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REPORTS ON ASTRONOMY

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TRANSACTIONS
OF THE
INTERNATIONAL ASTRONOMICAL UNION
VOLUME XXA

REPORTS
ON
ASTRONOMY

Edited by

JEAN-PIERRE SWINGS

General Secretary of the Union

KLUWER ACADEMIC PUBLISHERS

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Foreword

A few months ago, I wrote to the 41 Presidents of the International Astronomical Union Commissions, requesting them to start preparing their contribution to these "Reports on Astronomy" which represent volume XXA of the Transactions. I specifically asked them to try to highlight the astronomical research relevant to their Commission, that took place between 1984 and 1987. During this exciting period we witnessed a few fascinating astronomical objects that appeared in the sky, such as Halley's comet, the supernova in the LMC SN 1987 A, new gravitational lenses, etc., so that these reports also contain preliminary results.

The topics of IAU Commissions deal with all of contemporary astronomy and astrophysics, so that the reports presented here should be most useful for those wishing to gain an overview of a certain field, not necessarily near their own research area. In some cases, extensive bibliographical data are provided as well. It is intended to make some publicity about the "Reports on Astronomy" so as to attempt to distribute them more widely.

Each Commission President was requested, by late 1986, to begin preparations for the compilation of his/her Commission report. Commission members were asked to supply details about their individual research programmes. The ensuing very substantial task of editing large amounts of valuable material was undertaken by the Presidents, often supported by a team of authors, all recognized authorities in their fields. In order to preserve some measure of uniformity -which is in any case very difficult with so many authors- editorial guidelines were sent to the Presidents, including the number of pages allotted to each Commission.

I am most thankful to all involved, Presidents and Members of Commissions, for having put so much work into the preparation of these reports and for having complied so well with the guidelines. It is due to their great efforts that it is possible to make this volume available well before the XXth General Assembly : it will serve as a valuable basis for the Commission meetings there as well.

I look forward to receiving your comments on these Transactions so as to improve them in the future, and I hope to meet you on the occasion of the XXth General Assembly in Baltimore, next August 2-11.

Jean-Pierre Swings
General Secretary, IAU
November 1987.

CONTENTS

REPORTS OF COMMISSIONS

Foreword		v
4 Ephemerides	Ephémérides	1
5 Documentation & astronomical data	Documentation & données astronomiques	7
6 Astronomical telegrams	Télégrammes astronomiques	13
7 Celestial mechanics	Mécanique céleste	15
8 Positional astronomy	Astronomie de position	29
9 Instruments & techniques	Instruments & techniques	41
10 Solar activity	Activité solaire	55
12 Radiation & structure of the solar atmosphere	Radiation & structure de l'atmosphère solaire	91
14 Atomic & molecular data	Données atomiques & moléculaires	111
15 Physical study of comets, minor planets & meteorites	L'Etude physique des comètes, des petites planètes & des météorites	143
16 Physical study of planets & satellites	Etude physique des planètes & satellites	167
19 Rotation of the earth	Rotation de la terre	179
20 Positions & motions of minor planets, comets & satellites	Positions & mouvements des petites planètes, des comètes & des satellites	195
21 Light of the night sky	Lumière du ciel nocturne	211
22 Meteors & interplanetary dust	Météores & poussière interplanétaire	219
24 Photographic astrometry	Astrométrie photographique	237
25 Stellar photometry & polarimetry	Photométrie & polarimétrie stellaires	243
26 Double & multiple stars	Etoiles doubles & multiples	253
27 Variable stars	Etoiles variables	257
28 Galaxies	Galaxies	293
29 Stellar spectra	Spectres stellaires	333
30 Radial velocities	Vitesses radiales	355

31	Time	L'heure	363
33	Structure & dynamics of the galactic system	Structure & dynamique du système galactique	377
34	Interstellar matter	Matière interstellaire	423
35	Stellar constitution	Constitution des étoiles	473
36	Theory of stellar atmospheres	Théorie des atmosphères stellaires	493
37	Star clusters & associations	Amas stellaires & associations	509
38	Exchange of astronomers	Echange des astronomes	537
40	Radio astronomy	Radio astronomie	539
41	History of astronomy	Histoire de l'astronomie	567
42	Close binary stars	Etoiles binaires serrées	569
44	Astronomy from space	L'astronomie à partir de l'espace	595
45	Stellar classification	Classification stellaire	631
46	Teaching of astronomy	Enseignement de l'astronomie	649
47	Cosmology	Cosmologie	653
48	High energy astrophysics	Astrophysique des hautes l'énergies	671
49	The Interplanetary plasma & heliosphere	Plasma interplanétaire & héliosphère	677
50	Identification & protection of existing & potential observatory sites	Protection des sites d'observatoires existants & potentiels	691
51	Search for extraterrestrial life	Recherche de la vie dans l'univers	693
	Working group for planetary system Nomenclature	Groupe de travail sur la nomenclature du système planétaire	703

4. EPHEMERIDES (EPHEMERIDES)

PRESIDENT : B. Morando

VICE-PRESIDENT : P. K. Seidelmann

ORGANIZING COMMITTEE : V. K. Abalakin, S. Aoki, J. Chapront, R. L. Duncombe, T. Lederle, J. H. Lieske, B. D. Yallop, A. Yamazaki.

I. Introduction

This report covers the period from 1 July 1984 to 30 June 1987. The ephemerides that have been published during this period have made use of the new system of astronomical constants adopted at the XVth General Assembly of the IAU in Grenoble. Yet some difficulties have arisen because of the lack of catalogues or maps of the heavens established for the epoch J2000.0. This is awkward for observers of comets and minor planets and, for that reason, Commission 20 decided, at the New Delhi meeting of IAU that there would be a gradual introduction of the J2000.0 system as far as those bodies are concerned.

The first issue of an IAU Commission 4 Circular has been sent to all the members of the Commission in May 1987. The aim of it is to exchange information in between general assemblies and generally to establish a link between the members of the commission. It is hoped that these members will contribute to the next issues of this circular.

II. International and National Ephemerides

1. THE FUNDAMENTAL SYSTEM

Starting with the volume for the year 1988 the Apparent Places of Fundamental Stars (APFS) are based on the mean positions and proper motions which will be published in the Fifth Fundamental Catalogue (FK5). The basic part of this catalogue, containing the classical 1535 fundamental stars, will become available for general use with its publication which is scheduled for the end of 1987. Further details concerning the status of the work on the FK5 are given in the report of commission 8 in this volume.

In order to provide the users of the already published Apparent Places of Fundamental Stars volumes for 1984 through 1987 with positions on the basis of the FK5, corrections FK5-FK4 to the FK4 stars are given in an appendix to the volume of the Apparent Places of Fundamental Stars for the year 1988. The corrections are the result of the systematic and individual improvement of the FK4, computed for the epoch and the equinox of the beginning of the years 1984 to 1988.

2. PRINTED EPHEMERIDES

H.M. Nautical Almanac Office, Royal Greenwich Observatory, Herstmonceux Castle, United Kingdom and the Nautical Almanac Office, U. S. Naval Observatory, Washington, D.C., USA have continued to cooperate in the production and publication of the unified almanacs, namely, the Astronomical Almanac, the Nautical Almanac, the Air Almanac and the Astronomical Phenomena. Beginning with 1987, the Air Almanac was published as a single issue for a full year. Sight Reduction Tables for Air Navigation, vol. 1, epoch 1990 have also been published. The

data, either composed or in machine readable form, have been supplied upon request for other countries. The Nautical Almanac Office of the U.S. Naval Observatory has continued to publish annually the Almanac for Computers containing the polynomial coefficients for computing the positions of the Sun, Moon and planets to the accuracy desired for anytime during the year. H. M. Stationery Office have published The Star Almanac for Land Surveyors for 1986, 1987 and 1988.

Bureau des Longitudes, Paris France, have published yearly the *Connaissance des Temps*, the *Ephémérides astronomiques-Annuaire du Bureau des Longitudes* and the *Ephémérides Nautiques*. The *Ephémérides astronomiques-Annuaire du Bureau des Longitudes* contain, starting from 1986, ephemerides of the minor planets whose magnitude is smaller than 10, at opposition during the year and, also, starting from 1987, ephemerides of periodic comets going through perihelion during the year. Bureau des Longitudes published also three Supplement to *Connaissance des Temps* : *Ephémérides des satellites de Jupiter, Saturne et Uranus* (Editions de Physique) that give the differential coordinates of the satellites and tables for the computation of the mutual phenomena of the Galilean satellites of Jupiter - *Phénomènes et Configuration des Satellites Galiléens de Jupiter*, since 1980 - *Configuration des Huit Premiers Satellites de Saturne*, since 1985. Bureau des Longitudes have also produced the following ephemerides, published in the *Notes Scientifiques et Techniques du Bureau des Longitudes* (designated by S followed by a number) : *Ephéméride de la comète de Halley pour 1985-1986-Courbes de visibilité* (S006), *Observation de la comète de Halley en 1985-1986* (S007), *Excentricités et inclinaisons moyennes des orbites des satellites galiléens de Jupiter* (S009), *Ephémérides des petites planètes de 1986 à 1988* (S010, S011, S016), *Détermination d'orbites de comètes pour 1986 et 1988* (S014, S017, S019).

The Institute for Theoretical Astronomy, Leningrad, USSR, have published The Astronomical Yearbook and the Ephemerides of Minor Planets.

The Japanese Ephemeris, the Nautical Almanac and the Abridged Nautical Almanac have continued to be published for the years 1986, 1987 and 1988 by the Hydrographic Department of Japan, Tokyo. All the volumes are compiled in accordance with the recommendations of IAU. No serious changes in the contents have been made after the volume for 1985 in which was introduced a new scheme of computation based on the fundamental reference frame of FKS, numerical integration for the coordinates of the bodies in the solar system, day numbers in rectangular coordinates etc. The Japanese Ephemeris from 1985 onwards contains the explanation of the method on which the new ephemerides are based. The Japanese Ephemeris for 1988 contains a new table "The orbital longitude and latitude of the Moon reduced from the lunar occultation observations" which replaces the former "Reduction from Ephemeris Time to Universal Time". The *Polaris Almanac for Azimuth Determination*, the *Altitude and Azimuth Observation Almanac for Antarctic Observation* and the *Abstract from the Japanese Ephemeris* have also been published yearly by the Hydrographic Department of Japan.

The Indian Astronomical Ephemeris, Tables of Sunrise, Sunset, Moonrise, Moonset and *Rashtriya Panchang*, in thirteen languages giving details on the Indian calendar and festival dates have been published by the Positional Astronomy Center, Calcutta, India.

3 EPHEMERIDES ON FLOPPY DISKS

For 1986 the Floppy Almanac was introduced by the Nautical Almanac Office, U. S. Naval Observatory. This is a disk that can be run on IBM compatible PCs and provides in an user friendly mode capability for computing in various coordinate systems the positions of the Sun, Moon, planets and stars. Topocentric phenomena and positions can be computed. The program is also available for Microvax Computers on RX 50 diskettes, or for VM CMS systems for the IBM 370, 4300, 3000 computers. A user's guide is available to accompany the software. The Floppy Almanac can be used to compute the data for other almanacs. Using projected values of ΔT , issues of the Floppy Almanac are available through the year 2000.

Bureau des Longitudes have issued the following softwares on floppy disks : Programme de Concordance des Calendriers et Fêtes Religieuses, Ephémérides de redécouverte des Comètes, Ephémérides des Satellites de Jupiter, Saturne et Uranus (for IBM compatible PCs).

4. BASIS OF THE EPHEMERIDES

The Jet Propulsion Laboratory (JPL) Ephemerides continue to be improved as newer and more accurate observational data become available. The ephemerides are now fitted to over 80 000 observations- meridian transits, astrolabes, photometry, radar, S/C tracking and ranging, ring and disk occultation timings and radio measurements of thermal emissions. Comparisons of the various datatypes have led to increased understanding of the systematic errors present in some of the earlier optical data types. As such, present ephemerides, for the outer planets in particular, are significantly improved over those of DE200.

Reference frame studies have included the establishment of the JPL Radio Frame and the Dynamical Reference Frame of the Lunar/Planetary Ephemerides, determination of ties between the various reference systems and development of the concept of the dynamical equinox as a reference point for the modern ephemerides and the connection of other coordinate systems to this reference point. Ties between VLBI and optical frames have been established via the observations of radio stars by JPL in collaboration with French astronomers. A link has been determined between the VLBI and the Ephemeris frame through the use of differential VLBI. Very Large Array measurements of Jupiter, Saturn, Uranus and Neptune provide both a tie between the outer planet ephemerides and the radio frame and a means of improving the ephemerides themselves.

5. LONG-TERM EPHEMERIDES

Bureau des Longitudes have published, on floppy disks for Macintosh microcomputers *Solution Approchée* (ELP 2000-85) du mouvement de la Lune valable sur plusieurs milliers d'années. P. Bretagnon and J.-L. Simon, from Bureau des Longitudes have published *Planetary Programs and Tables from -4000 to +2800* (Willmann-Bell, Inc) that provide time-dependent expansions of the longitude and radius vector of the Sun and the heliocentric coordinates of the planets. Bureau des Longitudes have also published *Tables des Positions du Soleil, des Planètes et de la Lune entre 1950 et 2020* (Note scientifique et technique du Bureau des Longitudes n°S012).

The following U. S. Naval Observatory Circulars have been prepared : N° 169, Phases of the Moon 2000-2049, n°170, Solar Eclipses 1991-2000.

B. D. Yallop and C. Y. Hohenkerk, of the Royal Greenwich Observatory have published, in 1985, *Compact Data for Navigation and Astronomy for the years 1986 to 1990*.

J. Laskar and R. A. Jacobson have published *An Analytical Ephemeris of the Uranian Satellites*, fitted on earth-based and Voyager data (*Astron. Astrophys.* in press).

III. Theoretical work related to the ephemerides

B. Guinot, of the Bureau International des Poids et Mesures and P. K. Seidelmann of the U.S. Naval Observatory have circulated a reprint of a paper titled "Timescales, their history, definition and interpretation". This paper was prepared to help achieve the agreement required of the working Group on reference frames established by the IAU in 1985.

J. Laskar (Bureau des Longitudes) has obtained a new solution for the motion of the pole of the ecliptic using his own general planetary theory, the VSOP82 theory by P. Bretagnon and the theory of the rotation of a rigid earth established in 1977 by Kinoshita. He obtains new formulae for the precession valid for 10 000 years

(Secular terms of classical planetary theories using the results of general theory- *Astron. Astrophys.*, 1986, 157, 59).

M. Chapront-Touzé and J. Chapront have computed the secular variations of the fundamental arguments of the lunar theory to the fourth power of the time (ELP2000-85: A semi-analytical lunar ephemeris adequate for historical times. *Astron. Astrophys.* in press).

A test for the continuity requirement at the 1984 changeover has been performed. Simultaneously the connection between the radio system and optical system has been discussed by Aoki et al. (*astrometric Techniques*, 123-131). Th. Hirayama, H. Kinoshita, M.-K. Fujimoto and T. Fukushima have found an analytical expression of TDB-TDT with an accuracy at the 5ns level (in press in the proceedings of the IAG symposium 1987).

Gutzwiller and Schmidt have published in the *Astronomical Papers prepared for the use of the American Ephemeris and Nautical Almanac* vol. XXIII, Part I, a paper on "The motion of the Moon as computed by the method of Hill, Brown and Eckert".

The following papers have been issued as Technical Notes of H. M. Nautical Office: n° 57 B. D. Yallop, 1986. Ground Illumination; n° 62 B. D. Yallop and C. Y. Hohenkerk; 1985. Coefficients for calculating the Greenwich Hour Angle and Declination of stars; n° 63 C. Y. Hohenkerk and A. T. Sinclair, 1985. The computation of angular atmospheric refraction at large zenith angles; n° 64 B. D. Yallop, 1986. Algorithms for calculating the dates of Easter; n° 65 C. Y. Hohenkerk, 1986. Determination of polynomial coefficients from B-spline coefficients. Astronomical and calendarial data up to 1992 were published in the Royal Greenwich Observatory Astronomical Information Sheets, as were also the following notes: n° 48 B. D. Yallop and C. Y. Hohenkerk, 1985. Closest approach of Polaris to the North Celestial Pole in AD 2100; n° 50 B. D. Yallop, 1987. Earliest sighting of the New Moon in 1987.

A. S. Sochilina, of the Institute for Theoretical Astronomy in Leningrad, USSR, has published a paper On the Choice of Reference Frame in Investigations of High Satellites Motions in *Bull. Inst. Astr. Leningr.* 15, n° 9 (172), 481-485, 1986.

M. Ilyas (Malaysia) has studied how to unify the various lunar calendars and how to predict the earliest visibility of the lunar crescent in the context of Islamic calendar (*J. Roy. Astron. Soc. Can.* 80, 1986, 134-141, 328-335).

IV. Observations in view of improving the ephemerides

D. Pascu has made photographic observations of the Martian moons, of Jupiter and the Saturnian satellites I-VIII with the 26-inch refractor of the U.S. Naval Observatory in Washington. D. Pascu and P. K. Seidelmann have continued to make observations of Jupiter XIV, Saturn XII, XIII and XIV, Uranus I-V and Neptune I and II with the Mark 4 CCD Camera of the Space Telescope Widefield Planetary Camera Team on the 61-inch telescope at Flagstaff, Arizona. K. J. Johnson, of the Naval Research Laboratory, C. M. Wade of National Radio Astronomy Observatory and G. H. Kaplan, T. S. Carroll and P. K. Seidelmann of the U. S. Naval Observatory have made observations of minor planets 1, 2, 4 and 10 with the Very Large Array in Socorro, New Mexico.

The last three years have seen improvement in Lunar Laser Ranging data quality and the development of Lunar Laser Ranging Network. Recent equipment and software improvements at the stations have resulted in approximately 5cm ranges (the data prior to 1984 had ranges over 10cm accuracy); data are currently being acquired from three stations: CERGA site (France), Manui (Hawaii-USA) and McDonald (Texas-USA). An analysis of the seventeen-year Lunar Laser Ranging data set yields a value for the GM of the Earth of $398\,600.437 \pm 0.006 \text{ km}^3/\text{s}^2$ in the solar system barycentric frame and $398\,600.443 \pm 0.006 \text{ km}^3/\text{s}^2$ in the geocentric system, comparable to Lageos (the Lunar Laser Ranging result agrees with the Lageos result within one standard

deviation of the error estimate). The IAU adopted values of the 18.6-year nutation and the precession have been checked against the Lunar Laser Ranging data. The increased accuracy of Lunar Laser Ranging should result in an improved lunar ephemeris. Many papers related to Lunar Laser Ranging or on reference frames, by G. L. Berge, J. O. Dickey, P. B. Esposito, J. L. Fanelow, J. F. Lestrade, R. P. Linfield, W. G. Melbourne, D. O. Muhleman, X. X. Newhall, A. E. Niell R. A. Preston, M. Rapaport, Y. Requième, D. J. Rudy, E. M. Standish, J. G. Williams will be found in the following publications : *Proceedings of the IAU Symposium n°128, The Earth's Rotation and Reference Frames for Geodesy and Geodynamics*, editors G. Wilkins and A. Babcock, D. Reidel, Boston, 1987, in press. The book *Reference Frames*, editors, B. Kolaczek, J. Kovalevsky, I. Mueller, D. Reidel, 1987, in press. The *Proceedings of the IUGG Symposium, Relativistic Effects in Geodesy XIX General Assembly*, Vancouver, 1987. Report on the *MERIT-COTES Campaign on Earth's Rotation and Reference System, Part I : Proceedings of the third MERIT workshop and the Joint MERIT-COTES Working Group Meetings*, editor G. Wilkins, Royal Greenwich Observatory, 1987, in press. Report on the *MERIT-COTES Campaign on Earth Rotation and Reference Systems, Part II : Proceedings of the International Conference on Earth Rotation and the Terrestrial Reference Frame*, editor I. Mueller, Ohio State University, vol. 2, 1985. *Proceedings of the IAU Symposium n°109 : Astrometric Techniques* (Gainesville, Florida, 1984), editors H. K. Eichhorn and R. J. Leacock, Reidel, Dordrecht-Holland, 1986. *Bulletin of the American Astronomical Society*, 1986. *Proceedings of the Joint discussion on Reference Frames at th XIX General Assembly of the IAU, Highlights of Astronomy*, vol. 7 editor J. P. Swings, Reidel, Dordrecht-Holland, 1986. *Proceedings of the IAU colloquium n°114 : Relativity in Celestial Mechanics and Astrometry*, Reidel, Boston, 1985. Special LAGEOS issue of the *Journal of Geophysical Research*, vol. 90, 1985. *Proceedings of the international symposium : Figure and Dynamics of the Earth, Moon and Planets*, special issue of the *Monograph Series of the Research Institute of Geodesy, Topography and Cartography*, editor P. Holota, in press, 1987. *Celestial Mechanics*, 37, 329-337, 1985. *Transactions of the American Geophysical Union*, EOS, 67, 16, 259, 1986. *Proceedings of the Fifth International Workshop on Laser Ranging Instrumentation*, editor J. Gaignebet, vol. 1, 19-28, 1985.

The services of the International Lunar Occultation Centre, in Japan, have been continued since 1981. The number of the timing data collected at the centre was 31 370 from 35 countries during the years 1984 to 1986. Reports containing all the reduced data as well as the station coordinates related are published annually.

A campaign for the observations of the mutual phenomena of the Galilean satellites of Jupiter in 1985 has been organized under the auspices of Bureau des Longitudes. Many good observations were made in France, Italy, Spain, Brazil and at the ESO observatory in Chile. Preliminary results will be found in the proceedings of a colloquium held at Bagnères-de Bigorre (*Annales de Physique*, vol. 12, 1987).

V. Working Groups having to do with ephemerides

The IAU/IAG/COSPAR Working Group on Cartographic Coordinates and Rotational Elements of the Planets and Satellites has continued to gather informations and will present an updated set of data in the report which will be presented at the Baltimore General Assembly of the IAU. The main changes will affect the radii of Jupiter, Saturn, Uranus, Neptune, Io, Mimas and the Uranian satellites.

A Working Group on astronomical constants has been formed following Resolution C1 of the IAU by the presidents of IAU Commissions 4, 7, 8, 19 and 31. The purpose is to review the current determinations of the astronomical and geodetic constants, provide best estimates, accuracies and sources. The Working Group is composed as follows : B. Morando, president, V. K. Abalakin, W. E. Carter, J. Chapront, B. Chovitz, H. Kinoshita, J. Lieske, J. Schubart, P. K. Seidelmann, E. M. Standish, J. M. Wahr, G. Wilkins, Ya. S. Yatskiv. The working group will send a preliminary report to the General Secretary of the IAU before the end of 1987.

Following Resolution C2 of the IAU a Working Group on Reference Systems has been formed by the presidents of IAU Commissions 4,7,8 19, 20, 24, 31, 33 and 40. The president of the working group is James A. Hughes. This working group and the working group on astronomical constants met together in Paris in June 1987.

B. MORANDO

President of the Commission.

COMMISSION 5: DOCUMENTATION AND ASTRONOMICAL DATA
DOCUMENTATION ET DONNEES ASTRONOMIQUES

PRESIDENT: G. A. Wilkins
VICE-PRESIDENT: B. Hauck
ORGANISING COMMITTEE: O. B. Dluzhnevskaya, W. D. Heintz, C. O. Jaschek,
P. Lantos, S. Mitton, F. Spite, P. A. Wayman,
G. Westerhout, C. E. Worley

REPORT BY THE PRESIDENT FOR THE PERIOD 1985 DECEMBER 1 TO 1987 OCTOBER 30

The aims of this report are, firstly, to review the activities of Commission 5 during the period since the IAU General Assembly in Delhi in November 1985 and, secondly, to draw attention to other relevant activities. It is based mainly on contributions from the Chairmen of the working groups and other members of the Commission, but it also includes some items of general interest that have been taken from the Commission's Newsletter. The Working Groups and their Chairmen are as follows:

Astronomical Data	G. Westerhout
Designations	C. O. Jaschek
Classification	P. Lantos
Abstracting Guidelines	L. D. Schmadel

The Newsletter, which was issued in March 1986 and July 1987, was primarily intended to provide a means of communication between the members and consultants of the Commission. It was hoped, however, that other astronomers would find items of interest in it and so it was reproduced in the information bulletin of the astronomical data centre at Strasbourg. Requests to be included in the distribution were received from librarians and others not previously associated with Commission 5. The frequency of issue will be increased if more items of information or comment are sent to the Editor.

The announcement of a Workshop on "Library and Information Services in Astronomy" to be held in Washington, D.C., just prior to the 1988 General Assembly attracted much interest and the IAU Executive Committee agreed that it shall be IAU Colloquium No. 110. A complementary Joint Discussion on "Documentation, Data Services and Astronomy" will be held early in the Assembly to bring together the users and providers of information services in considering the problems and opportunities presented by the availability of new techniques.

ASTRONOMICAL DATA

Much information about activities in data compilation and data handling is published bi-annually in the Bulletin d'Information du Centre de Données Stellaires (CDS) in Strasbourg, France. Issue No. 31 contains the papers presented at meetings organized by the CDS on "Archiving Astronomical Observations" and on "Astronomical Data Networks". The proceedings of the Tblisi Colloquium on "Stellar Catalogs: Data Compilation, Analysis, Scientific Results" were published in Bulletin 59, Abastumani Astrophysical Observatory, Tblisi, 1985. A large symposium (over 110 participants) organized by the ESA/ESO Space Telescope European Coordinating Facility, was held in Garching, FRG, on 12-14 October 1987 on "Astronomy from Large Data Bases: Scientific Objectives and Methodological Approaches." The Working Group on Astronomical Data held an ad hoc meeting during this symposium.

The IAU Executive Committee has requested that the Commission give particular attention to the problems of data archiving and refreshing, and so this topic will be discussed during the ordinary meetings of the Commission at Baltimore as well as at Colloquium No. 110 and at the Joint Discussion.

CODATA activities

The 10th International CODATA Conference which was held in July 1986 in Ottawa, Canada, on the topic of "Computer Handling and Dissemination of Data", was attended by only four astronomers even though it is an excellent forum for interdisciplinary scientific exchange. It was attended by 270 people and among other things contained excellent discussions on data dissemination (CD-ROMS, etc) and expert systems. CODATA Bulletin No. 64 contains selected papers. Bulletin No. 63 contains the "Adjustment of the Fundamental Physical Constants". The 11th CODATA Conference will be held in Karlsruhe, FRG, 26-29 September 1988, with the theme "Scientific and Technical Data in a New Era". Among the topics to be covered is "Geo- and space sciences", with three invited papers on astronomical data. The IAU representative on CODATA is G. Westerhout.

Centre de Données Stellaires: Strasbourg

The most important development concerning the SIMBAD database of the Stellar Data Centre (CDS) at the University of Strasbourg is its enhanced accessibility through networks. In October 1987 it can be accessed from 122 astronomical institutes in 21 countries, and the number of users keeps growing rapidly. The transfer of data to users has been improved, so that samples may be easily copied for further treatment. Projects are underway to incorporate the whole Durchmusterungen into SIMBAD, as well as the IRAS Point Source Catalogue and the brightest stars of the Guide Star Catalogue. Finally, the number of catalogues available has also increased through exchange with other data centres, and is now of the order of 500.

Directories of astronomical associations, societies and professional institutions have been issued as special publications by CDS (Heck and Manfroid, 1985 and 1986); new editions are in preparation. A new survey of astronomical data sources has been made by Jaschek (1987).

Astronomical Data Center: NASA/GSFC

During this period the Astronomical Data Center (ADC) at the Goddard Space Flight Center completed 1460 requests for data and/or information, with 1465 machine-readable catalogues disseminated. The archive of astronomical data now contains more than 500 catalogues. A machine-readable version of the Bonner Durchmusterung (zones +89 to -23) was completed through an international collaborative effort, while a new catalogue of WDS-DM-HD-ADS cross identifications was prepared. The Infrared Source Cross Index (Schmitz et. al., 1987) and a second edition of the Catalog of Infrared Observations (CIO; Gezari et. al., 1987) were prepared and published; the latter now contains all IRAS data for sources in the CIO database. An updated version of the Bibliographical Index of Objects Observed by IUE (Mead et. al., 1987) was completed and the first and second versions of the machine-readable Data Inventory of Space-based Celestial Observations (DISCO; Brozman et. al., 1987) were prepared. An electronic network distribution service for data was begun using BITNET and the Space Physics Analysis Network (SPAN). An ADC Online Information System was also developed and implemented to provide a search capability by keywords and an interactive ordering service.

Central Institute of Astrophysics: Potsdam

The cooperation between the CDS at Strasbourg and the Central Institute for Astrophysics (CIAP) at Potsdam was continued, and CIAP now holds 364 catalogues that have been obtained from the CDS in order to make them available to scientists of the GDR and other socialist countries. The Bibliographical Catalogue of Variable Stars was extended so that it now contains nearly 323000 records for about 30000 stars. A bibliographical catalogue of suspected variable stars is in preparation. New data on variable stars and equivalent widths (Friedemann, 1987) were sent to the CDS. Three thematical databases (STAR, containing basic information on stars; CAL, on non-stellar objects; and TPK, the Tautenburg plate catalogue) were developed on the basis of the Swedish database system MIMER and are now available on-line.

FITS Task Force

The FITS Task Force was created by the Working Group on Astronomical Data during the IAU General Assembly in 1982 when the FITS tape format was recommended for the interchange of image data between observatories. The two main functions of the Task Force are: (1) to channel comments and suggestions on the usage of FITS for the interchange of data, and (2) to investigate the extension of FITS for use in the exchange of catalogues. The FITS Task Force consists at present of: P. Grosbol (ESO, Chairman), F. Ochsenbein (ESO), W. H. Warren, (NASA), and D. Wells (NRAO).

A European FITS Committee was created with members from major institutes in most European countries to act as a local forum for discussions of FITS matters. After extensive tests, a proposal for a Generalized Extension of FITS including a Table Extension was finalized and presented to the AAS-WGAS FITS Group and to the European FITS Committee; both groups accepted the proposal. The final text of the proposal was accepted for publication in *Astronomy and Astrophysics Supplement Series*. The Task Force also made a proposal for the physical blocking of FITS data files to improve efficiency, while maintaining the logical blocksize of 2880 bytes; it allows a blocking factor of 1 to 10 on nine-track magnetic tapes. This proposal was also accepted, and both came into use from 1 January 1987.

An electronic mailbox for FITS was set up at NRAO by D Wells. It is accessible from all major computer networks and will distribute mail messages to all major institutes using FITS. It enables a faster and more general discussion of the FITS standard in the community.

DESIGNATIONS

The general resolution (C3) on astronomical designations that was adopted by the Commission at Delhi was published in *IAU Information Bulletin* No. 55 (February 1986, pp. 19-21), as were the resolutions of Commission 28 on the designation of supernovae (C10, pp. 22-23) and Commission 40 on radio-source nomenclature (C12, pp. 23-24); they were also published in the *Transactions of the IAU* (19B, 40-44, 48, 49-51, 1986). It is too early to assess their influence on authors and editors, but the "clearing house" of Dickel, Jaschek, Lortet, Mead and Warren has operated successfully in several cases. The Working Group on Nomenclature of Commission 34 (Interstellar Matter) has subsequently published its recommendations (Dickel et. al., 1987). Further valuable dictionaries of designations have been published by Lortet (1986a, b) and Lortet and Spite (1986).

The astronomical community at large is only gradually becoming aware of the importance of the use of proper practices for the designation of astronomical objects, but the rapidly growing use of data centres may help to enforce them. The attention of authors, editors and referees will also be drawn to them in the new IAU Style Book.

CLASSIFICATION AND KEYWORDS

There has been no progress of note in the revision of the Universal Decimal Classification for Astronomy (UDC 52). A revised draft list of keywords has been prepared by P. Lantos. The preparation of a thesaurus is now in hand by a group led by R. M. Shobbrook (Librarian of the Anglo-Australian Observatory). Questionnaires were distributed to 96 librarians to seek assistance and information about current lists of subject headings. It is hoped that a draft listing will be available for comment during IAU Colloquium No. 110.

The American Institute of Physics has published (AIP, 1987) a physics and astronomy classification scheme for use in its publications; it is based on the 1977 ICSU/AB system, which is now under revision by the Physics Working Group of ICSTI (see below).

ABSTRACTING

The Astronomisches Rechen-Institut (ARI) at Heidelberg, which produces Astronomy and Astrophysics Abstracts (AAA), will cooperate with the Fachinformationszentrum (FIZ) at Karlsruhe in the fields of astronomy and astrophysics; FIZ is responsible for abstracting and other information services for physics and many other areas. FIZ has cancelled its "Monthly Service" of astronomical abstracts and ARI will not distribute the AAA abstracts on magnetic tape, but instead these abstracts will be included in the FIZ database "Physics Briefs" and so will be accessible on-line prior to publication in AAA.

The second report on "Guidelines for Abstracts" (Schmadel, 1985) is being used in the preparation of the new IAU Style Book (see below), while the appended list of keywords serves as a basis for the production of the IAU thesaurus (see above). The increasing use of on-line searching of abstracts makes it all the more important that all authors use unambiguous designations for the astronomical objects referred to in astronomical papers and catalogues. Studies are being made to ensure that the systems used by AAA, FIZ and CDS (Strasbourg) are compatible with each other and consistent with the IAU recommendations. Already a high degree of correspondence has been demonstrated.

IAU STYLE BOOK

A first draft of the new IAU Style Book was distributed for comment on April 1986 to about 30 persons who were believed to have an active interest in its recommendations; some of the copies were circulated to other astronomers and editorial staff. The large number of comments that were returned represented the views of a good cross-section of those concerned in the preparation, publication and use of the astronomical literature. The draft, which had the subtitle "A Manual for use on the Preparation of Astronomical Reports and Papers" was intended primarily for use in the preparation of typewritten camera-ready copy for IAU publications, especially for the Transactions and the proceedings of symposia and colloquia. The General Secretary of the IAU suggested that an attempt should be made to seek the agreement of the editors of the principal astronomical journals in order to reduce as far as practicable the differences between the requirements of these publications. This increased the difficulty of the task by an order of magnitude and made it impossible to issue the manual in 1986 as had been intended. It has also become clear that the

manual must contain recommendations for use with desk-top systems capable of producing copy of type-set quality. It is hoped that a second draft will be discussed at a meeting of editors early in 1988 and that an agreed version will be available at the General Assembly.

ICSTI

The Officers of the IAU have decided that the IAU should, for the time being, no longer participate in the activities of the International Council for Scientific and Technical Information (ICSTI) with effect from 1 January 1988. ICSTI was established in June 1984 as the successor to the Abstracting Board of the International Council of Scientific Unions (ICSU AB). Its activities are of general interest to astronomy and include the revision of the international classification system for physics and the preparation of a directory of numerical databases, but at present the value to the IAU of membership does not match the costs for dues and attendance at the annual meeting. Astronomy and Astrophysics Abstracts is a member of ICSTI.

UNION LISTS AND OTHER PUBLICATIONS

A compilation of the serial holdings of 14 astronomy collections in the USA was prepared by J. A. Lola (Yerkes Observatory) and a list for the United Kingdom was prepared by A. R. Macdonald (Royal Observatory, Edinburgh). The guide to information services in astronomy by Rey (1983) is under revision. Various lists of observatories were published by Howse (1986) and Vercoutter (1986). An English-Chinese Dictionary of Astronomy containing 16000 terms and seven lists of specialised terms was published in China in 1986, and the multilingual dictionary that is being prepared by J. Kleczek is in press.

OTHER MATTERS

The problems caused by the increases in the costs of journals and books have been exacerbated for many libraries by reductions in budgets and by the extra costs of providing new on-line services. As a consequence, subscriptions to many journals, particularly the less heavily used smaller journals, including translations from other languages into English, are liable to be cancelled, and hence the viability of such journals is in doubt. The Commission may wish to consider whether it could take any action that might alleviate these problems. The Commission also needs to follow up the meeting that was held in Delhi (Trans. IAU 19B, 100) to consider the problems of "developing astronomical institutions". These need access to past and current literature and to the new information-retrieval services if they are to carry out their programmes effectively. It is hoped that it will be possible for such institutions to be represented at IAU Colloquium No. 110 and that better cooperative arrangements may be established as a consequence of the discussions at the meeting.

The programme of the meetings of the Commission at Baltimore will need to be very extensive in order to cover adequately all of the many topics discussed in this report as well as others that for various reasons have not been mentioned. It is clear that the increased activity in astronomical-data topics that has taken place in recent years is about to be matched by a corresponding increase in activity in the other fields of concern to the Commission. It is of interest to note that some of these topics, such as designation and information retrieval techniques, are not only of concern to all of the members of the Commission but that their importance is being recognized by a much higher proportion of the astronomical community. I would like to conclude my report by thanking all those who have contributed to this report and to the activities of the Commission during this period.