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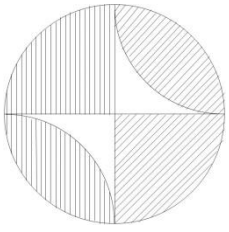
The Geodesist's Handbook

Le Manuel du Géodésien

1992



International Association of Geodesy

International Union of Geodesy and Geophysics

Union Géodésique et Géophysique Internationale

Editor
C.C. Tscherning

BULLETIN GEODESIQUE

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GEODESIST'S HANDBOOK 1992 MANUEL DU GEODESIEN

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FOREWORD
AVANT-PROPOS

C.C. Tscherning

The Executive Committee of the International Association of Geodesy has decided to publish after every General Assembly a special issue of Bulletin Géodesique devoted to a detailed description of the Association. The first "*Geodesist's Handbook 1980*" was published after the Canberra General Assembly in 1979. This is the "*Geodesist's Handbook 1992*". It aims at providing all the practical informations on the Association, supplemented with information of importance for the International scientific cooperation.

The first part refers to the history of the Association and to its present place and activities within the International Union of Geodesy and Geophysics, Statutes and By-Laws. As the quadrennial General Assembly is a very important date in the administrative and scientific life of the Association, the second part of the book contains the reports of the last General Assembly which was held in Vienna, Austria, August, 1991. These reports deal with the activities during the preceding four-year period, with the decisions taken during the Assembly and their administrative and scientific consequences. The third part is mainly devoted to the review of the basic constituents of the Association, the Sections, the Commissions, the Special Commissions and the Special Study Groups, namely their structure and program of activities for the coming period 1991-1995. The important information on the Geodetic Reference System 1980 is reprinted from the 1980-edition of the Handbook and is found in the fourth part. Here is also included information on the current estimates of important parameters, prepared by the president of Special Study Group 5.100, Prof. M. Bursa. The fourth part also includes a list of major international and national data centers and scientific publications series.

Le Comité Exécutif de l'Association Internationale de Géodésie a pris la décision de publier après chaque Assemblée Générale un numéro spécial du Bulletin Géodésique consacré à une description détaillée de l'Association. Le premier "*Manuel du Géodésien-1980*" fut publié après l'Assemblée Générale de Canberra en 1979. Ceci est le "*Manuel du Géodésien-1992*". Le but de cette publication est de fournir tous les renseignements pratiques sur l'Association, et également toutes les informations concernant la coopération scientifique internationale.

La première partie traite de l'histoire de l'Association, de sa place actuelle et de ses activités au sein de l'Union Géodésique et Géophysique Internationale, de ses Statuts et de son Réglement Intérieur. L'Assemblée Générale étant une étape importante dans la vie scientifique et administrative de l'Association, la deuxième partie comprend les comptes rendus de la dernière Assemblée Générale qui s'est tenue à Vienne (Autriche) en Août 1991. Ces comptes rendus se rapportent aux activités de la période quadriennale précédente, ainsi qu'aux décisions prises pendant l'Assemblée Générale et aux conséquences administratives et scientifiques qui en découlent. La troisième partie est principalement consacrée à la présentation des constituants de base de l'Association, les Sections, les Commissions, les Commissions Spéciales et les Groupes Spéciaux d'Etudes, notamment leur structure et leur programme d'activités pour la période quadriennale 1991-1995. L'importante note sur le Système Géodésique de Référence 1980 a été reprise de l'édition 1980 et figure dans la quatrième partie de l'ouvrage. Dans cette partie, on trouve également des informations sur les estimateurs actuels de certains paramètres importants, préparées par le président du Groupe Spécial d'Etudes 5.100, Prof. M. Bursa. Cette quatrième partie contient aussi une liste des principaux

Finally, the Handbook contains information for contributors to the Bulletin Géodesique and (maybe most important) a list of addresses.

The Executive Committee has discussed whether to include other pratical information such as addresses of geodetic research and educational institutions, or information on regional or national geodetic datums. Only one source of information was readily available, namely the addresses of educational institutions.

The Handbook has been compiled by P. Willis at the Central Bureau of the Association. Here corrections, updates, suggestions and proposals for improvements of the Handbook should be sent. It is planned to publish the most important updates in the Newsletter section of Bulletin Géodesique.

centres de données internationaux et nationaux ainsi que des publications scientifiques régulières.

Enfin le Manuel contient des informations nécessaires aux auteurs d'articles pour le Bulletin Géodésique, et (peut-être le plus important) une liste d'adresses.

Le Comité Exécutif a aussi discuté de l'éventualité d'inclure d'autres informations pratiques telles que les adresses des instituts géodésiques de recherche et de formation, ou des informations sur les références géodésiques régionales ou nationales. Seule une source d'information était actuellement disponible, les adresses des instituts géodésiques de formation.

Le Manuel du géodésien a été préparé par P. Willis au Bureau Central de l'Association qui serait heureux de recevoir toutes corrections, mises à jour, suggestions et propositions afin d'en améliorer le contenu. Il est prévu de publier les mises à jour les plus importantes dans la partie "Newsletter" du Bulletin Géodésique.

HISTORY OF THE

INTERNATIONAL ASSOCIATION OF GEODESY

M. Louis

The 1980 Geodesist's Handbook contains a very detailed note on the "History of the International Association of Geodesy" prepared by J.J. Levallois, Honorary Secretary General.

Then the 1984 Geodesist's Handbook contains brief biographical memoirs of former Presidents and General Secretaries of the Association. For the 1988 Geodesist's Handbook the Special Study Group 0.67 (History of Geodesy, Chairman : Ch. Whitten) has prepared similar memoirs for three Presidents of the old Association and also concise bio-reference notes for deceased former Section, Commission and Special Study Group officers as well as other geodesists who have made significant contributions.

In order to provide a continuous information about the history of the Association, the Central Bureau has prepared biographical memoirs of two former Presidents of the Association and one Secretary General who recently ended their terms of office. Similarly bio-reference notes have been prepared for those IAG officers and other geodesists who have deceased after 1987.

I- *Past officers of the International Association of Geodesy*

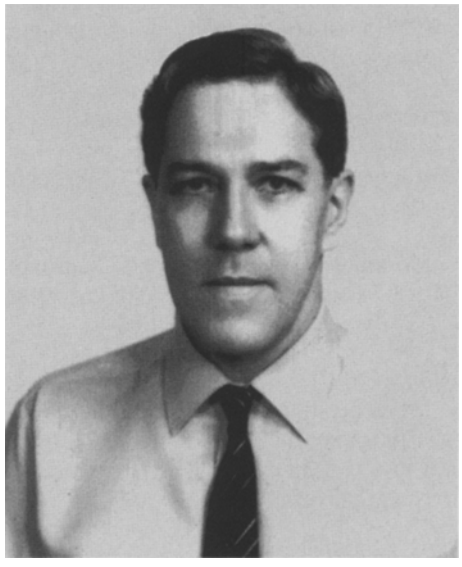
1. Presidents

. Peter Vincent ANGUS-LEPPAN

President of the International Association of Geodesy, (1983-1987).

Peter Angus-Leppan was born in 1930 in Johannesburg, South Africa, and studied surveying at the University of the Witwatersrand. After practical experience, he lectured at the University of Natal, from 1954 to 1962, in geodesy and astronomy.

While an undergraduate he was inspired by a visit to Witwatersrand University of Dr J. de Graaff Hunter. As a result he later undertook research on atmospheric refraction, and in 1959 was awarded a Ph D on the basis of these studies. He moved to Australia in 1962 as Senior Lecturer in the University of New South Wales, and was appointed as Foundation Professor of Surveying in 1963.



Prof. Peter Angus-Leppan

He developed geodesy in the Department, later the School of Surveying, and was largely responsible for developments which have led to the current international reputation in geodesy, of both the University and Australia. He supervised numerous doctoral students, and assisted and encouraged many in their geodetic research, including the late Ron Mather and other who are active in geodesy today.

Peter Angus-Leppan's major contributions in research are in aspects of geodetic refraction, though his publications and studies are widespread. In 1960 he helped to organize the first Conference of Southern African Surveyors (CONSAS), which continues to be organized at four-year intervals. He was Chairman of the Organizing Committee for the very successful 1979 IUGG General Assembly held in Canberra. Offices held in Australian Academy of Science, include Chairman of the National Committee on Geodesy and Geophysics 1974-1980, and Chairman of the Geodesy Subcommission, 1969-1980.

He travelled widely to represent his School and conducted research at the University of New Brunswick (1966); at the Topocom Research Institute, US Dept. of the Army (1971); under an Alexander von Humboldt Fellowship, at the Geodetic Institute, University of Karlsruhe (1978); and at the Canadian Geodetic Survey, Dept. of Surveys and Mapping, (1981).

In 1983, as Senior Visiting Scientist at the US National Geodetic Survey he undertook studies of refraction in geodetic levelling.

Peter Angus-Leppan has always been a proponent of the widest possible applications of geodesy, and in 1985-90 he worked as Project Coordinator in implementing the 20-year Land Titling Project, in Thailand. This included designing systems whereby modern techniques of geodesy were applied in accelerating the issuance of title deeds to the 85% of farmers whose tenure of the land was not documented.

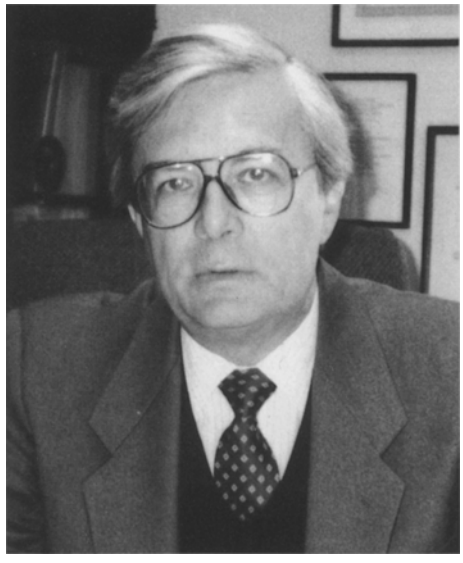
. *Ivan I. MUELLER*

1. President of the International Association of Geodesy (1987-1991).

Ivan I. Mueller is a Professor and Chairman in the Department of Geodetic Science and Surveying, The Ohio State University.

He was born January 9, 1930, in Budapest, Hungary. He received the Dipl. of Engineering from the Technical University of Budapest in 1952. Emigrating to the U.S. in 1957, he earned a PhD in Geodesy from The Ohio State University in 1960.

His teaching and research career focussed on geodetic astronomy and satellite geodesy during which he was principal advisor to 25 PhD graduates. His book *Spherical and Practical Astronomy As Applied to Geodesy* became a standard text in the English-speaking world. His fifth book *Earth Rotation: Theory and Observation* was coauthored with Professor Helmut Moritz of Graz, Austria. Ivan I. Mueller served as Associate Editor of the *Journal of Geophysical Research* and was President of the Geodesy Section of the American Geophysical Union. He was Chairman of the Editorial Board of the journal *manuscripta geodaetica*, and *Editor-in-Chief* of *Bulletin Géodésique* for 12 years.



Prof. Ivan I. Mueller

IAG activities in which he was a moving force are Project ADOS (African Doppler Survey), Project MERIT and COTES - leading to the establishment of the International Earth Rotation Service, and the International GPS Service. He was the first President of IAG Commission VIII-CSTG. Honors include Fellows of the American Geophysical Union; Alexander von Humboldt Award: Distinguished Scholar of the Ohio State University; Corresponding Member of the German Geodetic Commission, Bavarian Academy of Sciences, and of the Austrian National Academy of Sciences, Vienna; Honorary Member, Hungarian Geodetic and Cartographic Association, and of the Hungarian Academy of Sciences.

2. *General Secretaries*

. *Michel LOUIS.*

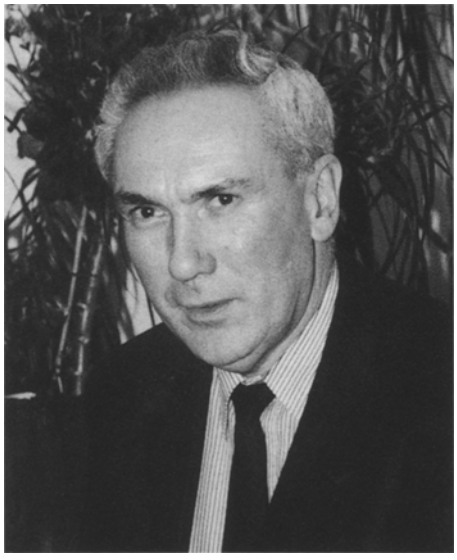
Secrétaire Général de l'Association Internationale de Géodésie (1975-1991).

Né le 21 septembre 1930, Michel Louis est ingénieur de l'Ecole Polytechnique (X 51) et ingénieur géographique diplômé de l'Ecole Nationale des Sciences Géographiques. Il débuta sa carrière à l'Institut Géographique National (1956) comme géodésien de terrain en participant à des missions d'établissement de canevas astronomiques et géodésiques en Afrique. Dès 1960, il introduit les mesures électro-magnétiques des distances dans la réalisation des canevas géodésiques. Il organisa de 1966 à 1970 les missions françaises du 12ème parallèle en Afrique avec l'A.M.S.

A partir de 1962, il prit une part très active à l'utilisation des techniques spatiales à l'IGN (cameras

balistiques) pour les liaisons à grande distance (rattachement de l'archipel des Açores à l'Europe, jonctions Europe-Afrique du Nord-Afrique de l'Ouest). En même temps, il dirigea l'unité chargée de l'application des techniques géodésiques au génie civil : implantations de haute précision, contrôles de ponts, barrages, tunnels, antennes de grande dimension, etc.

Non seulement il forma les opérateurs à ces techniques nouvelles, mais il enseigna ces parties de la géodésie appliquée à l'Ecole Nationale des Sciences Géographiques et au Conservatoire National des Arts et Métiers.



Ing. Gén. Géog. Michel Louis

Elève et disciple de J.J. Levallois au Service de la Géodésie à l'IGN, il fut aussi son adjoint à l'Association Internationale de Géodésie: secrétaire adjoint de 1963 à 1975 et rédacteur du Bulletin Géodésique de 1965 à 1975. En 1975, il fut élu Secrétaire Général de l'AIG en remplacement de J.J. Levallois.

A l'IGN, Michel Louis devint Chef du Service de la Géodésie en 1976, puis Directeur de la Production en 1981, enfin il est Directeur Général Adjoint depuis 1983.

II- Deceased former Section, Commission, Special Study Group officers and other geodesists who made significant contributions (in brackets biographical notice published).

BERGSTRAND, Erik (1905-1987).
Sweden, Geographical Survey Office
Electromagnetic distance measurement: geodimeter
Velocity of light
[Bulletin Géodésique, 61-3, 1987].

CONZETT, Rudolf (1922-1987).
Switzerland, Zurich, ETH
Classical geodesy
[Bulletin Géodésique, 62-2, 1988].

CORON, Suzanne (1917-1989).
France, Paris, Institut de Physique du Globe
Gravimetry
Secretary of International Gravimetric Commission (1971-1975)
(Vice-Director of Bureau Gravimétrique International (1975-1979)
[Bulletin Géodésique, 64-1, 1990].

LECOLAZET, Robert (1910-1990).
France, Strasbourg, Institut de Physique du Globe
Physical geodesy, Earth Tides
President of Commission on Earth Tides (1963-1979)
[Bulletin Géodésique, 64-2, 1990].

LI, Qinghai (1910-1986).
China, Wuhan Technical University, Surveying and Mapping
Mathematical geodesy
[Bulletin Géodésique, 62-4, 1988].

MARSH, James, G. (1939-1991)
U.S.A., Goddard Space Flight Center
Satellite geodesy
[Bulletin Géodésique, 65-4, 1991].

PESCHEL, Horst (1910-1989).
Germany, Dresden, Technische Hochschule
Classical geodesy
[Bulletin Géodésique, 63-4, 1989].

RINNER, Karl (1912-1991).
Austria, Graz, Technical University
Classical and satellite geodesy
Chairman of SSG on Combination of Terrestrial and Satellite Networks (1967-1975)
President of Section I: Control Surveys (1975-1979)
President of Commission on Education (1972-1979)
Third Vice-President of IAG (1987-1991)
[Bulletin Géodésique, 65-4, 1991].

SZABO, Bela (1914-1990).
U.S.A., Air Force Geophysics Laboratory
Gravimetry
[Bulletin Géodésique, 64-3 and 4, 1990].

FLINN, Edward A., (1931-1989).
U.S.A., Washington, NASA
Seismology, Space Geodesy
Chief NASA's Geodynamics Program
Secretary General Inter-Union Commission on the Lithosphere (1980-1985)
[EOS, Transactions-AGU Vol. 71, N° 18, 1990].

Introduction to the I.A.G.

P.V. Angus-Leppan

The International Association of Geodesy is an organisation devoted to the study of scientific problems of geodesy, and the promotion of international cooperation in this field.

It is one of seven associations forming the International Union of Geodesy and Geophysics (IUGG) (see ***Figure 1***). The Union, along with other International Unions, is a member of ICSU, the International Council of Scientific Unions.

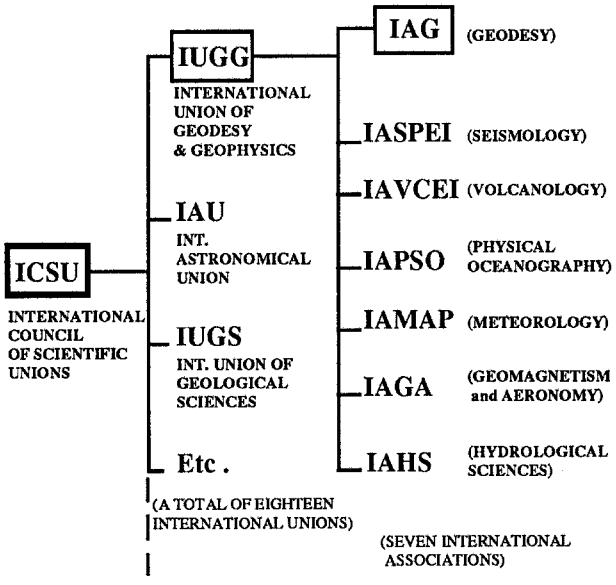


Fig. 1 - Structure of the International Organizations

The I.A.G. has a long tradition and can trace its origins back to the great mathematicians and geodesists of the early 19th century. In 1862, **General Baeyer**, who had been a pupil and disciple of Bessel, proposed an international geodetic meeting in Prussia, which led to the formation of the ***Mitteleuropäische Gradmessung*** (literally, the Central European Degree Measurement). The expansion in the geographical and scientific scope of the organization is mirrored in the changes of its title:

1864 Mitteleuropäische Gradmessung
1871 Europäische Gradmessung
1889 International Geodetic Association
1920 Geodesy Section, International Union of Geodesy and Geophysics
1946 International Association of Geodesy, IUGG

The I.A.G., which is the oldest Association in the Union, took a leading role in the establishment of the IUGG. The ***Bureau*** of the I.A.G. consists of the President, Secretary General and First Vice-President. The ***Executive*** comprises the Bureau members, the other Vice-President, the President of the Sections and the immediate Past President, with other officers of the Association in attendance. The ***Council***, which is the most important deliberative body, consists of the chief delegates from each of the member countries of the Union, with the Executive members in attendance. Decisions of the Council, for example amendments to the Statutes and By-Laws, must be transmitted to the **General Assembly**, a body comprising all the delegates from member countries accredited to the Association, at a particular General Assembly of the Union. ***Figure 2*** shows the relationships between these units.

For its scientific activities, the Association is divided into five Sections. The present **Sections**, reaffirmed at the General Assembly in 1991 are :

I Positioning
II Advanced Space Technology
III Determination of the Gravity Field
IV General Theory and Methodology
V Geodynamics

The function of the division into Sections is to bring together scientists with common interests, but it is not possible, nor is it desirable, to avoid interests overlapping from one Section into another. Each Section has a **President** and two or three **Secretaries**. The activities of each Section are guided by a **Section Steering Committee**, comprising the President, Secretaries, Presidents of the Commissions within that Section and others who may be coopted.

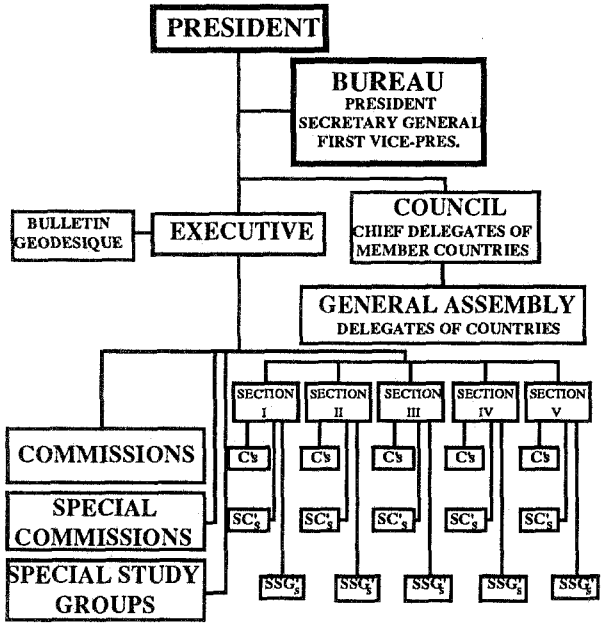


Fig. 2 - I.A.G. Structure

More details of the structure of the Association and the functions of its components are given in the Statutes and By-Laws, printed later in this Handbook. The Association also has Guidelines setting out its procedure in other activities.

The scientific working groups of the Association are the **Commissions**, **Special Commissions** and **Special Study Groups**, each assigned to one of the Sections, or, in a few cases, to the Association. **Commissions** are established to cover topics of broad, long-term international interest. Every member country is entitled to nominate a representative to a Commission. **Special Commissions** (SCs) are smaller, with a maximum membership of 30, and are designed to cover topics of more specialized interest, which are ongoing or require medium to long-term duration. **Special Study Groups** (SSGs) are established to cover topical scientific questions with the intention that they should be intensively investigated and reported on, generally within one or, at most, two four-year periods. Each SSG has a Chairman and a maximum of twenty members who are specialists in the topic.

The Association participates in the **IUGG General Assemblies** which are held every four years. At each General Assembly the Association is involved in Union interdisciplinary symposia, as well as its own administrative and scientific meetings. Elections of office-bearers are held at General Assemblies, following a procedure which aims to ensure a wide and balanced representation, while at the same time conforming to the principles of participatory democracy.

In betwen General Assemblies, the Association usually holds a **General Meeting** with scientific presentations on several selected topics. As well it organizes numerous **symposia**, each on a single topic, covering the topic area of more than one SSG or Commission. SSGs and Commissions can arrange workshops in their topic areas.

The Association publishes a quarterly journal, the **Bulletin Geodesique**, which contains scientific papers and administrative reports on the Association. The association has turned over the administration of the journal to a commercial publisher, Springer Verlag, while at the same time retaining adequate control. The Association publishes the Geodesist's Handbook every four years. This includes details of its activities, complete lists of its office-bearers and other relevant information. The two official languages of the Association are English and French.

Scientists interested in participating in I.A.G. activities are welcome to attend its meetings and symposia and to contact presidents of Sections, Commissions or Special Commissions, or Chairmen of Special Study Groups covering their special interests. The members of the Association, as of the Union, are those countries which have been admitted as members. Individual scientists who participate in I.A.G. activities are eligible to become *Associates* of the Association, while office-bearers and others may be elected *Fellows*.

STATUTS ET REGLEMENT INTERIEUR

I- STATUTS

I- Définition et mission de l'Association Internationale de Géodésie

1. *L'Association Internationale de Géodésie*, ci-après désignée *l'Association*, est l'une des associations constituant *l'Union Géodésique et Géophysique Internationale*, ci-après désignée *l'Union.*

2. L'Association a pour *mission* :

a) de promouvoir l'étude de tous les problèmes scientifiques de la géodésie et d'encourager la recherche géodésique;

b) de prendre toute initiative pour faciliter et coordonner la coopération internationale dans ce domaine et de promouvoir les activités géodésiques dans les pays en développement;

c) d'assurer, sur le plan international, la discussion et la publication des résultats des études, recherches et travaux mentionnés aux paragraphes a) et b) ci-dessus.

3. Pour atteindre ces objectifs, l'Association comprend un petit nombre de Sections, chacune d'entre elles traitant une partie distincte de la géodésie. Des Commissions, des Commissions Spéciales, des Groupes Spéciaux d'Etudes peuvent être créés selon des formes précisées dans le Règlement Intérieur.

4. Chaque pays adhérant à l'Union *(Pays Membre)* est admis à se faire représenter à l'Association par des Délégués.

4A. Des scientifiques peuvent devenir *Affiliés* de l'Association, soit en tant que *Compagnons*, soit en tant qu'*Associés*, selon des règles précisées dans le Règlement Intérieur.

II- Administration

5. L'***Assemblée Générale*** de l'Association est constituée par les Délégués des Pays Membres, dûment accédités par l'Organisme Adhérent de chaque pays, tel que défini par les Statuts de l'Union.

6. Le ***Conseil*** de l'Association est constitué par les Délégués, appelés Délégués au Conseil, désignés et dûment accrédités par les Organismes Adhérents des Pays Membres pour les représenter à chacune des réunions du Conseil, à raison d'un Délégué par Pays Membre. Chaque membre du Conseil est soit un Compagnon, soit un Associé de l'Association.

Aucun membre du Bureau de l'Association ne peut être choisi comme Délégué au Conseil d'un Pays Membre. Le Président de l'Association préside les réunions du Conseil, sans participer aux votes, sauf dans le cas d'égalité de voix comme précisé à l'Art. 16 ci-après.

7. La *responsabilité* de la direction des affaires de l'Association est dévolue au Conseil de l'Association. Les décisions prises par le Conseil sont présentées à l'Assemblée Générale. Si une majorité à l'Assemblée Générale est en désaccord avec les décisions du Conseil, celui-ci doit reconsidérer sa position et prendre une décision qui devient définitive.

8. Dans l'intervalle des réunions du Conseil, la gestion des affaires de l'Association est dévolue au *Bureau* et au *Comité Exécutif* dont la composition et les attributions respectives sont définies ci-après.

9. Le ***Bureau*** de l'Association est constitué par le *Président*, le *Premier Vice-Président* et le *Secrétaire Général*, tous trois élus par le Conseil. Le rôle du Bureau est d'administrer l'Association conformément aux présents Statuts et Règlement Intérieur et aux décisions du Conseil et du Comité Exécutif.

10. Le ***Comité Exécutif*** de l'Association est constitué par le Bureau, le Président sortant et le second Vice-Président de l'Association, ainsi que par les Présidents des Sections.

Les Présidents Honoraires et les Secrétaires Généraux Honoraires de l'Association, les Présidents des Commissions, les Secrétaires des Sections, les Secrétaires adjoints de l'Association et le Rédacteur en Chef du Bulletin Géodésique peuvent assister, à titre consultatif, à toute réunion du Comité Exécutif de l'Association.

Le rôle du Comité Exécutif est de guider les Sections et autres organismes scientifiques de l'Association vers la réalisation de leurs aspirations scientifiques, en assurant entre eux une coordination efficace et en formulant les règles générales nécessaires au bon déroulement des travaux scientifiques de l'Association.

Les membres du Comité Exécutif participent, à titre consultatif, à toutes les délibérations du Conseil.

III- Droit de vote

11. Un Délégué au Conseil ne peut être le Délégué que d'un seul Pays Membre.

Un Pays Membre non représenté à une réunion du Conseil peut voter par correspondance sur toute question bien précisée à l'ordre du jour définitif distribué à l'avance aux Pays Membres, pourvu que les débats n'aient pas introduit d'importants aspects nouveaux de cette question, ni modifié sa substance, et pourvu que le bulletin de vote considéré soit parvenu au Président avant l'ouverture du vote.

12. Pour que les délibérations du Conseil soient valables, la présence effective au Conseil de la moitié au moins des Délégués des Pays Membres représentés à l'Assemblée Générale de l'Union est nécessaire.

13. Pour toutes les questions n'ayant aucune incidence financière, le vote au Conseil se fait par Pays Membre, chaque Pays Membre ayant une voix, à condition qu'il ait payé ses cotisations à l'Union jusqu'à la fin de l'année civile qui précède le vote.

14. Pour toutes les questions financières, le vote au Conseil se fait par Pays Membre, à condition également que le pays considéré ait payé ses cotisations à l'Union jusqu'à la fin de l'année civile qui précède le vote. Le nombre de voix attribuées à chaque Pays Membre est alors égal au numéro de la catégorie dans laquelle le Pays adhère à l'Union.

15. Avant un vote en Conseil, il revient au Président de décider si la question prise en considération est d'ordre financier ou non, et si la procédure du vote par correspondance s'applique.

16. Les décisions au Conseil sont prises à la majorité simple, sauf dans les cas spécialement mentionnés dans les présents Statuts. Si, au cours d'un vote au Conseil, il y a égalité de voix, la décision appartient au Président. La majorité simple ou la majorité des deux-tiers sont déterminées par la proportion des votes affirmatifs à la somme de tous les votes (affirmatifs, négatifs, abstentions). Les bulletins blancs, les bulletins non valables et les votes non exprimés par les délégués présents sont décomptés comme abstentions.

IV- Généralités

17. Les propositions formulées en vue de la modification d'un article des Statuts de l'Association doivent parvenir au Secrétaire Général au moins six mois avant la date fixée pour la réunion du Conseil au cours de laquelle elles seront examinées. Le Secrétaire Général devra faire connaître à tous les Pays Membres, au moins quatre mois avant la date fixée pour la réunion du Conseil, toutes les propositions reçues à ce sujet.

18. Les Statuts de l'Association ne peuvent être modifiés que par un vote du Conseil à la majorité des deux tiers.

Les présents Statuts, ou toute modification ultérieure, prennent effet à la clôture de la réunion du Conseil à laquelle ils ont été approuvés.

19. Dans le cadre des Statuts de l'Association, le Conseil a pouvoir d'adopter un Règlement Intérieur.

Ce Règlement Intérieur ne peut être modifié que par un vote du Conseil à la majorité simple.

Ce Règlement Intérieur, ou toute modification ultérieure, prend effet à la clôture de la réunion du Conseil à laquelle il (ou elle) a été approuvé(e).

20. En cas de dissolution de l'Association, ses avoirs sont cédés à l'Union.

21. Sauf au cas où les Statuts, ou le Règlement Intérieur, en décideraient autrement, les réunions de travail seront conduites selon les règles: "Robert's Rules of Order".

22. Les présents Statuts et le Règlement Intérieur sont établis en Français et en Anglais.

Leur validité ne peut être mise en cause par toute erreur de caractère formel ou accidentel.

II- REGLEMENT INTERIEUR

I- *Structure de l'Association*

1. Les travaux scientifiques de l'Association Internationale de Géodésie sont répartis dans les *Sections* dont les attributions respectives sont décidées par le Conseil sur recommandation du Comité Exécutif. La structure de ces Sections est revue tous les huit ans (soit deux périodes) par un Comité, appelé Comité Cassinis, qui présente ses propositions au Comité Exécutif. En raison des relations complexes entre les différentes activités de l'Association, des interactions entre les Sections sont nécessaires.

L'Association comprend actuellement les ***cinq Sections*** ci-après:

- **Section I** : *Détermination de position.*
  . réseaux horizontaux et verticaux de précision;
  . méthodes spatiales de positionnement;
  . méthodes inertielles de positionnement;
  . méthodes cinématiques de positionnement;
  . astronomie géodésique;
  . positionnement en mer;
  . réfraction.

- **Section II** : *Technologie spatiale avancée.*
  . développement des techniques spatiales en géodésie, telles que: techniques radioélectriques de poursuite de satellite, techniques radio-interférométriques, mesures de distance laser terre-satellite et terre-lune, altimétrie par satellite, poursuite de satellite par satellite, gradiométrie par satellite, mesures géodésiques depuis l'espace;
  . calculs d'orbites;
  . résultats géodésiques directement issus de ces techniques;
  . techniques géodésiques pour la lune et les planètes.

- **Section III** : *Détermination du champ de pesanteur.*
  . mesures terrestres absolues et relatives de pesanteur;
  . variations de pesanteur non liées aux marées;
  . détermination du champ extérieur de pesanteur et du géoïde à l'aide de la gravimétrie, de la gradiométrie, de l'astronomie géodésique, des techniques spatiales et inertielles;
  . réduction et estimation des paramètres du champ de pesanteur.

- **Section IV** : *Théorie Générale et Méthodologie.*
  . modèles mathématiques généraux en géodésie;
  . analyse statistique et numérique;
  . traitement et gestion des données;
  . méthodes d'optimisation;
  . méthodes des moindres carrés;
  . théories différentielle et intégrale du champ de pesanteur;
  . théorie de l'estimation, l'approximation et la représentation du champ de pesanteur.

- **Section V** : *Géodynamique.*
  . systèmes de référence;
  . observation et étude des phénomènes variant avec le temps: mouvement du pôle, rotation terrestre, marées terrestres, mouvements récents de l'écorce terrestre, variations de la pesanteur, topographie de la surface marine et niveau moyen des mers;
  . aspects géodésiques des projets géodynamiques internationaux;
  . dynamique des planètes et de la lune;
  . interprétation géophysique de la pesanteur et des données s'y rapportant.

1A- Chaque Section crée en son sein un ***Comité Directeur*** constitué par le Président et les Secrétaires de la Section, les Présidents des Commissions et des Commissions Spéciales appartenant à la Section et par toute personne qui, ayant travaillé dans la Section, est cooptée par le Président de Section.

2. Des ***Commissions*** peuvent être créées pour certaines activités qui nécessitent une coopération ou une organisation internationale importante, en particulier pour les problèmes de longue durée ou les activités intéressant de vastes territoires.

Chaque Pays Membre de l'Union a le droit de nommer un représentant dans chaque Commission, excepté dans celles traitant de zones géographiques particulières; dans ce dernier cas, seuls les pays membres situés dans la zone géographique considérée peuvent nommer un représentant dans la Commission.

Normalement, une Commission fait partie d'une Section. Chaque Commission peut s'organiser selon les exigences qui lui sont propres tout en respectant les Statuts et Règlement Intérieur de l'Association et en se soumettant à l'approbation du Comité Exécutif; elle peut, par exemple, créer des Sous-Commissions régionales.

2A- Des ***Commissions Spéciales*** peuvent être créées pour étudier des problèmes scientifiques à long terme requérant une coopération étroite entre spécialistes de différents pays.

Normalement, une Commission Spéciale fait partie d'une Section.

Chaque Commission Spéciale peut s'organiser selon des exigences qui lui sont propres tout en se conformant aux Statuts et Règlement Intérieur de l'Association et en se soumettant à l'approbation du Comité Exécutif, elle peut, par exemple, créer des Sous-Commissions pour étudier des problèmes spécifiques dans son domaine.

3. Des ***Groupes Spéciaux d'Etudes*** peuvent être créés pour étudier des problèmes scientifiques particuliers d'étendue limitée mais qui requièrent une coopération étroite entre les spécialistes de différents pays.

Normalement, un Groupe Spécial d'Etudes fait partie d'une Section.

4. La création et la dissolution des Commissions, des Commissions Spéciales et des Groupes Spéciaux d'Etudes sont décidées par le Comité Exécutif qui précise également si la Commission, la Commission Spéciale ou le Groupe Spécial d'Etudes doit être placé sous l'autorité directe de l'Association ou de l'une de ses Sections.

La liste des Commissions, des Commissions Spéciales et des Groupes Spéciaux d'Etudes est publiée dans le Manuel du Géodésien à l'issue de chaque Assemblée Générale.

5. L'Association peut aussi prendre part aux activités d'organismes scientifiques communs avec d'autres Associations de l'Union Géodésique et Géophysique Internationale ou, représentant l'Union, avec d'autres Unions. Ces Organismes sont administrés suivant des règles spécifiques découlant des relations avec les autres groupes, mais ils présentent un rapport sur leurs activités scientifiques aux Assemblées Générales de l'Association.

Le Comité Exécutif de l'Association décide si la participation à un tel organisme commun doit être placée sous la responsabilité de l'Association ou de l'une des Sections. Cette responsabilité inclut la désignation des représentants à ces organismes ainsi que la participation à la planification de leurs activités futures.

II- *Elections*

6. Les élections sont faites par le Conseil au cours de chaque Assemblée Générale Ordinaire de l'Association.

Le Président en exercice, après avoir pris l'avis des membres du Comité Exécutif, désigne un Comité de Nomination composé d'un président et de trois autres membres. Le Comité de Nomination, après avoir pris l'avis des Organismes Adhérents des Pays Membres et des Officiels de l'Association, propose un candidat pour chacun des postes soumis à élection au Conseil. Les candidats doivent signifier leur acceptation et fournir un résumé de leur carrière, en 150 mots maximum, mettant en évidence leur fonction actuelle, leurs intérêts de recherche et leurs activités en rapport avec l'Association. Les délégués sont tenus informés, très tôt au cours de l'Assemblée Générale, de ces candidatures ainsi que des résumés les accompagnant, en outre, des annonces sont faites pour permettre, pendant une période d'au moins 48 heures, à d'autres candidatures de se manifester. Celles-ci doivent êtres présentées par écrit, avoir l'appui d'au moins deux membres du Conseil, et être adressées, accompagnées des résumés tels que décrits ci-dessus, au Secrétaire Général. Les délégués ont connaissance de ces dernières candidatures, des résumés, ainsi que des noms des personnes apportant leur soutien.

Les élections ont lieu au scrutin secret.

Une même personne ne peut occuper en même temps plus d'un des postes suivants : Président de l'Association, Vice-Président, Président de Section et Président de Commission ou de Commission Spéciale.

7. L'intervalle de temps séparant les clôtures de deux Assemblées Générales Ordinaires successives de l'Association est appelé "*période*".

8. Le ***Président*** de l'Association est élu pour une période. Il n'est pas immédiatement rééligible à ce poste, mais le Conseil peut le nommer Président honoraire.

9. Le ***Premier*** et le ***Second Vice-Présidents*** sont élus pour une période et ne sont pas immédiatement rééligibles aux mêmes postes.

10. (*Article supprimé*).

11. Le ***Secrétaire Général*** est élu initialement pour une période. Il peut être ré-élu pour deux autres périodes, par périodes successives.

12. Ces mêmes règles (Art. 11) s'appliquent aux ***Secrétaires adjoints*** de l'Association, à l'exception du Secrétaire adjoint élu selon la procédure prévue à l'Art. 37A.

13. Les membres du Bureau et du Comité des Finances de l'Union ne peuvent occuper les postes de Président, Premier Vice-Président ou Secrétaire Général de l'Association.

14. Si le poste de Président devient vacant dans l'intervalle entre deux Assemblées Générales Ordinaires, les fonctions en sont assurées jusqu'à la fin de l'Assemblée Générale Ordinaire suivante par le Premier Vice-Président. De la même façon, les fonctions du Premier Vice-Président reviennent alors au Second Vice-Président.

Si le poste de Secrétaire Général devient vacant, le Président charge immédiatement le Comité Exécutif d'élire par correspondance un remplaçant de façon à assurer la continuité de fonctionnement du Bureau Central. Cette élection n'a d'effet que jusqu'à la fin de l'Assemblée Générale Ordinaire suivante.

15. Les ***Présidents des Sections*** sont élus pour une période et ne sont pas immédiatement rééligibles aux mêmes postes.

16. Les ***Secrétaires des Sections*** sont élus pour une période et sont rééligibles pour une autre période.

Le Président de chaque Commission appartenant à une Section devient Secrétaire de cette Section. Le nombre maximum de Secrétaires dans une Section est deux, sauf si le nombre de Commissions dans cette Section dépasse un, dans ce cas le nombre de Secrétaires est égal au nombre de Commissions plus un.

17. Si un poste de Président de Section devient vacant entre deux Assemblées Générales Ordinaires, le Comité Exécutif désigne un Président intérimaire qui tient le poste jusqu'à la fin de la prochaine Assemblée Générale.

Dans le cas d'autres vacances, le Comité Exécutif peut désigner des intérimaires.

18. Les ***Présidents des Commissions*** et des ***Commissions Spéciales*** sont élus par le Conseil de l'Association pour une période et peuvent être immédiatement ré-élus pour une autre période.

19. Le ***Président d'un Groupe Spécial d'Etudes*** est nommé par le Comité Exécutif pour une période seulement.

20. Une même personne ne peut être à la fois président de plus d'un des organismes visés aux Art. 18 et 19.

III- *Assemblées Générales*

21. L'Association tient ses propres Assemblées Générales Ordinaires en liaison avec celles de l'Union, à la même date et dans le même pays.

22. Avant chaque Assemblée Générale, le Bureau de l'Association prépare un ordre du jour détaillé. Pour ce qui concerne les travaux scientifiques, l'ordre du jour est établi par le Comité Exécutif. Cet ordre du jour est envoyé aux pays membres et à tous les Officiels de l'Association de façon à leur parvenir au moins deux mois avant la date de l'Assemblée. En principe, seules les questions qui figurent à l'ordre du jour sont prises en considération pendant les sessions; il peut en être autrement par un vote acquis à la majorité des deux tiers soit en Conseil, soit au Comité Exécutif.

23. A chaque Assemblée Générale, le Président de l'Association présente un rapport détaillé sur les activités scientifiques de l'Association pendant la période de sa présidence. Le Secrétaire Général présente, pour la même période, un rapport détaillé concernant les activités administratives et les finances de l'Association. Ils soumettent chacun des propositions sur les activités à entreprendre au cours de la période à venir dans la mesure où les ressources envisagées le permettent.

Ces rapports sont remis aux Délégués présents à l'Assemblée Générale avant l'ouverture de cette Assemblée.

24. Les réunions scientifiques ont généralement lieu par Section, mais l'étude de certaines questions peut nécessiter des réunions communes à plusieurs Sections ou des symposiums placés sous la responsabilité de présidents désignés par le Comité Exécutif.

Des symposiums communs couvrant des sujets intéressant au moins deux Associations de l'Union peuvent être organisés.

25. A chaque Assemblée Générale, les travaux de chaque Section font l'objet d'un rapport présenté par son Président assisté de ses Secrétaires. De même, les travaux de chaque Commission, Commission Spéciale ou Groupe Spécial d'Etudes sont présentés par les présidents respectifs.

26. L'inscription de communications scientifiques à l'ordre du jour des séances de l'Assemblée Générale est décidée par un Comité constitué par un membre du Bureau et les Présidents des Sections.

27. Les communications scientifiques individuelles sont reproduites par leur auteurs. Elles sont distribuées aux Délégués par le Bureau Central avant la séance à laquelle elles doivent être présentées. Elles peuvent être publiées dans le Bulletin Géodésique sous réserve d'en satisfaire la politique d'édition.

IV- *Publication*

28. Le journal officiel de l'Association est le **Bulletin Géodésique**, ci-après désigné "le Journal". Le Journal est publié à intervalles réguliers, par une société d'édition liée par accord à l'Association, ou par tout autre moyen approuvé par le Comité Exécutif. Les termes sont négociés par le Président et sont ratifiés par le Comité Exécutif.

Un (ou plusieurs) Rédacteur(s) en Chef, désigné(s) ci-après "le Rédacteur", est (sont) en charge du Journal.

Le Rédacteur est conseillé et assisté par un Comité des Rédacteurs, ci-après désigné "le Comité".

Le Rédacteur est responsable du contenu scientifique du Journal. Tous les articles scientifiques sont soumis à la procédure de revue et le Rédacteur prend la décision finale d'accepter ou non l'article pour le publier. Le Rédacteur informe l'Association des activités et de l'état des opérations concernant le Journal.

28A. A chaque Assemblée Générale, le Rédacteur, après consultation et accord du Président de l'Association, recommande des candidats pour devenir membres du nouveau Comité appelé à opérer pendant la période suivant l'Assemblée Générale.

Pendant cette Assemblée, le Comité en exercice élit les membres du nouveau Comité parmi les candidats recommandés. Après son entrée en fonction, le nouveau Comité élit un (ou plusieurs) Rédacteur(s) pour la période à venir. La désignation du Rédacteur doit être approuvée par le Comité Exécutif.

Le Rédacteur, ainsi que les membres du Comité, sont élus pour une période, mais sont susceptibles d'être ré-élus pour une période supplémentaire.

28B. Après chaque Assemblée Générale, il est publié un numéro spécial du Bulletin Géodésique appelé le "***Manuel du Géodésien***". Cette publication a pour but de fournir des informations détaillées sur l'Association, sa structure, ses activités scientifiques et bien d'autres informations à caractère technique ou administratif.

29. A l'issue de chaque Assemblée Générale, l'ensemble des rapports présentés par les Sections, Commissions et Groupes Spéciaux d'Etudes est publié sous le nom de "***Travaux de l'Association Internationale de Géodésie***". Cette publication est adressée gratuitement aux Officiels de l'Association et aux Organismes Adhérents des Pays Membres.

30. L'Association assure également des ***publications spéciales*** qui présentent les références recommandées en géodésie.

31. A chaque Assemblée Générale les Pays Membres de l'Union sont invités à fournir un certain nombre d'exemplaires de leur ***Rapport National*** sur les travaux géodésiques effectués depuis la précédente Assemblée Générale. Ces Rapports Nationaux, dans la mesure où ils sont disponibles, sont distribués comme les "*Travaux de l'Association*" par le Bureau Central de l'Association.

V- *Administration*

32. Le ***Conseil*** de l'Association :

a) examine les questions de politique scientifique générale ou d'administration dans les affaires de l'Association et désigne, à cet effet, les Comités qui, le cas échéant, peuvent être jugés nécessaires;

b) élit les membres du Bureau et du Comité Exécutif, les Secrétaires adjoints de l'Association, les Secrétaires des Sections, les Présidents des Commissions et des Commissions Spéciales;

c) reçoit les rapports du Secrétaire Général et examine, pour approbation, les décisions ou mesures prises par le Bureau et le Comité Exécutif depuis la dernière réunion du Conseil;

d) désigne les trois membres du comité ad hoc créé pour l'examen des finances de l'Association, étudie ses recommandations et adopte le budget définitif;

e) examine les propositions de modification des Statuts et du Règlement Intérieur.

Le Conseil se réunit sur convocation du Président de l'Association. Il se réunit normalement pendant les Assemblées Générales Ordinaires.

33. Le ***Comité Exécutif*** de l'Association :

a) prend les mesures et établit les règles nécessaires à l'accomplissement des missions scientifiques de l'Association;

b) comble toute vacance de poste qui pourrait survenir, entre deux Assemblées Générales, selon les règles des Statuts et du Règlement Intérieur;

c) crée et dissout les Commissions, Commissions Spéciales et Groupes Spéciaux d'Etudes;

d) nomme les Présidents des Groupes Spéciaux d'Etudes et approuve l'élection du(des) Rédacteur(s) en Chef du Bulletin Géodésique;

e) nomme les membres du Comité Cassinis;

f) présente des recommandations au Conseil sur les questions de politique générale de l'Association;

g) sur recommandation du Bureau, désigne les Compagnons et les Associés de l'Association. Les anciens Officiels de l'Association, y compris ceux des Commissions et des sous-Commissions, ont vocation à être nommés Compagnons de l'Association et sont invités à le devenir. Les personnes élues Officiels de l'Association ou désignées comme membres des Commissions, Commissions Spéciales ou Groupes Spéciaux d'Etudes deviennent automatiquement Associés de l'Association. Les personnes de Pays Membres qui en font la demande, en mentionnant leurs activités passées au sein de l'Association, ou présentant une recommandation de leur Organisme Adhérent national ou celle d'un Officiel ou d'un Compagnon de l'Association, peuvent être admises à devenir Associés et sont recommandées par le Bureau.

Le Comité Exécutif se réunit sur convocation du Président de l'Association. Il se réunit au cours des Assemblées Générales et ses membres participent, à titre consultatif, aux réunions du Conseil. Il se réunit également au moins une fois entre deux Assemblées

Générales, un an avant l'Assemblée Générale pour préparer le programme des activités scientifiques et le projet d'emploi du temps de cette Assemblée Générale.

Lors d'une réunion du Comité Exécutif, aucun membre ne peut se faire représenter par quiconque, sauf un Président de Section qui peut être représenté par un Secrétaire de sa Section. Les délibérations du Comité Exécutif sont déclarées valides si au moins la moitié des membres sont présents au représentés.

L'ordre du jour de chaque réunion du Comité Exécutif est préparé par le Bureau et adressé aux membres au moins trois mois avant la réunion.

34. Le ***Bureau*** de l'Association :

a) établit l'ordre du jour des réunions du Conseil et du Comité Exécutif;

b) assure l'administration de l'Association.

Il se réunit normalement avant chaque réunion du Comité Exécutif.

35. Le ***Président*** de l'Association :

a) représente l'Association dans ses relations avec les Organismes ou Institutions nationales ou internationales;

b) convoque et préside les Assemblées Générales et toutes les réunions du Conseil, du Comité Exécutif et du Bureau;

c) présente à l'Assemblée Générale le rapport sur les activités scientifiques de l'Association pendant la période de sa présidence.

Il est membre du Comité Exécutif de l'Union. En cas d'indisponibilité du Président, le *Premier Vice-Président* le remplace.

36. Le ***Secrétaire Général*** de l'Association :

a) assume les fonctions de secrétaire de l'Assemblée Générale, du Conseil, du Comité Exécutif et du Bureau; il organise leurs réunions, prépare et diffuse promptement l'ordre du jour et les procès-verbaux de toutes ces réunions;

b) remplit les fonctions de Directeur du Bureau Central;

c) gère les affaires de l'Association, se charge de la correspondance et assure la conservation des archives;

d) distribue toutes les informations concernant l'Association;

e) prépare les rapports d'activité de l'Association, en particulier il présente à l'Assemblée Générale le rapport sur l'administration et les finances de l'Association pour la période en cours;

f) accomplit toutes autres tâches qui lui sont confiées par le Bureau.

37. Pour aider le Secrétaire Général dans l'accomplissement de ses tâches envers l'Association, celle-ci établit une structure permanente, le *Bureau Central*, comportant un nombre variable d'employés payés sur des fonds de l'Association.

Le Secrétaire Général est également assisté d'un petit nombre de *Secrétaires adjoints*, dont l'un deux réside dans la même localité que le Secrétaire Général. Ces fonctions sont gratuites et ne peuvent donner lieu qu'au remboursement des frais occasionnés par ces charges.

37A. Un Secrétaire Adjoint supplémentaire, désigné "*Le Secrétaire de l'Assemblée*", peut également être nommé par le Conseil sur recommandation du pays où se tiendra la prochaine Assemblée Générale. Si cette procédure de nomination n'est pas réalisable, le Conseil délègue cette nomination au Bureau de l'Association.

En collaboration avec le Bureau Central, ce Secrétaire Adjoint est responsable des relations avec les organisateurs s'occupant de la préparation de l'Assemblée Générale. Ce Secrétaire Adjoint n'est nommé que pour une seule période.

VI- *Activités des Sections, Commissions, Commissions Spéciales et Groupes Spéciaux d'Etudes*

38. Le ***Président d'une Section*** a la responsabilité du développement des activités scientifiques de sa Section et il représente sa Section au Comité Exécutif de l'Association. En liaison étroite avec son Comité Directeur, il encourage, guide et coordonne les travaux des Commissions, Commissions Spéciales et Groupes Spéciaux d'Etudes de sa Section, et, en particulier, rend compte annuellement des activités de sa Section aux officiels de la Section ainsi qu'aux membres du Bureau de l'Association.

Le Président d'une Section, ou, à défaut, l'un de ses Secrétaires, doit assister à chaque symposium concernant la Section.

Avant chaque Assemblée Générale, le Président d'une Section reçoit les rapports d'activité des Commissions, Commissions Spéciales et Groupes Spéciaux d'Etudes rattachés à sa Section et, assisté du Comité Directeur, il prépare alors le compte rendu des activités de la Section à présenter à l'Assemblée Générale. Il reçoit les suggestions pour créer de nouveaux Groupes Spéciaux d'Etudes et pour continuer

l'activité de Groupes déjà existants, selon la procédure exposée à l'Art. 43. Après consultation du Comité Directeur de la Section, il coordonne ces demandes et transmet ses recommandations au Comité Exécutif.

Chaque ***Comité Directeur de Section*** se réunit au moins une fois durant chaque Assemblée Générale Ordinaire et au moins à une autre occasion au cours de la période entre deux Assemblées Générales. Lors de la réunion à l'Assemblée Générale, ou au cours de toute autre occasion appropriée, le Comité Directeur passe en revue les activités des Commissions, Commissions Spéciales et Groupes Spéciaux d'Etudes pendant la période écoulée, et examine les programmes de celles et ceux dont la poursuite de l'activité est proposée pour la période suivante.

Les ***Secrétaires de Section*** assistent le Président de Section dans ses fonctions.

39. Le ***Président d'une Commission*** a la responsabilité d'en promouvoir et d'en diriger les travaux et d'en recruter les membres, à l'exception des représentants des Pays Membres, désignés comme indiqué à l'Art. 2.

Le Président de chaque Commission établit une brève description du travail à accomplir et une liste des membres, pour publication dans le Manuel du Géodésien après chaque Assemblée Générale.

Afin d'assurer la communication et la coopération au sein de chaque Commission, les membres sont tenus informés, annuellement, des résultats obtenus et des problèmes en cours.

39A. Le ***Président d'une Commission Spéciale*** a la responsabilité d'en promouvoir et d'en diriger les travaux et d'en recruter les membres.

La répartition géographique de ces derniers doit refléter une bonne coopération internationale sur le sujet d'étude et leur nombre ne doit pas excéder 30.

Le Président de chaque Commission Spéciale établit une brève description du travail à accomplir et une liste des membres, pour publication dans le Manuel du Géodésien après chaque Assemblée Générale.

Afin d'assurer la communication et la coopération au sein de chaque Commission Spéciale, les membres sont tenus informés, annuellement, des résultats obtenus et des problèmes en cours.

40. Le ***Président d'un Groupe Spécial d'Etudes*** a la responsabilité d'en promouvoir et d'en diriger les travaux et d'en recruter les membres.

La répartition géographique de ces derniers doit refléter une bonne coopération internationale sur le sujet d'étude et leur nombre ne doit pas excéder 20.

Le Président de chaque Groupe Spécial d'Etudes établit une brève description du travail à accomplir et une liste des membres, pour publication dans le Manuel du Géodésien après chaque Assemblée Générale.

Afin d'assurer la communication et la coopération au sein de chaque Groupe Spécial d'Etudes, les membres sont tenus informés, annuellement, des résultats obtenus et des problèmes en cours.

41. Le Président de l'Association, le Bureau Central et le Président de la Section concernée reçoivent copie des correspondances officielles et des notes aux membres des Commissions, Commissions Spéciales et Groupes Spéciaux d'Etudes.

42. Les rapports d'activité de chaque Commission, Commission Spéciale et Groupe Spécial d'Etude doivent être transmis au Président de la Section concernée au moins trois mois avant chaque Assemblée Générale. Ces rapports ainsi que les rapports des Sections sont publiés dans les "*Travaux de l'Association Internationale de Géodésie*".

43. La période d'activité de chaque Groupe Spécial d'Etudes prend normalement fin à l'Assemblée Générale ordinaire. Dans le cas exceptionnel où une poursuite d'activité est jugée nécessaire, le Président du Groupe Spécial d'Etudes soumet à son Président de Section trois mois avant l'Assemblée Générale une proposition écrite bien argumentée, y compris une suggestion pour la désignation de son successeur. Le Président de Section présente alors une recommandation au Comité Exécutif.

44. Les Commissions, Commissions Spéciales et Groupes Spéciaux d'Etudes non rattachés à une Section particulière sont placés sous la responsabilité du Président de l'Association.

45. Les Commissions, Commissions Spéciales et Groupes Spéciaux d'Etudes sont libres d'organiser des réunions de travail de leurs membres. S'ils désirent organiser des Symposiums scientifiques, ils doivent suivre la procédure d'approbation des symposiums prévue par l'Association. Les symposiums ne peuvent être organisés que si leur sujet déborde du cadre d'activité d'une Commission, Commission Spéciale ou d'un Groupe Spécial d'Etudes.

VII- *Symposiums*

46. L'Association peut organiser des symposiums scientifiques pour étudier des problèmes particuliers d'intérêt général.

Le Comité Exécutif a la responsabilité de veiller au choix judicieux des symposiums, de façon à garantir une équitable représentation par sujet et une bonne

répartition géographique et aussi à éviter des doubles emplois, des recouvrements et une fréquence injustifiée.

Les symposiums parrainés par l'Association sont ouverts à tous les scientifiques, selon les règles du Conseil International des Unions Scientifiques.

47. Les propositions de symposiums pour la période entre deux Assemblées Générales Ordinaires sont normalement soumises par les Organisateurs au Secrétaire Général, avant l'Assemblée Générale précédant cette période. Au cours de cette Assemblée Générale d'autres propositions peuvent être soumises au Secrétaire Général, au plus tard deux jours avant la dernière réunion du Conseil.

Le Conseil, sur recommandation du Comité Exécutif, décide si l'Association doit parrainer tel ou tel symposium.

Dans des cas très exceptionnels, le Comité Exécutif peut donner son accord à des demandes faites hors des délais normaux. De telles demandes ne peuvent être faites moins de 18 mois avant la date proposée pour le symposium.

48. L'Organisateur d'un symposium doit envoyer une annonce officielle au Bulletin Géodésique au moins un an à l'avance, ou immédiatement après l'approbation par l'Association; la date annoncée ne doit plus changer ensuite.

49. Moins de trois mois après le symposium, l'Organisateur est tenu de fournir un rapport pour le Bulletin Géodésique. Ce rapport doit indiquer si les Actes du symposium seront publiés, et où, et quand ils le seront. Les Actes du symposium, ou au moins une copie de chaque communication présentée, doivent être adressées au Bureau Central de l'Association.

50. Le parrainage d'un symposium par l'Association signifie une reconnaissance officielle mais n'implique pas un soutien financier.

VIII- *Coopération scientifique internationale*

51. L'Association peut coopérer à des travaux scientifiques de caractère international ou interdisciplinaire, elle peut également les entreprendre directement ou en surveiller la réalisation. En principe, l'Association est représentée aux Congrès, réunions internationales, Assemblées Générales, etc... des organismes scientifiques internationaux dont l'activité est en rapport avec la sienne propre. Le Président de l'Association ou son délégué représente l'Association à ces réunions.

Les frais de voyage et de séjour du représentant de l'Association peuvent être mis en totalité ou partiellement à la charge de l'Association. Un compte rendu de ces réunions incluant les discussions en rapport avec la géodésie, est préparé par ce représentant, en vue d'une publication, totale ou partielle, dans le Bulletin Géodésique.

L'Association peut aussi représenter l'Union au sein de Commissions inter-Unions ou de Comités spéciaux communs traitant de sujets en rapport avec ses propres études.

La désignation des représentants de l'Association ou de l'Union à ces organismes permanents est faite par le Comité Exécutif. Ces représentants sont élus pour une période et peuvent être ré-élus pour une période supplémentaire.

IX- *Finances*

52. Les *ressources* de l'Association proviennent:

a) des cotisations des pays membres de l'Union dont une partie, déterminée par le Conseil de l'Union sur recommandation de son Comité des Finances, est versée à l'Association par le Trésorier de l'Union;

b) de la vente des publications;

c) de toute autre origine (subventions, dons, intérêts, fonds disponibles après un symposium, etc...).

53. Le Secrétaire Général reçoit du Bureau et du Conseil de l'Association, la responsabilité de gérer ces ressources conformément aux Statuts et Règlement Intérieur, ainsi qu'aux décisions du Conseil et aux recommandations du Comité des Finances de l'Union.

Le Secrétaire Général est seul responsable de la maîtrise des opérations financières de l'Association, cependant un Secrétaire Adjoint reçoit délégation de signature pour chaque compte bancaire ouvert au nom de l'Association.

54.A chaque Assemblée Générale Ordinaire de l'Association, le Secrétaire Général présente la proposition de budget pour la période à venir et la soumet au Conseil pour approbation.

Le budget, tel qu'approuvé par le Conseil, est exécuté par le Secrétaire Général.

A l'Assemblée Générale ordinaire suivante, le Conseil examine si les dépenses ont été engagées conformément aux propositions précédemment approuvées. Le Conseil désigne un Comité ad hoc pour effectuer cet examen dans le détail.

De plus, cette comptabilité est vérifiée par un comptable agréé et est ensuite présentée au Trésorier de l'Union, selon les prescriptions de l'Art. 20 du Règlement Intérieur de l'Union.

STATUTES AND BY-LAWS

I- *Definition and objectives of the International Association of Geodesy*

1. The *International Association of Geodesy*, hereafter called the Association, is one of the constituent associations of the *International Union of Geodesy and Geophysics*, hereafter called the *Union*.

2. The *objectives* of the Association are :

a) to promote the study of all scientific problems of geodesy and encourage geodetic research;

b) to promote and coordinate international cooperation in this field, and promote geodetic activities in developing countries;

c) to provide, on an international basis, for discussion and publication of the results of the studies, researches and works indicated in paragraphs a) and b) above.

3. To achieve these objectives, the Association shall comprise a small number of Sections, each of which deals with a distinct part of geodesy.

Commissions, Special Commissions and Special Study Groups may be formed as provided in the By-Laws.

4. Every country adhering to the Union *(Member Country)* may be represented by Delegates to the Association.

4A. Scientists may become *Affiliates* of the Association, either as *Fellows* or *Associates*, as provided in the By-Laws.

II- *Administration*

5. The *General Assembly* of the Association shall consist of the Delegates of the Member Countries duly accredited by the corresponding Adhering Bodies, as defined in the Statutes of the Union.

6. The ***Council*** of the Association shall consist of the *Delegates*, known as Council Delegates, designated for meetings of the Council and formally accredited by the Adhering Body of Member Countries on the basis of one Delegate for each Member Country. Each Council member shall be an Associate or a Fellow of the Association.

No member of the Bureau of the Association shall serve as a Council Delegate of a country. The President of the Association shall preside over the Council meetings, without vote, except in the case of a tie as provided in article 16 hereafter.

7. Responsibility for the direction of the Association affairs shall be vested in the Council of the Association. Decisions of the Council shall be reported to the General Assembly. In the case that the majority of those present at a General Assembly meeting disagrees with the decisions of the Council, the Council shall reconsider the question, and make a decision, which shall be final.

8. Between meetings of the Council, the direction of the affairs of the Association shall be vested in the *Bureau* and the *Executive Committee*, the respective composition and responsabilities of which are defined hereafter.

9. The ***Bureau*** of the Association shall consist of the *President*, the *First Vice-President* and the *Secretary General*, all of whom shall be elected by the Council. The duties of the Bureau shall be to administer the affairs of the Association in accordance with these

Statutes and By-Laws and with the decisions of the Council and the Executive Committee.

10. The ***Executive Committee*** shall consist of the *Bureau*, the *immediate past President* and the *Second Vice-President* of the Association, and the *Presidents of the Sections.*

The Honorary Presidents and the Honorary General Secretaries of the Association, the Presidents of Commissions, the Secretaries of the Sections, the Assistant Secretaries of the Association and the Chief Editor of the Bulletin Géodésique may attend any meeting of the Executive Committee of the Association, with voice but without vote.

The duties of the Executive Committee shall be to further the scientific objectives of the Sections and other scientific bodies of the Association through effective coordination and through the formulation of general policies to guide the scientific work of the Association.

The members of the Executive Committee shall attend meetings of the Council, with voice but without vote.

III- Voting

11. A Council Delegate may represent only one Member Country.

A Member Country which is not represented at a Council meeting may vote by correspondence on any specific question, provided that the matter has been clearly defined on the final agenda distributed in advance to the Member Countries and that the discussion thereon has not produced any significant new considerations or changed its substance, and provided that the said vote has been received by the President prior to the voting.

12. In order that the deliberations of the Council shall be valid, the number of the Council Delegates present must be at least half of the Member Countries represented at the General Assembly of the Union.

13. On questions not involving matters of finance, the voting in Council shall be by Member Countries, each Member Country having one vote, provided that its Union subscriptions shall have been paid up to the end of the calendar year preceding the voting.

14. On questions involving finance, the voting in Council shall be by Member Countries, with the same provision that a voting country shall have paid its Union subscriptions up to the end of the calendar year preceding the voting in Council. The number of votes allotted to each Member Country shall then be equal to the number of its category of membership as defined by the Union.

15. Before a vote in a Council meeting, the President shall decide whether or not the matter under consideration is financial in character and whether the procedure of voting by correspondence applies.

16. Decisions of the Council shall be taken by a simple majority, except as otherwise specified in these Statutes. If a tie should occur in a Council vote, the President shall cast the decisive vote. Simple and two-thirds majorities are determined by the proportion of affirmative votes to the sum of all votes (affirmative, negative and abstention). Blank and invalid ballots and votes not cast by delegates present are counted as abstentions.

IV- General

17. Proposals for a change of any article of the Statutes of the Association must reach the Secretary General at least six months before the announced date of the Council meeting at which it is to be considered. The Secretary General shall notify all Member Countries of any proposed change at least four months before the announced date of the Council meeting.

18. The Statutes of the Association may not be modified except by the approval of a two-thirds majority of votes cast at a Council meeting.

These Statutes or any further modification of them shall come into force at the close of the Council meeting at which they are approved.

19. The Council shall have the power to adopt By-Laws within the framework of the Statutes of the Association.

These By-Laws may not be modified except by a simple majority of votes cast at a Council meeting.

These By-Laws or any further modification of them shall come into force at the close of the Council meeting at which they are approved.

20. In the event of the dissolution of the Association, its assets shall be ceded to the Union.

21. Conduct of meetings : Except as otherwise provided in the Statutes or By-Laws, business meetings shall be conducted according to Robert's Rules of Order.

22. These Statutes and By-Laws of the Association are set out in French and in English.

The validity of these rules shall not be vitiated by any error of a formal or accidental nature.

II- BY-LAWS

I- Structure

1. The scientific work of the International Association of Geodesy is allocated to *Sections*, the respective responsabilities of which are decided by the Council on recommendation of the Executive Committee. The structure of these Sections shall be reviewed every eight years (two periods) by a committee, called the Cassinis Committee, which shall make proposals to the Executive Committee. Because of the complex interrelations among various activities of the Association, interactions between the individual sections are implied.

There are at present ***five sections*** which are the following :

- **Section I** : *Positioning.*
  . high precision horizontal and vertical networks;
  . satellite and spatial positioning;
  . inertial positioning;
  . kinematic positioning;
  . geodetic astronomy;
  . marine positioning;
  . refraction.

- **Section II** : *Advanced Space Technology.*
  . development of space techniques for geodesy, such as: satellite radio-tracking techniques, radio-interferometric techniques, satellite and lunar laser ranging, satellite altimetry, satellite-to-satellite tracking, satellite gradiometry, geodetic measurements from space;
  . orbital computations;
  . direct results of such techniques;
  . planetary and lunar geodetic techniques.

- **Section III** : *Determination of the Gravity Field.*
  . absolute and relative terrestrial gravity measurements;
  . non tidal gravity variations;
  . determination of the external gravity field and the geoid from gravimetry, gradiometry, geodetic astronomy, space and inertial techniques;
  . reduction and estimation of gravity field quantities.

- **Section IV** : *General Theory and Methodology.*
  . general mathematical models for geodesy;
  . statistical and numerical analysis;
  . data processing and management;
  . optimization methods;
  . least squares methods;
  . differential and integral theories of the gravity field;
  . theory of estimation, approximation and representation of the gravity field.

- **Section V** : *Geodynamics.*
  . reference systems;
  . monitoring and study of time-dependent phenomena: polar motion, Earth rotation, Earth tides, recent crustal motions, variations of gravity, sea surface topography and mean sea level;
  . geodetic aspects of international geodynamic projects;
  . planetary and lunar dynamics;
  . geophysical interpretation of gravity and related data.

1A- Each Section shall set up a ***Steering Committee*** consisting of the Section President, the Secretaries, the Presidents of Commissions and Special Commissions within the Section, and such other persons, who have participated in the work of the Section, as are coopted to the Committee, on the recommendation of the Section President.

2. ***Commissions*** may be formed for activities for which close international cooperation or organization is necessary, in particular for long term problems or activities relating to large regions.

Every Member Country of the Union is entitled to nominate one representative to each Commission, except those dealing with specific geographical areas; to the latter Commissions, only Member Countries of the Union in the geographical area in question are entitled to nominate one representative each.

A Commission is normally assigned to one Section.

Each Commission may be organized according to its own requirements in compliance with the Statutes and By-Laws of the Association and subject to approval by the Executive Committee, for instance through the formation of regional Sub-Commissions.

2A- ***Special Commissions*** may be formed to study scientific problems of a long term character which require close cooperation between specialists from different countries.

A Special Commission is normally assigned to a particular Section. Each Special Commission may be organized to its own requirements in compliance with the Statutes and By-Laws of the Association and subject to the approval by the Executive Committee, for instance through the formation of special Sub-Commissions to study defined aspects in its field.

3. ***Special Study Groups*** may be formed to study specific scientific problems of limited scope which require close cooperation between specialists from different countries.

A Special Study Group is normally assigned to a particular Section.

4. The setting-up and dissolution of the Commissions, the Special Commissions and the Special Study Groups are decided by the Executive Committee which also specifies whether the Commission, the Special Commission or the Special Study Group is to be placed under the direct authority of the Association or of one of its Sections.

The list of Commissions, Special Commissions and Special Study Groups shall be published in the Geodesist's Handbook after each General Assembly.

5. The Association may also participate in joint scientific bodies with other Associations of the International Union of Geodesy and Geophysics, or, representing this Union, with other Unions. These bodies shall be administered according to specific rules proceeding from their relations with other agencies, but they shall report on their scientific work at each General Assembly of the Association.

The Executive Committee of the Association shall decide whether the relationship with any such common body is to be placed under the responsibility of the Association or of one specific Section. This responsibility includes the appointment of representatives to these common bodies as well as participating in the planning of their future activities.

II- Elections.

6. Elections shall take place in the Council during each Ordinary General Assembly of the Association.

The President in office, after taking advice from members of the Executive Committee, shall appoint a *Nominating Committee* consisting of a Chairman and three other members. The Nominating Committee, after taking advice from the Adhering Bodies of the Member Countries and officers of the Association, shall propose a candidate for each position to be filled by election in the Council. Candidates shall be asked to signify their acceptance of nomination and to prepare a resume, maximum 150 words, outlining their position, research interests and activities relating to the Association. The delegates shall be informed of these nominations and the resumes, early in the General Assembly, and a notice posted allowing for submission, over a period of at least 48 hours, of further nominations. Such nominations shall be in writing, shall be supported by at least two members of the Council, and shall be submitted with resumes as described above to the Secretary General. Delegates shall be informed of these further nominations and resumes and of their supporters.

Elections shall be by secret ballot.

No person may hold more than one of the following offices at the same time : President of the Association, Vice-President, President of a Section and President of a Commission and a Special Commission.

7. The time interval between the closures of two successive Ordinary General Assemblies of the Association is called here *a period.*

8. The ***President*** of the Association is elected for one period. He may not be immediately re-elected to this office, but the Council may appoint him as *Honorary President.*

9. The ***First*** and ***Second Vice-Presidents*** are elected for one period and may not be immediately re-elected to the same office.

10. deleted.

11. The ***Secretary General*** is elected for one period initially. He may be re-elected for two additional single periods.

12. The same rules as in Art. 11 apply to ***Assistant Secretaries***, other than the Assistant Secretary appointed under Art. 37A.

13. A member of the Bureau or of the Finance Committee of the Union may not occupy the post of *President*, of First *Vice-President* or of *Secretary General* of the Association.

14. Should the position of President become vacant in the interval between two Ordinary General Assemblies, his duties devolve to the First Vice-President until the closure of the next Ordinary General Assembly. In the same way the duties of the First Vice-President then devolve on the Second Vice-President.

Should the post of Secretary General become vacant, the President shall arrange without delay for the Executive Committee to elect a replacement by correspondence so as to ensure the continuity of the work of the Central Bureau. This election has effect until the closure of the next Ordinary General Assembly.

15. The ***Presidents of Sections*** are elected for one period and may not be immediately re-elected to the same office.

16. The ***Secretaries of Sections*** are elected for one period but may be re-elected for one further period.

The President of each Commission which is in a Section shall be a Secretary of that Section. The maximum number of Secretaries in a Section shall be two, except where the number of Commissions in a

Section is greater than one, the number of Secretaries shall then equal the number of Commissions plus one.

17. Should the position of President of Section become vacant between two Ordinary General Assemblies, the Executive Committee shall appoint an interim member to take office until the closure of the next General Assembly.

Should other vacancies occur, the Executive Committee may make interim appointments.

18. The ***Presidents of Commissions*** and ***Special Commissions*** are elected by the Council of the Association for one period and may be immediately re-elected for one further period.

19. The ***Chairman of a Special Study Group*** is appointed by the Executive Committee for one period only.

20. A person may be President or Chairman at the same time of no more than one of the bodies referred to in Arts. 18 and 19.

III- General Assemblies.

21. The Association shall hold its own Ordinary General Assemblies in conjunction with the Ordinary General Assemblies of the Union, at the same time and in the same country.

22. Before any General Assembly, a detailed agenda is prepared by the Bureau of the Association. As far as the scientific work is concerned, the agenda is drawn up by the Executive Committee. This agenda is sent to the member countries and to all the officers of the Association so as to reach them at least two months prior to the Assembly. In principle, only matters on the agenda may be considered during the sessions, unless a decision to do otherwise is passed by a two-thirds majority in the Council or in the Executive Committee.

23. At each General Assembly, the President of the Association shall present a detailed report on the scientific work of the Association during his tenure. The Secretary General shall present a detailed report on the administrative work and on the finances of the Association for the same period. They both should submit proposals regarding work to be undertaken during the coming period, within the limits of expected resources.

These reports are handed to the delegates attending the General Assembly before the opening of the Assembly.

24. The scientific meetings generally take place Section by Section, but the study of some questions may require joint meetings of several Sections or Symposia under chairmen appointed by the Executive Committee.

Joint Symposia covering topics interesting two or more Associations within the Union may be arranged.

25. At each General Assembly, the work of each Section shall be reported by its President assisted by his Secretaries. Similarly, the work of each Commission, Special Commission or Special Study Group shall be reported by its President or Chairman.

26. The inclusion on the agenda of scientific papers for presentation at sessions of the General Assembly is decided by a committee consisting of one member of the Bureau and the Presidents of Sections.

27. Individual authors are responsible for the reproduction of their scientific papers. These papers are distributed to the delegates by the Central Bureau prior to the meeting where they are presented. They may be published in the Bulletin Géodésique subject to its editorial policy.

IV- Publications.

28. The Association's journal is the **Bulletin Géodésique**, hereinafter referred to as the *Journal*. The journal is published at regular intervals, through an agreement between the Association and a publishing company, or by other arrangement approved by the Executive Committee. The terms of any agreement for publication of the journal shall be negotiated by the President and ratified by the Executive Committee.

There shall be one or more *Editors-in-Chief* for the journal, hereinafter referred to as the *Editor*. The Editor shall be advised and assisted by a *Board of Editors*, hereinafter referred to as the *Board*.

The Editor shall be responsible for the scientific content of the journal. All scientific manuscripts shall be subject to a refereeing process and the Editor shall make the final decision on whether a manuscript is accepted for publication. The Editor shall keep the Association informed of the activities and status of operations of the journal.

28A. At the time of each General Assembly, the Editor shall, in consultation and agreement with the President of the Association, recommend candidates for membership of the new Board, which is to hold office for the next period. During the Assembly, the current Board shall elect the members of the new Board from those recommended. After taking office, the new Board shall elect one, or more, Editors(s) for the next period. The nomination of the Editor(s) shall be approved by the Executive Committee.

The Editor and the members of the Board, shall each hold office for one period, but shall be eligible to be elected for one further period.

28B. After each General Assembly, a special issue of the Bulletin Géodésique shall be published under the name of *"Geodesist's Handbook"*. This issue aims at providing detailed information on the Association, its structure and scientific activities, and other relevant technical and administrative information.

29. After each General Assembly, a collection of the reports presented by the Sections, Commissions and Special Study Groups shall be published in the *"Travaux de l'Association Internationale de Géodésie"*. This publication is supplied free of charge to the Officers of the Association and to the Adhering Body of each Member Country.

30. The Association also issues ***special publications*** which contain information on recommended standards in geodesy.

31. At every General Assembly each Member Country of the Union is invited to supply an adequate number of copies of its National Report on geodetic work done since the previous General Assembly. These **National Reports**, as far as available, are distributed by the Central Bureau of the Association in the same manner as the "Travaux de l'Association Internationale de Géodésie".

V- Administration.

32. The ***Council*** of the Association shall :

a) examine questions of general scientific policy or administration in the business of the Association and appoint such Committees as may, from time to time, be deemed necessary for this purpose;

b) elect the members of the Bureau and of the Executive Committee, the Assistant Secretaries of the Association, the Secretaries of Sections, the Presidents of Commissions and of Special Commissions;

c) receive reports from the Secretary General and consider for approval the decisions or actions taken by the Bureau and the Executive Committee since the last Council meeting;

d) appoint the three members of the ad hoc committee created for examining the finances of the Association, consider its recommendations and adopt the final budget;

e) consider proposals for changes in the Statutes and By-Laws;

The Council is convened by the President of the Association. It shall normally meet during the Ordinary General Assemblies.

33. The ***Executive Committee*** of the Association shall :

a) initiate actions and issue guidelines, as required, to guide the Association towards the achievement of its scientific objectives;

b) fill vacancies occuring between General Assemblies, in accordance with the present Statutes and By-Laws;

c) set up and dissolve Commissions, Special Commissions and Special Study Groups;

d) appoint Chairmen of Special Study Groups, and approve the election of the Editor(s) in Chief of the Bulletin Géodésique;

e) appoint members of the Cassinis Committee;

f) make recommendations to the Council on matters of General policy of the Association and on the implementation of its objectives;

g) on the recommendation of the Bureau, appoint Fellows and Associates of the Association. Past officers of the Association, including those of the Commissions and sub-Commissions, shall be eligible for appointment as Fellows and shall be invited to become Fellows of the Association. Persons elected as officers of the Association or nominated as members of Commissions, Special Commissions, or Special Study Groups, shall automatically become Associates of the Association. Persons from Member Countries who apply, indicating previous participation in Association activities, or providing a recommendation from their national Adhering Body or a recommendation from an officer or a Fellow of the Association, shall be eligible to become Associates, and shall be recommended by the Bureau.

The Executive Committee is convened by the President of the Association, it shall meet at General Assemblies and its members shall attend the meetings of the Council, with voice but without vote. It shall also meet normally at least once betwen General Assemblies, one year ahead of the General Assembly, in order to prepare the scientific agenda and the time-table during the next General Assembly.

At a meeting of the Executive Committee, no member may be represented by any other person, except a President of a Section who may be represented by a Secretary of his Section. In order that the deliberations of the Executive Committee shall be valid, half at least of its members must be present or represented.

The agenda for each meeting of the Executive Committee shall be prepared by the Bureau and sent to the members at least three months prior to the meeting.

34. The ***Bureau*** of the Association shall :

a) draw up the agenda of the meetings of the Council and Executive Committee;

b) ensure the adequate administration of the Association. It shall normally meet before each meeting of the Executive Committee.

35. The ***President*** of the Association shall :

a) be the representative of the Association in its dealing with National or International Organizations or Institutions;

b) convene and preside over the General Assembly and over all meetings of the Council, Executive Committee and Bureau;

c) submit a report to the General Assembly on the scientific work of the Association during his tenure;

He is a member of the Executive Committee of the Union. In case of his absence, the *First Vice-President* shall act.

36. The ***Secretary General*** shall :

a) serve as secretary of the General Assembly, the Council, the Executive Committee and the Bureau, arrange for meetings of these bodies, prepare and distribute promptly the agenda and the minutes of all their meetings;

b) be the Director of the Central Bureau;

c) manage the affairs of the Association, attend to correspondence, preserve the records;

d) circulate all appropriate information related to the Association;

e) prepare the reports on the Association's activities, especially report to the General Assembly on the administration and the finance of the Association during the current period;

f) perform such other duties as may be assigned to him by the Bureau.

37. To assist the Secretary General in the performance of his duties to the Association, the Association establishes a permanent agency, the Central Bureau, including a variable number of employees paid out of Association funds.

The Secretary General is also assisted by a small number of *Assistant-Secretaries*, one of whom is located in the same office as the Secretary General. All these functions are unpaid and only expenses incurred in connection with them are repayable.

37A. An additional *Assistant Secretary* to be known as the *Assembly Secretary* may also be appointed by the Council on the recommendation of the Adhering Body of the country in which the next General Assembly takes place. If this procedure is not feasible then the Council may delegate the appointment to the Bureau.

In cooperation with the Central Bureau, this Assistant Secretary has responsibilities for liaison with the organizers working on the preparation of the General Assembly. This Assistant Secretary shall be appointed for one period only.

VI- Activities of Sections, Commissions, Special Commissions and Special Study Groups.

38. The ***President of a Section*** is responsible for the scientific development within the area of his Section and is the representative of his Section on the Executive Committee of the Association. Working closely with the Steering Committee he shall encourage, guide and coordinate the work of the Commissions, Special Commissions and Special Study Groups within his Section, and in particular keep the officers of his Section as well as the Bureau of the Association informed of the Section's activities, on an annual basis.

It is desirable that the President of a Section, or else one of the Secretaries of the Section, should attend each of the Symposia related to the Section.

Before each General Assembly the President of a Section shall receive the reports of the Commissions, Special Commissions and Special Study Groups within his Section and, assisted by the Steering Committee, prepare a report on the activities of the Section to be presented at the General Assembly.

He shall receive suggestions for new Special Study Groups, and suggestions for continuation of existing Special Study Groups under Art. 43, and, after consulting his Section Steering Committee, shall coordinate them and transmit his recommendations to the Executive Committee.

Each ***Section Steering Committee*** shall meet at least once during each Ordinary General Assembly and on at least one other occasion during the period. At the General Assembly meeting, or on some other appropriate occasion, the Steering Committee shall review the activities of Commissions, Special

Commissions and Special Study Groups over the past period, and, for those which will be recommended for continuation, review their programmes for the forthcoming period.

The ***Section Secretaries*** assist the Section President in his duties.

39.The ***President of a Commission*** is responsible for initiating and directing its work and selecting its members, apart from those representatives of Member Countries appointed under Art. 2.

The President of each Commission shall issue a brief description of the work to be performed and a list of members, to be published in the Geodesist's Handbook after each General Assembly.

To assist communication and cooperation within each Commission, members should be informed, on an annual basis, of results achieved and of outstanding problems.

39A. The ***President of a Special Commission*** is responsible for initiating and directing its work and selecting its members. Special Commission membership should be balanced so as to reflect international cooperation in the subject and shall be limited to a number not exceeding 30.

The President of each Special Commission shall issue a brief description of the work to be performed and a list of members, to be published in the Geodesist's Handbook after each General Assembly.

To assist communication and cooperation within each Special Commission, members should be kept informed, on an annual basis, of results achieved and of outstanding problems.

40. The ***Chairman of a Special Study Group*** is responsible for initiating and directing its work and appointing its members. Special Study Group membership should be balanced so as to reflect international cooperation in its subject and shall be limited to a number not exceeding 20.

The Chairman of each Special Study Group shall issue a brief description of the work to be performed and a list of members, to be published in the Geodesist's Handbook after each General Assembly.

To assist communication and cooperation within each Special Study Group, members should be kept informed, on an annual basis, of results achieved and of outstanding problems.

41. The President of the Association, the Central Bureau and the President of the relevant Section should receive copies of all official correspondence and of notices to members of Commissions, Special Commissions and Special Study Groups.

42. The reports of each Commission, Special Commission and Special Study Group should reach the President of each relevant Section at least three months before each General Assembly. These reports and the reports of the Sections are published in the "Travaux de l'Association Internationale de Géodésie".

43. The period of work of each Special Study Group normally ends at an Ordinary General Assembly. In the exceptional case that a continuation of the work is deemed necessary, the Special Study Group Chairman shall submit in writing a well-grounded proposal, including a suggestion for his successor, to his Section President, at least three months before the General Assembly. The Section President shall then make a recommendation to the Executive Committee.

44. Commissions, Special Commissions and Special Study Groups not assigned to one Section shall be under the responsibility of the President of the Association.

45. Commissions, Special Commissions and Special Study Groups are free to hold working meetings of their members. If they wish to arrange scientific Symposia, these are subject to the usual approval procedure for Symposia of the Association. Symposia should be arranged only if the topic transcends the frame of one Commisson, one Special Commission or one Special Study Group.

VII- Symposia.

46. The Association may organize scientific Symposia to study particular questions of wide interest.

The Executive Committee is responsible for a balanced selection of Symposia, to ensure a representative coverage of subjects and a good geographical distribution and to avoid duplication, overlap and undue frequency.

Symposia sponsored by the Association shall be freely open to all scientists, in accordance with ICSU regulations.

47. Normally applications for Symposia to be held in the period between two Ordinary General Assemblies should be submitted by the Host Organization to the Secretary General before the General Assembly preceding that period. During this General Assembly other applications may be submitted to the Secretary General at least two days before the last meeting of the Council.

The Council, on recommendation of the Executive Committee, shall decide whether the Symposium in question will be sponsored by the Association.

In exceptional cases, the Executive Committee may approve late applications. Such applications must be submitted at least 18 months before the proposed date for the Symposium.

48. The Symposium Organizer must send an official announcement of the Symposium to the Bulletin Géodésique at least one year in advance or immediately after the approval by the Association; the announced date of the Symposium must not be changed later.

49. Within three months after the Symposium, the Symposium Organizer shall provide a report to be published in the Bulletin Géodésique. This report should indicate whether, where, and when the Proceedings will be published. A copy of the Symposium Proceedings, or else one copy of each paper presented at the Symposium, shall be sent to the Central Bureau of the Association.

50. Sponsorship by the Association means only official recognition and does not imply financial support.

VIII- International Scientific Cooperation.

51. The Association may undertake directly, supervise or cooperate in scientific work of an international or interdisciplinary character. As a matter of principle, the Association should be represented at Congresses, International Meetings, General Assemblies, etc... of scientific organizations whose activities are connected with its own. The President of the Association or his designate will be the representative of the Association at these meetings.

Travelling and accommodation expenses of the Delegate of the Association may be charged, in whole or in part, to the Association. The Delegate shall prepare a report of the meeting, including the discussions relating to geodesy, which may be published, in whole or in part, in the Bulletin Géodésique.

The Association may also represent the Union in inter-Union Commissions or special joint Committees dealing with topics that are related to its own studies.

Elections of Association or Union geodetic representatives to those permanent bodies shall be made by the Executive Committee. These representatives shall be elected for one period and may be re-elected for one further period.

IX- Finance.

52. The *funds* of the Association derive from :

a) the contributions of the member countries of the Union of which a proportion, determined by the Council of the Union on recommendation of its Finance Committee, is paid to the Association by the Treasurer of the Union;

b) the sale of publications;

c) any other source (including grants, donations, interest, funds remaining after a symposium, etc...).

53. The Secretary General is responsible to the Bureau of the Association and to the Council for managing the funds in accordance with the Statutes and By-Laws, with the decisions of the Council and with the recommendations of the Finance Committee of the Union.

The Secretary General alone shall be responsible for control of the financial operations of the Association; however for each bank account of the Association, there shall be one Assistant Secretary who shall also have access to the account.

54. At each Ordinary General Assembly of the Association the budget proposal for the ensuing period shall be presented by the Secretary General and submitted for approval to the Council.

The budget as approved by the Council shall be implemented by the Secretary General.

During the next Ordinary General Assembly, the Council shall examine all expenditures to ensure that they were in accordance with the proposals previously approved. The Council shall appoint an *ad hoc* committee for carrying out this examination in detail.

In addition, these accounts shall be audited by a qualified accountant and shall then be reported to the Treasurer of the Union, as prescribed in Art. 20 of By-Laws of the Union.

GUY BOMFORD PRIZE, LEVALLOIS MEDAL

Rules For The Award Of The Guy Bomford Prize

Purpose: the Guy Bomford Prize is awarded by the International Association of Geodesy for outstanding contribution to Geodesy. It was established by the British National Committee for Geodesy and Geophysics to mark the contributions to geodesy of Brigadier G. Bomford, formerly of the University of Oxford and a Past President of the International Association of Geodesy. It has been inaugurated by the I.A.G. in 1975. The Prize is normally awarded at intervals of four years on the occasion of the General Assembly of the I.A.G. held concurrently with the General Assembly of the International Union of Geodesy and Geophysics. The following rules for the award of the Guy Bomford Prize may be altered by the I.A.G. Executive if a majority of its voting members sees a necessity to do so.

Eligibility: The Guy Bomford Prize is awarded to a young scientist or to a team of young scientists for outstanding theoretical or applied contributions to geodetic studies, particularly in the four year period preceding the General Assembly at which the award is made. Scientists who are under 40 years of age on December, 31, of the year preceding the Assembly at which the award is made, are eligible for the award.

Nominations: Nominations will be invited by the I.A.G. Bureau from all National Committees of I.U.G.G. member countries at least one year ahead of the General Assembly. Each committee can make one nomination which has not necessarily to be from its own country. The deadline for nominations will normally be six months before the next General Assembly and will be explicitly started in the letter of invitation.

Nominations must be accompanied by:

- The full name, address, age, academic and/or professional qualifications and position of the candidates and the name of the National Committee making the nomination.

- An outline of the reasons for the nomination including a general summary of the career and scientific achievement of the candidate.

- A review of the recent achievements of the candidates which would merit the award, including references to key papers, published, alone or jointly, during the preceding four-year period.

- A curriculum vitae, publication list, and copies of up to two key papers which are considered to justify candidature.

- The name and address of two referees who could be consulted.

Selection procedure: A screening committee will be appointed consisting of the presidents of the I.A.G. Sections and two other members to be appointed by the I.A.G. Bureau. Based on the material submitted by the National Committees, each member of the screening committee will rank the nominations and send a short list of three to the I.A.G. Bureau. The decision among the three top ranking candidates will be communicated to all National Committees, and the successfull candidate(s). The Prize may be withheld if, in the opinion of the I.A.G. Bureau, there is no sufficiently qualified candidate.

Presentation of award: The Prize shall be presented to the successfull candidate at the opening Plenary Session of the I.A.G. Assembly. He or she shall be invited to deliver a lecture during the course of the I.A.G. Assembly.

Levallois Medal

The **Levallois Medal** was established by the International Association of Geodesy in 1979 to honour **Jean-Jacques Levallois**, and to recognize his outstanding contribution to the I.A.G., particularly his long service as Secretary General, 1960-1975.

The award of the Medal will be made in recognition of distinguished service to the Association, and/or to the science of geodesy in general.

The Medal is normally awarded at four year intervals, on the occassion of the General Assemblies of the International Association of Geodesy and International Union of Geodesy and Geophysics; but the award may be omitted if it is considered that there is no candidature of sufficient merit, and an additional award may be made at any time if justified by exceptional circumstances.

A nomination for the award shall be made by an ad hoc committee consisting of the Honorary Presidents and must be confirmed by the I.A.G. Executive Committee. The ad hoc committee shall prepare a citation, suitable for publication, setting out the grounds for the proposed award before the General Assembly.

PRESIDENTIAL ADDRESS

International Association of Geodesy
XXth IUGG General Assembly
Vienna, August, 1991

by Ivan I. Mueller

I- *Introduction*

It is my pleasure to use this opportunity to report on the accomplishments of IAG during the last quadrennium and also provide a few suggestions for the future. With your permission I will be relatively brief on the accomplishments since most probably they will also be reported on by the Secretary General, and spend more time on the future, but first I would like to express a special welcome to representatives of our sister organizations: Mr. Juha Talvitie, President, International Federation of Surveyors; Professor Kennert Torlegard, President, International Society of Photogrammetry and Remote Sensing; and Professor Fred Christ of the International Cartographic Association.

I also would like to give special greetings to the IAG Past Presidents present: Dr. Charles Whitten (1960-63), Professor T.J. Kukkamaki (1975-79), Professor Helmut Moritz (1979-83), and Dr. Peter Angus-Leppan (1983-87), as well as to this year's IAG award winners: Professor Paul Melchior, Levallois Medal recipient, and Dr. Shuhei Okubo, winner of the Bomford Prize.

Please also remember colleagues who are no longer with us: Rudolf Conzett, Suzanne Coron, Edward Flinn, Robert Lecolazet, ShingHai Li, James Marsh, Horst Peschel, Georg Strasser, Bela Szabo, among others.

II- *Internal accomplishments*

The main internal accomplishments which will affect the future of the Association are primarily organizational in nature and are the result of deliberations of our Cassinis Committee. As you know, the function of the Cassinis Committee is to provide continuous review of the structure of the organization. It is through these continuous reviews that we try to prevent senility from setting in in our 125-year-old association. Review alone of course is not sufficient because without communication we will become senile fast because things are changing fast. Most of the internal changes are aimed at improving communications and are pending the approval of the Council:

The establishment of Fellows and Associates of the IAG serves the purpose of encouraging two-way communication between current officers and those individuals who have had an earlier role in the life of the association. We hope that these informal types of "memberships" will make the IAG a permanent home for all geodesists involved in international activities.

The inclusion of the presidents of most of the permanent Commissions in the Executive Committee (at the expense of electing fewer Section secretaries) is another way of improving communication. In the past, the Commissions, where a great deal of work between General Assemblies takes place, had great difficulty in influencing in a timely fashion the work of the Executive Committee.

The new Special Commissions (six are proposed) will be organizations situated between our Special Study Groups, having a lifetime of only four years, and the permanent Commissions, which provide continuity for project-type activities. Long-term investigations are planned within these Special Commissions.

Changes in the election rules should make the procedure not only more democratic but also will enable us to reach out for the best available candidates for all IAG offices.

Restricting the membership of the Council to IAG Associates or Fellows in the future will make the Council's work more meaningful and responsive to IAG needs due to the fact that all Council members who are appointed by the National Committees will have had previous involvement in IAG activities.

III- *External accomplishments*

1. Publications

On the external side a number of significant events are to be reported. Among these probably the most significant, from the point of view of its long lasting effect, are the agreements between IAG and Springer Verlag making Springer in practice the official publisher of IAG and therefore of international geodesy. These agreements call for the publication of the *Bulletin Géodésique* from this year on, as well as the coordination of articles between the *BG* and *manuscripta geodaetica*, also published by Springer, through a single editorial structure. It is hoped this arrangement will provide a much greater visibility of a unified international geodetic community to the outside world.

Springer has also been designated as the publisher of the proceedings of all IAG-organized symposia. This effort has already resulted in some 12 volumes either published or in production.

2. Cooperation with Other International Organizations

I am happy to report that after years of negotiations finally IAG is in a position to join the **International Union of Surveys and Mapping.** The negotiations primarily resulted in satisfactory modifications of the original IUSM statutes. We are looking forward to close cooperation with the societies which are members of IUSM—namely, FIG (International Federation of Surveyors), ISPRS (International Society of Photogrammetry and Remote Sensing), ICA (International Cartographic Association)—to foster the influence of geodesists in the mapping sciences.

With the **International Astronomical Union** we have established the International Earth Rotation Service which started its activities on January 1, 1988, following ten years of experimentation through the MERIT Campaign. In addition, we set up a number of joint working groups such as the one on fundamental constants to assure better communication.

With the **International Hydrographic Office** we are establishing a working group on the Geodetic Aspects of the Law of the Sea (GALOS), and with IAPSO, a group on various aspects of mean sea level determination

I should emphasize also the recent memorandum of understanding with the **Pan-American Institute of Geography and History** (PAIGH) to encourage cooperation with our colleagues in Latin America. This agreement already resulted in two jointly organized symposia. The first one was held in San Jose, Costa Rica, on the occasion of the 14th General Assembly of the PAIGH, February, 1990; the second one will take place during this General Assembly.

All in all, we have ten representatives in other international organizations.

3. New Initiatives

New and forthcoming initiatives include placing more emphasis on education which will be looked upon as a joint activity with IUSM—a steering group is to meet during this General Assembly to set up plans for an IUSM Working Group on the subject in which IAG will take an active role. The first meeting on education organized by the new Working Group will be during the 1992 ISPRS Congress in Washington, D.C.

During the past year the IAG Executive Committee formed a planning group which worked hard to prepare a proposal for the establishment of **an International GPS Service for Geodynamics** (IGS). The report of the planning group which will be presented during this Assembly calls for a test campaign during 1992. Some 200 organizations expressed interest in participation in this carnpaign which, it is hoped, will lead to an international service during the next few years. The IGS activities will be coordinated by our CSTG Commission.

Another significant initiative is our proposed **Special Commission on Geodesy in Engineering.** We hope that this new group, together with FIG, will provide a forum for those colleagues who are involved in the engineering aspects of geodesy.

Initiatives discussed but without tangible results, and which need to be jump started include external fundraising for the IAG, possibly through our new "membership," and effective IAG participation in ICSU programs such as the International Geosphere-Biosphere Programme: A Study of Global Change.

This General Assembly is to culminate four years of scientific activities during which IAG sponsored 25 symposia on specialized topics and a General Meeting in Edinburgh which in 1989 celebrated our 125th anniversary. During this Assembly we will have three symposia, three joint Section meetings, and five individual Section meetings with a total of over 400 presentations. These numbers alone indicate that geodesy is active and in good health.

IV- *IAG's new role in the future (?)*

IAG's main business is facilitating scientific communications among active geodesists; meetings and publications are its main products, and IAG is very good

at producing both. However, paraphrasing recent comments of Don Anderson, past president of the American Geophysical Union, this is not enough anymore. Geodesists must communicate their results and their concerns to the general public and to decision makers. The public relations, public information, and educational aspects of IAG are becoming increasingly important. These are essential to the health and survival of our science. Our officers and "new" Fellows and Associates must be involved in guiding public policy and extending public awareness. We must continue to increase the visibility of geodesy, defined broadly in all its aspects, that is, its geophysical, mapping and engineering aspects. Quoting Don Anderson,

Our science is a global science and we must cooperate with other earth and planetary organizations regardless of their location. Earth scientists have a responsibility to their planet that goes beyond communicating interesting results to each other. We cannot completely understand what we are doing to our planet or what it might do to us if we let national political boundaries limit the breadth of our inquiries.

In other words, we must learn how to be active and how to shape science policy nationally as well as internationally instead of reacting to it. This, by the way, is of great importance not just in geodesy but in all of the Earth sciences, which fact brings me to the IUGG.

V- *Suggestions for the IUGG*

Several IUGG associations, and their programs, are not attracting enough attention among top maturing scientists in the younger generation. The critical roles that the Union formerly played in providing the main international forum for geodesy and geophysics no longer seem quite so important. Its original functions are also being eroded by an increasing number of ICSU committees and other international bodies. The Union seems to be on a slide from which it can only recover if it can recapture the interest and imagination of all the world's geophysical scientists. Its unique role in the developing world seems to be unaffected yet, but will soon slide for financial and other reasons.

The Union is also weakened by the lack of interaction among its constituent Associations. Both the Union and the Associations bear responsibility for this failure. The associations tend to treat IUGG General Assemblies as simultaneous association meetings rather than as unique opportunities for interdisciplinary programs. The Union administration, for its part, has not adequately involved the Associations in planning and management. The result is a lack of sense of responsibility among the Associations for the Union and its objectives.

This year, 1991, provides a window of opportunity for turning the Union around, and perhaps the last chance. For the first time in decades, the Union will be selecting a new President and a new Secretary General at the same time. The right team in the top three slots (President, Secretary General, and Vice President), if provided adequate financial and staff support, could initiate a program that would reinvigorate IUGG. The team approach is emphasized because the apparent slide of the Union can no longer be turned around by individuals acting alone. In the alternative, the unique functions that IUGG serves will disappear, much to the short- and long-term detriment of geophysics.

What are these unique functions, those that are unquestionably served best by IUGG? IUGG provides a neutral forum in which scientists from all countries can meet on an equal footing, a forum in which science interests are at the fore and national interests and political concerns very much in the background. That forum is also an interdisciplinary one that covers a very wide range of the earth and space sciences. The challenge to IUGG is to maintain this forum and to do the things that can uniquely be done in, and based on it. To maintain the forum the IUGG will need to :

- set up mechanisms for reaching national committees as well as individual scientists throughout the world. Make this a two-way street so that important information in geophysics from every corner of the world filters to every other corner.

- eliminate divisiveness among the associations and foster a cooperative atmosphere. Encourage more interassociation activity.

- assure continuing communication among the participants. Four- and two-year meetings and quarterly publications are not sufficient to command attention, much less to serve the needs of science in today's fast paced environment.

- assure that meetings of the Union are attractive to leading scientists and accessible to those with limited means.

- strengthen areas that can provide a basis for more interdisciplinary communication and which are essential to advancing understanding of the Earth system.

1. Suggested Actions

The leadership of the Union should form a team which is committed to change and growth and must be eager to work for it.

The Executive Committee and Bureau should meld in the decision-making process so that the Associations can feel ownership of the Union. For now this can be done within the Statutes simply by having the two

always meet together. For the future, one body is probably all that is necessary. The current situation where the presidents of the associations meet only once with each other and the Bureau between the assemblies to lead the Union is unacceptable. This leads to a lack of communication both between the associations and the Bureau to the detriment of all Union roles and functions.

The central administration should have access to more financial support. The "team," i.e., the President, the Vice President, and especially the Secretary General should travel widely and have funds to establish the kind of staff support and communication that is essential. The necessary funds should be raised both internally and externally. To maintain momentum between the meetings of committees and commissions, staff work is necessary. Volunteers can carry an activity only so far. The team will need staff support, and for the long term provision should be made to assure that ideas and plans are followed up on rapidly. Efforts should be made to hold large and small meetings where those in the less developed world can attend and those from the developed country will attend. Programs must be designed to serve the full spectrum of attendees. Opportunities to talk about international programs, standards, and techniques should always be made.

Establish an ongoing communication system that retains visibility for IUGG while taking advantages of new technology and existing networks of individual scientists such as regional and national societies. Assure that the Union's message regularly reaches scientists in every country with significant geophysics activity.

The Union and those concerned with geophysics should undertake a campaign to refocus around science and to reduce the distraction of ICSU committees that are problem or geographically oriented, and therefore require enormous new bureaucracies to pull them together. Inter-Union groups working through existing administrations can do the same job more effectively without sapping strength from the science. SCOR and SCAR, because of their strong inter-Union focus, have been reasonably successful; however, COSPAR has grown to divisive proportions and it appears that IGBP will do the same. Reorganization at the ICSU level is called for.

When the Associations pull together the Union will begin to gain credits. Then it will again become a more important and interesting place for all geophysicists. It is critical that this process begin immediately and that in the next four years several Union activities with the potential for being highly visible and successful should be picked out and nurtured by the staff of the Associations and the central office of the Union.

VI- *Concluding remarks*

Let me close with the story of a professor who is invited to give an after dinner speech and has taken the opportunity to speak at great length about a topic which interested almost no one but himself. As this professor droned on into the night showing no mercy toward his audience, a restless gentleman in the back of the room who had had far too much of both the speech and the wine staggered forward waving an empty wine bottle as a club. He walked up to the podium and took a swing at the speaker's head, but instead struck the head of an honored guest sitting next to the podium. The guest crashed to the floor and the shocked speaker looked down and asked, "Are you hurt?" The unsteady voice of the honoree came back just barely audible for all to hear, "Hit me again! I can still hear him."

So with this "hint" I thank you for your patience. And thank all of you who contributed to these successful four years: Special Study Group members; Commission members; *BG* authors and reviewers; presidents of Special Study Groups and of Commissions, bureaus and centers; Section secretaries; Section presidents; *BG* Editor-in-Chief and IAG assistant secretaries; the Bureau— Secretary General, Vice Presidents; the Council; contributors not listed above.

Have a successful and interesting meeting and a good time in this great city!

XXème Assemblée Générale de l'AIG
Rapport du Secretaire Général

Michel Louis

Le Secrétaire Général de l'Association Internationale de Géodésie a l'honneur de présenter à la XXème Assemblée Générale le rapport d'activité de l'Association qu'il a établi pour la période écoulée depuis la XXème Assemblée Générale.

Conformément aux Statuts et Règlement Intérieur le rapport du Secrétaire Général traite des activités administratives et des finances de l'Association, le rapport du Président présentant les activités scientifiques.

I - *Activités administratives de l'Association*

Ces activités ont été marquées, au cours de la période qui s'achève, par les réunions du Bureau et du Comité Exécutif où ont été prises les décisions qui engagent la politique de l'Association, par les travaux du Comité Cassinis, et par les publications qui diffusent l'information aussi bien scientifique qu'administrative.

1. Réunions du Comité Exécutif

Au cours de cette période, le Comité Exécutif a tenu deux réunions, à Paris, en mars 1988 et en mars 1990, et le Comité, réduit au Bureau et aux Présidents de Section, s'est également réuni à Paris en mars 1991. Ces réunions ont été précédées de réunions du Bureau.

Les comptes rendus détaillés des deux premières réunions ont été publiés dans le Bulletin Géodésique, Vol. 62, N°4 et Vol. 64, N°2. Une large partie des travaux de ces réunions a été consacrée à la préparation de la Réunion Générale (General Meeting) à Edimbourg, août 1989, et de la présente Assemblée Générale.

Parmi les autres principaux points traités on peut citer :

a) Les réflexions menées par des groupes ad hoc créés au cours de la réunion de mars 1988 sur :

- l'amélioration du fonctionnement de l'Union et de ses Associations en vue d'une meilleure participation des jeunes géodésiens et géophysiciens;

- les règles précises nécessaires à l'organisation et au suivi des réunions scientifiques organisées par l'AIG. Ces règles adoptées par le Comité Exécutif ont été publiées dans le BG Vol. 63 N°3 et elles s'appliquent aux symposiums organisés par l'AIG qui sont intégrés dans la série "symposiums de l'AIG", avec un numéro d'ordre officiel, et dont les communications présentées sont publiées par Springer Verlag, selon un accord passé avec l'AIG;

- la plaquette AIG, dont la mise au point et la sortie ont été quelque peu retardées, et qui est maintenant disponible;

- la "lettre d'information" (Newsletter) sur les activités de l'AIG, préparée par le Bureau Central et systématiquement publiée dans chaque Bulletin Géodésique;

- la possibilité de créer un fonds AIG permettant de subventionner les activités géodésiques dans les pays en développement, d'aider les jeunes géodésiens, et de financer de nouvelles publications. Les différentes approches pour réaliser ce fonds n'ont pas encore abouti, le prochain Comité Exécutif devra poursuivre ces études.

b) Les relations suivies avec les sociétés-sœurs : Fédération Internationale des Géomètres (FIG), Association Internationale de Cartographie (ACI) et Société Internationale de Photogrammétrie et de Télédétection (SIPT). Ces trois associations se sont récemment regroupées en une union (Union Internationale des Levés et de la Cartographie), non

membre du Conseil International des Unions Scientifiques, mais cependant fort intéressante pour l'AIG. Aussi après avoir demandé et obtenu quelques modifications des Statuts de cette nouvelle Union, le Comité Exécutif a décidé de présenter la candidature de l'AIG. Dès que la réponse de cette Union sera connue, le Conseil de l'AIG sera appelé à ratifier cette adhésion, qui permettra de renforcer les liens avec les géomètres, photogrammètres et cartographes et d'accroître l'influence de l'AIG dans ce milieu;

c) La nouvelle politique éditoriale de l'AIG : voir "Publications" ci-après;

d) Le rapport du Comité Cassinis : voir (2) ci-après.

2. Travaux du Comité Cassinis

Le Règlement Intérieur de l'AIG prévoit que la structure des Sections de l'AIG soit revue tous les huit ans (deux périodes) par un Comité, appelé Comité Cassinis, qui soumet ses porpositions au Comité Exécutif. Le Comité Cassinis créé à la dernière Assemblée Générale, composé de P.V. Angus-Leppan (Président) et de M. Bursa, R. Rummel, C.C. Tscherning, G. Veis et A.M. Wassef, a reçu pour mission de revoir non seulement la structure des Sections mais aussi l'ensemble Statuts et Règlement Intérieur en vue d'améliorer le fonctionnement de toute l'Association.

Le rapport des travaux du Comité Cassinis a été présenté au Comité Exécutif en mars 1990. Il a été adopté après quelques amendements, et le nouveau texte des Statuts et du Règlement Intérieur a été diffusé aux Comités nationaux et est maintenant soumis au Conseil pour approbation. Conformément aux Statuts actuels, les modifications prendront effet à la fin de la réunion du Conseil à laquelle ils auront été adoptés.

Les principales propositions faites par le Comité Cassinis et approuvées par le Comité Exécutif concernent :

. la possibilité de créer des **Commissions spéciales**, intermédiaires entre Commissions et Groupes Spéciaux d'Etudes; c'est une structure moins lourde qu'une Commission, mais traitant cependant des sujets exigeant une longue durée et une bonne collaboration internationale;

. des améliorations à l'organisation des élections au Conseil pour rendre le processus plus visible et permettre aux Délégués qui le désirent de s'exprimer avant la séance des élections (cette dernière est prévue, au cours de cette Assemblée Générale, le 15 août en soirée);

. la création d'un Comité Directeur dans chaque Section pour mieux impliquer les différents responsables des Commissions et des Groupes Spéciaux d'Etude de la Section dans la conduite des affaires de cette Section;

. la tenue régulière de Réunions Générales entre les Assemblées générales de l'UGGI;

. les affiliations individuelles à l'Association par la création de deux catégories d'affiliés, les "compagnons" : ceux qui ont servi en tant qu'officiels de l'Association et continuent à s'intéresser à ses activités, les "associés" : ceux qui participent actuellement à la vie active de l'Association comme membre des Commissions, Groupes Spéciaux d'Etudes, ...

. les publications : Bulletin Géodésique, communications présentées aux symposiums (ce sujet est développé ci-après).

. un certain nombre d'autres modifications de détail, de simples mises à jour ou des améliorations de texte.

Les recommandations détaillées du Comité Cassinis ont été publiées dans le Bulletin Géodésique Vol.64, N°2.

3. Publications

3.1. **Bulletin Géodésique** - Après d'assez longues négociations menées par le Bureau (notamment le Président) et la société allemande d'édition Springer Verlag, un accord a été mis au point pour la publication du Bulletin Géodésique par cette société à compter du 1er janvier 1991. Cette société publie également Manuscripta Geodaetica.

Le Comité Exécutif, au cours de sa réunion de mars 1990, a approuvé cet accord, ainsi que l'accord tripartite entre le Comité de rédaction de manuscripta geodaetica, l'AIG et Springer Verlag (ces documents sont publiés dans le BG 64-2). Le Comité a aussi insisté sur la nécessité de maintenir au Bulletin Géodésique son rôle de publication officielle de l'AIG avec un bon niveau scientifique.

Les conditions d'abonnement diffèrent quelque peu de celles en vigueur avant 1991, elles ont été diffusées à la fin de l'année 1990 par Springer Verlag auprès de qui ont peut toujours les obtenir, le Bureau Central de l'AIG peut aussi fournir les informations utiles.

Cette expérience sera jugée aux résultats dans quelques années, elle soulagera sûrement les finances de l'AIG sans accroître les charges pour les abonnés.

3.2. Manuel du Géodésien

Le prochain Manuel du Géodésien sera publié par Springer Verlag en 1992 à la place d'un numéro du Bulletin Géodésique. Cette publication est maintenant très appréciée des géodésiens et de bon nombre de non-géodésiens, mais elle doit être diffusée le plus tôt possible après l'Assemblée Générale pour garder cet intérêt. Les renseignements demandés aux futurs responsables des Sections, Commissions, Groupes Spéciaux d'Etudes ainsi qu'aux Comités Nationaux devront donc parvenir au Bureau Central de l'Association à des dates et sous des formes qui seront précisées par la Rédaction, dès la fin de cette Assemblée Générale.

3.3. Travaux de l'Association Internationale de Géodésie

Le volume des Travaux, contenant les rapports quadriennaux des Sections, Commissions, Groupes Spéciaux d'Etudes, Bureaux et autres Services permanents, continuera à être publié par le Bureau Central de l'AIG. Ces rapports doivent parvenir au Bureau Central au plus tôt (la date limite est déjà dépassée), sous une forme directement reproductible par photographie (les instructions nécessaires ont été données dans le B.G. Vol.64 N°3 et 4) pour une publication du Volume 29 dès le début de 1992.

3.4. Publication des communications présentées aux Symposiums

Le Bureau Central de l'AIG a publié au début de l'année 1988 les communications présentées aux symposiums de l'AIG à la XIXème Assemblée Générale. Désormais cette publication sera assurée par Springer Verlag pour les symposiums qui seront déclarés "symposiums de l'AIG". C'est de cette manière que les symposiums organisés au cours de la Réunion Générale à Edimburg ont déjà été publiés (symposiums 101 à 105). Depuis, 3 autres symposiums (106, 107 et 108, voir Appendix A) ont été inclus dans cette série et sont en cours de publication, il en sera de même des 3 symposiums organisés par l'AIG au cours de cette Assemblée Générale. Cette solution permet d'assurer une présentation homogène pour ces publications, une publication rapide et une bonne diffusion. Pour les symposiums et ateliers de travail patronnés mais non organisés par l'AIG, les organisateurs sont libres de choisir l'éditeur de la publication. Il leur est seulement demandé de publier au plus tôt après le symposium et d'en informer le Bureau Central.

4. Réunions scientifiques

4.1. Symposiums et ateliers de travail

La liste de ces réunions placées sous le patronage de l'AIG est publiée à l'Appendix A. Elle montre la variété des thèmes abordés et l'effort fait pour une répartition géographique convenable des lieux de réunions.

4.2. Réunion Générale

Une telle réunion, la première après celle de Tokyo en 1982, s'est tenue à Edimbourg en août 1989. Ce fut comme à Tokyo un réel succès, la participation active des géodésiens a été remarquable. Compte tenu de ces précédents succès et de la recommandation du Comité Cassinis il est vraisemblable qu'une troisième Réunion Générale aura lieu en 1993 : deux invitations officielles ont été reçues. La décision définitive sera prise au cours de cette Assemblée Générale.

II- Finances

Le rapport financier quadriennal est présenté dans le tableau résumé de l'Appendix B. Il appelle les commentaires suivants :

1. Recettes

. Le niveau de la subvention annuelle de l'UGGI, en US Dollars, a augmenté de 2 % au cours de la période. C'est peu compte tenu de la baisse régulière du taux du Dollar par rapport aux monnaies européennes - Franc suisse et Franc français - pendant la même période. Cependant des subventions supplémentaires de l'UGGI ont été obtenues pour certains symposiums, pour l'Assemblée Générale de Vancouver et pour la Réunion Générale d'Edimbourg, en augmentation par rapport à la précédente période. En revanche les subventions de l'ICSU ont été moindres, malgré des demandes toujours aussi importantes.

. La vente des publications a notablement augmenté, en raison des ajustements des tarifs d'abonnement au Bulletin Géodésique et aussi de la vente des publications diverses (symposiums AIG de Vancouver, Manuel du Géodésien, Travaux) plus importantes que précédemment.

. Les recettes diverses concernent surtout les gains sur les variations de taux de change (chute du Dollar).

2. Dépenses

. Les dépenses de personnel ont repris leur ascension en raison de taxes sur les salaires en nette augmentation en France, ces dernières années.

. L'augmentation importante du coût des publications a la même explication que celle des recettes: plus de publications produites, mais aussi hausse des tarifs d'édition et d'expédition.

. Dans le domaine des aides aux participations aux Assemblées Générales et symposiums, l'AIG a fait un gros effort, soutenu par l'UGGI, mais encore bien insuffisant au regard des demandes venant des jeunes géodésiens et des représentants des pays en développement. De même le soutien aux services permanents et aux projets est notoirement insuffisant. Notre Comité Exécutif cherche depuis de nombreuses années les moyens d'accroître les recettes pour satisfaire les besoins et mieux implanter les activités de l'AIG dans ces pays en développement. Cette recherche n'a pas abouti, elle doit être poursuivie...

. L'exercice est donc déficitaire de près de 30 000 US Dollars, si bien que la disponibilité au 31.12.1990 a atteint un niveau beaucoup trop bas. Des mesures sont prises dès 1991 pour redresser la situation par des diminutions de dépenses en ce qui concerne l'Administration (grâce au soutien de l'IGN) et les Publications (mise en oeuvre de la nouvelle politique d'édition). Les propositions de budget pour la période à venir figurent à l'Appendix C.

III - *Prix Bomford*

Les comptes concernant ce Prix ne sont pas inclus dans le tableau de l'Appendix B. Ils sont les suivants :

a) Réserves au 1.1.1987	1 874.19 US $
Intérêts pour la période 87-90	511.50
Total	2 385.69
b) Remise du prix Bomford 1987	550.00
Réserves au 31.12.1990	1 835.69
Total	2 385.69

Le lauréat du Prix Bomford 1991 a été désigné par le Bureau de l'AIG, après avis d'un comité constitué par les Présidents des Sections. Il s'agit du Dr. Shuhei Okubo, un prix de 500 US Dollars lui sera remis au cours de cette Assemblée Générale.

En raison de la réorganisation des relations entre la Royal Society avec les organismes dépendant de l'ICSU, le sous-comité britannique n'intervient plus dans la désignation du candidat. Les règles d'attribution du Prix sont donc modifiées pour tenir compte de ce retrait.

Par ailleurs, la procédure interne à l'AIG de jugement des candidats doit être revue, des propositions seront faites au cours de cette Assemblée Générale.

Il m'est maintenant nécessaire de conclure, d'autant plus que ceci est le dernier rapport de Secrétaire Général que je présente à l'Assemblée Générale. Pendant cette longue période il m'a été très agréable de travailler en parfaite harmonie avec quatre Présidents et avec tous les membres des Comités Exécutifs qui se sont succédés. Qu'ils en soient tous remerciés, nous avons tous ensemble oeuvré de notre mieux pour le succès de l'AIG avec une foi inébranlable dans nos actions. Je vous remercie aussi, toutes et tous, chers collègues et amis, votre présence à nos différentes réunions, vos fréquentes correspondances adressées au Bureau Central, ont été un soutien permanent pour notre mission d'officiels de l'AIG. Que tous ces soutiens se reportent sur nos successeurs pour le plus grand succès de l'AIG.

XXth IAG General Assembly
Report of the Secretary General

Michel Louis

The Secretary General of the International Association of Geodesy is pleased to submit to the XXth General Assembly his report on the activities of the Association for the period between the XIXth and the XXth General Assemblies.

In accordance with the Statutes and By-Laws, the Secretary General reports on the administrative and financial affairs, the President reporting on the scientific work of the Association.

I- *Administrative activities of the Association*

During the past period the main features of the administrative activities were: (i) meetings of the Bureau and Executive Committee where decisions were taken on future actions of the Association, (ii) Cassinis Committee's work, and (iii) publication of scientific and administrative information.

1. Meeting of the Executive Committee

During this period the Executive Committee met twice, in Paris, in March 1988 and March 1990, and the Committee, reduced to the Bureau and the Presidents of Section, also met in Paris in March 1991. All those meetings were prepared by meetings of the Bureau.

The detailed reports of the first two meetings were published in Bulletin Géodésique, Vol. 62 n°4 and Vol. 64 n°2. Large parts of those meetings were devoted to the preparation of the General Meeting, Edinburgh, August 1989, and of the present General Assembly.

Among other items dealt with during the meetings we can mention :

a) Investigations by ad hoc groups during the March 1988 meeting on :

- improvements on the functioning of the Union and its Associations for a better participation of geodesists and geophysicists, mainly the young ones;

- precise rules which are necessary for the organization and follow-up of scientific meetings, especially Symposia organized by the IAG. These new rules adopted by the Executive Committee were published in B.G. Vol. 63 n°3, and they now apply to those Symposia organized by the IAG, integrated in the series of IAG Symposia, with official numbering, and proceedings published by Springer Verlag according to an agreement passed with IAG;

- IAG flier, which is now available, after a rather long delay for realisation and issue;

- "Newsletter" on IAG activities, edited by the Central Bureau and regularly published in the Bulletin Géodésique;

- possibility to create an IAG-Fund to support geodetic activities in developing countries, new publications, and also to give financial assistance to young geodesists for their participation in IAG activities. Different ways were explored, but none gave a positive result; the next Executive Committee should continue with this work.

b) Continuing relations with sister-societies : Fédération Internationale des Géomètres (FIG), International Cartographic Association (ICA), and International Society of Photogrammetry and Remote Sensing (ISPRS). These societies have created together a specific union (International Union for Surveys and Mapping: IUSM), not affiliated to the International Council of Scientific Unions (ICSU), but nevertheless of

great interest for IAG. After discussion on some amendments of the Statutes of this new Union the IAG Executive Committee agreed on the IAG application for candidature. After acceptance by the IUSM the IAG Council will have to ratify this adhesion, which aims to reinforce our links with surveyors, photogrammetrists and cartographers and increase geodetic influence in those societies;

c) New editorial policy of IAG (see "Publications" hereafter);

d) Report by Cassinis Committee (see item 2 hereafter).

2. Cassinis Committee's work

According to the By-Laws, the structure of the Sections in IAG shall be reviewed every eight years by a Committee, called the Cassinis Committee, which shall make proposals to the Executive Committee. This Cassinis Committee, appointed during the last General Assembly and consisting of P.V. Angus-Leppan (chairman) and M. Bursa, R. Rummel, C.C. Tscherning, G. Veis and A.M. Wassef, was also charged with the review of the Statutes and By-Laws for an improvement in the functioning of the entire Association.

The Cassinis Committee reported on its works to the Executive Committee in March 1990. After some amendments the report was adopted and the new version of the Statutes and By-Laws was circulated to National Committees, and it is now submitted to the Council for approval. According to the Statutes, the modifications shall come into force at the close of the Council meeting at which they are adopted.

The main proposals made by the Cassinis Committee and approved by the Executive Committee concern :

. the possibility to create ***Special Commissions*** (the Cassinis Committee recommended the name ***General*** **Study Groups**), it will be a structure intermediate between a Commission and a Special Study Group, less heavy to handle than a Commission, but however dealing with long term problems for which close international cooperation is necessary;

. improvements to the organization of the elections in Council in order to make the procedure clearer and to allow Council Delegates to express their proposals before the election session (for this General Assembly the elections will take place on August 15th, evening);

. the setting up of a Steering Committee in each Section for a better implication of the various officers within the Section in the Section's activities;

. the organization of General Meetings of the Association between the ordinary General Assemblies of the IUGG;

. individual affiliations to the Association through the creation of two categories of affiliates : (i) **Fellows**, who have served as officers during at least one period and are still involved in IAG activities, (ii) **Associates**, who are presently participating in IAG activities as members of Commissions, Study Groups, etc.;

. publications of Bulletin Géodésique, Proceedings of Symposia (see Publications, hereafter).

Other minor modifications in the Statutes and By-Laws are only updates or improvements in the text.

The detailed recommendations made by the Cassinis Committee were published in B.G. Vol. 64 n°2.

3. Publications

3.1. **Bulletin Géodésique** - After a rather long negotiation between the Bureau and the German publishing company, Springer Verlag, an agreement was reached for the publication of the Bulletin Géodésique by Springer Verlag, from 1991, January 1st. This company also publishes manuscripta geodaetica.

This Agreement, as well as the Memorandum of Understanding between the editorial board of manuscripta geodaetica, the IAG and Springer Verlag were approved by the Executive Committee, March 1990. (These documents were published in B.G. Vol. 64 n°2, along with a note of the Chief Editor of the B.G. on this new editorial policy, and notes for contributors). The Executive Committee strongly insisted on the necessity of keeping the Bulletin Géodésique as the official journal of the IAG, with high-standard quality papers.

Conditions of subscription slightly different from the previous ones were announced by Springer Verlag by the end of 1990, they can still be obtained from Springer Verlag or from the Central Bureau. It is hoped that this new editorial policy will be successful and will help the IAG Central Bureau to save money.

3.2. **Geodesist's Handbook** - The next Geodesist's Handbook will be published by Springer Verlag in 1992 in place of one regular issue of the Bulletin Géodésique. This publication is now well appreciated by geodesists and non-geodesists, but it must be available early after the General Assembly to keep its interest. Information requested from the future officers in charge of Sections, Commissions, Study Groups and from National Committees should be sent to the Central Bureau, following rules which will be issued by the Editor at this General Assembly.

3.3 Travaux de l'Association Internationale de Géodésie

Volumes of the Travaux will continue to be published by the Central Bureau of IAG. They contain the quadrennial reports concerning the activities of Sections, Commissions, Special Study Groups, Bureaus, and other Permanent Services, with the relevant bibliography. These reports are due to reach the Central Bureau as soon as possible in photo-direct reproducible form (necessary instructions were given in B.G. 64-3 and 64-4) for rapid publication in 1992 of Vol. 29.

3.4. Publication of Symposia Proceedings

In 1988 the Proceedings of IAG Symposia at the XIXth General Assembly were published by the Central Bureau. According to the new editing policy the Proceedings of IAG Symposia are now published by Springer Verlag. This new procedure was already used for the publication of Symposia organized at the General Meeting in Edinburgh (Symposia 101 to 105). Since then, 3 other Symposia (106, 107, 108 : see Appendix A) were included into this series of IAG Symposia and are now being published by Springer Verlag, the 3 IAG Symposia organized during this General Assembly will also be treated in the same way. This solution guarantees an homogeneous presentation of these IAG publications, a fast publication and an adequate distribution. For the other Symposia and Workshops which are only sponsored by the IAG the organizers are free to choose their own publishing agency. They are however requested to have the proceedings published early after the Symposium and to inform the Central Bureau.

4. Scientific meetings

4.1. **Symposia and Workshop** - The list of these meetings sponsored by the IAG is given in Appendix A. One can note the large variety of topics treated and the effort towards a good geographical distribution. I must insist again on the necessity to receive from the organizers information in due time on announcement, report and publication of proceedings.

4.2. **General Meeting** - Such a meeting was held in Edinburgh, August 1989, it was the second General Meeting of IAG after the first one in Tokyo, May 1982. As in Tokyo, the meeting in Edinburgh was a real success with a very active participation of geodesists from all continents. Taking into account these first successes and the recommendation of the Cassinis Committee, the Executive Committee considers that a third General Meeting should be organized in 1993. Two official invitations have been received : the final decision will be taken during this General Assembly.

II- *Finance*

The financial report for the period 1987-1990 is presented in Appendix B. The following comments may be added :

1. Receipts

. During the period, the IUGG allocation, including grants for General Assemblies and Symposia, has increased by a small percentage (3.5), as compared to the preceding period. Nevertheless, due to the decreasing exchange rate of the U.S Dollar, those allocations can be considered as stable. Moreover the grants from ICSU were less, in spite of many important and well-funded demands.

. Sales of Publications have increased considerably due to readjustments of rates of subscription to the Bulletin Géodésique and to a higher demand of various publications, such as IAG-Symposia at Vancouver, Geodesist's Handbook and Travaux.

. Miscellaneous receipts mainly concern gains on change (decrease of the U.S Dollar).

2. Expenditures

. Personnel-expenditures have grown because of the increase of salary taxes in France during these last years.

. Higher costs for Publications are due to the larger number of publications produced, and also to increased printing and mailing costs, and finally the balance of Publications : Receipts-Expenditures is still negative.

. During this period the IAG made a great effort to provide support for participation in the General Assembly and General Meeting, and to Symposia, IUGG also contributed. Nevertheless these financial supports are still under the level of demands which come from young scientists and geodesists from developing countries. Furthermore, IAG cannot support permanent services, nor international projects, as it should do. The Executive Committee has tried for several years to find ways and means to satisfy these needs and also to promote IAG activities in developing countries. Though presently unsuccessful, this search should continue.

. Thus the financial result for the period shows a deficit of about 30 000 US $, so that the reserves, cash and investments, have reached an alarming low level. Measures for improving this situation have already been taken in 1991 : decrease of expenses concerning Administration (thanks to IGN's support) and Publications (according to the new editorial policy). The budget proposal for the next period is presented in Appendix C.

III- *Bomford Prize*

The accounts concerning the Bomford Prize are not included in Appendix B. These are :

a) Reserves on 1.1.1987		1 874.19 US $
Interests for the period 87-90		511.50
	Total	2 385.69
b) Bomford Prize 1987		550.00
Reserves on 31.12.1990		1 835.69
	Total	2 385.69

Dr. Shuhei Okubo was declared the winner of the Bomford Prize 1991 by the IAG Bureau, on the recommendation of a review committee consisting of the Presidents of Section. A cheque of 500 US $ will be presented to him during this session.

We have been informed that due to the reorganization of links between the Royal Society and the ICSU family, the British Sub-committee cannot intervene any more in the procedure for the designation of the Prize winner. The rules of the Bomford Prize will be modified accordingly.

Furthermore, the review process of the candidates should be improved, and proposals will be made during the General Assembly.

Now it is time to conclude. This is the last report that I am pleased to present you as Secretary General of the Association. During this long four-term period, I was very fortunate to work in calm harmony with four Presidents and all the members of the successive Executive Committees. I sincerely thank all of them, all together we have done our best for the success of the Association, with a resolute belief in our actions. I also thank you, dear friends and colleagues, who, through your attendance at our various meetings, and through your frequent request addressed to the Central Bureau, have permanently supported our efforts in accomplishing our duty as IAG officers.

I kindly ask you to carry your support to our successors for even greater successes of the IAG.

Appendix A

Symposia and Workshops sponsored by the IAG

Year 1988

. ***International GPS - Workshop Darmstadt 1988***

Darmstadt, F.R. Germany, 10-13 April
Report in B.G. 62-4
Proceedings : E. Groten and R. Strauss, Editors

. ***International Symposium on Instrumentation, Theory and Analysis for Integrated Geodesy***

Sopron, Hungary, 16-20 May
Report in B.G. 63-1
Proceedings : Geodetical and Geophysical Research Institute, Sopron

. ***International Summer School of Theoretical Geodesy on Theory of Satellite Geodesy and Gravity Field Determination***

Assisi, Italy, 23 May-3 June
Report in B.G. 62-4
Proceedings : Lecture Notes in Earth Sciences Springer-Verlag

. ***Sixth International Symposium on Geodesy and Physics of the Earth***

Potsdam, Germany, 22-27 August
Report in B.G. 62-4
Proceedings : Veröffentlichungen des Zentralinstituts für Physik der Erde, Potsdam

. ***Chapman Conference on Progress in the Determination of the Earth's Gravity Field***

Fort-Lauderdale, Fl, USA, 13-16 September
Report in B.G. 63-3
Proceedings : Report n°397 of the Department of Geodetic Science and Surveying, the Ohio State University, Colombus

Year 1989 :

. ***Fifth International Geodetic Symposium on Satellite Positioning***

Las Cruces, N. Mex., USA, 13-17 March

. ***Ron Mather Symposium on Four-Dimensional Geodesy***

Sydney, Australia, 28-31 March
Report in B.G. 63-3
Proceedings : Lecture Notes in Earth Sciences Springer Verlag

. ***Second Hotine-Marussi Symposium on Mathematical Geodesy***

Pisa, Italy, 5-8 June
Report in B.G. 64-2
Proceedings : F. Sanso, Editor

. ***XIth International Symposium on Earth Tides***

Helsinki, Finland, 31 July-5 August
Report in B.G. 64-1
Proceedings : I. Kakkuri, Editor
published by E. Schweitzerbart'sche Verlagsbuchhandlung, Stuttgart

. ***IAG General Meeting*, consisting of :**

.Ceremony on the 125th Anniversary of the First International Geodetic Conference
.Symposium 101 : Global and Regional Geodynamics
.Symposium 102 : GPS and other Radio Tracking Techniques
.Symposium 103 : Gravity, Gradiometry and Gravimetry
.Symposium 104 : Sea Surface Topography, the Geoid and Vertical Datums
.Symposium 105 : Earth Rotation and Coordinate reference frames

held at Edinburgh, Scotland, 3-12 August
Report in B.G. 63-4
Proceedings (5 volumes) : I.I. Mueller, series Editor
published by Springer Verlag

. ***International Workshop on GPS and Inertial Survey Systems***

Lagos, Nigeria, 11-15 September
Report in B.G. 64-3
Proceedings : R.O. Coker, Editor

. ***International Symposium "Geodesy and Seismology : Deformation and Prognosis"***

Erevan, USSR, 2-6 October
Report in B.G. 64-2
Proceedings : in Technophysics (Amsterdam)

Year 1990 :

. ***8th International Symposium on Geodetic Computation***

Wuhan, China, 8-11 May
Report in B.G. 64-3
Proceedings : Prof. Ning Jinshen, Editor
Wuhan Technical University

. ***Quatrième Symposium sur la Géodésie en Afrique***

Tunis, Tunisie, 21-27 Mai
Compte rendu dans B.G. 64-4
Rapport des travaux (version française) et Proceedings (English version) : publié par l'Office de la Topographie et de la Cartographie, Tunis

. ***First Meeting of the International Geoid Commission (IAG Symposium n°106)***

Milano, Italy, 11-13 June
Report in B.G. 64-3
Proceedings : published by Springer Verlag in the series of IAG Symposia

. ***13th Meeting of the International Gravity Commission***

Toulouse, France, 10-14 September
Report in B.G. 65-1
Proceedings : B.G.I. Bulletin d'Information n°67, 68

. ***International Symposium on Kinematic Systems in Geodesy, Surveying and Remote Sensing (IAG Symposium n°107)***

Banff, Canada, 10-13 September
Report in B.G. 65-3
Proceedings : published by Springer Verlag in the series of IAG Symposia

. ***Workshop on Precise Vertical Positioning***

Hanover, Germany, 8-12 October
Report in B.G. 65-1
Proceedings : H. Pelzer and A. Witte, Editor
published by Dümmler Verlag

. ***International Symposium on Marine Positioning, INSMAP'90***

Miami, USA, 15-19 October
Report in B.G. 65-1
Proceedings : M. Kumar and G.A. Maul, Editors
published by PIP Publishing
11415 Woodglen Drive,
Rockville, MD 20852 - USA

. ***Third Symposium on Recent Crustal Movements in Africa***

Aswan, Egypt, 8-15 December
Report in B.G. 65-2
Proceedings : P. Vyskocil, ICRCM, Editor
to be published in the Journal of Geodynamics

Year 1991 :

. ***International Symposium on Application of Geodesy to Engineering (IAG Symposium n°108)***

Stuttgart, Germany, 13-17 May
(This Symposium was previously scheduled in September 1990)
Report in B.G. 65-3
Proceedings : Prof. K. Linkwitz, Editor
to be published by Springer Verlag in the series of IAG Symposia

APPENDIX B

INTERNATIONAL ASSOCIATION OF GEODESY
Financial Report for the Period : 1987 - 1990
Amounts in USA dollars, Exchange rate 1 US $ = 5.129 FF = 1.288 SF

	RECEIPTS	I.U.G.G.	GRANTS & CONTRATS
15	I.U.G.G. ALLOCATION	102 800.00	
2	UNESCO GRANTS		
3	OTHER GRANTS (IUGG, ICSU, COSPAR)	8 200.00	6 800.00
4	CONTRACTS WITH UNESCO, etc		
5	SALES OF PUBLICATIONS	172 575.38	
6	MISCELLANEOUS	30 242.02	
7	TOTAL RECEIPTS	313 817.40	6 800.00
8	CASH ON HAND AND IN BANKS (Jan. 1, 1987)	31 822.61	2 500.00
9	INVESTMENTS & RESERVES (Jan. 1, 1987)	10 813.68	
10	TOTAL	356 453.69	9 300.00

	EXPENDITURES	I.U.G.G.	GRANTS & CONTRATS
11	ADMINISTRATION		
11.1	Personnel	45 328.93	
11.2	Quarters (rents and services)		
11.3	Supplies and Equipement	5 483.49	
11.4	Communication	3 770.28	
11.5	Travel (administrative only)	11 372.10	
11.6	Miscellaneous	1 505.48	
12	PUBLICATIONS		
12.1	Proceedings of Assemblies	11 149.44	
12.2	Proceedings of Symposia	1 238.35	
12.3	Periodicals	197 303.52	
12.4	Others	9 451.94	4 000.00
13	ASSEMBLIES		
13.1	Organization	5 334.82	
13.2	Travel	37 140.48	800.00
14	SYMPOSIA & SCIENTIFIC MEETINGS		
14.1	Organization		
14.2	Travel	4 679.68	
16	GRANTS (Permanent Services, etc.)	5 461.77	4 500.00
17	CONTRACTS WITH UNESCO, etc		
18	MISCELLANEOUS	1 360.94	
19	TOTAL EXPENDITURES	340 581.22	9 300.00
20	CASH ON HAND AND IN BANKS (Dec. 31, 1990)	15 219.12	
21	INVESTMENTS & RESERVES (Dec. 31, 1990)	653.35	
22	TOTAL	356 453.69	9 300.00

January - 1 - 1987 December - 31 - 1990

INTERNATIONAL ASSOCIATION OF GEODESY
Estimate and Expense for the Period 1991 - 1994
Amounts in USA dollars, Exchange rate 1 US $ = 5.8 FF

	RECEIPTS	I.U.G.G.	GRANTS & CONTRATS
15	I.U.G.G. ALLOCATION	102 800	
2	UNESCO GRANTS		
3	OTHER GRANTS (IUGG, ICSU, COSPAR)	5 000	10 000
4	CONTRACTS WITH UNESCO, etc.		
5	SALES OF PUBLICATIONS	10 000	
6	MISCELLANEOUS		
7	TOTAL RECEIPTS	117 800	10 000
8	CASH ON HAND AND IN BANKS (Jan. 1, 1991)	15 200	
9	INVESTMENTS & RESERVES (Jan. 1, 1991)	650	
10	TOTAL	133 650	10 000

	EXPENDITURES	I.U.G.G.	GRANTS & CONTRATS
11	ADMINISTRATION	30 000	
12	PUBLICATIONS	20 000	
13	ASSEMBLIES	40 000	
14	SYMPOSIA &SCIENTIFIC MEETINGS	15 000	5 000
16	GRANTS (Permanent Services, etc.)	5 000	5 000
17	CONTRACTS WITH UNESCO, etc.		
18	MISCELLANEOUS		
19	TOTAL EXPENDITURES	110 000	10 000
20	CASH ON HAND AND IN BANKS (Dec. 31, 1994) (estimated)	20 000	
21	INVESTMENTS & RESERVES (Dec. 31, 1994) (estimated)	3 650	
22	TOTAL	133 650	10 000

XXth General Assembly of the International Association of Geodesy (Vienna, 12-23 August 1991)

REPORT on the MEETINGS of the - Executive Committee - Council - General Assembly

Michel Louis

During this General Assembly,

. the Executive Committee met on August 12 (morning, evening) 16 and 20,
. the Council met on August 12, 15 and 21,
. the General Assembly met on August 12 and 22.

The participants to the Executive Committee meetings were the President, the First Vice-President, the immediate past President, the Secretary General and Assistant Secretaries of the Association, the Presidents and Secretaries of the Sections, the Editor-in-Chief of the Bulletin Géodésique and Profs. H. Moritz and T.J. Kukkamäki, as Honorary Presidents of the Association. The newly elected members of the Executive Committee were invited to take part in the meeting of August 20.

At the meetings of the Council the following 33 Countries were represented : Algeria, Austria, Belgium, Canada, China, Czechoslovakia, Denmark, Egypt, Finland, France, F.R. Germany, Hungary, Indonesia, Israel, Italy, Ivory Coast, Japan, Luxembourg, Morocco, the Netherlands, New Zealand, Norway, Poland, Portugal, Sweden, Switzerland, Tunisia, Turkey, United Kingdom, United States of America, U.S.S.R., Yugoslavia, Zimbabwe.

Some other countries (Australia, Brazil, Bulgaria, Greece, Indonesia, Iran, Kenya, Libya, Nigeria, Saudi Arabia, South Africa, Spain, Thaïland, Venezuela) were also represented at the General Assembly meetings.

During these meetings topics concerning the activities and administrative affairs of the Association were treated, decisions or conclusions were drawn as follows.

1 - *Finances - Approval of the financial report of the Secretary General*

The financial report for the period 1987-1990 was presented by the Secretary General during the opening session of the General Assembly. An Audit Committee was nominated by the Council for carrying out detailed examination of the accounts, and the following report was unanimously adopted by the Council :

"Report of the Audit Committee of the Council of the I.A.G."

At the first session on Monday, August 12 1991, the Council elected the following Committee to audit the accounts of the Association from 1987 to 1990:

B. G. HARSSON
A. MAINVILLE
U. VAN TWEMBEKE (chairman)

The Audit committee met twice.

1. The Audit Committee performed the following:

11. Compared the I.U.G.G. Financial Guide examples to the yearly and quadrennial reports of the I.A.G.

12. Browsed the daily and monthly reports, the amounts could not be verified against the original bills and receipts since they were not available in Vienna.

13. Made sample numerical checks on various documents.

14. Made queries which were clarified by Mr. Louis, Secretary General.

2. The Audit Committe makes the following comments:

21. The accounts are neatly given in details, unfortunately they are difficult to follow because of the different currencies involved.

22. The balance between total receipts and expenditure is negative for the period 1987 - 1990, the deficit is 29.263,82 US $. Taken into account the surplus of 18.639,64 US $, for the period 1983-1986, there has been an over-expenditure of 47.903, 46 US $ which has been justified by the Secretary General.

23. Since the estimate of the I.U.G.G. allocation for the period 1991-1994 is the same as the precedent one, it is recommended that the allocation in the future increases, at least follows the inflation.

24. At the end of the period 1987 to 1990 the working capital of the I.A.G. is 15.852,47 US $.

25. The I.A.G. should be grateful to the Institut Geographigue National of France for providing the accommodation for I.A.G. Bureau.

3. Recommendation

The Audit Committee recommends the Council of the I.A.G. to accept the financial report for the period 1987 - 1990 as presented in the appendix B of the report of the Secretary General.

2 - *New Statutes and By Laws - Report by the Cassinis Committee*

New Statutes and By Laws were elaborated by the Cassinis Committee (P.V. Angus-Leppan, M. Bursa, R. Rummel, C. Tscherning, G. Veis and A.M. Wassef), then presented to the Executive Committee for approval, in March 1990. After some amendments the new texts were circulated to National Committees in April 1991 and then submitted here to the Council for final decision. They were adopted with two minor amendments proposed by the Bureau and concerning : (i) the appointment of Fellows, and (ii) the election of the Editor of the Bulletin Géodésique.

These new Statutes and By Laws came into force at the close of the Council meeting at which they were approved, and as a consequence the new rules concerning elections immediately applied for the elections which took place during this General Assembly.

3 - *Elections*

The elections were prepared by the Nominating Committee (P.V. Angus-Leppan, chairman, M. Bursa, R. Rummel, C. Tscherning) which presented its list of candidates at the first meeting of the Council on Monday August 12. For some positions other candidates were presented by members (at least two) of the Council. The elections took place in the Council on Thursday August 15 and Wednesday August 21; they gave the following results :

President	: W. TORGE (F.R. Germany)
Ist Vice President	: K.P. SCHWARZ (Canada)
2nd Vice President	: J.Y. CHEN (China)
Secretary General	: C. BOUCHER (France)
Assistant Secretary	: P. WILLIS (France)
Section 1 - President	: M. PRILEPIN (U.S.S.R.)
Secretaries	: F. BRUNNER (Australia)
	: K. PODER (Denmark)
Section 2 - President	: C. REIGBER (F.R. Germany)
Secretaries	: R. RUMMEL (the Netherlands)
	: B. SCHUTZ (U.S.A.)
Section 3 - President	: H.G. WENZEL (F.R. Germany)
Secretaries	: R. FORSBERG (Denmark)
	: I. MARSON (Italy)
	: H. SUNKEL (Austria)
Section 4 - President	: F. SANSO (Italy)
Secretaries	: P. HOLOTA (Czechoslovakia)
	: P. TEUNISSEN (The Netherlands)
Section 5 - President	: J. DICKEY (U.S.A.)
Secretaries	: M. FEISSEL (France)
	: H. HSU (China)
	: T. TANAKA (Japan)
Bulletin Géodésique chief Editors	: C. TSCHERNING (Denmark)
	: P. VANICEK (Canada)
Honorary President	: I.I. MUELLER (U.S.A.)
Honorary Secretary General	: M. LOUIS (France)

Commissions (Presidents) :

III - (in Sec. 3) : I. MARSON (Italy)
V - (in Sec. 5) : H. HSU (China)
VII - (in Sec.5) : T. TANAKA (Japan)
VIII - (in Sec. 2, with COSPAR) : B. SCHUTZ (U.S.A.)
IX - R. LANGLEY (Canada)
X - (in Sec. 1) : K. PODER (Denmark)
XI - M. CHARFI (Tunisia)
XII - (in Sec. 3) : H. SUNKEL (Austria)

Special Commissions (Presidents) :

SC1 - Mathematical and Physical Foundations of Geodesy (in Sec. 4) : E. GRAFAREND (F.R. Germany)
SC2 - History of Geodesy : J. WEIGHTMAN (U.K.)

SC3 - Fundamental Constants (in Sec. 5) : M. BURSA (Czechoslovakia)
SC4 - Applications of Geodesy to Engineering (in Sec. 1): K. LINKWITZ (F.R. Germany)
SC5 - Marine Positioning (in Sec. 1) : M. KUMAR (U.S.A.)
SC6 - "Wegener Project" (in Sec. 2) : P. WILSON (F.R. Germany)

4 - *Review of Commissions, Special Commissions and Special Study Groups*

4.1 - Commissions

No new Commission was created, but one Commission, Commission VI - International Geodetic Bibliography -, was dissolved and a small group (C. Tscherning, chairman, C. Boucher, B. Kolaczek and W. Torge) will seek proposals on how to solve the bibliographic problem with the assistance of the existing bibliographic data centers, and especially of IfAG/Frankfurt am Main which has recently taken over the activities of the Dresden Center. A report should be presented at the next Executive Committee meeting, March 1992.

The other Commissions will continue with new Presidents (except in Commission V where Prof. Hsu was re-elected for one period). Nevertheless more attention was given to Commission XI - Geodesy in Africa - in which the activity was not as strong as it should be. It was recommended that this Commission create more active sub-commissions in common with the other Commissions of the I.A.G. By this way a better cooperation could be developed between geodesists from Africa and from other countries.

Commission IX - Education in Geodesy - was encouraged to continue its collaboration with the sister societies in I.U.S.M., and to also develop links with the other associations in IUGG.

4.2 - Special Commissions - According to the new By-Laws Special Commissions may be formed to study scientific problems of a long term character which require close cooperation between specialists from different countries. The Executive Committee thus decided to create the 6 following Special Commissions :

SC 1 : Mathematical and Physical Foundations of Geodesy (in Section IV)
SC 2 : History of Geodesy (*)
SC 3 : Fundamental Constants (*) (in Section V)
SC 4 : Applications of Geodesy to Engineering (in Section I)
SC 5 : Marine Positioning (in Section I)
SC 6 : "Wegener Project" (in Section II)

This last Special Commission was placed in Section II rather than in Section V, though dealing with geodynamical problems, because it emphasizes the technological aspects, particulary the use of new space techniques. The name of this Special Commission is temporary and a final designation will be made at the Executive Committee meeting in March 1992 after consultation with the President of the SC.

(*) these previous Special Study Groups really study problems of a long term character, they automatically belong to the category "special commissions".

4.3 - Special Study Groups

As special Study Groups are created to study specific scientific problems of limited scope many of them should be terminated at each General Assembly and others have to be created. After long discussions in the Executive Committee, in particular concerning the future activities of Section V, the following decisions were taken :

Section I :

a) termination of :

SSG 1.73 : Integrated geodesy
1.77 : Utilization of inertial techniques for geodesy and surveying
1.79 : Optical interferometry and short range distance measurement
1.101 : Sea-floor positioning
1.103 : Rapid precise levelling
1.104 : Static and geodynamic positioning with G.P.S.

b) continuation of :

SSG 1.105 : Kinematic global positioning system - chairman : H. Landau (F.R. Germany)

c) creation of :

SSG 1.125 : Positioning with inertial systems - chairman: J.M. Rüeger (Australia)
1.126 : Permanent GPS arrays-chairman: Y. Bock (U.S.A.)
1.127 : Error propagation in GPS networks: chairman: P.A. Cross (U.K.)
1.128 : Wet propagation delay - chairman: G. Elgered (Sweden)

Section II

a) termination of :

SSG 2.54 : Radio-tracking techniques
2.106 : Determination of orbits to cm accuracy

2.108 : Evaluation of new concepts of satellite systems for position determinations

b) continuation of :

SSG 2.107 : Gravity field determination by satellite gravity-gradiometry - chairman : E. Schrama (the Netherlands)
2.109 : Application of space VLBI in the field of astrometry and geodynamics - chairman : J. Adam (Hungary)

c) creation of :

SSG 2.129 : Precise orbit determination software validation - chairman : K. Wakker (the Netherlands)
2.130 : Non-gravitational force modelling effects on satellite orbits - chairman : J. Ries (U.S.A.)
2.131 : Spaceborne G.P.S./GLONASS - Chairman: T. Yunck (U.S.A.)
2.132 : Time - varying gravitational effects on satellite orbits - chairman : C. Shum (U.S.A.)
2.151 : Altimetry optimal processing for geodesy, geophysics and oceanography - chairman : W. Bosch (F.R. Germany)

Section III

a) termination of all existing study groups, i.e :

SSG 3.110 : Local gravity variations
3.111 : Terrestrial and airborne gravity gradiometry
3.112 : Gravimetric tests of the Newtonian gravity law
3.113 : Spectral gravity field modelling methods

b) creation of :

SSG 3.133 : Techniques of precise gravimetry - chairman: M. Becker (F.R. Germany)
3.134 : Airborne gravimetry - chairman: G. Hein (F.R.Germany)
3.135 : Optimization of spectral gravity field modelling methods - chairman : M. Sideris (Canada)
3.136 : High resolution geoid modelling and evaluation - chairman : H. Denker (F.R. Germany)
3.137 : Combined use of gravimetry and stress-strain measurement techniques - chairman : S. Takemoto (Japan)

Section IV

a) dissolution of all existing study groups, i.e. :

SSG 4.91 : Local gravity field approximation
4.92 : Global gravity field approximation
4.93 : Wave propagation in refractive media
4.115 : Mathematical analysis of geodetic boundary value problem
4.116 : Kinematic and dynamic modelling in geodesy
4.117 : Optimization of modern positioning techniques
4.118 : Inverse geodetic problems
4.119 : Relativistic effects in geodesy
4.120 : Non-linear adjustment

b) creation of :

SSG 4.138 : Modelling and quality control for precise integrated navigation - chairman : A. Kleusberg (Canada)
4.139 : The role of terrain in gravity field modelling - chairman : A. Geiger (Switzerland)
4.140 : Tomography of the atmosphere by geodetic measurements - chairman : T. Spoelstra (the Netherlands)
4.141 : Integrated inverse gravity modelling - chairman: R. Barzaghi (Italy)
4.142 : Orbital dynamics and the geodetic boundary value problem - chairman : B. Heck (F.R. Germany)

Section V

a) dissolution of all existing study groups, i.e. :

SSG 5.98 : Atmospheric excitation of the Earth's rotation
5.99 : Tidal friction and the Earth's rotation
5.100 : Parameters of common relevance of astronomy, geodesy and geodynamics (transformed into Special Commission SC3)
5.121 : Causes and mechanisms of the post-glacial uplift
5.122 : Geodynamic effects of global gravity field variations
5.123 : Definition and realization of terrestrial reference systems
5.124 : Transmission of stress and geodynamic implications

b) creation of :

SSG 5.143 : Rapid Earth orientation variations (common with I.A.U.) - chairman : J.O. Dickey (U.S.A.)
5.144 : Dynamic effects in Earth rotation theory - chairman: S. Molodensky (U.S.S.R.)
5.145 : Long-term variations in Earth rotation - chairman : P. Brosche (F.R. Germany)
5.146 : Processing of optical polar motion data in view of plumb line variations -

chairman : P. Pâquet (Belgium)
5.147 : Studies of the Baltic Sea - chairman : J. Kakkuri (Finland)
5.148 : Global variations of the Earth - chairman : B. Chao (U.S.A.)
5.149 : Studies of vertical datums (with I.A.P.S.O.) - chairman : E. Groten (F.R. Germany)
5.150 : Density distribution within the lithosphere - chairman : H.G. Kahle (Switzerland)

It was also decided to set up a working group under the chairmanship of the President of Section V to elaborate proposals for a better contribution to Global Change (with the other I.U.G.G. - associations).

Several other proposals for new Special Study Groups are still under question, the Executive Committee will take a final decision at its meeting in March 1992.

4.4 - International Bureaus, Services and Centers

All these existing bodies were accepted for continuation,

a) affiliated to FAGS :

. Bureau Gravimétrique International (B.G.I.) director : G. Balmino (France)
. International Centre of Earth Tides (I.C.E.T.) director : P. Melchior (Belgium)
. International Earth Rotation Service (I.E.R.S.) president : K. Yokoyama (Japan) - director of the Central Bureau : M. Feissel (France)
. Permanent Service for Mean Sea Level (P.S.M.S.L.) director : Ph. Woodworth (U.K.)

b) others :

. International Center for Recent Crustal Movements - director : P. Vyskocil (Czechoslovakia)

5 - IAG Representatives to other Organizations

The following representatives were appointed by the Executive Committee :

. Cartographic Office of the United Nations : K. Poder
. C.O.D.A.T.A. : C. Tscherning
. F.A.G.S. : O.B. Andersen
. P.A.I.G.H. : W. Torge
. I.E.R.S. : K. Yokoyama
. I.G.S. : I.I.Mueller
. I.U.S.M. : I.I. Mueller and W. Torge
. I.C.L. (Lithosphere) : P. Wilson
. Joint group with IAU on Standards : D. McCarthy
. C.O.S.P.A.R. Working group (IAU-IAG) on "Cartographic coordinates and rotational elements of the Planets and Satellites" : M. Bursa.

6 - Awards

6.1 - The Bomford Prize 1991 was awarded to Dr. Shuhei Okubo, Research Associate at the Earthquake Research Institute of the University of Tokyo, for his outstanding contribution to geodesy, and particularly his recent works on theoretical formulation of gravity and potential changes associated with seismic activity and on its application to various geophysical phenomena. The Prize was handed over to him by the President of the Association during the opening ceremony, and Dr. S. Okubo gave a short lecture summarizing his research work during the closing session.

6.2 - The Levallois Medal was awarded to Prof. P. Melchior in recognition of distinguished service to the Association and to the science of geodesy in general. The President of the Association remitted the medal to Prof. Melchior during the opening ceremony.

7 - Resolutions

7.1 - Resolutions presented by the International Association of Geodesy and endorsed by the International Union of Geodesy and Geophysics.

Four resolutions proposed by I.A.G. were accepted by I.U.G.G. :

. Resolution I.U.G.G. N° 2 for the definitions of the Conventional Terrestrial Reference System (C.T.R.S.) with reference to the I.A.U. Geocentric Reference System adopted at the XXIst I.A.U. General Assembly, Buenos Ayres, 1991;

. Resolution I.U.G.G. N° 3 for a better determination of rapid variations in Earth rotation and their implication for geodynamics;

. Resolution I.U.G.G. N° 4 for the implementation of ARISTOTELES space mission due to improve the determination of Earth's gravity and magnetic fields with important implications for Earth system studies;

. Resolution I.U.G.G. N° 5 for the study of an International G.P.S. Geodynamics Service (I.G.S.) during the next four year period, with one or more

international campaigns to test and evaluate the concept.

7.2 - Other I.U.G.G. resolutions also of interest for I.A.G. :

. Resolution N° 6 for the development of knowledge needed to reduce the disastrous effects of extreme natural events, within the frame of the "International Decade for Natural Disaster Reduction (I.D.N.D.R)";

. Resolution N° 8 for a better geographical distribution of geophysical stations to optimize data gathering on a global basis by ground - and space - based measurements.

7.3 - I.A.G. resolutions

. Resolution N° 1 for the use of the International Terrestrial Reference System (I.T.R.S.) currently implemented by the International Earth Rotation Service (I.E.R.S.);

. Resolution N° 2 for a precise geoid determination using high-resolution gravimetric and terrain data available;

. Resolution N° 3 for the continuation of observations at existing L.L.R. stations and the establishment of new stations;

. Resolution N° 4 for the establishment of a Polish-Tunisian geodynamic station in Tunisia and for the support to other similar stations in Africa.

8 - *Publications*

8.1 - BG/mg

According to the Journal Publishing Agreement between the IAG and Springer Verlag, the Memorandum of Understanding between the Editorial Board of manuscripta geodaetica, the I.A.G. and Springer Verlag, and I.A.G. By-Laws art. 28 A, a new Board of Editors for BG/mg was elected during this Assembly. The nomination of two Editors in Chief by this new Board was then approved by the Executive Committee.

a) BG/mg Board of Editors :

. continuing : F. Barlier, P. Cross, J. Dickey, P. Holota, H. Montag, J. Ning, L. Sjöberg, P. Teunissen, C. Tscherning, P. Vanicek,

. new : D. Arabelos, Y. Bock, B. Heck, G. Hein, C. Jekeli, D. Milbert, S. Okubo, W. Prescott, A. Stolz (or C. Rizos).

b) Editors-in-Chief : C. Tscherning, P. Vanicek.

8.2 - I.A.G. Symposia Proceedings Editorship

As decided earlier, most of the I.A.G. Symposia Proceedings are now published by Springer Verlag under the responsibility of the convenors of Symposia. But due to some recent difficulties in communication between those convenors and Springer it was decided to continue with a series - editor acting as coordinator on behalf of the I.A.G. I.I. Mueller accepted to be this editor.

9 - *Scientific matters*

9.1 - GALOS

An ad hoc group on "Geodetic Aspects of the Law of the Sea (GALOS)" was established in 1989 to "formulate recommendations concerning geodetic aspects of international maritime boundary delimitation within the framework of the law of the Sea Convention 1982, and to write a report describing the various possible scenarios admissible under the Convention from the point of view of geodesy". This report was presented to the Executive Committee by P. Vanicek, chairman of the group. The group has been very active, holding meetings and cooperating with the working group on "Technical Aspects of the law of the Sea (TALOS)" of the International Hydrographic Organization. An international GALOS Conference will be held next year in Bali, Indonesia.

The Executive Committee decided to reconstruct this ad hoc group as a working group attached to the E.C., with the aim of creating a common working group with the International Hydrographic Organization and the Federation Internationale des Géomètres. This subject will be on the agenda of the next E.C. meeting in March 1992.

9.2 - International GPS Geodynamics Service (I.G.S.)

After the call for participation to I.G.S. Campaign by the ad hoc Planning Committee (I.I. Mueller, chairman), 110 answers were received. Detailed discussions took place in Symposium G2 during this General Assembly, a steering Committee was set up and the 1992 test campaign was approved. A resolution prepared by the IAG was endorsed by the I.U.G.G. (see item 7.1 above).

9.3 - Global Change

A meeting was convened by E. Groten on "Global

Change activities", with participation of IAG representatives and some concerned colleagues from the other associations. It was unanimously recognized that I.A.G. has an important role to play in this project and that many geodesists are individually participating in Global Change programs and activities. The consensus of the participants was that I.A.G. itself should play a role in the Global Change Program. A working group under the chairmanship of the President of Section V was set up to elaborate proposals for this contribution of I.A.G. to Global Change.

9.4 - COSPAR - World Space Congress sponsorship

The Executive Committe agreed to give the I.A.G.-sponsorship to three Symposia organized during the COSPAR-World Space Congress in Washington D.C., 31 August - 5 September 1992 :

- Symposium B7-M : The orientation of the planet Earth as observed by modern space techniques;
- Symposium B9-M : Contribution of altimetric satellites to solid earth and ocean sciences;
- Symposium Pl-M : Dynamics of satellites and probes.

The nomination of I.A.G.-representatives in the scientific organizing Committee was also approved.

10 - *I.U.S.M. membership*

The application of I.A.G. to become a member of the International Union for Surveys and Mapping (I.U.S.M.) has been approved by their Council. The I.A.G. Council has then ratified this adhesion to the Union, and the nomination of I.I. Mueller and W. Torge as I.A.G. representatives in I.U.S.M. Executive Board was reconfirmed. Prof. K. Torleqard, Vice-President of I.U.S.M. and President of I.S.P.R.S., Prof. J. Talvitie, President of F.I.G. and Prof. E. Christ, Vice-President of I.C.A., attended the opening ceremonies of this General Assembly. Prof. Torlegard, on behalf of I.U.S.M., delivered a short address at the I.A.G. opening ceremony.

11 - *Future scientific meetings*

11.1 - General Meeting 1993

The Secretary General first received invitations from two national committees : Poland and China. But Poland withdrew its invitation, then the Executive Committee and the Council warmfully accepted to hold the next General Meeting of I.A.G., in Beijing, August 8-15, 1993, Prof. J.Y. Chen being the chairman of the Organizing Committee.

11.2 - Other I.A.G. - sponsored scientific meetings for the period 1992-1994

The Executive Committee gave its sponsorship to the following meetings :

1 - Sixth International Symposium on Satellite Positioning
17 - 20 March 1992 - Columbus, Ohio, U.S.A

2 - Symposium on Refraction of Transatmospheric Signals in Geodesy
19 - 22 May 1992 - The Hague, the Netherlands

3 - I.A.U./I.A.G. Symposium on Development of Astrometry and its Impact on Astrophysics and Geodynamics
14 - 19 September 1992 - Shanghai, China

4 - 7th International Symposium on Geodesy and Figure of the Earth (I.A.G. N° : 112)
5 - 10 October 1992 - Potsdam, Germany

5 - 8th International Symposium on Recent Crustal Movements
6 - 11 December 1993 - Kobe, Japan

6 - COSPAR/I.A.G. Symposia
31 Aug. - 5 Sept. 1992 - Washington DC, U.S.A.
B.7-M : The Orientation of the Planet Earth as observed by Modern Space Techniques
B.9-M : Contribution of Altimetric Satellites to Solid Earth and Ocean Science.
P.I-M : Dynamics of Satellites and Probes

7 - Geodetic Aspects of the Law of the Sea (Workshop)
May 1992 - Bali, Indonesia

8 - International Summer School of Theoretical Geodesy
"Satellite Altimetry in Geodesy and Oceanography"
25 May - 6 June 1992 - Trieste, Italy

9 - First Continental Workshop on the Geoid in Europe
11 - 14 May 1992 - Prague, Czechoslovakia

10 - International Conference "Cartography - Geodesy" (with PAIGH)
24 Nov. - 3 Dec. 1992 - Maracaibo, Venezuela

11 - Regional Symposium on Recent Crustal Movements in Europe
1992 or 1993 - Budapest, Hungary

12 - Regional Symposium on Recent Crustal Movements in Africa
December 1994 - Kenya

13 - 3rd Orlov Conference : "The Study of the Earth as Planet by methods of Astronomy, Geophysics and Geodesy"
21 - 26 september 1992 - Odessa, U.S.S.R.

14 - International Workshop : "GPS in the Geosciences"
8 - 10 June 1992, Khania - Greece

15 - Workshop on Geodetic Applications in Crustal Movements and Deformation Studies
September 1993 - Lagos, Nigeria

This list is provisional, other Symposia or workshops may be added, should their organizers send applications to the Central Bureau at least 18 months before the proposed date for the meeting.

It was also recommended that Proceedings of Symposia organized by I.A.G. should be published by Springer-Verlag in the series of I.A.G.-Symposia. Convenors are urgently requested to contact the Secretary General and/or I.I. Mueller, series editor.

11.3 - Next I.U.G.G. General Assembly

On invitation of the U.S. National Committee for Geodesy and Geophysics the next I.U.G.G. General Assembly will take place, in 1995, on the campus of the University of Colorado in Boulder, probably in July.

12 - *Next meeting of the I.A.G. Executive Committee*

This meeting will take place in March 1992, in Columbus, Ohio, just before or just after the Sixth International Symposium on Satellite Positioning.

IUGG Resolutions adopted at the XXth IUGG General Assembly in Vienna and related to Geodesy

RESOLUTION N°2

The International Union of Geodesy and Geophysics

considering the need to define a Conventional Terrestrial Reference System (CTRS) which would be unambiguous at the millimetre level at the Earth's surface and that this level of accuracy must take account of relativity and of Earth deformation, and

noting the resolutions on Reference Systems adopted by the XXIst General Assembly of the International Astronomical Union (IAU) at Buenos Aires, 1991,

endorses the Reference System as defined by the IAU at their XXIst General Assembly at Buenos Aires, 1991, and

recommends the following definitions of the CTRS :

1) CTRS to be defined from a geocentric non-rotating system by a spatial rotation leading to a quasi-Cartesian system,
2) the geocentric non-rotating system to be identical to the Geocentric Reference System (GRS) as defined in the IAU resolutions,
3) the coordinate-time of the CTRS as well as the GRS to be the Geocentric Coordinate Time (TCG),
4) the origin of the system to be geocentre of the Earth's masses including oceans and atmosphere, and
5) the system to have no global residual rotation with respect to horizontal motions at the Earth's surface.

RESOLUTION N°3

The International Union of Geodesy and Geophysics

recognizing the importance of determination of rapid variations in Earth rotation and their implication for geodynamics, and the resulting need to measure variations in Earth orientation with an accuracy of at least 0.1 milli-arc second and at a high temporal resolution, better than daily,

noting the resolution of the XXIst International Astronomical Union (IAU) General Assembly at Buenos Aires, 1991, on this subject, and

considering the plans of the International GPS Geodynamic Service (IGS) to realize a first intensive campaign in summer 1992, and the need for auxiliary data from geophysical, oceanographic and atmospheric sources for the interpretation of high resolution measurements of Earth rotation variations,

recommends :

1) that a joint IUGG/IAU Working Group be established to pursue the goal of the determination of rapid variations in Earth rotation, and
2) that a major campaign for high time resolution measurement of Earth rotation by space techniques, be coordinated with the International Earth Rotation Service (IERS), be held during the planned IGS campaign and that the best possible auxiliary data be obtained during that period.

RESOLUTION N°4

The International Union of Geodesy and Geophysics

recalling Resolution n°4 of the XIXth General Assembly, Vancouver, 1987, on the urgent need for an improved determination of the global gravity field of the Earth, and Resolution n°5 of the International Association of Geomagnetism and Aeronomy (IAGA) at the XIXth IUGG General Assembly concerning satellite measurements of the geomagnetic field at both low and high altitudes and of long duration, and

noting that ESA and NASA have joint plans to develop a dedicated mission (ARISTOTELES) for the improved determination of the Earth's gravity and magnetic fields with important implications for Earth system studies,

recommends the implementation of this mission, the objectives of which promise to meet the expectations of the above-mentioned Resolutions.

RESOLUTION N°5

The International Union of Geodesy and Geophysics

recognizing that the use of the Global Positioning System (GPS) for Geodesy and Geophysics is rapidly increasing and that this system will play a major role over the next decades in global and regional studies of the Earth and its evolution, and

noting that its fully scientific potential can only be realized with international cooperation and coordination to deploy and operate a global tracking network with data analysis and effective dissemination of data,

recommends that the concept of an International GPS Geodynamic Service (IGS) be explored over the next four years, that as a first step one or more campaigns be conducted to test and evaluate the concept, that all Member Countries participate to the best of their ability, and that this activity be coordinated as closely as possible with comparable global deployments by other member associations, as well as those by other organizations, and

requests that existing global geodetic systems such as Very Long Baseline Interferometry (VLBI) and Satellite Laser Ranging (SLR) be used to carry out intensive observing campaigns in conjunction with the proposed IGS work.

RESOLUTION N°6

The International Union of Geodesy and Geophysics

recognizing that the United Nations have created the "International Decade for Natural Disaster Reduction" for the 1990s, that the International Council of Scientific Unions is working to promote and coordinate the activites of the Unions in this effort, and that terrible human suffering and economic disruption are caused each year by phenomena, the study of which is within the scope of IUGG,

recommends that scientists associated with IUGG join in the endeavor to develop the additional knowledge needed to reduce the disastrous effects of extreme natural events, and that the Member Countries of IUGG enthousiastically and vigorously support the research needed to meet this great human need.

RESOLUTION N°8

The International Union of Geodesy and Geophysics

recognizing that global geophysical and geodetic studies are urgently needed to better understand many aspects of global change,

noting that with recent technological advances, the collection and analysis of digital geodetic and geophysical data is now possible on a global scale, and

considering the economies of scale and scientific benefits can be derived from optimally located ground and seabed measurements, including their integration with space-based observations,

urges that relevant organizations, agencies and Member Countries should review the geographical distribution of those geophysical stations under their control which make continuous earth and space observations, and should jointly locate as many of these stations as is practical, so that data gathering on a global basis by ground-and space-based measurements be optimized.

Vœux de l'UGGI adoptés à la XX^{ème} Assemblée Générale à Vienne et concernant la Géodésie

VŒU N°2

L'Union Géodésique et Géophysique Internationale,

considérant la nécessité de définir un Système de Référence Terrestre Conventionnel (SRTC) non ambigu au niveau millimétrique à la surface de la Terre, et que ce niveau d'exactitude nécessite la prise en compte de la relativité et des déformations de la Terre,

notant les résolutions sur les Systèmes de Références adoptées par la XXI^{ème} Assemblée Générale de l'UAI (Union Astronomique Internationale) à Buenos Aires, 1991,

adopte le système de référence tel qu'il a été défini par l'UAI lors de sa XXI^{ème} Assemblée Générale à Buenos Aires, 1991, et

soutient la définition suivante du SRTC:

1) le SRTC sera défini par une rotation spatiale d'un système géocentrique non tournant, aboutissant ainsi à un système quasi cartésien;
2) le système géocentrique non tournant sera identique au Système de Référence Géocentrique (SRG) défini dans les résolutions de l'UAI;
3) le temps-coordonnée du SRTC aussi bien que du SRG sera le temps-coordonnée géocentrique (TCG);
4) l'origine du système sera le centre des masses de la Terre, y compris les océans et l'atmosphère;
5) le système n'aura pas de rotation globale résiduelle par rapport aux mouvements horizontaux à la surface terrestre.

VŒU N°3

L'Union Géodésique et Géophysique Internationale,

reconnaissant l'importance de la détermination des variations rapides de la rotation de la Terre et de leurs implications géodynamiques, et la nécessité qui en résulte de mesurer les variations d'orientation de la Terre avec une exactitude supérieure au dix-millième de seconde d'arc, et ceci avec une haute résolution temporelle, supérieure au jour,

notant la résolution adoptée par la XXIème Assemblée Générale de l'UAI (Union Astronomique Internationale) à Buenos Aires, 1991, concernant ce sujet, et

considérant les projets du Service International GPS (Global Positioning System) pour la Géodynamique (SIG) d'entreprendre une première campagne intensive pendant l'été 1992, et le besoin de données auxiliaires d'origine géophysique, océanographique et atmosphérique, pour l'interprétation des mesures haute résolution des variations de la rotation terrestre,

recommande

1) qu'un Groupe de Travail UGGI/UAI soit établi afin de poursuivre un objectif d'une détermination des variations rapides de la rotation de la Terre;
2) qu'une importante série de mesures à haute résolution temporelle de la rotation de la Terre par techniques spatiales soit entreprise avec la coordination de l'IERS (International Earth Rotation Service) pendant la campagne prévue par le SIG, et que les données auxiliaires les meilleures possibles soient enregistrées durant cette période.

VŒU N°4

L'Union Géodésique et Géophysique Internationale,

rappelant la résolution n°4 de la XIXème Assemblée Générale de Vancouver, 1987, concernant le besoin urgent d'améliorer la détermination du champ de gravité global de la Terre, ainsi que la résolution n°5 de l'Association Internationale de Géomagnétisme et d'Aéronomie (AIGA) adoptée lors de la XIXème Assemblée Générale de l'UGGI concernant les mesures par satellite du champ géomagnétique à basse et haute altitudes et sur une longue période, et

notant que l'ASE et la NASA ont un projet commun de mission (ARISTOTELES), consacré à l'amélioration de la détermination des champs gravitationnel et magnétique de la Terre, avec des retombées importantes pour l'étude du système terrestre,

recommande la réalisation de cette mission, dont les objectifs promettent d'atteindre les souhaits des résolutions précitées.

VŒU N°5

L'Union Géodésique et Géophysique Internationale,

reconnaissant que l'utilisation du Global Positioning System (GPS) en géodésie et en géodynamique se développe rapidement et que ce système va jouer un rôle majeur dans les prochaines décennies pour les études globales et régionales de la Terre et de son évolution,

notant que ses potentialités scientifiques ne pourront être pleinement réalisées que par une coopération et une coordination internationales en vue d'installer et de faire fonctionner un réseau global de poursuite, ainsi que pour assurer le traitement des données et leur diffusion effective,

recommande que le projet d'un Service International GPS pour la Géodynamique (SIG) soit étudié pendant les quatre prochaines années, que, dans un premier temps, une ou plusieurs campagnes soient réalisées pour évaluer les qualités de ce projet et que les Pays Membres y participent dans la mesure de leurs possibilités, que ces travaux soient coordonnés aussi étroitement que possible avec des activités semblables, réalisées par d'autres associations ou organisations, et

demande que les systèmes existants de géodésie globale, tels que l'interférométrie à longue base (VLBI) et la télémétrie par laser sur satellite (SLR), soient utilisés pour réaliser des campagnes d'observations intensives conjointement à l'activité proposée par le SIG.

VŒU N°6

L'Union Géodésique et Géophysique Internationale,

reconnaissant que les Nations Unies ont déclaré la décennie 1990 "décennie internationale pour la réduction des désastres naturels", que le Conseil International des Unions Scientifiques travaille à promouvoir et coordonner les activités des Unions dans le cadre de cet effort, et que de terribles souffrances humaines et des perturbations économiques sont chaque année causées par des phénomènes dont l'étude est du domaine de l'UGGI,

recommande que les chercheurs associés à l'UGGI contribuent aux efforts visant à accroître les connaissances nécessaires à la réduction des effets des événements naturels désastreux, et que les Pays Membres de l'UGGI soutiennent avec enthousiasme et vigueur la recherche requise pour satisfaire cet important besoin de mieux-être pour l'humanité.

VŒU N°8

L'Union Géodésique et Géophysique Internationale,

reconnaissant la nécessité urgente de réaliser des études géophysiques et géodésiques à l'échelle du globe afin de mieux comprendre le fonctionnement du système géosphère-biosphère,

notant que de récents progrès techniques permettent maintenant d'acquérir et d'analyser des données géodésiques et géophysiques sous forme numérique à l'échelle du globe, et

considérant qu'il est possible de faire des économies d'échelle et d'obtenir des avantages scientifiques grâce à des mesures réalisées en des endroits choisis au mieux, à terre comme au fond des mers, et à leur coordination avec des observations spatiales,

demande instamment que les organisations et agences compétentes, ainsi que les Pays Membres, examinent la répartition géographique des stations géophysiques qui réalisent, sous leur contrôle, des observations terrestres et spatiales combinées, et qu'elles coopèrent pour en placer un aussi grand nombre que possible en des endroits qui permettent d'optimiser la collecte des données sur l'ensemble de la Terre au moyen de mesures terrestres et spatiales bien réparties.

IAG Resolutions adopted at the XXth IUGG General Assembly in Vienna

RESOLUTION N°1

The International Association of Geodesy,

considering the IUGG Resolution on Conventional Terrestrial Reference System (CTRS), and noting

1) that the International Earth Rotation Service (IERS) is currently implementing such a system under the name of the International Terrestrial Reference System (ITRS) from VLBI, SLR, LLR and now GPS data, and
2) that the ITRS is within one metre of WGS 84,

recommends :

1) that groups making highly accurate geodetic, geodynamic or oceanographic analysis should either use the ITRS directly or carefully tie their own systems to it,
2) that IERS standards should contain all necessary documentation to assist this task,
3) that for mapping, navigation or digital databases where sub-metre accuracy is not required, WGS 84 may be used in the place of ITRS,
4) that for high accuracy in continental areas, a system moving with a rigid plate may be used to eliminate unnecessary velocities provided it coincides exactly with the ITRS at a specific epoch (e.g. the ETRS 89 system selected by the EUREF subcommission).

RESOLUTION N°2

The International Association of Geodesy

considering the urgent need of high-precision geoid determination in combination with GPS positioning and for new continental reference systems.

recommends that national agencies make available their high-resolution gravimetric and terrain data for precise geoid determination by the appropriate IAG centres or commissions.

RESOLUTION N°3

The International Association of Geodesy

considering the importance of uninterrupted long-term Lunar Laser Ranging (LLR) data series for astronomy, geodesy and physics, in order to study the Earth-Moon system and testing General Relativity, and noting recent attempts to establish new LLR stations.

recommends the continuation of observations at existing LLR stations and the establishment of new stations which would improve the global distribution of observatories.

RESOLUTION N°4

The International Association of Geodesy

considering :

1) that the African tectonic plate is of great interest for geodynamic research,

2) that there is so far too little involvement of Africa in global techniques to monitor these phenomena, and
3) that the Polish/Tunisian proposal to install a geodynamic station in Tunisia makes a substantial contribution to this research,

recommends :

1) that Tunisia and Poland should continue with their efforts to establish this station,
2) that advantage should be taken of current international projects which impinge on Africa,
3) that member countries should consider giving the necessary support to sustain this station as well as other high accuracy tracking ones, coming from similar proposals.

Vœux de l'AIG adoptés à la XX^{ème} Assemblée Générale à Vienne

VŒU N°1

L'Association Internationale de Géodésie,

considérant le vœu de l'UGGI sur le Système de Référence Terrestre Conventionel (SRTC), et notant

1) que le Service International de la Rotation Terrestre (IERS) met actuellement en place un tel système, du nom de Système de Référence Terrestre International (ITRS) à partir des données VLBI, SLR, LLR et maintenant GPS, et
2) que l'ITRS est différent de moins d'un mètre du WGS 84,

recommande :

1) que les groupes effectuant des calculs de haute précision dans des buts géodésiques, géodynamiques ou océanographiques, soit utilisent l'ITRS directement, soit rattachent soigneusement leurs propres systèmes à l'ITRS,
2) que les standards IERS contiennent toute l'information nécessaire pour les aider dans cette tâche,
3) que pour la cartographie, la navigation ou les bases de données numériques, où une exactitude submétrique n'est pas requise, le WGS 84 puisse être utilisé à la place de l'ITRS,
4) que pour des applications de haute précision pour une échelle continentale, un système se déplaçant avec la plaque rigide peut être utilisé pour éliminer des vitesses non nécessaires pourvu qu'il coincide exactement avec l'ITRS à une époque spécifique (e.g. le système ETRS 89 sélectionné par la sous-commission EUREF).

VŒU N°2

L'Association Internationale de Géodésie

considérant le besoin urgent de la détermination d'un géoïde de très grande précision en combinaison avec le positionnement par GPS et pour les nouveaux systèmes de référence continentaux,

recommande que les organismes nationaux rendent disponibles leurs données gravimétriques de haute résolution et leurs données de terrain pour la détermination d'un géoïde de précision par les centres ou les commissions de l'AIG appropriés.

VŒU N°3

L'Association Internationale de Géodésie

considérant l'importance de séries temporelles ininterrompues de données de Laser Lune (LLR) sur de longues périodes pour l'astronomie, la géodésie et la physique, en vue d'étudier le système Terre-Lune et de vérifier la Relativité Générale, et notant des tentatives récentes d'implantation de nouvelles stations Laser-Lune.

recommande la continuation des observations pour les stations Laser-Lune existantes et la réalisation de nouvelles stations qui amélioreraient la répartition mondiale des observatoires.

VŒU N°4

L'Association Internationale de Géodésie,

considérant :

1) que la plaque tectonique Africaine possède un grand intérêt pour la recherche géodynamique,
2) qu'il existe actuellement trop peu d'implication de l'Afrique dans les techniques globales pour surveiller ces phénomènes, et
3) que la proposition Polonaise/Tunisienne d'implanter une station géodynamique en Tunisie apporte une contribution substantielle à cette recherche,

recommande :

1) que la Tunisie et la Pologne continuent leurs efforts pour établir cette station,
2) que l'on saisisse la chance de projets internationaux pour impliquer l'Afrique,
3) que les nations membres doivent considérer de donner le soutien nécessaire pour faire fonctionner cette station aussi bien que d'autres stations de poursuite de grande exactitude, provenant de propositions semblables.

STRUCTURE of the INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS for the PERIOD 1991-1995

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President : **M. Prilepin** (U.S.S.R.)
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(Commission X) : **K. Poder** (Denmark)

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Secretaries : **R. Rummel** (The Netherlands)
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* : Correspondant for the Boulder General Assembly

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Special Commissions of Section I:
SC4: Aplications of Geodesy to Engineering
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SC5: Marine Positioning
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Special Study Groups of Section I
SSG 1.105-Kinematic Global Positioning System
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Commission VIII: International Coordination of Space Techniques for Geodesy and Geodynamics (CSTG)
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Special Commission of Section II
SC6: "Wegener Project"
President : **P. Wilson** (Germany)

Special Study Groups of Section II
SSG 2.107-Gravity Field Determination by Satellite Gravity-Gradiometry:
E. Schrama (The Netherlands)
SSG 2.109-Applications of Space VLBI in the Field of Astrometry and Geodynamics:
J. Adàm (Hungary)
SSG 2.130-Non-Gravitational Force Modelling Effects on Satellite Orbits:
J. Ries (U.S.A.)
SSG 2.131-Spaceborne GPS/GLONASS:
T. Yunck (U.S.A.)
SSG 2.132-Time-Varying Gravitational Effects on Satellite Orbits:
C. Shum (U.S.A.)
SSG 2.151-Altimetry: Optimal Processing for Geodesy, Geophysics and Oceanography:
W. Bosch (Germany)

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(Commission III) : **I. Marson** (Italy)
(Commission XII) : **H. Sünkel** (Austria)

Commissions of Section III
Commission III: International Gravity Commission
President : **I. Marson** (Italy)
Commission XII: International Geoid Commission
President : **H. Sünkel** (Austria)

Special Study Groups of Section III
SSG 3.133-Techniques of Precise Gravimetry:
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SSG 3.134-Airborne Gravimetry:
G. Hein (Germany)
SSG 3.135-Optimization of Spectral Gravity Field Modelling Methods:
M. Sideris (Canada)
SSG 3.136-High Resolution Geoid Modelling and Evaluation:
H. Denker (Germany)
SSG 3.137-Combined Use of Gravimetry and Stress-Strain Measurement Techniques:
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International Gravimetric Bureau (**BGI**)
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Special Commission of Section IV
SC1: Mathematical and Physical Foundations of Geodesy
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SSG 4.138-Modelling and Quality Control for Precise Integrated Navigation:
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SSG 4.139-The Role of Terrain in Gravity Field Modelling:
A. Geiger (Switzerland)
SSG 4.140-Tomography of the Atmosphere by Geodetic Measurements:
T. Spoelstra (The Netherlands)
SSG 4.141-Integrated Inverse Gravity Modelling:
R. Barzaghi (Italy)
SSG 4.142-Applications of the Boundary Value Problem Techniques to Space and Airborne Gravity Field:
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Commissions of Section V

Commission V: Earth tides
President : **H. Hsu** (China)
Commission VII: Recent Crustal Movements
President : **T. Tanaka** (Japan)

Special Commission of Section V

SC3: Fundamental constants
President : **M. Bursa** (Czechoslovakia)

Special Study Groups of Section V

SSG 5.143-Rapid Earth Orientation Variations (common with IAU):
J.O. Dickey (U.S.A.)
SSG 5.144-Dynamic Effects in Earth Rotation Theory:
S. Molodensky (Russia)
SSG 5.145-Long-term Variations in Earth Rotation:
P. Brosche (Germany)
SSG 5.146-Processing of Optical Polar Motion Data in View of Plumb Line Variations:
P. Pâquet (Belgium)
SSG 5.147-Studies of the Baltic Sea:
J. Kakkuri (Finland)
SSG 5.148-Global Geodynamic Variations:
B. Chao (U.S.A.)
SSG 5.149-Studies on Vertical Datums (with IAPSO):
E. Groten (Germany)
SSG 5.150-Density Distribution within the Lithosphere:
H.G. Kahle (Switzerland)
SSG 5.152-Geodetic Research Toward the Reduction of Natural Hazards:
S. Okubo (Japan)

International Services in Section V:

International Centre of Earth Tides (affiliated to FAGS) (**ICET**)
Director: **P. Melchior** (Belgium)
International Centre for Recent Crustal Movements (**ICRCM**)
Director: **P. Vyskocil** (Czechoslovakia)
International Earth Rotation Service (affiliated to FAGS) (**IERS**)
Chairman of the Directing Board:
K. Yokoyama (Japan)
Director of the Central Bureau:
M. Feissel (France)
Permanent Service for Mean Sea Level (affiliated to FAGS) (**PSMSL**)
Director: **P.L. Woodworth** (U.K.)
BIPM Time Section:
Director: **C. Thomas** (France)

Out of Section Commissions and Special Commissions

Out of Section Commissions

Commission IX: Education
President : **R. Langley** (Canada)
Commission XI: Geodesy in Africa
President : **M. Charfi** (Tunisia)

Out of Section Special Commission

SC2: History of Geodesy
President : **J. Weightman** (U.K.)

SECTION I

POSITIONING
DETERMINATION DE POSITION

President : M. Prilepin (Russia)
Secretaries : F.K. Brunner (Australia)
(Commission X) : K. Poder (Denmark)

I- *Program of activities*

Through items of symposia and workshops, tasks of Commission and special study groups, adopting relevant resolutions, the section will try :

- to coordinate the international projects of establishment the global and regional networks bearing in mind the versatility of their utilization.

- to carry out the comparative assessment of different measuring systems (space and terrestrial), to find properly place to them in positioning and promote the modernization,

- to improve the technology of field measurements and processing the data, especially the elimination of the systematic errors,

- to constantly work the long-term stability of fundamental and first order sites of geodetic networks,

- to encourage the improvements of geodetic education in the field of geology and geophysics.

II- *Structure*

Section I consists of the following bodies :

Commission

Commission X : Continental Networks
President: K. Poder (Denmark)

Special Commissions

Special Commission SC4 : Applications of Geodesy to Engineering
Chairman: K. Linkwitz (Germany)

Special Commission SC5 : Marine Positioning
Chairman: M. Kumar (USA)

Special Study Groups

SSG 1.105 : GPS Kinematic positioning methods and applications
Chairman: H. Landau (Germany)

SSG 1.125 : Positioning with inertial systems
Chairman: J.M. Rüegger (Australia)

SSG 1.126 : Permanent GPS arrays
Chairman: Y. Bock (USA)

SSG 1.127 : Error propagation in GPS Networks
Chairman: L.W. Baran (Poland)

SSG 1.128 : Wet propagation delay
Chairman: G. Elgered (Sweden)

- Commission X

Continental Networks
Réseaux Continentaux

President : **K. Poder** (Denmark)
Secretary : **C. Schwarz** (USA)

I- *Task*

To promote scientific and practical activities for the establishment and maintenance of continental networks for geodetic science and for public applications.

II- *Plan of Work*

- by the continental commissions work for using available coordinates derived from VLBI, SLR, and LLR observations to produce fundamental continental networks on a global, geocentric datum,

- support the establishment of such fundamental network, which can be integrated into a global network,

- cooperate with the work realized by IGS.

III- *Structure*

Commission X

President : K. Poder (Denmark)
Secretary : C. Schwarz (USA)

Sub-Commissions

European Triangulation (EUREF)

President : E. Gubler (Switzerland)
Secretary : H. Hornik (Germany)

European Levelling (U.E.L.N.)

President : O. Remmer (Denmark)

Secretary : F. Brouwer (The Netherlands)

North America

President : M. Pinch (Canada)
Secretary : R. Steeves (Canada)

South America

President : E. Pallejá (Argentina)

South-East Asia & The Pacific

President : C. Veenstra (Australia)
Secretary : J. Rais (Indonesia)

West Asia

President : R. Majali (Jordan)

VI- *Members*

E. Pallejá	(Argentina)
U. van Twembeke	(Belgium)
M. Pinch	(Canada)
Y. Zhang	(China)
N.L. Marakenko	(CIS)
J. Kostelecky	(Czechoslovakia)
O. Remmer	(Denmark)
M.M. Ibrahim	(Egypt)
M. Le Pape	(France)
J. Kakkuri	(Finland)
E. Grafarend	(Germany)
A. Czobor	(Hungary)
V.K. Nagar	(India)
B.S. Rajal	(India)
J. Rais	(Indonesia)
S. Arca	(Italy)
J. Segawa	(Japan)
F.W.O. Aduol	(Kenya)
Choe Jae Pok	(Korea)
J. Majali	(Jordan)
B. Engen	(Norway)
B.G. Reit	(Sweden)
E. Gubler	(Switzerland)
M. Charfi	(Tunisia)
M. Rezgui	(Tunisia)
T. Ayan	(Turkey)
F. Brouwer	(The Netherlands)
V. Ashkenazi	(United Kingdom)

Special Commission SC4 on Applications of Geodesy to Engineering

President : **K. Linkwitz** (Germany)

Present rapid developments in engineering, microelectronics and the computersciences are of great impact upon geodesy and have created the need for intensive research within the context of applying geodesy to engineering. The proposed working program reflects actual problems in this field. Their solution would not only promote geodesy as a whole but also contribution to interdisciplinary approaches.

Five fields of interest are regarded to be challenging and rewarding:

1) Theory of local networks, reference frames and datum: integration of classical and modern techniques, i.e. trilateration, levelling, GPS and inertial methods: presenting their results in a local uniform frame of reference.

Comments and context.

Increasing accuracies in prefabrication, modern methods of construction and project management on site have lead to the consequence, that objects of construction on contemporary sites are of equal complexity in geometry and prerequisites of accuracy as complicated objects in mechanical engineering. CAD is being introduced in architecture and civil engineering; in its realization the engineering object is tackled simultaneously at many different spots on site and in prefabrication factories (concrete-and steelparts, fassades, timberworks, special parts, etc). Furthermore, the

advent of masonry-construction-and other robots will create a demand for on-line and realtime monitoring with high reliability and mm-accuracies.

In postconstruction control and maintenance, speedy and integrated measurements of high accuracy are employed to detect critical deformations or to navigate repair-and adjusting machinery.

Basis and framework for realizations and controls are very precise local geodetic nets established today by classical methods of positioning and levelling combined with GPS, gravimetry and inertial methods, all relating to different reference frames. These have to be unified and then transformed into the cartesian 3D-space in which engineers and architects design and execute their works.

2) Realtime observations, monitoring and navigation, including processing of the feed-back emanating from the monitoring objects.

Comments and context.

Often combined with the determination and monitoring of rigid body motion in space, this field finds applications in:

- monitoring of slow moving construction machinery of road surfaces, earth-grading, etc.
- monitoring of masonry robots,
- monitoring of excavation machinery for channels and pipes,
- monitoring of tunnel excavation machinery,
- monitoring of subterranean pipe-pressings,
- monitoring of rail adjusting machines, etc.

Characteristic for this type of application is the necessity to determine coordinates and other parameters of actual position and compare them in real time with predetermined positions including the potential to correct and to navigate. Classical and non-conventional methods may be applied, and very often the use of preinformation about the trajectories and the dynamic properties of the monitored objects are know and have to be fed into the mathematical model describing the whole process.

3) System developments combining classical and non-conventional methods for applications in engineering using multisensor approaches.

Comments and context.

The different measurement components have to be integrated into site monitoring systems. In combination with adequate software and incorporated into the fabrication process, such systems will give at any time full information about the geometrical status of the object under construction, under monitoring, or under observation. The geometrical status information includes the potential to perform all subconsequent further relevant analyses, i.e. determination of surfaces, volumes, absolute and relative position in space, deviations from predesigned geometrical or other parameters. In navigation model, such systems will provide real time correction parameters for the monitored object.

4) Data acquisition and processing, using and transforming modern concepts of the computer and information sciences.

Comments and context.

Objects planned and designed by civil engineers and architects have to be converted from their geometrical description in plans to a digital description by coordinates and geometrical parameters. This digital description has to include the geometrical prerequisites, parameters and plans issued by the group of other engineering professionals: Specialists of construction, installation, interior design, the ensemble of which will yield the digital model of the object to be constructed. This has to be loaded into a data bank providing arbitrary relational cross references.

During realization of the object on site, this digital model and its data bank are the basis for a permanent real-time comparison of given and actual geometrical parameters and for the monitoring of construction machinery and robots, taking into account also the always present possibility of gross errors in measurements.

The data bank has to allow permanent updating in agreement with all changes of plans and designs made during execution.

5) Promotion and integration of non-conventional ("exotic") measurement techniques including tests, calibrations and comparisons.

Comments and context.

In permanently installed geometrical controlsystems used in dams, tunnels, synchrotons, atomic reactors, etc. non-conventional measurement techniques - often introducted by mechanical engineers or physicists - have to be combined with and incorporated into geodetic measurement techniques so that integrated systems evolve.

6) Members

K. Linkwitz (Germany) President

J.M. Rüeger	(Australia)
H. Kahmen	(Austria)
G. Milev	(Bulgaria)
A. Chrzanowski	(Canada)
K.-P. Schwarz	(Canada)
B. Teskey	(Canada)
H. Haggren	(Finland)
L. Gründig	(Germany)
N. Korittke	(Germany)
H.-J. Mönicke	(Germany)
H. Pelzer	(Germany)
H. Nakamura	(Japan)
T. Oshima	(Japan)
B.N. Yambaer	(Russia)
M. Mayoud	(Switzerland)
S. Mogilny	(The Ukraine)
V. Ashkenazi	(United Kingdom)
Z.F. Biac	(USA)
T. Greening	(USA)
R. Ruland	(USA)
R. Wilkins	(USA)
H. Henneberg	(Venezuela)
R.T. Todorovic	(Yugoslavia)

Special Commission SC5

Marine Positioning (ISCOMAP)

President : **M. Kumar** (USA)

I- *Purpose*

The ISCOMAP purpose is to promote comprehensive research related the positioning in the marine environment utilizing common scientific investigations through international cooperation, to foster inter-disciplinary dialogue and exchange of ideas, to encourage new instrumentation and techniques, and to established applications.

II- *Tasks/objectives*

a. To define the main problem areas whose solutions require international and inter-disciplinary cooperation for scientific investigations.

b. To develop, recommend, and coordinate international and inter-disciplinary programs for promotion of scientific and research investigations in new areas and other disciplines.

c. To promote coordination, free exchange, and sharing of results to avoid overlaps and duplications.

d. To promote participation by the developing countries.

e. To promote exchange of the results of the international research studies.

III- *Organizations*

President :
M. Kumar (USA)

Executive Board

Vice-Presidents :

P.J. Fell	(USA)
G. Seeber	(Europe)
J. Rais	(Asia)

Secretary :
M. Lockwood (USA)

Advisor :
F. Spiess (USA)

Members :

J. Morton	(USA)
H. Fujimoto	(Japan)
H. Dragert	(Canada)
S. Drummond	(USA)
H. Henneberg	(Venezuela)

6.3. Special Sub-Commissions (SSC)

SSC #1 - Seaflor Positioning (SEAPOST)
Chairman : G. Seeber (Germany)
SSC #2 - Seaflor Spreading
Chairmen : N. Saxena (USA)
W. Normark (USA)
SSC #3 - Geodetic Aspect of The Law of The Sea (GALOS)
Chairman : P. Vanicek ((Canada)
SSC #4 - Height Systems and Bathymetry
Chairman : N. Pavlis (USA)
SSC #5 - Surface Positioning
Chairman : G. Hein (Germany)
SSC #6 - Geoid and Mean Sea Level
Chairman : G.A. Maul (USA)

6.4. Working Groups

WG #1 - Instrumentation/Measurement Techniques
Chairman : H. Fujimoto (Japan)
WG #2 - Acoustic Methods
Chairman : A. Zielinski (Poland)
WG #3 - Estimation Techniques
Chairman : P.J. Fell (USA)
WG #4 - Marine Positioning Applications
Chairman : T.S. Murty

IV- *List of Members*

C. Rizos (Australia)

D. Wells	(Canada)
A.M. Wassef	(Canada)
G. Carrera	(Canada)
V.P. Glumov	(CIS)
W. Lechner	(Germany)
H. Schenke	(Germany)
A. Vafidis	(Greece)
S.P. Mertikas	(Greece)
V.K. Nagar	(India)
S. Mira	(Indonesia)
T. Furuta	(Japan)
U. Zuments	(Latvia)
J. Hannah	(New Zeland)
D.M. Fubara	(Nigeria)
A. Ezequiel	(Portugal)
L. Sjöberg	(Sweden)
W.A. van Gein	(The Netherlands)
A.M. Ben Hadj Salem	(Tunisia)
J. Weightman	(United Kingdom)
J. Beavan	(USA)
M. Bevis	(USA)
W. Brogdon	(USA)
J. Brozena	(USA)
C.E. Carmichael	(USA)
W. Liu	(USA)
M. Mc Intyre	(USA)
A. Meyer	(USA)
B. Minster	(USA)
C.N.K. Mooers	(USA)
G.F. Purcell	(USA)
J.P. Reilly	(USA)
C. Rocken	(USA)
M. Sarafin	(USA)
S. Tucker	(USA)
P. Vogt	(USA)
C. Walker	(USA)
L. Young	(USA)
J. Zund	(USA)

Special Study Group 1.105

GPS Kinematic Positioning Methods and Applications

Chairman : **H. Landau** (Germany)

I- *Main Objectives*

The task of SSG 1.105 is the development of techniques and algorithms for high-precision kinematic GPS positioning in differential mode. Real-time positioning with GPS and its applications in geodesy will be investigated.

II- *Program of Activities*

1. Assessment of OTF (on-the-fly) ambiguity resolution algorithms. The possible combination of methods to improve performance and reliability. Performance analysis of algorithms and the dependance between convergence time and satellite geometry, baseline length, dynamic environment and dual-frequency capabilities. Comparisons with standard datasets already available (our group can provide different datasets sampled in buoys, ships and aircrafts).

2. Research into the real-time implementation of # 1 in various configurations. Data and data rate required. Investigation of data link formats like RTCM SC104, RINEX or future developments. Integrity issues. Field testing and evaluation.

3. Effect of various Selective Availabilty levels on #1 and #2 as a function of monitor-remote distance. Impact of using multiple monitor stations.

4. Determination of attitude and heading with GPS antenna arrays. Comparison of different algorithms. Analysis of multipath and platform bending effects.

5. Wide area differential GPS concepts. Development of special algorithms suited for WADGPS with respect to atmospheric, clock and orbital modelling. Data link formats (type and rate of data, transfer channels). Simulation and field testing.

III- *Members*

H. Landau	(Germany) Chairman
J.C. Blankenburg	(Norway)
E. Cannon	(Canada)
P. Cross	(United Kingdom)
C. de Jong	(Japan)
H.J. Euler	(Germany)
A.G. Evans	(USA)
T. Fukushima	(Japan)
R. Hatch	(USA)
P. Kielland	(Canada)
A. Kleusberg	(Canada)
G. Lachapelle	(Canada)
M. Lang-Varga	(Ungary)
M. Le Gouic	(France)
M. Lufeng	(China)
G. Mader	(USA)
S. Mira	(Indonesia)
B. Remondi	(USA)
Ch. Rizos	(Australia)
G. Seeber	(Germany)

Special Study Group 1.125

Positioning with Inertial Systems

Chairman : **J. M. Küeger** (Australia)

I- *Study Areas*

1. Testing and introduction of new inertial technology.

2. Testing and introduction of cheaper inertial technology.

3. Practical aspects of the integration of GPS and inertial equipment.

4. Inertial equipment for attitude and trajectory determination; non-conventional inertial positioning.

II- *List of members*

J.M. Rüeger	(Australia) Chairman
J. M. Becker	(Sweden)
G. Boedecker	(Germany)
W. Caspary	(Germany)
R. Forsberg	(Denmark)
E. Groten	(Germany)
W. Heger	(Germany)
G.W. Hein	(Germany)
H. Heister	(Germany)
J.R. Huddle	(USA)
E.T. Knickmeyer	(Germany)
M. Lidberg	(Sweden)
H-J Mönicke	(Germany)
O.S. Salychev	(Russia)
K.P Schwarz	(Canada)
Y.S. Zhang	(China)

Special Study Group 1.126

Permanent GPS Arrays

President : **Y. Bock** (U.S.A.)

I. *Main Objective*

There are a growing number of permanent GPS arrays being established for continuous monitoring of deformation with apertures up to several hundred kilometers. For example, permanent arrays are in operation in central Japan, and in California to monitor crustal deformation and the earthquake cycle. Permanent arrays are also being established to support various types of ongoing GPS operations (e.g., navigation, rapid static surveys). The primary objective of this group is to study a variety of technical and scientific aspects of permanently and continuously operating GPS arrays.

II. *Program of Activities*

The SSG will investigate the following issues:

1. Technical requirements for establishing a permanent station (instrumentation, monumentation, communications, power);

2. Temporal vs. spatial resolution of continuous monitoring with GPS;

3. Systematic errors that effect continuous monitoring (e.g., instrumental, orbital, atmospheric);

4. Algorithms and models for real-time processing.

III. *Membership*

Y. Bock	(U.S.A.) Chairman
B.C. Ambrosius	(The Netherlands)
B. Betti	(Italy)
M. Crespi	(Italy)
D. Delikaraoglou	(Canada)
H. Dragert	(Canada)
B. Engen	(Norway)
K. Ferguson	(U.S.A)
W. Gurtner	(Switzerland)
R. King	(U.S.A)
U.J. Lindqwister	(U.S.A)
C-C. Liu	(Taiwan)
P. Morgan	(Australia)
E.C. Pavlis	(U.S.A.)
S.S.O. Puntodewo	(Indonesia)
S. Shimada	(Japan)
H. Tsuji	(Japan)
V. Velikov	(Russia)

Special Study Group 1.127

Error Propagation in GPS Networks

Chairman : **L.W. Baran** (Poland)

I- *Terms of Reference*

The main purpose of SSG 1.127 will be intensive research on the accuracy analysis of GPS networks. This will comprise very large networks (national networks) tied to the existing Reference Frames (e.g. EUREF) as well as the local networks established for engineering purposes.

The main goal of future reasearch will be the identification and determination of the influence of the error in GPS observations, the impact of different methods of modelling of the ionospheric and tropospheric effects and the inner geometry of a network on the accuracy and precision of GPS positioning.

II- *Program of Activities*

The following areas are selected for intensive investigation :

1. Statistical analysis of GPS data and error modelling.

2. The impact of error modelling on the result of GPS network adjustments.

3. The application of different estimation techniques for the processing of GPS data and the influence of the selection of the particular method on the results of GPS network adjustment.

4. Error propagation in the case of GPS network densification and extension.

III- *Membership*

J.W. Baran	(Poland), Chairman
P. Cross	(United Kingdom)
R. Jaeger	(Germany)
L. Kubàckovà	(Czechoslovakia)
A. Leick	(USA)
F. Madsen	(Denmark)
P. Morgan	(Australia)
S. Oszczak	(Poland)
M. Rothacher	(Switzerland)
B. Schaffrin	(USA)
G. Shanurov	(Russia)
T. Tanaka	(Japan)
M. Unguendoli	(Italy)
A. Wassef	(Canada)
W. Welsch	(Germany)

Special Study Group 1.128

Wet Propagation Delay

Chairman : **G. Elgered** (Sweden)

I- *Main objectives*

- Improve the accuracy of measurement techniques for estimation of the propagation delay due to atmospheric water vapor. Evaluate instrumentation that can be used during geodetic campaigns for a direct correction of the wet delay and/or for calibration of other equipment.

- Acquire and survey data on temporal (seconds to years) and spatial (meters to hundreds of kilometers) variations in atmospheric water vapor. Analyze these data, e.g., by searching for and characterize possible site and seasonal dependences.

- Develop and evaluate models for variations in the wet delay. Study the appropriate definitions for the separation of the wet delay and the remaining ("dry" or "hydrostatic") atmospheric delay. Determine the interaction between these delay types. Models and model parameters may be based on findings from the above objectives and/or use geodetic data to estimate the propagation delays.

II- *Program of activities*

- Distribute information (reports, papers, etc) within the SSG.

- Hold SSG meetings at appropriate conferences and symposia.

III- *Members*

G. Elgered	(Sweden) Chairman
F.K. Brunner	(Australia)
B. Bürki	(Switzerland)
J.L. Davis	(USA)
A.H. Dodson	(United Kingdom)
T.A. Herring	(USA)
M. Ishiguro	(Japan)
S.J. Keihm	(USA)
C.E. Kuehn	(USA)
R.B. Langley	(Canada)
R. Peter	(Switzerland)
A. Rius	(Spain)
A.A. Stotskii	(Russia)
D.M. Tralli	(USA)
R.N. Treuhaft	(USA)
S.J. Walter	(USA)
Ed.R. Westwater	(USA)
C. Zhao	(China)

SECTION II

ADVANCED SPACE TECHNOLOGY
TECHNOLOGIE SPATIALE AVANCEE

President : Ch. Reigber (Germany)
Secretaries : R. Rummel (The Netherlands)
(Commission VIII) : B. Schutz (USA)

I- *Objectives*

Section II, Advanced Space Technology, is engaged in new Space techniques for geodesy and geodynamics such as microwave tracking techniques, satellite and lunar laser ranging, satellite altimetry, satellite gradiometry, satellite to satellite tracking and any other geodetic measurement techniques from space.

The activities in the section include :

1. Evaluation of the results from space techniques for application to geodesy and geodynamics.

2. Development of high precision orbit determination.

3. Simulation and evaluation of new satellite systems for geodesy and geodynamics.

4. Development of lunar and planetary geodetic techniques.

5. Initiation and coordination of multi-national observing projects and scientific investigation programs with advanced space technology.

II- *Structure*

The section includes Commission VIII "International Coordination of Space techniques for Geodesy and Geodynamics" (President : B.E. Schutz, USA) and the Special Commission SC6 "Wegener project" (President : P. Wilson, Germany) and the seven Special Study Groups :

SSG 2.107 : Gravity Field Determination by Satellite Gravity-Gradiometry
Chairman : E. Schrama (The Netherlands)

SSG 2.109 : Application of Space VLBI in the Field of Astrometry and Geodynamics
Chairman : J. Adam (Hungary)

SSG 2.130 : Non-Gravitational Force Modelling Effects on Satellite Orbits
Chairman : J.C. Ries (USA)

SSG 2.131 : Spaceborne GPS/GLONASS
Chairman : T. Yunk (USA)

SSG 2.132 : Time-Varying Gravitational Effects on Satellite Orbits
Chairman : C.K. Shum (USA)

SSG 2.151 : Altimetry : Optimal Processing for Geodesy, Geophysics and Oceanography
Chairman : W. Bosch (Germany)

- Commission VIII

International Coordination of Space Techniques for Geodesy and Geodynamics

President : B. Schutz (USA)

I- *Objectives*

The Commission on International Coordination of Space Techniques for Geodesy and Geodynamics (CSTG) was established during the XVIIth General Assembly of the IUGG in Canberra in 1979. It is Commission VIII of Section II in the International Association of Geodesy and Subcommission B.2 in COSPAR. The charter of the Commission is the following:

"Develop links between various groups engaged in the field of space geodesy and geodynamics by various techniques, coordinate work of these groups, elaborate and propose projects implying international cooperation, follow their progress and report on their advancement and results."

The role of the CSTG is to facilitate the activities of national and international groups through the collection and dissemination of information within the groups and the member countries mainly through correspondence and also through international or regional meetings and to help in setting up coordinated multi-national observing projects and scientific investigation programs.

CSTG operates through an Executive Committee and a broad-based Steering Committee, as well as through the National Representatives in carrying out the Commission objectives stated in the charter. In addition, a number of Projects and Subcommissions have been created to coordinate activities in the field of space geodesy and geodynamics which could benefit from the coordinating role of the Commission. Each Project and Subcommission has its own organizational structure and most issue their own informational bulletins or newsletters. Projects generally consist of highly focused activities over a limited period of time, whereas Subcommissions cover long-term programs, often with programmatic implications.

It is the Commission plan to promote space geodesy in areas of the world in which there have been few space geodetic measurements and to encourage the continued conduct of comparisons between space geodetic techniques. The Commission will also encourage the development of new techniques and application areas.

As in the past, the CSTG will encourage dissemination of information between the various groups engaged in space geodesy and geodynamics through the publication of the CSTG Bulletin. Current plans call for a version to be published in multiple languages, including English and Spanish which have been used in the past. These bulletins will provide reports on current results and future plans for applications of space techniques to geodesy and geodynamics.

The goals of the CSTG are fostered by the various Subcommissions:

- Subcommission International Radio Interferometric Surveying (IRIS), established in 1983 :
  Chairman : T. Yoshino
- Subcommission Satellite Laser Ranging, established in 1986:
  Chairman : J. Degnan
- Subcommission Global Positioning System, established in 1987:
  Chairman : G. Mader
- Subcommission Site Issues, established in 1989 :
  Chairman : J. Bosworth

The REGIN Project, formerly a CSTG Project, has now evolved into a Special Commission in Section 2. A new Project, the International GPS Service (IGS) Campaign, scheduled for mid-1992 has been established under CSTG, chaired by G. Beutler.

II- *Membership*

Executive Committee :

B. E. Schutz	(U.S.A.) President
Ch. Reigber	(Germany)
A. G. Stolz	(Australia)
Ya. Yatskiv	(Ukraine)

Steering Committee

F. Barlier	(France)
G. Beutler	(Switzerland)
J. Bosworth	(U.S.A.)
M. Campos	(Brasil)
J. Degnan	(U.S.A.)
B. Engen	(Norway)
D. Fubara	(Nigeria)
A. Finkelstein	(Russia)
J. Hannah	(New Zealand)
S. Hieber	(France)
E. Kausel	(Chile)
G. Mader	(U.S.A.)
W. Melbourne	(U.S.A.)
H. Montag	(Germany)
J. Ning	(China)
F. Nouel	(France)
J. Rais	(Indonesia)
R. Rummel	(The Netherlands)
A. Sengoku	(Japan)
J. Slater	(U.S.A.)
S. Tatevian	(Russia)
P. Willis	(France)
P. Wilson	(Germany)
T. Yoshino	(Japan)
S. Ye	(China)
S. Zerbini	(Italy)
J. Zielinski	(Poland)

Representatives by Country (this list is believed to be incomplete):

P. Pâquet	(Belgium)
M. Bursa	(Czechoslovakia)
J. Hu	(China)
M.T. Prilepin	(CIS)
F. Madsen	(Denmark)
M. Tawedros	(Egypt)
F. Barlier	(France)
I. Fejes	(Hungary)

B. Rajal	(India)
B. Okumu	(Kenya)
Kim Cha Un	(Korea)
W. Gurtner	(Switzerland)
B. Ronnang	(Sweden)
R. M. Rezgui	(Tunisia)
O. Gurkan	(Turkey)
A. Sinclair	(United Kingdom)
T. Clark	(U.S.A.)

Special Commission SC6

"WEGENER Project" Geodetic Investigations Related to the Kinematics and Dynamics of the African, Arabian and Eurasian Plates

Chairman : P. Wilson (USA)

I- *Main Objectives*

Three main objectives have been defined. They are :

1. The investigation of deformations along the Afro-Arabian/Eurasian plate boundary which includes :

- the determination of the relative plate motions in the framework of 3-D global plate motions,
- the estimation of the extent of the deformation zones directly associated with the plate boundaries,
- the assessment of the relative magnitudes of horizontal and vertical change and the variation of the deformations occurring across the boundary zones;

2. the investigation of post-glacial rebound in Fennoscandia, which includes :

- estimation of the extent of the rebound phenomena in the Fennoscandian region,
- determination of the rate of vertical deformation and the variation of rate as a function of distance from the centres of rebound,
- analysis of the geodetic results to constrain the viscosity of the mantle and the models describing deformation of the lithosphere in response to loading;

3. the investigation of height variation and changes of sea level, which includes :

- contributions to the establishment of a common global height datum,
- the determination of improved geoidal information for the plate boundary and Fennoscandian regions,
- estimation of the relative magnitudes of the different factors contributing to height and sea-level variations and the relationship of change in sea level to global change.

Each of these objectives will draw upon the analysis of SLR, VLBI, GPS and (high precision absolute and relative) gravity data.

II- *Program of Activities*

The currently scheduled activities comprise both field measurements and analysis. These include:

1. continuation of SLR measurements at the permanent sites and at temporary sites in Italy, Greece, Turkey and the Commonwealth of Independent States;

2. VLBI measurements between the permanent installations across Europe as well as observations at a number of temporary sites in Northern and Western Europe, in Iceland and in North Africa using the MVIII mobile VLBI system;

3. extensive GPS observations across the Mediterranean and the Black Sea regions including Bulgaria and Rumania; GPS measurements in Fennoscandia and in the Commonwealth of Independent States; the establishment and operation of a number of permanent GPS tracking stations across Europe, the Mediterranean and in the Commonwealth of Independent States; GPS measurements to connect tide gauges across the Mediterranean, the Black Sea and in Northern Europe;

4. measurements of absolute and/or relative gravity at selected fiducial stations, in the vicinity of tide gauges across Europe and in North Africa and along selected profiles where the gradient of height change is especially pronounced;

5. development and exploitation of models and analytical techniques to facilitate the estimation of time variant three-dimensional positional change and the time variant components of the gravity field;

6. inter-disciplinary interpretation of the results achieved.

III- *Membership*

The formal membership of this Special Commission represents an international cross-section of interest in the WEGENER activities. However, in view of the strong regional character of WEGENER and the

project oriented interests of this group, the prime membership must be reserved for those who have actively committed funding and effort to the achievement of the goals which have been established by the WEGENER Consortium. Nominations from other interested areas will be welcomed.

P. Wilson	(Germany) Chairman
H. Sünkel	(Austria)
G. Milev	(Bulgaria)
S.K. Tatevian	(CIS)
P. Vyskocil	(Czechoslovakia)
F. Barlier	(France)
H. Seeger	(Germany)
Ch. Reigber	(Germany)
G. Veis	(Greece)
J. Somogyi	(Hungary)
A. Shapira	(Israel)
G. Bianco	(Italy)
S. Zerbini	(Italy)
D.B. Sari	(Morocco)
K.F. Wakker	(The Netherlands)
B. Engen	(Norway)
J.B. Zielinski	(Poland)
J.P. Osorio	(Portugal)
I. Kumkova	(Russia)
A. Rius	(Spain)
B.O. Rönnang	(Sweden)
H.G. Kahle	(Switzerland)
W. Gurtner	(Switzerland)
O. Ergunay	(Turkey)
Y.S. Yatskiv	(Ukraine)
P. Cross	(United Kingdom)
M.R. Pearlman	(USA)
J.A. Scheid	(USA)

Special Study Group 2.107

Gravity Field Determination by Satellite Gravity-Gradiometry

Chairman : J.O. Schrama (The Netherlands)

I- *Terms of reference*

The special study group shall concentrate on :

- development and discussion of new and existing concepts for global and regional recovery of gravity field parameters from satellite gradiometry,

- feasibility studies of proposed satellite gravity gradiometer missions,

- investigations in spaceborne GPS to complement satellite gravity gradiometer solutions,

- theoretical aspects related to satellite gradiometry.

II- *Membership*

E. Schrama	(The Netherlands)
Chairman	
G. Balmino	(France)
S. Bettadpur	(U.S.A.)
F. Bocchio	(Italy)
B. Heck	(Germany)
K.H. Ilk	(Germany)
E. Livieratos	(Greece)
F. Migliaccio	(Italy)
R.S. Nerem	(U.S.A.)
E.C. Pavlis	(U.S.A.)
R.H. Rapp	(U.S.A.)
J.W. Robbins	(U.S.A.)
D. Rossikopoulos	(Greece)
F. Sansó	(Italy)
C.C. Tscherning	(Denmark)
M. Vermeer	(Denmark)
P. Visser	(The Netherlands)
T. Yunck	(USA)

Special Study Group 2.109

"Application of Space VLBI in the Field of Astrometry and Geodynamics"

Chairman: J.Adám (Hungary)

I. *Terms of Reference*

There are projects to place one or more radio telescopes in space for VLBI purposes planned or proposed by several space agencies. Currently two dedicated space VLBI projects are in preparation. One in Russia called RADIOASTRON which is an approved and funded mission. It will be launched in 1994. The second one is a Japanese orbiting VLBI mission called VSOP also approved and funded. The expected launch date is 1995. The QUASAT mission, and later its successor, IVS, were not approved by ESA. It is likely that a second generation space VLBI mission will be proposed towards the end of the decade.

Although potential new applications of space VLBI in the field of astrometry, geodesy and geodynamics have been recognized, little effort has been made to explore these applications in detail, so far.

An important application of space VLBI in astrometry would be to measure proper motions of extragalactic H20 maser sources and with statistical or orbital parallax methods directly determine distances of extragalactic objects up to 20 Mpc. This could lead to an independent estimate of the Hubble constant.

In the field of geodesy and geodynamics, space VLBI may be useful to improve the determination of the Earth's gravity field and in the unification and connection of reference frames inherent in the space VLBI technique. More accurate orbit reconstruction is essential of the potential of space VLBI in these fields is to be realised. The space VLBI missions offer and will provide new types of satellite observables (VLBI time delay, delay rate and differential VLBI tracking data) with high accuracy for these potential applications.

Considering the complexity of the problem and the international character of the subject, these studies should be carried out in broad international collaboration.

II. *Program of Activities*

The activities of this SSG should include:

- coordination of astrometric, geodetic and geodynamic research in the field of space VLBI,

- investigation of the accuracy requirements and optimal conditions for the measurements,

- identification of the scope and the limits of applications,

- advise to the respective science teams on potential astrometric, geodetic and geodynamic experiments and observing programs,

- development of software and test computations,

- organization of meetings and workshops at times appropriate for the members.

III- *Membership*

J. Adám	(Hungary) Chairman
V.A. Alexeev	(Russia)
N. Bartel	(USA)
F.J.J. Brouwer	(The Netherlands)
U. Cannon	(Canada)
N. Capitaine	(France)
J.M. Dow	(Germany)
I. Fejes	(Hungary)
E.W. Grafarend	(Germany)
T. Herring	(USA)
N. Kawaguchi	(Japan)
M. Kulkarni	(India/USA)
E.C. Pavlis	(USA)
D. Priou	(France)
Z. Qian	(China)
B.O. Rönnang	(Sweden)
R.T. Schilizzi	(The Netherlands)
Y. Takahashi	(Japan)
N. Zarraoa	(Spain)

Corresponding members

Z. Altamimi	(France)
V. Altunin	(Russia)
J. Campbell	(Germany)
A. Dermanis	(Greece)
H. Hirabayashi	(Japan)
I.I. Mueller	(USA)
J. Popelar	(Canada)
B. Schaffrin	(USA)
H. Schuh	(Germany)
T. Szeto	(Canada)
Ya.S. Yatskiv	(The Ukraine)
T. Yoshino	(Japan)

Special Study Group 2.130

Non-Gravitational Force Modelling Effects on Satellite Orbits

Chairman : J. Ries (USA)

I- *Terms of Reference*

Non-gravitational forces on satellites tend to have a stochastic and uncertain nature, and to some degree, they may never be fully modelled when determining precision orbits. Atmospheric drag and terrestrial radiation pressure have significant random variation, while solar radiation pressure and thermal imbalances depend on the complex interaction of the surface properties and satellite geometry. Nevertheless, improvements in the models for these effects are essential now that considerable progress has been made in the gravitational models. The objective of this study group will be to understand the effects of the various non-gravitational forces on satellite orbits, categorize those effects which are significant, develop more accurate models where possible, and where model improvements are likely to be difficult to obtain, develop estimation strategies to compensate for the modelling deficiencies.

II- *Program of Activities*

1. Continue the efforts to improve the atmospheric density models and investigate estimation techniques which reduce the effects of drag model errors on satellites such as ERS-1 and Starlette.

2. Investigate improvements to the models for direct solar pressure effects on satellites with simple as well as complex shapes.

3. Refine models for the effects of reflected light and emitted heat from the Earth on satellite orbits.

4. With the increased orbit accuracy requirements for satellites such as GPS and Topex/Poseidon, the effects of temperature imbalances (thermal thrusts) cannot be ignored, and the development of models for these effects should be continued.

5. Continue to investigate the along-track acceleration of the Lageos satellite. Determination of the Lageos spin axis orientation will be an essential part of these studies. Effects observed on Lageos may also be important for the Etalon satellites.

III- *Membership*

J. Ries	(USA) Chairman
G. Alfonso	(Brazil)
F. Barlier	(France)
B. Bertolli	(Italy)
N. Borderies	(USA)
J. Feltens	(Germany)
H. Fliegel	(USA)
E. Gaposchkin	(USA)
A. Hedin	(USA)
F. Herrero	(USA)
T. Killeen	(USA)
H. Klinkrad	(Germany)
A. Marshall	(USA)
P. Moore	(United Kingdom)
A. Nobili	(Italy)
G.W. Rosborough	(USA)
D. Rubincam	(USA)
R. Scharroo	(The Netherlands)
V. Slabinski	(USA)

Special Study Group 2.131

Spaceborne GPS/GLONASS

Chairman : Thomas P. Yunck (USA)

I- *Objectives*

1. To identify and explore the relevant issues, track the progress, and help to advance the state of the art, in such areas as:

- GPS/GLONASS flight receiver development, design, requirements, and performance.
- Precise orbit determination (POD) with GPS/GLONASS.
- Long wavelength gravity model improvement with spaceborne GPS/GLONASS.
- The role of spaceborne GPS/GLONASS in monitoring global change.
- Security aspects of the use of GPS/GLONASS.

2. To facilitate communication and promote cooperation within the worldwide community of current and prospective users of spaceborne GPS/GLONASS.

3. To bring to the attention of a broader user community the diverse and powerful applications of spaceborne GPS/GLONASS, promote its wider use, and realize the economies of coordinated efforts.

II- *Program of Activities*

SSG 2.131 will hold formal meetings twice per year, typically once in the U.S. (for example, around the time of the fall AGU in San Francisco) and once overseas. Less formal discussions and get-togethers may be convened at other well-attended meetings, as appropriate. Group members will select topics of special interest and lead discussions of those topics at each meeting. The list of topics and the membership of the group will evolve as new issues are raised and new activities begun. The initial list of topics will include:

- *System Status:* Current operational status and performance of GPS and GLONASS

- *Flight receivers:* What are the basic functional and performance requirements for different applications? What flight qualified receivers are currently available? What are their capabilities? What are their costs? Are new receiver developments needed to meet current mission objectives? Is it possible to develop a low-cost (<$1M) flight receiver for use on multiple missions? Is it feasible to combine GPS and GLONASS in a moderate-cost flight receiver? Are current antenna designs adequate?

- *Missions:* What are the current missions (existing, planned, proposed) that expect to use GPS/GLONASS? What are their objectives and requirements for flight receiver performance and ground tracking of GPS/GLONASS satellites? Can we identify general classes of mission that can be served efficiently by a single receiver design? Can a single ground network support all missions?

- *POD:* What are the various techniques by which GPS/GLONASS can be used for POD? What are the requirements (e.g., data types, visibility, number of satellites) of each technique and expected performance? Is POD accuracy of 1 cm a realistic goal for supporting ocean altimetry in the year 2000? What are the limiting errors? Is there a role for GPS-based attitude determination on space platforms?

- *Gravity:* What is the current state of the art of Earth gravity modeling? In what ways can spaceborne GPS/GLONASS help to improve current gravity

models? What are the most suitable orbits? What other instruments can complement GPS/GLONASS for gravity recovery? What algorithms and solution strategies are available and how do they compare? What are the limiting errors?

- *Global Change:* What is the potential role of GPS/GLONASS atmospheric occultation measurement in monitoring global climatic change? Does atmospheric temperature monitoring (and the high data rates required) impose significant new demands on flight receivers and ground networks? How can spaceborne GPS/GLONASS enhance the performance of ground-based observation of global change?

- *Security:* What are the security issues connected with using GPS and GLONASS? Can all mission requirements be met in the presence of GPS selective availability and anti-spoofing without adopting classified equipment or operations? Does GLONASS offer an open alternative to GPS? How is GPS security policy changing with world politics? Can we have a voice in influencing that policy?

- *Ongoing Missions:* What lessons are being learned from current orbital missions carrying GPS receivers, including the Extreme Ultra-Violet Explorer, TOPEX/POSEIDON, and Landsat?

An important objective of this study group is to facilitate communication among the worldwide community of prospective spaceborne GPS/GLONASS users, with the hope that through our common interests and joint efforts we can hasten progress and reduce costs. There will therefore be no fixed agenda. Rather, we will focus our attention on the issues of most pressing concern and shift our emphasis as developments warrant.

III- *Membership*

T.P. Yunck	(USA) Chairman
B.C. Ambrosius	(The Netherlands)
J.M. Dow	(Germany)
I. Fejes	(Hungary)
C. Goad	(USA)
C. Jekeli	(USA)
K.M. Larson	(USA)
S.M. Lichten	(USA)
E.C. Pavlis	(USA)
Ch. Reigber	(Germany)
E.J.O. Schrama	(The Netherlands)
B.E. Schutz	(USA)
T.N. Upadhyay	(USA)
P. Wilson	(Germany)
P. Willis	(France)
Y. Yatskiv	(Ukraine)

Special Study Group 2.132

Advanced Space Technology: Time-Varying Gravitational Effects on Satellite Orbits

President : C. Shum (USA)

I. *Terms of Reference*

The temporal changes in the Earth's gravity field are the result of interaction of the solid Earth with its atmosphere, oceans, cryosphere and ground water circulation, and with celestial bodies, primarily the Sun and the Moon, and the result of post-glacial rebound in the Earth's mantle due to deglaciation since the last ice age. These time-varying changes in the gravity field produce significant effect on orbits of Earth-orbiting artificial satellites. The time scales of these variations vary from 12 hours to 18.6 years and to geological time scale. Among these variations, the causes and consequences of temporal changes in the gravity field due to geophysical and meteorological phenomena are not well understood. Using satellite tracking data, altimeter measurements, VLBI data, tide gauge data and the associated meteorological observations, the existing models will be intercompared with "in situ" measurements and geophysical predictions as a step towards achieving the goal of refinement of these models.

II. *Program of Activities*

The primary objectives include the improvement and accuracy assessment of available models which compute perturbations due to the following time-varying gravitational effects on satellite orbits:

- Earth, ocean and atmospheric tides (time scales from 12 hours to 18.6 years).

- Meteorological and geophysical mass redistribution (atmosphere, ground water circulation, ice/snow melting and accumulation, earthquakes, etc.), time scales varying from episodic, sub-diurnal, seasonal, interannual to decadal.

- Post-glacial rebound and phenomena associated with present-day melting and accumulation of polar and continental glaciers (geological time scales, secular).

The following measurements will be used:

- Satellite laser ranging, DORIS, PRARE and GPS satellite-to-satellite tracking data and radar altimeter data collected from historic and future geodetic and oceanographic satellites, including Lageos-1, -2 and -3, Starlette, Ajisai, Etalon-1 and -2, Geosat (ERM and GM), TOPEX/POSEIDON, ERS-1 and -2, Stella, Spot-2 and -3, Geosat-Followon, and GP-B.

- VLBI measurements.

- Hourly averaged tide gauge data over the global ocean and covering a long time span.

- Meteorological data such as WMO, NMC, ECMWF air pressure and ground water circulation data; sea level data from TOGA, PSMSL, and the U.S. Navy; and snow accumulation/melting data from NOAA, etc.

III- *Membership*

C. Shum	(USA) Chairman
S. Casotto	(Italy)
A. Cazenave	(France)
B. Chao	(USA)
M. Cheng	(USA)
S.R. Dickman	(USA)
R. Dietrich	(Germany)
R.J. Eanes	(USA)
C. Huang	(China)
J. Klokocnik	(Czechoslovakia)
C. Le Provost	(France)
J.X. Mitrovica	(USA)
P. Moore	(United Kingdom)
R.S. Nerem	(USA)
W.R. Peltier	(Canada)
Ch. Reigber	(Germany)
J. Wahr	(USA)
K. Wakker	(The Netherlands)
C. Yoder	(USA)
W. Zahel	(Germany)

Corresponding Members:

D. Cartwright	(United Kingdom)
B. Douglas	(USA)
E.M. Gaposchkin	(USA)
R. Ray	(USA)
D-N. Yuan	(USA)

Special Study Group 2.151 .

Altimetry: Optimal Processing for Geodesy, Geophysics and Oceanography

Chairman : W. Bosch

I- *Terms of Reference*

With its fast, precise and global monitoring of the sea surface, altimetry has already provided emphasizing results for Earth sciences. Altimeters are core instruments for ongoing and future Earth observation missions. Considering applications in different disciplines and a multi-mission altimetry, the processing is to be optimized in terms of data administration, algorithms, and knowledge about signals and errors of all phenomena affecting the measurement scenario. The possibility to estimate the deviations between geoid and sea surface is (due to its relation to ocean circulation and a global geodetic height datum) one of the most dedicated problems to be addressed jointly by experts from both, geodesy and oceanography. In addition, use of altimetry over land and ice are to be adressed.

II- *Program of activities*

- Specify requirements or recommendations for structure, archival and administration of multi-mission altimeter data (dual frequency, different sampling) in view for applications in different disciplines.

- (Re)investigate errors of the altimetric measurement scenario and determine statistical information about signal, noise, and correlations.

- Investigate separability of Earth geapotential (geoid) and quasi-stationary sea surface (altimetry used in combination with surface gravity, tracking data, and ocean climatology) to estimate sea surface topography.

- Analyze methods to monitor and represent sea surface variability (altimetric and its combination or correlation with ocean dynamics).

- Investigate methods to overcome datum problems due to geographically correlated errors, the differential (relative) nature of crossover-and colinear analysis, and dynamic heights from oceanography.

Study techniques for altimetry application over land and the mapping of ice topography.

III- *List of Members*

W. Bosch	(Germany) chairman
D. Arabelos	(Greece)
A. Brenner	(U.S.A.)
M. Brovelli	(Italy)
W. Cudlip	(United Kingdom)
S. Ekholm	(Denmark)
Th. Engelis	(Greece)
W. Fuerst	(Austria)
Y. Fukuda	(Japan)
R. Haagmans	(The Netherland)
S. Houry	(France)
P. Knudsen	(Denmark)
R.S. Nerem	(U.S.A.)
J. Noreus	(Sweden)
Ch. Rizos	(Australia)
P. Samuel	(Norway)
E.J.O. Schrama	(The Netherland)
C.K. Shum	(U.S.A.)
D. Stammer	(Germany)
V. Zlotnicki	(U.S.A.)

SECTION III

DETERMINATION OF THE GRAVITY FIELD
DETERMINATION DU CHAMP DE PESANTEUR

President : H-G. Wenzel (Germany)
Secretaries : R. Forsberg (Denmark)
(Commission III) : I. Marson (Italy)
(Commission XII) : H. Sünkel (Austria)

I- *Terms of Reference*

According to the By-Laws of the IAG, Section III is responsible for :

- absolute and relative terrestrial gravity measurements;
- gravity networks and control stations;
- non-tidal gravity variations;
- determination of the external gravity field and the geoid from gravimetry, gradiometry, satellite altimetry, geodetic astronomy, space and inertial techniques; and
- reduction and estimation of gravity field quantities.

The earth's gravity field contains significant information for different fields of applications, such as geodesy, geophysics and navigation. The determination of the gravity field is based on various types of measurements distributed both in space and time. The quantities measured are the gravity potential and its first and second order derivatives, or linear combinations of these quantities. They are provided by techniques such as levelling, satellite altimetry, gravimetry, gradiometry, geodetic astronomy, and space and inertial techniques. The measurements are the basis for modelling of the external gravity field and the geoid, using various mathematical techniques for the reduction, prediction and combination of the data. The estimation, approximation and representation of the gravity field and the geoid are strongly required with high precision in global, regional and local scales. As the measurement accuracy in both absolute and relative gravimetry on land is in the order of 10^{-9} g, the study of non-tidal gravity changes becomes increasing important for geodynamic studies.

II- *Structure*

Section III is composed of two Commissions and five Special Study Groups :

Commissions

Commission III : International Gravity Commission
President : I Marson (Italy)

Commission XII : International Geoid Commission
President : H. Sünkel (Austria)

Special Study Groups

SSG 3.133 : Techniques of Precise Gravimetry
Chairman : M. Becker (Germany)

SSG 3.134 : Airbone Gravimetry
Chairman : G.W. Hein (Germany)

SSG 3.135 : Optimization of Spectral Gravimetric Techniques
Chairman : M.G. Sideris (Canada)

SSG 3.136 : High Resolution Geoid Modelling and Evaluation
Chairman : H. Denker

SSG 3.137 : Combined Use Of Gravimetry and Stress-Strain Measurement Techniques
Chairman : S. Takemoto (Japan)

- Commission III

International Gravity Commission
Commission Gravimétrique Internationale

President : **I. Marson** (Italy)
Vice-President : **G. Boedecker** (Germany)
J. Mäkinen (Finland)
Secretaries : **N. Courtier** (Canada)
E. Klingele (Switzerland)

1. *Program of Activities*

1.1. The International Gravity Commission (IGC) promotes scientific investigations of the gravity field of the Earth, its relationship to the form and processes of the Earth's interior and exterior and its variations with time. It does so through the concerted actions of its members to acquire homogeneous gravity anomaly coverage of the Earth. It regulates the operation of the Bureau Gravimetric Inernational (BGI), the operational agency of the IGC, established to promote the free exchange of gravity data among the member countries for the benefit of not only geodesists but also geophysicists and geologists.

1.2. The commission shall seek to collaborate with all international and national organizations concerned with the work of the IGC, particularly for the benefit of the developing countries.

1.3. The Commission will encourage and promote special campaigns to develop and compare gravity instrumentation, techniques of operation and procedures for the adjustment of the results of surveys.

1.4. The Commission will review its functions from time to time to ensure that its activities are commensurate with the needs of the geodetic community.

1.5. The Commission will organize at least one meeting of a global nature in the four-year period between the IUGG/IAG Assemblies. In addition, it would encourage regional meetings or workshops dedicated to a specific problem where appropriate.

2. *Functions*

The functions of the IGC shall be :

(a) To find solutions to problems requiring international cooperation in gravity research and review the results of such investigations;

(b) To recommend and coordinate international programmes for scientific investigation in gravity and related matters which call for concerted action by its members and interested organizations;

(c) To make recommendations to international organizations in matters which relate to the Commission's programme;

(d) To promote and make recommendations for the exchange of gravity data and the publication and dissemination of results of scientific investigations;

(e) To make recommendations to strenghten education and training programmes in gravity and its technology;

(f) To assist developing countries in gravity-related research and technology development;

(g) To promote scientific investigation of gravity on behalf of the international community, taking into account special interests and rights of countries concerning scientific research in the zones under their jurisdiction.

In carrying all its functions, the IGC shall bear in mind the special needs and interests of developing countries.

3. *Cooperation*

The IGC shall give due attention to supporting the objectives of the international organizations with which it collaborates and which may request the IGC to act, as appropriate, as the medium, for discharging certain of their responsibilities in matters relating to gravity investigations. The IGC may also request these organizations to take its requirements into account in planning and executing their own programmes.

4. *Organization*

4.1. The Assembly of the IGC shall be its principal organ and, without prejudice to the previsions of paragraph 3 of this Article, shall make all decisions necessary to fulfill the functions of the IGC.

4.2. In accordance with the By-Laws of the IAG, the President of the Commission is appointed by the Council of the IAG. Every four years, the Assembly shall elect two Vice-Presidents and a Secretary at its ordinary session. They, along with the President, shall

constitute the Executive Board. The President may appoint a second Secretary to assist with the operation of the Commission.

4.3. The Executive Board shall exercise the responsibilities delegated to it by the Assembly and act on its behalf in the implementation of decisions of the Assembly.

4.4. The Executive Board shall review the effectiveness of the operating structure of the Commission and make recommendations to the Assembly on structural or other changes necessary.

5. *Working Procedures*

5.1. The Assembly shall be convened in ordinary session every four years. Extraordinary sessions may be convened at the discretion of the Executive Board or at the request of at least five National Committees.

5.2. Each Country belonging to the IAG and represented at the Assembly shall have one vote, but may accompany its representative to sessions of the Assembly with alternates and advisers as it deems necessary.

5.3. The IGC either through its Assembly of by Executive action subject to the approval of the Assembly may create, for the examination and execution of specific projects, working groups or other subsidiary bodies composed of experts interested in such projects.

6. *Financial Support*

6.1. The programmes endorsed and coordinated by the IGC and recommended to its Members Countries for their concerted action shall be carried out with the aid of the resources of participating member Countries, in accordance with the obligations that each Country is willing to assume.

6.2. The expenditures of the IGC shall be financed from funds appropriated for this purpose by the IAG or other organizations of the IUGG.

6.3. Contributions to the Commission from outside the structure of the IUGG may be accepted and established as trust in accordance with the financial regulations of the IAG. Such funds will be allocated to programmes of the Commission in accordance with any special whishes of the donor or decisions of the Assembly or the Executive Board.

6.4. Funds so allocated shall be expended by a Secretary of the Commission who will be accountable in this matter to the Central Bureau of the IAG.

7. *Sub-Commissions*

7.1. The Commission is divided into the fowolling Sub-Commissions :

Sub-Commission	Coordinator	
North Pacific Region	I. Nakagawa	(Japan)
North America	R. Moose	(USA)
Western Europe	D. Ruess	(Austria)

7.2. The terms of reference for the Sub-Commissions are :

(a) To act as a regional centre for maintaining a catalogue of information of the International Gravity Standardization Network (IGNS71), the International Absolute Gravity Base Station Network (IAGBN) and other gravity base stations in the area, including marine gravity bases, and to facilitate the supply of this information to the BGI.

(b) To coordinate the maintenance, revision and extension of the network of international gravity base stations in the region.

(c) To collaborate with, and where necessary to coordinate assistance to, countries in the area wishing to set up and maintain national gravity reference networks.

(d) To assist the BGI in obtaining a good regional coverage of surface gravity data in the area.

(e) To undertake, in consultion with the President of the IGC, other activities as required in the pursuit of the objectives of the Commission.

(f) To act as a regional agency of the IGC.

7.3. The coordinators are requested to organize the Bureau of each Sub-Commission as appropriate, based on regional support by parent agencies.

7.4. Membership of each Sub-Commission is envisaged to comprise :

(a) Representatives of member Countries of the IUGG in the area concerned, as provided in the IAG Rules for Commissions.

(b) Representatives of countries in the area who are not members of the IUGG, to be appointed in consultation with representatives of Member Countries.

7.5. Communication and Reporting

(a) The Sub-Commission shall communicate to its members by circular letters, with information copies to the President of the IGC, the Director of the BGI, the President of the IAG, the President of Section III, and Presidents of eventual other Commissions of the IAG interested.

(b) The Sub-Commission shall report to the President of the IGC as required.

8. *Work to be Performed*

8.1. Bureau Gravimétrique International

The Commission supports the continuing operation of the BGI with the emphasis on expanding its gravity data base to include national areas for which no data have been released and to improve coverage on land and on the oceans.

8.2. Absolute Gravity Measurements

(a) Intercomparisons of transportable absolute gravity meters at locations to be determined and in conjunction with the observations of the IAGBN, in order to investigate systematic errors.

(b) Further development of the IAGBN.

(c) Collection of new absolute gravity measurements, regional and local network connections and adjustments.

8.3. International Gravity Standardization Net 1971

Improvements and extensions where necessary, new regional adjustments where necessary, comparison with absolute gravity measurements.

8.4. Marine Gravity Data

Connection of harbour sites to existing gravity base station networks, comparisons with satellite altimetry.

8.5. Gravity Variation with Time

Coordination of absolue gravity measurements at superconducting gravimeter sites in order to study instrumental effects and non-tidal gravity variations with time.

9. *Working Groups*

The Commission has established four Working Groups in order to perform a specific task and to assist the BGI:

WG1 - Data Processing

Chairman:	R.K. McConnell	(Canada)
Members:	G. Balmino	(France)
	M. Sarrailh	(France)
	C.C. Tscherning	(Denmark)
	H.-G Wenzel	(Germany)

WG2 - World Gravity Standards

Chairman:	G. Boedecker	(Germany)
Members:	J.E. Faller	(USA)
	H. Hanada	(Japan)
	I. Marson	(Italy)
	R.K McConnell	(Canada)
	G. Peter	(USA)

WG5 - Monitoring of Non-Tidal Gravity Variations

Chairman:	C. Poitevin	(Belgium)
Members:	D. Crossley	(Canada)
	B. Ducarme	(Belgium)
	J.E. Faller	(U.S.A.)
	T. Higashi	(Japan)
	J. Hinderer	(France)
	H.T. Hsu	(China)
	J. Mäkinen	(Finland)
	I. Marson	(Italy)
	B. Richter	(Germany)
	A. Sakuma	(France)
	T. Sato	(Japan)
	P. Steinhauser	(Austria)
	T. Tsubokawa	(Japan)
	R. Warburton	(USA)
	H.-G. Wenzel	(Germany)
	W. Zürn	(Germany)

WG6 - Intercomparison of Absolute Gravimeters

Chairman:	I. Marson	(Italy)
Members:	G. Cerutti	(Italy)

N. Courtier	(Canada)
C. Elstner	(Germany)
J.E. Faller	(U.S.A.)
Y.G. Guo	(China)
H. Ishii	(Japan)
A. Kiviniemi	(Finland)
G. Peter	(USA)
D. Ruess	(Austria)
A. Sakuma	(France)
W. Torge	(Germany)

10. *National Representatives of the Commission*

C. Poitevin	(Belgium)
H. Hsu	(China)
P.P Medvedev	(CIS)
L. Kubàckovà	(Czechoslovakia)
R. Forsberg	(Denmark)
S. Riad	(Egypt)
Y. Albouy	(France)
G. Csapo	(Hungary)
B.C. Roy	(India)
C. Morelli	(Italy)
H.N. Nyapola	(Kenya)
Rin Ryong Un	(Korea)
L.A. Haller	(Sweden)
E. Klingelé	(Switzerland)
I. Zid	(Tunisia)
E. Ayhan	(Turkey)
G. Hipkin	(United Kingdom)

- Commission XII

Internation Geoid Commission
Commission Internationale du Géoïde

President : **H. Sünkel** (Austria)

I- *Main Objectives*

The International Geoid Commission is considered the primary activity center of the IAG for information related to the determination of the geoid for geodetic, geophysical and oceanographic purposes.

The following tasks should be accomplished :

- data collection,

- coordination of computational efforts (merging of geoids),

- execution of geoid determinations through computer centers financed nationally or by international organizations,

- execution of computational tasks of regional character,

- evaluation and exchange of tested software,

- organization of vertical positioning campaigns for geoid control,

- organization of contacts to oceanographers in need of geoid data,

- organization of expert meetings.

II- *Program of Activities*

1. The Commission will identify centers having data needed for geoid determinations. Such centers include the Bureau Gravimétrique International (gravity data), IGMI (vertical deflection data), The Ohio State University (Earth gravity field models). Others centers collecting related data such as satellite altimeter data topographic data, station positions, etc. will also be identified.

2. The commission will make available selected software for geoid computations.

3. The commission will help coordinate geoid computations by active communication with countries and groups involved with such work.

4. The Commission will prepare a newsletter at six-month intervals which will be sent to all active country representatives and interested parties.

5. The Commission will organize at least meeting of a global nature in the four-year period between the IUGG/IAG Assemblies. In addition, it would encourage regional meetings where appropriate.

6. The Commission will provide information to groups and disciplines needing geoid data.

III- *National representatives*

H. Sünkel	(Austria) President
N. Lopez	(Argentina)
W. Kearsley	(Australia)
C. Poitevin	(Belgium)
D. Blitzkow	(Brazil)

J.A Zelaya	(Bolivia)
A. Mainville	(Canada)
P.P. Medvedev	(CIS)
K. Colic	(Croatia)
Z. Martinec	(Czechoslovakia)
M. Pick	(Czechoslovakia)
H.T. Hsu	(China)
C.C. Tscherning	(Denmark)
S.R. Archiniegas-Ortega	(Ecuador)
M.S. Hanafy	(Egypt)
H. Duquenne	(France)
M. Vermeer	(Finland)
H.G. Wenzel	(Germany)
D. Arabelos	(Greece)
J. Adàm	(Hungary)
B.S. Rajal	(India)
J. Supomo	(Indonesia)
E. Mogilowski	(Israel)
F. Sansò	(Italy)
Y. Ganeko	(Japan)
N. Yahya-Sagarat	(Jordan)
A.S. Lwangasi	(Kenya)
Chan peng Yue	(Malaysia)
I. Reilly	(New Zealand)
D. Solheim	(Norway)
C. Ezeigbo	(Nigeria)
A. Lyszkowicz	(Poland)
M.R. Lisboa	(Portugal)
R.B. Feir	(Philippines)
P. Medvedev	(Russia)
B. Bürki	(Switzerland)
L. Sjöberg	(Sweden)
J. Saburi	(Tanzania)
C.Wichiencharoen	(Thailand)
G.L. Strang van Hees	(The Netherlands)
J. Zid	(Tunisia)
E. Ayhan	(Turkey)
A. Dobson	(United Kingdom)
D.G. Milbert	(USA)

Special Study Group 3.133.

Techniques of Precise Gravimetry

Chairman: **M. Becker** (Germany)

I- *Terms of Reference*

The objectives of this SSG are the study and the improvement of techniques used in precise relative gravimetry in view of the application to the measurement of gravity field and gravity field variations.

II- *Program of Activities*

The proposed program of activities is as follows :

1- Studies of instrumental error sources in Gravity Meters and Feedback Systems.

2- Calibration techniques of Gravimeters and Feedback Systems.

3- Techniques for Data-logging and storing.

4- Improvement of stochastic and functional model of the adjustment.

5- Environmental effects on gravity and gravity meter.

6- Detection and modeling of gravity changes by repeated campaigns.

7- Organization of technical meetings on items 1-6 and, in case of interest among the members, joint instrumental intercomparisons.

III *List of Members*

M. Becker	(Germany) Chairman
G. Csapo	(Hungary)
H. Dragert	(Canada)
C. Elstner	(Germany)
R. Hipkin	(United Kingdom)
A. Kopaev	(Russia)
J. Liard	(Canada)
J. Mäkinen	(Finland)
I. Marson	(Italy)
B. Meurers	(Austria)
S. Nakai	(Japan)
S. Okubo	(Japan)
B. Richter	(Germany)
R. Röder	(Germany)
J. Tresl	(Czechoslovakia)
M. Van Rymbecke	(Belgium)
P. Varga	(Hungary)
H.-G Wenzel	(Germany)

Special Study Group 3.134

Airborne Gravimetry

Chairman: **G. W. Hein** (Germany)

I- *Main Objectives*

The task of SSG 3.134 is the development of techniques and the design of software and hardware for airborne scalar as well as vector gravimetry using new technology both on the disturbing acceleration

determination side (e.g. use of observations to the Global Positioning System) as well as with respect to the gravity sensor (e.g. strapdown Intertial Navigation System).

II- *Program of Activities*

The following topics are selected for intensive investigation :

1. Disturbing acceleration determination (GPS and other sensors, analysis techniques, design and testing of lowpass filters).

2. Gravity data analysis (transfer function of accelerometers, consideration of gyro data, questions of pick-up and discretization of raw data, filtering).

3. Hardware design (air-and shipborne gravity meters, inertial navigation systems with both local level and strapdown technology, navigation sensors).

4. Airbone vector gravimetry (development of GPS/INS integration for gravity recovery, additional sensors, simulation studies).

5. Airborne gravity flight test (results of pratical investigations and experiments).

III- *List of Members*

G.W. Hein	(Germany) Chairman
D. Arabelos	(Greece)
R.E. Bell	(USA)
G. Boedecker	(Germany)
J. Brozena	(USA)
O. Colombo	(USA)
R. Forsberg	(Denmark)
J. Fritsch	(Germany)
A. Geiger	(Switzerland)
E. Groten	(Germany)
W. Gumert	(USA)
K. Hehl	(Germany)
J.R. Huddle	(USA)
C. Jekeli	(USA)
A. Kleusberg	(Canada)
E. Knickmeyer	(Germany)
K.P. Schwarz	(Canada)
M. Vermeer	(Denmark)

Special Study Group 3.135

Optimization of Spectral Gravimetric Techniques

Chairman: **M.G. Sideris** (Canada)

I- *Program of Activities*

1. Use of three-dimensional spectral techniques for computing terrain effects and Molodensky series terms on the surface of the earth and on level surfaces.

2. Fast algorithms for processing and analyzing airborne gravity and gradiometry data.

3. Use of spectral methods for gridding and computing geoids from irregular data. Study of the aliasing and gridding errors.

4. Further study of spectral formulas for Molodensky's problem and optimization of the classical formulas, including proper propagation of errors (frequency-domain collocation).

5. Application of spectral techniques to the solution of inverse gravimetric problems.

6. Optimization of the spherical FFT method for computing deflections, undulations, and terrain effects.

7. Use of the fast Hartley transform (FHT) as an alternative to the FFT.

II- *List of Members*

Members

M.G. Sideris	(Canada) Chairman
E. Ayhan	(Turkey)
R. Barzaghi	(Italy)
G. Boedecker	(Germany)
H. Denker	(Germany)
R. Forsberg	(Denmark)
J.C. Harrison	(U.S.A.)
K. Hehl	(Germany)
R. Hipkin	(U.K.)
K.H. Ilk	(Germany)
N. Kühtreiber	(Austria)
Z. Li	(China)
A. Mesko	(Hungary)
D. Milbert	(U.S.A.)
G. Papp	(Hungary)
L.E. Sjöberg	(Sweden)

G. Strang Van Hees	(The Netherlands)
G.C. Tsuei	(Taiwan)
I.N. Tziavos	(Greece)
Y.M. Wang	(U.S.A.)
R. Weber	(Austria)

Corresponding Members

J. Adam	(Hungary)
D. Arabelos	(Greece)
C. Boucher	(France)
M. Doufexopoulou	(Greece)
R.J. Fury	(U.S.A.)
A. Geiger	(Switzerland)
X. Li	(China)
Y. Li	(Canada)
D. Nagy	(Canada)
R. Rapp	(U.S.A)
F. Sansò	(Italy)
H.G. Wenzel	(Germany)

Special Study Group 3.136

High Resolution Geoid Modelling and Evaluation

Chairman : **H. Denker** (Germany)

I- ***Program of Activities***

- Investigation of different geoid prediction methods and data reduction techniques (effect of approximations in the theory, computational efficiency, error propagation, heterogeneous data handling).

- Pratical implementation and numerical test of different methods (handing of wavelength gravity model errors, use of topographic information, comparison with GPS/levelling and altimetric/oceanographic data at local and regional scale).

- Development of efficient techniques for the combination of heterogeneous gravity field data sets, e.g. gravity + GPS/levelling, gravity + vertical deflections, gravity + altimetric/oceanographic data (brute force methods, spectral methods, fast collocation, etc.).

- Merging of regionally derived gravity field data sets (mean gravity anomalies, local geoids, etc.).

- Gravity field data on non-level surfaces (Molodensky's problem, terrain reduction techniques, upward/downward continuation of gravity field data, impact of new measurement techniques as airborne gravimetry or gradiometry).

- Use of geophysical information for local and regional geoid computations and geophysical interpretation of these models.

II- ***Membership***

H. Denker	(Germany) Chairman
A.J. Anderson	(U.S.A.)
D. Arabelos	(Greece)
E. Ayhan	(Turkey)
T. Basic	(Croatia)
E. de Min	(The Netherlands)
R. Forsberg	(Denmark)
Y. Ganeko	(Japan)
A. Geiger	(Switzerland)
B. Heck	(Germany)
J. Ihde	(Germany)
A.H.W. Kearsley	(Australia)
A. Kenyeres	(Hungary)
A. Mainville	(Canada)
D.G. Milbert	(U.S.A.)
D. Sguerso	(Italy)
M.G. Sideris	(Canada)
D. Solheim	(Norway)
H. Sünkel	(Austria)
M. Vermeer	(Denmark)
Y.M. Wang	(U.S.A.)

Special Study Group 3.137

Combined Use of Gravimetry and Stress-Strain Measurement Techniques

Chairman: **S. Takemoto** (Japan)

I- ***Program of Activities***

The aim of this Group is to study specific scientific problems related to combined use of gravimetry and stress-strain measurement techniques for investigating geodynamic phenomena and physical properties of the Earth's interior. The proposed program of activities is as follows :

1. Investigation of the effect of underground water flows on gravity and stress-strain measurements .

2. Estimation of load Green's function and Love's numbers by employing superconducting gravity meters and laser strainmeters.

3. Geodynamic investigation by means of combined use of gravimeters, tiltmeters and strainmeters.

4. Monitoring temporal geoid undulations and stress accumulations in tectonic active regions.

5. Development of gravity and stress-strain measurement systems based on new ideas and techniques.

6. Organization of technical meetings on the items 1-5.

II- ***Membership***

S. Takemoto	(Japan) Chairman
M. Araneda-Cabiera	(Chile)
T.F. Baker	(U.K.)
M. Becker	(Germany)
B. Ducarme	(Belgium)
D.M.J. Fubara	(Nigeria)
Y. Fukuda	(Japan)
J.M. Goodkind	(U.S.A)
J. Hinderer	(Canada)
J. Kääriäinen	(Finland)
A.V. Kopaev	(Russia)
J. Levine	(U.S.A)
R.H. Li	(Chine)
M. Mena	(Mexico)
K.-S. Osypov	(Russia)
B.-C. Roy	(India)
H.-G. Scherneck	(Sweden)
J. Tresl	(Czechoslovakia)
P.-R. Wood	(New Zealand)
J. Zschau	(Germany)

Corresponding Members

H. Drewes	(Germany)
A.P. Iakolev	(Russia)
H. Spetzler	(U.S.A.)
T. Tsubokawa	(Japan)

- International Gravimetric Bureau *Bureau Gravimétrique International* (B.G.I.)

Director : **G. Balmino** (France)

1. ***Objectives and Terms of Reference***

The main task of BGI is to collect, on a worldwide basis, all gravity measurements and pertinent informations about the gravity field of the Earth, to compile them and store them in a computerized data base in order to redistribute them on request to a large variety of users for scientific purposes. The data consist of: gravimeter observations (mainly location - three coordinates, gravity value, corrections, anomalies...), mean free air gravity values, gravity maps, reference station descriptions, publications dealing with the Earth's gravity. BGI also has at its disposal through one of this host agencies: satellite altimetry derived geoid heights, presently from the Geos 3, Seasat and Geosat missions; spherical harmonic coefficients of current global geopotential models; mean topographic heights. These data are sometimes used internally for data validation and geophysical analysis.

BGI has been developing various algorithms and software for data validation and analysis, as well as its own data management system. A large number of services are offered to the users (see below).

All kinds of gravity data can be sent to BGI, with or without restrictions of redistribution to be specified by the contributors, sometimes in the form of a protocol of usage.

2. ***Structure and Membership***

- BGI is one of the offices of the Federation of Astronomical and Geophysical Data Analysis Services (FAGS). It may also be considered as an executive office of the International Gravity Commission.

- It has a Directing Board composed of the following members :

Voting members :

I. Marson	(Italy)	IGC president
J. Mäkinen	(Finland)	IGC vice-president
G. Balmino	(France)	BGI director
H.G. Wenzel	(Germany)	Section III president
J.E. Faller	(U.S.A.)	elected
C.C. Tscherning	(Denmark)	elected
E. Groten	(Germany)	elected
P.P. Medvedev	(Russia)	elected

Non-voting members :

K. McConnell	(Canada)	WG 1 chairman
G. Boedecker	(Germany)	WG 2 chairman
Ch. Poitevin	(Belgium)	WG 5 chairman
N. Courtier	(Canada)	Secretary

Ex-officio members :

H. Sünkel	(Austria)	Geoid.Com.president
J. Kovalevsky	(France)	FAGS representative

The central office is located in Toulouse, France, in the premises of the Observatoire Midi-Pyrénées, of which it is one of the services. The other supporting organizations are : the Centre National d'Etudes Spatiales, the Bureau de Recherches Geologiques et Minières, the Institut Géographique National, the Centre National de la Recherche Scientifique (via the Institut National des Sciences de l'Univers). There exists a covenant between these agencies to guarantee their support to BGI.

The address of the office is :

Bureau Gravimétrique International
18, Avenue Edouard Belin
31055 Toulouse Cedex, France
Phone: (33) 6133 2980
Telex: 530776FO
Fax: (33) 6125 3098
Telemail (OMNET): G. BALMINO
Nasamail: G. BALMINO
Bitnet : BALMINO@FRCICT81

Four Working Groups are presently helping BGI in different tasks :

WG1 - Data Processing

Chairman :	R.K. McConnell	(Canada)
Members :	C.C. Tscherning	(Denmark)
	H.-G. Wenzel	(Germany)
	G. Balmino	(France)
	M. Sarrailh	(France)

WG2 - World Gravity Standards

Chairman :	G. Boedecker	(Germany)
Members :	Yu. D. Boulanger	(Russia)
	J.E. Faller	(USA)
	H. Hanada	(Japan)
	I. Marson	(Italy)
	R.K. McConnell	(Canada)
	G. Peter	(USA)

WG5 - Monitoring of Non-Tidal Gravity Variations

Chairman :	C. Poitevin	(Belgium)
Members :	D. Crossley	(Canada)
	B. Ducarme	(Belgium)
	J.E. Faller	(U.S.A.)
	J. Hinderer	(France)
	T. Higashi	(Japan)
	J. Mäkinen	(Finland)
	I. Marson	(Italy)
	B. Richter	(Germany)
	T. Sato	(Japan)
	A. Sakuma	(France)
	P. Steinhauser	(Austria)
	R. Warburton	(USA)
	H.-G. Wenzel	(Germany)
	H. Xu	(China)
	W. Zürn	(Germany)

WG6 - Intercomparison of Absolute Gravimeters

Chairman :	I. Marson	(Italy)
Members :	E. Groten	(Germany)
	D.E. Ajakaiye	(Nigeria)
	A. Aksoy	(Turkey)
	M. Becker	(Germany)
	Yu.D. Boulanger	(Russia)
	H. Dragert	(Canada)
	C. Elstner	(Germany)
	L.A. Haller	(Norway)
	B.G. Hipkin	(United Kingdom)
	T.M. Hunt	(New Zealand)
	C.S. Joshi	(India)
	A. Kiviniemi	(Finland)
	R. Klees	(Germany)
	A. Lambert	(Canada)
	S. Okubo	(Japan)
	B. Richter	(Germany)
	R. Röder	(Germany)
	H.B. von Luetzow	(USA)

3. *The BGI Bulletin d'Information*

The office issues a Bulletin d'Information twice a year (generally in June and December).

It contains:

. general information in the field of the Bureau itself, about new available data sets,

. contributing papers in gravimetry,

. communications at meetings dealing with gravimetry (e.g. IGC meeting).

Every four years, an issue (which may be an additional one) contains the National Reports of Activities in Gravimetry.

The full catalogue of the holdings is issued every two years.

The Bulletin is sent free of charge to individuals, institutions which currently provide informations, data

to the Bureau. In other cases, information and subscription prices can be obtained on request.

There exists 70 issues and about 330 subscribers as of mid-1992.

4. *Providing Data to BGI*

Essential quantities and information for gravity data submission are :

(a) Position of the site :
- latitude, longitude (to the best possible accuracy),
- elevation or depth :
  . for land data : elevation of the site (on the physical surface of the Earth)
  . for water stations : water depth.

(b) Measured (observed) gravity, corrected to eliminate the periodic gravitational effects of the Sun and the Moon, and the instrumental drift.

(c) Reference (base) station(s) used. For each reference station (a site occupied in the survey where a previously determined gravity value is available and used to help establish datum and scale for the survey), give name, reference station number (if known), brief description of location of site, and the reference gravity value used for that station. Give the datum of the reference value; example : IGSN71

Give supplementary elevation data for measurements made on towers, on upper floor of buildings, inside of mines or tunnels, atop glacial ice. When applicable, specify whether gravity value applied to actual measurement site or it has been reduced to the Earth's physical surface (surface topography or water surface). Also give depth of actual measurement site below the water surface for underwater measurements.

For marine gravity stations, gravity value should be corrected to eliminate effects of ship motion, or this effect should be provided and clearly explained.

Additional informations are optional, but welcome.

5. *Services*

The most frequent service BGI can provide is data retrieval over a limited area. Data are sent on tapes or diskettes or printouts. Data coverage plots may also be provided, usually over 20° x 20° areas. Cases of massive data retrieval requests may be considered; they are studied and may be processed in a specific way.

Other services include :
- data screening,
- provision of gravity base station informations,
- data evaluation and gridding,
- computation of mean values,
- contouring,
- supply of, or information on existing maps (catalogue available).

The costs of the services have been established in view of the categories of users-mostly contributors of measurements and scientists, and also considering the large amount of our host organizations.

The charging policy is explained in detail in the Bulletin d'Information.

Some of the services may be provided free of charge upon request, to data contributors, individuals working in universities, such as students, and generally to any person who can contribute to our activites on a data or documentation exchange basis.

6. *Program of Activities for the Next Four years*

- Continue publication of the Bulletin d'Information.

- Continue data collection, archiving and distribution: emphasis will be on those countries which have not, or seldom, contributed to the BGI data bank. First priority is then given on careful data evaluation; an interactive graphic software developed for that purpose in 1989 is to be used on land data. Another software is to be written for marine data, the core of it being the crossover differences minimization over different legs and cruises.

- Assist IGC in setting up the International Absolute Gravity Base Station Network (IAGBN), and assist in the intercomparisons of instruments.

- Establish simple procedures for the collection and archiving of absolute measurements.

- Link with the Commission for the Geoid in data preparation in view of geoid computations and evaluations to be performed by the International Service for the Geoid.

- Assist in promoting satellites techniques to improve our global knowledge of the Earth's gravity field: satellite-to-satellite tracking, satellite gradiometry, etc...

SECTION IV

GENERAL THEORY AND METHODOLOGY
THEORIE GENERALE ET METHODOLOGIE

President : F. Sansò (Italy)
Secretaries : P. Holota (Czechoslovakia)
P. Teunissen (The Netherlands)

I- *Report*

As stated in the by-laws, Section IV has primarily a methodological character, as such there is no particular item in Geodesy which is peculiar of this Section but rather all items are shared in one way or another with other Sections, with the accent of the research pointing towards the systematic mathematical treatment of geodetic questions.

The Section IV Steering Committee, following the preparatory work done by the former president K.P. Schwarz, has decided to adopt à completely new organization, by establishing a novel structure in the core of the Section, i.e. the "Special Commission on Mathematical and Physical Foundations of Geodesy".

By this Special Commission (even this brand new name was born in the framework of Section IV) we meant to collect real specialists on the mathematical treatment of various geodetic problems, e.g. the geodetic B.V.P., and put them to work on the assessment of difficult questions, open ever since many 4-years periods.

In this concept the new S.S.G.'s are on the contrary in duty to treat a much smaller range of problems, focussing on some very specific open questions to be solved as a rule in one 4-years period; collective numerical experiments in the framework of S.S.G.'s are encouraged, when possible.

II *Structure*

SSG 4.138 : Modelling and Quality Control for Precise Integrated Navigation
Chairman : A. Kleusberg (Canada)

SSG 4.139 : The Role of Terrain in Gravity Field Modelling
Chairman : A. Geiger (Switzerland)

SSG 4.140 : Tomography of the Atmosphere by Geodetic Measurements
Chairman : T. Spoelstra (The Netherlands)

SSG 4.141 : Integrated Inverse Gravity Modelling
Chairman : R. Barzaghi (Italy)

SSG 4.142 : Application of the Boundary Value Problem Techniques to Space and Airborne Gravity Field Observations
Chairman : B. Heck (Germany)

Special Commission on Mathematical and Physical Foundations of Geodesy SC1

Chairman : **E.W. Grafarend** (Stuttgart/Germany)

Objectives :

- to encourage and promote research on the foundations of geodesy in any way possible
- to publish, at least once every four years, comprehensive reviews of specific areas of active research in a form suitable for use in teaching as well as a research reference
- to actively promote interaction with other sciences
- to closely cooperate with the special study groups in Section IV

Subcommissions :

Subcommission "statistics"
Chairman : B. Schaffrin (USA)

Subcommissions "Numerical and Approximation Methods"
Chairman : R. Klees (Germany)

Subcommission " Boundary Value Problems"
Chairman : F. Sacerdote (Italy)

Subcommission "Differential Geometry"
Chairman : J. Zund (USA)

Subcommission "Theory of Orbits and Dynamics of Systems"
Chairman : A. Drozyner (Poland)

Invited members :

Balmino, G.	(France)
Dermanis, A.	(Greece)
Demianov G.V.	(Russia)
Drozyner, A.	(Poland)
Heck, B.	(Germany)
Holota, P.	(CSFR)
Hofmann-Wellenhof, B.	(Austria)
Ilk, K.-H.	(Germany)
Jekeli, C.	(USA)
Keller, W.	(Germany)
Klees, R.	(Germany)
Marchenko, A.M.	(Russia)
Moritz, H.	(Austria)
Otero, J.	(Spain)
Petrovskaya, M.	(Russia)
Rummel, R.	(The Netherlands)
Sacerdote, F.	(Italy)
Sansò, F.	(Italy)
Schaffrin, B.	(USA)
Schwarz, K.-P.	(Canada)
Sünkel, H.	(Austria)
Teunissen, P.	(The Netherlands)
Tscherning, C.C.	(Denmark)
Zund, J.	(USA)

Subcommission 1 "Statistics"

Chairman : **B. Schaffrin**

Research program

1- *Linear Models (of type Gauss-Markov etc.)*

- nonlinear and biased estimation/prediction (e.g. least lP-norm adjustment)
- robust and resistent estimation techniques (e.g. iteratively reweighted least-squares adjustment)
- influential analysis versus outlier search (including aspects of optimal design)
- use of stochastic prior information (including Bayesian methods, "inverse estimation", etc.)

2- *Nonlinear Models*

- differential geometric aspects of nonlinear least-squares adjustment
- analysis of iterative algorithms for nonlinear equation systems and the statistical interpretation of preconditioning (including efficient algorithms for variance component estimation)
- appropriate test statistics with their approximate distribution
- information based-methods (e.g. maximum entropy)

3- *Space-time Processes and Geographical Information Systems (GIS)*

- Suboptimal filtering and smoothing of randoms states in Dynamic Models (including real-time algorithms and applications to self-similar/self-affine processes)
- Kriging methods for (global) processes on the sphere and the problem of ergodicity (e.g. the "intrinsic property")
- hypothesis testing for space-time processes (including autoregressive schemes, moving averages, etc.)
- error analysis and quality control for Geographical Information Systems (including neural network theory and aspects of stochastic geometry)

4- *Stochastic Boundary Value Problems (BVP)*

- boundary values contaminated by random errors and the overdetermined BVP (including distortion analysis of error fields)
- stochastic differential equations (including martingale theory and stability analysis for evolutionary systems)
- BVPs on stochastic boundaries
- continuous geodetic networks involving a "weak datum"

Additional Members :

J.A.R. Blais	(Canada)
K.R. Koch	(Germany)
L. Kubácková	(CSFR)
K. Kubik	(Australia)

Subcommission 2 "Numerical and Approximation Methods"

Chairman : **R. Klees**

Research Program

1- Interpolation and approximation methods for two-dimensionally distributed, unequally spaced data sets of arbitrary size, working as fully automatically as

possible and being able to solve two quite different problems: Firstly, the calculation of gridded data points, because data on a grid are the starting point for all fast numerical techniques and, secondly, the analytical representation for such gridded data sets, often disregarded in the past but very important to reduce the numerical expenditure in view of modern numerical techniques, e.g. for the solution of boundary value problems using finite element or boundary element methods. High speed and less storage requirements are very important criteria, too. Hereby we should mainly concentrate on local methods because only local methods have the capability to handle "arbitrarily" large data sets and to minimize the numerical expenditure. Especially for global problems we should focus our attention on approximation/interpolation functions living on the surfaces in $\mathbb{R}^3$, e.g. spheres, and not in some two-dimentional parameter domains.

2- Investigation in the use of multigrid-methods in Geodesy, e.g. for the solution of large linear systems often arising in modern numerical techniques.

3- Development of fast and precise numerical integration procedures for surface and volume integrals in three-dimensional euclidean space concentrating on those types of singularities often arising in Physical and Satellite Geodesy, e.g. weakly, strongly and hyper-singular integrals with a singularity of type $r^{-\sigma}$, $\sigma \geq 1$, where r denotes the euclidean distance in $\mathbb{R}^3$. Here we should also think about the degree of precision and the numerical stability of such formulae.

4- Investigation or, if necessary, development of fast methods for the solution of linear systems not necessarily symmetric and sparse but mainly non-symmetric and dense, whereby both direct and indirect methods should be included. Additionally, we should focus our attention on trends in the development of sparse techniques on vector pipeline machines.

5- We should continue our work on the use of modern numerical techniques for the solution of different boundary value problems which are based on a rigorous theory without doubtful reductions, e.g. boundary element methods and finite element methods. Also the use of boundary element methods for inhomogeneous partial differential equations should be investigated. Both local and global solutions should be considered.

6- Examintion of alternative representation methods for the Earth's gravitational field especially with respect to modern satellite techniques (low altitude satellites). In particular, we should pay attention to fast speed and numerical stability. Examples are spherical and ellipsoidal harmonics, mass points, single layer, double layers and multiple layers.

Additional Members :

W. Freeden	(Germany)
R. Forsberg	(Denmark)
M. Vermeer	(Denmark)

Subcommission 3
"Boundary Value Problems"

Chairman : **F. Sacerdote**

Research Program

1- References to the general mathematical theory of Boundary Value Problems

2- Refinements in classical geodetic BVPs :

- role of topography
- effect of non-linearities
- interior BVPs

3- From discrete to continuum :

- non-uniform distribution of data
- treatment of measurement errors
- boundary and out-of-boundary data
- unified treatment of uniquely determined and over determined BVPs

4- Stocchastic boundary values and stochastic boundary

5- Representations of approximate solutions

Additional Members :

Z. Shu (China)

Subcommission 4
"Differential Geometry"

Chairman : **J. Zund**

Research program

The topic "differential geometry" includes a broad spectrum of subjects involving both differential geometry in the traditional sense, and also relativistic geodesy with regard to the former, an obvious task is to determine to what extent differential geodesy in the sense of Marussi and Hotine provides an adequate, or complete, theory suitable for theoretical geodesy. It also includes topological aspects of the gravity field; critical points on equipotential surface, e.g. the geoid; the gravity space approach to plumblines/orthogonal trajectories/Jacobi fields of equipotential surfaces; the general analytical fields of equipotential surfaces; and geometric problems in the theory of non-linear adjustment.

Relative to the latter, the Subcommission will continue the work of the SSG 4.119 organized by E.W. Grafarend at the Vancouver General Assembly. Topics include application to satellite orbits; GPS positioning, VLBI measurements in space; the general relativistic gravity field of the Earth; the relativistic definition of the Earth mass center; the gm* value; the minimal coupling of gravitation and electromagnetism; solution of the Einstein-Maxwell equations in the vicinity of the Earth; computation of the path of an electromagnetic signal transmitted by a satellite and received on the Earth taking into account the properties of the atmosphere refraction and the curvature of space-time; and geodetic applications of the leg calcus in a pseudo-Riemannian curved space-time.

Additional Members :

B. Mashhoon	(USA)
T. Damour	(France)

Subcommission 5
"Theory of Orbits and Dynamics of Systems"

Chairman : **A. Drozyner**

Research Program

1- ***Satellite of Orbit Theory***

- parameterization of satellite orbits
- higher orders of analytical perturbation theories of satellite motion for different sets of orbital parameters
- numerical perturbation theory in the full force field
- verification of theoretical considerations by numerical integration (for analytical theories) and by comparison with observations (for numerical methods)
- asymptotic artificial satellite orbits

2- ***Modelling of non-Gravitational Forces on Satellite Orbits***

- theory of global description of the so-called "unmodelled effects" in the satellite motion
- analytical treatment of the Poyinting-Robertson and Yarkovsky-Schach effects, Lorentz and Coulomb forces, interaction of an artificial satellite with plasma and dust in the Space
- theoretical investigations of drag and lift parameters description

3- ***Theory of Multi-Satellite Motion***

- investigation of subsatellite's relative motion with respect to mother satellite
- determination of the relative motion from the spaceborne observations
- evolution and probabilistic considerations for the multi-satellite systems

4- ***Dynamics of Systems***

Activity in this field will cover both theoretical and numerical studies of dynamical systems that arise in the fields of astrodynamics and celestial mechanics, but that are strictly connected to the foundation of Geodesy. Special emphasis will be placed on the interaction of orbital and rotational dynamics of rigid (and visco-elastic) bodies, with applications to artificial and natural systems.

Additional Members :

Emelianov	(CIS)
J. Adám	(Hungary)
K. Aksnes	(Norway)

Special Study Group 4.138

Modelling and Quality Control for Precise Integrated Navigation

Chairman : **A. Kleusberg** (Canada)

I- ***Terms of Reference***

The main objective of the study group is to increase the understanding of modelling and quality control in Precise Integrated Navigation Systems. Of primary interest is the development of related processing methodologies for systems integrating the Global Positioning System with Inertial Navigation Systems.

II- ***Activities***

- Define the requirements for Quality Control in Precise Integrated Navigation.

- Define modelling and estimation issues related to Precise Integrated Navigation.

- Develop processing strategies and algorithms incorporating Quality Control.

- Provide a test data set with sufficiently accurate "ground truth".

- Assess the performance of software based on different approaches and algorithms using the test data set.

III- *Membership*

A. Kleusberg	(Canada) Chairman
O.L. Colombo	(USA)
P. Cross	(United Kingdom)
G. Hein	(Germany)
E. Knickmeyer	(Germany)
H.J. Krijnen	(USA)
P.J.V. Rapatz	(USA)
C. Rizos	(Australia)
R. Santerre	(Canada)
B. Schaffrin	(USA)
P. Teunissen	(The Netherlands)
M. Wei	(Canada)

Special study Group 4.139

The Role of Terrain in Gravity Field Modelling

Chairman : **A. Geiger** (Switzerland)

I- *Program of activities*

1- Systematize the effects of topography on different measurement types of the gravity field (eg. $|g|$ for gravitymeters, e for zenith camera, M for gradiometry, Geoid etc.)

2- Systematize the evaluation algorithms for treatment of topographic effects (Integral solutions, FFT, spherical devel., surface integrals etc.)

3- Improved modeling of topographic effects by introducing additional information (e.g. density distribution, input from geophysical inversions etc.)

4- Qualify the different topographic models and algorithms in view of their applications (e.g. cm-Geoid, airborne gravimetry, local/global gravity field)

II- *List of Members*

A. Geiger	(Switzerland) Chairman
D. Arabelos	(United Kingdom)
R. Barzaghi	(Italy)
B. Benciolini	(Italy)
H. Denker	(Germany)
R. Forsberg	(Denmark)
R.G Hipkin	(United Kingdom)
A.H.W Kearsley	(Australia)
Zhang Ke Fei	(China)
M. Sideris	(Canada)
I.Z. Tziavos	(United Kingdom)
J. Závoti	(Hungary)

Corresponding members :

I. Colomina	(Spain)

IAG Special Study Group 4.140

Tomography of the Atmosphere by Geodetic Measurements

Chairman : **T. Spoelstra** (The Netherland)

I- *Terms of Reference*

Recently, several tomographic techniques for ionospheric electron density imaging have been proposed. Most of the techniques reconstruct a vertical slice image of electron density using total electron content data. The data are measured between a low orbit beacon satellite and fixed receivers located along the projected orbital path of the satellite. By using such techniques it many be possible to image ionospheric electron density in a vertical plane several times per day.

Since geodetic measurements suffer significantly from atmospheric effects such as signal delay and refraction, the application of tomographic methods in geodesy provide information of the vertical structure of the atmosphere (troposphere and ionosphere) which is of fundamental importance for improved understanding of the propagation medium. This improved knowledge may be used for the development of better correction techniques and calibration models and the use of geodetic data for purely ionospheric research.

The scope of the SSG is to coordinate and stimulate this research within the geodetic community.

II- *Program of Activities*

The activities of the SSG may include :

1- Definition of the instrumental characteristics for optimum use of the tomographic technique: e.g. minimum/optimum/maximum distance between fixed receivers depending on the satellite system.

2- Extension of the method to the usage of satellite systems different from the Navy Navigation Satellite System, NNSS (which may no longer exist after a few years from now): i.e. by using satellite-ground and satellite-satellite-signal links.

3- Extension of the method to measurements of the troposphere.

4- Integration of results from tomography in calibration techniques.

5- Development of new correction techniques.

6- Integration of results from tomography in geodetic programs as e.g. study of inverse problems.

7- Integration of geodetic methods in topography: e.g. estimation techniques for tomography.

The SSG plans to produce a report covering the described topics.

III- *Membership*

T. Spoelstra	(The Netherlands) Chairman
L. Bányai	(Hungary)
F.K. Brunner	(Australia)
P.A. Cross	(United Kingdom)
U. Gehlich	(Germany)
Y. Georgiadou	(Canada)
V.E. Kunitsyn	(Russia)
T. Parm	(Finland)
E.C. Pavlis	(USA)
T.D. Raymund	(USA)
A.I. Terekhov	(Russia)
P. Teunissen	(The Netherlands)
L. Wanninger	(Germany)
R. Warnant	(Belgium)
J. Xin-Xiang	(Germany)

Special Study Group 4.141

Integrated Inverse Gravity Modelling

Chairman : **R. Barzaghi** (Italy)

I- *Main objectives*

The task of SSG 4.141 is to define both theoretical and numerical procedures to combine heterogeneous data, measured at the earth surface, to estimate the earth density distribution and relevant geophysical structure (Moho discontinuity, buried masses such as the Ivrea body an so on). The problem will be tackled on a local scale, that is in areas with some degrees of size. The input data to be considered in the inversion procedure are the gravity field, the magnetic field and seismic signals.

II- *Program of activities*

1. Inversion of potential fields

- Further research on the non uniqueness problem in the inversion of gravity and magnetic data.
- Connection between depth of the source and spectral properties of the related potential.
- Possible combination of gravity and magnetic data to improve the modelling.
- Numerical algorithms to solve unstable systems.
- Tests on synthetic and real data sets.

2. Inversion of combined data

- Inversion of gravity and seismic data. Stepwise procedure: seismic interpretation to support gravity modelling. One step procedure: combination of gravity and seismic data in an unified scheme. Numerical tests.
- Inversion of magnetic and seismic data following stepwise and unified procedures as for gravity.
- Combination of gravity data, magnetic data and seismic signals.

III- *Membership*

R. Barzaghi	(Italy) Chairman
D. Arabelos	(Greece)
M. Demartin	(Italy)
M. Doufexopoulou	(Greece)
W. Fuerst	(Austria)
A. Geiger	(Switzerland)
P. Knudsen	(Denmark)
V. Lajos	(Hungary)
A. Marchenko	(The Ukraine)
M. Sideris	(Canada)
G. Strykowski	(Denmark)
S. Tinti	(Italy)
G. Toth	(Hungary)
I. Tziavos	(Greece)

Associate members

K-H. Ilk	(Germany)
A. Rauhut	(Canada)
K. Rautz	(Austria)

Special Study Group 4.142

Application of Boundary Value Problem Techniques to Space and Airborne Gravity Field Observations

Chairman : **B. Heck** (Germany)

I- *Program of Activities*

1. Investigation of different existing approaches into over-determined Geodetic Boundary Value problems using :

a) space methods such as satellite gradiometry, satellite-to-satellite tracking and altimetry;

b) airborne methods such as scalar gravimetry, and gravity gradiometry.

Comparison of analytical and numerical properties, space and frequency domain representations.

2. Implementation and numerical tests of different solution strategies in the over-determined GBVP (promotion of algorithms).

3. Extention of numerical studies based on :

a) a simulated global set of satellite data (global and regional solutions of the over-determined GBVP including continuous space and terrestrial data);

b) simulated and actual airborne data sets.

4. Inverstigation of special problems in the context of this numerical evaluation, e.g. effects of gaps in the boundary and of out-of-boundary data, mixed data on different subsets of the boundary surface, aliasing problems in spherical harmonic analysis, etc.

5. Upward and downward continuation problems in the context of BVP techniques, e.g. reduction of spatially distributed (clustered) data to a single closed surface, downward continuation from satellite level to the earth's surface, stability/stabilization of kernels related to downward continuation.

6. Combination of airborne and satellite data.

II- *Membership*

B. Heck	(Germany) Chairman
M. Belikov	(Russia)
R. Hipkin	(United Kingdom)
P. Holota	(Czechoslovakia)
W. Keller	(Germany)
A.M. Marchenko	(Russia)
M. Migliaccio	(Italy)
M. Petrovskaya	(Russia)
K-P. Schwarz	(Canada)
L. Sjöberg	(Sweden)
N. Sneeuw	(The Netherlands)
D. Sonnabend	(USA)
P.J.G. Teunissen	(The Netherlands)
C.C. Tscherning	(Denmark)
I.N. Tziavos	(Greece)
M. Vermeer	(Finland/Denmark)
Li Zuofa	(China)

Corresponding Members :

O. Colombo	(USA)
K.H. Ilk	(Germany)
C. Jekeli	(USA)
H. Sünkel	(Austria)

SECTION V

GEODYNAMICS
GEODYNAMIQUE

President : J.O Dickey (USA)
Secretaries : M. Feissel (France)
H.Hsu (China)
T. Tanaka (Japan)

I- *Terms of Reference*

According to the new By-Laws of the I.A.G. approved by the council of the Association during the XVIIIth General Assembly, Hamburg, August 1983, the Section V "Geodynamics" deals whith the following topics :

- reference systems,
- monitoring and study of time-dependent phenomena, such as polar motion, Earth rotation, Earth tides, recent crustal movements, variations of gravity, seasurface topography including mean-sea level,
- geodetic aspects of international geodynamic projects, such as the Lithosphere project,
- geophysical interpretation of gravity and related data.

The objectives of the Section V are :

a) to promote the study of all scientific problems mentioned above and to encourage the research in these fields;

b) to promote and coordinate international cooperation in this field;

c) to provide, on an international basis, for discussion and exchange of the results of the studies, research and works indicated in paragraphs a) and b) above;

d) to involve as many active geodesists as possible in the program of the Section V and to make them enthusiastic supporters;

e) to promote the cooperation with other international organizations working in the field of geodynamics.

II- *Structure*

The following Commissions, International Centres and Special Study Groups are assigned to Section V :

Commissions

Commission V : Earth Tides
President : H.T. Hsu (China)

Commission VII : Recent Crustal Movements
President : T. Tanaka (Japan)

Special Commission

Special Commission SC3 : Fundamental constants
President : M. Bursa (Czechoslovakia)

Special Study Groups

SSG 5.143 : Rapid Earth Rotation Variations
Chairman : J.O Dickey (USA), (Joint with IAU)

SSG 5.144 : Dynamic Effects in Earth Rotation
Chairman : S. Molodensky (Russia)

SSG 5.145 : Long-term Variations in Earth Rotation
Chairman : P. Brosche (Germany)

SSG 5.146 : Processing of Optical Polar Motion Data
in View of Plumb Line Variations
Chairman : P.Pâquet (Belgium)

SSG 5.147 : Studies of the Baltic Sea
Chairman : J. Kakkuri (Finland)

SSG 5.148 : Global Geodynamic Variations
Chairman :B. Chao (USA)

SSG 5.149 : Studies on Vertical Datums (with IAPSO)
Chairman : E. Groten (Germany)

SSG 5.150 : Density Distribution within the Lithosphere
Chairman : H.G Kahle (Switzerland)

SSG 5.152 : Geodetic Research Toward the Reduction of Natural Hazards.
Chairman : S.Okubo (Japan)

International Services reporting to Section V

International Centre Earth Tides (affiliated to FAGS)
Director : P. Melchior (Belgium)

International Centre of Recent Crustal Movements
Director : P. Vyskocil (Czechoslovakia)

International Earth Rotation Service (affiliated with FAGS)
President : K. Yokoyama (Japan)
Director of the Central Bureau : M. Feissel (France)

Permanent Service for Mean Sea Level (affiliated with FAGS)
Director : P.L. Woodworth (United Kingdom)

Time Section, Bureau International des Poids et Mesures.
Director : C.Thomas (France)

- Commission V

Earth Tides
Marées Terrestres

President : **H.T. Hsu** (China)
Vice-President : **T. Baker** (United Kingdom)
Secretary : **P. Melchior** (Belgium)

I- *Program of activities*

The goal of the Commission is to promote the Cooperation in Advancing Earth Tides and its related studies, especially :

- to promote establishment of Earth Tidal stations in regions where Earth Tidal stations are still few; and to develop the modern space techniques for the determination of tide parameters.

- to establish Earth Tidal models for various precision observation corrections;

- to strengthen interpretation and studies of Earth Tidal observation results and to relate Earth Tidal studies to interdisciplinary fields, particularly in geophysics, seismology, astrometry ang geodesy.

The Commission will continue to support the activies of International Centre for Earth Tide (ICET) in collecting and analysing the results of Earth Tidal measurements, publishing the accumulated results and establishing the data base for Earth tides.

The 12 th International Symposium on Earth Tides will be held in China in summer 1993, with Prof. Hsu Hou Tse as convenor. In the meantime, the working groups of the Commission plan to hold scientific meetings once between 1992 and 1994.

II- *Membership*

President	: H.T Hsu	(China)
Vice-President	: T. Baker	(United Kingdom)
Secretary	: P. Melchior	(Belgium)
Honorary Member	: J.T. Kuo	(U.S.A)

National representatives

K. Bretreger	(Australia)
H. Lichetenegger	(Austria)
B. Ducarme	(Belgium)
E. Ratton	(Brazil)
A. Venedikov	(Bulgaria)
D. Bower	(Canada)
S.M Molodenski	(CIS)
Z. Simon	(Czechoslovakia)
N. Andersen	(Denmark)
A.A. Tealeb	(Egypt)
J. Hinderer	(France)
J. Kääriäinen	(Finland)
M. Bonatz	(Germany)
H.-J. Dittfeld	(Germany)
J. Zschau	(Germany)
P. Varga	(Hungary)
M. Zadro	(Italy)
C.S Joshi	(India)
B.C. Roy	(India)
R.W Matindas	(Indonesia)
S. Okubo	(Japan)
M.K. Gachari	(Kenya)
J. Flick	(Luxemburg)
T. Chojnicki	(Poland)
A.V.C Simoes Da Silva	(Portugal)
B. Pertsev	(Russia)
D. Zugravescu	(Rumania)
R.W. Green	(South Africa)
H.G Scherneck	(Sweden)
R. Vieira Diaz	(Spain)

R. Unchaiya	(Thailand)
S. Hekimogh	(Turkey)
T. Baker	(U.K)
J. Wahr	(U.S.A.)

- Working Group I : Theoretical tidal model
  Chairman : V. Dehant (Belgium)

- Working Group II : High Precision tidal data processing
  Chairman : G. Jentzsch (Germany)

- Working Group III : Tidal measurements and Geodynamic research.
  Chairman : R. Vieira (Spain)

- Working Group IV : Calibration of gravimeters
  Chairman : B. Richter (Germany)

- Commission VII

Recent Crustal Movement
Mouvements recents de l'écorce terrestre

President : **T. Tanaka** (Japan)
Secretary : **W. Augath** (Germany)

I- *Objectives*

To promote the study of recent crustal movements.

To promote and coordinate international cooperation in research of recent crustal movements.

To support to compile the data and to publish the results of the international studies.

II- *Program of activities*

1. Investigation of recent crustal movements from the global view point of geodynamics by combining conventional and space techniques.

2. Continuous improvement of methods for monitoring recent crustal movements in various scales as well as data processing and analysis to develop modeling the dynamical process and to understand the mechanism of their driving forces.

3. Further improvement of cooperation with CSTG and geophysical study groups in order to promote the above activities.

4. Initiation of a cooperation with oceanic science research groups in order to understand the crustal movements under the ocean bottom.

The results from local, regional and global scale researchs in recent crustal movements will be presented, discussed at the 8th International Symposium in Kobe (1993), the General Meeting at Beijing (1993), and at the Regional Symposia in Budapest (1992) and in Kenya (1994).

III- *The internal organization*

Bureau :

President	: T. Tanaka (Japan)
Vice-President	: P. Vanicek (Canada)
Vice-President	: H.G. Kahle (Switzerland)
Secretary	: W. Augath (Germany)

Members of Bureau :

: Yu.D. Boulanger (C.I.S) (Past-pr.)
: C.A Whitten (U.S.A)
: P. Vyskocil (Czechoslovakia)

Members of Executive Committee :

Chairman of Sub-Commissions :

Europe	: W. Augath (Germany)
Nordic	: A. Kiviniemi (Finland)
North America	: R.A. Snay (USA)
Central and South America	: H. Henneberg (Venezuela)
West Pacific	: P. Wood (New Zealand)
South Asia	: B.S Rajal (India)
Africa	: A.W Wassef (Egypt)

Operational Agency :

International Center on Recent Crustal Movements (ICRCM), 250 66 Zdiby, 98, County, Praha-Vychod (Czechoslovakia)

IV- *The list of members*

National Representatives

N. Höggerl	(Austria)
R. Coleman	(Australia)
A. Introcasso	(Argentina)
B. Ducarme	(Belgium)
E. Smets	(Belgium)
J. Argollo	(Bolivia)
G. Carrera	(Canada)
R-H. Li	(China)
Yu.D. Boulanger	(CIS)
P. Vyskocil	(Czechoslovakia)
N. Anderson	(Denmark)
L.M Asfaw	(Ethiopia)
H. Sildvee	(Estonia)
A.A Tealeb	(Egypt)
A. Kiviniemi	(Finland)
J.-C. Ruegg	(France)

M. Kasser	(France)
W. Augath	(Germany)
G. Lorenz	(Germany)
R.G. Carrera	(Guatemala)
I. Joó	(Hungary)
B. Gudmundssen	(Iceland)
B.S. Rajal	(India)
B.C. Roy	(India)
J. Kahar	(Indonesia)
M. Caputo	(Italy)
J. Abla	(Ivory Coast)
H. Ishii	(Japan)
N. Inoue	(Japan)
O.H. Dhaimat	(Jordan)
J.D Obel	(Kenya)
Ri Yong Hwan	(Korea)
J.A. Flick	(Luxembourg)
J.A Labokoson	(Madagascar)
K. Hang Peng	(Malaysia)
A. Vatrican	(Monaco)
O. Fadahunsi	(Nigeria)
J. Danielsson	(Norway)
Nasratullah	(Pakistan)
M.C Manansala	(Philippines)
M. Victor	(Portugal)
T. Wyrzykowski	(Poland)
C.S. Calota	(Rumania)
D.P.M Rousseau	(South Africa)
A. Barbadillo	(Spain)
A.R Ahmar	(Syria)
M. Ekman	(Sweden)
E. Gubler	(Switzerland)
S. John	(Tanzania)
S. Sanguanruang	(Thailand)
F.J.J Brouwer	(The Netherlands)
M. Charfi	(Tunisia)
J. Zaiem	(Tunisia)
A. Aksoy	(Turkey)
P. Cross	(United Kingdom)
S.R Holdahl	(USA)
J.B Minster	(USA)
H. G. Henneberg	(Venezuela)
K. Colic	(Yugoslavia)

Special Commission SC3

Fundamental Constants (SCFC)

President : **M. Bursa** (Czechoslovakia)

I- *Objectives*

- To collect the system of the primary geodetic parameters defining the geodetic reference system (GRS).

- To review the most current information on the values of physical quantities which are fundamentally important in the fields of astronomy, geodesy, and geodynamics.

- To reconcile this information into a uniform, compatible set.

- To recommend to the XXIst General Assembly (1995) of the I.A.G. the publication of a set of most up-to-date representative values.

- To consider the status of the GRS 1980, and if any changes in this reference system, to give recommendation to the XXIst I.A.G. General Assembly.

II- *Membership*

M. Bursa	(Czechoslovakia) President
H. Moritz	(Australia)
M.I Yurkina	(CIS)
C.C. Tscherning	(Denmark)
C. Boucher	(France)
M. Feissel	(France)
G. Petit	(France)
J. Kovalevsky	(France)
P. Brosche	(Germany)
E.W. Grafarend	(Germany)
E. Groten	(Germany)
B. Eitschberger	(Germany)
T. Fukushima	(Japan)
H. Kinoshita	(Japan)
K.I. Yokoyama	(Japan)
R.O. Vincente	(Portugal)
M.I. Yurkina	(Russia)
L.P. Pellinen	(Russia)
K.F. Wakker	(The Netherlands)
Y. Yatskiv	(The Ukraine)
A.H. Cook	(United Kingdom)
A.T. Sinclair	(United Kingdom)
M.E. Davies	(USA)
J.O Dickey	(USA)
R.J. Eanes	(USA)
D. Mc Carthy	(USA)
E.C Pavlis	(USA)
B.H Chovitz	(USA)
R.H Rapp	(USA)

Special Study Group 5.143

Rapid Earth Orientation Variations

Chairman : **J.O. Dickey** (USA)

I- *Objectives*

Observe and understand the interactions of the atmosphere and ocean with the rotational dynamics of the Earth, particulary their contributions, as well as

those of seismotectonics, to the excitation of Earth rotation variations over time scales of hours to months.

II- *Program of Activities*

- Interface with the IERS in the determination of rapid variations in Earth rotation by the space geodetic techniques, especially during the intensive IGS compaign planned for the summer of 1992.

- Advocate for the best possible auxiliary data from geophysical, oceanographic and atmospheric sources.

- Advocate for improvements in measurement techniques (including geodetic, atmospheric, oceanographic and geophysical).

- Encourage cooperative multidisciplinary studies; provide a forum dor discussion.

II- *Membership*

J.O. Dickey	(USA) Chairman
P. Brosche	(Germany)
A. Brzezinski	(Poland)
B. Chao	(USA)
T. Clark	(USA)
S. Dickman	(USA)
M. Eubanks	(USA)
M. Feissel	(France)
R. Gross	(USA)
T. Herring	(USA)
R. Hide	(United Kingdom)
B. Kolaczek	(Poland)
R. Langley	(Canada)
S. Manabe	(Japan)
D. Mc Carthy	(USA)
W. Melbourne	(USA)
J. Miller	(USA)
Z. Ming	(China)
I. Naito	(Japan)
P. Pâquet	(Belgium)
J. Ray	(USA)
D. Robertson	(USA)
R. Rosen	(USA)
D. Salstein	(USA)
B. Shutz	(USA)
N. Sidorenkov	(Russia)
C. Veillet	(France)
C. Wilson	(USA)
K. Yokoyama	(Japan)

Special Study Group 5.144

Dynamic Effect in Earth Rotation Theory

Chairman : **S. Molodensky** (Russia)

I- *Objectives*

The construction of more exact theories of hydrodynamic effects including effects of the real liquid core model, effects of the inner rigid core effects of the core, mantle topography and effects of the oceans on the rotation of the Earth.

The comparison of the predictions of new theories with the measurements.

The investigations of the Earth's inner structure on the ground of new astronometric data.

II- *Membership*

S. Molodensky	(Russia) Chairman
I. Ballani	(Germany)
Z. Bergen	(USA)
V. Bykova	(CIS)
J.A. Carton	(USA)
V. Dehant	(Belgium)
S. Djakonov	(Russia)
Z. Gergen	(USA)
E. Groten	(Germany)
H. Jochmann	(Germany)
T. Sasao	(Japan)
J. Wahr	(USA)
J. Zurkis	(CIS)

Special Study Group 5.145

Long term variations in Earth Rotation

Chairman : **P. Brosche** (Germany)

I- *Objectives*

It is our aim to improve the measurement and understanding of all processes which influence the rotation of the Earth and the angular momentum budget of the Earth-Moon-System on long timescales.

II- *Program of activities*

1. Developing and evaluating increasingly realistic ocean tide models, including the interactions with the solid Earth;

2. Studying the various mechanisms for producing changes in the moments of inertia;

3. Utilizing the increased documentation of historical astronomical observations;

4. Examining the implications for tidal friction of new or refined knowledge of the past configurations and reconstructions of the continents.

5. Encouraging cooperative work with sedimentologists and palaeontologists to evaluate the significance of diurnal and tidal rythms in the sedimentary and fossil records.

III- ***List of members***

P. Brosche	(Germany) Chairman
K. Bretterbauer	(Austria)
M. Bursa	(Czechoslovakia)
C. Liu	(China)
C. Denis	(Belgium)
J.O. Dickey	(USA)
S.R. Dickman	(USA)
H. Greiner-Mai	(Germany)
H. Jochmann	(Germany)
J. Kostelecky	(Czechoslovakia)
C.A. Richardson	(United Kingdom)
H.-G. Scherneck	(Sweden)
H. Schuh	(Germany)
A.G. Smith	(United Kingdom)
J. Sündermann	(Germany)
P. Varga	(Hungary)
G.E. Williams	(Australia)

Special Study Group 5.146

Processing of optical polar motion data in view of plumb line variations

Chairman : **P. Pâquet** (Belgium)

I- ***Program of activities***

- Choice of operational stations located in seismic areas as well as those in areas known for their low seismic activity.

- Inventory of usable past observation series.

- Processing of the past and current data, partly by two different groups.

- Interpretation.

II- ***Membership***

P. Pâquet	(Belgium) Chairman
F. Chollet	(France)
B. Kolaczek	(Poland)
Li Zheng-Xin	(China)
C.C. Tscherning	(Denmark)

Special Study Group 5.147

Studies of the Baltic Sea

Chairman : **J. Kakkuri** (Finland)

I- ***Task***

- Unification of vertical datums and their time variability for the countries around the Baltic Sea.

- Contrubution to determination of the gravity field and geoid in the Baltic Sea.

- Determination of the mean sea level and sea surface topography of the Baltic Sea.

- Study of the effect of the sea floor topography.

- Monitoring the postglacial rebound of the Earth's crust, especially in the sea area.

- Remeasurements of the Baltic Ring for horizontal deformation study.

II- ***Members***

J. Kakkuri	(Finland) Chairman
J.B Zielinski	(Poland) Secretary
I. Balodis	(Latvia)
J. Davis	(USA)
R. Dietrich	(Germany)
M. Ekman	(Sweden)
B. Engen	(Norway)
A.M. Finkelstein	(Russia)
E. Grafarend	(Germany)
E. Groten	(Germany)
T. Parm	(Finland)
M. Poutanen	(Finland)
B. Rönnäng	(Sweden)
B. Schutz	(USA)
H. Seeger	(Germany)
L.E. Sjöberg	(Sweden)
M. Vermeer	(Finland)
E. Zaharchenko	(Latvia)

The members of Denmark, Estonia and Lithuania will be announced later.

Special Study Group 5.148

"Global Geodynamic Variations"

Chairman : **B.F Chao** (USA)

I- ***Objectives***

1. To identify, raise awareness of, discuss, and study the outstanding scientific problems in global geodynamics and geopotentials and their variations on all time scales, so that it will lead to better theoretical understanding as well as tangible and pratical solutions to these problems.

2. To determine and make recommendations for possible directions for future research in the subject matter.

3. To make the above known to the general geophysical community.

II- *Activities*

Regular formal and informal correspondences among members. Open discussion sessions at opportune time during international meetings. A symposium/workshop at the I.A.G General Meeting in Beijing, China, Aug. 6-13 , 1993. Reports to be published in open literature and to IUGG, and if feasible, a final publication of collective papers in special issue or monograph form.

III- *Members*

B.F. Chao	(USA), Chairman
A. Anderson	(USA)
K. Bretterbauer	(Austria)
M. Bursa	(Czechoslovakia)
B. Heck	(Germany)
R. Hide	(United Kingdom)
J. Hinderer	(France)
R. Li	(China)
L. Mansinha	(Canada)
D. McAdoo	(USA)
I. Naito	(Japan)
C.K. Shum	(USA)
L. Sjöberg	(Sweden)
J. Trésl	(Czechoslovakia)
J. Wahr	(USA)
C. Yoder	(USA)

Special Study Group 5.149

Studies on Vertical Datums (with IAPSO)

Chairman : **E. Groten** (Germany)

I- *Program of Activities*

It is the aim the SSG to consider the use of presently existing information on the gravity field and the geoid (geopotential) as well as altimeter (Topex-Poseidon, ERS-1 and ERS-2), tide gauge, GPS and similar other data in establishing Vertical references and Datums in combined approaches, to investigate Mean Sea Level information as a base of Zero Elevation information in geodetic systems, to evaluate accuracy and trend functions in order to take into account temporal changes of Mean Sea Level (MSL). Associated geodynamic considerations including loading effects have to be carefully studied. Those parts of the Sea where more or less optimal information is available, such as the Baltic Sea, Mediterranean Sea, may serve as a local test fields. In general, local and regional studies should be the base for further global investigations. Summarizing, the following principal topics should be investigated.

II- *Goals*

1. Definition of Vertical Datums in view of high precision applications in geodesy and geodynamics.

2. Implementation techniques for local, regional and global Vertical Datums.

3. Application of geopotential techniques to unify Vertical Datums.

4. Elaborating techniques and methods for unifying local and regional (national) Vertical Datums.

5. Elaboration of techniques to clearly define and identify MSL and LMSL changes with time.

6. Combination of tide gauge, altimetric, GPS, VLBI and physical geodesy methods to verify MSL and LMSL variations.

III- *Membership*

E. Groten	(Germany) Chairman
I. Balodis	(Latvia)
C. Boucher	(France)
W.E. Carter	(USA)
B. Engen	(Norway)
A. Finkelstein	(Russia)
Dong Hongwen	(China)
H. Henneberg	(Venezuela)
J. Kakkuri	(Finland)
G.W. Lennon	(Austalia)
G.L. Merry	(South Africa)
D.G. Milbert	(USA)
D.T. Pugh	(United Kingdom)
R.H Rapp	(USA)
H.-W. Schenke	(Germany)
P. Vincent	(France)
P.L. Woodworth	(United Kingdom)
J.B. Zielinski	(Poland)

Special Study Group 5.150

Density distribution within the Lithosphere

Chairman : **Hans-Gert Kahle** (Switzerland)

I- *Objectives*

The objective for this SSG is to investigate the possibilities of utilizing gravity field data and

geophysical information such as, for instance, seismic reflection, refraction, tomography and heat flow data for improving models of the density distribution within the sedimentary layers, the crystalline basement and the lithosphere including the lithosphere/asthenosphere boundary. Emphasis is also placed on laboratory experimental work which provides velocity/density relationships for various mineralogical constitution under different temperature and pressure conditions.

Knowledge of the density distribution forms the basis geodynamic interpretation (rheological models, flexural rigidity) and it has also become important for high resolution geoid determination, especially in mountain belt regions.

It is therefore, considered to cooperate closely with SSG 4-139 and SSG 4-141.

II- ***Program of activities***

Discussion and up-dating of current density models and their implications on gravity field modelling. Geoid determination and geodynamic interpretation; organize workshops and splinter meetings. Compilation of a density report.

III- ***Members***

H.G Kahle	(Switzerland) Chairman
D. Chung	(USA)
K. Colic	(Croatia)
Czarnecki	(Poland)
D Dyrelius	(Sweden)
W. Girdler	(United Kingdom)
G. Hein	(Germany)
R.G. Hipkin	(UK)
G.R. Johnson	(USA)
J. Kakkuri	(Finland)
I. Marson	(Italy)
S. Okubo	(Japan)
V.M. Vyskocil	(CSFR)
Y.S. Yatskiv	(The Ukraine)

Corresponding member

H. Fujimoto	(Japan)

Special Study Group 5.152

Geodetic Research Toward the Reduction of Natural Hazards

Chairman : **S. Okubo** (Japan)

I- ***Objectives***

Providing theoretical, observational, and instrumental background for optimal retrieval of geodetic information on earthquake, volcanic eruption, and land slide.

II- ***Planned activities***

- Improving theory, which predicts changes of the geodetic observables : baseline change, elevation change, gravity change, strain and tilts changes and so on.

- Devoloping systems to make geodetic observations possible around places hardly accessible on foot or by car. We will make a feasibility study of air-borne precise gravimetry, balloon-borne geomagnetism, and so on with the aid of GPS; we will test whether the observational accuracy meets the requirement for the assessment of natural hazards.

- Developing techniques to detect hidden seismic faults, premonitory signals of volcanic eruption/land slide from geodetic data.

III- ***Membership***

S. Okubo	(Japan) Chairman
J.M Brozena	(USA)
D. Blitzkow	(Brazil)
G. Hein	(Germany)
Y. Honkura	(Japan)
J. Kahar	(Indonesia)
R-H. Li	(China)
P. Pâquet	(Belgium)

- International Centre of Earth Tides
Centre International des Marées Terrestres

Director : **P. Melchior** (Belgium)

Location : Observatoire Royal de Belgique
Avenue Circulaire 3
1180 Bruxelles, Belgium

Directing Board : **H.H. Tsé** (China) Chairman
M. Bonatz (Germany)
J.T. Kuo (USA)
J. Picha (Czechoslovakia)

Activities

The tasks ascribed to ICET as a FAGS Centre are basically :

1. To collect all available measurements of earth tides (which is its task as World Data Centre C).

2. To evaluate these data by convenient methods of analysis in order to reduce the very large amount of

measurements to a limited number of parameters which should contain all the desired and needed geophysical information.

3. To compare these parameters with any other geophysical information, in particular oceanic cotidal maps, earth rotation parameters, etc.

4. To compare the data from different instruments and differents stations distributed all over the world, evaluate their precision from the point of view of internal errors as well as external errors.

5. To help to solve the basic problem of calibrations and to organize reference stations or build reference calibration devices.

6. To fulfil gaps in informations or data as far as possible, in particular by assisting the Developing Countries in organizing observations.

7. To build a Data Bank allowing instantaneous and easy comparison of earth tide parameters with different earth models and different oceanic cotidal maps.

8. To ensure a broad dissemination of the results and informations to all interested laboratories or individual scientists and in paricular a transfer of technology towards the Developing Countries.

9. To continue the edition of the Bulletin d'Information.

- International Center on Recent Crustal Movements
Centre International des mouvements récents de l'écorce terrestre

Director : **P. Vyskocil** (Czechoslovakia)

Directing Board: **T. Tanaka** (Japan) Chairman
W. Augath (Germany) Vice-Chair.
E. Gubler (Switzerland)
M.T. Prilepin (Russia)
B.E Schutz (USA)
A.M. Wassef (Canada)
A. Cisternas (France) repr.**IASPEI**

Activities

Its tasks are basically :

1. To collect, store and distribute available informations on recent crustal movements,

2. To collect, store and distribute the basic bibliographical data on recent crustal movements of tectonic and non tectonic origin,

3. To evaluate the informations and distribute term in the form of catalogues, maps, or other means of illustration,

4. To compare the available data with other geological and geophysical information, in particular the struture of the Earth's crust and discontinuities within lithosphere, with special emphasis to the seismicity,

5. To encourage the projects aimed at monitoring recent crustal movements, by means of consultations, trainings and scientific stays in the ICRCM, with special regard to the developing countries,

6. To continue the edition of the ICRCM Bulletin, containing the necessary information on the CRCM and ICRCM activities as well as scientific communications, data catalogues etc.

- International Earth Rotation Service
Service International de la Rotation Terrestre

Chairman of the Directing Board :
K. Yokoyama

The International Earth Rotation Service **(IERS)** was established in 1987 by IAU and IUGG and it started operation on 1988 january 1. It replaces the **International Polar Motion Service (IPMS)** and the Earth Rotation Section of the **Bureau International de l'Heure (BIH)**; the activities of **BIH** on time are continued at the **Bureau International des poids et Mesures (BIPM). IERS** cooperates with **BIPM** on its activities concerning the **UTC** time scale. It also cooperates with the SSG'S relevant to the **IERS** activities. **IERS** is a member of the **Federation of Astronomical and Geophysical Data Analysis Services (FAGS).**

I- *Functions*

IERS should provide the information necessary to define a Conventional Terrestrial Reference System and a Conventional Celestial Reference System and relate them as well as their frames to each other and to other reference systems used in the determination of the earth-orientation parameters.

IERS is responsible for :
- defining and maintaining a conventional terrestrial reference system based on observing stations that use the high-precision techniques in space geodesy;
- defining and maintaining a conventional celestial reference system based on extragalactic radio sources, and relating it to other celestrial reference systems;

- determining the earth orientation parameters connecting these systems, the terrestrial and celestial coordinates of the pole and the universal time;
- organizing operational activities for observation and data analysis, collecting and archiving appropriate data and results, and disseminating the results to meet the need of users.

Initially, it relies on three observing techniques : Very Long Baseline Interferometry (**VLBI**), Lunar Laser Ranging (**LLR**), and Satellite Laser Ranging (**SLR**), but now Global Positioning System (**GPS**) is working as the fourth technique.

II- *Organization*

IERS consists of a Coordinating Center and other technical centers for each of the four observing techniques, and a Central Bureau with associated Sub-Bureaux. It is supported by many other organizations that contribute to the tasks of observation and data processing.

The coordinating Centers are responsible for developing and organizing the activities in each technique to meet the objectives of the service. The Central Bureau combines the various types of data collected by the service, and disseminates to the user community the appropriate information on earth-orientation and the terrestrial and celestial reference systems. In 1992, it includes two sub-bureaux: one is the Sub-Bureau for Rapid Service and Predictions and the other for Atmospheric Angular Momentum. The Central Bureau decides and disseminates the announcements of leap seconds in UTC and values of DUT1 to be transmitted with time signals.

The principal centers are :

VLBI Coordinating Center :
National Geodetic Survey
Gravity, Astronomy and Satellite Branch
U.S Department of Commerce
Rockville, MD 20852, USA

LLR Coordinating Center :
Centre d'Etude et de Recherches
Géodynamiques et Astronomiques,
Avenue Nicolas Copenic
06130 Grasse, France

SLR Coordinating Center :
Center for Space Research
The University of Texas at Austin
Austin, TX 78712-1085, USA

GPS Coordinating Center :
Jet Propulsion Laboratory
MS 238-540
4800 Oak Grove Drive
Pasadena, CA 91109, USA

Central Bureau :
Observatoire de Paris,
61, avenue de l'Observatoire
75014 Paris, France

Terrestrial Frame Section :
Institut Géographique National
B.P 68
94160 Saint Mandé, France

Celestial Frame Section :
Observatoire de Paris
61, avenue de l'Observatoire
75014 Paris, France

Sub-Bureau for Rapid Service and Predictions :
National Earth Orientation Service (NEOS)
U.S Naval Observatory
Washington DC 20392-5100, USA

Sub-Bureau for Atmospheric Angular Momentum :
Climate Analysis Center
NOAA/National Weather Service
5200 Auth Road-Room 805
Washington DC, 20233, USA

The Directing Board exercices general control over the activities of the services, including modifications to the organization and participation that would appropriate to maintain efficiency and reliability, while taking full advantage of the advances in technology and in theory. It is advised by a group of Corresponding Members, who are kept informed of the activity of the Directing Board and are encouraged to submit comments and suggestions.

The Members of the Board, in 1992, are :

K. Yokoyama	International Union of Geodesy and Geophysics
Ya. Yatskiv	International Astronomical Union
O.B Andersen	Federation of Astronomical and Geophysical Data Analysis Services.
W.E Carter	VLBI Coordinating Center
C. Veillet	LLR Coordinating Center
B.E Schutz	SLR Coordinating Center
W.G. Melbourne	GPS Coordinating Center
M. Feissel	Central Bureau.

The secretary of the Board is provided by the Central Bureau.

III- *Activities and services*

The observing stations for VLBI, LLR, SLR, and GPS are organized in independent networks, managed

by network centers. In 1992, the following networks are functioning :

VLBI : Four programs are continuing routine observing campaigns. The International Radio Interferometric Surveying (IRIS : about 20 fixed stations included) project coordinated by NGS operates three networks : **IRIS-A** (Trans-Atlantic, since 1980) and **IRIS-P** (Trans-Pacific, since 1987), **IRIS-S** (Southern Hemisphere, since 1986). The crustal Dynamics Project (**CDP** : about 30 fixed stations and about 40 mobile site included) of NASA has been operating the Deep Space Network (**DNS** : 3 station network) since 1978. Six analysis centers are in operation.

LLR : A network composed of three stations is producing LLR data : McDonald (Texas), Haleakala (Hawaii), and CERGA (Grasse). Most of the values came from CERGA, as it the only station completely devoted to lunar observation. Four analysis centers are in operation.

SLR : LAGEOS is the primary laser ranging target in support of IERS. A network of nearly 50 stations participated in the program, totaling approximately 5000 passes per year. Eight analysis centers are contributing with global analysis to IERS.

GPS : A network with about 130 stations carried out first the observing compaign in 1991. 20 analysis centers and 13 processing centers are in operation.

The Coordinating Centers are responsible for organizing observations, objects to be observed, schedules, preprocessing of observational results, etc. and for the selection of models and procedures to be used in the analysis of observations.

The network centers analyze the observational data in operational mode (weekly and monthly) and transmit earth-rotation results to the Central Bureau. Analysis centers perform scientific processing of the observations to derive results on the reference frames and on the earth-rotation and associated parameters; they contribute results typically every year to the Central Bureau.

The Central Bureau is a joint effort of the Paris Observatory, the Institut Géographique National and the Bureau des Longitudes. It makes a final monthly determination of the earth-rotation parameters. From the results of the analysis centers, it also performs a simultaneous ajustement of the conventional celestial and terrestrial systems and of corresponding earth-orientation determinations (polar motion, universal time, procession/nutation). In consultation with **BIPM**, the Central Bureau decides and disseminates the announcements of leap seconds in **UTC** and values of **DUT1** to be transmissed with time signals.

The Sub-Bureau for Rapid Service and Predictions operated by the US National Earth Orientation Service (**NEOS**) witch is a joint venture of **USNO** and **NGS** combines the results on earth-rotation received from the network centers to form and advanced weekly solution, it also makes predictions of future values.

Sub-Bureau for Atmospheric Angular Momentum is hosted by **NMC** (USA) and benefits from a cooperation with the Atmospheric and Environmental Research, Inc. (USA). Currently, there are four participating centers contributing to the Sub-Bureau. It serves as a focal point for the collection of atmospheric measurements. The data is made available within the IERS and to the users community. Research is performed in order to assess the accuracy and completeness of the series derived by the participating meteorological centers.

IV- *Data management and archiving*

The observational results from optical astrometry received by **IPMS** and **BIH** until 1987 are archived respectively at the National Astronomical Observatory, Mizusawa, Japan and the Paris Observatory. Earth-rotation results of IPMS are archived at the National Astronomical Observatory, Mizusawa; a copy is archived at the IERS Central Bureau. The BIH results are archived at the Paris Observatory.

The observational results of **VLBI, LLR** and **SLR** are archived at several centers, subject to the agreement of the relevant Coordinating Centers. The results on earth rotation and reference frames are archived at the network and analysis centers which obtained them, as well as at the Central Bureau.

V- *Publications*

- Weekly **Bulletin A**

Earth-rotation parameters (x, y, UT1, celestial pole offsets) : combined and individual series. Rapid service and prediction. First issue covering observation dates in the last week in 1987 (rapid service distributed on 1988 January 7).

- Monthly **Bulletin B**

Earth-rotation parameters (x, y, celestial pole offsets) : combined solutions and indivudual series of EOP (continuing BIH Circular D, pages 3 to 7, and BIH Circular B/C) and information on UTC and time scale.

- Annual **Report of IERS**

Earth-rotation parameters, Terrestrial and Celestial Reference Systems: combined solutions and individual results of EOP.

- Special **Bulletin C**

Announcement of the leap seconds in UTC.

OUT OF SECTION

- Commission IX

Education in Geodesy
Enseignement de la Géodesie

President: **R.B. Langley** (Canada)

I- *Program of Activities*

In his presidential address at the XXth IUGG General Assembly in Vienna, Prof. Mueller announced several new IAG initiatives for the forthcoming quadrennium. One of these is a renewed emphasis on education. With the continued fractionation of the surveying and mapping community, it is important, now more than ever before that the other disciplines in the community recognize and understand the important role played by geodesists. This recognition will be fostered, in part, through the IAG's membership in the International Union of Surveys and Mapping (IUSM). The IUSM has established a working group on education which has two broad objectives: (i) to continue to strengthen the respective educational activities of the member societies of IUSM and (ii) to integrate these activities, along with the new scientific and technological developments in the acquisition, analysis, and management of spatially-related data. A first step in this inter-society activity will be the holding of an IUSM Education Session at the XVIIth Congress of the International Society for Photogrammetry and Remote Sensing in Washington, D.C. in August 1992. The objective of this meeting will be to perform a synthesis of the educational needs of the sister societies of IUSM and to prepare a joint document on education in the surveying and mapping sciences. In preparation for this meeting, an IAG position paper on geodetic education will be drafted. The activities of Commission IX will evolve from the position paper and the IUSM working group deliberations as well as from suggestions made by the members of the commission.

II- *Membership*

R.B. Langley	(Canada) President
S. Kahlouche	(Algeria)
C. Rizos	(Australia)
U. van Twembeke	(Belgium)
R. Santerre	(Canada)
E.J. Krakiwsky	(Canada)
J. Ning	(China)
Y.M. Neiman	(CIS)
Z. Nadenik	(Czechoslovakia)
C.C. Tscherning	(Denmark)
A. Shaker	(Egypt)
H. Duquenne	(France)
B.U. Witte	(Germany)
A. Detrekoi	(Hungary)
C.B. Jhaldiyal	(India)
D.K. Macoco	(Kenya)
L. Sjöberg	(Sweden)
H. Dupraz	(Switzerland)
M. Serbetçi	(Turkey)
P.J. Dare	(United Kingdom)
B. Schaffrin	(USA)

- Commission XI

Geodesy in Africa
Geodesy en Afrique

President: **M. Charfi** (Tunisia)

I- *Objectives of the Commissions*

1. To make an inventory of the statuts of geodetic work in Africa and to update and maintain such an inventory;

2. To stimulate and sustain interest of survey organizations in Africa in Geodetic work with a view to organizing geodetic control and gravity networks for scientific and cartographic purposes;

3. To encourage education in geodesy and to advise on curriculum development in geodetic sciences in Africa;

4. To establish and maintain data banks with a view to making geodetic information in Africa available nationally and internationally;

5. To organize meetings, seminars, symposia and training courses in order to promote the objectives of the Commission;

6. To prepare a budget for each approved project for submission to IAG in order to secure enough funds for timely implementation;

7. To foster international cooperation in geodetic projects and to coordinate bilateral and multilateral aids in geodetic projects in Africa;

8. To encourage African scientists to cooperate in the various study groups and commissions of the I.A.G. and attend the various meetings arranged by the Association;

9. To establish contacts between African geodesists and geodesists from countries outside Africa;

10. To maintain close collaboration and cooperation with the U.N./Economic Commission for Africa, U.N. Cartographic Section and other U.N. and African Agencies on geodetic matters.

II- ***Bureau***

President	: M. Charfi	(Tunisia)
Past Presidents	: R.O. Coker	(Nigeria)
	J. Abla	(Ivory Coast)
1st Vice-President	: M.W.L. Chodota	(Kenya)
2nd Vice-president	: W.Van. Gysen	(South Africa)
3nd Vice-President	: K. Tayou	(Ivory Coast)
Secretary	: L. Tikdirine	(Morroco)
Assistant Secretary	: M. Rezgui	(Tunisia)

Working group : Integrated Geodetic Network for Africa

Chairman :

M.W.L. Chodota	(Kenya)

Members :

K. Bouchibi	(Algeria)
A. Tealeb	(Egypt)
A.M. Wassef	(Egypt)
C. Boucher	(France)
M. Sarrailh	(France)
C.B. Jhaldiyal	(India)
F.W.O. Aduol	(Kenya)
J.D. Obel	(Kenya)
A. Taker	(Libya)
A. Ben Yahia	(Morroco)
C. Ezeigbo	(Nigeria)
F.A. Fajamirokun	(Nigeria)
D.M. Fubara	(Nigeria)
H. Eslin	(Soudan)
H. van Gysen	(South Africa)
R. Wannacott	(South Africa)
M. Rezgui	(Tunisia)
M. Kumar	(U.S.A.)
F. Lugoe	(Zimbabwe)
F. Podmore	(Zimbabwe)

Special Commission SC2

History of Geodesy
Histoire de la Géodésie

President : **J. Weightmann** (United Kingdom)

I- ***Introduction***

An attempt will be made to build on the solid fundation laid by SSG 0.67, using the greater human resources now available in terms of numbers. Although most will be done by correspondence, we will seek to use opportunities of mid-term IAG events to meet either all together or by region, if individual time and travel funds permit.

II- ***Plan of work***

It is proposed to focus on people and organizations; instruments and techniques; projects; sources of geodetic data, information and bibliographies. Possible topics would include:

a) Special Study Groups

Since the 1951 Brussels assembly, 150 such groups have been set up with a further 7 under consideration. It is proposed to list each in numerical order with names, dates and a short statement of what it has achieved.

b) Commissions

As Special Study groups; but there are fewer of them, their "life" is in general much longer and involves more officers, and their aims and achievements are less clearcut.

c) IAG Fellows

The list of fellows already published to be cross-referenced to the SSG list, and augmented with organisation details and a short statment of areas of expertise and interest. This archive of geodetic potential would be available for anyone requiring to contact an acknowledged expert on a particular topic - and for necrological purposes in due course.

d) Biographic/Historic Memoirs

Short (half-page) notes on selected people, instruments, techniques or projects.

e) Sources and Bibliographies

"Yellow Pages" giving places, names etc. from which various types of geodetic data and information may be obtained.

III- *Members*

J. Weightamnn	(United Kingdom) President
P. Angus Leppan	(Australia)
P. Vanicek	(Canada)
S-L. Gao	(China)
M.J. Yurkina	(CIS)
E. Kejiso	(Denmark)
J. Kakkuri	(Finland)
J-J. Levallois	(France)
G. Kirschmer	(Germany)
G. Szadeczky-Kardoss	(Hungary)
M.K. Szacherska	(Poland)
M. Ekman	(Sweden)
P.K. Clark Ma	(United Kingdom)
D.G. King-Hele	(United Kingdom)
J.R. Smith Arics	(United Kingdom)
B.H. Chovitz	(USA)
I. Fischer	(USA)
F. Podmore	(Zimbabwe)
C.A. Whitten	(USA)
J. Zund	(USA)

GEODETIC REFERENCE SYSTEM 1980

by H. Moritz

1- *Definition*

The **Geodetic Reference System 1980** has been adopted at the XVII General Assembly of the IUGG in Canberra, December 1979, by means of the following :

"RESOLUTION N° 7

The International Union of Geodesy and Geophysics,

recognizing that the Geodetic Reference System 1967 adopted at the XIV General Assembly of IUGG, Lucerne, 1967, no longer represents the size, shape, and gravity field of the Earth to an accuracy adequate for many geodetic, geophysical, astronomical and hydrographic applications and

considering that more appropriate values are now available,

recommends

a) that the Geodetic Reference System 1967 be replaced by a new **Geodetic Reference System 1980**, also based on the theory of the geocentric equipotential ellipsoid, defined by the following conventional constants :

. equatorial radius of the Earth :
$a = 6378\ 137$ m,

. geocentric gravitational constant of the Earth (including the atmosphere) :
$GM = 3986\ 005 \times 10^8\ m^3\ s^{-2}$,

. dynamical form factor of the Earth, excluding the permanent tidal deformation :
$J_2 = 108\ 263 \times 10^{-8}$,

. angular velocity of the Earth :
$\omega = 7292\ 115 \times 10^{-11}$ rad s^{-1},

b) that the same computational formulas, adopted at the XV General Assembly of IUGG in Moscow 1971 and published by IAG, be used as for Geodetic Reference System 1967, and

c) that the minor axis of the reference ellipsoid, defined above, be parallel to the direction defined by the Conventional International Origin, and that the primary meridian be parallel to the zero meridian of the BIH adopted longitudes".

For the background of this resolution see the report of IAG Special Study Group 5.39 (**Moritz**, 1979, sec.2).

Also relevant is the following IAG resolution :

"RESOLUTION N° 1

The International Association of Geodesy,

recognizing that the IUGG, at its XVII General Assembly, has introduced a new Geodetic Reference System 1980,

recommends that this system be used as an official reference for geodetic work, and

encourages computations of the gravity field both on the Earth's surface and in outer space based on this system".

2- *The Equipotential Ellipsoid*

According to the first resolution, the Geodetic Reference System 1980 is based on the theory of the equipotential ellipsoid. This theory has already been the

basis of the Geodetic Reference System 1967; we shall summarize (partly quoting literally) some principal facts from the relevant publication (IAG, 1971, Publ. Spéc. n° 3).

An equipotential ellipsoid or level ellipsoid is an ellipsoid that is defined to be an equipotential surface. If an ellipsoid of revolution (semimajor axis **a**, semiminor axis **b**) is given, then it can be made an equipotential surface

$$U = U_0 = \text{const.}$$

of a certain potential function U, called normal potential. This function U is uniquely determined by means of the ellipsoidal surface (semiaxes a, b), the enclosed mass M and the angular velocity ω, according to a theorem of Stokes-Poincaré, quite independently of the internal density distribution. Instead of the four constants a, b, M and ω, any other system of four independent parameters may be used as defining constants.

The theory of the equipotential ellipsoid was first given by **Pizzeti** in 1894; it was further elaborated by **Somigliana** in 1929. This theory had already served as a base for the International Gravity Formula adopted at the General Assembly in Stockholm in 1930.

Normal gravity $\gamma = |\text{grad } U|$ at the surface of the ellipsoid is given by the closed formula of **Somilgiana**,

$$\gamma = \frac{a\gamma_e \cos^2 \Phi + b\gamma_p \sin^2 \Phi}{\sqrt{a^2 \cos^2 \Phi + b^2 \sin^2 \Phi}} ,$$

where the constants γ_e and γ_p denote normal gravity at the equator and at the poles, and Φ denotes geographical latitude.

The equipotential ellipsoid furnishes a simple, consistent and uniform reference system for all purposes of geodesy: the ellipsoid as a reference surface for geometric use, and a normal gravity field at the earth's surface and in space, defined in terms of closed formulas, as a reference for gravimetry and satellite geodesy.

The standard theory of the equipotential ellipsoid regards the normal gravitational potential as a harmonic function outside the ellipsoid, which implies the absence of an atmosphere. (The consideration of the atmosphere in the reference system would require an ad-hoc modification of the theory, whereby it would lose its clarity and simplicity.)

Thus, in the same way as in the Geodetic Reference System 1967, the computation are based on the theory of the equipotential ellipsoid without an atmosphere. The reference ellipsoid is defined to enclose the whole mass of the earth, including the atmosphere; as a visualization, one might, for instance, imagine the atmosphere to be condensed as a surface layer on the ellipsoid. The normal gravity field at the earth's surface and in space can thus be computed without any need for considering the variation of atmospheric density.

If atmospheric effects must be considered, this can be done by applying corrections to the measured values of gravity; for this purpose, a table of corrections will be given later (sec.5).

3- *Computational Formulas*

An equipotential ellipsoid of revolution is determined by four constants. The IUGG has chosen the following ones :

a	equatorial radius,
GM	geocentric gravitational constant,
$\mathbf{J_2}$	dynamical form factor,
ω	angular velocity.

The equatorial radius **a** is the semimajor axis of the meridian ellipse; the semiminor axis will be denoted by **b**. The geocentric gravitational constant **GM** is the product of the Newtonian gravitational constant, **G**, and the total mass of the earth, **M**. The constant J2 is given by :

$$J_2 = \frac{C-A}{Ma^2} ,$$

where **C** and **A** are the principal moments of inertia of the level ellipsoid (**C**... polar, **A**... equatorial moment of inertia).

We shall also use the first excentricity **e**, defined by:

$$e^2 = \frac{a^2 - b^2}{a^2} ,$$

and the second excentricity **e'**, defined by :

$$e'^2 = \frac{a^2 - b^2}{b^2}$$

Closed computational formulas are given in sec.3 of (IAG, 1971, Pub.Spéc. n° 3); we shall here reproduce this section practically unchanged.

The derivation of these formulas is found in the book (**Heiskanen** and **Moritz**, 1967) sections 2-7 to 2-10. Reference to this book is by page number and number of equation.

Computation of e^2

The fundamental derived constant is the square of the first excentricity, e^2, as defined above.

From p. 73, equations (2-90) and (2-92'), we find :

$$J_2 = \frac{e^2}{3}\left(1 - \frac{2}{15}\frac{me'}{q_o}\right)$$

This equation can be written as :

$$e^2 = 3J_2 + \frac{2me'\,e^2}{15\,q_o}$$

with :

$$m = \frac{\omega^2\,a^2\,b}{GM}$$

(p. 69, eq. (2-70)) and with be' = ae it becomes :

$$e^2 = 3J_2 + \frac{4}{15}\,\frac{\omega^2\,a^3}{GM}\,\frac{e^3}{2\,q_0}$$

This is the basic equation which relates e^2 to the data a, GM, J_2 and ω. It is to be solved iteratively for e^2, taking into account :

$$2\,q_0 = \left(1 + \frac{3}{e'^2}\right) \mathit{arctan}\, e' - \frac{3}{e'}$$

$$= \sum_{n=1}^{\infty} \frac{4(-1)^{n+1}\,n}{(2n+1)\,(2n+3)}\,e'^{2n+1}$$

with

$$e' = \frac{e}{\sqrt{1 - e^2}} \quad \text{(second excentricity)}$$

(p. 66, eq. (2-58); p. 72, second equation from top).

Geometric Constants

Now the other geometric constants of the reference ellipsoid can be computed by the well-known formulas:

$b = a\sqrt{1 - e^2}$ (semiminor axis),

$f = \frac{a - b}{a}$ (flattening),

$E = \sqrt{a^2 - b^2}$ (linear excentricity),

$c = \frac{a^2}{b}$ (polar radius of curvature).

The arc of meridian from equator to pole (meridian quadrant) is given by :

$$Q = c\int_0^{\pi/2} \frac{d\Phi}{(1+e'^2\cos^2\Phi)^{3/2}}$$

where Φ is the geographical latitude. This integral can be evaluated by a series expansion :

$$Q = \frac{c\pi}{2}\left(1 - \frac{3}{4}e'^2 + \frac{45}{64}e'^4 - \frac{175}{256}e'^6 + \frac{11025}{16384}e'^8\right)$$

Various mean radii of ellipsoid are defined by the following formulas :

arithmetic mean :

$$R_1 = \frac{a + a + b}{3} = a\left(1 - \frac{f}{3}\right);$$

radius of sphere of the same surface :

$$R_2 = c\left(\int_0^{\pi/2} \frac{\cos\Phi}{(1+e'^2\cos^2\Phi)^2}\,d\Phi\right)^{1/2}$$

$$= c\left(1 - \frac{2}{3}e'^2 + \frac{26}{45}e'^4 - \frac{100}{189}e'^6 + \frac{7034}{14175}e'^8\right);$$

radius of sphere of the same volume :

$$R_3 = \sqrt[3]{a^2\,b}\,.$$

Physical Constants

The reference ellipsoid is a surface of constant normal potential, $U = U_0$. This constant U_0, the normal potential of the reference ellipsoid, is given by :

$$U_0 = \frac{GM}{E}\,\mathit{arctan}\, e' + \frac{1}{3}\omega^2\,a^2$$

$$= \frac{GM}{b}\left(1 + \sum_{n=1}^{\infty}(-1)^n\,\frac{e'^{2n}}{2n+1} + \frac{1}{3}\,m\right)$$

(p. 67, eq. (2-61)).

The normal gravitational potential **V** (gravity potential **U** minus potential of centrifugal force) can be developed into a series of zonal spherical harmonics :

$$V = \frac{GM}{r}\left(1 - \sum_{n=1}^{\infty} J_{2n}\left(\frac{a}{r}\right)^{2n} P_{2n}(\cos\Phi)\right);$$

where **r** (radius vector) and Φ (polar distance) are spherical coordinates. The coefficient J_2 is a defining constant; the other coefficients are expressed in terms of J_2 by :

$$J_{2n} = (-1)^{n+1} \frac{3e^{2n}}{(2n+1)(2n+3)} \left(1 - n + 5n \frac{J_2}{e^2}\right)$$

(p.73, eqs. (2-92) and (2-92')).

Normal gravity at the equator, γ_e, and normal gravity at the poles, γ_p, are given by the expressions :

$$\gamma_e = \frac{GM}{ab}\left(1 - m - \frac{m}{6}\frac{e' q'_0}{q_0}\right)$$

$$\gamma_p = \frac{GM}{a^2}\left(1 + \frac{m}{3}\frac{e' q'_0}{q_0}\right)$$

with

$$q_0' = 3\left(1 + \frac{1}{e'^2}\right)\left(1 - \frac{1}{e'}\arctan e'\right) - 1$$

and

$$m = \frac{\omega^2 a^2 b}{GM}$$

(p. 69, eqs. (2-73) and (2-74); p.68, eq. (2-67)).

The constant :

$$f^* = \frac{\gamma_p - \gamma_e}{\gamma_e} \qquad \text{(gravity flattening)}$$

is also needed.

A check is provided by the closed form of **Clairaut**'s theorem for the equipotential ellipsoid :

$$f + f^* = \frac{\omega^2 b}{\gamma_e}\left(1 + \frac{e' q'_0}{2q_0}\right)$$

(p. 69; eq. (2-75)).

The Gravity Formula

Somiglinana's closed formula for normal gravity is

$$\gamma = \frac{a\gamma_e \cos^2\Phi + b\gamma_p \sin^2\Phi}{\sqrt{a^2\cos^2\Phi + b^2 \sin^2\Phi}}$$

For numerical computations, the form

$$\gamma = \gamma_e \frac{1 + k \sin^2\Phi}{\sqrt{1 - e^2 \sin^2\Phi}}$$

with

$$k = \frac{b\gamma_p}{a\gamma_e} - 1$$

is more convenient.

The conventional abbreviated series expansion is :

$$\gamma = \gamma_e \left(1 + f^* \sin^2\Phi - \frac{1}{4} f_4 \sin^2 2\Phi\right)$$

with

$$f_4 = \frac{1}{2} f^2 + \frac{5}{2} fm$$

(p.77, eqs. (2-115) and 2-116)).

More generally, the above closed formula for normal gravity may be expanded into the series

$$\gamma = \gamma_e \left(1 + \sum_{n=1}^{\infty} a_{2n} \sin^{2n} 2\Phi\right)$$

where

$$a_2 = \frac{1}{2}e^2 + k, \qquad a^6 = \frac{5}{16}e^6 + \frac{3}{8}e^4 k,$$

$$a_4 = \frac{3}{8}e^4 + \frac{1}{2}e^2 k, \qquad a_8 = \frac{35}{128}e^8 + \frac{5}{16}e^6 k,$$

The average value of gravity over the ellipsoid is

$$\overline{\gamma} = \int_0^{\pi/2} \frac{\gamma \cos\Phi \, d\Phi}{(1 - e^2\sin^2\Phi)^2} : \int_0^{\pi/2} \frac{\cos\Phi \, d\Phi}{(1 - e^2\sin^2\Phi)^2}$$

$$= 1 + \frac{1}{6}e^2 + \frac{1}{3}k + \frac{59}{360}e^4 + \frac{5}{18}e^2 k +$$

$$+ \frac{2371}{15120}e^6 + \frac{259}{1080}e^4 k + \frac{270229}{1814400}e^8 + \frac{9623}{45360}e^6 k.$$

4- *Numerical values*

The following derived constants are accurate to the number of decimal places given. In case of doubt or in those cases where a higher accuracy is required, these quantities are to be computed from the defining constants by means of the closed formulas given in the preceding section.

Defining Constants (exact)

a	= 6378 137 m	semimajor axis
GM	= 3 986 005 x 10^8 m^3 s^{-2}	geocentric gravitational constant
J_2	= 108 263 x 10^{-8}	dynamic form factor
ω	= 7 292 115 x 10^{-11} rad s^{-1}	angular velocity

Derived Geometric Constants

b	= 6 356 752.3141 m	semiminor axis
E	= 521 854.0097 m	linear excentricity
c	= 6 399 593.6259 m	polar radius of curvature
e^2	= 0.006 694 380 022 90	first excentricity (e)
e'^2	= 0.006 739 496 775 48	secondexcentricity (e')
f	= 0.003 352 810 681 18	flattening
f^{-1}	= 298.257 222 101	reciprocal flattening
Q	= 10 001 965.7293 m	meridian quadrant
R_1	= 6 371 008.7714 m	mean radius $R_1=(2a+b)/3$
R_2	= 6 371 007.1810 m	radius of sphere of same surface
R_3	= 6 371 000.7900 m	radius of sphere of same volume

Derived Physical Constants

U_0	= 6 263 686.0850 x 10 m^2 s^{-2}	normal potential at ellipsoid
J_4	= -0.000 002 370 912 22	spherical-harmonic coefficents
J_6	= 0.000 000 006 083 47	
J_8	= -0.000 000 000 014 27	
m	= 0.003 449 786 003 08	$m = \omega^2 a^2 b/GM$
γ_e	= 9.780 326 7715 ms^{-2}	normal gravity at equator
γ_p	= 9.832 186 3685 ms^{-2}	normal gravity at pole
f*	= 0.005 302 440 112	$f^* = \frac{(\gamma_p - \gamma_e)}{\gamma_e}$
k	= 0.001 931 851 353	$k = \frac{(b\gamma_p - a\gamma_e)}{a\gamma_e}$

Gravity Formula 1980

Normal gravity may be computed by means of the closed formula :

$$\gamma = \gamma_e \frac{1 + k \sin^2 \Phi}{\sqrt{1 - e^2 \sin^2 \Phi}} ,$$

with the values of γ_e, k, and e^2 shown above.

The series expansion, given at the end of sec. 3, becomes :

$$\gamma = \gamma_e (1 + 0.005\,279\,0414 \sin^2 \Phi + 0.000\,023\,2718 \sin^4 \Phi + 0.000\,000\,1262 \sin^6 \Phi + 0.000\,000\,0007 \sin^8 \Phi) ;$$

it has a relative error of 10^{-10}, corresponding to 10^{-3} µm s^{-2} = 10^{-4} mgal.

The conventional series

$$\gamma = \gamma_e (1 + f^* \sin^2 \Phi - \frac{1}{4} f_4 \sin^2 2\Phi)$$

$$= 9.780\,327 (1 + 0.005\,3024 \sin^2 \Phi - 0.000\,0058 \sin^2 2\Phi) \text{ m } s^{-2}$$

has only an accuracy of **1 µm s^{-2} = 0.1 mgal.** It can, however, be used for converting gravity anomalies from the International Gravity Formula (1930) to the Gravity Formula 1980 :

$$\gamma_{1980} - \gamma_{1930} = (-16.3 + 13.7 \sin^2 \Phi) \text{ mgal},$$

where the main part comes from a change of the Postdam reference value by - 14 mgal; see also (IAG, 1971, Publ. Spéc. n° 3, p.74).

For the conversion from the Gravity Formula 1967 to the Gravity Formula 1980, a more accurate formula, corresponding to the precise expansion given above, is :

$$\gamma_{1980} - \gamma_{1967} = (0.8316 + 0.0782 \sin^2 \Phi - 0.0007 \sin^4 \Phi) \text{ mgal},$$

Since former gravity values are expressed in the units **"gal"** and **"mgal"**, we have, in the conversion formulas, used the unit **1 mgal = 10^{-5} m s^{-2}.**

Mean values of normal gravity are :

$\bar{\gamma}$ = 9.797 644 656 m s^{-2} average over ellipsoid,

γ_{45} = 9.806 199 203 m s^{-2} γ at latitude $\Phi = 45°$.

The numerical values given in this section have been computed independently by **Mr. Chung-Yung Chen**, using series developments up to f^5, and by **Dr. Hans Sünkel**, using the formulas presented in sec. 3.

5- *Atmospheric Effects*

The table given here is reproduced from (IAG, 1971, Publ. Spéc. n° 3, p.72). It shows atmospheric gravity correction δg as a function of elevation **h** above sea level. The values δg are to be added to measured gravity. The effect of this reduction is to remove, by

computation, the atmosphere outside the Earth by shifting it vertically into the interior of the geoid.

Atmospheric Gravity Corrections δg
(to be added to measured gravity)

h [km]	δg [mgal]	h [km]	δg [mgal]
0	0.87	10	0.23
0.5	0.82	11	0.20
1.0	0.77	12	0.17
1.5	0.73	13	0.14
2.0	0.68	14	0.12
2.5	0.64	15	0.10
3.0	0.60	16	0.09
3.5	0.57	17	0.08
4.0	0.53	18	0.06
4.5	0.50	19	0.05
5.0	0.47	20	0.05
5.5	0.44	22	0.03
6.0	0.41	24	0.02
6.5	0.38	26	0.02
7.0	0.36	28	0.01
7.5	0.33	30	0.01
8.0	0.31	32	0.01
8.5	0.29	34	0.00
9.0	0.27	37	0.00
9.5	0.25	40	0.00

6- *Origin and Orientation of the Reference System*

IUGG Resolution n° 7, quoted at the begining of this paper, specifies that the Geodetic Reference System 1980 be geocentric, that is, that its origin be the center of mass of the earth. Thus, the center of the eliipsoid coincides with the geocenter.

The orientation of the system is specified in the following way. The rotation axis of the reference ellipsoid is to have the direction of the Conventional International Origin for the Polar Motion (**CIO**), and the zero meridian as defined by the Bureau International de l'Heure (**BIH**) is used.

To this definition there corresponds a rectangular coordinate system **XYZ** whose origin is the geocenter, whose **Z**-axis is the rotation axis of the reference ellipsoid, defined by the direction of **CIO**, and whose **X**-axis passes through the zero meridian according to the **BIH**.

REFERENCES

W.A. HEISKANEN, and H. MORITZ (1967) : Physical Geodesy. W.H. Freeman, San Francisco.

International Association of Geodesy (1971) : Geodetic Reference System 1967. Publi. Spéc. n° 3 du Bulletin Géodésique, Paris.

H. MORITZ (1979) : Report of Special Study Group N° 539 of I.A.G., Fundamental Geodetic Constants, presented at XVII General Assembly og I.U.G.G., Canberra.

Editor's Note :
Additional useful constants can be obtained from : "United States Naval Observatory, Circular N° 167, December 27, 1983, Project MERIT Standards", with updates of December 1985.

Parameters of Common Relevance of Astronomy, Geodesy, and Geodynamics

by **M. Bursa** (Czechoslovakia)
former president of **SSG 5-100**

The aims of SSG 5-100 :

- To review the most current information on the values of physical quantities which are fundamentally important in the fields of astronomy, geodesy, and geodynamics.

- To reconcile this information into a uniform, compatible set.

- To recommend to the XXth General Assembly the publication of a set of most up-to-date representative values.

- To consider the status of the Geodetic Reference System 1980, and if there should be any changes in this reference system, to give recommendations to the I.A.G. General Assembly.

Members :

M. Bursa	(Czechoslovakia) Chairman
A.H. Cook	(United Kingdom)
M.E. Davies	(USA)
J.O. Dickey	(USA)
B.H. Chovitz	(USA)
H. Kinoshita	(Japan)
R. Kolenkiewicz	(USA)
J.G. Marsh	(USA)
D. Nagy	(Canada)
L.P. Pellinen	(USSR)
R.H. Rapp	(USA)
E. Ratton	(Brazil)
D.E. Smith	(USA)

This study group is to cooperate closely with international organizations and institutions in which related problems are studied. During the period covered (1987-1991) these have been especially :

- IAU Working Group on Reference System, Subgroup on Astronomical Constants;
Chairman: T. Fukushima (Japan),

- IAU/IAG/COSPAR Working Group on Cartographic Coordinates and Rotational Elements of the Planets and Satellites;
Chairman: M.E. Davies (USA).

The data used in the report were based on information supplied by the SSG 5-100 members and other scientists involved in the topic.

It is particularly emphasized the these values are **current estimates**; whereas for reference purposes the Geodetic Reference System 1980, as adopted by the I.U.G.G., at the XVIIth General Assembly, should be used.

Five classes of parameters are considered: defining, primary, derived, additional and long-term varying. Only parameters needed for recent studies, particularly in geodynamics have been included.

The only defining constant is the velocity of light, being used to define the meter, its value being exact. That is why it cannot be placed in the same class of constants as G etc.

During the period covered, a lively discussion took place on the four primary geodetic parameters defining the geodetic reference system (GRS), (Kinoshita 1990, 1991). In addition to the SSG 5-100 members many consultants involved in the topic participated in the discussion and contributed valuably to the problem. The discussion should be continuing during the next period 1991-1995 to make the final decision to be submitted to the XXIth I.A.G. General Assembly in 1995.

I- ***Current (1991) representative values of the parameters of common relevance of astronomy, geodesy, and geodynamics***

1. Defining constant

1.1. Velocity of light in vacuum

$c = 299\ 792\ 458$ m s^{-1}

This value is the same as in the SI and IERS standards. It is the value defining the length of 1 meter in terms of the SI second. It is adopted by definition and that is why, no uncertainty is stated. SI units are to be used throughout and consequently.

2. Primary parameters

2.1. Newtonian gravitational constant

$G = (6.672\ 59 \pm 0.00030) \times 10^{-11}$ m^3 s^{-2} kg^{-1}

References : Report of CODATA (1986)
IERS Standards (1989)
Sir A.H. Cook (1991)

2.2. Primary parameters defining the geodetic reference system (GRS)

2.2.1. Geocentric gravitational constant (the mass of the Earth's atmosphere included)

$GM = (398\ 600.441 \pm 0.001) \times 10^9$ m^3 s^{-2}

References : J.C. Ries et al. (1989)
T. Fukushima (1991)

It is the rounded value. The change of approximately 7×10^{-10} in relative value, i.e. $\approx 0.0003 \times 10^9$ m^3 s^{-2} in absolute value, is to be expected as the result of a change of the unit of time prepared by the IAU in order to have a unit of time and of length (Guinot, 1990). That is why, the rounded value is given.

2.2.2. Mean angular velocity of the Earth's rotation

$\omega = 7\ 292\ 115 \times 10^{-11}$ rad s^{-1}

It is the actual mean value (see Table 1 and **IERS (BIH) Annual Report**). Because of the variability of ω the next figure depends on the averaging time and should be **derived from the data given** in the **IERS Annual Report** (Guinot 1990, 1991).

Table 1

Years	ω [10^{-11} rad s^{-1}]
1978	7 292 114.903
1979	4.925
1980	4.952
1981	4.964
1982	4.964
1983	4.954
1984	5.019
1985	5.025
1986	5.043
1987	5.032
1988	5.036
1989	5.018
1990	4.983

2.2.3. Second-degree zonal geopotential (Stokes) parameter (tide free, conventional, not normalized)

a) $J_2 = (1082.6269 \pm 0.0006) \times 10^{-6}$

It is the GEM-T2 value, epoch 1990, scaled for $a = 6\ 378\ 136$ m

Reference : B. Chovitz (1991)

To be consistent with the I.A.G. General Assembly Resolution 16, 1983 (Hambourg), the indirect tidal effect on J_2 should be included; then (if the Love number $K_2 = 0.9$)

b) $J_2 = (1082.6362 \pm 0.0006) \times 10^{-6}$

Reference : J.G. Marsh et al. (1989)
J.G. Marsh et al. (1990)
R.H. Rapp et al. (1990)

2.2.4. Equatorial radius of the Reference Ellipsoid (mean equatorial radius of the Earth)

$a = (6\ 378\ 136.3 \pm 0.5)$ m

IERS standard is 6 378 136 m.

Reference : R.H. Rapp et al. (1990)
R.H. Rapp (1987)
Proposed T/P Standard, K.H. Wakker (1990)

3. Derived parameters
(computed from primary parameters GM, ω, J_2, a)

3.1. The geopotential value on the geoid

$W_0 = (62\ 636\ 858 \pm 5)\ m^2\ s^{-2}$

3.2. Geopotential scale factor

$$R_0 = \frac{GM}{W_0} = (6\ 363\ 672.3 \pm 0.5)\ m$$

3.3. Mean equatorial gravity

$$g_e = (978\ 032.74 \pm 0.08) \times 10^{-5}\ m\ s^{-2}$$

3.4. The Earth's polar flattening

a) tide free

$$f = \frac{1}{298.258 \pm 0.001}$$

b) zero frequency indirect tide included ($K_2 = 0.3$)

$$f = \frac{1}{298.257 \pm 0.001}$$

3.5. Factor of potential of centrifugal force

$$q = \frac{\omega^2 a^3}{GM} = (3461.390 \pm 0.002) \times 10^{-6}$$

4. Additional figure and some other parameters

4.1. Triaxiality parameters

4.1.1. Equatorial flattening

$$f_1 = \frac{1}{91\ 500 \pm 100}$$

For different models see Table 2 (best-fitting).

Table 2

Model	GRIM 4 S1	GEM-T1	GEM-T2
a [m]	6 378 171.36	6 378 171.36	6 378 171.36
1/f	297.774	297.774	297.774
$1/f_1$	91 457	91 476	91 470
λ_1	-14.95	-14.94	-14.94
$\bar{a}$ [m]	6 378 136.49	6 378 136.49	6 378 136.50
$1/\bar{f}$	298.2578	298.2577	298.2575

a, f, f_1, λ_1 - triaxial $\bar{a}$, $\bar{f}$ - rotational

4.1.2. Longitude of major axis of equatorial ellipse

$$\lambda_1 = -(14.95^\circ \pm 0.05^\circ)$$

4.2. Parameter $H = [C - \frac{1}{2}(A + B)]/C$ in the precession constant

$$H = 0.003\ 273\ 9567 \pm 2 \times 10^{-9}$$

References : H. Kinoshita and J. Souchay (1990)
J.G. Williams et al. (1991)

4.3. Moments of inertia (tide free)

$$\frac{C-A}{Ma^2} = J_2 + 2J_{2,2} = (1086.258 \pm .002) \times 10^{-6}$$

$$\frac{C-B}{Ma^2} = J_2 - 2J_{2,2} = (1078.996 \pm .002) \times 10^{-6}$$

$$\frac{B-A}{Ma^2} = 4J_{2,2} = (7.262 \pm .006) \times 10^{-6}$$

$$Ma^2 = \frac{GM}{G} a^2 = (2.4301 \pm .0001) \times 10^{38}\ kg\ m^2$$

$$C-A = (2.6397 \pm .0005) \times 10^{35}\ kg\ m^2$$

$$C-B = (2.6221 \pm .0005) \times 10^{35}\ kg\ m^2$$

$$B-A = (1.764 \pm .002) \times 10^{33}\ kg\ m^2$$

$$\frac{A}{Ma^2} = 0.329\ 591 \pm .000\ 001$$

$$\frac{B}{Ma^2} = 0.329\ 599 \pm .000\ 001$$

$$\frac{C}{Ma^2} = 0.330\ 678 \pm .000\ 001$$

$$A = (8.0094 \pm .0003) \times 10^{37}\ kg\ m^2$$

$$B = (8.0096 \pm .0003) \times 10^{37}\ kg\ m^2$$

$$C = (8.0358 \pm .0003) \times 10^{37}\ kg\ m^2$$

5. Long-term varying parameters

5.1. Long-term decrease in the second-degree zonal geopotential parameters

$$\left(\frac{dJ_2}{dt}\right) = -(2.8 \pm 0.3) \times 10^{-9}\ cy^{-1}$$

References : IERS Standards (1989)
Proposed T/P Standards, K.H. Wakker (1990)

5.2. Tidal acceleration of the Moon (Long-term variation in the mean motion n)

$$\frac{dn}{dt} = -(25.5 \pm 1.0)\ \text{arcsec}\ cy^{-2}$$

this value is based on LLR data.

Reference : J.O. Dickey et al. (1991)

5.3. Long-term variations in the angular velocity of the Earth's rotation

5.3.1. Positive relative long-term acceleration due to $\frac{dJ_2}{dt}$ (5.1)

$$\frac{d\omega}{dt}_{rel} = +(1.29 \pm 0.28) \times 10^{-22}\ \text{rad}\ s^{-2}$$

References : J.O. Dickey et al. (1991)
J.G. Marsh et al. (1990)

5.3.2. Resulting long-term deceleration (total) (rounded value)

$$\frac{d\omega}{dt} = -(5.0 \pm 0.3) \times 10^{-22}\ \text{rad}\ s^{-2}$$

Reference : J.G. Marsh et al. (1990)

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