CHAPTER V

REPORTS OF MEETINGS OF COMMISSIONS

https://doi.org/10.1017/S0251107X00005496 Published online by Cambridge University Press

Commission 4: Ephemerides

President: P. K. Seidelmann Secretary: C. A. Williams

Commission 4 was convened in 9 sessions by President, P. K. Seidelmann.

Business Meeting, Session 1, July 24: A tribute was made to the commission's deceased member R. F. Haupt.

C. A. Williams was appointed by the President as secretary.

The President reported that the executive committee of the IAU had begun discussions of possible reorganization of some commissions, including Commission 4. It has also been suggested that the General Assembly contain more science. In keeping with this spirit, the sessions of Commission 4 at this assembly will emphasize scientific papers.

The elected officers of Commission 4 for 1991–1994 are President, B. D. Yallop and Vice President, H. Kinoshita.

The following membership of the organizing committee was approved:

V. K. Abalakin	Y. Kubo	H. Schwan	E. M. Standish
J. Chapront	B. Morando	P. K. Seidelmann	Fu Tong
L. E. Doggett			

The following new members were elected:

T. Fukushima	G. H. Kaplan	Mitsuru Soma	C. A. Williams
Miaofu He	Ciyuan Liu	Nguyen Mau Tung	

No consulting members were announced.

A special report was presented by G. I. Eroshkin on the topic "Numerical Modeling of the Planetary Orbital Motion and Lunar Orbital and Rotational Motions for the AE91 Ephemeris". Eroshkin also presented a report entitled "On the Scientific Programs of ITA in the Field of Ephemeris Astronomy," authored by N. I. Glebova, G. I. Eroshkin, M. A. Fursenko, V. N. Lvov, M. L. Sveshnikov, V. I. Skripnichenko, R. I. Smekhacheva, V. I. Valyaev, and A. A. Shiryaev. Eroshkin offers the following summary of these reports:

" 'Integral program systems' or program complexes with features of informative and inquiry systems as well as of data base control systems with graphic means and advanced interface are under active development in the Institute of Theoretical Astronomy (ITA, St. Petersburg). Among these systems are the following:

1. ephemerides of major bodies of the Solar System,
2. ephemeris maintainance of the observations of major bodies of the Solar System as well as predictions of star occultations by these bodies,
3. acquisition, storing and fitting of astronomical observations.

Experimental versions of AE91 ephemeris of the Sun, major planets, and the Moon, based on the high-precision numerical theory are also obtained in ITA."

Ephemerides: Present and Future, Issues and Uses, Scientific Sessions 2 and 3, July 24: The following 13 scientific papers were given.

1. R. West, *User Requirements* Very accurate ($\pm 0\farcs1$) source positions (for pointing) and source motions (for tracking) are needed when objects cannot be seen because they are

https://doi.org/10.1017/S0251107X00005496 Published online by Cambridge University Press

faint or the observation is not being made in the visible part of the spectrum, when the field of view of the telescope is small, especially true with adaptive optics and, when telescope time is at a premium, for reasons of efficiency. Data in machine readable form is essential for many reasons: it can be easily read into the small computers that control telescopes but cannot be stored on them, circumstances may change during observation when other data will be required that can be retrieved quickly; and it minimizes errors and increases the performance efficiency of observers who use pc's containing the data and algorithms for transforming it to formats needed for specific observations.

2. B. Morando, *Publications: Contents and Future Requirements* Ephemerides are published in France primarily by the Bureau des Longitudes and by some private groups. BDL offers some tabulated ephemerides and software for computation of ephemerides in machine readable form. For example, ephemerides of satellites are available for a pc or a Macintosh. An astronomical ephemeris was also prepared for the "MINITEL" service on the french telephone system. From telephones, equipped with keyboard and monitor, one simply dials 36 16 BDL to get information on the calendar, rise and set times, eclipses, phases of the Moon, and other information of public interest.

3. C. Smith, *Star Catalogs* The work reported here was done in collaboration with Schwan. Catalogs currently available are listed in order of decreasing accuracy, together with the number of stars they contain, the mean epoch, mean error in position, and mean error in proper motion.

Catalog	Stars	Epoch	m e (″)	m e (″/*cy*)
FK5 basic	1535	1949	0.019	0.071
FK5 extension	3117	1944	55	255
IRS, Part 1	29163	1949.5	80	430
IRS, Part 1,2 ($\delta > 0$)	17,431	1952	*	*
IRS, Part 1,2 ($\delta < 0$)	18,596	1945	*	*
ACRS Part 1	250,052	1950	120	470
ACRS Part 2	70,159	($\delta > 0$)1945	*	*
		($\delta < 0$)1955	*	*
PPM South	144,787	1950	140	550
PPM North	181,731	1931	100	430

* Discordances and poor observational history make it difficult to give meaningful statistics on mean errors.

4. B. D. Yallop, *Compact Data for Navigation* The level of precision required for navigation is $\pm 0\overset{s}{.}1$ for ephemeris data, with approximately 3 coefficients required to represent motion of a body for 15^0. Presentation of the data in book form is currently required by law for some vessels. Presentation by computer requires decisions regarding computer type, size and disk densities, languages and specific user requirements. Presentation with optical disk could provide sound, pictures, moving pictures, as well as explanations and calculations.

5. B. Morando (for J. Chapront), *Connaissance des Temps* Data for the Sun, Moon, planets, four minor planets and the Galilean satellites are presented in the *Connaissance des Temps*. The satellite data are given as differential coordinates with respect to Jupiter. Data are available as mean or apparent place with respect to the epoch J2000. The planetary theory of Bretagnon, VSOP87, is available in Fortran subroutines for the planets Mercury to Neptune, in several sets of variables including heliocentric, geocentric, rectangular or

https://doi.org/10.1017/S0251107X00005496 Published online by Cambridge University Press

spherical.

6. L. E. Doggett, *Almanacs on Disks* MICA stands for Multi-Year Interactive Computer Almanac. It is a menu driven, compiled program available for the Macintosh and MS–DOS systems to provide almanac data with a precision of $\pm 1''$. The computation kernel uses DE/LE 200 and provides data for 10 years in a variety of coordinate systems (barycentric, helicentric, geocentric, rectangular, spherical, equatorial, ecliptic) and several different epochs. The program is in β testing at the present time. Questions still being considered concern maintainance, production of higher versions, and a contact office for users to get help with problems.

7. T. Fukushima, *Standardized Software* Standard software refers to a library of subroutines, similar to the IMSL library, providing numerical recipes for astronomical phenomena such as precession, nutation, time transformations, prediction of phenomena, planet/lunar ephemerides. Open questions concern not only construction but maintainance. A possible organizational structure would be to have a central bureau serving local computer centers and private users, while maintaining a research group and receiving outside contributions which they would have reviewed by an independent editorial board.

8. G. H. Kaplan, *Bulletin Board Almanac* Bulletin Boards have the advantage of providing data with frequent updates, being easily accessed and giving faster response times. Their disadvantages are that the computer connections are sensitive to the quality of the telephone lines and they present security risks. Another consideration is that professionals may have difficulty accessing them when there is a phenomena occurring that has wide popular appeal, such as an eclipse.

9. V. K. Abalakin, *Minor Planet Data* At ITA, pc's and main frames are now available. In addition to ephemerides and integration software for distribution, about 30,000 observations of stellar occultations by minor planets are available with an rms error of about $\pm 0''.5$. These observations may be used for detecting systematic errors in catalogs as well as determining planetary masses, predicting future occultations, and helping to connect the optical – radio reference frames. The new software for ephemeris production is called STAMP and for data base management, CERES.

10. J. E. Arlot, *Satellite Ephemerides* Expressions using Chebyshev polynomials or mixed functions (secular and periodic terms) are used for satellite ephemerides. Mixed functions are used primarily for telescope guiding. Differential positons typically require 16 to 20 coefficients for sufficient accuracy. A permanent effort in observing is needed to provide consistent ephemerides.

11. D. Pascu, *Stellar Data – Calibration Sources* For the past decade the redesigned *Astronomical Almanac* has carried a considerably expanded list of stars and other astrophysical data. The motivation for this effort was to make the Almanac useful to a wider group of scientists as well as to aid the IAU in the standardization of data. Lists of calibrational objects and finding lists for the most commonly observed objects comprise the contents of Section H of the Almanac. A system of experts from the international astronomical community is used to provide data and technical information.

12. E. M. Standish, *Principal Planets and Moon* The quality of an ephemeris depends on the numerical integration algorithm, the equations of motion, the initial conditions and the values of the constants. At the present time, numerical integration methods and the equations of motion are equal to the level of accuracy of the observations. The quality, then,

https://doi.org/10.1017/S0251107X00005496 Published online by Cambridge University Press

depends on establishing accurate values of the initial conditions and constants. There is a need to archive data and to keep track of versions of software used in data reductions. The ability to trace the values of constants used in older solutions and to access the original data is a valuable asset.

13. B. D. Yallop, *Astronomical Phenomena* Many phenomena, such as the time of conjunctions or of maximum elongations, can be calculated as the root of an equation of the type $f(t) = 0$ or $f'(t) = 0$. Ambiguities in definitions or in the connection of a definition to a particular coordinate system may lead to inconsistencies in predicting phenomena. This suggests a need to make definitions independent of the choice of the coordinate system and to adopt definitions with simpler algorithms.

Business Meeting, Session 4, July 27: After much discussion, the resolution on Earth-crossing asteroids was approved for submission to the General Assembly. It was also approved by Commissions 7, 9, 15, 16, 20, 21, and 22.

IAU/IAG/COSPAR Working Group on Cartographic Coordinates and Rotational Elements of Planets and Satellites, Session 5, July 26: The report of the working group was given by M. E. Davies, with special attention given to the data that have been revised since the last report. The session was held jointly with Commission 16. The report was approved.

Ephemerides Research, Scientific Sessions 6 and 7, July 26: These sessions were held jointly with Commission 7. The following papers were contributed:

J. Laskar	*Long-Term Planetary Motions*
E. M. Standish	*Ephemerides Accuracy Limitations*
C. A. Veillet	*Present and Future Observational Accuracies*
V. A. Brumberg	*Relativistic Effects - 2nd Order*
J. L. Hilton	*Force Model Improvements*
E. M. Standish	*Ephemerides Solution Parameters*
A. Deprit	*Preparing a Problem for Mathematica*

Working Group on Reference Frames, Sessions 8 and 9, July 29: A joint discussion was held with Commissions 7, 8, 19, 20, 24, 31, 33, 40 to discuss the report of this working group. Nine resolutions were accepted, with only minor changes to the versions printed in the IAU Final Program, for presentation to the General Assembly for adoption.

https://doi.org/10.1017/S0251107X00005496 Published online by Cambridge University Press