to ARI, Heidelberg. The NPZT declinations have been sent to Tokyo and R.A.s will soon follow. (E Marcus, I Rusu, M Tudor, E Toma).

j) Spain

The astrolabe at San Fernando has been used for observations of stars and the planets Saturn, Jupiter, Mars, and Vesta. Results were published in IAU Colloquium No. 48 (1979), A & A Supp. 41 (1980) and A & A, 96 (1981). Since 1980 fourteen radio sources from the Commission 24 list are being observed systematically.

The NPZT programme of the meridian circle from 1973 to 1980 resulted in 4 observations for each of the 1717 stars and they have been sent to Tokyo. In addition 99 transits of planets were observed: Mars 22, Jupiter 31, Saturn 38, Uranus 8.

Meridian observations of 38 radio sources were started in 1981.

Since 1980 the Instituto y Observatorio de Marina (IOM) is associated to the joint Anglo-Danish project for operation of the Carlsberg Automatic Transit Circle on the Island of La Palma.

Astrograph observations of 20 minor planets of the Leningrad programme has resulted in 242 plates. (L Quijano, M Sánchez).

k) USA

Instrumental improvements on the three transit circles of USNO have been introduced. They have all been equipped with new digital motor drive systems on the micrometers. An image dissector micrometer is being tested on the 7-inch, while the 6-inch and 8-inch have visual micrometers. The former ATC with mirror optics has now been converted to a conventional 8-inch transit circle and it has obtained a new lens objective. The IBM 1800 system at the 6-inch is being replaced by an HP 1000. (B L Klock).

l) USSR

At Pulkovo observations of 505 stars of the Pulkovo latitude programmes have been obtained with the Zverev photographic vertical circle.

Photoelectric observations of RA of about 500 circumpolar stars have been commenced with the modernized meridian circle MK-200 ( $\emptyset = 200$  mm,  $F = 2000$  mm). Pilot observations of declinations of FK4 stars have begun with the Sukharev mirror meridian circle.

The reduction of declination observations of SRS, BS, and DS stars (in the zone  $-47^\circ$  to  $-90^\circ$ ) with the meridian circle of the Cerro-Calan Observatory has been completed. Corrections to the declinations of FK4 stars have been derived from observations in the zone  $-40^\circ$  to  $-90^\circ$  and observations of series of reference stars in the zone  $+40^\circ$  to  $-90^\circ$ .

Observations of 4000 stars of the latitude and photoelectric zenith tube programmes with the Ertel vertical circle and photographic observations of the catalogue of geodetic stars (northern sky) have been reduced.

A catalogue of absolute RA of 1960 FK4 and FKSZ stars has been published. It was compiled on the basis of observations with the Pulkovo large transit instrument at the Cerro-Calan Observatory during 1969-1973. Three catalogues of absolute RA of stars from the Backlund-Hough, Kimura and Kopff lists compiled of observations at the Melbourne Observatory in 1928-1941 came out (Trudy of the Glavn. Astr. Obs., v. 84, 1981). Visual meridian observations of double stars (DS) and photographic observations of areas with distant radio sources have been commenced at several observatories of the USSR.

Theoretical and practical studies concerning absolute determinations of quasar coordinates with the VLBI method are being made. Photographic observations of the bodies of the solar system are carried out.

From Golosseyevo, Kiev, three papers were published in Naukova Dumka, Kiev, 1980.

By A S Kharin, E M Nenakhova, P F Lazorenko: Modernization of the Wanschaff vertical circle and the results of observations of the Sun and the major planets in

1940-1947.

By D P Duma, L I Kizjun, Yu I Safronov: Orientation of the FK4 frame using meridian observations of planets.

By M S Zverev, A M Kurianova, D D Polozhentsey, Ya S Yatskiv: A compiled catalogue of fundamental faint stars with Dec.  $+90^{\circ}$  to  $-20^{\circ}$ , PFKSZ-2.

A catalogue of declinations of 100 equatorial stars of the A A Mikhailov list was compiled (N F Minailo. *Astrometry and Astrophysics*, vyp. 43, 1981).

At Kazan a differential catalogue of declinations of 2884 stars of latitude programmes has been compiled. An absolute catalogue of decl. of 203 FK4 stars, a general catalogue of 2679 KSZ stars in the zone from  $-20^{\circ}$  to  $-5^{\circ}$  in declination on the basis of observations in Perth, Bucharest, Nikolayev, Tashkent, and Odessa and a compilation catalogue of declinations of KSZ stars in the zone  $-5^{\circ}$  to  $+90^{\circ}$  on the basis of an improvement of the AGK3R with respect to accidental errors (Bucharest, Moscow, Kiev, and Kazan observations were used) have been finished.

At Kharkov a catalogue of declinations of 1407 circumpolar faint stars has been compiled on the basis of the observations made in 1909-1914.

Differential observations of RA of 650 double stars (DS) and 167 high luminosity stars (HLS) have been carried out.

At Kiev University Observatory the compilation of a general catalogue of bright stars (BS) and observations of double star programmes (DS) and high luminosity star programmes (HLS) with the meridian circle have been continued.

At Moscow the following catalogues have been compiled:

A Catalogue of Declinations of 436 stars of the zenith zone from observations with the zenith-telescope.

A catalogue of RA of 261 stars from observations with the PZT.

A Moscow catalogue of 3696 stars of latitude programmes.

The work on a compilation catalogue of radio source coordinates has been continued. Observations of cepheids, high luminosity stars and double stars have been continued with the meridian circle and of Venus and Mars with the wide-angle astrograph.

At Nikolayev a catalogue of absolute RA of 531 stars have been compiled from observations on the West Spitzbergen. Other catalogues were completed:

431 stars from observations at Nikolayev;

RA of 586 FKSZ stars;

Decl. of 9560 zodiacal stars from observations at Nikolayev.

Meridian observations and photographic observations of major planets, their satellites and minor planets have been continued.

At Tashkent a catalogue of RA of 433 FK4 stars and a catalogue of RA of 376 stars in the declination zone from  $-20^{\circ}$  to  $+90^{\circ}$  is in press.

Observations of RA of selected FK4 stars and day time observations of the bodies of the solar system are carried out with the meridian circle.

At Leningrad theoretical and practical work has been done on the use of the VLBI method for the goals of positional astronomy. (K N Tavastsherna).

#### m) Yugoslavia

At the Belgrade vertical circle 308 bright circumpolar stars were observed 4 times in each of the upper and lower culminations by M Mijatov, Dj Bozhichkovich and G Teleki.

At the Askania meridian circle the NPZT programme was completed and Sun, Mercury, Venus, and Mars are regularly observed. A programme of 3000 double stars has been started.

Papers related to fundamental astrometry and astronomical refraction are (22.082.094, 22.032.020, 25.002.014, 25.041,049, 26.082.040, 27.032.039).

Publ. Obs. Astron. Sarajevo 1 (1981) contains papers by Teleki on refraction, by Bozhichkovich on meridian instrumentation, by Sadžakov, Šaletić, and Dačić on NPZT observations and observations of Sun, Mercury, and Venus.

Ed. Fan, Kazan, 1981, contains papers (in Russian) by Teleki on fundamental astrometry and on refraction, and by Sadžakov, Šaletić, and Dačić on NPZT observations.

Publ. Astron. Obs. Belgrade 30 (1981) contains the catalogue of NPZT stars by Sadžakov, Šaletić, and Dačić and a paper on refraction by Teleki. (G Teleki, S Sadžakov).

### III. OTHER REPORTS

#### a) Working Group on Astronomical Refraction

(i) Chairman: G Teleki. Members: W J Altenhoff (Bonn), F K Brunner (Kensington), B Garfinkel (New Haven), J A Hughes (Washington), I G Kolchinskij (Kiev), A I Nefed'eva (Kazan), K Ramsayer (Stuttgart), J Saastamoinen (Ottawa), C Sugawa (Tokyo), E Tengström (Uppsala), and H Yasuda (Tokyo).

(ii) The Group continues the work on the elaboration of the new international refraction tables. In the frame of this activity, J Saastamoinen (National Research Council of Canada) finished a study on the latitudinal distribution of meridian tilts in the atmosphere (1980), which gives a global atmospheric model.

(iii) The Group and the Special Study Group 1.42 on Electromagnetic Wave Propagation and Refraction in the Atmosphere of International Association of Geodesy has decided to organize a workshop "Three-dimensional Refraction", as a Special Session of the Sixth European Regional Meeting in Astronomy. Organizers: F K Brunner, G Teleki, and E Tengström. The preliminary agenda contains 8 invited papers, 9 contributed papers and one round table discussion.

(iv) G Teleki published (Bull. Obs. Astron. Belgrade, 131, 1981, pp. 3-8) a review on new tendencies of research in astronomical refraction. (G Teleki).

#### b) Astrolabe Reports

These have been given under the appropriate national headings of Chile, France, Italy, and Spain.

#### c) Study Group on Horizontal Meridian Circles

(i) Chairman: E Høg. Members: R d'E Atkinson (Bloomington), J W Gietzen (RGO), G van Herk (Leiden), B L Klock (USNO), J Osorio (Oporto), G J Pinigin and G M Timashkova (Pulkovo), Xu Tong-qi (Shanghai), and Hu Ning-sheng (Nanjing).

(ii) A communication by G I Pinigin was distributed to the members: "Investigation of the Pulkovo horizontal meridian circle for observations of star declinations" containing a study of refraction in horizontal tubes.

(iii) On the glass meridian circle, GMC, four working papers have been distributed by E Høg: Geometrical theory of a GMC; Aberrations of the GMC telescope; Study of air in a horizontal tube, Parts 1 and 2,

The present design of the Danish GMC contains a short copper cylinder instead of the original solid glass cylinder which was found to be too difficult and expensive to manufacture and difficult to mount in any bearing. The copper tube will carry a plane 45° mirror at one end and a plane auxiliary mirror perpendicular to the optical axis at the other end. The high thermal conductivity of copper will ensure a constant angle between the two mirrors. A counterpoised mounting of a



dummy 45° mirror of 24 cm aperture is being tested on the copper tube with respect to mechanical properties.

(iv) Studies of the GMC have started at the Astronomical Instruments Factory, Nanjing, in consultation with E Høg. An overall theoretical study of the instrument has been written by Yao Zheng-qin (in Chinese) and experiments on refraction in a horizontal tube has been initiated by Hu Ning-sheng. (E Høg).

#### d) Theory of Nutation

A mailing vote on the adoption of the 1980 IAU Theory of Nutation in replacement of the 1979 Theory was conducted in the Commission with the following result: 63 votes in favour, 1 against, 5 abstentions, and 45 members did not reply.

#### e) SRS Project

The most recent previous reports on the projects are: IAU Trans. Vol. XV B, 1973, p. 81, Comm. 8 report. IAU Trans. Vol. XVI A, Part 2, 1976, p. 9, Comm. 8 report. IAU Coll. No. 48, 1978, p. 489, on Pulkovo work on R.A.

The observations of the different parts of the programme have been reduced and exchanged between Pulkovo and USNO except the Santiago-Pulkovo Dec. observations zone -47° to -90° and the Leoncito observations. The transmission of the last data awaits the completion of certain protocols.

An SRS meeting of representatives from Pulkovo, Washington, and Heidelberg, and the President of the Commission will take place at Brorfelde in March 1982. It was proposed by K N Tavastsherna and at first arranged for October 1981, but it was postponed because the Pulkovo astronomers were not able to come. (E Høg).

#### f) HIPPARCOS Satellite

The ESA astrometry satellite was approved in March 1980 and is scheduled for launch in late 1986. It is expected to obtain positions, annual proper motions and parallaxes with an accuracy about 0"002 for about 100 000 stars, mostly brighter than  $B = 11$ .

ESA has issued three Announcements of Opportunity (AO) calling for commitments to tasks in connection with the mission.

1. An AO for forming the Input Catalogue of presumably 100 000 stars. This catalogue shall contain all information needed for observation and reduction, such as positions to  $\pm 1''$ , approximate magnitudes, parallaxes etc.
2. Another AO for Data Reduction. The reduction will be based on the photoelectric recordings, readings of gyroscopes etc. and shall give the final results in a catalogue.
3. An AO for proposals of observing programmes. It will perhaps be distributed to scientists outside the ESA member states (while 1. and 2. are limited to institutions in these countries). The proposals will be submitted to a selection committee which will select the stars to be observed, in case not all can be accommodated. Based on this selection the task 1. can be completed.

Scientists and groups whose contributions are selected in 1. to 3. will have exclusive access to all HIPPARCOS data for a period of not more than 5 years from the date of launch. On the basis of the time expected to prepare the total catalogue, this should mean that these scientists will have exclusive access to that catalogue for a period of not less than one year.

The activities associated with 1. to 3. will be financed by the institutions selected for the work and not by ESA.

ESA has nominated a Project Scientist, M A C Perryman, and has appointed a HIPPARCOS Science Team (HST) led by the Project Scientist consisting of instrument

experts, astrometry experts, and astro-physicists. HST will provide ESA management with the appropriate scientific advice and assistance during the various phases of the mission.

The industrial studies for the payload have started. It is noted that some doubt has previously been cast on the feasibility of the present optical system. Particularly on the feasibility of manufacturing the complex mirror with the deformed surface to the high accuracy of  $\lambda/50$ . Other possibilities are being studied and it is expected that the revised optical system will perform to the accuracy predicted hitherto.

Project TYCHO: In addition to the primary scientific result of extremely accurate astrometric data to be obtained for 100 000 stars by the main HIPPARCOS detection system ( $\pm 0.002$  arcsec) it appears that exploitation of the satellite's "star mappers" (originally designed to be used only for the attitude determination) can give further results of great scientific value. This can be achieved if the two star mappers are provided with B and V colour filters, respectively, and if the complete photon record generated by the star mapper photomultipliers is transmitted to the ground for evaluation.

The star mappers could observe at least 400 000 stars brighter than  $B = 11$  with an accuracy at  $B = 10$  of 0.03 arcsec for positions and 0.03 mag for the B and V magnitudes.

Proper motions with an accuracy of 0.003 arcsec per year can then be derived for most of the 400 000 stars by comparison of the resulting positions with first epoch positions from the photographic catalogues AGK2, Cape, etc.

The number of known bright variable stars ( $V < 10$ ) of small amplitudes will be much increased compared to present knowledge, e.g. of most cepheid types and eclipsing variables.

The resulting catalogue of positions, proper motions, magnitudes and colour indices would be about an order of magnitude more accurate than existing precise star catalogues and should carry the name TYCHO in honour of the creator of the first accurate star catalogue in Modern Time.

This project proposed by E Høg has marginal cost impacts on the present mission and was approved by ESA in December 1981.

The photon records from the star mappers will contain valuable information for an additional 800 000 fainter stars. This information can be more easily and accurately extracted if positions and B and V magnitudes for all stars down to  $B=13$  were available with an accuracy corresponding to one astrographic plate in each of the two colours. Thus, a collaboration between this part of the TYCHO project and ground based facilities is suggested.

A Colloquium on the Scientific Aspects of the HIPPARCOS Mission is to be held in Strasbourg on 22-23 February 1982. (E Høg).

#### IV LATE REPORTS

No late reports were received.

E Høg  
President of the Commission