

UNION GÉODÉSIQUE ET GÉOPHYSIQUE INTERNATIONALE
INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS

ASSOCIATION INTERNATIONALE DE GÉODÉSIE

BULLETIN GÉODÉSIQUE



THE GEODESIST'S HANDBOOK

1988

LE MANUEL DU GÉODÉSIEN

Editor
C. C. TSCHERNING

Volume 62 N° 3
Année 1988

BUREAU CENTRAL
DE L'ASSOCIATION INTERNATIONALE DE GÉODÉSIE

140, rue de Grenelle — 75700 PARIS

Trimestriel

MANUEL DU GEODESIEN

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GEODESIST'S HANDBOOK

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FOREWORD

The Executive Committee of the International Association of Geodesy has decided to publish after every General Assembly a special issue of Bulletin Géodésique 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 *"Geodesists's Handbook-1988"*. 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 Vancouver, Canada, **August, 1987**. 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 and the Special Study Groups, namely their structure and program of activities for the coming period 1987–1991. 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, **Dr. B. Chovitz**. The fourth part also includes a list of major international and national data centers and scientific publications series.

Finally the Handbook contains information for contributors to the Bulletin Géodésique and — maybe most important — a list of addresses.

The Executive Committee has discussed whether to include other practical 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 location of national *edm* calibration baselines. This information was collected by the president of Section I for the period 1983–1987, **J.D. Bossler**, whose assistance is very much appreciated.

The Handbook has been compiled by 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 ordinary issues of Bulletin Géodésique.

C.C. Tscherning

AVANT – PROPOS

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 – 1988"*. 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 Geophysique Internationale, de ses Statuts et de son Règlement 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 Vancouver (Canada) en *Août 1987*. 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 et les Groupes Spéciaux d'Etudes, notamment leur structure et leur programme d'activités pour la période quadriennale 1987–1991. 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, Dr. B. Chovitz. Cette quatrième partie contient aussi une liste des principaux 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, la localisation des bases d'étalonnage nationales pour les mesures électro-magnétiques de distance. Ces informations ont été collectées par le président de la Section I pendant la période 1983–1987, J.D. Bossler, dont la contribution est très appréciée.

Le Manuel du Géodésien a été préparé par le Bureau Central 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 les numéros ordinaires du Bulletin Géodésique.

C.C. Tscherning

HISTORY OF THE INTERNATIONAL ASSOCIATION OF GEODESY

prepared by **Charles WHITTEN**

former President of SSG 0.67 "History of Geodesy"

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 General Secretary. Then the 1984 Geodesist's Handbook contains brief biographical memoirs of former Presidents and General Secretaries of the Association. In an effort to make this collection more complete, the Special Study Group 0.67 has prepared similar memoirs for three Presidents of the old Association : **Ibanez** from Spain (1886–1891), **Faye** from France (1892–1902) and **Bassot** from France (1903–1917).

This report also contains concise bio-reference notes for deceased former Section, Commission and Special Study Group Officers as well as other geodesists who have made significant contributions. The reader will note that some of these are incomplete — missing dates of birth or death, missing country, city, institute, etc.. Also, undoubtedly there are others who should be included. Your assistance is urgently sought to help us make this list more accurate. Please send the corrections and additions to :

Dr. B. Chovitz,
President SSG 0.67

On the last page of this report we have identified the geodesists who have had the primary responsibility for the **I.L.S.** and the **B.I.H.** We are suggesting that consideration be given to preparing a very complete history of these two services after the new service is instituted. This effort should be a joint project — **I.A.G.** and **I.A.U.** Preliminary discussions were held with **Dr. Dennis McCarthy** of the U.S. Naval Observatory. He is active in both international bodies and could assist in organizing this cooperative project.

1. Presidents of the former International Geodetic Association

. Carlos IBÁÑEZ (1825–1891).



President of die Internationale Erdmessung
(The International Geodetic Association)
from 1886 to 1891.

Born in Barcelona, Spain, 14 April 1825; died Nice, France, 28 January 1891. In 1839 he entered the Academy of Army Engineers receiving training in both military and scientific subjects. He developed a keen interest in geodesy while teaching at the Academy. In 1853 he joined a newly created commission specifically established to prepare a national map for Spain. At his initiative the Census and Geographic Institute was established in 1870. He was its first director.

General Ibáñez was responsible for planning and measuring the large quadrilateral of triangulation crossing the western end of the Mediterranean connecting Spain

with Algeria. Observations were made between the peaks of Mulhacén and Teticas in Spain and Filhaoussen and M'Sabiha in Algeria. It is one of the classic examples of long geodesic lines. Ibáñez reported on the completion of the project at the General Conference of the Association held in Munich in 1880. A few years later he was awarded the title Marquis of Mulhacén in appreciation of this historic work. In addition to his active participation in the geodetic association, he took part in the formation of the International Bureau of Weights and Measures in Paris serving as its first president.

. Hervé, Etienne, Auguste, Alband FAYE (1814–1902).



Président de l'Association Géodésique Internationale de 1892 à 1902.

Né le 1^{er} Octobre 1814 à Saint-Benoit du Sault (Indre), il entre à l'Ecole Polytechnique en 1832. Après quelques difficultés politiques, qui lui valent un court emprisonnement, il est appelé par Arago à l'Observatoire de Paris où il entre en 1841 et où va se dérouler la suite de sa carrière. Il s'y distingue bientôt, découvre la petite planète qui porte son nom et consacre une partie de ses études aux comètes et à la force répulsive qu'exerce le soleil sur leur queue.

Il est élu au Bureau des Longitudes (dont il deviendra président) et est élu membre de l'Académie des Sciences en 1847, âgé de 33 ans.

Son rôle est essentiel pour le développement de la géodésie française :

- un des tout premiers, il souligne l'importance des mesures gravimétriques, étudie leur réduction, propose la correction à l'air libre (correction de Faye), montre l'intérêt de la mesure des déviations de verticale et de leur étude,

- il est le principal inspirateur du programme de 1864 présenté par le Bureau des Longitudes qui préconise :

- a) d'étudier et calculer l'influence des attractions locales sur la verticale,
- b) de vérifier les parties douteuses de la méridienne de Delambre et de reprendre les déterminations de longitudes astronomiques par télégraphie,
- c) de comparer les étalons de longueur des différents pays,
- d) de maintenir un contact étroit entre théoriciens et géodésiens de terrain.

- il encourage vivement **F. Perrier** pour la reprise en France des travaux de triangulation et intervient dans ce sens auprès des autorités,

- il présente un rapport très favorable à l'adhésion de la France à l'Europäische Gradmessung, ancêtre de l'Association Géodésique Internationale (1863).

Il présidera l'Académie des Sciences en 1872, sera élu à la présidence de l'Association Géodésique Internationale en 1892 qu'il exercera jusqu'en 1902.

Esprit universel, travailleur acharné, on compte de lui des centaines de notes aux comptes rendus de l'Académie des Sciences sur de nombreux projets d'astronomie, d'astrophysique naissante, de géodésie, etc ...

. Général Jean, Antonin, Léon BASSOT (1841—1917).



Président de l'Association Géodésique Internationale de 1903 à 1917.

Né le 6 Avril 1841 à Renève (Côte d'Or), il entre à l'Ecole Polytechnique en 1861 et sort dans le corps d'Etat Major dont dépendait à cette époque le Dépôt de la Guerre chargé des opérations topographiques et géodésiques de la carte de France, dite de l'Etat-Major. Il y est affecté en 1870 pour participer aux observations de la Nouvelle Méridienne de France dont **F. Perrier** venait d'obtenir la reprise. Fait prisonnier au cours de la guerre franco-allemande de 1870, il est interné à Hambourg. A son retour (1871), il reprend les observations de la méridienne dont il prendra la direction à la nomination de **F. Perrier** comme Directeur du Service Géographique de l'Armée.

Il participe à la célèbre jonction Espagne-Algérie de 1878.

Il est nommé chef de la Section de Géodésie en 1882 et prendra en 1898 le

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commandement du Service Géographique de l'Armée. Il prend sa retraite en 1903, et sera nommé Directeur de l'Observatoire de Nice.

Membre de l'Académie des Sciences en 1893 (section de géographie et navigation), sa carrière s'est déroulée uniquement comme géodésien ou astronome.

Il s'est occupé, en dehors de ses activités initiales d'observateur :

- d'organiser et poursuivre la géodésie en Algérie,
- de développer en France la nouvelle triangulation,
- d'organiser et contrôler les observations du nouvel Arc du Pérou.

Il fut élu, en 1903, *président de l'Association Géodésique Internationale* à l'Assemblée Générale de Copenhague et fut réélu en 1911 à celle de Hambourg, lieu de sa captivité en 1870–1871.

2. Deceased former Section, Commission, Special Study Group officers and other geodesists who made significant contributions

(in brackets biographical notice published).

AIRY, Sir George Biddell (1801–1892).

England, Greenwich Observatory

Astronomy, Isostasy.

[EnBr].

ANDERSEN, Einar (1905–1987).

Denmark, Copenhagen, Geodetic Institute

Classical geodesy

Treasurer, I.U.G.G. (1960–1971).

[Bulletin Géodésique, 61–4, 1987].

ANDOYER, Henri (1861–1929).

France, Paris

Astronomy.

[Bull. Geod. 1929, pp. 120–124].

ASPLUND, Lars (1914–1987).

Sweden, Stockholm, Rikets Allmänna Kartverk

Control surveys, Land surveys

Pres. Sect. I, Geometrical Determination of Positions (1967–1971)

2nd Vice-Pres. I.A.G. (1971–1975)

[Bulletin Géodésique, 61–2, 1987].

BAETSLE, P. L. (1909–1983).

Belgium, Bruxelles, Univ. of Bruxelles

Mathematical geodesy

Pres. Sect. I, Control Surveys (1971–1975)

2nd Vice-Pres. I.A.G. (1975–1979)

[Bull. Geod. 58–1, 1984].

BAMBERG, Carl (1847–1892).

Geodetic instruments

[ZfV, 1927, 495–6].

BANACHIEWICZ, T. (1882–1954).

Poland, Cracow, Observatory

Astronomy, Mathematical geodesy

[CD of SB, p. 45].

- BONSDORFF, Toivo Ilmari (1879–1950).**
 Finland, Helsinki, Finnish Geodetic Institute
 Geodetic astronomy, Solar eclipse measurements
 Ex. Com., I.A.G. (1930–1936)
 [Bull. Geod. 1951, pp. 98–103].
- BOSKOVIC, Stevan, P.**
 Yugoslavia, Belgrade, Institut Géographique Militaire
 Mathematical geodesy, Projections
 Reporter — Projections I.A.G. (1928–).
- BROWNE, Benjamin, C.**
 England, Cambridge, Dept. of Geodesy and Geophysics
 Gravity, Pendulums
 Pres. Sect. IV, Gravimetry (1951–1957).
- BRUNS, (Ernst), Heinrich (1848–1919)**
 Germany, Leipzig, University & Observatory
 Astronomy, Geodesy
 [World Who's Who in Sc. p. 261].
- CAHIERRE, Loic (1901–1984).**
 France, Paris, Institut Géographique National
 Leveling
 Pres. Sect. II, Leveling and Movements of the Crust (1963–1971).
- CHOLESKY, André-Louis (1875–1918)**
 France, Paris, Geographic Service
 Mathematics
 [Bull. Geod. 1922, pp. 159–161].
- CISSE, A. (—1984)**
 Ivory Coast, Abidjan, Institut Géographique
 Pres. Com. XI, Geodesy in Africa (1983–1984)
 [Bull. Geod. 1984, p. 1].
- COX, Jacques (1898–1972)**
 Belgium, Bruxelles, Univ. of Bruxelles
 Classical geodesy
 Pres. Sect. III, Astronomy (1951–1957)
 [Annuaire de l'Académie (Belg.) Vol. CLI, 1985].
- DORE, Paolo (1892–1969)**
 Italy, Bologna, Univ. of Bologna
 Classical geodesy
 Pres. Sect. II, Precise Leveling (1954–1957)
 [Bull. Geod. 1970, pp. 97–98].
- EGGERT, Otto (1874–1944)**
 Germany, Potsdam, Geodetic Institute
 Classical geodesy
 [ZfV 1944, pp. 49–54].
- EÖTVÖS, Roland, Baron von (1848–1919)**
 Hungary, Budapest, University
 Physics, Gravity
 [ZfV, 1919, p. 343].
- GAUTIER, Raoul (1854–1931)**
 Switzerland, Geneva, Observatory — Director
 Geodetic astronomy
 Pres. Reduced Geodetic Association (World War I, 1917–1922)
 Vice-Pres. I.A.G. (1922–1931)
 [Bull. Geod. 1931, pp. 60–75].

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GIGAS, Erwin (1899–1976)

Fed. Rep. Germany, Frankfurt aM., Institut für Angewandte Geodäsie
Control Surveys, Photogrammetry, Cartography
[Verlag Inst. Ang., Geod., Frankfurt aM., 1984].

GROSSMANN, Walter (1907–1980)

Fed. Rep. Germany, Hannover, Technischen Hochschule
Physical geodesy, Gravity, Ellipsoidal geodesy
Sec. Sect. IV, Gravimetry (1960–1967)
[ZfV, 1980, pp. 505–509].

HALMOS, Ferenc (1931–1980)

Hungary, Sopron, Geodetic and Geophysical Research Institute
Mathematical geodesy
Sec. Sect. IV, Theory and Evaluation (1979–1980)
[Bull. Geod. 55–1, 1981].

HAYFORD, John Fillmore (1868–1925)

U.S.A., Washington, D.C., U.S. Coast and Geodetic Survey
Evanston, Ill., Northwestern University
Physical geodesy, Astronomy, Isostasy
Reporter at I.G.A. Assemblies 1906 and 1909 – new ellipsoid
[Bull. Geod. 1925, pp. 126–128].

HEISKANEN, Weikko Aleksanteri (1895–1971)

Finland, Helsinki, Geodetic Institute
Classical geodesy, Gravity, Isostasy
Pres. Sect. V, Geoid (1957–1963)
[Bull. Geod. 1972, p. 3].

HEUVELINK, Hendrik Jan

Netherlands, Delft, Technical Institute
Classical geodesy, Instruments
Exec. Com, I.A.G. (1924–)

HIRSCH, Adolph

Switzerland
Astronomy
Gen. Sec. I.G.A. (1886–1900).

HONKASALO, Tauno Brunolf (1912–1975)

Finland, Helsinki, Geodetic Institute
Gravity
Pres. Spec. Study Group No. 21, Special Techniques of Gravity Measurements (1971–1975)
Elected Pres. Sect. III, Gravimetry (1975).
[Bull. Geod. 1976, pp. xi–xii].

HOTINE, Martin (1898–1968)

England, Tolworth, Overseas Surveys
Mathematical geodesy
Reporter – Projections (1948)
Pres. Spec. Study Group, Adjustment of Triangulation Systems (1957–1960)
[Bull. Geod. 1969, pp. 8–12].

JACQUINET, P. (1895–1966)

France, Paris, Institut Géographique National
Control surveys
Pres. Sect. I, Triangulation (1948–1954).

JOLLY, H. L. P.

England,
Control surveys
Reporter – Astronomy (1924–)

- JONES, Louis (1914–1975)
 Belgium, Bruxelles, Watermael Boitsfort
 Leveling, Crustal movement
 Pres. Com. for European Leveling Network (1971–1975)
 [Bull. Geod. 1976, pp. ii–x].
- JORDAN, Wilhelm (1842–1899)
 Germany, Hannover, Technische Hochschule
 Classical geodesy
 [ZfV, 1922, pp. 577–585].
- KING, W. F. (1884–1916)
 Canada, Ottawa, Geodetic Survey
 Dominion Geodesist
 [Bull. Geod. 1922, pp. 131–136].
- KNEISSL, Max (1907–1973)
 Fed. Rep. Germany, Munich, Geodetic Institute
 Classical geodesy
 Pres. Com. No. I, Readjustment of European Triangulation (1954–1973)
 [Bull. Geod. 1974, pp. 5–8].
- KOBOLD, Fritz (1905–1985)
 Switzerland, Zurich, Federal Institute of Technology
 Classical geodesy
 Pres. Com. No. I, Readjustment of European Triangulation (1973–1979)
 [Bull. Geod. 59–4, 1985].
- KRASOVSKII, F. N. (1878–1947)
 U.S.S.R., Moscow, Central Scientific Research Institute of Geodesy
 Classical geodesy
 [Bull. Geod. 1946, pp. 5–6].
- KRÜGER, Johannes, Heinrich, Louis (1857–1923)
 Germany,
 Geodesy, Projections
 [ZfV, 1923, pp. 281–284].
- KRZEMINSKI, Wojciech (1926–1981)
 Poland, Warsaw
 Classical geodesy
 Adjoint Sec. I.A.G. (1975–1981)
 [Bull. Geod. 55–2, 1981].
- LALLEMAND, Charles (1857–1938)
 France, Paris
 Leveling
 Pres. I.U.G.G. (1922–1933)
 [Bull. Geod. 1938, pp. 76–84].
- LEDERSTEGGER, Karl (1900–1972)
 Austria, Vienna, Technische Hochschule
 Classical geodesy
 Sec. Sect. V, Geoidal Studies (1957–1963)
 [Bull. Geod. 1973, p. 114].
- LEJAY, Pierre (1898–1958)
 France, Paris
 Physical geodesy, Gravity
 Pres. Sect. IV, Gravimetry (1948–1954)
 [Bull. Geod. 1959, pp. 2–6].

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LENOX-CONYNGHAM, Sir Gerard (1866–1956)

England, Cambridge, Trinity College
India, Survey of India (31 years)
Classical geodesy, Pendulums
Member Exec. Com. 1922–
2nd Vice-Pres. I.A.G. (1933–1936)
[Bull. Geod. 1957, pp. 78–81].

MATHER, Ronald S. (1933–1978)

Australia, Kensington, Univ. of New South Wales
Physical geodesy
Pres. Sect. V, Physical Interpretation (1975–1978)
[Bull. Geod. 52–4, 1978].

MEISSL, Peter (1934–1982)

Austria, Graz, Institut für Geodäsie, Technische Hochschule
Mathematical geodesy
Pres. Study Group 4.38, Computer techniques in geodesy (1975–1979)
[Bull. Geod. 56–3, 1982].

MESCHERIKOV, Ju (1922–1970)

U.S.S.R., Moscow, Institute of Geophysics
Physical geodesy, Crustal movement
Pres. Com, No. VII, Recent Movements of the Earth's Crust (1963–1970)

NIETHHAMMER, Theodore (1876–1947)

Switzerland, Binningen (Bale), Dir. Astro. Met. Anstalt
Classical geodesy
[Bull. Geod. 1948, pp. 189–190].

NØRLUND, N. E. (1885–)

Denmark, Copenhagen, Geodetic Institute
Classical geodesy, Mathematics
Pres. Sect. III, Astronomy (1948–1954)
Honorary Member Exec. Com, (1957–1967)

PEIRCE, Charles, Sanders (1839–1914)

U.S.A., Washington, D.C., U.S. Coast and Geodetic Survey
Mathematics, Pendulums, Philosophy
Reporter to I.G.A.
[EnBr].

RICE, Donald, A. (1909–1978)

U.S.A., Washington, D.C., U.S. Coast and Geodetic Survey
Classical geodesy, Gravity
Pres. Sect. IV, Measurement of Gravity (1960–1967)
[Bull. Geod. 52–4, 1978].

ROSS, J. Earl R. (1892–)

Canada, Ottawa, Geodetic Survey of Canada
Classical geodesy, Shoran
Pres. Study Group, Calculation of shoran Networks (1957–1960)

ROUSSILE, H. (1879–1945)

France, Paris
Hydrography, Cartography, Classical Geodesy, Photogrammetry
Reporter – Projections (1922–1933), Pres. Com, Finances (1927–1933).

RUNE, G. A. (1882–1969)

Sweden, Stockholm, Rikets Allmänna Kartverk
Control surveys
Pres. Sect. II, Leveling (1947–1951)
[Bull. Geod. 1969, p. 217].

van de SANDE BAKHUYZEN, Hendrikeus Gerardus (1838–1923)

Netherlands, Leyde, Observatory

Astronomy

Sec. Gen. I.G.A. (1900–1922)

[Bull. Geod. 1924, pp. 107–116].

SCHERMERHORN, Willem (1894–1977)

Netherlands, Delft, Geodetic Institute

International School of Photogrammetry

Classical geodesy, Photogrammetry

[ZfV, 1977, p. 280].

SELIGMANN, Henri, D' (1868–1955)

Belgium, Bruxelles, Military Geographic Institute

Control surveys

Member Exec. Com. (1924–)

[Ciel et Terre (Belg.), Vol. 71, 1955].

SOLER, Emanuele (1867–1940)

Italy, Parma, University

Classical geodesy, Gravity

Reporter — Gravity (1924–)

Vice-Pres. I.A.G. (1936–1939)

[Bull. Geod. 1938, pp. 832–834].

STOKES, Sir George, Gabriel (1819–1903)

England, Cambridge, University

Mathematics, Physics

[EnBr].

TIENSTRA, Jacob, M. (1895–1951)

Netherlands, Delft, Geodetic Institute, Tech. Univ.

Mathematical geodesy

Reporter — Triangulation, Oslo Assembly (unable to attend)

[Bull. Geod. 1951, pp. 377–380].

VÄISÄLÄ, Yrjö (1891–1971)

Finland, Helsinki, Geodetic Institute

Turku, University

Astronomy, Physics

[Bull. Geod. 1972, p. 4].

VIGNAL, Jean (1897–1969)

France, Paris, Institut Géographique National

Leveling

Pres. Sect. II, Leveling (1948–1951)

[Bull. Geod. 1969, p. 210].

ZHONGOLOVICH, Ivan, Danilovich (1892–1981)

U.S.S.R., Leningrad, Astronomical Institute

Physical geodesy

Sec. Sect. V, Geoidal Studies (1957–1960)

[Bull. Geod. 56–3, 1982].

INTERNATIONAL ASSOCIATION OF GEODESY

3. Geodesists associated with International Latitude Service

ALBRECHT, Th.
Germany, Potsdam

CARNERA, L.
Italy

WANACH, B.
Germany, Potsdam

CECCHINI, G.
Italy, Turin

MAHNKOPF, H.
Germany, Potsdam

YUMI, S.
Japan

KIMURA, H.
Japan

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INTRODUCTION TO THE STRUCTURE AND ACTIVITIES OF THE I.A.G.

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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.

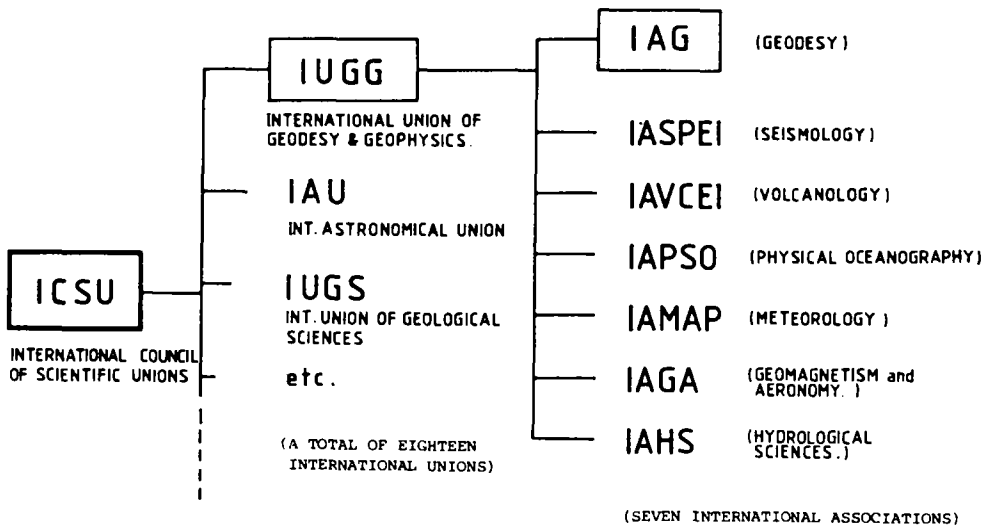


Fig. 1 – Structure—International Organizations

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 organisation 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 two other Vice Presidents, the Presidents 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 (see *Figure 2*).

For its scientific activities the Association is divided into five Sections. The present Sections, adopted at the General Assembly in 1983, are :

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

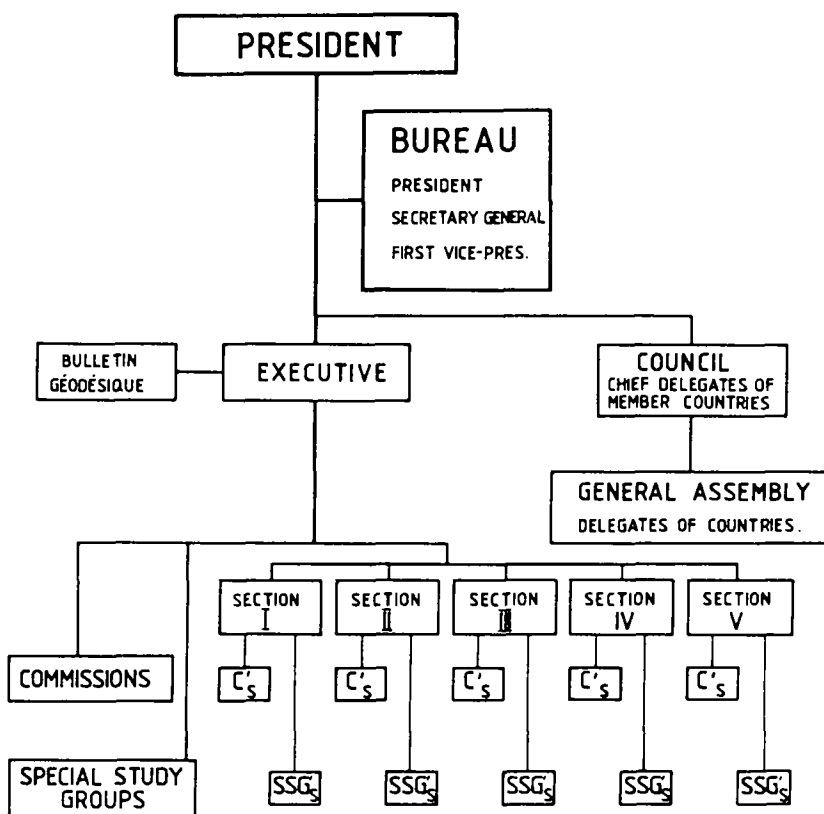


Fig. 2 -- I.A.G. Structure

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.

For more details on the structure of the Association and the function of its components, reference should be made to the Statutes and By-Laws, printed hereafter in this Handbook.

The scientific working areas of the Association are the 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 broad and long term matters. Each member country is entitled to nominate a representative to a Commission. Special Study Groups (SSG's) are established to cover topical scientific questions, with the intention that they should be intensively investigated and reported on, generally within one four-year period. Each SSG has a President and a maximum of twenty members who are specialists in the topic. In addition an SSG may have correspondents, who are kept fully informed of its activities.

The Association participates in the IUGG General Assemblies which are held every four years. At each General Assembly, besides administrative meetings, the Association is involved in the Union's interdisciplinary symposia, as well as its own program of scientific meetings.

In between General Assemblies, the Association sponsors Symposia, each of which covers the topic area of more than one SSG or Commission, while SSG's can arrange workshops in their topic areas.

The Association publishes the quarterly journal, the *Bulletin G  od  sique*, which contains scientific papers and administrative reports on the Association. The two official languages of the Association are English and French.

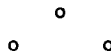
The Association has close links with FAGS (Federation of Astronomical and Geophysical Services, an agency of ICSU), which receives an annual grant from UNESCO. FAGS is responsible for a number of services which are of direct interest to geodesy such as the International Gravimetric Bureau. The Association participates in the work of numerous Inter-Association and Inter-Union bodies, such as COSPAR (Committee on Space Research).

The Association publishes the *Geodesist's Handbook* every four years. This gives full details of the activities and lists of its office-bearers.

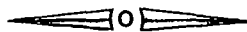
Scientists interested in participating in I.A.G. activities are welcome to attend its meetings and symposia, and to contact Presidents of Sections, Commissions or Special Study Groups covering their special areas of interest.

**UNION GEODESIQUE ET GEOPHYSIQUE INTERNATIONALE
ASSOCIATION INTERNATIONALE DE GEODESIE**

**STATUTS
ET REGLEMENT INTERIEUR**



**STATUTES
AND BY – LAWS**



Adoptés à la XVIII^e Assemblée Générale de l'U.G.G.I., Hambourg, Août 1983.

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 ;

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 et des Groupes Spéciaux d'Etudes peuvent être créés selon des formes précisées dans le Règlement Intérieur.

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

II – *Administration*

5. *L'Assemblée Générale* de l'Association est constituée par les Délégués des Pays Membres, dûment accrédités 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. 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'article 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 la décision finale.

I – STATUTES

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 ;

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 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.

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. 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 final decision.

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, les Vice—Présidents de l'Association, et les Présidents des Sections.

Les Présidents et Secrétaires Généraux honoraires de l'Association, 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 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

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 responsibilities 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 Vice-Presidents of the Association, and the Presidents of the Sections.

The Honorary Presidents and the Honorary General Secretaries of the Association, 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

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.

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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 the 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.

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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 ;
- . 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 ;

II – BY – LAWS

I – *Structure*

1. The scientific work of the International Association of Geodesy is allocated to **Sections**, the respective responsibilities 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 ;
- . 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 ;

- . 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 tels que : mouvement du pôle, rotation terrestre, marées terrestres, mouvements récents de l'écorce terrestre, variations de la pesanteur, topographie de la surface marine, y compris le niveau moyen des mers ;
- . aspects géodésiques de projets géodynamiques internationaux tels que le "Projet Lithosphère" ;
- . interprétation géophysique de la pesanteur et des données s'y rapportant.

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 des 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.

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 et des Groupes Spéciaux d'Etudes sont décidées par le Comité Exécutif qui précise également si la Commission ou le Groupe Spécial d'Etudes est placé sous l'autorité directe de l'Association ou de l'une de ses Sections.

La liste des Commissions 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

- . 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 such as : polar motion, Earth rotation, Earth tides, recent crustal movements, variations of gravity, sea–surface topography including mean–sea level ;
- . geodetic aspects of international geodynamic projects such as the Lithosphere Project ;
- . geophysical interpretation of gravity and related data.

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.

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 and of the Special Study Groups are decided by the Executive Committee which also specifies whether the 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 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

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 et le choix de leurs activités futures.

II – *Elections.*

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

Le Président en exercice désigne un Comité de Nomination formé de quatre personnes chargé de proposer au Conseil un candidat pour chacun des postes soumis à élection. Outre les propositions de ce Comité de Nomination, tout Délégué au Conseil a la possibilité de présenter d'autres candidats avant ou pendant la séance des élections.

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.

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. Le *Troisième Vice—Président* est nommé par le Conseil sur recommandation de l'Organisme adhérent du pays où aura lieu la prochaine Assemblée Générale de l'Union. Au cas où cette procédure de nomination n'est pas réalisable, le Conseil délègue cette nomination au Bureau de l'Association.

En liaison avec le Bureau Central le Troisième Vice—Président a la charge de préparer cette prochaine Assemblée Générale. Cependant, si le Président, le Premier ou le Second Vice—Président, ou le Secrétaire Général appartient à la nation invitante, il n'y a pas de Troisième Vice—Président.

11. Le *Secrétaire Général* est élu initialement pour deux périodes. Il est ensuite rééligible par périodes successives, la durée de ses mandats ne dépassant pas quatre périodes au total.

12. Ces mêmes règles (art. 11) s'appliquent aux *Secrétaires adjoints* et au *Rédacteur en Chef du Bulletin Géodésique*.

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.

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 and the influence on their future activities.

II – *Elections.*

6. Elections shall be made by the Council of the Association during the Ordinary General Assembly of the Association.

The President in office shall appoint a Nominating Committee consisting of four persons to propose to the Council a candidate for each position to be filled by election in the Council. Besides the proposals of the Nominating Committee it is possible for Council Delegates to make other nominations before or during the session where these officers are elected.

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.

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 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. The *Third Vice-President* is appointed by the Council on recommendation of the Adhering Body of the country in which the next General Assembly of the Union will take place. If this procedure is not feasible, the Council may delegate the appointment to the Bureau.

In cooperation with the Central Bureau, the Third Vice-President has special responsibility for the preparation of that General Assembly. However, if the President, or the First or the Second Vice-President, or the Secretary General belongs to the host country, no third Vice-President shall be appointed.

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

12. The same rules as in art. 11 apply to *Assistant Secretaries* and to the *Chief Editor of the Bulletin Géodésique*.

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.

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.

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. Le *Président d'une Commission* est élu par le Conseil de l'Association pour une période et est immédiatement rééligible pour une nouvelle 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 président de plus d'une Commission ou d'un Groupe Spécial d'Etudes à la fois.

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 décidé 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.

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.

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 *President of a Commission* is elected by the Council of the Association for one period and may be immediately re-elected for one further period.

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

20. A person may be the President at the same time of no more than one of the bodies covered 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.

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 son (ses) Secrétaire (s). De même, les travaux des Commissions et Groupes Spéciaux d'Etudes sont présentés par leurs Présidents.

26. L'inscription de communications scientifiques à l'ordre du jour des séances d'une Assemblée Générale est décidée par un comité constitué par les Présidents des Sections.

27. Les communications scientifiques individuelles sont reproduites par leurs 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 – Publications.

28. L'Association soutient et subventionne une revue périodique indépendante gérée par un Rédacteur en Chef élu par le Conseil de l'Association sur recommandation du Comité Exécutif. Cette revue, publiée à intervalles réguliers, est appelée *"Bulletin Géodésique"*. C'est un organe de diffusion scientifique qui vise à établir une liaison entre les géodésiens des différents pays ; il publie des contributions scientifiques originales intéressant la géodésie au sens large, des rapports et des informations sur les activités de l'Association.

Une partie des ressources nécessaires à cette publication périodique provient de la publicité et du produit des abonnements dont le tarif est fixé par le Conseil de l'Association, qui arrête en même temps le nombre d'exemplaires – au moins un – fournis gratuitement à chaque Pays Membre.

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.

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 Secretary (ies). Similarly, the work of each Commission or Special Study Group shall be reported by its President.

26. The inclusion on the agenda of scientific papers for presentation at sessions of a General Assembly is decided by a committee consisting of 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 supports and subsidizes an independent periodical managed by a Chief Editor elected by the Council of the Association on recommendation of the Executive Committee. This periodical published at regular intervals is called "*Bulletin Géodésique*". It is a scientific publication which aims at establishing contacts between geodesists of various countries; it publishes original scientific contributions of broad geodetic interest, reports and news items related to the activities of the Association.

The funds required for this periodical publication derive in part from advertising and from paid subscriptions, the rates of which are decided by the Council of the Association, which at the same time decides the number of copies, at least one, to be supplied free of charge to each Member Country.

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*".

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 le Rédacteur en Chef du Bulletin Géodésique ;

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 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 et Groupes Spéciaux d'Etudes ;

d) – nomme les Présidents des Groupes Spéciaux d'Etudes ;

e) – nomme les membres du Comité Cassinis ;

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

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 ou 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.

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 the Chief Editor of the Bulletin Géodésique ;

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, as required, to guide the Association towards the achievement of its scientific objectives ;

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

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

d) – appoint Presidents of Special Study Groups ;

e) – appoint members of the Cassinis Committee ;

f) – make recommendations to the Council on matters of general policy of the Association.

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

- a) — établit les programmes 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 Organisations 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, l'Association dispose d'un organisme permanent, le **Bureau Central**, comportant un nombre variable d'employés rétribués sur les ressources de l'Association.

Le Secrétaire Général est également assisté d'un petit nombre de **Secrétaires adjoints**, dont l'un d'eux 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.

VI — Activités des Sections, Commissions et Groupes Spéciaux d'Etudes.

38. Le **Président d'une Section** a la responsabilité du développement scientifique dans le cadre des activités de sa Section, il représente sa Section au Comité Exécutif de l'Association. Il encourage, guide et coordonne les travaux des Commissions et Groupes Spéciaux d'Etudes de sa Section, assure un échange satisfaisant de l'information, 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.

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

a) – draw up the programmes of the meetings of the Council and the 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) – act as 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 comprises 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.

VI – Activities of Sections, 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. He shall encourage, guide and coordinate the work of the Commissions and Special Study Groups within his Section, maintain a satisfactory exchange of information, 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.

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 et Groupes Spéciaux d'Etudes rattachés à sa Section, il prépare alors le rapport sur les activités de la Section. Il reçoit, coordonne et transmet au Comité Exécutif les suggestions de création de nouveaux Groupes Spéciaux d'Etudes pour la période à venir.

Le *Secrétaire de Section* assiste le Président de Section dans ses fonctions.

39. Le *Président d'une Commission ou d'un Groupe Spécial d'Etudes* a la responsabilité de promouvoir et de diriger les travaux et de recruter les membres. La répartition des membres d'un Groupe Spécial d'Etudes doit refléter une bonne coopération internationale sur le sujet d'étude et leur nombre est limité (maximum 20) pour assurer une meilleure efficacité.

40. Après chaque Assemblée Générale le Président d'une Commission ou d'un Groupe Spécial d'Etudes établit une brève description du travail à accomplir et une liste des membres, pour publication dans le Manuel du Géodésien.

Afin d'assurer les liaisons et la coopération au sein des Commissions et Groupes Spéciaux 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 des Commissions et Groupes Spéciaux d'Etudes.

42. Les rapports d'activité de chaque Commission et Groupe Spécial d'Etudes 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 et Groupes Spéciaux d'Etudes non rattachés à une Section particulière sont placés sous la responsabilité du Président de l'Association.

45. Les Présidents des Commissions et Groupes Spéciaux d'Etudes réunissent leurs membres à leur convenance. S'ils désirent organiser des symposiums scientifiques, ils doivent suivre la procédure d'approbation des symposiums prévue par l'Association. Des symposiums ne peuvent être organisés que si le sujet traité déborde du cadre d'une Commission ou d'un Groupe Spécial d'Etudes.

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 and Special Study Groups within his Section and prepare a report on the activities of the Section to be presented at the General Assembly. He shall receive, coordinate and transmit to the Executive Committee suggestions for new Special Study Groups for the forthcoming period.

The *Section Secretary* assists the Section President in his duties.

39. The *President of a Commission or a Special Study Group* is responsible for initiating and directing its work and for appointing its members. Special Study Group membership should be balanced so as to reflect international cooperation in the subject and shall be limited to a number not exceeding 20, so as to ensure maximum efficiency.

40. The President of each Commission and 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 the Commissions and Special Study Groups, 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 of Commissions and Special Study Groups.

42. The reports of each 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 President 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 and Special Study Groups not assigned to one Section shall be under the responsibility of the President of the Association.

45. 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 Commission or one Special Study Group.

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 Organismes 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 adressés 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 est publié dans le Bulletin Géodésique, il doit insister plus particulièrement sur les discussions en rapport avec la géodésie.

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. A report of these meetings should be published in the Bulletin Géodésique, in particular the discussions relating to geodesy.

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 de quatre ans et ne peuvent être réélus que 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 (par exemple : dons, fonds non utilisés à un symposium, intérêts, ...).

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.

En ce qui concerne chaque compte bancaire de l'Association, l'un des Secrétaires adjoints reçoit délégation de signature, mais seul le Secrétaire Général est responsable des opérations financières 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.

Ce budget voté par le Conseil est ensuite exécuté par le Secrétaire Général.

A l'Assemblée Générale Ordinaire suivante, le Conseil examine si les dépenses engagées sont conformes aux propositions antérieurement approuvées. Il délègue à un Comité ad hoc le soin d'effectuer ces vérifications dans le détail.

De plus, cette comptabilité, préalablement vérifiée par un comptable qualifié, est soumise au Trésorier de l'Union, ainsi qu'il est prescrit à l'article 20 du Règlement Intérieur de l'Union.

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 on those permanent bodies are made by the Executive Committee. These representatives are elected for one quadrennium and may be re-elected for not more than one further quadrennium.

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 (for instance : grants, funds remaining after a symposium, interest, ...).

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.

To each Bank Account of the Association, one of the Assistant Secretaries shall also have access, but the Secretary General alone shall be responsible for control of the financial operations of the Association.

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.

This budget voted 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 are in accordance with the proposals previously approved. It appoints an ad hoc committee for carrying out this examination in detail.

In addition, these accounts, previously audited by a qualified accountant, are reported to the Treasurer of the Union, as prescribed in Article 20 of the By-Laws of the Union.

GUY BOMFORD PRIZE FOR GEODETIC RESEARCH

**ROYAL SOCIETY'S
BRITISH NATIONAL COMMITTEE
FOR GEODESY AND GEOPHYSICS**

**INTERNATIONAL ASSOCIATION
OF GEODESY**

To mark the contributions to geodesy by **Brigadier G. Bomford**, formerly head of the Department of Surveying and Geodesy of the University of Oxford, chairman of the Geodesy Subcommittee of the Royal Society's British National Committee for Geodesy and Geophysics, and President of the International Association of Geodesy from 1963 to 1967, the I.A.G. has agreed to the inauguration of a **Guy Bomford Prize** for distinguished contributions to geodesy. The prize is awarded at intervals of four years on the occasion of the Assembly of the International Association of Geodesy during the General Assembly of the International Union of Geodesy and Geophysics.

Rules for the award of the Guy Bomford Prize

1. The **Guy Bomford Prize** is awarded by the I.A.G. and honours **Brigadier G. Bomford** formerly of the University of Oxford and a Past President of the Association. The prize is awarded normally at intervals of four years on the occasion of the Assembly of the International Association of Geodesy during the General Assembly of the International Union of Geodesy and Geophysics.

2. The **Guy Bomford Prize** is awarded to a young scientist (defined as being under 40 years of age on 31 December of the year preceding the Assembly at which the award is made) for outstanding individual contributions to geodetic studies, particularly in the four-year period preceding the General Assembly at which the award is made. Exceptionally, the prize may be shared between two or more young scientists who have been jointly responsible for a particular geodetic study.

(Hereafter, "a candidate" should be taken to refer to one or several scientists).

3. National Committees of member countries of the I.U.G.G. will each be invited by the I.A.G. Bureau to nominate a candidate (not necessarily from their own country), if they so wish.

4. The nominations must be accompanied by :

(i). The full name, address, age, academic and/or professional qualifications and position of the candidate.

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

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

(iv). A copy of up to two of the above key papers which are considered to justify candidature.

(v). The name and address of two referees who could be consulted.

(vi). The name of the National Committee making the nomination.

5. After consideration of the information in clause 4 above, the I.A.G. Bureau shall prepare a short list of candidates in order of preference which (together with the supporting documentation) shall be sent to the Geodesy Subcommittee of the Royal Society. The Geodesy Subcommittee shall be invited to indicate its view on the choice of the preferred candidate and communicate its comments to the I.A.G. Secretary General.

6. After consideration of the views of the Royal Society's Geodesy Subcommittee, the I.A.G. Bureau shall select the prize winner, and make its decision known to all National Committees of the I.U.G.G. and to the successful candidate. The Prize may be withheld if, in the opinion of the I.A.G. Bureau, there is no sufficiently qualified candidate.

7. The prize shall be presented to the successful 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, provided the I.A.G. Bureau agrees that there is a suitable opportunity for such a lecture.

8. The I.A.G., in consultation with the Geodesy Subcommittee of the Royal Society, may alter these rules from time to time if so desired.



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 occasion 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 candidate 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.



XIXth GENERAL ASSEMBLY

PRESIDENTIAL ADDRESS

P.-V. Angus – Leppan

Distinguished Colleagues and Friends, Ladies and Gentlemen,

We are fortunate to be meeting for our **XIXth** General Assembly in this City of Vancouver, on the western coast of Canada. It is a beautiful city, in beautiful surroundings, and as an Australian I appreciate its location on the Pacific Rim, a region of growing importance, in geodesy, as well as in other fields. It is appropriate that this General Assembly is being held in Canada : a young country, but one which has made important contributions to geodesy, which has consistently been in the forefront with the newest geodetic methods, and which has a strong program for helping the developing countries.

In 1979, at the General Assembly in Canberra, the President at that time, **Professor Kukkamäki**, presented a wooden gavel or hammer to the Association, as a tool for the use of the President at the meetings. So far, it has not been needed for self defence, but only to mark the passing of resolutions. It is interesting because the rounded head of the gavel has the continents carved on it, with a tiny golden stud to mark the home of each of the past IAG Presidents. I am delighted that at the end of my term the geographical range will have been extended beyond the confines of Europe and Eastern United States, and a golden stud should be added "down under".

Our Association has a venerable history, and not only predates all the other Associations, but also the IUGG, by more than 50 years. On our gavel the stud in the position of Potsdam, is the mark of the first IAG President, **General J.J. Baeyer**. It was he who proposed, in 1861, that the states of Central Europe should work together in determining the shape and size of the Earth. The King of Prussia approved the plan, and by 1862, that is, 125 years ago this year, fifteen countries had agreed to join in. A small preliminary meeting was held. The names of the fifteen foundation countries of our Association make an interesting list, as they show up dramatically the political changes which have occurred in Europe since that time : Denmark, Saxe-Gotha, The Netherlands, Russia (on behalf of Poland), Switzerland, Baden, Saxony, Italy, Austria, Sweden, Norway, Bavaria, Mecklenberg, Hannover and Belgium. And so it is that at this Assembly we can celebrate an important 125th anniversary in geodesy : we commemorate the international agreement of fifteen nations to work together in the interests of geodesy. The anniversary was also suitably celebrated in April of this year by a scientific colloquium held in Potsdam.

However, an even more momentous occasion will be in two years' time, when the IAG celebrates the 125th anniversary of the first International Geodetic Conference, held in Berlin in 1864. At this meeting the Mitteleuropäische Gradmessung — the Central European Arc Measurement — was founded. This is the body that evolved into the

International Geodetic Association, and eventually under the IUGG became the International Association of Geodesy. The constitution adopted in 1864 was the forerunner of our Statutes and By-laws of today. That anniversary will be celebrated at a general Meeting of the Association, which is to be held in August 1989, in Edinburgh, Scotland, where there will be appropriate functions and festivities.

I am very glad to welcome so many friends here. Unfortunately there are some old friends who are no longer with us. I mention some who have passed away since our last Assembly :

- **Mr. Alpha Cisse** of the Ivory Coast.
- Our dear friend **Prof. Antonio Marussi** of Italy, Honorary President of the Association.
- **Professor Fritz Kobold** of Switzerland.
- **Dr. Alan Pope** of the U.S.A.
- **Professor Antal Tarczy-Hornoch** of Hungary.
- **Professor G. Teleki** of Yugoslavia.
- **Dr. Jean Goguel** of France.
- **Professor Lars Asplund** of Sweden.
- **Professor Erik Bergstrand** of Sweden, and, most recently,
- **Professor Einar Andersen** of Denmark.

I ask you to stand for a few moments of silence to honour the memory of all those friends who have died since we met last.

Thank you.

During the past four years the level of activity in scientific geodesy has been high. As we will find during the sessions of this Assembly, there are interesting and highly significant results to report. The work in the Sections of the Association will be described by the Section Presidents. I will not pre-empt them. However, I would like to recognize the excellent work of our five Section Presidents during the four years and to thank them for their efforts : **John Bossler**, of Section I, Positioning ; **Dick Anderle**, Section II, Advanced Space Technology ; **Wolfgang Torge**, Section III, Determination of the Gravity Field ; **Erik Grafarend**, Section IV, General Theory and Methodology ; and **Heinz Kautzleben**, Section V, Geodynamics.

The scope of our meetings can be seen from the symposia which our Association is participating in. IAG will be the leading Association in three IUGG interdisciplinary symposia, "Impact of G.P.S. on Geophysics", "Variations in Earth Rotation", and "Slow Deformation and Transmission of Stress in the Earth". We will hold our own Section meetings, and as well, Inter-Section symposia on : Relativistic Effects in Geodesy, Advances in Gravity Field Modelling, and Analysis of Satellite Altimetry. And there will be Scientific Meetings covering the specialized topics, Refraction Effects in Geodesy, Advances in Gravimetric Techniques, and The Challenge of the Centimetre-Geoid.

There are some Commissions, which are not within a Section. These are Commission : **VI**, International Geodetic Bibliography, whose President is **Dr. Stange** ; **IX**, Education in Geodesy, President, **Ed. Krakiwsky** ; and **XI**, Geodesy in Africa, President **J. Abl**. These Commissions will all be holding sessions during the Assembly to present their reports and discuss programs. There is also one Special Study Group not within a Section, **SSG 0-67**, History of Geodesy. Since there will be no formal meeting

of this **SSG**, those interested in historical aspects of geodesy should make a point during the Assembly of contacting the President, **Dr. Charles Whitten**, who can describe some very interesting work undertaken by his group.

At this time the President is expected to say something about the current state of geodetic science. This is not the place for a systematic review. Instead I will make some general remarks about developments.

In theoretical geodesy the theory of the gravity field is still of absorbing interest even though its history can be traced directly from the work of Newton. The Geodetic Boundary Value Problem still exerts its fascination. There is no general solution; **Molodensky** freed it from the necessity for data on the earth's internal density, and further recent advances continue to develop the theory even closer to the form that we need : it must be rigorous and adapted to suit our practical observations. This is in the area of global gravity. We should not overlook the work in regional and local fields, dedicated to representing gravity in ever greater detail.

Another major area of theory is in estimation procedures. This used to be simply adjustments and error theory. However, nowadays the geodesist is confronted with vast numbers of observations of different types. The systems have grown so huge and so complex that new developments such as collocation have been necessary to ensure that we can calculate results which have some meaning, and that we have a reliable way of assessing the precision. Important applications such as optimization and solution of inverse problems have been developed extensively.

In geodetic theory we should not forget the great number of theoretical areas dealing with improvement of the models for our solutions. An example is atmospheric refraction. This can be seen as a problem in pure physics, or is it micrometeorology, or merely statistics ? In these studies I have noted that the geodesist often does not go back to fundamentals; for this he would need the help of the specialist in the area. Only together can they work out the best solution : interdisciplinary cooperation is not only healthy, it is essential.

The range of applications of geodetic observations is vast, and growing. I will only mention three areas : the impact of **GPS** , the Global Positioning System ; the measurement of Earth Rotation ; and continental control networks.

In geodetic positioning we have seen a revolution caused by satellite systems, particularly **GPS** . Classical triangulation/trilateration has been swept aside. The need for a control network would also have been swept aside if it were not for one characteristic of **GPS** — it measures absolute positions with only a moderate accuracy, say ± 5 m , but it is the relative accuracy that is so high. So we still need a network of points on the ground, as an absolute reference for those precise relative positions.

If position fixing becomes easy and automatic, is the geodesist necessary ? Well yes, he is; his job is not observing, but interpreting the data. Never before has the ordinary engineer, scientist or surveyor come up directly against problems of different ellipsoids, datums and projections, and the difference between geoidal and ellipsoidal heights ; in all these the geodesist's advice is essential.

In geophysics, once the **GPS** system is fully operational, the ability to determine relative positions over hundreds of kilometres, to about one part per million, will be of enormous value in local studies of crustal movement. There are factors which limit the precision of **GPS** over distances of thousands of kilometres — the orbit needs to be known more accurately, the reference frame is more critical and atmospheric

refraction becomes a problem. But these problems are being tackled, and it is only a matter of time before **GPS** can give vectors over thousands of kilometres, to about one part per million.

This will provide us with a tool of unprecedented precision and convenience for global geophysics. It should be possible to monitor relative crustal motions in great detail and to resolve the complexities of regions such as the Philippines and Papua New Guinea.

Instead of merely allowing these things to happen, perhaps the time is ripe for the IAG to take a hand and set out a plan for a Global Survey of Crustal Movements. It would be an appropriate contribution to international scientific programs such as the current Lithosphere Program.

Other techniques of precise position measurement such as **VLBI** and Laser Ranging have come of age during the period and can be used in routine measurements for Earth Rotation. The **MERIT/COTES** Project was the focus of these developments.

A Working Group set up in 1978 developed a program of international collaboration to *Monitor Earth-Rotation* and *Intercompare the Techniques* of observation and analysis (**MERIT**). The proposal was endorsed by the General Assemblies of the International Astronomical Union and the IUGG/IAG, both in 1979. The **MERIT** Short Campaign was held in 1980 as a test and the Main Campaign followed in 1983–84. The **MERIT** Campaigns showed that whereas the classical techniques could determine the polar and rotation parameters to 30 cm and 1 ms, laser ranging and **VLBI** can give an accuracy of 5 cm and 0.2 ms.

A further Working Group was established in 1983 to prepare for a new *Conventional Terrestrial Reference System* (**COTES**). The two Working Groups collaborated to organize further campaigns in 1984 and 1985. The observations were obtained from 35 countries and analyses and intercomparisons were carried out in 7 countries. As a result, a new International Earth Rotation Service has been recommended, to be based on **VLBI**, and satellite and lunar laser ranging. Thus **MERIT/COTES** has been a very successful project, involving collaboration between astronomers and geodesists, between participants from the International Astronomical Union and IAG, and between scientists of many nations.

During this same period important progress has been made in understanding the causes of variations in earth rotation. They have been shown to correlate in detail with variations in the mass distribution and angular momentum of the atmosphere.

It is interesting to note that the readjustment of the geodetic control network for the continent of North America has been completed by the US National Geodetic Survey. This was a remarkable achievement. It involved 1.8 million observations and 900,000 unknowns, to fix 270,000 points. It took 350 man-years and the adjustment used the Helmert Block method.

Another continent, Australia, earlier also readjusted its control network. This operation was remarkable for achieving results in a short time and on a shoestring budget. The observation sets were prepared by the State and Federal Government mapping agencies, which had been responsible for the observations. The adjustment was performed at the University of New South Wales by a professor with one, and occasionally, two assistants, in about three years. The Helmert Block method was also used. Only first order observations were included, so the number of points was far smaller, about 6000, but the precision achieved was similar.

XIXth GENERAL ASSEMBLY

I have only had time to touch on a few of the fields of geodesy. There are many others where excellent progress is being made.

Scientific research is the lifeblood of the Association. It is ironical then, that the committees of IAG spend so much time on administration. The objectives of the IAG are very simple : to encourage research in geodesy and assist in the dissemination of the results. So the administrative efforts are aimed at creating the optimum circumstances for scientific geodesy. In this, the Association has had some success.

In 1985 the Bureau of the IUGG decided to review the activities of each of the Associations in turn. The first two, the IAG and the International Association for Meteorology and Atmospheric Physics (**IAMAP**) , were reviewed at a meeting of the Bureau in May 1986 in Graz, Austria. Your President and Secretary General presented reports on the structure and activities of the Association. The Bureau members were very favourably impressed.

The Associations all have different structures and procedures, depending on their history and the needs of their service. The IAG has an administrative structure that mirrors that of the Union, but has its own scientific structure. For international developments, which will take some time, there are Commissions, while for the cutting edge of research there are task forces of limited size and duration : the Special Study Groups. Their maximum number of members is 20 and their duration is four years, or at the most, eight years. The IUGG Bureau was interested in the balance between stability and constant updating in this system. Also in the emphasis given by the IAG to helping developing countries, and its participation in international projects.

Over the past period the Association has investigated a number of questions which affect you, the participants in IAG activities. These include the arrangements at General Assemblies, IAG Finances, Publications and International Scientific Programs.

As a result of these investigations and the recommendations which followed, you will find that your program for this General Assembly is less crowded and has fewer overlaps than at past Assemblies. The papers in the symposia have been carefully selected, and there is a new set of guidelines which we hope will result in fewer, more effective Resolutions.

I do not want to conclude without expressing thanks for the support I have received during my term as President. First and foremost to our hard-working Secretary General, **Michel Louis**, also to our First Vice-President, **Ivan Mueller**; and to the Executive Committee, a lively but a very supportive group.

I have spoken about the successes of IAG in the scientific and the administrative spheres. I am not suggesting that we rest on our laurels. On the contrary, we should redouble our efforts towards greater successes in the future. We should continue to support the IAG efforts to optimize the conditions for science and interchange of information, and remember the special missions of IAG : to encourage geodesy in developing countries, to foster interdisciplinary efforts and to participate in international projects.

I hope that you will find this General Assembly scientifically stimulating and exciting; that you make good contacts with geodesists with similar interests; and above all that you enjoy your time here.

Ladies and Gentlemen, it is with great pleasure that I declare our General Assembly open.

RAPPORT DU SECRETAIRE GENERAL

M. Louis

Le Secrétaire Général de l'Association Internationale de Géodésie a l'honneur de présenter à la **XIX^e** Assemblée Générale le rapport qu'il a établi pour la période écoulée depuis la **XVIII^e** Assemblée Générale.

Conformément aux Statuts et Règlement Intérieur adoptés lors de cette précédente Assemblée Générale le rapport du Secrétaire Général traite des activités administratives et des finances de l'Association, la présentation des activités scientifiques revenant au Président.

I. — Activités Administratives de l'Association

Ces activités sont marquées, en dehors de la période des Assemblées Générales, par les réunions du Bureau et du Comité Exécutif où sont prises les décisions sur la conduite de la politique de l'Association et par les publications qui assurent la diffusion de l'information aussi bien scientifique qu'administrative.

1. Réunions du Comité Exécutif

Au cours de la période passée deux réunions du Comité Exécutif ont été tenues à Paris, l'une en février 1984, l'autre en mars 1986, elles ont été précédées à chaque fois par la tenue d'une réunion du Bureau.

Les comptes rendus détaillés de ces réunions ont été publiés dans le Bulletin Géodésique, Vol. 58, N° 4, et Vol. 60, N° 3.

Deux points importants méritent d'être dégagés des décisions prises au cours de ces réunions :

(i) la création de groupes de travail spécifiques pour préparer la tâche du Comité Exécutif, et

(ii) la préparation très détaillée de la prochaine Assemblée Générale.

Ainsi quatre groupes de travail spécifiques ont été créés en février 1984 (Finances, Publications, Organisation de l'Assemblée Générale de 1987, Projets Internationaux de l'AIG). Ces groupes ont remis des propositions au Comité Exécutif dès mars 1986 et certaines de ces propositions adoptées ont été immédiatement appliquées :

Groupe "Finances" : des actions sont proposées pour essayer d'accroître les revenus de l'Association (membres de soutien, services, ventes de publications, ...) en vue de financer des travaux et études à caractère scientifique. La procédure de recherche des membres de soutien est à mettre au point au cours de cette Assemblée Générale et par le nouveau Comité Exécutif qui résultera des élections.

Groupe "Publications" : l'accent est surtout mis sur la publication des *Actes des Symposiums*. Il est du devoir des organisateurs d'en assurer la publication; s'ils ne le peuvent pas, ils doivent s'adresser au Bureau Central qui les aidera. (On trouvera en **Annexe 1** la liste des Symposiums et autres réunions scientifiques organisés sous le patronage de l'AIG au cours de la récente période. Il est regrettable que, malgré des rappels, le compte rendu de certains d'entre eux n'ait encore pu être publié dans le Bulletin Géodésique et que des informations sur la publication prochaine des Actes ne puissent être données). Ces publications, de même que celles des Travaux de l'Association, doivent avoir lieu dans les six mois qui suivent les réunions où les communications sont présentées.

Le Groupe propose aussi de mener des réflexions sur la possibilité de faire assurer la publication du *Bulletin Géodésique* par une société commerciale permettant d'accroître les revenus de l'Association tout en maintenant les tarifs d'abonnement à des taux raisonnables.

Groupe "Préparation de l'Assemblée Générale de 1987" : Afin d'éviter une trop grande dispersion dans les activités au cours de l'Assemblée Générale, une sélection très sévère des Symposiums a été effectuée (nombre et durée). Des règles strictes pour la préparation, l'adoption et le suivi des Résolutions sont édictées (à noter qu'une assez longue séance pour la mise au point des résolutions est prévue le samedi 15 août, matin). Enfin les élections statutaires prévues au Conseil auront lieu dès le vendredi 14, soir, permettant aux nouveaux élus de préparer le travail pour la prochaine période dès la deuxième semaine de l'Assemblée Générale.

Groupe "Projets Internationaux de l'AIG" : A la suite du succès des projets internationaux patronnés par les groupes MERIT et COTES un nouveau Service International va être créé pour reprendre les activités du Bureau International de l'Heure (BIH) et du Service International du Mouvement du Pôle (SIMP) : rotation de la Terre, mouvements du pôle, système de référence terrestres et célestes, en les basant sur les nouvelles techniques de mesure et d'analyse. Il appartient à cette Assemblée d'approuver les propositions de ces groupes et de les faire entériner par l'UGGI.

Le projet géodésique africain par méthode Doppler (ADOS) est quasi achevé dans ses phases d'observation, de calcul et de formation : les documents présentant les premiers résultats ont été préparés par le Centre de Nairobi avec l'aide de l'Ohio State University. Ce projet a été mené à bien grâce à la collaboration des Commissions VIII et XI de l'AIG, de l'Association Africaine de Cartographie et des pays africains aidés par des pays non africains. C'est un magnifique exemple de coopération internationale, d'une part, et inter-agence, d'autre part.

Les Commissions III et XI de l'AIG envisagent maintenant un projet gravimétrique africain : des difficultés en retardent l'exécution mais l'exemple d'ADOS prouve qu'un tel projet est réalisable.

Il est hautement souhaitable que ces exemples soient suivis dans d'autres parties du monde, l'AIG est prête à aider le développement de tels projets. Il revient aux différentes Commissions (et sous-Commissions) de les susciter, de les organiser et d'en favoriser la réalisation.

2. Publications

2.1. Bulletin Géodésique

Le nombre des abonnés annuels payants se maintient au niveau de 600 – 620, un léger fléchissement est constaté en 1986 par rapport à 1985. Un effort a été fait pour aider les étudiants grâce à un tarif d'abonnement réduit, mais le nombre de ces étudiants reste faible et n'a guère fait progresser le nombre total d'abonnés. Un appel a été lancé auprès des comités nationaux pour qu'ils suscitent de nouveaux abonnements dans leurs pays. Malgré toutes ces mesures le nombre d'abonnés payants reste stationnaire et comme il ne saurait être question d'accroître les tarifs de façon exagérée, le résultat du compte financier reste déficitaire si l'on tient compte du nombre assez élevé d'exemplaires distribués gratuitement (officiels de l'AIG, comités nationaux, échanges).

Comme on l'a vu, le groupe *"Publications"* du Comité Exécutif étudie si la solution n'est pas de confier cette publication à une société privée, qui reverserait à l'Association un pourcentage de ses recettes. Mais compte tenu du coût actuel dans le domaine de l'édition il est à craindre que les tarifs d'abonnement soient alors fortement accrus. Cependant cette étude doit être poursuivie.

Lors de la dernière réunion du Comité Exécutif, mars 1986, C.C. Tscherning a été désigné comme Rédacteur en Chef provisoire, en remplacement de I.I. Mueller qui a souhaité se retirer. Cette nomination est soumise au Conseil pour approbation.

2.2. Manuel du Géodésien

Le deuxième numéro est paru après la XVIII^e Assemblée Générale, en 1984, c'est un numéro spécial du Bulletin Géodésique, B.G. Vol. 58, N° 3. Il a reçu un accueil très favorable, les renseignements qu'il apporte sur l'Association et ses activités sont très appréciés. Pour maintenir cet intérêt une mise à jour des informations est nécessaire, la contribution de chacun, et particulièrement des comités nationaux, est demandée. Une circulaire a été largement distribuée il y a plus d'un an, le nombre des réponses est encore faible : une contribution est encore possible pendant l'Assemblée Générale. Grâce à l'effort de tous, le troisième numéro du Manuel du Géodésien pourrait paraître très tôt après cette Assemblée Générale et constituer un véritable ouvrage de référence sur notre Association. Son rédacteur en chef désigné, C.C. Tscherning, attend vos suggestions et contributions.

2.3. Travaux de l'Association Internationale de Géodésie

Le Volume 27 des Travaux a été publié en 1984 sous une nouvelle forme : un seul volume, mais format réduit et reproduction photographique directe des rapports. Le coût est ainsi resté acceptable et la qualité a été jugée bonne. Cette formule sera donc reconduite pour le Volume 28 qui devrait paraître dès le début de 1988 si tous les rapports qui doivent y être inclus sont remis au Bureau Central dès que possible et sous une forme apte à fournir une bonne reproduction photographique.

2.4. Autres publications

Suivant les recommandations du Groupe *"Publications"* du Comité Exécutif on ne saurait trop insister sur la nécessité de publier les Actes des symposiums dans les délais les plus brefs après la tenue de ces manifestations.

3. *Réunions scientifiques*

3.1. *Symposiums*

La liste donnée en *Annexe 1* montre l'importance de ces réunions par les sujets traités, le nombre des réunions, l'effort pour les répartir dans le temps et l'espace afin qu'un maximum de géodésiens puisse y participer.

3.2. *Réunion Générale*

Une telle réunion à caractère scientifique s'est tenue pour la première fois au Japon en 1982. Répondant à l'invitation du Comité Britannique de Géodésie et Géophysique, le Comité Exécutif a décidé de tenir une nouvelle Réunion Générale. Elle sera organisée à Edimbourg (Ecosse) du 7 au 12 août 1989. Les grandes lignes du programme (sujets scientifiques, durée exacte, ...) seront débattues au cours de la présente Assemblée Générale.

4. *Divers*

4.1. *Changement d'adresse*

Depuis le mois de février 1986, le Bureau Central de l'AIG a quitté les locaux de la rue Gay-Lussac à Paris pour s'installer dans d'autres locaux appartenant également à l'Institut Géographique National et situés au 140, rue de Grenelle, 75700 Paris. Il est important que chacun prenne bien acte de ce changement d'adresse pour toute correspondance destinée au Bureau Central.

4.2. *Prix Bomford 1987*

Pour la quatrième fois le Prix Bomford va être attribué à l'occasion de cette Assemblée Générale à un jeune géodésien plein de talent :

P. TEUNISSEN (Pays-Bas)

La valeur des candidats à cette récompense montre bien tout l'intérêt de l'organisation de ce Prix et aussi la richesse des jeunes générations de géodésiens.

4.3. *Comité Cassinis*

Conformément à l'actuel Règlement Intérieur, la structure des Sections fixée à la XVIII^e Assemblée Générale est à revoir tous les huit ans (deux périodes) par le Comité Cassinis.

En vue des décisions à prendre à la XX^e Assemblée Générale il est nécessaire de prévoir dès à présent la désignation des membres de ce Comité.

II. — **Finances**

Le rapport financier quadriennal est résumé dans le tableau récapitulatif présenté en *Annexe 2*. Il appelle les commentaires suivants :

1. *Recettes*

La subvention annuelle de l'UGGI a continué à croître, mais la baisse récente du taux du dollar a pratiquement annulé les effets de cette croissance. Des subventions supplémentaires de l'Union ont également été accordées en 1983 et 1986 pour la participation à la XVIII^e Assemblée Générale et au Symposium sur la Géodésie en Afrique.

Au cours de cette période l'AIG a présenté régulièrement chaque année des demandes de subvention à l'ICSU; 19000 Dollars ont été ainsi obtenus pour aider la participation à certains Symposiums et pour faciliter certaines publications. Il y a là une source de revenus appréciable à exploiter à condition que les besoins exprimés entrent dans les catégories d'activités que l'ICSU souhaite voir développer, et que les aides demandées soient compatibles avec les possibilités offertes par l'ICSU et représentent une proportion convenable du financement nécessaire des projets proposés.

La vente des publications — essentiellement du Bulletin Géodésique — paraît avoir diminué par rapport à la période précédente, cela est dû au taux du dollar en moyenne plus élevé que précédemment. On doit cependant noter que les recettes de publicité ont atteint un niveau très bas malgré les efforts de la Rédaction auprès des annonceurs habituels.

2. Dépenses

En "Administration" les dépenses ont diminué en ce qui concerne le personnel, mais ont augmenté pour les achats d'équipement en raison du remplacement de la machine à écrire utilisée pour la préparation du Bulletin Géodésique acquise en 1967. Les voyages et autres dépenses pour les réunions de Comité Exécutif représentent aussi une charge assez lourde dans cette rubrique.

En "Publications" la rubrique "C.R. Assemblées" concerne la publication des "Travaux" (la publication des Actes des Symposiums de la XVIII^è Assemblée Générale a été couverte presque entièrement par les recettes de la vente et la contribution bénévole de l'Ohio State University). Les dépenses pour les "Périodiques" (le Bulletin Géodésique) restent supérieures aux recettes, cela est dû surtout à la distribution gratuite d'environ 150 exemplaires de chaque numéro du Bulletin Géodésique (comités nationaux, officiels de l'Association, échanges).

Grâce aux aides de l'UGGI et de l'ICSU et à une gestion plus rigoureuse de ses autres dépenses, l'Association a pu apporter un soutien d'environ 47000 Dollars aux organisateurs et participants de l'Assemblée Générale de 1983 et des Symposiums patronnés par l'AIG.

Sous les rubriques "Divers" (6 et 18) apparaissent les gains et pertes dus aux variations des taux de change pendant la période, la résultante étant un gain d'environ 10000 Dollars. A part les intérêts du Prix Bomford, il y a eu peu d'intérêts de placement, le seul placement intéressant était à Washington jusqu'en 1984, mais à partir de 1985 un placement sans immobilisation de fonds a été effectué à la Banque Nationale de Paris, le rapport n'est pas tout à fait négligeable.

3. Fonds Bomford

Les intérêts de ce Fonds, placé à la Banque de Washington, permettent de récompenser tous les 4 ans le lauréat du Prix Bomford. Le bilan du Fonds a été le suivant :

	U.S. \$
a) Réserves au 1.1.1983	: 1 645.04
Intérêts pendant la période 83—86	: 579.15
Total	2 224.19
b) Remise du Prix Bomford 1983	: 350.00
Réserves au 31.12.1986	: 1 874.19
Total	2 224.19

La valeur importante des intérêts pendant cette période permet d'accroître très notablement la valeur du Prix pour 1987, un chèque de **550 Dollars** est donc remis au lauréat.

4. Prévisions pour la période 1987 – 1990 (voir *Annexe 3*)

Bien que des recettes supplémentaires soient possibles les prévisions de recettes et dépenses restent très voisines du constat de la période précédente. Les incertitudes sur le taux du dollar et le niveau des recettes ne provenant pas de l'UGGI incitent à une certaine prudence. Cependant tous les efforts seront faits pour obtenir ces recettes supplémentaires (ICSU, UNESCO, vente de publications, cotisations de membres de soutien, ...) afin d'aider au maximum le développement de la géodésie dans toutes les régions du monde.

Annexe 1

Symposia and Workshops sponsored by the I.A.G.

Year 1984 :

- . ***Recent Crustal Movements of the Pacific Region*** (International Symposium), Wellington, New Zealand, **9–14 February**.
Report in B.G. 58–4.
Proceedings : Bulletin of the Royal Society of New Zealand
Private Bag
Wellington, New Zealand.
- . ***Optimization and Design of Geodetic Networks*** (International School of Advanced Geodesy), Erice, Italy, **April 25 – May 10**.
Report in B.G. 59–1.
Proceedings : E. Grafarend and F. Sansò, Editors
published by :
Springer – Verlag, Berlin, Heidelberg, New York, Tokyo.
- . ***Space Techniques for Geodynamics*** (First International Symposium), Sopron, Hungary, **9–13 July**.
Report in B.G. 59–1.
Proceedings : J. Somogyi and Ch. Reigber, Editors.
- . ***Local Gravity Field Approximation*** (International Summer School), Beijing, China, **August 21 – September 4**.
Report in B.G. 59–1.
Proceedings : Division of Surveying Engineering
BSS – Proceedings, University of Calgary
Calgary, Alberta, T2N 1N4 Canada.
- . ***Laser Ranging Instrumentation*** (International Workshop), Herstmonceux, England, **10–14 September**.

- . *Geodesy and Physics of the Earth* (5th International Symposium), Magdeburg, G.D.R., **23–29 September**.
Report in B.G. 59–3.
Proceedings : Veröffentlichungen des Zentralinstitute für Physik der Erde
Telegrafenberg A 17
DDR – 1500 Potsdam.
- . *Recent Crustal Movements in Africa* (2nd International Symposium), Cairo, Egypt, **November 26 – December 3**.
Report in B.G. 59–2.
Proceedings : in preparation (CRCM).
- . IAG represented at the :
United Nations International Meetings of Experts on Remote Sensing Information Systems, Feldafing, FRG, **7–11 May**.

Year 1985 :

- . *Recent Crustal Movements in Central and South America* (International Symposium), Maracaibo, Venezuela, **10–16 February**.
Report in B.G. 60–2.
Proceedings : Special issue of Tectonophysics.
- . *African Doppler Survey (ADOS) Training Seminar*, Nairobi, Kenya, **11–22 February**.
Report in B.G. 59–3.
- . *Séminaire de Géodésie Spatiale*, Yamoussoukro, Côte d'Ivoire, **4–17 Mars**.
Report in B.G. 59–3.
- . *Precise Positioning with the Global Positioning System* (First International Symposium), Rockville, U.S.A., **15–19 April**.
Report in B.G. 59–3.
Proceedings published by : **NOAA**
National Geodetic Information Center
N/CG 17 x 2, Rockville, Md. 20852, USA.
- . *North American Vertical Datum* (Third International Symposium – NAVD Symposium 85), Rockville, U.S.A., **21–26 April**.
Report in B.G. 61–2.
Proceedings published by : **NOAA**
National Geodetic Information Center
N/CG 17 x 2, Rockville, Md. 20852, USA.
- . *Density Distribution of the Lithosphere : Static and Dynamic Models* (International Workshop), Zurich, Switzerland, **28–31 May**.
Report in B.G. 60–2.
Proceedings : Report N° 102
of the Institute of Geodesy and Photogrammetry
HPV G 53
ETH Hönggerberg – 8093 Zurich, Switzerland.

- . ***Mathematical Geodesy*** (International Symposium — First Hotine Marussi Symposium), Roma, Italy, **3–6 June**.
Report in B.G. 61–1.
Proceedings published by : Istituto di Topografia, Fotogrammetria e Geofisica
Politecnico di Milano
Piazza Leonardo da Vinci, 32
20133 Milano, Italy.
- . ***Educating Surveying and Mapping Professionals for the Year 2000*** (Joint Colloquium on Surveying and Mapping Education, with FIG, ICA and ISPRS).
Fredericton, Canada, **12–14 June**.
Report in B.G. 60–1.
Proceedings published by : Department of Surveying Engineering
University of New Brunswick, P.O. Box 4400
Fredericton, N.B. E3B 5A3 Canada.
- . ***Geodetic Computations*** (7th International Symposium), Cracow, Poland, **18–21 June**.
Report in B.G. 60–2.
Proceedings published by : Institute of Geodesy and Cartography
ul. Jasna 2–4, 00950 Warszawa, Poland.
- . ***Absolute Gravity Measurements*** (Second International Comparison), Sèvres, France, **24 June – 10 July**.
Report in B.G. 61–1.
Detailed account in : Bulletin d'Information du BGI (n° 57–59)
18, Avenue Edouard Belin
31055 Toulouse Cedex, France.
- . ***Gravimetric Workshop***, Paris, France, **2–3 July**.
Report in B.G. 61–2.
Detailed account in : Bulletin d'Information du BGI (n° 57)
18, Avenue Edouard Belin
31055 Toulouse Cedex, France.
- . ***On the Rotation of the Earth and the Terrestrial Reference System*** (Joint workshop of the IAU/IUGG working groups MERIT and COTES), Columbus, U.S.A., **July 30 – August 3**.
Detailed report in B.G. 60–1.
- . ***Inertial Technology for Surveying and Geodesy*** (Third International Symposium), Banff, Canada, **16–20 September**.
Report in B.G. 60–2.
Proceedings published by : Division of Surveying Engineering
University of Calgary
2500 University Drive N.W.
Calgary, Alberta T2N 1N4, Canada.

- . *Earth Tides* (Xth International Symposium), Madrid, Spain, **23–28 September**.

Report in B.G. 61–2.

Proceedings published by : Consejo Superior de Investigaciones Cientificas

available at : Instituto de Astronomia y Geodesia
Facultad de Ciencias Matematicas
Ciudad Universitaria
28040 Madrid, Spain.

- . *Commission on Recent Crustal Movements* (International Symposium), Budapest, Hungary, **1–5 October**.

Report in B.G. 60–2.

Proceedings : Journal of Geodynamics.

Year 1986 :

- . *Neo-Tectonics of South Asia* (International Symposium), Dehra Dun, India, **18–21 February**.

Report in B.G. 61–1.

Proceedings : under process

Geodetic and Research Branch
P.B. 77, Survey of India
Dehra Dun, India.

- . *Geodesy in Africa* (Third International Symposium), Yamoussoukro, Côte d'Ivoire, **10–17 April**.

Report in B.G. 61–1.

Proceedings : under process

Commission Géodésie en Afrique
c/o IGCI, B.P. 3862
Abidjan 01, Côte d'Ivoire.

- . *Satellite Positioning* (Fourth International Symposium), Austin, U.S.A., **28 April – 2 May**.

Report in B.G. 61–3.

Proceedings published by : The University of Texas (ARL)

P.O. Box 8029
Austin, Texas 78713–8029, U.S.A.

- . *Definition of the Geoid* (International Symposium), Florence, Italy, **26–30 May**.

Report in B.G. 61–1.

Proceedings published by : Istituto Geografico Militare Italiano
Firenze, Italy.

- . *Applications of Space Techniques for Geodesy and Geodynamics* (Joint International Symposium with COSPAR), Toulouse, France, **30 June – 3 July**.

Report in B.G. 61–3.

Proceedings in : Advances in Space Research (Vol. 6, N° 9).
Pergamon Press.

- . *Mathematical and Numerical Techniques in Physical Geodesy* (Fourth International Summer School in the Mountains), Admont, Austria, **25 August – 5 September**.
Report in B.G. 60–4.
Proceedings in : Lecture Notes in Earth Sciences , Springer – Verlag.
- . *Recent Crustal Movements* (7th International Symposium), Talinn, U.S.S.R. **8–13 September**.
Report in B.G. 61–3.
Proceedings under process (CRCM) .
- . *Height Determination and Recent Crustal Movements* (Symposium), Hannover, FRG, **15–19 September**.
Report in B.G. 61–2.
Proceedings in : Determination of Heights and Height Changes
Dümmer – Verlag, Bonn, 1987.
- . *Figure and Dynamics of the Earth, Moon and Planets* (International Symposium), Prague, Czechoslovakia, **15–20 September**.
Report in B.G. 61–1.
Proceedings published by : Astronomical Institute of the Czechoslovak Academy
and Research Institute of Geodesy, Topography
and Cartography
250 66 Zdiby 98, Prague-East, Czechoslovakia.
- . *Combined Adjustment of Heterogeneous Geodetic and Photogrammetric Data* (Joint Workshop with ISPRS), Munich, F.R.G., **22–24 September**.
Report in B.G. 61–3.
Minutes edited by H. Ebner, D. Fritsch and G. Hein.
- . *International Gravimetric Commission* (12th Meeting) , Toulouse , France , **23–26 September**.
Report in B.G. 61–1.
Proceedings in : Bulletin d'Information du BGI (N° 59).
- . *Laser Ranging Instrumentation* (6th International Symposium), Juan-les-Pins, France, **22–26 September**.
Report in B.G. 62–1.
Proceedings published by : J. Gaignebet and F. Beaumont
GRGS/CERGA, Av. Copernic, 06130 Grasse (France)
- . *Marine Positioning* (International Symposium – INSMAP 86), Reston, U.S.A., **14–17 October**.
Report in B.G. 61–3.
Proceedings available from : Marine Technology Society
2000 Florida Avenue NW
Washington, D.C. 20009, U.S.A.
- . *Earth's Rotation and Reference Frames for Geodesy and Geodynamics* (IAG/IAU Symposium 128), Washington, U.S.A., **20–24 October**.
Report in B.G. 61–1.
Proceedings published by : D. Reidel, Feb. 1988

INTERNATIONAL ASSOCIATION OF GEODESY
Financial Report for the Period : 1983 - 1986 (*)
Amounts in US dollars, Exchange rate 1 U.S. \$ = 6.44 FF.

RECEIPTS		GRANTS & CONTRACTS		EXPENDITURES		GRANTS & CONTRACTS	
	I.U.G.G.					I.U.G.G.	
15 I.U.G.G. ALLOCATION	100 800.00			11 ADMINISTRATION		23 892.89	
2 UNESCO GRANTS	-			11.1 Personnel		-	
3 OTHER GRANTS (IUGG, ICSU, COSPAR)	6 450.00	19 000.00		11.2 Quarters (rents and services)		7 712.72	
4 CONTRACTS WITH UNESCO, etc	-	-		11.3 Supplies and Equipment		1 848.95	
5 SALES OF PUBLICATIONS	87 687.26	-		11.4 Communications		9 448.43	
6 MISCELLANEOUS	24 517.69 ^(*)	-		11.5 Travel (administrative only)		1 409.50	
7 TOTAL RECEIPTS	219 454.85	19 000.00		11.6 Miscellaneous		-	
8 CASH ON HAND AND IN BANKS	23 238.71	3 444.38		12 PUBLICATIONS		8 005.44	1 000.00
(Jan. 1, 1983)				12.1 Proceedings of Assemblies		53.85	
9 INVESTMENTS & RESERVES	42.71	-		12.2 Proceedings of Symposia		103 603.40	
(Jan. 1, 1983)				12.3 Periodicals		105.30	
10 TOTAL	242 736.27	22 444.38		12.4 Others		-	
				13 ASSEMBLIES		1 069.98	
				13.1 Organization		5 672.56	3 444.38
				13.2 Travel		-	
				14 SYMPOSIA & SCIENTIFIC MEETINGS		5 167.55	15 500.00
				14.1 Organization		16 005.40	
				14.2 Travel		1 864.21	
				16 GRANTS (Permanent Services, etc.)		-	
				17 CONTRACTS WITH UNESCO, etc		-	
				18 MISCELLANEOUS		14 239.80 ^(*)	-
				19 TOTAL EXPENDITURES		200 099.98	19 944.38
				20 CASH ON HAND AND IN BANKS		31 822.61	2 500.00
				(Dec. 31, 1986)		-	
				21 INVESTMENTS & RESERVES		10 813.68	-
				(Dec. 31, 1986)		-	
				22 TOTAL		242 736.27	22 444.38

(*) : excluding Bomford Fund

(°) : gain and loss due to the variable exchange rate of the US \$ are included here (see annual notes to the Treasurer).

January - 1 - 1983 December - 31 - 1986

24 ACCOUNTS RECEIVABLE

2 500.00

25 ACCOUNTS PAYABLE

INTERNATIONAL ASSOCIATION OF GEODESY
Estimate of Income and Expense for the Period 1987 – 1990
Amounts in US dollars, Exchange rate 1 U.S. \$ = 8.0 FF.

RECEIPTS		EXPENDITURES		GRANTS & CONTRACTS	
	I.U.G.G.			I.U.G.G.	GRANTS & CONTRACTS
15 I.U.G.G. ALLOCATION	105 000	11 ADMINISTRATION		40 000	
2 UNESCO GRANTS		12 PUBLICATIONS		120 000	
3 OTHER GRANTS	5 000	13 ASSEMBLIES		25 000	
4 CONTRACTS WITH UNESCO, etc		14 SYMPOSIA & SCIENTIFIC MEETINGS		30 000	10 000
5 SALES OF PUBLICATIONS	100 000	16 GRANTS (<i>Permanent Services, etc.</i>)		5 000	
6 MISCELLANEOUS	5 000	17 CONTRACTS WITH UNESCO, etc			
7 TOTAL RECEIPTS	215 000	18 MISCELLANEOUS		5 000	
8 CASH ON HAND AND IN BANKS (Jan. 1, 1987)	30 000	19 TOTAL EXPENDITURES		225 000	10 000
9 INVESTMENTS & RESERVES (Jan. 1, 1987)	10 000	20 CASH ON HAND AND IN BANKS (Dec. 31, 1990)		20 000	
10 TOTAL	255 000	21 INVESTMENTS & RESERVES (Dec. 31, 1990)		10 000	
		22 TOTAL		255 000	10 000

Association Internationale de Geodésie

XIX^{ème} Assemblée Générale (Vancouver, 10–22 août 1987)

COMPTE RENDU des REUNIONS

du Comité Exécutif
du Conseil
de l'Assemblée Générale

Pendant cette Assemblée Générale,

- . le **Comité Exécutif** s'est réuni les **10, 11, 13, 17, 18 et 20 août**, dans sa formation ancienne, et le nouveau Comité s'est réuni le **20 août**,
- . le **Conseil** s'est réuni les **12, 14 (elections) et 19 août**,
- . et l' **Assemblée Générale** a tenu sa séance d'ouverture le **10 août** et celle de clôture le **20 août**.

Tous les membres du Comité Exécutif ayant droit de vote ont siégé à chaque séance du C.E., ainsi que tous les secrétaires des Sections et deux secrétaires-adjoints de l'A.I.G. (C. Boucher et J. Krynski).

Aux séances du Conseil 43 pays étaient représentés : Afrique du Sud (D.P.M. Rousseau), Allemagne (Rep. Dem.) (L. Stange), Allemagne (Rép. Féd.) (E. Grafarend), Argentine (E. Pallega), Australie (A. Stolz), Autriche (K. Bretterbauer), Belgique (P. Pâquet), Bulgarie (N. Georgiev), Burundi (C. Murigande), Canada (D.E. Wells), Chili (J.L. Tapia-Castillo), Chine (Rép. Pop.) (J.Y. Chen), Corée (Rép.) (B.M. Yeu), Côte d'Ivoire (J. Abla), Danemark (O.B. Andersen), Egypte (A.A. Tealeb), Etats-Unis d'Am. (R.H. Rapp), Finlande (J. Kakkuri), France (A. Comolet-Tirman), Grande Bretagne (Royaume Uni) (V. Ashkenazi), Grèce (G. Veis), Hongrie (I. Joò), Inde (C.S. Joshi), Indonésie (J. Rais), Italie (C. Morelli), Japon (I. Nakagawa), Kenya (J.D. Obel), Libye (M. Unis), Luxembourg (J. Flick), Maroc (L. Tikdirine), Nigéria (O. Coker), Norvège (S. Bakkelid), Nouvelle-Zélande (B.M. Jones), Pays-Bas (R. Rummel), Pologne (B. Ney), Portugal (J.M. Agria Torres), Suède (B.G. Reit), Suisse (H.-G. Kahle), Tchécoslovaquie (M. Burša), Thaïlande (T. Udomsorayuth), Tunisie (M. Charfi), U.R.S.S. (Y.D. Boulanger), Vénézuéla (H. Henneberg).

Des représentants du Brésil, de l'Espagne, de la Malaisie, des Philippines, du Soudan et du Zimbabwe ont également pris part aux séances scientifiques pendant l'Assemblée Générale.

Questions débattues et décisions prises au cours de cette Assemblée Générale

1. Finances

1.1. Approbation du rapport financier

Le rapport financier pour la période 1983–1986 présenté par le Secrétaire Général au cours de la séance d'ouverture de l'Assemblée générale fut examiné par le comité de vérification (audit committee) désigné par l'assemblée. Le rapport ci-après soumis par ce Comité au Conseil a été approuvé à l'unanimité.

“ **Report of the Audit Committee of the Council of the IAG**

At its first session, the Council of the IAG elected the following Committee to audit the accounts of the Association from 1983 to 1986 :

E. Gubler
B. Ney (Chairman)
W.G. Qiu

The Audit Committee met twice, made sample checks of the accounts in considerable depth, and makes the following comments :

a) The accounts are very complete, easy to follow and, in general, very clear. A few queries which arose were clarified by M. Louis.

b) The major receipts of the IAG arise from the IUGG allocation (about 101,000 US\$) and from the sales of publications (about 88,000 US\$). The major expenditure arises from the cost of publications (about 104,000 US\$).

c) The balance between total receipts and expenditure is positive, namely 18,639.64 US\$ for the period 1983–1986, compared with a deficit of 23,371 US\$ for 1979–1983.

d) Estimates of Income and Expenditure prepared for the period 1983–1986 were followed, and those for the period 1987–1990 are realistically prepared.

e) The Audit Committee notes, that the Receipts for the IAG could be increased by special contracts, namely, with UNESCO. These contracts could be prepared and proposed by the Sections and Commissions of the IAG.

f) The IAG should be grateful to the Institut Geographique National of France for providing the accommodation for the IAG Bureau free of rent, and free access to telephone and telex facilities.

The Audit Committee recommends to the Council that the Executive Committee of the IAG urgently examines new ways and means to increase the income of the Association and that appreciation be expressed to the Bureau of the IAG for its excellent work in endeavouring to improve the financial situation.

E. Gubler

B. Ney (Chairman)

W.G. Qiu

Vancouver, August 19, 1987.

”

1.2. Sources de financement

Le financement des activités de l'A.I.G. est assuré par la subvention de l'UGGI, la vente des publications (Bulletin Géodésique, Travaux, Geodesist's Handbook), ainsi que par des subventions exceptionnelles de l'UGGI et de l'ICSU pour aider certains projets scientifiques.

Dans ce dernier domaine l'AIG se doit de faire plus, notamment pour les jeunes scientifiques, et pour accroître les activités de recherche et aussi celles dans les pays en développement. Dans son allocution de remerciement au Conseil, après son élection au poste de Président, I.I. Mueller a mis l'accent sur la nécessité d'accroître la recherche en cette période de forte évolution technologique et de réduire simultanément

le "fossé" entre les pays en développement et les pays développés. Pour tout cela il faut des moyens notamment financiers. Un comité a donc été créé pour explorer les possibilités d'alimenter un *Fonds de Recherche de l'AIG* destiné à promouvoir la recherche en géodésie et les activités géodésiques dans les pays en développement. Ce comité composé de représentants régionaux (Bossler, Mueller et Schwarz : Amérique du Nord, Nakagawa : Asie du Nord-Est, Angus-Leppan : Asie du Sud-Est, Torge : Europe de l'Ouest et Kautzleben : Europe de l'Est) identifiera les sources possibles de financement et rendra compte de ses approches à la prochaine réunion du Comité Exécutif.

2. Prix Bomford

Pour la quatrième fois le Prix Bomford destiné à récompenser les travaux d'un jeune géodésien a été décerné à l'occasion d'une Assemblée Générale. Le lauréat 1987 est : Dr. P.J. Teunissen (Pays-Bas), qui, après réception de son prix des mains du Président de l'AIG, P.-V. Angus-Leppan, et du représentant du National Geodetic Subcommittee of the Royal Society, V. Ashkenazi, a bien voulu faire une brève présentation des études qui lui ont valu cette récompense :

"Mr. President, Ladies and Gentlemen,

I consider it as an extremely great honour to be awarded the prestigious Brigadier Guy Bomford Prize for 1987 and I am really very thankful for it. The Prize is awarded in recognition of my scientific contributions in geodesy, but as you surely will realize scientific work is very seldom personifiable. I consider the prize therefore also a credit to my masters, who taught me, guided me and criticized me. And I can assure you I had many masters ! Especially in the field on non-linear estimation, one of my fields of interest in the last couple of years, I was profoundly influenced by the work of Prof. Willem Baarda, Prof. Erik Grafarend and Dr. Torben Krarup. It was through my discussions with them, that I became convinced that a general theoretical and practical investigation of non-linear adjustment was needed. Because of time restrictions I have to refrain from giving you a sketch of the really exciting geometric theory of non-linear adjustment. Let me therefore give you instead my motivation for studying the geometry of non-linear adjustment in the hope that it makes one more susceptible to its intrinsic difficulties and also of course to make some propaganda for it.

One may ask why study non-linear adjustment ? As you are aware we use in our geodetic adjustments predominantly the ideas, concepts and results from the theory of linear estimation. But how often are our geodetic models truly linear ? Indeed, almost never. Essential properties which are used repeatedly in the development of the linear theory break down completely in the non-linear case. Think for instance of the well-known Gauss-Markov theorem which probabilistically justifies linear least squares. It formulates a lot of "ifs" before it states why least-squares should be used. The first "if" however, which calls for the manifold to be linear, already breaks down in case of non-linearity. Also the well-known distributional properties which hold true for linear models do not carry over to the non-linear case. Moreover, we can hardly expect our estimators to be unbiased in general, since the mean of the image of a non-linear map differs from the image of the mean. Of course one may argue that probably most non-linear models are only moderately non-linear and thus permit the use of a linear or linearized model. This is true. It does however in no way release us from the obligation of really proving whether a linear or linearized model is sufficient as approximation. What we need therefore is knowledge and understanding of how non-linearity manifests itself at the various stages of an adjustment. This deeper understanding is in my opinion rendered possible in a general and simple way through the use of geometry, in particular differential geometry.

Geometry enters if we consider the mathematical model, being a set of probability distributions to which we believe the true distribution belongs, as a smooth subset or manifold of all possible regular probability distributions. Then in order to evaluate statistical inference procedures, it is important to know what *part* the model occupies in the entire set of probability distributions and what *shape* the model has in the entire set. Usually the theory of non-linear adjustment is constructed through the tangentspace approach. However, the tangentspace only accounts for local properties of the model. In order to elucidate larger-scale properties one needs to introduce mutual relations between different tangentspaces at different points. It is here where in my opinion the true power of

contemporary differential geometry enters and where differential geometric concepts like metric, distance, connection, covariant differentiation, curvature, parallel transport, geodesics, etc., can be used to our benefit.

In order to give you some idea of how the differential geometric concepts come about in some of the results of non-linear adjustment, let me give you some examples. One can show that the rate of convergence of Gauss' iteration method is determined by the in absolute value largest extrinsic curvature; that the bias in the estimator of the random vector of observables is determined by the unique mean curvature vector; that, on the other hand, the bias in the parameter estimators is determined by the weighted trace of the Christoffel symbols of the second kind; that so-called line-search strategies are only needed if the curvature range is large; and that in some cases of so-called ruled manifolds, for instance in what I call the Symmetric Helmer transformation with a rotational invariant covariance structure, exact non-linear inversion free solutions can be formulated.

Of course there are in the field of non-linear adjustment still many topics open for future research and it will probably take some time before we understand non-linear adjustment as well as we understand linear adjustment. Let me therefore conclude by expressing the wish that the rather unsurveyed area of non-linear adjustment and statistical inference will receive more attention than it has received hitherto.

I thank you very much."

3. Médaille Levallois

Cette médaille est destinée à rendre hommage à ceux qui, comme J.J. Levallois, ont oeuvré pour le renom de notre association et ont rendu d'éminents services à la géodésie.

Dans cet esprit, des règles pour le choix des futurs lauréats ont été préparées par P.V. Angus-Leppan, en consultation avec le Bureau et les précédents lauréats de cette médaille. Le Comité Exécutif a approuvé ces règles et a désigné le Prof. A. Bjerhammar comme lauréat 1987 de la Médaille Levallois. La médaille lui sera remise à l'occasion du General Meeting de l'AIG en 1989.

4. Commissions, Groupes Spéciaux d'Etudes, Services Internationaux

Le Comité Exécutif a examiné les différentes propositions concernant le maintien, la suppression ou la création de Commissions, Groupes Spéciaux d'Etudes et Services Internationaux.

Commissions : Les Commissions existantes (III, V, VI, VII, VIII, IX, X, XI) sont maintenues avec possibilité de changement de certaines sous-commissions.

— Sur proposition de la Section III, la création d'une nouvelle Commission sur le Géoïde est discutée par le Comité Exécutif. Il y a unanimité pour reconnaître que les travaux nécessités par la connaissance précise du géoïde correspondent mieux aux objectifs d'une commission qu'à ceux d'un groupe spécial d'études (coopération et organisation internationales, problème de longue durée à l'échelle globale). Mais ne peut-on inclure ces travaux dans le champ des activités de la Commission III (Commission gravimétrique internationale), en créant une sous-commission par exemple? La spécificité du sujet paraît telle aux yeux de certains qu'une nouvelle commission est nécessaire pour plus de clarté et d'efficacité dans cette tâche. Finalement un vote majoritaire amène le Comité Exécutif à créer cette commission sous le nom de "Commission Internationale sur le Géoïde — International Geoid Commission" (Commission XII).

— Les activités de la Commission VI paraissent devoir être étendues dans deux directions, informations géodésiques et standards, d'une part, collaboration avec les

organisations-soeurs (FIG, ISPRS, ICA, ...) , d'autre part. Il est recommandé de soumettre ces idées au prochain Comité Cassinis.

— Il est demandé à la Commission X de réactiver la sous-commission pour l'Amérique du Sud en liaison avec l'Institut Pan-Américain pour la Géographie et l'Histoire (PAIGH).

Groupes Spéciaux d'Etudes. (voir détails plus loin).

Section I.

suppression des G.S.E. 1.59, 1.72, 1.74, 1.75, 1.76 et 1.78.

maintien des G.S.E. 1.73, 1.77 et 1.79.

création des G.S.E. 1.101, 1.102, 1.103, 1.104 et 1.105.

Section II.

suppression des G.S.E. 2.80, 2.81, 2.82, 2.83 et 2.84.

maintien du G.S.E. 2.54.

création des G.S.E. 2.106, 2.107, 2.108 et 2.109.

Section III.

suppression des G.S.E. 3.85, 3.86, 3.87, 3.88, 3.89 et 3.90.

création des G.S.E. 3.110, 3.111, 3.112 et 3.113.

Section IV.

suppression des G.S.E. 4.56, 4.57, 4.60, 4.66, 4.71, 4.94, 4.95 et 4.96.

maintien des G.S.E. 4.91, 4.92 et 4.93.

création des G.S.E. 4.115, 4.116, 4.117, 4.118, 4.119 et 4.120.

Section V.

suppression du G.S.E. 5.97.

maintien des G.S.E. 5.98, 5.99 et 5.100.

création des G.S.E. 5.121, 5.122, 5.123 et 5.124.

Le G.S.E. 5.99 (Tidal Friction and the Earth's Rotation) sera le groupe de liaison avec le Comité de l'Union : Study of the Earth's Deep Interior (**SEDI**).

Le G.S.E. 5.98 (Atmospheric Excitation of the Earth's Rotation) constituera un groupe de travail permanent pour l'International Earth Rotation Service (**IERS**).

Le G.S.E. 5.124 (Transmission of Stress and Geodynamic Implications) sera le groupe de liaison avec la commission inter-union sur la Lithosphère (**ICL**).

Le G.S.E. 5.100 (Parameters of Common Relevance of Astronomy, Geodesy and Geodynamics) ayant une tâche permanente, doit-il rester simple groupe d'études ? Comment pourrait-il évoluer ? La question devra être tranchée par le futur Comité Cassinis.

Hors Section

Le G.S.E. 0.67 est maintenu.

Services Internationaux

Sont maintenus : Le Bureau gravimétrique international (en Section III), le Centre International des Marées Terrestres et le Centre International des Mouvements Récents de l'Ecorce terrestre (en Section V). Le Service Permanent du Niveau moyen des mers continuera à être en liaison avec la Section V.

Conformément aux décisions prises par le Comité Exécutif en mars 1986 et à la résolution n° 1 de l'UGGI à cette Assemblée Générale, le Bureau International de l'Heure et le Service International du Mouvement des Pôles seront remplacés à compter du 1^{er} janvier 1988 par un nouveau et unique service, le Service International de la Rotation de la Terre. Ce service sera affilié à **FAGS**, comme le sont le **BGI**, l'**ICET** et le **PSMSL**. L'idée de créer un groupe spécial de liaison entre ce Service et l'AIG n'est pas retenue; le représentant de l'UGGI au Comité directeur du service, désigné sur proposition de l'AIG, assurera la liaison avec le Bureau de l'AIG à qui il rendra compte des travaux du Comité directeur. Ces informations seront transmises aux Sections II et V. Les activités du Service seront présentées à chaque Assemblée Générale ordinaire dans le cadre de la Section V.

5. Elections

Afin de laisser la possibilité aux nouveaux élus de prendre les contacts nécessaires, pendant l'Assemblée Générale, pour démarrer leurs nouvelles activités de manière concertée et efficace, le Comité Exécutif avait décidé d'organiser les élections dès la fin de la première semaine de l'Assemblée Générale. Elles ont donc eu lieu au Conseil le vendredi 14 août en soirée. Certains membres du Conseil se sont plaint de ne connaître la liste proposée par le Comité de Nomination que trop tardivement. Ce problème devra aussi être examiné par le Comité Cassinis.

Le résultat des élections est conforme à la liste de candidats présentés par le Comité de Nomination (voir Structure de l'AIG).

6. Nomination de représentants de l'AIG

- . au comité inter-association : "Mathematical Geophysics" : **F. Sansò** (Italie).
- . représentant de l'UGGI au Comité Directeur du Service International de la Rotation de la Terre, proposition de l'AIG : **K. Yokoyama** (Japon).

7. Résolutions

Conformément à la décision prise par le Comité Exécutif le nombre de Résolutions passées par l'AIG a été limité à 6, celles proposées pour adoption par l'UGGI étant au nombre de 4 (voir les textes ci-après). De plus chaque résolution est proposée et suivie par un responsable qui s'assure qu'elle atteint bien le(s) destinataire(s) et qu'elle est suivie d'effet. Ces responsables sont pour les résolutions passées par l'AIG :

1. format pour les données **GPS** : Commission **VIII**
2. comparaison des gravimètres absolus au **BIPM** : **Y. Boulanger, J.-G. Tanner**
3. projet gravimétrique en Amérique du Sud : Commission **III**
4. gravimètres supra-conducteurs et réseau gravimétrique absolu : Commission **III**
5. établissement d'un réseau international gravimétrique absolu : Commission **III**
6. réseau fondamental de stations spatiales et gravimétriques absolues : Sections **II** et **III**.

8. Publications

– *Symposiums*. Les "Proceedings" des symposiums de l'Association tenus au cours de cette Assemblée Générale (symposiums a, b et c) seront publiés au plus tôt par le Bureau Central. Liberté est laissée aux organisateurs des réunions scientifiques (s m 1, s m 2 et s m 3) pour la publication des communications présentées.

– *Geodesist's Handbook 1988*. La poursuite de cette publication est décidée, le G.H. 1988 reprendra les mêmes thèmes que le G.H. 1984 en les actualisant. Le contenu plus détaillé sera étudié à la réunion du Comité Exécutif en mars 1988. Le G.H. 1988 devra être prêt à la mi-88.

– *Rapports des Sections*. Des règles sont à préparer (Comité Cassinis) pour les rapports quadriennaux (Travaux), ainsi que pour les rapports annuels (B.G.).

9. Futures réunions scientifiques

9.1. General Meeting in Edinburgh (U.K.), August 1989

Le Comité Exécutif, approuvé par le Conseil, a décidé de donner une suite favorable à l'aimable invitation du Comité britannique de tenir une Réunion Générale de l'AIG à Edimbourg en août 1989. Le détail du programme scientifique sera étudié par le Comité Exécutif en mars 1988, mais les principes suivants sont retenus :

- symposiums plutôt que réunions des sections seules,
- pas de réunions en parallèle,
- favoriser les "poster sessions" qui ne doivent pas être considérées comme des sessions de 2^{ième} qualité.

V. Ashkenazi et A. Dodson sont invités à venir participer à la réunion du Comité Exécutif en mars 1988 pour la mise au point du programme de cette Réunion Générale. Au cours de la cérémonie d'ouverture de la Réunion l'AIG célébrera le 125^{ème} anniversaire de la tenue de la première "conférence géodésique internationale".

9.2. Autres réunions scientifiques pendant la période 1988–1991, approuvées par l'AIG.

1988

- *Workshop "GPS–Applications"*, Darmstadt (F.R.G.), 11–13 April;
convenor : E. Groten
- *"Instrumentation, Theory and Analysis for Integrated Geodesy"*, Sopron (Hungary), 16–20 May;
convenor : J. Somogyi
- *International Summer School of Theoretical Geodesy : "Theory of Satellite Geodesy and Gravity Field Determination"*, Assisi (Italy), 23 May – 3 June,
convenors : R. Rummel and F. Sansò
- *Sixth International Symposium : "Geodesy and Physics of the Earth"*, Potsdam (G.D.R.), 22–26 August;
convenors : H. Kautzleben, L. Stange

XIX^{ème} ASSEMBLEE GENERALE

- . *"Progress on the Determination of the Earth's Gravity Field"*, (Chapman Conference, sponsored with AGU), Fort Lauderdale (U.S.A.), **13–16 September**,
convenor : R.H. Rapp
- . *Second International Workshop on the Stability of the African Plate* (with IASPEI and ICL), Conakry (Guinea), **24–31 October**;
convenor : E. Oni

1989

- . *First International Workshop on the Geodesy for the Europe–Africa Fixed Link Feasibility Studies in the Strait of Gibraltar*, Madrid (Spain), **8–10 March**,
convenors : J.L. Caturla and L. Tikdirine
- . *"Ron Mather Symposium on Four-Dimensional Geodesy"*, Sydney (Australia), **28–31 March**,
convenor : F.K. Brunner
- . *Second Hotine–Marussi Symposium*, Pisa (Italy), **May** (or *June*).
convenor : F. Sansò
- . *Elfth International Symposium on Earth Tides*, Helsinki (Finland), **31 July–5 August**,
convenor : J. Kakkuri
- . *Joint Symposium of CSTG (C. VIII) and CRCM (C. VII) : "Global and Regional Geodynamics"* (Coordinated with the General Meeting), Edinburgh (U.K.), **3–5 August**,
convenors : Ch. Reigber and P. Vyskočil
- . *"Geodesy and Seismology : Deformation and Earthquake Prediction"*, Yerevan (U.S.S.R.), **October**;
convenor : Y. Boulanger
- . *Workshop on "Comparison of absolute gravity-meters"*, Paris, **november**, (in conjunction with the Campaign in Sèvres);
convenor : Y. Boulanger
- . *International Symposium on "G.P.S. and Inertial Survey Systems"*, Nigeria,
convenor : R.O. Coker
- . *Conference for Young European Geodesists (COYEG)*, The Hague, Netherlands, **spring** (4 days);
convenor : R. Rummel

1990

- . *Fourth Symposium on Geodesy in Africa*, Tunis (Tunisia), **May**,
convenor : M. Charfi
- . *Summer School in the Mountains*, Admont (Austria),
convenor : H. Sünkel

- . *Eighth International Symposium on Geodetic Computations* , Wuhan (China) , first half of the year ;
convenor : J.Y. Chen
- . *International Symposium on Kinematic Methods in Geodesy and Surveying* , Banff, (Canada) , *September* ;
convenors : K.P. Schwarz and G. Lachapelle
- . *International Meeting of Gravity Commission* , France (Paris or Toulouse) ,
convenor : J. Tanner
- . *International Meeting of Geoid Commission* ,
convenor : R.H. Rapp
- . *Symposium of the CRCM Sub-Commission for Africa* , Cairo (Egypt) .

10. Relations avec les sociétés : FIG, ISPRS, ICA, ...

Dans le cadre des bonnes relations qui existent avec les sociétés-soeurs, FIG (Fédération Internationale des Géomètres), ISPRS (International Society of Photogrammetry and Remote Sensing) et ICA (International Cartographic Association), leurs présidents avaient été invités à l'assemblée générale d'ouverture. Ils ont eu l'occasion de présenter leur société et leurs relations avec la géodésie. Une séance de travail a ensuite rassemblé le Bureau de l'AIG et Présidents des Sociétés. Les possibilités de collaborer en organisant des réunions scientifiques communes ont été envisagées. Des échanges d'information sur le calendrier de telles réunions auront lieu. Au cours de la période précédente deux telles réunions avaient déjà été organisées avec succès. C'est un moyen pour l'AIG d'étendre son champ d'influence.

11. Comité Cassinis

En application de l'article 1 du Règlement Intérieur la structure des Sections doit être revue tous les huit ans (2 périodes) par le Comité Cassinis. D'autres études sur le fonctionnement de l'Association peuvent être demandées à ce Comité. Les dernières modifications ont été adoptées à la XVIII^{ème} Assemblée Générale en 1983, il est temps de préparer les évolutions nécessaires pour la XX^{ème} Assemblée Générale en 1991. Le nouveau Comité Cassinis a donc été formé, il comprend : P.V. Angus-Leppan (président), M. Burša, R. Rummel, C.C. Tscherning, C. Veis et A.M. Wassef. Il aura notamment à revoir les règles concernant les élections, la structure en sections, commissions et groupes spéciaux d'études, les rapports annuels et quadriennaux, le rôle des présidents des Commissions vis-à-vis du Comité Exécutif,

XIXth I.U.G.G. General Assembly

RESOLUTIONS

**presented by the International Association of Geodesy
and endorsed by the International Union of Geodesy and Geophysics**

VOEUX

**présentés par l'Association Internationale de Géodésie
et adoptés par l'Union Géodésique et Géophysique Internationale**

XIX^{ième} Assemblée Générale

RESOLUTION N° 1

The International Union of Geodesy and Geophysics,

noting that the improved determination of the Earth's orientation parameters resulting from the MERIT and COTES programmes of observation and analysis is highly significant,

considering the importance for scientific research and operational purposes of regularly monitoring the Earth's orientation and of establishing and maintaining a new conventional terrestrial frame of reference,

approving the replacement of the International Polar Motion Service (IPMS) and of the Bureau International de l'Heure (BIH) by the International Earth Rotation Service (IERS) which will be responsible both for earth rotation and for the associated conventional frames of reference, and

recognizing that organisations in many countries have indicated their willingness to participate in such a new service,

endorses the recommendations of its Provisional Directing Board on the terms of reference, structure and composition of the new service,

decides to establish, in cooperation with the International Astronomical Union, the International Earth Rotation Service within the Federation of Astronomical and Geophysical Data Analysis Services (FAGS) as from 1 January 1988, and

thanks all organisations and individuals who have helped to develop and implement the MERIT and COTES programmes, all who have operated IPMS and BIH in the past and all who have indicated their willingness to participate in the new Service.

RESOLUTION N° 2

The International Union of Geodesy and Geophysics,

noting that :

1) International Atomic Time (TAI) and Coordinated Universal Time (UTC) are at present established by the Bureau International de l'Heure (BIH) , and

2) the parent Unions of the BIH are the International Union of Geodesy and Geophysics (IUGG) , the International Astronomical Union (IAU) and the International Union of Radioscience (URSI) , and

recognizing that :

1) atomic time scales have numerous and important scientific, technical and public applications,

2) TAI is based solely on physical measurements independent of the motions of the Earth,

3) there is an Intergovernmental Organisation, with the Bureau International des Poids et Mesures (BIPM) as its executive body, charged with unifying the units of measurement of the major physical quantities, and

VOEU N° 1

L'Union Géodésique et Géophysique Internationale,

notant l'apport très significatif des programmes d'observation et d'analyse **MERIT** et **COTES** pour l'amélioration de la détermination des paramètres d'orientation de la Terre,

considérant l'importance pour la recherche scientifique et les objectifs opérationnels de mesurer régulièrement l'orientation de la Terre et d'établir et de maintenir un nouveau système de référence terrestre conventionnel,

approuvant le remplacement du Service International du Mouvement du Pôle (SIMP) et du Bureau International de l'Heure (BIH) par le Service International de la Rotation de la Terre (SIRT) responsable à la fois de la rotation de la Terre et des systèmes de référence conventionnels associés, et

reconnaissant la volonté d'organismes de nombreux pays de participer à un tel nouveau service,

adopte les recommandations du Comité Directeur Provisoire de ce Service en ce qui concerne ses fonctions, sa structure et sa composition,

décide d'établir, en coopération avec l'Union Astronomique Internationale, le Service International de la Rotation de la Terre (SIRT) au sein de la Fédération des Services d'analyse des données Astronomiques et Géophysiques (FAGS), à compter du 1er janvier 1988, et

remercie les institutions et personnalités qui ont collaboré au développement et à la réalisation des programmes **MERIT** et **COTES**, toutes celles qui ont oeuvré au sein du **SIMP** et du **BIH** dans le passé et celles qui sont décidées à participer à ce nouveau Service.

VOEU N° 2

L'Union Géodésique et Géophysique Internationale,

notant :

1) que le Temps Atomique International (**TAI**) et le Temps Universel Coordonné (**UTC**) sont présentement établis par le Bureau International de l'Heure (**BIH**), et

2) que les Unions responsables du **BIH** sont l'Union Géodésique et Géophysique Internationale (**UGGI**), l'Union Astronomique Internationale (**UAI**) et l'Union Radioscopique Internationale (**URSI**), et

reconnaissant :

1) que les échelles de temps atomique ont de nombreuses applications scientifiques, techniques et publiques importantes,

2) que le **TAI** est fondé seulement sur des mesures physiques indépendantes des mouvements de la Terre,

3) qu'il existe un organisme intergouvernemental chargé de l'unification des unités de mesure des grandeurs physiques fondamentales, organisme dont l'exécutif est le Bureau International des Poids et Mesures (**BIPM**), et

4) UTC is based both on TAI and on the astronomical time scale designated as Universal Time (UT1), and

considering the URSI recommendation A-1, 1984, and the IAU resolution B-1, 1985, on the transfer of TAI to the BIPM,

approves TAI becoming solely the responsibility of the BIPM, under the authority of the Comité International des Poids et Mesures (CIPM) and of the Conférence Générale des Poids et Mesures,

recommends that :

1) the determination and publication of the leap seconds of the UTC system and of the DUT1 corrections should be by the new International Earth Rotation Service (who have been charged by the IAU and IUGG with monitoring Earth rotation) as soon as they are able to fulfil this function, and

2) a permanent committee with IUGG representation should be created, with CIPM as sponsor, to protect the interests of TAI users, and

expresses its thanks to the Paris Observatory for their service to the International community in supporting the BIH .

RESOLUTION N° 3

The International Union of Geodesy and Geophysics,

noting that variations of sea level are of great importance when monitoring ocean circulation and flow through straits as well as climatic change over a timescale of tens of years,

noting also that such monitored variations are useful when calibrating satellite altimetry, and

recognizing that :

1) satellite altimetry applications need only two months of transmitted data, and

2) interpretation of long time scale changes is complicated by vertical land movement,

recommends that all national authorities make maximum effort to instal new tide gauges and to maintain, renew and recalibrate existing ones to modern scientific precision; these should be at as many oceanic sites as possible, especially at those spanning straits and major jet flows, and

recommends further that such sites should regularly measure atmospheric pressure and precise absolute geodetic position, with telemetry of all the data to collecting centres, such as Permanent Service for Mean Sea Level.

4) que le Temps Universel Coordonné (UTC) est fondé à la fois sur le TAI et sur l'échelle de temps astronomique désignée Temps Universel (UT1), et

considérant la recommandation A-1, 1984, de l'URSI, ainsi que la résolution B-1, 1985, de l'UAI, relatives au transfert du TAI au BIMP,

approuve que le TAI soit désormais de la responsabilité unique du BIMP, sous l'autorité du Comité International des Poids et Mesures (CIPM) et de la Conférence Générale des Poids et Mesures,

recommande :

1) que la détermination et la publication des sauts de seconde du temps UTC et des corrections DUT1 soient faites par le nouveau Service International de la Rotation de la Terre (lequel a pour mission définie par l'UAI et l'UGGI la mesure de la rotation de la Terre), dès que celui-ci pourra remplir cette fonction, et

2) qu'un comité permanent, parrainé par le CIPM, avec représentation de l'UGGI, soit créé afin de protéger les intérêts des usagers du TAI, et

exprime ses remerciements à l'Observatoire de Paris pour les services rendus à la communauté internationale grâce au soutien apporté au BIH.

VOEU N° 3

L'Union Géodésique et Géophysique Internationale,

notant que les variations du niveau de la mer ont une grande importance pour la surveillance de la circulation dans les océans et des courants dans les détroits, ainsi que pour l'étude des changements climatiques s'échelonnant sur des dizaines d'années,

notant également que la connaissance de telles variations est utile pour la calibration de l'altimétrie par satellite, et

reconnaissant :

1) que les applications de l'altimétrie par satellite ne requièrent des données transmises que sur deux mois seulement,

2) que l'interprétation des changements à long terme est rendue difficile par les mouvements verticaux de terrain,

recommande que toutes les autorités nationales fassent le maximum d'efforts pour installer de nouveaux marégraphes et pour entretenir, renouveler et ré-étalonner, avec une précision scientifique moderne, ceux qui existent; ces marégraphes devraient être placés en un nombre de sites océaniques aussi grand que possible, particulièrement à proximité des détroits et des flux de courant les plus importants, et

recommande, en outre, qu'en ces stations soient mesurées régulièrement la pression atmosphérique et, de façon précise, la position géodésique absolue, avec envoi par télécommunication de toutes les données vers les centres de collecte, tels que le Service Permanent du Niveau Moyen des Mers.

RESOLUTION N° 4

The International Union of Geodesy and Geophysics,

recognizing that an improved determination of the global gravity field of the earth is urgently needed to support :

- 1) continental geophysics,
- 2) a high precision and high resolution geoid for physical oceanography,
- 3) geodetic positioning and land surveying, and
- 4) high precision orbits for earth observation satellites,

noting the encouraging ability to meet that need in modern space technique such as satellite-to-satellite tracking and satellite gradiometry, but *considering* the potentially high cost and complexity of satellite systems using these techniques,

recommends that :

- 1) the space agencies should continue to develop a dedicated gravity mission,
- 2) efforts continue to be made to foster a spirit of international cooperation for developing a joint mission, and
- 3) steps be taken to launch the dedicated gravity mission by the mid-1990's.

VOEU N° 4

L'Union Géodésique et Géophysique Internationale,

reconnaissant qu'une meilleure détermination du champ de pesanteur global terrestre est plus que jamais nécessaire

- 1) à la géophysique continentale,
- 2) à l'établissement d'un géoïde de haute précision et de haute résolution pour l'océanographie physique,
- 3) au positionnement géodésique et à la topographie, et
- 4) à la détermination d'orbites précises pour les satellites d'observation de la Terre,

notant qu'il existe des possibilités encourageantes pour satisfaire ce besoin grâce aux techniques spatiales modernes telles que la poursuite satellite-satellite et la gradiométrie par satellite, mais *considérant* le coût potentiellement élevé et la complexité des systèmes spatiaux utilisant ces techniques,

recommande

- 1) que les agences spatiales continuent à développer les études d'une mission consacrée à la mesure du champ de gravitation,
- 2) que les efforts soient poursuivis pour promouvoir un esprit de coopération internationale en vue d'une mission commune, et
- 3) que les dispositions soient prises pour lancer la mission dédiée à la pesanteur vers le milieu des années 1990.

XIXth I.U.G.G. General Assembly

RESOLUTIONS

adopted by the International Association of Geodesy

VOEUX

adoptés par l'Association Internationale de Géodésie

XIX^{ième} Assemblée Générale

RESOLUTION N° 1

The International Association of Geodesy,

recognizing that the use of the Global Positioning System (GPS) in geodesy and geophysics should increase greatly over the next few years as it approaches operational status,

recognizing that a standard format would make much easier the exchange of GPS data sets for comparisons to ensure consistency between different GPS software packages, and

considering that such a format should be :

- 1) machine independent and adaptable to new receivers,
- 2) adaptable to new data parameters, and
- 3) able to accept complete raw receiver data,

recommends that all GPS investigators adopt the FICA (Floating Point, Integer, Character, Ascii) format of the University of Texas Applied Research Laboratory, which satisfies the above requirements, and

recommends that GPS investigators and in particular receiver manufacturers develop GPS conversion software to create FICA formatted records from complete new data records of other types of GPS receiver, and make these routines, with documentation, available to investigators on request.

RESOLUTION N° 2

The International Association of Geodesy,

recognizing the continuing need to investigate systematic errors in transportable absolute gravity instruments, and

considering the achievements to date of previous comparison campaigns at BIPM , Sèvres,

recommends that such comparisons continue at Sèvres and other major observatories, as well as in conjunction with the observations of the International Absolute Gravity Base Station Network, and

invites the institutions concerned to cooperate as requested by the International Gravity Commission.

VOEU N° 1

L'Association Internationale de Géodésie,

reconnaissant que l'utilisation du système GPS en géodésie et en géophysique augmentera énormément au cours de ces prochaines années à mesure qu'il deviendra opérationnel,

reconnaissant qu'un format standard faciliterait l'échange de données en vue d'assurer la cohérence entre les différents logiciels GPS et

considérant qu'un tel format devrait être :

- 1) indépendant des matériels et adaptable aux nouveaux récepteurs,
- 2) adaptable aux nouveaux systèmes de données, et
- 3) capable d'accepter les données brutes des récepteurs,

recommande que tous les chercheurs concernés par GPS adoptent le format FICA (Floating Point, Integer, Character, Ascii) du Laboratoire de Physique Appliquée de l'Université du Texas qui satisfait aux exigences énumérées ci-dessus, et

recommande que tous les chercheurs et en particulier les fabricants de récepteurs développent des logiciels de transformation pour créer des enregistrements selon le format FICA pour tout enregistrement de nouvelles données des autres types de récepteur GPS, et que ces routines, avec leur documentation, puissent être mises à disposition sur demande.

VOEU N° 2

L'Association Internationale de Géodésie,

reconnaissant le besoin constant d'étudier les erreurs systématiques des instruments transportables de mesure absolue de la pesanteur, et

considérant les résultats actuels des précédentes campagnes de comparaison au BIPM, à Sèvres,

recommande que de telles comparaisons continuent à Sèvres, et en d'autres observatoires importants, ainsi qu'en liaison avec les observations du Réseau International Gravimétrique Absolu de Stations de Base, et

invite les institutions concernées à coopérer selon la demande de la Commission Gravimétrique Internationale.

RESOLUTION N° 3

The International Association of Geodesy,

recognizing the increased need to collect gravity data, on a local and regional scale, for scientific and practical requirements such as high resolution geoid determination, and

considering that various institutions in Argentina, Brazil and Uruguay have planned a detailed gravity mapping programme in the southeastern part of South America,

approves these endeavours, and

invites the relevant agencies to support the work.

RESOLUTION N° 4

The International Association of Geodesy,

recognizing the need to study non-tidal gravity changes on a global scale, and

considering the ability of both superconducting and absolute gravimeters to monitor variations of the gravity field at the microgal level,

endorses :

1) Resolution No. 2 of the Permanent Commission on Earth Tides (Madrid 1985), and

2) Resolution No. 2 of the International Gravity Commission (Toulouse 1986), and

recommends that the superconducting gravimeters be included in a network monitored by absolute gravity measurements, to fulfil this requirement, and

invites the institutions using absolute or superconducting gravimeters to participate in establishing this network.

VOEU N° 3

L'Association Internationale de Géodésie,

reconnaissant le besoin croissant de collecter des données gravimétriques à l'échelle locale et régionale pour des besoins scientifiques et pratiques tels que la détermination d'un géoïde à haute résolution, et

considérant que diverses institutions en Argentine, au Brésil et en Uruguay ont décidé d'établir une cartographie gravimétrique détaillée de la partie sud-est de l'Amérique du Sud,

approuve cette initiative, et

invite les institutions concernées à soutenir cette oeuvre.

VOEU N° 4

L'Association Internationale de Géodésie,

reconnaissant la nécessité d'étudier de façon globale les changements de la pesanteur non dus aux marées, et

considérant l'aptitude des gravimètres supra-conducteurs et absolus à déceler les variations du champ de pesanteur avec une résolution de 1 microgal,

approuve :

1) la résolution No. 2 de la Commission Permanente des Marées Terrestres (Madrid 1985), et

2) la résolution No. 2 de la Commission Gravimétrique Internationale (Toulouse 1986), et

recommande que, pour satisfaire à cette demande, des gravimètres supra-conducteurs soient mis en oeuvre dans un réseau des stations de mesures absolues de la pesanteur, et

invite les institutions utilisant des gravimètres supra-conducteurs ou absolus à participer à l'établissement de ce réseau.

RESOLUTION N° 5

The International Association of Geodesy,

recognizing the urgent need for a global absolute gravity reference network of high accuracy, particularly for monitoring variations with time and maintaining world gravity standards, and

considering the proposal of IAG SSG 3.87 for an International Absolute Gravity Base station Network (IAGBN) on an appropriate basis,

recommends this should be put in hand now, coordinated by the International Gravity Commission,

requests :

1) relevant agencies to give active support to station installation and gravity connections to existing base networks such as IGSN 71 ,

2) institutes using absolute gravimeters to make the necessary observations, to cover the complete IAGBN in a reasonably short time interval, and

invites further groups to participate with other observations, e.g. positions as required.

RESOLUTION N° 6

The International Association of Geodesy,

recognizing the highly efficient support of advanced space techniques and absolute gravimetry for terrestrial height systems when monitoring recent vertical crustal movements, and

considering that a number of scientific groups in Europe are operating sophisticated instruments of different types,

recommends that a fundamental network of space and absolute gravity stations should be established for investigating height variations, and

invites agencies and institutes using these advanced systems, as well as national survey agencies, to support these investigations.



VOEU N° 5

L'Association Internationale de Geodésie,

reconnaissant l'urgente nécessité de disposer d'un réseau global gravimétrique absolu de référence de haute précision, en particulier pour déceler les variations temporelles et entretenir une référence gravimétrique mondiale, et

considérant tout à fait appropriée la proposition du Groupe Spécial d'étude 3.87 de l'AIG pour l'établissement d'un Réseau International Gravimétrique Absolu de Stations de base (IAGBN)

recommande que ce travail soit mis en route dès maintenant sous la coordination de la Commission Gravimétrique Internationale,

demande :

1) que les institutions intéressées accordent un soutien actif à l'installation de stations et aux liaisons avec les réseaux de base existants tels que l'IGSN 71 ,

2) que les instituts utilisant des gravimètres absolus fassent les observations nécessaires pour couvrir tout le réseau IAGBN dans un délai raisonnable, et

invite d'autres groupes à participer en fournissant d'autres observations, notamment les déterminations de position nécessaires.

VOEU N° 6

L'Association Internationale de Géodésie,

reconnaissant l'apport hautement efficace des techniques spatiales et de la gravimétrie absolue aux systèmes terrestres d'altitude pour déceler les mouvements verticaux récents de la croûte terrestre, et

considérant qu'en Europe, de nombreux groupes de scientifiques utilisent des appareils perfectionnés de différents types,

recommande qu'un réseau fondamental de stations spatiales et gravimétriques absolues soit établi pour l'étude des variations d'altitude, et

invite les institutions et instituts utilisant ces systèmes avancés, ainsi que les services nationaux de géodésie, à apporter leur soutien à ces études.



STRUCTURE of the INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS for the PERIOD 1987 – 1991

1. BUREAU

President	: Prof. V.I. Keilis Borok (U.S.S.R.)
Vice President	: Prof. C. Kisslinger (U.S.A.)
Secretary General	: Prof. P. Melchior (Belgium)
Treasurer	: Dr. S. Gregersen (Denmark)
Members	: Prof. H. Moritz (Austria) Prof. G.A. McBean (Canada) Prof. Ye Duzheng (China)
Assistant Secretary General	: Prof. P. Pâquet (Belgium)
Assistant Treasurer	: Dr. F. Marsden (Denmark)

2. EXECUTIVE COMMITTEE

- The Bureau
- The Past President : Prof. D. Lal (India)
- The Presidents of Associations :

. International Association of Geodesy :

President	: Prof. I.I. Mueller (U.S.A.)
(Secretary General	: Ing. M. Louis (France))

. International Association of Seismology and Physics of the Earth's Interior :

President	: Prof. St. Mueller (Switzerland)
(Secretary General	: Dr. R.D. Adams (U.K.))

. International Association of Volcanology and Chemistry of the Earth's Interior :

President	: Prof. A. Aramaki (Japan)
(Secretary General	: Prof. H.-U. Schmincke (F.R.G.))

. International Association of Geomagnetism and Aeronomy :

President	: Dr. R. Gendrin (France)
(Secretary General	: Dr. M. Gadsden (U.K.))

. International Association of Meteorology and Atmospheric Physics :

President	: Dr. G.B. Tucker (Australia)
(Secretary General	: Prof. M. Kuhn (Austria))

. International Association of Hydrological Sciences :

President : **Dr. V. Klemes** (Canada)
(Secretary General : **Mr. H.J. Colenbrander** (Netherlands))

. International Association for the Physical Sciences of the Ocean

President : **Prof. J.J. O'Brien** (U.S.A.)
(Secretary General : **Dr. R.E. Stevenson** (U.S.A.))

(The Secretary Generals of the Associations may attend any meeting of the Executive Committee of the Union in an advisory capacity).

3. FINANCE COMMITTEE

President : **Prof. J.O. Cardus** (Spain)
Secretary : **Prof. J. Somogyi** (Hungary)
Members : **Prof. A. Ashour** (Egypt)
 Prof. J. Rais (Indonesia)
 Dr. A.F. Spilhaus (U.S.A.)

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STRUCTURE of the INTERNATIONAL ASSOCIATION OF GEODESY for the PERIOD 1987 – 1991

1. BUREAU

President : **I.I. Mueller** (U.S.A.)
 First Vice President : **W. Torge** (F.R.G.)
 Secretary General : **M. Louis** (France)
 (Second Vice President : **H. Kautzleben** (G.D.R.) : attending any meeting of the Bureau on invitation of the President).

2. EXECUTIVE COMMITTEE

- The Bureau and the Second Vice President
- The Past President : **P.-V. Angus-Leppan** (Australia)
- The Third Vice President : **K. Rinner** (Austria)
- The Presidents of Sections :

. Section I : *Positioning*

President : **J.Y. Chen** (China)
 (Secretaries : **M. Prilepin** (U.S.S.R.)
 F. Brunner (Australia)
 M. Sevilla (Spain))

. Section II : *Advanced Space Technology*

President : **B. Kolaczek** (Poland)
 (Secretaries : **R. Rummel** (Netherlands)
 B.E. Schutz (U.S.A.))

. Section III : *Determination of the Gravity Field*

President : **I. Nakagawa** (Japan)
 (Secretaries : **D. Ajakaiye** (Nigeria)
 H.-G. Wenzel (F.R.G.))

. Section IV : *General Theory and Methodology*

President : **K.-P. Schwarz** (Canada)
 (Secretaries : **F. Sansò** (Italy)
 P. Holota (Czechoslovakia))

. Section V : *Geodynamics*

President : E. Groten (F.R.G.)
(Secretaries : H.-G. Kahle (Switzerland)
D. McCarthy (U.S.A.)
Y.S. Yatskiv (U.S.S.R.))

3. OTHER OFFICERS

Editor in Chief of the Bulletin Géodésique :
C.C. Tscherning (Denmark)

Assistant Secretaries of the Association :
C. Boucher (France)
K. Daugherty (U.S.A.)
J. Krynski (Poland)

Honorary Presidents :
C. Whitten (U.S.A.)
G. Bomford (U.K.)
Y. Boulanger (U.S.S.R.)
T.J. Kukkamäki (Finland)
H. Moritz (Austria)
P.-V. Angus-Leppan (Australia)

Honorary Secretary General :
J.-J. Levallois (France)

(The Secretaries of the Sections and the Other Officers may attend any meeting of the Executive Committee of the Association in an advisory capacity).

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International Association of Geodesy

SECTIONS, COMMISSIONS, SPECIAL STUDY GROUPS, ... for the Period 1987—1991

SECTION I

POSITIONING — DETERMINATION DE POSITION

President : J.Y. Chen (P.R. China)

Secretaries : M. Prilepin (U.S.S.R.)

F. Brunner (Australia)

M. Sevilla (Spain)

Objectives

Section I is responsible for the positioning aspects of the geodetic sciences within I.A.G. The objectives of Section I are to :

- . Advance geodetic sciences and related fields and to establish a central source of reference for its members,
- . Speak on the international level as the collective voice of the scientific disciplines embodied within I.A.G.,
- . Encourage improvement of college curricula for the teaching of geodetic sciences,
- . Honor the leaders in geodetic sciences and related fields, and
- . Support a program of publications that will represent the geodetic sciences interests.

Activities

Section I activities include :

- . Sponsorship of and participation in meetings and symposia,
- . Individual and collective research and development projects, and
- . Scientific reports including the annual and quadrennial Section I reports.

Structure

Section I is composed of seven Special Study Groups which foster the development of geodetic sciences pertaining to positioning. The emphasis areas of the study groups include :

- . Integrated Geodesy (1.73)
- . Inertial Systems (1.77)
- . Optical Interferometry (1.79)
- . Sea-floor Positioning (1.101)
- . Vertical Reference Systems (1.102)
- . Static Global Positioning System (1.104)
- . Kinematic Global Positioning System (1.105)

Section I also includes Commission X, Continental Networks, responsible for promoting uniform systems of geodetic control through establishment of worldwide fundamental geodetic networks. The Commission includes seven sub-commissions responsible for particular areas of the globe.

– Commission X

Continental Networks

Réseaux Continentaux

President : **J. Kakkuri** (Finland)

Secretary : **R. Steeves** (Canada)

1. The task of the IAG Commission X (Continental Networks) is :

- to promote scientific and practical activities for the establishment of fundamental geodetic networks, and
- to issue recommendations for the establishment of a uniform model system of fundamental points for worldwide geodetic and geophysical operations.

2. Plan of Work

In order to fulfill the tasks, the Commission X shall :

- support scientific relations between national geodetic control survey agencies and other interested organisations;
- submit requests to national geodetic control survey agencies to provide assistance in making new measurements needed for strengthening continental networks and achieving a worldwide reference system;
- make procedures for the analysis and reduction of observation data as well as observation methods as uniform as possible for making the continental networks more homogeneous;
- maintain contacts with the Sub-Commissions for providing them with coordination, guidance and assistance necessary for the establishment of a worldwide reference system;
- recommend the use of space techniques when strengthening continental and regional networks as well as when connecting various continents and regions; and
- contact all the I.A.G. member countries and organizations that do not yet belong to any Sub-Commission in order to make the world geodetic net as large as possible.

3. Structure

1) Commission X

President : **J. Kakkuri** (Finland)

Secretary : **R. Steeves** (Canada)

2) Sub-Commissions

2.1) European Triangulation (EURef)

President : **K. Poder** (Denmark)

Secretary : **H. Homik** (F.R.G.)

INTERNATIONAL ASSOCIATION OF GEODESY

2.2) *European Levelling* U.E.L.N.

President : **O. Remmer** (Denmark)
Secretary : **P.G. Schwarz** (The Netherlands)

2.3) *North America*

President : **J. Gergen** (U.S.A.)
Secretary : **R. Steeves** (Canada)

2.4) *South America*

A *working group* was established in Vancouver in August 1987 for the re-organization of the South American Sub-Commission. The working group consisted of the following members : **E. Pallejá** (Argentina); **R. Rodrigues** (Argentina) (representing **PAIGH**); **E. Ratton** (Brasil); **W. Subiza** (Uruguay); **H. Henneberg** (Venezuela) .

A *new Sub-Commission for South-America* will be established. **E. Pallejá** is the president of this Sub-Commission. The presidency started on the 17th of May, 1988.

2.5) *South-East Asia & the Pacific*

President : **C. Veenstra** (Australia)
Secretary : **J. Rais** (Indonesia)

2.6) *South Asia (Indian Subcontinent)*

President : **C.S. Joshi** (India)
Vice-President: **Q.K. Lu** (P.R. China)

2.7) *West Asia*

President : **R. Majali** (Jordan)

4. *Membership*

National representatives to Commission **X** or its Sub-Commissions :

E. Pallejá	(Argentina)	J. Rais	(Indonesia)
P. O'Donnell	(Australia)	S. Arca	(Italy)
U. Van Twembeke	(Belgium)	R. Majali	(Jordan)
G. Valev	(Bulgaria)	J.E.V. Mulder	(New Zealand)
C. Hakizimana	(Burundi)	D.A. Omoigui	(Nigeria)
Lu Qiankun	(V.P.S.C. South Asia)(China)	W. Baran	(Poland)
K. Poder	(Denmark)	J. Agria Torres	(Portugal)
J. Kakkuri	(EURef)	M. Newling	(South Africa)
T. Parm	(EURef) (Finland)	L. Eliasson	(Sweden)
A. Kiviniemi	(U.E.L.N)	S. Nilobol	(Thailand)
C. Boucher	(CX, EURef)	A. Ben Haj Salem	(Tunisia)
J.Y. Laigre	(EURef) (France)	E. Oztürk	(Turkey)
H. Duquenne	(REUN)	V. Ashkenazi	(EURef)
P. Willis	(EURef)	R. Bordley	(EURef) (U.K.)
R. Dietrich	(G.D.R.)	"	(REUN)
E. Grafarend	(F.R.G.)	J. Weightman	(REUN)
C.S. Joshi	(India)	J. Gergen	(U.S.A.)

5. Working group on***“Description of space geodesy sites and related local surveys”***

Chairman : C. Boucher (France)

**— Special Study Group 1.73****Integrated Geodesy*****Géodésie intégrée***

President : A. Dermanis (Greece)

Study Areas

1. Integrated geodesy in the classical sense.
2. Fourdimensional integrated geodesy.
3. Integration of terrestrial and space techniques.
4. Integrated geodetic-photogrammetric mapping.
5. Theoretical and operational estimation-prediction problems in integrated data analysis.
6. Optimization problems in integrated geodesy.
7. Operational and numerical experience, development of software.

Membership

A. Dermanis, <i>President</i>	(Greece)	Gu Dan Sheng	(P.R. China)
V. Argeanu	(Australia)	G. Hein	(F.R.G.)
V. Ashkenazi	(U.K.)	R. Kelm	(F.R.G.)
C. Boucher	(France)	T. Krarup	(Denmark)
E. Buschman	(G.D.R.)	A. Mainville	(Canada)
Chao Dingbo	(P.R. China)	D. Milbert	(U.S.A.)
A. Czobor	(Hungary)	L. Mussio	(Italy)
R. Dietrich	(G.D.R.)	D. Rossikopoulos	(Greece)
B. Eissfeller	(F.R.G.)	G. Schmitt	(F.R.G.)
E.W. Grafarend	(F.R.G.)	Sec Men Shen	(P.R. China)

— Special Study Group 1.77**Utilization of Inertial Techniques for Geodesy and Surveying*****Utilisation des techniques inertielles pour la géodésie et les levés***

President : J.R. Huddle (U.S.A.)

Topics

1. New inertial technology applicable to geodesy and surveying.

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2. Integration of GPS and inertial survey equipment.
3. Advances in gravity vector measurement with inertial systems.
4. Refinements relative to existing inertial survey systems.
5. Integration of inertial and gravity gradient measurement systems.

Membership

J.R. Huddle, <i>President</i>	(U.S.A.)	R. Moreau	(Canada)
G. Barth	(Hungary)	M. Napier	(U.K.)
J.-M. Becker	(Sweden)	L. Pfeifer	(U.S.A.)
G. Boedecker	(F.R.G.)	E. Roof	(U.S.A.)
A. Brockstein	(U.S.A.)	J.M. Rueger	(Australia)
W. Caspary	(F.R.G.)	K.-P. Schwarz	(Canada)
R. Forsberg	(Denmark)	D. Scott	(Canada)
E.W. Grafarend	(F.R.G.)	Shou Wei	(U.S.A.)
E. Groten	(F.R.G.)	R. Wong	(Canada)
G.W. Hein	(F.R.G.)	Y.S. Zhang	(P.R. China)

Correspondent Members

G. Babbage	(Canada)	G. Lachapelle	(Canada)
A.R. Barringer	(U.S.A.)	A. Mancini	(U.S.A.)
H.B. von Luetzow	(U.S.A.)	L. McCormick	(U.S.A.)
P. Cross	(U.K.)	J.-C. Radix	(France)
B. Eissfeller	(F.R.G.)	R. Rummel	(The Netherlands)
W. Hausch	(F.R.G.)	W. Waterhouse	(U.S.A.)
M. Van den Herrewegen	(Belgium)	G.A. Wilkinson	(Canada)
M. Higgins	(Australia)		

— Special Study Group 1.79

Optical Interferometry and short range distance measurement

Interférométrie optique et mesure de distances courtes

President : A.H. Dodson (U.K.)

Programme of Activities

1. Study of the error sources of modern high precision short range EDM instruments.
2. Comparative assessment of optical interferometry and high precision EDM instruments.
3. The use of optical interferometry as a tool for laboratory and baseline calibration of EDM equipment.
4. Review and comparison of National EDM calibration facilities with the aim of establishing a programme of observations to assess their absolute and relative accuracies.
5. Study of the use of optical interferometry for the measurement of local crustal deformation and Earth tides.

Membership

A.H. Dodson, <i>President</i>	(U.K.)	G.Y. Graczka	(Hungary)
J.M. Rueger	(Australia)	H. Kahmen	(Austria)
J. Kääriäinen	(Finland)	J.C. de Munck	(The Netherlands)
R. Konttinen	(Finland)	M. Dubrov	(U.S.S.R.)
T. Tanaka	(Japan)	M. Prilepin	(U.S.S.R.)
M. Mayoud	(Switzerland)	I. Peterson	(Sweden)
T.J.M. Kennie	(U.K.)	G. Brandstätter	(Austria)

— Special Study Group 1.101**Sea-floor Positioning***Détermination de position sur le fond marin*

President : **M. Kumar** (U.S.A.)

Principal Goal

Investigations concerning seafloor positioning (4–D) .

Study Areas

- (a) Measurement and survey techniques/types, their error and math models.
- (b) Monumentation of “known” positions.
- (c) Feasibility of a permanent global marine geodetic control network, its accuracy and density requirements.
- (d) Inter-disciplinary requirements, their coordination and overlap.

Objectives

- (a) Promote, coordinate and guide individual research and efforts internationally.
- (b) Promote inter-disciplinary research, dialogue and exchange of ideas.
- (c) Promote cooperative research with other international and national technical organizations/societies.
- (d) Coordinate and establish dialogue on related research (through IAG Section V) with Commission VII and Permanent Service for Mean Sea Level.

Technical Activities (1987–1991)

- (a) Compilation of bibliography of the related technical literature.
- (b) Cataloguing of related research projects, their current status, technical details and availability of project reports.
- (c) SSG meeting at the **PACON 88** in Honolulu, HI, May 1988.
- (d) SSG meeting, presentation of report and sponsoring of invited paper(s) on **SEAPOSTS** at the IAG General Assembly Meeting in Edinburgh, UK, August 1989.
- (e) SSG sponsoring of technical session(s) and workshop(s) on related topics at the International Symposium on Marine Positioning (**INSMAP**) 1990 in Miami, FL, October 1990.
- (f) SSG sponsoring of technical papers within Section I Theme Session and presentation of complete 4 year report at the **XX IUGG** General Assembly in Vienna, Austria, August 1991.

Membership

M. Kumar, <i>President</i>	(U.S.A.)	B. Loncarevic	(Canada)
M.G. Arur	(India)	G.A. Maul	(U.S.A.)
R. Coleman	(Australia)	M. McIntyre	(U.S.A.)
C. Collins	(U.S.A.)	W. Normark	(U.S.A.)
H. Fuzimoto	(Japan)	G. Obenson	(Cameroon)
P. Guangyu	(P.R. China)	J. Proni	(U.S.A.)
P.C. Hedgecock	(U.K.)	N.K. Saxena	(U.S.A.)
H. Henneberg	(Venezuela)	G. Seeber	(F.R.G.)

Corresponding Members

G. Lachapelle	(Canada)	J. Rais	(Indonesia)
Y. Bock	(U.S.A.)	M. Sasaki	(Japan)
J. Ashjae	(U.S.A.)	J.C. Blankenburgh	(Norway)
L. Spielvogel	(U.S.A.)	D.E. Wells	(Canada)
W. Carter	(U.S.A.)	A. Ezequiel	(Portugal)
W. Stein	(U.S.A.)		

— Special Study Group 1.102

Vertical Reference Systems

Systèmes de référence altimétrique

President : D. Zilkoski (U.S.A.)

Program of Activities

- Review existing Vertical Reference Systems
 - . Datum definition
 - . Data types
 - . Estimates of precision and accuracy.
- Estimate effects of systematic errors in Vertical Reference Systems
 - . Realistic accuracy estimates for heights and height differences
 - . Realistic relative weighting schemes for network adjustments.
- Develop strategies for incorporating **GPS** into Vertical Reference Systems.
- Examine the role of absolute gravity measurements in a Vertical Reference System.
- Investigate strategies for developing and implementing a World Vertical Datum.
 - . Document programs underway which will assist in the implementation of a World Vertical Datum.

Membership

D. Zilkoski, <i>President</i>	(U.S.A.)	C. Joshi	(India)
J.M. Becker	(Sweden)	B. Kearsley	(Australia)
C. Boucher	(France)	A. Mainville	(Canada)
A.H. Dodson	(U.K.)	O. Remmer	(Denmark)
F. Faucher	(Canada)	M. Szacherska	(Poland)
J. Hannah	(New Zealand)	A. Wassef	(Egypt)
L. Huang	(P.R. China)	G. Young	(U.S.A.)

— Special Study Group 1.104

Static and Geodynamic Positioning with GPS

Positionnement statique et géodynamique avec le GPS

President : Y. Bock (U.S.A.)

I. Terms of Reference

The Global Positioning System (GPS) should become operational towards the end of the four-year term of the SSG. Already with the Block I satellite constellation, three-dimensional accuracies of several millimeters on short baselines and 1 part in 10^7 ~~or better on longer baselines~~ have been achieved. It is apparent that GPS will profoundly change the concept and practice of geodetic (3-D) positioning. GPS will also provide a powerful tool for geodynamic (4-D) positioning.

The scope of the SSG is to investigate requirements for high-accuracy geodetic and geodynamic positioning with GPS. During the term of the SSG, networks spanning a wide range of scales and applications will be established :

0 — 100 km : site stability, precise engineering applications, local deformation monitoring near fault zones,

100 — 1000 km : regional positioning with orbit improvement, deformation monitoring near active plate boundaries, intra-plate deformations,

1000 — 5000 km : orbit determination, reference frames, plate motions.

New data handling and data processing techniques will be developed for these different network scales and in anticipation of the full constellation environment. New hardware will become available, for example, continuous and dedicated monitoring systems.

II. Program of Activities

The SSG, within the context of the full Block II satellite constellation and over the spectrum of different network scales and applications, plans to :

1. Compare and assess data handling and data analysis algorithms, recommend data exchange formats and procedures ;

2. Study systematic error sources (instrumental, orbital, atmospheric, operational, etc.) ;

3. Develop measurement specifications and standards for geodetic and geodynamic networks ;

4. Collect and disseminate information on relevant hardware and software developments.

The SSG plans to produce a report covering the described topics in time for the deployment of the full GPS satellite constellation. We plan to hold meetings and initiate workshops as deemed appropriate. We will cooperate with other related study groups within IAG.

III. Membership

Y. Bock, *President* (U.S.A.)

V. Ashkenazi (U.K.)

N. Beck (Canada)

P.L. Bender (U.S.A.)

M.W.L. Chodota (Kenya)

J.M. Davidson (U.S.A.)

G. Dedes (U.S.A.)

G.H. Gu (P.R. China)

W. Gurtner (Switzerland)

R.R. Hatch (U.S.A.)

INTERNATIONAL ASSOCIATION OF GEODESY

T. Kato	(Japan)	C. Rizos	(Australia)
A. Kleusberg	(Canada)	D. Sharni	(Israel)
J.W. Ladd	(U.S.A.)	W.E. Strange	(U.S.A.)
H. Landau	(F.R.G.)	Ziqing Wei	(P.R. China)
R. Matindas	(Indonesia)	G. Wubben	(F.R.G.)
W.H. Prescott	(U.S.A.)		

Corresponding Members

O.L. Colombo	(U.S.A.)	G. Mader	(U.S.A.)
G. Lachapelle	(Canada)	W.G. Melbourne	(U.S.A.)

— Special Study Group 1.105

GPS Kinematic Positioning Methods and Applications

Méthodes de positionnement cinématique par GPS et applications

President : G. Lachapelle (Canada)

Objectives

1. Develop and test more accurate and more reliable methods for GPS land, shipborne and airborne absolute and differential positioning and navigation.
2. Investigate the combination of code (pseudo-range) and carrier (phase) data using both filtering and smoothing techniques.
3. Access the gain in accuracy and reliability when using receivers with up to 10 channels, and/or when using receivers with high data output rates (e.g., 5 to 10 Hz).
4. Investigate the effects of parameters such as multipath, clock drifts, troposphere, and ionosphere on kinematic absolute and differential positioning.
5. Develop and test methods of combining GPS with other navigation sensors to improve either or both accuracy and reliability; such sensors may include attitude measuring devices, low cost inertial systems, and shore-based radiopositioning systems (e.g., Loran-C, Omega).
6. Prepare kinematic data sets for the testing of existing and new kinematic positioning software.
7. Make recommendations related to the use of GPS for kinematic positioning.

Membership

G. Lachapelle, <i>President</i>	(Canada)	P. Klelland	(Canada)
J. Blankenburgh	(Norway)	A. Kleusberg	(Canada)
P. Cross	(U.K.)	G. Mader	(U.S.A.)
A. Evans	(U.S.A.)	Miao Lufeng	(P.R. China)
T. Fukushima	(Japan)	S. Mira	(Indonesia)
C. Goad	(U.S.A.)	G. Nard	(France)
R. Hatch	(U.S.A.)	C. Rizos	(Australia)
G. Hein	(F.R.G.)	G. Seeber	(F.R.G.)
C. de Jong	(The Netherlands)	B. Schrumpf	(France)

Corresponding Members

K.P. Schwarz (pres. SSG 4.116)	(Canada)	D. Wells (past pres. former SSG 1.72)	(Canada)
Y. Bock (pres. SSG 1.104)	(U.S.A.)	M. Prilepin (pres. SSG 2.108)	(U.S.S.R.)
J.R. Huddle (pres. SSG 1.77)	(U.S.A.)	J. Riemersma (pres. The Hydrographic Society)	(The Netherlands)
M. Kumar (pres. SSG 1.101)	(U.S.A.)		

SECTION II
ADVANCED SPACE TECHNOLOGY
TECHNOLOGIE SPATIALE AVANCEE

President : **B. Kolaczek** (Poland)
Secretaries : **R. Rummel** (Netherlands)
B.E. Schutz (USA)

Objectives

The Advanced Space Technology Section is responsible for the development of space techniques for geodesy such as radiosatellite techniques, satellite and lunar laser ranging, satellite altimetry, satellite to satellite tracking, satellite gradiometry, or any geodetic measurements from space.

The work includes :

1. Evaluation of the results of space techniques for the application to geodesy and geodynamics.
2. Development of orbit computation.
3. Stimulation and evaluation of new concepts of satellite systems for geodesy.
4. Development of planetary and lunar geodetic techniques.

Activities

Section II activity includes :

- Providing a platform for an exchange of ideas on all aspects related to advanced space technology.
- Sponsorship and participation in meetings and symposia.
- Scientific reports including the annual and quadrennial Section II reports.

Structure

Section II is composed of the Commission VIII "International Coordination of Space Techniques for Geodesy and Geodynamics" : (President : **C. Reigber**, FRG) and five Special Study Groups :

SSG 2.54 : Radio — Tracking Techniques
President : **W.G. Melbourne**, (USA).

SSG 2.106 : Determination of Orbits to cm — accuracy
President : **O.L. Colombo**, (USA).

SSG 2.107 : Gravity Field Determination by Satellite Gravity — Gradiometry.
President : **R. Rummel** (Netherlands).

SSG 2.108 : Evaluation of New Concepts of Satellite Systems for Position Determinations.
President : **M. Prilepin** (USSR).

SSG 2.109 : Application of Space VLBI in the Field of Astrometry and Geodynamics
President : **I. Fejes**, (Hungary).

— **Commission VIII**

**International Coordination of Space Techniques
for Geodesy and Geodynamics**

*Coordination internationale des techniques spatiales
pour la géodésie et la géodynamique*

President : **Ch. Reigber** (F.R.G.)

I. Charter, Structure and Activities

The Commission on International Coordination of Space Techniques for Geodesy and Geodynamics (**CSTG**) was established during the **XVII** General Assembly of the IUGG in Canberra in 1979. It is Commission **VIII** of the International Association of Geodesy and is the reorganized successor to the former IAG Commission on Satellite Geodesy. 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 general structure of the Commission is as follows :

1. Representatives nominated by countries interested in **CSTG** activities. Representatives of countries which adhere to IUGG/COSPAR constitute the voting membership.

2. A Steering Committee consisting of representatives of existing cooperative programs, e.g. **NASA CDP**, **INTERCOSMOS**, **WEGENER**, representatives of other IUGG associations, **COSPAR ISC's**, **ICL WG's**, chairmen of **CSTG** Subcommissions and projects, and representatives of the most active groups in the fields which are of primary interest to **CSTG**.

3. An Executive Committee.

In accordance with the Canberra IUGG Resolution No.11, **COSPAR** was approached to include the **CSTG** formally within **COSPAR**. As a result, at the 23rd **COSPAR** Plenary Meeting in Budapest in 1980, the **CSTG** was incorporated as **COSPAR** Interdisciplinary Scientific Subcommission **B.2** with the above charter as terms of reference.

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 the **CSTG** Executive and Steering Committees as well as through the **CSTG** National Representatives in performing the role assigned to it in the Charter. In addition, a number of so-called "projects" and "subcommissions" has been created to coordinate certain activities in the field of space geodesy and geodynamics which by their nature, i.e. multi-national, multi-disciplinary and/or embracing a variety of techniques, could benefit from the coordinating role of the Commission. Each project and subcommission has its own organisational structure headed by a chairman. Projects consist in a specific high-priority scientific undertaking to be completed by means of space techniques within a limited period of time. Subcommissions cover long-term programs, the proper coordination of which may have administrative implications.

To develop and maintain the above-mentioned links between the various groups engaged in space geodesy and geodynamics, a **CSTG Bulletin** is published at irregular intervals in English and Spanish. This Bulletin, distributed free of charge through the **CSTG National Representatives** in each country, is complemented by bulletins, newsletters, circular letters and reports of the various subcommissions and projects. This material gives detailed and in some cases regular information on the progress and results achieved by the individual subcommissions.

CSTG Subcommissions

At present the **CSTG** comprises five subcommissions. In the sequence of their establishment these are : Subcommission on Standards (**SCS**, 1981), Subcommission on International Radio Interferometric Surveying (**IRIS**, 1983), Subcommission on the International Campaign for Optical Observations of Geosynchronous Satellites (**COGEOS**, 1985), Subcommission on Satellite Laser Ranging (**SLRS**, 1986) and the **GPS** Subcommission (**GPSS**, 1987).

CSTG – Supported Projects

CSTG has very actively been involved in the coordination of a number of projects, namely **ADOS**, **MERIT/COTES**, **MEDOC 2** and **WEGENER/MEDLAS**. According to the terms of reference projects are considered to concentrate on high-priority scientific issues to be completed by means of space techniques within a limited period of time. A good demonstration of the success of the Commission's work is that two projects (**ADOS**, **MERIT/COTES**) were completed successfully with the presentation of the final reports and recommendations during the General Assembly in Vancouver. The **MEDLAS** project became the basic element of a new **CSTG** project called **REGIN** aiming at the support for the implementation of space techniques in regional geodynamic networks.

CSTG Subcommissions and Projects

. Standards

C. Boucher, Chairman	(France)	H. Montag	(G.D.R.)
W.E. Carter	(U.S.A.)	C.R. Schwarz	(U.S.A.)
L.D. Hothem	(U.S.A.)	C.C. Tscherning	(Denmark)
J. Kakkuri	(Finland)	J.I. Vette	(U.S.A.)
H. Linder	(U.S.A.)	O. Bulygina	(U.S.S.R.)
W.G. Melbourne	(U.S.A.)		

. IRIS – International Radio Interferometric Surveying

J. Campbell, Chairman	(F.R.G.)	G. Lundqvist	(Sweden)
W.E. Carter	(U.S.A.)	Ye She-Hua	(China)
N. Kawajiri	(Japan)		

. COGEOS – International Campaign for Optical Observations of Geosynchronous Satellites

A.M. Nobili, Chairman	(Italy)	F. Barlier	(France)
D.P. Duma	(U.S.S.R.)	M. Gaposchkin	(U.S.A.)
Y. Kozai	(Japan)	G.E. Taylor	(U.K.)
G. Wilkins	(U.K.)	Y.S. Yatskiv	(U.S.S.R.)

. SLRS – Satellite Laser Ranging Subcommission

B.E. Schutz, Chairman	(U.S.A.)	R.B. Coates	(U.S.A.)
B. Greene	(Australia)	H. Montag	(G.D.R.)
P. Wilson	(F.R.G.)	M. Pearlman	(U.S.A.)

INTERNATIONAL ASSOCIATION OF GEODESY

GPSS – Global Positioning System Subcommittee

G. Mader, Chairman	(U.S.A.)	G. Beutler	(Switzerland)
R. King	(U.S.A.)	W. Melbourne	(U.S.A.)
A. Stolz	(Australia)	H. Seeger	(F.R.G.)
T. Kato	(Japan)	R. Langley	(Canada)

REGIN – Project to Support the Implementation of Space Techniques in Regional Geodynamic Investigations

P. Wilson, Chairman	(F.R.G.)	G. Veis	(Greece)
S. Zerbini	(Italy)	B.H.W. van Gelder	(Netherlands)
L. Mendes-Victor	(Portugal)	H.-G. Kahle	(Switzerland)
Gen. Ulkekül	(Turkey)	B. Melbourne	(U.S.A.)
S. Tatevjan	(U.S.S.R.)	R. Majali	(Jordan)

II. Membership

Executive Committee

Ch. Reigber, President	(F.R.G.)	I.I. Mueller	(U.S.A.)
Y. Kozai	(Japan)	S. Tatevjan	(U.S.S.R.)

Steering Committee

M. Bonatz	(F.R.G.)	A.M. Nobili	(Italy)
C. Boucher	(France)	P. Pâquet	(Belgium)
J. Campbell	(F.R.G.)	M. R. Pearlman	(U.S.A.)
M. Feissel	(France)	P. Pesec	(Austria)
C. Finley	(U.S.A.)	J. Rais	(Indonesia)
E.A. Flinn	(U.S.A.)	R. Rodriguez	(Argentina)
A.A. Giesecke	(Peru)	B.E. Schutz	(U.S.A.)
P. Hartl	(F.R.G.)	B.A. Sikilo	(Kenya)
S. Hieber	(France)	D.E. Smith	(U.S.A.)
M.J. Kovalevsky	(France)	B.D. Tapley	(U.S.A.)
R. Leitinger	(Austria)	E. Vermaat	(The Netherlands)
M.M. Macomber	(U.S.A.)	K. Wakker	(The Netherlands)
G. Mader	(U.S.A.)	G.E. Wilkins	(U.K.)
A.G. Massevitch	(U.S.S.R.)	P. Wilson	(F.R.G.)
P. Melchior	(Belgium)	S. Zerbini	(Italy)

Representatives by Country (Members of IUGG and/or COSPAR)

R.O. Malberti	)	J.G. Hu	(P. Rep. of China)
L.R. Perdomo	)	A.G. Fletcher	(Colombia)
A. Stolz		C.V. Rodriguez	(Costa Rica)
K. Rinner		M. Burša	(Czechoslovakia)
P. Pâquet		F. Madsen	(Denmark)
A.V. Benavides	)	J.A.A. Caceres	(Ecuador)
H.A. Cortez	)	B. Baghous	(Egypt)
G.E.O. Giacaglia	)	R.L. Meyer	(El Salvador)
A.J. Pavan	)	Ethiopian Mapping Agency	(Ethiopia)
N.I. Georgiev		J. Kakkuri	(Finland)
J. Kouba		C. Boucher	(France)
E. Kausel	)	G. Seeber	(F.R.G.)
C.C. Yanez	)	H. Montag	(G.D.R.)

G. Veis	(Greece)	J. Tasayco del Solar	)	
E.V. Vasquez	(Guatemala)	G.L. Perez del Aguila	)	(Peru)
J.W. Simeon	(Haiti)	G.T. Marzan		(The Philippines)
G. Alpar	(Hungary)	J.B. Zielinski		(Poland)
C.S. Joshi	(India)	J.P. Osorio	)	
J. Rais	(Indonesia)	L.A. Mendes Victor	)	(Portugal)
S. Zerbini	(Italy)	S. MB. Thiam		(Senegal)
A. Tsuchiya	(Japan)	H.S. Williams		(South Africa)
R. Majali	(Jordan)	R.H. Garcia		(Spain)
J.D. Obel	(Kenya)	B. Rönning		(Sweden)
Chul-Ho Ahn	(Rep. of Korea)	I. Bauersima		(Switzerland)
P. Pâquet	(Luxembourg)	A.M. Safi		(Syria)
S. Andriamihaja	(Madagascar)	J. Tairo		(Tanzania)
A.M. Mohamed	(Malasia)	T. Udomsorayuth	)	
J.M. Espindola	(Mexico)	S. Mingsamon	)	(Thailand)
K.F. Wakker	(The Netherlands)	M. Rezgui		(Tunisia)
A. Rodriguez	(Nicaragua)	O. Gürkan		(Turkey)
J. Hannah	(New Zealand)	M. Prilepin		(U.S.S.R.)
F.A. Fajemirokun	(Nigeria)	V. Ashkenazi		(U.K.)
J. Sundsby	(Norway)	J. Marsh		(U.S.A.)
S.Z. Gilani	(Pakistan)	I.F. Da Cunha		(Uruguay)
A. Vergara	)	A.A. Fonseca Antunez		(Venezuela)
J. Saenz	) (Panama)	M. Solaric		(Yugoslavia)
		F. Podmore		(Zimbabwe)

— Special Study Group 2.54

Satellite Radio Tracking Techniques

Techniques de poursuite radioélectrique des satellites artificiels

President : W.G. Melbourne (U.S.A.)

I. Program of Activities

SSG 2.54 is concerned with developing satellite radio tracking systems, associated modeling and data analysis techniques, and their applications to satellite geodesy, navigation, ocean topography, and geodynamics. Included within its purview are systems such as DORIS, GLONASS, GPS, PRARE, as well as potential future systems such as NAVSAT and GEOSTAR. The study group will :

1. Maintain an up-to-date status of the development schedules for currently planned and operational satellite radio tracking systems including deployment schedules and demonstration milestones.
2. Encourage and coordinate exchange of technical information to facilitate intercomparison of radio tracking systems in terms of their accuracies, scope, applications and complementarity.
3. Identify targets of opportunity for application of one or more of the tracking techniques.
4. Identify and promote areas for potential improvement in the performance of certain tracking systems.
5. Investigate and propose standards where appropriate.

II. Membership

W.G. Melbourne, <i>President</i>	(U.S.A.)	F. Nouel	(France)
M. Ananda	(U.S.A.)	J. O'Toole	(U.S.A.)
Y. Bock	(U.S.A.)	C. Reigber	(F.R.G.)
C. Boucher	(France)	B. Remondi	(U.S.A.)
I. Fejes	(Hungary)	W. Schlueter	(F.R.G.)
V.S. Gubanov	(U.S.S.R.)	B.E. Schutz	(U.S.A.)
P. Hartl	(F.R.G.)	A. Stolz	(Australia)
R.W. King	(U.S.A.)	K.F. Wakker	(The Netherlands)
J.G. Marsh	(U.S.A.)	J.B. Zielinski	(Poland)

— Special Study Group 2.106

Determination of orbits to cm-accuracy

Détermination des orbites à la précision du centimètre

President : Oscar L. Colombo (U.S.A.)

Program of Activities

- clarification, exchange and development of ideas relevant to the reduction of adverse effects of orbit errors on the technical and scientific utilization of spacecraft data,
- consideration of practical and theoretical aspects of precise orbit determination of satellites of current or future geodetic interest, including laser, altimeter, and positioning (GPS, TRANET) spacecraft,
- study of the possibilities presented by the introduction of novel tracking systems (GPS, DORIS, PRARE, etc.),
- discussion of error budgets, sensitivity studies, and similar technical subjects, in connection with the ephemerides of spacecraft of particular interest to geodesists,
- organization of technical meetings, if possible in cooperation with related Study Groups of the IAG, on the subject of precise orbit determination.

Membership

O.L. Colombo, <i>President</i>	(U.S.A.)	J. Kouba	(Canada)
C.F. Peters	(U.S.A.)	S. Lichten	(U.S.A.)
M. Rothacker	(Switzerland)	F. Nouel	(France)
R. Biancale	(France)	E. Pavlis	(U.S.A.)
D. Delikaraoglou	(Canada)	C. Rizos	(Australia)
J. Dow	(F.R.G.)	G.W. Rosborough	(U.S.A.)
A. Drozyner	(F.R.G.)	D.P. Rubincam	(U.S.A.)
R.J. Eanes	(U.S.A.)	E.O. Schrama	(Netherlands)
J. Klokočník	(Czechoslovakia)	Che Kwan Shum	(U.S.A.)
S.M. Klosko	(U.S.A.)	S. Zerbini	(Italy)

— Special Study Group 2.107

Gravity Field Determination by Satellite Gravity-Gradiometry

Détermination du champ de pesanteur à l'aide de la mesure du gradient de pesanteur par satellite

President : R. Rummel (The Netherlands)

Program of Activities

- development and discussion of new concepts for global and regional gravity parameter recovery from satellite gradiometry,
- evaluation of existing recovery methods in the context of satellite gradiometry,
- analysis of the required models from the physical and numerical point of view,
- comparative studies with simulated data sets.

Membership

R. Rummel, <i>President</i>	(The Netherlands)	E. Livieratos	(Greece)
G. Balmino	(France)	J.B. Lundberg	(U.S.A.)
F. Bocchio, B. Betti	(Italy)	R.H. Rapp	(U.S.A.)
O.L. Colombo	(U.S.A.)	Ch. Reigber	(F.R.G.)
K.H. Ilk	(R.F.G.)	H. Suenkel	(Austria)
W.M. Kaula	(U.S.A.)	C.C. Tscherning	(Denmark)
W.D. Kahn	(U.S.A.)	S.C. Bose	(U.S.A.)
		B. Heck	(F.R.G.)

Corresponding member

Ho Jung Paik (U.S.A.)

— Special Study Group 2.108

Evaluation of conception of satellite systems for geodetic determinations

Conception de systèmes de satellites destinés aux déterminations géodésiques

President : M.T. Prilepin (U.S.S.R.)

I. Terms of Reference

It is presumed that the volumes of geodetic and geophysical field work in the near future shall be essentially expanded due to the involvement of tectonically active areas of the Earth's crust into industrial development. Under these circumstances, the precision studies of crustal deformations on large territories and frequent repetition of observations are required, for the regions with particularly high seismic hazards it will be necessary to set up the monitoring service of deformations to obtain operative data for earthquake prediction.

Obviously, the solution of these problems will be possible only on the basis of satellite systems usage.

INTERNATIONAL ASSOCIATION OF GEODESY

The operation of GPS system, or a similar GLONASS system, may prove economically ineffective, because the main purpose of the systems was military navigation with "protected" coded signals. The receipt and processing of the signals require rather complicated and expensive terrestrial receivers, even if static relative geodetic measurements are carried out.

Another drawback in GPS and GLONASS usage is the impossibility of application of satellites of these systems as communication tools.

The requirements of the problem, however, indicate that earthquake prediction needs an operative communication between test areas and interpretation and prediction centres. The most rational realisation of such communication is the exploitation of those satellites which are carriers of coordinates and of measuring signals.

II. Program of Activities

The goals of SSG 2.108 are to analyse the possibilities of establishing the satellite system for the problems designated above, including, of course, the classical geodetic problems as well, and to work out a concept of this system for its future construction on the basis of multilateral participation of countries, particularly those experiencing seismic hazards.

The principal tasks to be solved in the process of formulation of the concept :

- the ways of using the satellites of the system as the means of storage and receipt of measurement data by member countries ;
- the achievement of high precision of relative determinations with more simple and less expensive terrestrial receivers, than those used at present with GPS .
- optimal number of satellites and their orbits ;
- the types of signals : independent, coherent ;
- the modes of measurements : one way, two ways ;
- the interaction schemes between the measurement sites and prediction centres.

Membership

M.T. Prilepin, <i>President</i>	(U.S.S.R.)	Sz. Mihaly	(Hungary)
J.D. Bossler	(U.S.A.)	H. Montag	(G.D.R.)
C. Boucher	(France)	P. Pâquet	(Belgium)
A. Caporali	(Italy)	Ch. Reigber	(F.R.G.)
Ph. Hartl	(F.R.G.)	B. Schutz	(U.S.A.)
S. Hieber	(France)	M. Sasaki	(Japan)
B. Hofmann-Wellenhof	(Austria)	S. Tatevian	(U.S.S.R.)
T.G. Hu	(China)	G. Veis	(Greece)
G. Lachapelle	(Canada)	J. Zielinski	(Poland)

— Special Study Group 2.109

Application of Space VLBI in the Field of Astrometry and Geodynamics

Application de l'interférométrie spatiale à très longue base en astrométrie et géodynamique

President : I. Fejes (Hungary)

I. Terms of Reference

Two dedicated space VLBI projects are in preparation for the years 1992-95. One in the Soviet Union called RADIOASTRON which is an approved mission, the other one in Western Europe with NASA contribution called QUASAT and it is now under study at ESA.

Although potential new applications of space VLBI in the field of astrometry, and geodynamics has been recognized, in fact little effort has been made to explore these applications in detail.

An important potential application of space VLBI in astrometry would be to measure proper motions of extragalactic H_2O maser sources and with statistical or orbital parallax methods directly determine distances of extragalactic objects up to 20 Mpc (Reid, 1984). This could lead to an independent estimate of the Hubble constant.

In the field of geodynamics the use of the orbiting element of a VLBI network has been suggested to tie the frame of the network directly to the mass centre of the Earth thus providing a direct connection between the Conventional Terrestrial Reference System (CTRS) and the Conventional Celestial Reference System (CCRS).

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, geodynamic and geodetic research in the field of space VLBI,
- investigate the accuracy requirements and optimal conditions for the measurements,
- identify the scope and the limits of applications,
- advise the respective Science Teams on system parameters and configuration concerning astrometric and geodynamic experiments,
- organize meetings and workshops at the time appropriate for the members.

III. Membership

I. Fejes , <i>President</i>	(Hungary)	P. Peseć	(Austria)
I. Almár	(Hungary)	M.J. Reid	(U.S.A.)
J. Campbell	(F.R.G.)	N.A. Renzetti	(U.S.A.)
D.L. Jauncey	(Australia)	B.O. Rönnang	(Sweden)
L. Kogan	(U.S.S.R.)	R.T. Schilizzi	(The Netherlands)
H. Hirabayashi	(Japan)	G. Tang	(Sweden)
P. Lála	(Czechoslovakia)	S. Urpo	(Finland)

Corresponding members

A. Baudry	(France)	J.D.H. Pilkington	(U.K.)
I.I. Mueller	(U.S.A.)	A. Stolz	(Australia)

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SECTION III
DETERMINATION OF THE GRAVITY FIELD
DETERMINATION DU CHAMP DE PESANTEUR

President : Ichiro Nakagawa (Japan)

Secretaries : Deborah Enilo Ajakaiye (Nigeria)
[Responsible for Gravimetry (SSGs 3.110, 3.111 and 3.112)]

Hans-Georg Wenzel (FRG)
[Responsible for Gravity Field Estimation (SSG 3.113)]

Terms of Reference

According to the By-Laws of the IAG, Section III is responsible for

- 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; 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 in both space and time. The quantities measured are the gravity potential and its first and second order derivatives, or their linear combinations. 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 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 resolution in global, regional and local scales. As the measurement accuracy in both absolute and relative gravimetry on land is now attained to $10^{-9} g$, the study of non-tidal gravity changes becomes an increasing importance for geodynamic studies.

Structure

Section III is composed of four Special Study Groups as follows :

Special Study Groups –

3.110 : Local Gravity Variations

President : Erwin Groten (FRG)

3.111 : Terrestrial and Airborne Gravity Gradiometry

President : Christopher Jekeli (USA)

3.112 : Gravimetric Tests of the Newtonian Gravity Law

President : Donald H. Eckhardt (USA)

3.113 : Spectral Gravity Field Modelling Methods

President : Michael G. Sideris (Canada)

The following two Commissions and one International Bureau are assigned to Section III. Commission XII was newly established at the XIXth General Assembly of the IAG in 1987.

Commissions –**III : Gravity**President : **James G. Tanner** (Canada)**XII : Geoid**President : **Richard H. Rapp** (USA)**Bureau Gravimétrique International**Director : **Georges Balmino** (France)**– Commission III****International Gravity Commission *****Commission Gravimétrique Internationale**President : **J.G. Tanner** (Canada)Secretaries : **C. Morelli** (Italy)
R.K. McConnell (Canada)Vice-Presidents : **S. Kryński** (Poland)
H.T. Hsu (China)**1. Program of Activities**

1.1. The IGC, as a Commission of the IAG, promotes scientific investigation 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 action of its members to acquire homogeneous gravity anomaly coverage of the earth. It regulates the operation of Bureau Gravimétrique International, the operational agency of the IAG, 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.

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 services 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 strengthen education and training programmes in gravity and its technology ;

* see list of national representants at the end of Section III

(f) To make recommendations for assisting 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 provisions 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 where 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 or 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 Member 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 International Union of Geodesy and Geophysics (IUGG).

6.3. Contributions to the Commission from outside the structure of the IUGG may be accepted and established as trust funds in accordance with the financial regulations of the IAG. Such funds will be allocated to programmes of the Commission in accordance with any special wishes 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 following Sub-Commissions :

Sub-Commission	Coordinator	
. North Pacific Region	I. Nakagawa	(Japan)
. South-West Pacific Region	W.I. Reilly	(New Zealand)
. North America	R. Moose	(USA)
. Central and South America	C. Gamael	(Brazil)
. Africa	R.O. Coker	(Nigeria)
. Western Europe	I. Marson	(Italy)
. Eastern Europe and USSR	Yu.D. Boulanger	(USSR)
. India and Arab Countries	C.S. Joshi	(India)

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 **IGSN 71** and other gravity base stations in the area, including marine gravity bases, and to facilitate the supply of this information to the Bureau Gravimétrique International.

(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 consultation 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 (BGI)

Support the continuing operation of the **BGI** in Toulouse with the emphasis on expanding its data base to include national areas for which no data have been released and to improve coverage in the oceans.

8.2. Absolute Measurements

(a) Intercomparisons of transportable absolute gravity apparatuses at the Bureau International des Poids et Mesures (**BIPM**) and other major observatories, as well as in conjunction with the observations of the International Absolute Gravity Base Station Network (**IAGBN**), in order to investigate systematic errors, in 1989.

(b) Development and implementation of a project to establish the **IAGBN**.

(c) Extension of the International Gravity Standardization Net to remote areas where no absolute gravity values are available.

(d) Collection of new absolute gravity measurements, regional and local network connections and adjustments.

(e) Develop and implement a plan to assist African countries in the measurements and adjustments of an African Gravity Standardization Net.

8.3. International Gravity Standardization Net

- Improvements and extensions.
- New regional adjustments as necessary.
- Comparison of **IGSN 71** with absolute gravity measurements.

8.4. Marine Gravity Data

- Connection of harbour sites to **IGSN 71**.
- Comparisons with satellite altimetry data.

9. Working Group

9.1. The establishment of Working Group “*Monitoring of Non-Tidal Gravity Variations*” has been approved by the Commission in 1987.

9.2. Objectives

Link together the existing and future superconducting gravimeters in a network monitored by the absolute gravimeters in order to study residuals, after removal of the tides, for geophysical interpretation; leading to the determination of non-tidal gravity variation at a global scale.

9.3. Program of Activities

(a) Coordination of regular intercomparisons between absolute and superconducting gravimeters in order to modelize instrumental effects (drift monitoring, ... calibration ..., evaluation of instrumental capabilities, ...).

(b) Exchange of “know how” between participants at different levels : technical, data processing, standardization, ...

(c) Multidisciplinary approach of environmental effects such as :

- Removal of the “complete” tides.
- Loading effects such as oceanic, atmospheric, ... loadings.
- Geohydrological effects, etc.

(d) Stimulation of instrumental developments such as :

- Improvement of absolute gravimeters.
- Development of a nitrogeic superconducting gravimeter ...

9.4. List of Members

C. Poitevin, Chairman	(Belgium)	A. Sakuma	(France)
D. Crossley	(Canada)	P. Steinhauser	(Austria)
B. Ducarme	(Belgium)	T. Tsubokawa	(Japan)
J. Faller	(USA)	R. Warburton	(USA)
J. Hinderer	(France)	H.-G. Wenzel	(FRG)
J. Mäkinen	(Finland)	H. Xu	(China)
I. Marson	(Italy)	W. Zurn	(FRG)
B. Richter	(FRG)	T. Higashi, T. Sato	(Japan)

– Commission XII**International Geoid Commission*****Commission Internationale du Géoïde***

President	: R.H. Rapp	(USA)
Secretaries	: C.C. Tscherning	(Denmark)
	W. Kearsley	(Australia)

1. Principal Tasks

The International Geoid Commission will be 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 could be envisaged :

- 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 GPS/ Levelling campaigns for geoid control,
- organize contact to oceanographers in need of geoid data,
- organization of expert meetings.

2. 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 (deflection of the vertical); Ohio State University (potential coefficient models). Other centers collecting related data (e.g., satellite altimeter data, topographic data, station positions, etc.) will also be identified.

2. The Commission will make available selected software for geoid computations through the Danish Geodetic Institute (C.C. Tscherning).

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 one meeting of a global nature in the four-year period between Assemblies. In addition, it would encourage regional meetings where appropriate.

6. The Commission will provide information to groups and disciplines needing geoid data.

3. List of National Representatives

R.H. Rapp , President	(USA)	M. Shotar	(Jordan)
N. Lopez	(Argentina)	A.M. Hamed	(Malaysia)
W. Kearsley	(Australia)	G.L. Strang van Hees	(Netherlands)
H. Sünkel	(Austria)	W.I. Reilly	(New Zealand)
C. Poitevin	(Belgium)	C. Ezeigbo	(Nigeria)
D. Blitzkow	(Brazil)	D. Solheim	(Norway)
A. Mainville)		R. Feir	(Philippines)
K.-P. Schwarz)	(Canada)	J. Bokun	(Poland)
H.T. Hsu	(China)	M.H. Rodrigues Lisboa	(Portugal)
Z. Martinec	(Czechoslovakia)	H. van Gysen	(South Africa)
C.C. Tscherning	(Denmark)	B. de Cominges	(Spain)
M. Vermeer	(Finland)	L. Sjöberg	(Sweden)
H.-G. Wenzel	(FRG)	B. Bürki	(Switzerland)
D. Arabelos	(Greece)	S.J. Saburi	(Tanzania)
C.S. Joshi	(India)	C. Wichiencharoen	(Thailand)
T. Puntowedo	(Indonesia)	E. Ayhan	(Turkey)
G. Birardi)		A.H. Dodson	(U.K.)
F. Sansò)	(Italy)	K. Colić	(Yugoslavia)
Y. Ganeko	(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 its host agencies : satellite altimetry derived geoid heights, presently from the **Geos 3** and **Seasat** missions; spherical harmonic coefficients of current global geopotential models; mean topographic heights. These data are used internally for data validation and geophysical analysis.

BGI has been developing various algorithms and softwares 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 :

Ex-Officio members : J.G. Tanner (Canada)
I. Nakagawa (Japan)

H.-G. Wenzel (FRG)
G. Balmino (France)
J. Kovalevsky (France) for FAGS
 Nominated members : **J. Faller** (USA)
J. Kryński (Poland)
C. Morelli (Italy)
C.C. Tscherning (Denmark)

The central office is located in Toulouse, France. The supporting organizations are : the Centre National d'Etudes Spatiales, the Bureau de Recherches Géologiques 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) 61.27.40.72 — Telex : 531081 F
 Telemail (OMNET) : **G. Balmino**

Four Working Groups are presently helping **BGI** in different tasks :

- **WG 1 : Data Processing and Evaluation**
 Chairman : **R.K. McConnell** (Canada)
 Members : **C.C. Tscherning** (Denmark)
 H.-G. Wenzel (FRG)
 G. Balmino (France)
 M. Sarrailh (France)
- **WG 2 : World Gravity Standards**
 Chairman : **G. Boedecker** (FRG)
 Members :
 Yu. D. Boulanger (U.S.S.R.) **I. Marson** (Italy)
 J.E. Faller (U.S.A.) **R.K. McConnell** (Canada)
 H. Hanada (Japan) **G. Peter** (U.S.A.)
- **WG 5 : Non-Tidal Gravity Variations**
 Chairman : **C. Poitevin** (Belgium)
 Members : See 9.4 of Commission III
- **WG 6 : Comparison of Absolute Gravimeters**
 Chairman : **Yu.D. Boulanger** (USSR)
 Members : (see at the end of Section III).

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 additional special issue 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 60 issues and about 300 subscribers as of November 1987.

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 : IGSN 71 .

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 welcomed.

5. Services

The most frequent service BGI can provide is data retrieval over a limited area. Data are sent on tapes 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 support 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 activities 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 is to be developed for that purpose.
- Assist IGC in setting up the International Absolute Gravity Base Station Network (IAGBN) , and assist in the intercomparisons of instruments.
- If manpower is available and providing that conflicts with other tasks are resolved, continue the digitization and correction of the worldwide bathymetric GEBCO maps so as to help the geophysicists in the interpretation of oceanic gravity anomalies and serve as the basic material for the next series of these maps.
- Assist in promoting satellite techniques to improve our global knowledge of the earth's gravity field : satellite-to-satellite tracking, satellite gradiometry, etc.

– Special Study Group 3.110

Local Gravity Variations

Variations locales de la pesanteur

President : E. Groten (FRG)

Program of Activities

1. High precision determination of local and regional gravity anomalies in various parts of the earth (with emphasis on seismic belts, postglacial uplift and similar active areas) is planned. Also, artificial and manmade gravity variations associated with lake and other water loading effects are to be investigated. Geometrical deformations in combinations with gravity changes with time are simultaneously measured using conventional (levelling etc.) and satellite or similar space techniques.

2. Modelling and related theoretical studies should lead to new and deeper understanding of underlying mechanisms. In this way, geodynamic interpretation in terms of earthquake prediction, polar motion variations etc. may be achieved.

3. New and improved instrumental and data processing methods are studied where emphasis is on various types of relative gravity. Also gravity gradient observations are a principal point of investigation mainly in view of gradient variations with time.

List of Members

E. Groten , <i>President</i>	(FRG)	T.M. Hunt	(New Zealand)
D.E. Ajakaiye	(Nigeria)	C.S. Joshi	(India)
A. Aksoy	(Turkey)	A. Kiviniemi	(Finland)
H. Baussus von Luetzow	(USA)	R. Klees	(FRG)
M. Becker	(FRG)	A. Lambert *	(Canada)
Yu. D. Boulanger	(USSR)	I. Marson	(Italy)
H. Dragert	(Canada)	S. Okubo	(Japan)
C. Elstner	(GDR)	B. Richter	(FRG)
L.A. Haller	(Sweden)	R. Röder	(FRG)
B.G. Harsson	(Norway)	Not determined	(China)
R.G. Hipkin	(UK)		

* Corresponding Member

— **Special Study Group 3.111**

Terrestrial and Airborne Gravity Gradiometry

Mesure terrestre et aéroportée du gradient de pesanteur

President : C. Jekeli (USA)

Areas of Interest

Moving-base gravity gradiometry recently became a reality as the Gravity Gradiometer Survey System (GGSS) was exercised for the first time in the airborne and ground modes with demonstrable (albeit qualified) success. It has the potential to revolutionize gravity surveying, not only because it is an accurate automated system (there are others), but also because all independent gradients, hence also the three components, of gravity are obtained. It thus offers a challenge to geodesists and geophysicists to make optimal use of these unconventional data in their fields of interest and in so doing to enhance these sciences in general.

As the title of SSG implies, the scope of **SSG 3.111** encompasses all aspects of gravity gradiometry in a regional and local setting. Satellite gradiometry is specifically excluded from consideration since it is covered in Section II.

Areas of interest include :

1. Gradient data processing for local gravity determination
 - (a) Numerical integration techniques
 - (b) Least-squares estimation techniques
 - (c) Downward continuation of gradient data
 - (d) Error handling and error estimation
 - (e) New techniques
2. Gravity gradiometry and its role in physical geodesy
 - (a) Spectral content of data
 - (b) Integration with other data types
 - (c) Surveying techniques in various geophysical environments
 - (d) Boundary-value problems
3. Geophysical interpretation and application
 - (a) Inverse problem of geophysics
 - (b) Geophysical (terrain, geologic, etc.) effects on data
 - (c) Correlation with seismic data
4. New instruments

The Goals of SSG 3.111

The research goals are simply and generally defined as follows :

1. To provide a thorough understanding of the advantages and disadvantages of gravity gradiometry (airborne and ground modes) for improving our knowledge of the gravity field within the context of geodesy and geophysics.
2. To demonstrate techniques for processing gradiometer data to obtain the desired products of geodetic and geophysical interest.
3. To provide recommendations for further research and improvements in

gradiometer instrumentation and gradiometer data processing in the interest of advancing the science.

List of Members

C. Jekeli , <i>President</i>	(USA)	T. Kling	(FRG)
D. Arabelos	(Greece)	J.-C. Radix	(France)
F. Bocchio	(Italy)	K.-P. Schwarz	(Canada)
S.C. Bose	(USA)	M.G. Sideris *	(Canada)
J.E. Faller *	(USA)	C.C. Tscherning	(Denmark)
R. Forsberg	(Denmark)	I.N. Tziavos	(Greece)
D. Gleason	(USA)	A.A. Vassiliou	(Canada)
J. Goldstein	(USA)	J. White	(USA)
G. Hein *	(FRG)	D.M. Zhou	(China)
W. Heller	(USA)		

* Corresponding Members

— Special Study Group 3.112

Gravimetric Tests of the Newtonian Gravity Law

Epreuves gravimétriques de la loi de Newton sur la pesanteur

President : D.H. Eckhardt (USA)

Principal Tasks

1. Encouraging the participation of geodesists and geophysicists in testing the validity of Newton's inverse-square law. Until recently, tests of Newtonian gravity have been almost the exclusive domain of physicists and dynamical astronomers. Experimental and theoretical considerations suggest that if there are detectable perturbative gravity-like forces (Fifth Force, Sixth Force ?), their maximum effective ranges of influence are probably between 1 m and 10 km. These are the ranges of geophysical experiments. Physical geodesists have the equipment and computational expertise to make valuable contributions in this field. The laws of physics are not handed down by the physicists to be accepted without question by the rest of the scientific community. Geodesists can and should participate in examining these laws.

2. Coordinating and publicizing results. Publications and meetings in this field are, again, usually in the domain of physicists. Geodesists usually do not read the physicists' journals nor participate in their meetings. The geodetic community should be kept informed on the progress of relevant gravity research, and it should open its own publications and meetings to the topic.

3. Educating. Physicists and geodesists usually do not speak the same technical language. Many geodesists would benefit from tutorial reviews of the relevant theoretical background (e.g., relativistic quantum theory) that physicists take for granted. And how many particle physicists know what the geoid is ?

4. Consolidating findings and making recommendations to Section III and the IAG. If non-Newtonian gravity is detected and confirmed, and its properties are clearly enough defined, there should be an impact to the conventions and practices of physical geodesy. The entire geodetic community should understand and adopt the same standards in the interpretation of gravimetric data.

Future Meetings

1. American Geophysical Union, San Francisco, USA, 11 December 1987. The

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Geodesy Section of the AGU is having a special session on the Fifth Force.

2. Moriond Workshop on Neutrinos and Exotic Phenomena, Les Arcs, Savoie, France, 23–30 January 1988. This workshop will include an in-depth discussion of possible evidence for the Fifth Force.

3. Royal Astronomical Society, Burlington House, London, UK, 12 February 1988. Discussion meeting on “The search for a Yukawa-like term in the gravitational potential”.

4. Fifth Marcel Grossman Meeting, Perth, Western Australia, 8–12 August 1988. This meeting on recent developments in theoretical and experimental general relativity, gravitation and relativistic fields will include a symposium/workshop on Fifth Force problems.

5. Inter-Assembly Meeting of the IAG, Edinburgh, UK, 7–12 August 1989. In the interest of furthering the goals of Tasks 1–3 (above), the scientific program at this meeting should include review and research presentations on non-Newtonian gravity.

Program of Activities

Members of SSG 3.112 will participate in all of the above meetings. The SSG proposes to organize the non-Newtonian gravity symposium for the IAG Edinburgh meeting. The SSG will compile a bibliography of relevant papers for IAG distribution; contributions are solicited. For this rapidly evolving scientific sub-discipline, it is difficult to predict when the Task 4 recommendations can be proposed; the target goal, however, is before the next IUGG General Assembly.

List of Members

D.H. Eckhardt, <i>President</i>	(USA)	A.T. Hsui	(USA)
J.E. Faller	(USA)	B. Richter	(FRG)
H. Hanada	(Japan)	S.K. Runcorn	(UK)
R. Hipkin	(UK)	F.D. Stacey	(Australia)

— Special Study Group 3.113

Spectral Gravity Field Modelling Methods

Méthodes spectrales de modélisation du champ de pesanteur

President : M.G. Sideris (Canada)

Program of Activities

1. Numerical comparison of spectral formulas for Molodensky's problem to the classical ones for geoid and deflection predictions.

2. Spectral methods for inverse gravimetric problems.

3. Application of non-linear spectral techniques in two dimensions.

4. Multiple input-output spectral relationships for airborne gradiometry.

5. Studies on aliasing effects and data gridding procedures.

6. Spectral computations for points on non-level surfaces and on non-uniform grids.

7. Combination of local and global spectral methods; proper treatment of stationary and non-stationary noise and error propagation.

List of Members

Members

M.G. Sideris , <i>President</i>	(Canada)	K.H. Ilk	(FRG)
J. Ádám	(Hungary)	C. Jekeli	(USA)
T. Bašić	(FRG)	N. Kühtreiber	(Austria)
B. Benciolini	(Italy)	M. Lindlöhr	(FRG)
S.C. Bose	(USA)	D. Nagy	(Canada)
O.L. Colombo	(USA)	R.V. Sailor	(USA)
W.T. Dewhurst	(USA)	L.E. Sjöberg	(Sweden)
M. Doufexopoulou	(Greece)	H. Sünkel	(Austria)
R. Forsberg	(Denmark)	K.S. Tait	(USA)
J.C. Harrison	(USA)	I.N. Tziavos	(Greece)
K. Hehl	(FRG)		

Corresponding Members

D. Blitzkow	(Brazil)	X. Li	(China)
R.J. Fury	(USA)	J. Lindenberger	(FRG)
B. Hofmann-Wellenhof	(Austria)	F. Sansò	(Italy)
E. Klingelé	(Switzerland)	K.-P. Schwarz	(Canada)

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List of members :

G. Cerutti	(Italy)	N. Courtier	(Canada)
C. Elstner	(GDR)	D. Ruess	(Austria)
J.E. Faller	(USA)	A. Sakuma	(France)
Y.G. Guo	(China)	W. Torge	(FRG)
H. Ishii	(Japan)	G. Peter	(U.S.A.)
A. Kiviniemi	(Finland)		

COMMISSION III – List of National Representatives

J.G. Tanner, <i>president</i>	(Canada)	G.L. Strang van Hees	(Netherl.)
J. Gilliland	(Australia)	W.I. Reilly	(New Zealand)
C. Poitevin	(Belgium)	R.O. Coker	(Nigeria)
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V. Vyskočil	(Czechoslov.)	M. Barlik	(Poland)
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C. Elstner	(G.D.R.)	S.J. Saburi	(Tanzania)
G. Palmason	(Iceland)	R. Unchaiya	(Thailand)
C.S. Joshi	(India)	Nat. Committee	(Tunisia)
M. Untung	(Indonesia)	H. Demirel	(Turkey)
C. Morelli	(Italy)	R.G. Hipkin	(U.K.)
M. Ooe	(Japan)	R. Moose	(U.S.A.)
M. Abou Karaki	(Jordan)	W.H. Subiza	(Uruguay)
J. Monges-Caldera	(Mexico)	Y.D. Boulanger	(U.S.S.R.)

SECTION IV
GENERAL THEORY AND METHODOLOGY
THEORIE GENERALE ET METHODOLOGIE

President : K.-P. Schwarz (Canada)
Secretaries : F. Sansò (Italy)
P. Holota (Czechoslovakia)

Terms of Reference

Section IV, General Theory and Methodology, studies problems related to the modeling of geodetic measurements, the mathematical analysis of the resulting equations, the statistical description of the measuring process, and the construction of numerical solutions which satisfy certain optimality criteria. In particular, the following tasks have been assigned to this Section :

- 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.

Besides its major task of developing geodetic theory, Section IV, by its very nature, performs a bridging function for geodesy. It assesses and applies new results achieved in other sciences, especially mathematics and physics, and it encourages interest in geodetic problems by actively pursuing the dialogue with specialists from other fields.

Structure

Section IV has, at present, no permanent body for theory development. It performs its mandate by ten Special Study Groups which cover areas of active research. Research topics and the program of activities for each Special Study Group are outlined in the following and are therefore not repeated here.

— Special Study Group 4.91

Local gravity field approximation

Approximation du champ de pesanteur local

President : R. Forsberg (Denmark)

Program of activities

- Precise local geoid determination (evaluation of medium-wavelength errors, comparisons to GPS, satellite altimetry on a local scale).
- Use of digital terrain models, geological information and geophysical inversion methods for improving local gravity field models.
- Gravity field data on non-level surfaces (Molodensky's problem), upward/downward continuation of gravity field data (e.g. for airborne gravimetry and gradiometry).

Membership

D. Arabelos	(Greece)	W. Kearsley	(Australia)
R. Barzaghi	(Italy)	T. Kling	(F.R.G.)
H. Denker	(F.R.G.)	P. Knudsen	(Denmark)
B. Eissfeller	(F.R.G.)	M. Lindlöhr	(F.R.G.)
H. Fan	(Sweden)	A. Mainville	(Canada)
Y. Ganeko	(Japan)	D. Milbert	(U.S.A.)
A. Geiger	(Switzerland)	J.S. Ning	(China)
H. van Gysen	(South Africa)	M.S. Petrovskaya	(U.S.S.R.)
W. Heller	(U.S.A.)	M. Sideris	(Canada)
C. Jekeli	(U.S.A.)	I. Tziavos	(Greece)

Associate members

V.V. Brovar	(U.S.S.R.)	W.-D. Schuh	(Austria)
G. Gerstbach	(Austria)	L. Sjöberg	(Sweden)
C. Harrison	(U.S.A.)	A. Vassiliou	(U.S.A.)
G. Hein	(F.R.G.)	H.-G. Wenzel	(F.R.G.)
K.-H. Ilk	(F.R.G.)		

— Special Study Group 4.92**Global Gravity Field Approximation*****Approximation du champ de pesanteur global***

President : H.-G. Wenzel (F.R.G.)

Program of Activities

- 1) Improved determination of 30' x 30' data (anomalies, elevations, altimeter heights) and their accuracy estimation.
- 2) Improved estimation procedures for geopotential models and their accuracy, further development of special sparse matrix techniques for the solution of the equation systems.
- 3) Estimation and consideration of error correlation of anomaly and altimeter data.
- 4) Role of terrain effects and corrections; investigation of isostatic models.
- 5) Comparison and testing of existing and new developed models; exclusion of data from combination solutions for independent checking procedures.
- 6) Problems in the application of global gravity field models e.g. in local gravity field determination; solving the problem of inconsistencies between global gravity field models and local gravity data.
- 7) Correlation between global gravity field and other geophysical parameters.
- 8) Investigation of the problem of large gaps in terrestrial gravity data.
- 9) Global models of the gravitational potential of isostatic reduced topography.

Membership

H.-G. Wenzel, <i>President</i>	(F.R.G.)	E.H. Knickmeyer	(Canada)
G. Balmino	(France)	B. Middel	(F.R.G.)
W. Bosch	(F.R.G.)	M. Petrovskaya	(U.S.S.R.)
J. Klokocnik	(C.S.S.R.)	R.H. Rapp	(U.S.A.)

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L. Sjöberg	(Sweden)	C.C. Tscherning	(Denmark)
H. Sünkel	(Austria)	I.N. Tziavos	(Greece)

Corresponding Members

D. Arabelos	(Greece)	B.D. Tapley	(U.S.A.)
F.J. Lerch	(U.S.A.)	C.A. Wagner	(U.S.A.)
Ch. Reigber	(F.R.G.)	Zhou Chuen Hui	(China)
R. Rummel	(Netherlands)		

— Special Study Group 4.93

Wave Propagation in Refractive Media

Propagation en milieu réfringent

President : F.K. Brunner (Australia)

I. Main Objectives

The task of SSG 4.93 is to extend the theory of electromagnetic wave propagation through the atmosphere to geodetic measurements. The propagation medium is the electrically neutral atmosphere and the ionosphere, and the frequencies range from the visible part of the spectrum to microwaves. The effects of the atmosphere on the following measurement types should be studied: phase delay, group delay, intensity, angle-of-arrival, polarisation and Doppler shift. Geodetic space measurements should be considered as the main application of the proposed research work.

The following four study areas are selected for intensive investigation :

A. Refractive index formulae

Study the current formulae for the refractive index of air including their validity, and develop new formulae if required. Prepare a resolution for the adoption of the revised formulae at the next General Assembly of IAG.

B. Geodetic refraction of microwaves

Study the effects of the atmosphere on the propagation of microwaves from first principles (first moments). Derive solutions of the wave propagation equations and state their applicability. The atmosphere should be considered as spatially inhomogeneous medium.

C. Effects of irregularities

Review the statistical description of the irregularities in the troposphere and the ionosphere.

D. Modelling

Study the theory of modelling (forecasting, nowcasting) and apply it to the assessment of the ultimate prediction error of modelling the atmospheric propagation effects.

II. Activities

The ultimate goal is to present comprehensive reports in the selected study areas. These reports should form a foundation for future applied research work.

In order to have a lively participation and communication, the following activities are planned :

1. At least two Circular Letters will be issued per year.
2. Distribute all information (reports, preprints, reprints) within the SSG.
3. Hold SSG meetings at appropriate international symposia.
4. Include the Presidents of related SSGs in the mailing list of the Circular Letters of SSG 4.93.

III. Membership

F.K. Brunner, <i>President</i>	(Australia)	D. Grant	(Australia)
M.A. Abdu	(Brazil)	L.A. Hajkowicz	(Australia)
G. Beutler	(Switzerland)	T. Kato	(Japan)
J. Churnside	(U.S.A.)	A. Kleusberg	(Canada)
S.F. Clifford	(U.S.A.)	R. Leitingner	(Austria)
J.L. Davis	(U.S.A.)	P. Shi	(P. R. China)
A.H. Dodson	(U.K.)	T.A.Th. Spoelstra	(Netherlands)
U. Gehlich	(F.R.G.)	A.A. Stotskii	(U.S.S.R.)
E.W. Grafarend	(F.R.G.)	R.N. Treuhaf	(U.S.A.)

— Special Study Group 4.115

Mathematical analysis of geodetic boundary value problem

Analyse mathématique du problème géodésique aux limites

President : F. Sacerdote (Italy)

I. Research Topics

General Formulation

From physical reality to mathematical formulation :

- different kinds of available data,
- transition from discrete to continuum,
- regularity requirements :
 - . function spaces for boundary conditions and solutions,
 - . class of boundary surface.

Well-Posedness Problems

Non-linear gravimetric problems : the role of singularities (edges, conical points) in the boundary.

Linearization : estimates on the order of magnitude of the non-linear terms.

Mixed problems :

- . Explicit solutions for the linearized problems in a non-spherical configuration.
- . Non-linear mixed problems.

Numerical Methods

Choice of base functions.

Iterative methods and their convergence.

Solutions of **BVP**'s in the form of integral equations.

Stochastic Aspects

Noisy boundary data : the introduction of stochastic boundary conditions (and even stochastic boundary surface) into the formulation of **BVP**'s.

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Solutions of overdetermined problems.

Relations with finite-dimensional stochastic problems.

Relations with Geophysical and Geodynamic Aspects

Kinematic BVP's : modelling and solution methods.

The role of density data.

Suggestion of items to be studied by the SSG 4.115

subgroup on Pseudodifferential Operators

S.L. Svensson, chairman

1. The formulation of boundary problems in terms of (pseudodifferential) operators on the boundary (very much along the lines of Jeffreys, Molodensky, and de Graaf-Hunter).

2. Discussing solutions in the spherical approximation (extending the classical formulae by Stokes and Vening-Meinesz) and paving the road to numerical solutions by operator theory and functional analysis.

3. Study how realistic cases are reached from the simple spherical starting model, perturbation by parameters, Neumann series, iterations, homotopy arguments, analytic continuation, variational methods.

4. How do you get numerical results ? How does the choice of methods (least squares, collocation, Galerkin) agree with the operator theory ? Which base functions should be used (finite elements, boundary elements, spherical harmonics, etc.) ?

II. Membership

F. Sacerdote, <i>President</i>	(Italy)	A.N. Marchenko	(U.S.S.R.)
J. Adam	(Hungary)	J. Otero	(Spain)
W. Freedeen	(F.R.G.)	M.S. Petrovskaya	(U.S.S.R.)
B. Heck	(F.R.G.)	R. Rummel	(The Netherlands)
P. Holota	(Czechoslovakia)	F. Sansò	(Italy)
A.H.W. Kearsley	(Australia)	L.E. Sjöberg	(Sweden)
W. Keller	(G.D.R.)	L. Svensson	(Sweden)
A. Mainville	(Canada)	Zuowen Zu	(P. Rep. China)

— Special Study Group 4.116

Kinematic and Dynamic System Modelling in Geodesy

Modélisation de systèmes cinématiques et dynamiques en géodésie

President : K.-P. Schwarz (Canada)

Terms of Reference

The main objective of the study group is the development of modelling strategies for dynamic systems in geodesy. Specific emphasis will be given to emerging measurement systems using GPS and inertial technology for kinematic positioning and gravimetry. Thus, the medium to high dynamics range will be of specific interest. However, the problems of slowly evolving dynamic systems with scarce measurement information will also be addressed.

Program of Activities

1. **Classification of geodetic systems** — dynamics, linearity, stability, reachability and observability.
2. **Modelling** — state space models, eigen value representations, alternative space domain parametrizations. Specifics of real-time and post-mission applications.
3. **Estimation** — Kalman filtering and smoothing, adaptive filtering approaches, nonlinear filtering, feedback control, applied system identification, optimality, robustification, blunder detection.
4. **Numerical problems** — data density and its effect on modelling, quantization of multi-axis rotational data, data flow in integrated systems, advantages of post-mission data handling.
5. **Comparison of methods using test data sets.**

Membership

K.P. Schwarz, <i>President</i>	(Canada)	E. Livieratos	(Greece)
G. Bartha	(Hungary)	W. Möhlenbrinck	(F.R.G.)
B. Eissfeller	(F.R.G.)	C. Rizos	(Australia)
D. Fritsch	(F.R.G.)	F. Sansò	(Italy)
A. Geiger	(Switzerland)	B. Schaffrin	(F.R.G.)
C.C. Goad	(U.S.A.)	M.K. Szacherska	(Poland)
B. Hofmann-Wellenhof	(Austria)	P. Teunissen	(The Netherlands)
A. Kleusberg	(Canada)	M. Wei	(P.R. China)
E. Knickmeyer	(Canada)		

— Special Study Group 4.117

Optimization of Modern Positioning Techniques

Optimisation des techniques modernes de positionnement

President : D. Delikaraoglou (Canada)

Terms of Reference

The main objective of **SSG 4.117** is to help clarify, develop and disseminate ideas related to the optimal utilization of **GPS** data for technical, and scientific purposes and to deal mainly with a wide scope of research topics relating to the optimization of methods with respect to the measurement operations, the general mathematical models, and the statistical and numerical analysis techniques applicable to the **GPS** system and its combination with other measuring systems currently available or under development.

Program of Activities

1. Optimization of methodologies and strategies for high precision orbit and positioning determinations for **GPS**-based geodetic measurements, including the definition of optimal network configurations for the unified determination of orbits, station coordinates and other geodetic parameters from regional and local networks of various scales and geometries.
2. Studies on the stochastic modelling of refraction, clock modelling and other propagation media effects or other statistical techniques which can be transferable to the **GPS** formulations.
3. Extension of classical network analysis to modern positioning techniques, particularly

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investigations stemming from the perceived need for design tools capable of providing the information necessary to access the accuracy and cost consequences associated with network observation strategies involving simultaneous deployment of several GPS receivers.

Membership

D. Delikaraoglou, <i>President</i>	(Canada)	H. Landau	(F.R.G.)
J. Adam	(Hungary)	S.T. Lichten	(U.S.A.)
V. Ashkenazi	(U.K.)	W. Lindlöhr	(F.R.G.)
C.D. Chadwell	(U.S.A.)	G. Mader	(U.S.A.)
O.L. Colombo	(U.S.A.)	P. Pesec	(Austria)
M.R. Craymer	(Canada)	K.W. Pointon	(Canada)
A. Geiger	(Switzerland)	C. Rocken	(U.S.A.)
D. Grant	(New Zealand)	P. Teunissen	(The Netherlands)
J. Kouba	(Canada)		

— Special Study Group 4.118

Inverse Geodetic Problems

Problèmes d'inversion en géodésie

President : K.H. Ilk (F.R.G.)

I. Terms of Reference

- . Inverse Problems to be investigated
 - instable problems (small changes in the input of the problem produce an unacceptable large change in the output),
 - nonunique problems
 - nonuniqueness because of discretized data sets,
 - nonuniqueness inherent in the problem.
- . Methods to be compared
 - information approach (Tarantola)
 - variational method
 - constrained least squares problems
 - optimization using inequality constraints
 - singular value decomposition techniques (constraint problems, subset selection, etc.)
 - nonlinear least squares problems
 - nonlinear spectral methods
- . Numerical techniques to be applied
 - steepest descent, Newton, conjugate direction, Davidson — Powell, etc.
- . Problems to be studied
 - downward continuation of gravity and gravity gradiometry information from satellite and aircraft heights to the earth's surface (effect of including surface gravity, etc)
 - gravity inversion for geophysical applications (implication of norm assumptions on subsurface density structures, use of geophysical data, e.g. density logs, validity of isostatic models, etc.)

numerical differentiation (gravity from altimetry, velocity (acceleration) from GPS (data))

inverse problems of dynamics (rotational dynamics, earth's tides)

inverse modelling of physical systems relevant to geodetic applications, elasticity parameters from geodetic observations.

II. Membership

K.H. Ilk , President	(F.R.G.)	R. Mayer	(Austria)
G. Anger	(G.D.R.)	R. Rummel	(The Netherlands)
R. Barzaghi	(Italy)	F. Sansò	(Italy)
H. Drewes	(F.R.G.)	B. Schaffrin	(F.R.G.)
K. Hehl	(F.R.G.)	K.-P. Schwarz	(Canada)
G. Hein	(F.R.G.)	M. Sideris	(Canada)
P. Holota	(Czechoslovakia)	H. Suenkel	(Austria)
A.N. Marchenko	(U.S.S.R.)	C.C. Tscherning	(Denmark)
R. Matindas	(Indonesia)	A. Vassiliou	(Canada)

— Special Study Group 4.119

Relativistic Effects in Geodesy

Effets relativistes en géodésie

President : **E. Grafarend** (F.R.G.)

I. Programme of Activities

- study of relativistic reference frames (spatial, temporal, geocentric, barycentric),
- dynamical satellite geodesy (relativistic equations of motion for orbital computations),
- study of relativistic levelling,
- relativistic propagation of electromagnetic waves, including refraction,
- clocks and time scales,
- relativistic modelling of geodetic measurements, namely high resolution gravimetry, accelerometers, gradiometers, VLBI, ms pulsar timing, SLR–LLR, satellite radio tracking,
- inertial techniques, relativistic Sagnac effect, strapdown systems,
- gravitomagnetic effect of the earth's angular momentum,
- study of relativistic geodetic constants.

II. Membership

E. Grafarend , President	(F.R.G.)	F. Hehl	(F.R.G.)
N. Ashby	(U.S.A.)	S. Heitz	(F.R.G.)
P. Bender	(U.S.A.)	B. Mashhoon	(U.S.A.)
B. Bertotti	(Italy)	B. Richter	(F.R.G.)
A. Bjerhammar	(Sweden)	B.E. Schutz	(U.S.A.)
C. Boucher	(France)	I. Shapiro	(U.S.A.)
V. Brumberg	(U.S.S.R.)	M.H. Soffel	(F.R.G.)
W. Cannon	(Canada)	P. Teyssandier	(France)
T. Damour	(France)	J.G. Williams	(U.S.A.)
M.-K. Fujimoto	(Japan)	S. Zhu	(R.P. China)
T. Fukushima	(Japan)	J.D. Zund	(U.S.A.)

— **Special Study Group 4.120**

Non-Linear Adjustment

Compensations non linéaires

President : **P.J.G. Teunissen** (The Netherlands)

I. Terms of Reference

The objectives of SSG 4.120 are to examine how performance measures of estimators vary when the actual model differs from the assumed model, to evaluate the performance of numerical methods for computing the desired estimates and to devise, test and evaluate methods which are robust with respect to certain departures from the assumed model.

The following research topics have been identified :

1. *Non-linear statistical inference* :

Evaluation of the consequences of non-linearity for the linear inference procedures customarily used (e.g. practical measures of non-linearity; distributional properties of non-linear estimators and statistics). Further development of the differential geometric theory of non-linear inference.

2. *Numerical methods for non-linear geodetic optimization* :

Methods for computing estimates in non-linear models are usually iterative in nature. An evaluation of the performance of the various iteration methods when applied to geodetic models is needed (e.g., local and global convergence proofs; rate of convergence).

3. *Perturbation analysis for linear inference* :

This includes, but goes beyond, the classical problem of hypothesis testing. The objective here is to analyze and describe the sensitivity of linear inference procedures for perturbations in the assumed linear(ized) model (e.g., influence of perturbations in functional and stochastic model on the estimators, test statistics, variance components estimation, reliability and precision measures).

4. *Robust statistics* :

Study to what extent and under which circumstances methods of robust statistics can compete with or complement the more traditional inference procedures in case of geodetic adjustments.

II. Membership

P.J.G. Teunissen, <i>President</i>	(Netherlands)	B. Heck	(F.R.G.)
J. Adám	(Hungary)	V. Hung Dang	(Poland)
G. Blaha	(U.S.A.)	L.M.A. Jeudy	(Canada)
J.A.R. Blais	(Canada)	K. Kubik	(U.S.A.)
W. Caspary	(F.R.G.)	K.W. Linkwitz	(F.R.G.)
A. Dermanis	(Greece)	J. v. Mierlo	(F.R.G.)
D. Fritsch	(F.R.G.)	P. Vaniček	(Canada)
E.W. Grafarend	(F.R.G.)	J.D. Zund	(U.S.A.)

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SECTION V
GEODYNAMICS
GEODYNAMIQUE

President : E. Groten (FRG)
Secretaries : H.-G. Kahle (Switzerland)
D. McCarthy (U.S.A.)
Y.S. Yatskiv (U.S.S.R.)

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 with 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, sea-surface 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, researchs 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.

Structure

The following Commissions, International Centres and Special Study Groups are assigned to Section V :

- **Commission V : *Earth Tides***
 - President : H.T. Hsu (China)
 - Vice-President : T. Baker (U.K.)
 - Secretary : P. Melchior (Belgium)
- **International Centre of Earth Tides (*affiliated to FAGS*)**
 - Director : P. Melchior (Belgium)
- **Commission VII : *Recent Crustal Movements***
 - President : P. Vyskočil (Czechoslovakia)

INTERNATIONAL ASSOCIATION OF GEODESY

– International Centre of Recent Crustal Movements

Director : P. Vyskočil (Czechoslovakia)

Special Study Groups :

- 5.98 : Atmospheric Excitation of the Earth's Rotation
President : J.O. Dickey (U.S.A.)
 - 5.99 : Tidal Friction and the Earth's Rotation
President : P. Brosche (F.R.G.)
 - 5.100 : Parameters of Common Relevance of Astronomy, Geodesy and Geodynamics
President : M. Burša (Czechoslovakia)
 - 5.121 : Causes and Mechanisms of the Post-Glacial Uplift
President : L. Sjöberg (Sweden)
 - 5.122 : Geodynamic Effects of Global Gravity Field Variations
President : B. Heck (F.R.G.)
 - 5.123 : Definition and Realization of Terrestrial Reference Systems
President : C. Boucher (France)
 - 5.124 : Transmission of Stress and Geodynamic Implications
(*liaison with ICL*)
President : M. McNutt (U.S.A.)
- International Services reporting to Section V :
- International Earth Rotation Service (*affiliated to FAGS*)
President : to be nominated in August 1988.
 - Permanent Service for Mean Sea Level (*affiliated to FAGS*)
Director : D.T. Pugh (U.K.)

– Commission V

Earth Tides

Marées Terrestres

President : H.T. Hsu (China)
Vice-president : T. Baker (U.K.)
Secretary : P. Melchior (Belgium)

Program of activities in 1988–1991

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 and geodesy.

The Commission will continue to support the activities of International Centre for Earth Tides (ICET) in collecting and analysing the results of Earth Tidal measurements, publishing the accumulated results and establishing the data base for Earth tides.

The 11th International Symposium on Earth Tides (including Ocean Tides) will be held in Helsinki (Finland) in summer 1989, with **Prof. Kakkuri** as convenor. In the meantime, the working groups of the Commission will hold the relevant meeting during the same period and plan to hold scientific symposium once between 1988 and 1991.

Membership

President	:	H.T. Hsu	(China)
Vice-President	:	T. Baker	(U.K.)
Secretary	:	P. Melchior	(Belgium)
Honorary Members	:	J.T. Kuo	(U.S.A.)
		R. Lecolazet	(France)

National representants

K. Bretreger	(Australia)	M. Zadro	(Italy)
H. Lichtenegger	(Austria)	S. Okubo	(Japan)
B. Ducarme	(Belgium)	B. Jaafreh	(Jordan)
E. Ratton	(Brazil)	J. Flick	(Luxemburg)
A. Venedikov	(Bulgaria)	D.M.J. Fubara	(Nigeria)
D. Bower	(Canada)	T. Chojinicki	(Poland)
Z. Simon	(Czechoslovakia)	A.V.C. Simões Da Silva	(Portugal)
N. Andersen	(Denmark)	D. Zugrăvescu	(Rumania)
H.J. Dittfeld	(D.D.R.)	R.W. Green	(South Africa)
J. Kääriäinen	(Finland)	R. Vieira Diaz	(Spain)
J. Hinderer	(France)	H.-G. Scherneck	(Sweden)
M. Bonatz	(F.R.G.)	S. Ndyetabula	(Tanzania)
J. Zschau	(F.R.G.)	R. Unchaiya	(Thailand)
P. Varga	(Hungary)	T. Baker	(U.K.)
C.S. Joshi	(India)	J. Wahr	(U.S.A.)
R.W. Matindas	(Indonesia)	B. Pertsev	(U.S.S.R.)

- **Working Group I** : Theoretical tidal model
Chairman : **V. Dehant** (Belgium)
- **Working Group II** : Acquisition and analysis of Earth Tidal data
Chairman : **G. Jentzsch** (F.R.G.)
- **Working Group III** : Worldwide drive of ocean tides measurements
Chairman : **J.T. Kuo** (U.S.A.)
- **Working Group IV** : Modern space techniques for the parameters.
Chairman : **J. Zschau**

– **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 : **R. Lecolazet** (France), *chairman*
M. Bonatz (F.R.G.)
J.T. Kuo (U.S.A.)
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 different 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 ensure a broad dissemination of the results and informations to all interested laboratories or individual scientists and in particular a transfer of technology towards the Developing Countries,
8. to continue the edition of the Bulletin d'Information.

– **Commission VII**

Recent Crustal Movements

Mouvements récents de l'écorce terrestre

President : **P. Vyskočil** (Czechoslovakia)
Secretary : **E. Gubler** (Switzerland)

Program of Activities 1988–1991

1. the further improvement of complex analysis of results available, aimed especially to the modelling of geodynamical processes in local or regional scale in order to understand the mechanisms of dynamical driving forces;
2. the stepwise improvement of the **CSTG** and **CRCM** cooperation in global and

regional scale in order to extend the information on recent crustal movements within and among the "classical" areas as Europe, North America and Pacific area, and to establish the proper basis for monitoring crustal movements at the African continent and in South America;

3. the continuous improvement of methods for monitoring recent crustal movements as well as data processing and analysis.

Membership

Bureau

President : P. Vyskočil (Czechoslovakia)
 Vice-president : S.R. Holdahl (U.S.A.)
 Vice-president : T. Tanaka (Japan)
 Secretary : E. Gubler (Switzerland)

Members of Bureau : Yu. D. Boulanger (Past-president) (U.S.S.R.)
 C.A. Whitten (U.S.A.)

Members of Executive Committee :

Chairmen of Sub-commissions * :

. West Europe : W. Augath (F.R.G.)
 . Nordic : A. Kiviniemi (Finland)
 . East Europe :- I. Joó (Hungary)
 . North America : R. Snay (U.S.A.)
 . Central and South America : H. Henneberg (Venezuela)
 . West Pacific : P. Wood (New Zealand)
 . South Asia : C.S. Joshi (India)
 . Africa : A.M. Wassef (Egypt)

Operational Agency :

International Center on Recent Crustal Movements (ICRCM)

Address : 250 66 Zdiby, 98, County, Praha-vých.
 (Czechoslovakia)

National Representatives

A. Introcaso	(Argentina)	C. Morelli	(Italy)
R. Coleman	(Australia)	S. Arca	(Ivory Coast)
N. Höggerl	(Austria)	J. Abia	(Japan)
B. Ducarme	(Belgium)	H. Ishii	(Jordan)
J. Argollo	(Bolivia)	R. Majali	(Kenya)
P. Vaniček	(Canada)	J.D. Obel	(Luxemburg)
Rui-Hao Li	(China)	J.A. Labokoson	(Madagascar)
O. Remmer	(Denmark)	S.Y. Khoo	(Malaysia)
A. Kiviniemi	(Finland)	A. Vatrican	(Monaco)
A. Tealeb	(Egypt)	P.G. Schwarz	(Netherlands)
H.L. Tebickie	(Ethiopia)	P. Wood	(New Zealand)
M. Kasser	(France)	O. Fadahunsi	(Nigeria)
B. Heck	(F.R.G.)	S. Bakkelid	(Norway)
G. Lorenz	(G.D.R.)	M. Bashir	(Pakistan)
R.G. Carrera	(Guatemala)	T. Wyrzykowski	(Poland)
I. Joó	(Hungary)	L.M. Victor	(Portugal)
J. Kahar	(Indonesia)		

* — The actual list of members is available by each chairman of Sub-commission.

INTERNATIONAL ASSOCIATION OF GEODESY

M.C. Manansala	(Philippines)	S. Sanguanruang	(Thailand)
A.R. Ahmar	(Syria)	M. Charfi	(Tunisia)
D.P. Rousseau	(South Africa)	A. Aksoy	(Turkey)
C.S. Calota	(Rumania)	P.A. Cross	(U.K.)
D.G.V. Pascual	(Spain)	S.R. Holdahl	(U.S.A.)
M. Ekman	(Sweden)	Yu. D. Boulanger	(U.S.S.R.)
E. Gubler	(Switzerland)	H. Henneberg	(Venezuela)
S.J. Saburi	(Tanzania)	K. Čolič	(Yugoslavia)

— International Centre on Recent Crustal Movements

Centre international des mouvements récents de l'écorce terrestre

Director : P. Vyskočil (Czechoslovakia)

Direction Board **Chairman** : Yu. D. Boulanger (U.S.S.R.)

Members : V.A. Magnitsky (U.S.S.R.)
H. Mälzer (F.R.G.)
N. Pavoni (Switzerland), IASPEI rep.
L. Stange (G.D.R.)

Activities

1. the continuation of collection, storage and distribution of bibliographical and numerical data on recent crustal movements;
2. the continuation of consultations and scientific help by establishment of monitoring networks for recent crustal movement studies and by performing the measurements and their analysis, especially aimed to the developing countries;
3. the continuation of contacts with other similar centers, including exchange of information etc. ,
4. the continuation of the ICRCM activity as the CRCM secretariat, issuing the information Bulletin and improving contacts with the CRCM Subcommissions.

— Special Study Group 5.98

Atmospheric Excitation of the Earth's Rotation

Excitation atmosphérique de la rotation terrestre

President : J.O. Dickey (U.S.A.)

I. Program of Activities

- . encourage multidisciplinary studies on the transfer of angular momentum between the oceans, atmosphere, and solid Earth, and its contribution to variations in the length of day and changes in polar motion, consider the hydrospheric influences (sea level changes and ground water storage) on the Earth's rotation,
- . advocate improvements in the measurements techniques,
- . strive for improved communication and data between the atmospheric and geodetic communities, continue and improve the existing data base and the associated documentation, and stress greater interaction on models and applications of results,

. encourage and coordinate (when appropriate) the study of various techniques for forecasting the atmospheric angular momentum (AAM) and Earth rotation by dynamical and statistical means; advise the Central Bureau of the International Earth Rotation Service (IERS) on the use of AAM in the new service.

II. Membership

J.O. Dickey, <i>President</i>	(U.S.A.)	W.R. Peltier	(Canada)
A. Brzezinski	(Austria)	R.D. Rosen	(U.S.A.)
T.M. Eubanks	(U.S.A.)	D.A. Salstein	(U.S.A.)
F.W. Fallon	(U.S.A.)	N.S. Sidorenkov	(U.S.S.R.)
M. Feissel	(France)	D.E. Smith	(U.S.A.)
D. Gambis	(France)	J.E. Sündermann	(F.R.G.)
R. Hide	(U.K.)	J. Vondrak	(Czechoslovakia)
H. Jochmann	(F.R.G.)	J. Wahr	(U.S.A.)
B. Kolaczek	(Poland)	C.R. Wilson	(U.S.A.)
A.J. Miller	(U.S.A.)	Dawai Zheng	(China)
I. Naito	(Japan)		

— Special Study Group 5.99

Tidal Friction and the Earth's Rotation

Frottement des marées et rotation terrestre

President : **P. Brosche** (F.R.G.)

I. Program of Activities

- scrutinize the tidal friction parameters from modern methods of observation such as Lunar Laser Ranging and Radio Interferometry,
- determine the instantaneous tidal parameters of the oceans and the solid Earth which enable us to check the theories,
- discuss the secular changes of the moments of inertia which enter into the angular momentum-balance,
- improve the theory, that is, especially the contribution from theoretical oceanography, since the oceans are the crucial place of exchange of angular momentum and energy between the Earth and the lunar orbit,
- search for better paleogeographic reconstructions of the old oceans,
- non-tidal sinks and sources of angular momentum and energy need to be estimated as accurate as possible, be it on an empirical or theoretical basis,
- check the paleoclimatic and the paleomagnetic data for signatures of the secular change in the Earth rotation.

II. Membership

P. Brosche, <i>President</i>	(F.R.G.)	L.V. Morrison	(U.K.)
M. Burša	(Czechoslovakia)	M. Ooe	(Japan)
V. Dehant	(Belgium)	H. Schuh	(F.R.G.)
C. Denis	(Belgium)	M.H. Soffel	(F.R.G.)
J.O. Dickey	(U.S.A.)	J. Sündermann	(F.R.G.)
J. Kostelecký	(Czechoslovakia)	P. Varga	(Hungary)

— **Special Study Group 5.100**

**Parameters of common relevance of astronomy, geodesy
and geodynamics**

Paramètres communs en astronomie, géodésie et géodynamique

President : **M. Burša** (Czechoslovakia)

Program of Activities

- 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 any changes in this reference system, to give recommendation to the I.A.G. General Assembly.

The parameters the SSG 5.100 should currently treat are as follows :

- Newtonian gravitational constant,
- Earth's figure parameters and their long-term variations,
- Geocentric gravitational constant,
- Stokes' parameters (geopotential harmonics) of low degrees (say, up to $n = 6$) and their long-term variations,
- Earth's rotation parameters and their long-term variations,
- Earth's principal moments of inertia and their long-term variations,
- Parameters of figures of planets and satellites.

Membership

M. Burša, President	(Czechoslovakia)	R. Kolenkiewicz	(U.S.A.)
E.A. Bjerhammar	(Sweden)	J.G. Marsh	(U.S.A.)
A.H. Cook	(U.K.)	D. Nagy	(Canada)
M.E. Davies	(U.S.A.)	L.P. Pellinen	(U.S.S.R.)
J.E. Dickey	(U.S.A.)	R.H. Rapp	(U.S.A.)
B.H. Chovitz	(U.S.A.)	D.E. Smith	(U.S.A.)
H. Kinoshita	(Japan)		

— **Special Study Group 5.121**

Causes and Mechanisms of the Post-Glacial Uplift

Causes et mécanismes de la surrection post-glaciaire

President : **L. Sjöberg** (Sweden)

Program of Activities

- modelling of present and past temporal change of gravity and height (including geoidal height) related with post-glacial rebound,
- modelling uplift and massflow from all available data,

- estimating the glaciation induced geoid undulations and gravity anomalies and discriminating against other causes,
- relations between rebound and variations of J_{20} , LOD, earthquakes, etc..

Membership

L.E. Sjöberg, <i>President</i>	(Sweden)	W. Fjeldskaar	(Norway)
A. Anderson	(Sweden)	G. Jentzsch	(F.R.G.)
S. Bakkelid	(Norway)	J. Kakkuri	(Finland)
S. Björck	(Sweden)	N.-A. Möner	(Sweden)
R. Dietrich	(G.D.R.)	S.L. Svensson	(Sweden)
J. Donner	(Finland)	P. Vaniček	(Canada)
M. Ekman	(Sweden)	A. Zeman	(Czechoslovakia)
H.-J. Euler	(F.R.G.)	J. Zschau	(F.R.G.)

Corresponding members :

L.M. Cathles	(U.S.A.)	E.W. Grafarend	(F.R.G.)
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– Special Study Group 5.122

Geodynamic Effects of Global Gravity Field Variations

Effets géodynamiques des variations globales du champ de pesanteur

President : B. Heck (F.R.G.)

Program of Activities

1. Interactions and relations between global time-like gravity field variations and geodynamic processes, such as e.g. tectonic plate motions, eustatic sea level changes, post-glacial rebound, core-mantle boundary interaction, mantle flow, signatures of lithospheric space-time structure in the external gravity field, variations in earth rotation, and dynamic processes within the atmosphere and oceans.

2. Relation between geodynamic processes and time-like variations of figure and gravity field parameters, including the impact of the observed rate of J_2 on geodynamics, nature and impact of changes of the pear-shape of the earth, relations between secular and periodic changes in Stokes' coefficients and dynamic processes within the earth body, atmosphere, and oceans, earth expansion and evolution of the earth's body.

3. Effects of global gravity field variations of various origin on geodetic observations, e.g. on classical terrestrial observations, absolute and relative positioning by satellite tracking, gravity gradiometry, satellite orbits.

4. Numerical evaluations of the space-time properties of global gravity field variations based upon different geodynamic hypotheses and models.

5. Consequences of global gravity field variations for the geodetic boundary value problem.

6. Consequences for the establishment of a global network of absolute gravity reference stations.

Membership

B. Heck, <i>President</i>	(F.R.G.)	K. Bretterbauer	(Austria)
P. Birò	(Hungary)	M. Burša	(Czechoslovakia)
G. Boedecker	(F.R.G.)	P. Fang	(Sweden/P.R. China)

H.T. Hsu	(P.R. China)	A. Stolz	(Australia)
R.H. Li	(P.R. China)	G.L. Strang van Hees	(Netherlands)
O. Remmer	(Denmark)	L. Sjöberg	(Sweden)
J. Segawa	(Japan)	J. Wahr	(U.S.A.)

— Special Study Group 5.123

Definition and Realization of Terrestrial Reference Systems

Définition et réalisation des systèmes de référence terrestres

President : C. Boucher (France)

Program of Activity

- 1) Investigations on :
 - . conceptual definition of terrestrial reference systems, taking into account relativistic and geodynamical effects (tides, plate motion, vertical motions ...),
 - . definition of the origin, scale and orientation of terrestrial systems; evolution with time (laws of evolution such as Tisserand relations ...),
 - . how each technique (VLBI, SLR, LLR, other satellite tracking, terrestrial networks) has solved these problems.
- 2) Standardization of procedures in order to :
 - . compare properly two sets of station coordinates coming from various techniques and analysis centers,
 - . combine optimally various results to determine a conventional reference frame for which the selection of origin, scale, orientation and evolution with time will be clearly identified.
- 3) Investigation on the ways to handle correctly station displacements, and review of the effects of the adoption of a given plate motion model on the overall system.
- 4) Recommendation of a standard plate motion model with careful guidelines.
- 5) Recommendation to the IERS Directing Board on the previous studies.

Membership

C. Boucher, <i>President</i>	(France)	J.B. Minster	(U.S.A.)
J. Adam	(Hungary)	M.H. Murray	(U.S.A.)
I. Bauersima	(Switzerland)	E. Pavlis	(U.S.A.)
R. Biancale	(France)	J.W. Ryan	(U.S.A.)
G. Blewitt	(U.S.A.)	B.E. Schutz	(U.S.A.)
P. Brosche	(F.R.G.)	P. Vaniček	(Canada)
W.E. Carter	(U.S.A.)	C. Veillet	(France)
J. Dickey	(U.S.A.)	J. Wahr	(U.S.A.)
J.A. Hughes	(U.S.A.)	W.H. Wooden	(U.S.A.)
S. Manabe	(Japan)	Xu Bang-Xin	(P.R. China)

— Special Study Group 5.124

Transmission of Stress and Geodynamic Implications

Transmission de contrainte et conséquences géodynamiques

President : M. McNutt (U.S.A.)

Program of Activities

- attempt to integrate kinematic and dynamic models in geophysics and geodesy ;
- decide how the thickness of the "Lithosphere" should be defined for geodynamic modelling ;
- consider the strain-rate dependence in the thickness of the lithosphere ;
- investigate what evidence exists for significant viscosity stratification in the upper mantle ;
- quantify the continent-ocean differences in viscosity of the lithosphere and asthenosphere.

Membership

M. McNutt, <i>President</i>	(U.S.A.)	H.-G. Kahle	(Switzerland)
G.F. Davies	(Australia)	B. Minster	(U.S.A.)
S. Cloetingh	(Netherlands)	H. Neugebauer	(F.R.G.)
L. Fleitout	(France)	B. Parsons	(U.K.)
S. Gavrilov	(U.S.S.R.)	R. Richardson	(U.S.A.)
B. Hager	(U.S.A.)	R. Stein	(U.S.A.)

— International Earth Rotation Service

Service International de la Rotation Terrestre

President : (to be nominated in 1988)

The International Earth Rotation Service (**IERS**) was established in 1987 by IAU and IUGG and it started operation on 1988 January 1st. 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 Bureau International des Poids et Mesures (**BIPM**). **IERS** is a member of the *Federation of Astronomical and Geophysical Data Analysis Services* (**FAGS**). It also cooperates with the Bureau International des Poids et Mesures (**BIPM**) on its activities concerning the **UTC** time scale and with IAG SSG 5.98 on its activities related to the atmospheric excitation of the Earth's rotation.

Functions

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 celestial reference systems;
- evaluating the earth rotation for these systems, in particular the coordinates of the pole and universal time;

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— organising operational activities for observation and data analysis, collecting and archiving appropriate data and results, and disseminating the results to meet the needs of users.

Initially, it relies on three observing methods : Very Long Baseline Radio Interferometry (**VLBI**) , Lunar Laser Ranging (**LLR**) , and Satellite Laser Ranging (**SLR**) .

Organisation

IERS consists of Coordinating Centres and other technical centres for each of the three principal observing techniques and a Central Bureau with associated Sub-Bureaux. It is supported by many observing stations and general control is exercised by a Directing Board that is made up of representatives of the Unions and the principal centres.

The Coordinating Centres are responsible for developing and organising 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-rotation and the terrestrial and celestial reference systems. In 1988 it includes one sub-bureau, dealing with rapid-service earth-rotation results.

The principal centres are :

VLBI Coordinating Centre	National Geodetic Survey, Rockville, MD, U.S.A.
LLR Coordinating Centre	Centre d'Etudes et de Recherches Géodynamiques et Astronomiques, Grasse, France.
SLR Coordinating Centre	Center for Space Research, University of Texas at Austin, U.S.A.
Central Bureau	Observatoire de Paris, France.
Sub-Bureau for the Rapid Service	US Naval Observatory (NEOS), Washington, D.C., U.S.A.

The Directing Board exercises general control over the activities of the service, including modifications to the organisation and participation that would be 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 1988, are :

K. Yokoyama	International Union of Geodesy and Geophysics
G.A. Wilkins	International Astronomical Union
W.E. Carter	VLBI Coordinating Centre
C. Veillet	LLR Coordinating Centre
B.E. Schutz	SLR Coordinating Centre
M. Feissel	Central Bureau

The secretariat of the Board is provided by the Central Bureau.

Activities and services

The observing stations for **VLBI**, **LLR**, **SLR** are organised in independent networks, managed by network centres. In 1988, the numbers of participating networks, are one for **SLR**, one for **LLR** and three for **VLBI** (**IRIS**-Atlantic, **IRIS**-Pacific, **JPL**-Deep Space Network). The total number of committed stations is about 50 .

The Coordinating Centres for each technique are responsible for the organisation of 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 centres analyse the observational data in operational mode (weekly and monthly) and transmit earth-rotation results to the Central Bureau. Analysis centres 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 Rapid Service Sub-Bureau combines the results on earth-rotation received from the network centres to form an advanced weekly solution, it also makes predictions of future values.

The Central Bureau makes a final monthly determination of the earth-rotation parameters. From the results of the analysis centres it also performs a simultaneous adjustment of the conventional celestial and terrestrial systems and of the corresponding earth-orientation determinations (polar motion, universal time, precession/nutation).

In consultation with **BIPM**, the Central Bureau decides and disseminates the announcements of leap seconds in **UTC** and values of **DUT1** to be transmitted with time signals.

Data management and archiving

The observational results from optical astrometry received by **IPMS** and **BIH** until 1987 are archived respectively at the Mizusawa and Paris Observatories. The earth-rotation results of **IPMS** are archived at Mizusawa Observatory; a copy is archived at the **IERS** Central Bureau. The **BIH** results on earth rotation are archived at the **IERS** Central Bureau.

The observational results of **VLBI**, **LLR**, and **SLR** are archived each in several centres, subject to the agreement of the relevant Coordinating Centres. The results on earth rotation and reference frames are archived at the network and analysis centres which obtained them, and at the Central Bureau.

Publications

- **Weekly Bulletin A** Earth-rotation parameters (**x**, **y**, **UT1**). Rapid Service, 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**, **UT1**): combined solution and individual series (continuing **BIH** Circular **D**, pages 3 to 7, and **BIH** Circular **B/C**).
First issue covering observation dates in January 1988 (mailed early March 1988).
- **Annual Report of the IERS** Earth-rotation parameters, Terrestrial and Celestial Reference Systems : combined solutions and individual results.
First issue, Report for 1988, to be published in June 1989.
- **Special Bulletin C** Announcement of the leap seconds in **UTC**.
- **Special Bulletin D** Announcement of the value of **DUT1** to be transmitted with time signals.
- **Technical Notes of the IERS** Reports and complementary information of relevance to the work of **IERS** on earth-rotation and the related reference systems.

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The precision of the published results depends on the delay of their availability. For the operational solutions of earth rotation (weekly and monthly bulletins) it is a few 0.001". The prediction accuracy is in the range of 0.005–0.020" for x , y and 0.002–0.015s for UT (prediction lags of 10 and 90 days). For the scientific solution of reference frames and earth-rotation it is 0.001–2" (5 – 10 cm) .

Information

Requests for publications and further information should be sent to the following address :

Central Bureau of **IERS**
Observatoire de Paris
61, avenue de l'Observatoire
75014 Paris , France.

Telephone : 33 – (1) 40 51 22 26
Telex : OBS 270776F
G.E. MARKIII : IERS–CB
EARN/BITNET/SPAN : IERS at FRIAP51

– Time Section

Bureau International des Poids et Mesures

The *Bureau International des Poids et Mesures* (**BIPM**) has taken full responsibility of the *International Atomic Time*, **TAI**, on 1988 January 1st. **TAI** was previously established by the Bureau International de l'Heure (**BIH**) .

Functions

BIPM is in charge of

- establishing **TAI**, and also the Coordinated Universal Time **UTC** (except for the **UTC** leap second occurrence and announcements, in charge of **IERS**),
- providing the data making **TAI** and **UTC** available in the standard laboratories,
- participating to the worldwide coordination for time comparisons.

Activities and services

TAI is established on the basis of atomic clock data and atomic frequency standards data provided by 40 laboratories or national centers.

TAI and **UTC** are made available by the dissemination of corrections to be applied to the readings of the master clocks of the participating laboratories.

This activity requires accurate time comparisons between remote clocks, which are now mostly based on the tracking of **GPS** satellites. The **LORAN–C** and television links remain in use in some laboratories. **BIPM** coordinates these time comparisons by providing **GPS** and **LORAN–C** tracking schedules, by making some measurements and calibrations of receivers. **BIPM** processes most of the data on time comparisons needed for **TAI** .

In 1988, the stability of **TAI** for averaging times of 2 months to 1 year is 1×10^{-14} or better. The second of **TAI** realizes the second of the International System of Units, at sea level, with an uncertainty of about 5×10^{-14} . For well equipped laboratories, the clock corrections to get **TAI** are given with uncertainties usually below 50 ns .

In addition to **TAI**, which is produced in near-real time and definitive as soon as issued, **BIPM** establishes a scientific time scale, **TT(BIPM)** by reprocessing past data, for applications where the utmost stability and accuracy is needed, this time scale is revised when improvements are possible.

Availability of BIPM time data

(a) Publications

- . Circular **T** (monthly) [continues **BIH** Circular **D**] .
Corrections to the readings of laboratory master clocks, to get **TAI** and **UTC** .
Data on time comparisons. Informations.
- . Annual Report of Time Section of **BIPM** [continues the Section on atomic time of the **BIH** Annual Report] . Methods of evaluation of **TAI** . Data on the clocks and time comparisons. Data from the primary frequency standards. **BIPM** results on time scales.
- . Schedules for **GPS** satellites tracking (for participating laboratories), issued about twice a year.

(b) Files on the General Electric Mark III System (user's catalog number 28)

- . Circular **T** : file **BIPMCRT**.

(c) BIPM data service

(Direct access by telephone line; contact **BIPM** for technical informations).

- . Circular **T** .
- . Tables of **TAI**–**TA**(lab), **UTC**–**UTC**(lab).
- . Schedules for **GPS** tracking.
- . Scientific time scale **TT(BIPM)** .

Address

Bureau International des Poids et Mesures
Pavillon de Breteuil
92312 Sèvres Cedex
France.

Telephone : + 33 1 45 34 00 51
Telex : BIPM 201067 F
GE Mark III : BIPM

— Permanent Service for Mean Sea Level

Service permanent du niveau moyen des mers

Director : **D.T. Pugh** (U.K.)

The Permanent Service for Mean Sea Level is a member of the Federation of Astronomical and Geophysical Data Analysis Services (**FAGS**) established by the International Council of Scientific Unions. Under the aegis of the International Association for the Physical Sciences of the Ocean, **PSMSL** is charged with the collection, dissemination and analysis of mean sea level data. Financial support is received from **UNESCO** through **FAGS** and through the Intergovernmental Oceanographic Commission, and from the United Kingdom Natural Environment Research Council. Directed by **Dr. D.T. Pugh**, the Service is guided by the **IAPSO** Commission for Mean Sea Level and Tides.

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In its role of collating data on a global basis, the **PSMSL** continues to access data and maintains an up-to-date databank. Requests for data are met with either computer listings or on magnetic tape or floppy disk in internationally approved formats. Information and advice in measuring sea levels is given. Advice is also given on data reduction and analysis techniques.

These activities will continue in the future. An inventory of data holdings has been published (1987). The development of a more co-ordinated global network, under the auspices of Intergovernmental Oceanographic Commission, is underway. This network (**GLOSS**) is already beginning to improve the quality and distribution of data available.

– **COSPAR WORKING GROUP (IAU – IAG)**

On Cartographic Coordinates and Rotational Elements of the Planets and Satellites

I A G members :

M. Burša (Czechoslovakia)

R.H. Rapp (U.S.A.)



OUT OF SECTION

– Commission VI

International Geodetic Bibliography

Bibliographie géodésique internationale

President : L. Stange (G.D.R.)

I. Program of Activities

The Permanent Commission VI of the I.A.G., "International Geodetic Bibliography", has to register all scientific publications of special periodicals, institutional bulletins and other sources (dissertations, patent specifications, etc.) on the field of geodesy in form of a bibliography. For the most important publications the bibliographic annotations are completed by short abstracts. These annotations and abstracts are published in English, annually in 6 volumes of the periodical "bibliographia geodaetica" by the Centre of International Geodetic Documentation of the Technical University, Dresden (G.D.R.).

For the solution of this task each I.A.G. member country nominates by its National Committee for Geodesy and Geophysics its national correspondent (NC) for the "International Geodetic Bibliography" who is at the same time member of the Permanent Commission VI.

Among the 78 member countries 50 countries have already nominated their NC. By the Dresden Centre the national correspondents were informed about the manner of their work for the International Geodetic Bibliography. They were asked to send bibliographic data and abstracts to the Dresden Centre monthly.

The continuity of the cooperation of the NC determines the topicality and the size of the IGB. The bibliographic data prove the activity of geodetic scientists in the different member countries and explain the international recognition of the results obtained.

II. Structure of the Commission – membership

President : L. Stange (G.D.R.)

Vice-president : H. Finger (G.D.R.)

Secretary : C. Boucher (France)

Members :

The National Correspondents for the International Geodetic Bibliography of the following member countries :

R.C. Rodriguez	(Argentina)	Yun Chel Jong	(D. P. Rep. Korea)
P. Morgan	(Australia)	F. Madsen	(Denmark)
E. Erker	(Austria)	W. Satzinger	(F.R.G.)
C. Poitevin	(Belgium)	R. Kontinen	(Finland)
N. Georgiev	(Bulgaria)	C. Boucher	(France)
A. Mainville	(Canada)	H. Finger	(G.D.R.)
H. Ponce Gerlach	(Chile)	L. Mavridis	(Greece)
X.-B. Wen	(P.R. China)	D. Balodimos	(Greece)
J. Šimek	(Czechoslovakia)	M. Verő-Hétenyi	(Hungary)

INTERNATIONAL ASSOCIATION OF GEODESY

R. Árnason	(Iceland)	A. Luczynska	(Poland)
G.C. Agarwal	(India)	M.A. Rego Chaves Beirão	(Portugal)
S. Mira	(Indonesia)	S. Diatta	(Senegal)
R. Kirwan	(Ireland)	C.L. Merry	(South Africa)
E. Vitelli	(Italy)	T. Miguel Lafuente	(Spain)
T. Hirayama	(Japan)	A.B. Salih	(Rep. Sudan)
G.O. Wayumba	(Kenya)	P. Hodacs	(Sweden)
H. Mdanat	(Jordan)	W. Fischer	(Switzerland)
Ki Soung Kim	(Korea)	D. Kifanga	(Tanzania)
A. Siala	(Libya)	V. Sungpriwon	(Thailand)
A. Razafinakanga	(Madagascar)	A. Ben Haj Salem	(Tunisia)
no nominee (*)	(Netherlands)	M. Serbetci	(Turkey)
N.C. Sutherland	(New Zealand)	H. Rogers	(U.K.)
M.B. Ebong	(Nigeria)	no nominee (*)	(U.S.A.)
L. Bockmann	(Norway)	J. Dobrochotov	(U.S.S.R.)
M.Q. Bari	(Pakistan)	F. Podmore	(Zimbabwe)
C.M. Santos	(Philippines)	Ch. Murigande	(Burundi)

(*) — for correspondence contact secretary of national committee.

— Commission IX

Education in Geodesy

Enseignement de la géodésie

President : E. Krakiwsky (Canada)

I. Program of Activities

Over this quadrennium (1987–1991) the task of I.A.G. Commission IX is to implement the resolutions arising from the International Symposium "Education in Geodesy" held September, 1982 at Graz, Austria. The symposium proceedings were prefaced by addresses from the Presidents of : FIG (Fédération Internationale des Géomètres), ICA (International Cartographic Association), ISM (International Society of Mining) and ISPRS (International Society of Photogrammetry and Remote Sensing), which signified the support of the several international associations involved in education in geodesy. Furthermore, the resolutions had the tacit support of the sister organizations.

The resolutions summarized below are recorded in *Proceedings of the International Symposium "Education in Geodesy"*, September 27–29, 1982. K. Rinner, symposium director. Graz, Austria : Mitteilungen der geodätischen Institute der Technischen Universität Graz, Folge 42, and reported to the XVIII I.U.G.G.—I.A.G. General Assembly in Hamburg, 1983, (see also B.G., Vol. 57, n° 1).

In *Resolution 1* the Symposium recommends that :

- cooperation between FIG, IAG, ICA, ISM, ISPRS and UNESCO in this field be continued,
- every effort be used to publicize to each other and to all interested bodies the report of studies already made of educational systems by the sister organizations in the field of education and practice, in particular, of the report of the regional working groups of IAG, and of Commission 2 of FIG, and of Commission VI of ISPRS.

In *Resolution 2* the Symposium recommends that :

- the Joint Board between the sister organizations, FIG, IAG, ICA, ISM and ISPRS be given official status by the participating societies with appointed members and regularly scheduled meetings.

In **Resolution 3** the Symposium strongly recommends

– the creation of an International Coordinating Committee on Education in surveying and mapping composed of representatives from each of the sister organizations.

In **Resolution 4** the Symposium urges

– that the Coordinating Committee on Education in surveying and mapping to be created, includes among its objectives :

- 1) the collection of information on the various educational systems;
- 2) the transformation of this information into computer readable form and the storage of such information in a computer data base;
- 3) the enhancement, dissemination and making accessible this information to member countries; and
- 4) the creation of a glossary of educational and professional terms used by the profession. (work of the Commission is directed mainly to Resolution 4).

II. Membership of the Commission

President : E.J. Krakiwsky (Canada)
 Secretaries : W. Welsch (F.R.G.)
 M. Kumar (U.S.A.)
 H.J. Matthias (Switzerland)

Regional Coordinators

Africa : new appointment needed.
 Asia : J. Rais (Indonesia)
 Australia : L.A. White (Australia)
 Europe : L. Hora (Czechoslovakia)
 North America : R.H. Rapp (U.S.A.)
 South America : J.B. Lugnani (Brazil)

National representatives

L.A. White	(Australia)	M. Szacherska	(Poland)
K. Rinner	(Austria)	J. Pereira Osorio	(Portugal)
L. Hora	(Czechoslovakia)	H.S. Williams	(South Africa)
A. Tealeb	(Egypt)	L. Sjöberg	(Sweden)
T. Parm	(Finland)	H. Matthias	(Switzerland)
P. Willis	(France)	S. Ndyetabula	(Tanzania)
D. Möller	(F.R.G.)	N. Ratanakarn	(Thailand)
A.K. Sanyal	(India)	M. Charfi	(Tunisia)
T.L. Aziz	(Indonesia)	T. Ayan	(Turkey)
A. Abdel Razek	(Jordan)	P.J. Dare	(U.K.)
J.E. Alberda	(The Netherlands)	B. Schutz	(U.S.A.)
B.M. Jones	(New Zealand)		
S.I. Agajelu	(Nigeria)		

– **Commission XI**

Geodesy in Africa

Géodésie en Afrique

President : **J. Abia** (Ivory Coast)

I. Objectives of the Commission

1. To make an inventory of the status of geodetic work in Africa and to update and maintain such an inventory ;
2. To stimulate and sustain interest of survey organisations in Africa in geodetic work with a view to organising 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 organise 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. Structure of the Commission

A. Bureau

President	: J. Abia	(Ivory Coast)
1 st Vice President	: M. Charfi	(Tunisia)
2 nd Vice President	: O. Fadahunsi	(Nigeria)
3 rd Vice President	: J.D. Obel	(Kenya)
Secretary	: K. Konan	(Ivory Coast)

B. Committees

1. Coordinating Committee for Inter African Geodetic Projects :
Chairman : **O. Adebekun** (Nigeria)
2. Committee on the Definition of African Geoid and Datum :
Chairman : **A.M. Wassef** (Egypt)

3. Committee on Data Bank :
Chairman : **F.A. Fajemirokun** (Nigeria)
4. Committee on Publication and Education :
Chairman : **R.S. Rostom** (Kenya)
5. Committee on Gravity Network :
Chairman : **D.E. Ajakaiye** (Nigeria)
6. Planning and Coordinating Committee :
Provisional Secretary : **J.D. Obel** (Kenya)

C. Executive Committee. It consists of :

- the Bureau
- the immediate past president, **R.O. Coker** (Nigeria)
- the chairmen of the Committees.

— Special Study Group 0.67

History of Geodesy

Histoire de la Géodésie

President : **B.H. Chovitz** (U.S.A.)

I. Program of Activities

To a larger extent than any other Study Group, this SSG depends on the personal interests and activities of the individual members. Therefore, the main objective of the Study Group will be to attempt to encourage contributions of papers, preliminary studies, outlines, and ideas on subjects relating to geodetic history from its members and other sources. Papers will be solicited for presentation at the 1989 IAG General Meeting in Edinburgh.

Further work will be done to update and refine the 1987 report of the SSG at the XIX General Assembly containing the listing of past IAG officers and other well-known geodesists.

Contacts will be made with related organizations (IAU, BIH, ILS, etc.) to solicit suggestions, contributions, and cooperation in preparing historical studies.

II. Membership

B.H. Chovitz, President	(U.S.A.)	J.-J. Levallois	(France)
C.H. Whitten	(U.S.A.)	I. Fischer	(U.S.A.)
M.R. Szacherska	(Poland)	J.A. Weightman	(U.K.)
G. Strasser	(Switzerland)	T. Soler	(U.S.A.)
H. Wolf	(F.R.G.)	C. Kamela	(Poland)
M. Ekman	(Sweden)	A. Waalewijn	(Netherlands)
T.J. Kukkamäki	(Finland)		

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 :

$$a = 6378\,137\text{ m},$$

. geocentric gravitational constant of the Earth (including the atmosphere) :

$$GM = 3986\,005 \times 10^8 \text{ m}^3 \text{ s}^{-2},$$

. dynamical form factor of the Earth, excluding the permanent tidal deformation :

$$J_2 = 108\,263 \times 10^{-8},$$

. angular velocity of the Earth :

$$\omega = 7292\,115 \times 10^{-11} \text{ rad s}^{-1},$$

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 the 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 gravity 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 Pizzetti 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 Somigliana,

$$\gamma = \frac{a \gamma_e \cos^2 \phi + b \gamma_p \sin^2 \phi}{\sqrt{a^2 \cos^2 \phi + b^2 \sin^2 \phi}} ,$$

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 computations 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,
- 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 **J_2** 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, Publ. 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

$$J_2 = \frac{e^2}{3} \left(1 - \frac{2}{15} \frac{me'}{q_0} \right).$$

This equation can be written as

$$e^2 = 3J_2 + \frac{2me'e^2}{15 q_0}.$$

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

$$\begin{aligned} 2 q_0 &= \left(1 + \frac{3}{e'^2} \right) \arctan e' - \frac{3}{e'} \\ &= \sum_{n=1}^{\infty} \frac{4(-1)^{n+1} n}{(2n+1)(2n+3)} e'^{2n+1} \end{aligned}$$

with

$$e' = e(1 - e^2)^{-\frac{1}{2}} \quad (\text{second excentricity})$$

(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 :

$$b = a \sqrt{1 - e^2} \quad (\text{semiminor axis}) ,$$

$$f = \frac{a - b}{a} \quad (\text{flattening}) ,$$

$$E = \sqrt{a^2 - b^2} \quad (\text{linear excentricity}) ,$$

$$c = \frac{a^2}{b} \quad (\text{polar radius of curvature}) .$$

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 :

$$Q = c \frac{\pi}{2} \left(1 - \frac{3}{4} e'^2 + \frac{45}{64} e'^4 - \frac{175}{256} e'^6 + \frac{11025}{16384} e'^8 \right).$$

Various mean radii of the 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

$$U_0 = \frac{GM}{E} \arctan e' + \frac{1}{3} \omega^2 a^2$$

$$= \frac{GM}{b} \left[1 + \sum_{n=1}^{\infty} (-1)^n \frac{e'^{2n}}{2n+1} + \frac{1}{3} m \right]$$

(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 :

$$V = \frac{GM}{r} \left[1 - \sum_{n=1}^{\infty} J_{2n} \left(\frac{a}{r} \right)^{2n} P_{2n}(\cos \theta) \right],$$

where r (radius vector) and θ (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

$$f^* = \frac{\gamma_p - \gamma_e}{\gamma_e} \quad (\text{gravity flattening})$$

is also needed.

A check is provided by the closed form of Clairaut's theorem for the equipotential ellipsoid :

$$f + f^* = \frac{\omega^2 b}{\gamma_e} \left(1 + \frac{e' q_0'}{2 q_0} \right)$$

(p. 69 ; eq. (2-75)).

The Gravity Formula

Somigliana'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

$$\gamma \doteq \gamma_e \left(1 + f^* \sin^2 \phi - \frac{1}{4} f_4 \sin^2 2\phi \right)$$

with

$$f_4 \doteq -\frac{1}{2} f^2 + \frac{5}{2} f m$$

(p. 77, eqs. (2-115) and (2-116)).

More generally, the above closed formula for normal gravity may be expanded into the series

$$\gamma = \gamma_e \left(1 + \sum_{n=1}^{\infty} a_{2n} \sin^{2n} \phi \right)$$

where

$$\begin{aligned} a_2 &= \frac{1}{2} e^2 + k, & a_6 &= \frac{5}{16} e^6 + \frac{3}{8} e^4 k, \\ a_4 &= \frac{3}{8} e^4 + \frac{1}{2} e^2 k, & a_8 &= \frac{35}{128} e^8 + \frac{5}{16} e^6 k. \end{aligned}$$

The average value of gravity over the ellipsoid is

$$\begin{aligned} \bar{\gamma} &= \int_0^{\pi/2} \frac{\gamma \cos \phi \, d\phi}{(1 - e^2 \sin^2 \phi)^2} : \int_0^{\pi/2} \frac{\cos \phi \, d\phi}{(1 - e^2 \sin^2 \phi)^2} \\ &= 1 + \frac{1}{6} e^2 + \frac{1}{3} k + \frac{59}{360} e^4 + \frac{5}{18} e^2 k + \\ &\quad + \frac{2371}{15120} e^6 + \frac{259}{1080} e^4 k + \frac{270229}{1814400} e^8 + \frac{9623}{45360} e^6 k. \end{aligned}$$

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)

$a = 6\,378\,137\text{ m}$	semimajor axis
$GM = 3\,986\,005 \times 10^8 \text{ m}^3 \text{ s}^{-2}$	geocentric gravitational constant
$J_2 = 108\,263 \times 10^{-8}$	dynamical form factor
$\omega = 7\,292\,115 \times 10^{-11} \text{ rad s}^{-1}$	angular velocity

Derived Geometrical Constants

$b = 6\,356\,752.3141\text{ m}$	semiminor axis
$E = 521\,854.0097\text{ m}$	linear excentricity
$c = 6\,399\,593.6259\text{ m}$	polar radius of curvature
$e^2 = 0.006\,694\,380\,022\,90$	e = first excentricity
$e'^2 = 0.006\,739\,496\,775\,48$	e' = second excentricity
$f = 0.003\,352\,810\,681\,18$	flattening
$f^{-1} = 298.257\,222\,101$	reciprocal flattening
$Q = 10\,001\,965.7293\text{ m}$	meridian quadrant
$R_1 = 6\,371\,008.7714\text{ m}$	mean radius $R_1 = (2a + b)/3$
$R_2 = 6\,371\,007.1810\text{ m}$	radius of sphere of same surface
$R_3 = 6\,371\,000.7900\text{ m}$	radius of sphere of same volume.

Derived Physical Constants

$U_0 = 6\,263\,686.0850 \times 10 \text{ m}^2 \text{ s}^{-2}$	normal potential at ellipsoid
$J_4 = -0.000\,002\,370\,912\,22$	} spherical—harmonic coefficients
$J_6 = 0.000\,000\,006\,083\,47$	
$J_8 = -0.000\,000\,000\,014\,27$	
$m = 0.003\,449\,786\,003\,08$	$m = \omega^2 a^2 b / GM$
$\gamma_e = 9.780\,326\,7715 \text{ ms}^{-2}$	normal gravity at equator
$\gamma_p = 9.832\,186\,3685 \text{ ms}^{-2}$	normal gravity at pole
$f^* = 0.005\,302\,440\,112$	$f^* = (\gamma_p - \gamma_e) / \gamma_e$
$k = 0.001\,931\,851\,353$	$k = (b\gamma_p - a\gamma_e) / a\gamma_e$

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

$$\begin{aligned} \gamma = \gamma_e (1 + 0.005\,279\,0414 \sin^2 \phi \\ + 0.000\,023\,2718 \sin^4 \phi \\ + 0.000\,000\,1262 \sin^6 \phi \\ + 0.000\,000\,0007 \sin^8 \phi); \end{aligned}$$

it has a relative error of 10^{-10} , corresponding to $10^{-3} \mu\text{m s}^{-2} = 10^{-4} \text{ mgal}$.

The conventional series

$$\begin{aligned} \gamma &= \gamma_e (1 + f^* \sin^2 \phi - \frac{1}{4} f_4 \sin^2 2\phi) \\ &= 9.780\,327 (1 + 0.005\,3024 \sin^2 \phi - 0.000\,0058 \sin^2 2\phi) \text{ m s}^{-2} \end{aligned}$$

has only an accuracy of $1 \mu\text{m s}^{-2} = 0.1 \text{ mgal}$. 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 Potsdam 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 series 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 $1 \text{ mgal} = 10^{-5} \text{ m s}^{-2}$.

Mean values of normal gravity are

$$\begin{aligned} \bar{\gamma} &= 9.797\,644\,656 \text{ m s}^{-2} && \text{average over ellipsoid,} \\ \gamma_{45} &= 9.806\,199\,203 \text{ m s}^{-2} && \gamma \text{ at latitude } \phi = 45^\circ. \end{aligned}$$

The numerical values given in this section have been computed independently by Mr. Chun—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 corrections 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 No. 7, quoted at the beginning 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 ellipsoid 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 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.



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- W.A. HEISKANEN, and H. MORITZ (1967) : Physical Geodesy. W.H. Freeman, San Francisco.
 International Association of Geodesy (1971) : Geodetic Reference System 1967. Publ. Spéc. n° 3 du Bulletin Géodésique, Paris.
 H. MORITZ (1979) : Report of Special Study Group No. 5.39 of I.A.G., Fundamental Geodetic Constants, presented at XVII General Assembly of I.U.G.G., Canberra.



Editor's Note : Additional useful constants can be obtained from :
"United States Naval Observatory, Circular No. 167, December 27, 1983,
Project MERIT Standards", with updates of December 1985.



PARAMETERS OF COMMON RELEVANCE OF ASTRONOMY, GEODESY, AND GEODYNAMICS

by B.H. Chovitz , former president of SSG 5.100

The 1983 IAG General Assembly charged SSG 5.100 to :

1. Review the most current information available on the values of physical quantities which are fundamentally important in the fields of astronomy, geodesy, and geodynamics.
2. Reconcile this information into a uniform, compatible set.
3. Recommend to the 1987 General Assembly the publication of a set of most up-to-date representative values.
4. Consider the status of the Geodetic Reference System 1980, and if any changes in this reference system should be recommended to the General Assembly.

Since only "parameters of common relevance" are to be considered, these are restricted to those which refer to the Earth as a *body*. Thus, those which relate only to the Earth's center of mass, or, equivalently, do not distinguish between topocentric and geocentric orientation are not discussed. Thus eliminated are astronomical parameters like the astronomical unit, star catalog information, and ephemerides of the Sun and Moon.

Furthermore, only parameters relating to the Earth, as opposed to corresponding ones for the Moon and planets, are reviewed, because the latter are presently only marginally relevant to geodesy. The parameters expressing the gravitational field of the Moon affect the determination of geodetic data from lunar ranging, but an up-to-date list can be found in Project MERIT Standards (1983), pp. 11–12.

The International Astronomical Union (IAU) at its 19th General Assembly in November 1985 authorized (Resolution C1) the formation of a working group to review the system of astronomical constants "in collaboration with the appropriate special study group of the International Association of Geodesy", which is, of course, SSG 5.100. It is essential that these two groups complement, rather than compete with, each other. Therefore, this report will concentrate on those parameters which are primarily geodetic in nature, in particular, the parameters which constitute the traditionally accepted definition of a geodetic reference system (GRS), and, furthermore, include geodynamical considerations by examining their time-varying aspects. It is hoped that a more comprehensive set of parameters, encompassing astronomical, planetary, relativistic, etc., domains, can be issued later as a joint venture of both study groups.

I. Time-invariant values

1. Angular velocity of the Earth's rotation, ω .

Extending the annual sequence of values for ω displayed in the previous SSG

survey (Rapp, 1983) obtained from the annual reports of the Bureau International de l'Heure :

<u>year</u>	<u>ω</u>
1978	7 292 114.903 (10^{-11}) rad/s
1979	4.925
1980	4.952
1981	4.964
1982	4.964
1983	4.954
1984	5.019
1985	5.025

The change in ω over this 8 year span is (10^{-12}) rad/s . Since seasonal variations are of the same order of magnitude, this reinforces the longstanding IAG decision to present a fixed value of ω to no more than 7 significant digits. Thus :

$$7.292\ 115\ (10^{-5})$$

is recommended for retention as the representative value.

2. Geocentric gravitational constant, GM .

The most productive source of information for determination of GM has been **Lageos**. Reduction of observations by NASA Goddard Space Flight Center (D. Smith, personal communication, November 1986) and by the University of Texas (Tapley et al., 1985) has yielded

$$3\ 986\ 004.40 \pm .02\ (10^8)\ m^3/s^2$$

Lunar laser ranging (LLR) provides another source of data, but these observations are referred to a coordinate system with origin at the Earth-Moon barycenter, and subject to a relativistic correction to transfer to a geocentric origin of $(+.06)\ (10^8)\ m^3/s^2$ (Martin et al., 1985). The most recent determination of GM by the Jet Propulsion Laboratory (JPL) based on LLR data, and shifted from the barycentric to the geocentric origin is (J. Dickey, personal communication, January 1987)

$$3\ 986\ 004.43 \pm .06\ (10^8)\ m^3/s^2$$

The above two values are compatible since the error bar range of the latter includes that of the former. Therefore, as the current representative value the **Lageos** determination has been chosen, but with a slightly more conservative standard error which overlaps the LLR estimate :

$$3\ 986\ 004.40 \pm .03\ (10^8)\ m^3/s^2$$

Of course, in accordance with the GRS 80 convention, this includes the atmospheric contribution.

3. Equatorial radius, a .

As implied in Rapp (1983), improvement in the determination of a depends more on refining its definition than in better measurement — a consequence of this parameter lacking the natural relationship to physical reality enjoyed by the other three

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of the Geodetic Reference System. (In this respect, the potential of a particular level surface would serve as a more complementary substitute.) Some additional information on the size of a has accumulated over the past 4 years, but the uncertainties associated with these determinations have not decreased, due mainly to the difficulty in precisely relating the ellipsoidal model to the geoid. The recent NASA Goddard GEM-T1 satellite solution for the Earth's gravitational field (J. Marsh, personal communication, November, 1986) yielded

$$6\,378\,137.8 \pm 2.6 \text{ m}$$

based on comparison of geoidal and ellipsoidal heights at 30 tracking stations. A combination of Doppler data and gravimetry at the Ohio State University (R. Rapp, personal communication, November, 1986) resulted in

$$6\,378\,136.2 \text{ m}$$

estimated to be good to ± 0.5 to $\pm 1 \text{ m}$.

Another possible source of evidence for a is the global mean equatorial value of terrestrial gravity, γ . To the first-order, a is a function of both GM and γ . Since GM is known to two orders of magnitude better than a , its value can be fixed at the representative value listed under para. 1., leaving a to vary just with γ . This yields the following tabular relationship :

γ (mgal)	a (m)
978 033.1	6 378 135
2.8	6
2.5	7
2.2	8

Rapp (ibid.) has supplied two recent values of γ , one from terrestrial data, and one utilizing comparisons with altimetric data found in Rapp (1986). The first reduces to

$$(978\,032.4 + c) \text{ mgal}$$

where $0 < c < 1.5$ represents an imperfectly determinable terrain correction. The second furnishes

$$978\,032.6 \text{ mgal}$$

with an unstated standard error. These values of γ indicate that they are hardly reliable to 7 significant figures and thus cannot yield definitive information to what is already known about a . However, they are sufficiently consistent with each other to lend credence to a value for a of 6 378 136 m (Rapp, 1983) or the GRS 80 value of 6 378 137 m. Since there is no real evidence to support a change in the 1983 recommendation, we retain as the current representative value

$$6\,378\,136 \pm 1 \text{ m}$$

However, it has been rewritten to display only seven significant figures, in order to emphasize the limits of our present information. The most promising approach over the next quadrennium for improving knowledge of a should be utilization of new altimetry data along with the means of filtering out the sea surface topography at the 10 cm level.

4. Second-degree zonal harmonic coefficient, J_2 .

The most recent comprehensive satellite-only solution for the Earth's

gravitational field is GEM-T1 (Marsh, *ibid.*), which produced for J_2 , corresponding to a scale of $a = 6\,378\,136\text{ m}$:

$$(1\,082\,625.6 \pm 0.9)(10^{-9})$$

The relation between J_2 and a is given by

$$dJ_2/da = -0.3(10^{-9})\text{ m}^{-1}$$

The uncertainty in a will slightly increase the formal uncertainty in the above value of J_2 to ± 1.0 .

The change in J_2 to GEM-T1 from the previously best accepted Goddard model, GEM-L2, quoted in Rapp (1983), is $-3.2(10^{-9})$. Although GEM-T1 is deemed the superior model, principally because of its more comprehensive modelling of ocean tides, it is definitely capable of improvement by addition of altimetric and terrestrial gravity data. These changes could very well affect the seventh significant digit in J_2 . Therefore, a current representative value of J_2 is conservatively taken to be

$$(1\,082\,626 \pm 2)(10^{-9})$$

In accordance with the accepted GRS definition, the zero-frequency tidal effect on J_2 of $+9.3(10^{-9})$ is excluded from the above value.

II. Time-varying values

This section will be devoted to consideration of the GRS parameters in the form

$$p = p_0 + \dot{p} t$$

where p represents ω , GM , a , or J_2 ; t is time elapsed from some epoch, and $\dot{p}$ is a constant rate of change for the parameter p . The only other sort of time variation for which there is firm evidence is periodicity in ω which will be discussed under that heading.

1. $\dot{\omega}$.

As mentioned before, periodic changes affect the eighth significant digit of ω . Previous SSG reports have stated that these do not affect most geodetic applications. However, they do entail important consequences in geodynamical processes. There are an extremely complex and very wide range of frequencies : daily, seasonal, annual, multi-year, decadal, etc. A great deal of fresh evidence has accumulated over the past several years on the shorter periods especially from VLBI observations. The annual reports of the Bureau International de l'Heure remain the best and most comprehensive source of data on this subject. A recent general review of the causes and consequences of periodic variations in ω can be found in Dickey and Eubanks (1985). It is felt that it would be premature for this SSG to attempt to extract and generalize from these and other reports, so this discussion will be confined to the secular variation only.

The secular change in ω consists of two parts : a tidal deceleration, $\dot{\omega}_T$, and a non-tidal acceleration, $\dot{\omega}_{NT}$, the possible causes of which are discussed in Lambeck (1980). Determination of $\dot{\omega}_T$ are derived from observations of $\dot{n}$, the change in the Moon's mean motion, or from Earth-satellite solutions for tidal components. The prime

source of recent information on $\dot{\omega}_{NT}$ has been $\dot{J}_2$, which reflects what currently may be the main cause of $\dot{\omega}_{NT}$: post-glacial backsurge in the Earth's mantle, affected by the gravitational attraction of the core. Total $\dot{\omega}$ is measured directly, and can be inferred from geological evidence and astronomic records. Thus there are three separate sources of data connecting the equation

$$\dot{\omega} = \dot{\omega}_T + \dot{\omega}_{NT}$$

providing a check on the reliability of the data and the underlying hypotheses.

Recent studies of $\dot{\omega}$ have been carried out at JPL and Goddard. The former (Yoder et al., 1983, revised by Dickey, personal communication, 1987) obtained

$$\dot{\omega}_T = -6.0 \pm 0.3 (10^{-22}) \text{ rad/s}^2$$

$$\dot{\omega}_{NT} = +1.5 \pm 0.2 (10^{-22}) \text{ rad/s}^2$$

The first is based on $\dot{n} = (-24.9 \pm 1.0)''/\text{cy}^2$ obtained from LLR data (Newhall et al., 1986). The second is due to Morrison and Stephenson (1982) derived from long-term astronomic data.

The Goddard (Christodoulidis et al., 1987) values are

$$\dot{\omega}_T = -5.98 \pm 0.22 (10^{-22}) \text{ rad/s}^2$$

$$\dot{\omega}_{NT} = +1.29 \pm 0.28 (10^{-22}) \text{ rad/s}^2$$

The first is based on a detailed tidal analysis derived from a multi-Earth-satellite solution, and the second utilizes $\dot{J}_2 = -2.8 (10^{-11})/\text{yr}$ (Rubincam, cf. para. 4 below).

Another recent solution for $\dot{\omega}_{NT}$ is by Burša (1986a) who obtains $+1.2 (10^{-22}) \text{ rad/s}^2$ based on $\dot{J}_2$ of $-2.6 (10^{-11})/\text{yr}$.

These results yield confidence that the components of $\dot{\omega}$ are now known to better than 5 in the second significant figure. Thus current representative values are assigned as

$$\dot{\omega}_T = -6.0 \pm 0.3 (10^{-22}) \text{ rad/s}^2$$

$$\dot{\omega}_{NT} = +1.4 \pm 0.3 (10^{-22}) \text{ rad/s}^2$$

yielding the composite result

$$\dot{\omega} = -4.6 \pm 0.4 (10^{-22}) \text{ rad/s}^2$$

It should be noted that this magnitude is 15 % smaller than the value given in Lambeck (1980).

The validity of the value and standard error assigned to $\dot{\omega}_{NT}$ should be understood as being limited by the following considerations. On the one hand, inter-decadal (10 to 100 years) fluctuations which can be an order of magnitude larger are supposed to be removed; on the other hand, the best source of evidence, $\dot{J}_2$, refers to a phenomenon (post-glacial rebound) which holds for a period of less than 10^5 years.

Quoting from Morrison and Stephenson (1982) who refer to their estimate of $\dot{\omega}_{NT}$ given above, "This value ... is clear evidence of a long-term, non-tidal acceleration component in the Earth's rotation which probably arises from a fractional change of the opposite amount in the moment of inertia. This is the average value over 2500 years and it is not necessarily constant over the intervening period."

2. $\dot{G}$

The scientific interest in change in GM centers on $\dot{G}$, because of its wide ramifications in physics, and because no evidence has turned up for any discernible change in $\dot{M}$. Based principally on Mars Viking Lander data, both Reasenberg (1983) and Hellings et al., (1983) have separately determined values that correspond at the level of

$$\dot{G}/G < \pm 1 (10^{-11})/\text{yr}$$

These values are compatible with $\dot{G} = 0$, representing upper bounds on $\dot{G}$. The uncertainty is due mainly to uncertainties in knowledge of the masses of the asteroids.

A non-zero value of $\dot{G}$ would affect $\dot{\omega}_{NT}$. Lambeck (1979) gives the relation, based on eclipse data

$$\dot{\omega}_{NT}/\omega = -1.8 \dot{G}/G$$

yielding, for given $\dot{\omega}_{NT} = 1 (10^{-22}) \text{ rad/s}^2$,

$$\dot{G}/G = -2.4 (10^{-11})/\text{yr}$$

This is near the bound stated above for $\dot{G}/G$ from Viking data, which is not affected by $\dot{\omega}_{NT}$. Lambeck (1980) obtains from differencing $\dot{\omega}$ and $\dot{\omega}_T$

$$\dot{\omega}_{NT} = +1.6 (10^{-22}) \text{ rad/s}^2 \quad \text{if } \dot{G} = 0$$

$$= +0.5 (10^{-22}) \text{ rad/s}^2 \quad \text{if } \dot{G} \neq 0.$$

This difference appears to correspond to $\dot{G}/G = 2.4 (10^{-11})/\text{yr}$ given above. Since the discussion under $\dot{\omega}$ indicated that $\dot{\omega}_{NT}$ due to $\dot{J}_2$ alone is $+1.4 (10^{-22}) \text{ rad/s}^2$, this puts a further constraint on the size of $\dot{G}$.

In summary, there is no real evidence at present that $\dot{G} \neq 0$.

3. $\dot{a}$

Lambeck (1979) lists $\dot{a}$ as one of the possible generators of $\dot{\omega}_{NT}$, and deduces that $\dot{a} = -1 \text{ mm/yr}$ corresponds to $\dot{\omega}_{NT} = (10^{-22}) \text{ rad/s}^2$. Since this is the approximate size of $\dot{\omega}_{NT}$ which is caused by other factors, primarily $\dot{J}_2$, this imposes an upper limit on the possible change in size to less than 1 mm/yr .

Burša (1984) shows that the Earth's principal moment of inertia cannot be increasing, based on derivations from the values of $\dot{n}$ and $\dot{\omega}$ determined from LLR, and as implied in the discussion of $\dot{\omega}_{NT}$.

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Thermal evolution models of the Earth (Christensen, 1985) indicate a rate of cooling of about $0.1^{\circ}\text{C}/\text{my}$. From this can be inferred a maximum $\dot{a}$ of less than $- .01 \text{ mm}/\text{yr}$.

Thus no evidence appears to exist for a non-zero value of $\dot{a}$.

It should be acknowledged, however, that some geophysicists have held a different view; cf., e.g., Wesson (1975) and Carey (1976).

4. $\dot{J}_2$

The principal results have again been obtained at JPL and Goddard. From Yoder et al., (1983) :

$$\dot{J}_2 = -3.1 (10^{-11})/\text{yr} \text{ based on glaciation rebound of } 2\,800 \text{ yr}$$

Dickey (personal communication, January 1987) states that a revised solution is underway which is anticipated to fall between -2.6 and $-3.1 (10^{-11})/\text{yr}$.

From Rubincam (1984) :

$$\dot{J}_2 = -2.6 \pm .6 (10^{-11})/\text{yr}$$

Rubincam's latest result (personal communication, November 1986) is

$$\dot{J}_2 = -2.8 \pm 0.3 (10^{-11})/\text{yr}$$

Since this corresponds very well with the latest JPL results, it is recommended as the current representative value.

III. Related results

In this section is covered related results pertaining to the GRS coordinate system and derived parameters, mostly due to studies by Milan Burša over the past 4 years.

Burša and Sidlichovsky (1985) show that $\dot{J}_2 = -3 (10^{-9})/\text{cy}$ affects the Eulerian period of polar motion by $+70 \text{ s}/\text{cy}$ and the amplitude by about $-2 \text{ cm}/\text{cy}$.

Burša (1986b) quotes Vondrak (1985) that the secular motion of the pole based on astrometric observations during 1900 to 1984 has been $.0033''/\text{yr}$ along the meridian 281.8°E with reference to the CIO pole.

Burša (1985) presents an interesting table on how the Earth's moments of inertia and the flattening, f , vary over the period covering -10^6 to $+4 (10^5) \text{ yr}$ with respect to the present. For example, $1/f$ ranges from 294.7 to 299.7 . (In doing this, however, he extrapolates the currently known value for $\dot{J}_2$ to apply over that entire time interval.)

Burša (1986c) computes $\dot{C}$, the secular variation in the Earth's principal moment of inertia, to be :

$$-3.8 \pm 0.6 (10^{29}) \text{ kg m}^2/\text{cy} \quad \text{from the constraint of angular momentum balance of the Earth-Moon-Sun system}$$

$$-4.2 \pm 0.9 (10^{29}) \text{ kg m}^2/\text{cy} \quad \text{from observed } \dot{J}_2$$

Also, from $\dot{J}_2$ he derives

$$(\dot{1}/f) = -4.1 (10^{-9})/\text{cy}$$

This last value is also affected to a lesser extent by the secular motion of the pole, and to an even lesser extent by $\dot{\omega}$.

Nagy (1985) has compared the GRS 1980 gravity formula with a revision obtained by substituting the representative values given by Rapp (1983), and shows that there is no practical difference.

Finally, detailed discussions on the distinction between the barycentric and geocentric coordinate systems as a result of the relativistic effect can be found in Hellings (1986), Martin et al., (1985), and Ashby and Bertotti (1986).

IV. Summary

It is recommended that a current set of representative values for the GRS parameters now include their secular changes. The following list is submitted :

$$\omega = 7.292\,115 \pm 0.1 (10^{-5}) \text{ rad/s}$$

$$\dot{\omega}_T = -6.0 \pm 0.3 (10^{-22}) \text{ rad/s}^2$$

$$\dot{\omega}_{NT} = +1.4 \pm 0.3 (10^{-22}) \text{ rad/s}^2$$

$$GM = 3\,986\,004.40 \pm 0.03 (10^8) \text{ m}^3/\text{s}^2$$

$$\dot{G}/G = 0 \pm 1 (10^{-11})/\text{yr}$$

$$a = 6\,378\,136 \pm 1 \text{ m}$$

$$\dot{a} = 0$$

$$J_2 = 1\,082\,626 \pm 2 (10^{-9})$$

$$\dot{J}_2 = -2.8 \pm 0.3 (10^{-11})/\text{yr}$$

It is not recommended that any change be made at present in GRS 80. However, serious consideration should be given over the next quadrennium to revising GRS 80 in two ways :

1. Establish time-varying rates (with an epoch) where warranted (J_2 being most likely).
2. Define and fix a reference coordinate system most compatible with modern measurements. (This might be most appropriately considered by the new Earth Rotation Service.)



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Bollettino di Geodesia e Scienze Affini

Istituto Geografico Militare Italiano, 10 Via Cesare Battisti, 50100 Firenze, Italy.

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140, rue de Grenelle, 75700 Paris, France.

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Bulletin Géodésique

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Geographical Survey Institute, Kitasato 1 Yatabe-Machi Tsukuba-Gum, Ibaraki 300-21, Japan.

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Federal Office of Topography, Seftigenstrasse 264, CH-3084 Wabern, Switzerland.

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Università di Cagliari, Istituto di Astronomia, 09100 Cagliari, Italy.

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Polish Academy of Sciences, Astronomical Latitude Observatory, Borowiec, 63-120 Kornik, Poland.

Communication of the Geodetic and Geophysical Research Institute of the Hungarian Academy of Sciences

Research Inst. of the Hungarian Academy of Sciences, Museum U. 6-8, P.O.B. 5, H-9401, Sopron, Hungary.

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Committee on Space Research, 51 Boulevard de Montmorency, 75016 Paris, France.

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DMA, Hydrographic & Topographic Center, 6500 Brooks Lane, Washington D.C. 20315, U.S.A.

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Department of National Development – Division of National Mapping Technical Report

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Institut für Geodäsie und Photogrammetrie, ETH-Hönggerberg, CH-8093 Zürich, Switzerland.

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The Kiev Institute of Engineering Construction

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American Geophysical Union, 2000 Florida Av., Washington D.C. 20009, U.S.A.

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European Space Agency, 8-10, Rue Mario Nikis, 75738 Paris 15, France.

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Spalena 51, 11302 Praha 1, Czechoslovakia.

Geodezia es Kartografia

Cartographia, Box 132, 1443 Budapest, Hungary.

Geodezja i Kartografia

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Géomètre

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The Royal Society, 6, Carlton House Terrace, London SW1Y 5AG, U.K.

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Harita Dergisi

Harita Genel Komutanligi, Yayinlari, Ankara, Turkey.

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Istituto di Geodesia e Geofisica dell'Università di Trieste – Pubblicazione

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Piazzale Europa 1, 34127 Trieste, Italy.

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VEB Carl Zeiss Jena, Carl Zeiss Str. 1, 6900 Jena, D.D.R.

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Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, Cal. 91109, U.S.A.

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American Geophysical Union (AGU), 2000 Florida Avenue N.W.,
Washington, D.C. 20009, U.S.A.

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Arcisstrasse 21, D-8000 München 2, F.R.G.

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Mommsenstrasse 13, 8027 Dresden, D.D.R.

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 (eight places, entry each centigrade).
- N° 2 — (out of print).
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All these publications are available on request to :

Bureau Central de l'A.I.G.
140, rue de Grenelle, 75700 Paris (France).

V — Bibliographie géodésique internationale

- From 1928 to 1960 : 10 issues (available from Bureau Central).
- From 1961 :
 - Cards
 - Monthly Review : "*Bibliographia Geodaetica*" (in English),

available from :

Zentralstelle für Internationale Dokumentation der Geodäsie
Mommсенstrasse 13, Dresden 8027 (German Dem. Republic).

VI — Catalogue of Reference Gravimetric Stations along the European Coasts from Norway to Italy

available at :

International Gravity Commission — Subcommission Western Europe
Bayer. Akademie der Wissenschaften, Marstallplatz 8,
D-8000 München 22, (F.R.G.).

A SURVEY OF CALIBRATION BASELINES

prepared by :

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Center for Mapping,
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1958 Neil Avenue,
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Introduction

In June 1987, a letter was sent to approximately 30 countries throughout the world requesting information on their baseline programs (**Appendix A**). Individual countries had different interpretations of the letter – the replies varied in length from a single page to over fifty pages. The chart (**Appendix B**) is an attempt to present the minimum common information received from the countries. Also included is a list of countries that have not yet responded.

The maps (**Appendix C**) show the baseline locations in the various countries. It should be noted that some countries indicated that they have several baselines but only gave the location of their National Standard Baseline. Therefore, some maps show only one baseline when there may actually be more.

Finally, it is encouraging to note that almost all of the countries contacted expressed their interest in the continuation of international cooperation. Developing international communication and cooperation will be beneficial for all geodesists interested in knowing the status of global geodetic science programs.

Acknowledgements

I want to thank Ms. Cindy Fowler, Mr. James Carswell, and Mr. Jeffrey Kass of the Department of Geodetic Science and Surveying at The Ohio State University for their assistance in preparing this report.

Appendix A

Letter sent to National Data Centers

June 17, 1987

Dear Colleague ,

The International Association of Geodesy (IAG) has decided to publish information about "Calibration Baselines" in the Geodesist's Handbook. These baselines are useful to national practitioners involved in surveying for checking, calibrating and using their electronic distance measuring devices. Because of our growing *international* cooperation this information may be of great value to a wide audience. Therefore, I would be grateful if you provided me with :

- (1) A statement indicating if such baselines exist in your country,
- (2) An address where one could write for more information about the baselines,
- (3) A map of the location of existing baselines, and
- (4) A one-paragraph description of your baseline "program".

Please send this information to me by August 30, 1987. My address is the Center for Mapping, 404 Cockins Hall, 1958 Neil Avenue, Columbus, Ohio 43210-1247. It may be possible to publish this information in the 1988 edition of the Geodesist's Handbook.

Thank you for your cooperation.

Sincerely,

John D. Bossler
President, Section I, IAG

Edition note : new information should be sent to the general secretary of IAG, in order to be included in contingent updates to the Geodesist's Handbook.

Appendix B

INFORMATION RECEIVED

Country	No. of Baselines	National Standard Baseline		
		Location	Length (m)	Established by
Australia	40			Geomensor
Canada	36	Ottawa		Geomensor Mekometer
China	20 (approx.)	Changyang	432	VLIC* Mekometer
Finland	2	Nummela	864	VLIC* Invar wires
France	**			
Great Britain	2 plus			Mekometer Geomensor
Hungary	5	Gödöllő	864	Invar wires VLIC*
Ireland	3			Tellurometer Siemens MD60
Kenya	***			
Madagascar	1	Laniera	2100	Invar wires
Netherlands	1	Loenermark	576	
New Zealand	15			
Norway	12	Eggemoen		
Portugal	1	Mata das Virtudes	480	VLIC*
South Africa	19			
Spain	1	Valladolid	432	VLIC*
Thailand	22 ¹			Invar wires
Tunisia	1 ¹		164	
United States	235		1000-1400	Invar/Lo-var tapes Tellurometer
West Germany	1	Munich	864	VLIC*

* Väisälä Light Interference Comparator

** France indicated that they have "several".

*** Kenya indicated that they have "a number".

¹ Baselines of triangulation network, not Calibration Baselines

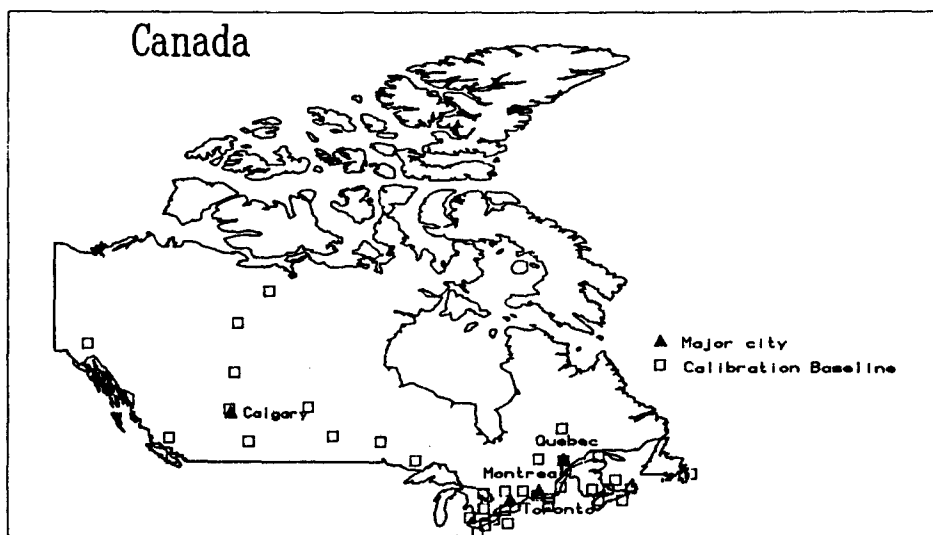
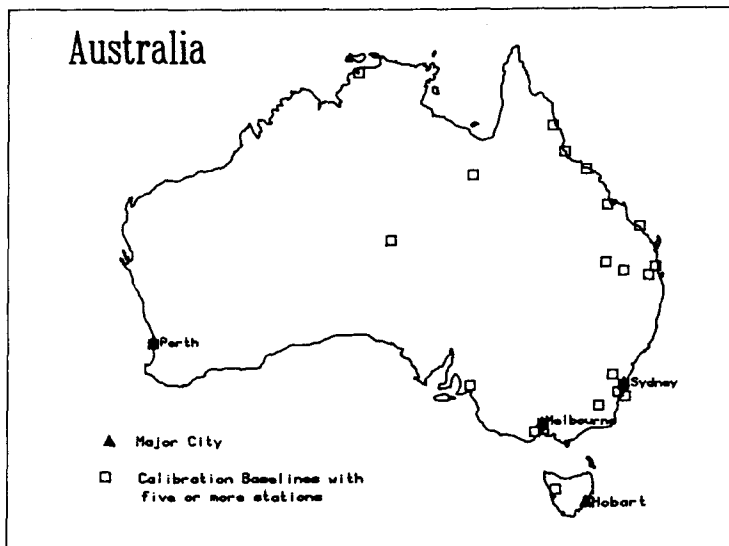
Note: Blank spaces in this chart indicate that the country did not supply the specific information required for the category.

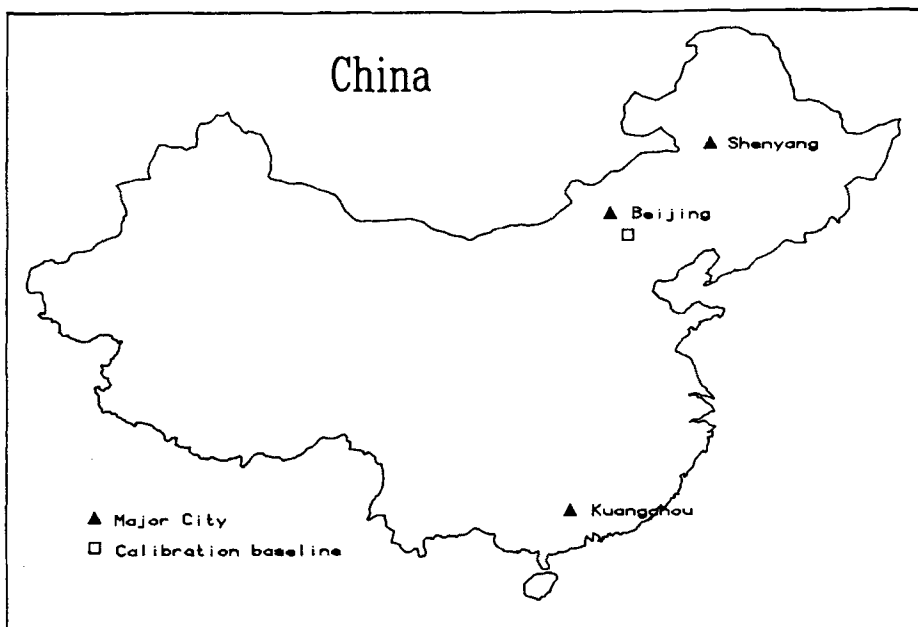
The following countries were contacted but have yet to respond:

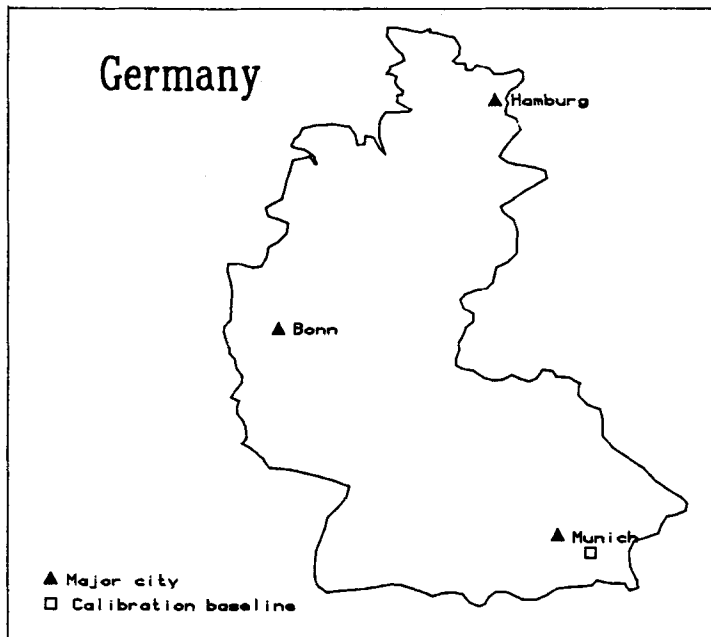
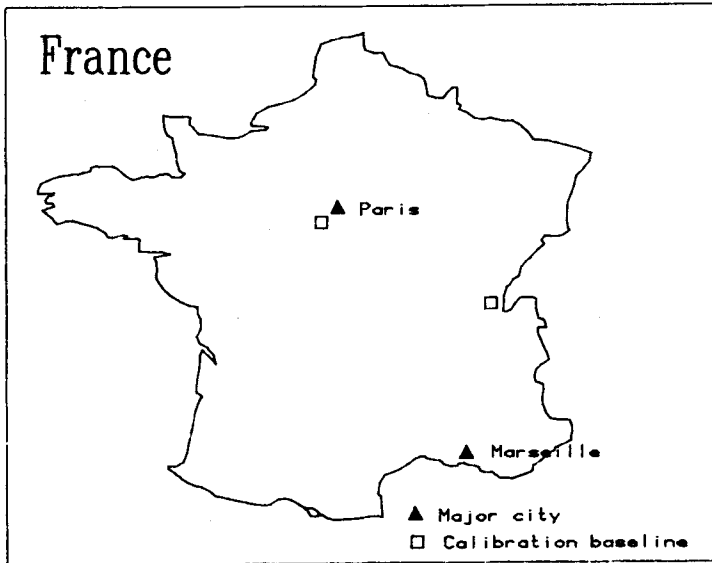
Algeria	Japan
Austria	Mexico
Belgium	Sweden
Denmark	Syria
Iceland	

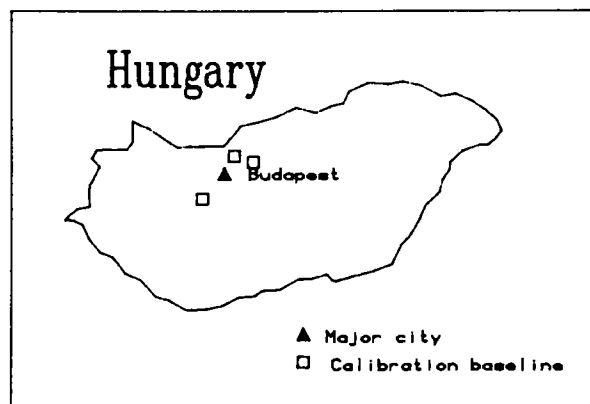
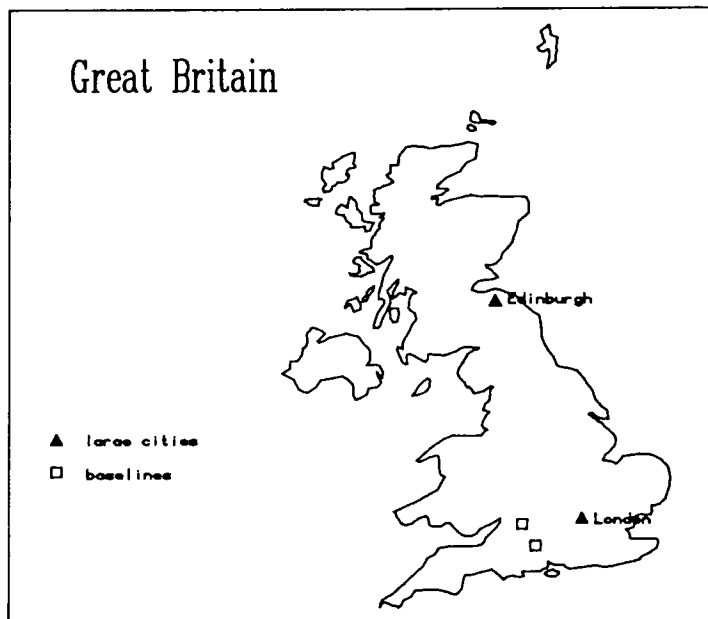
Appendix C

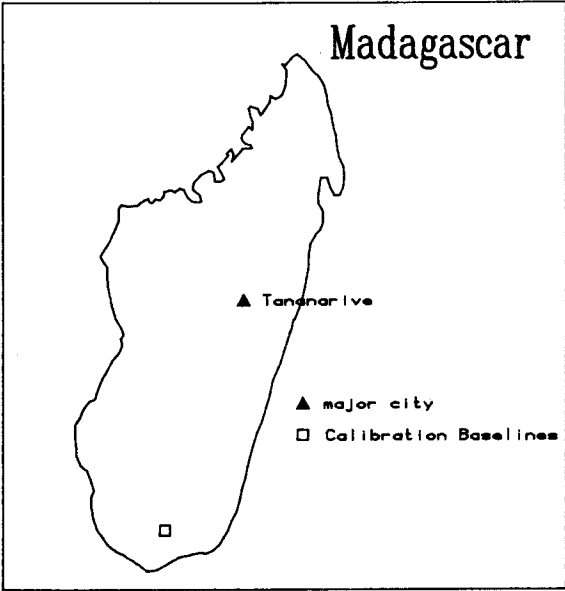
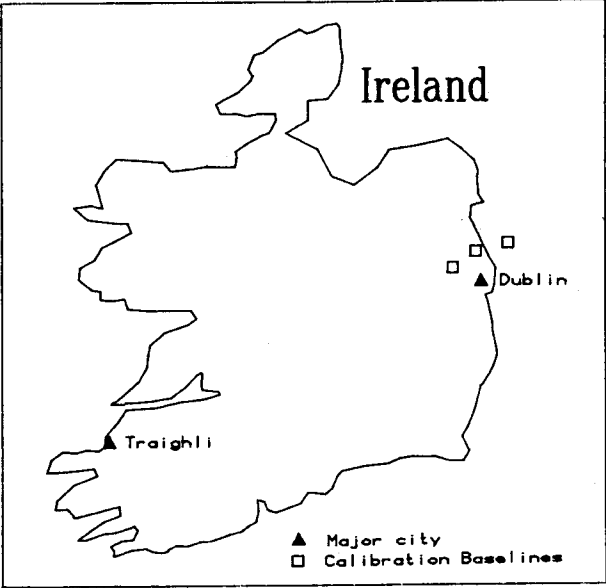
LOCATION OF CALIBRATION BASELINES

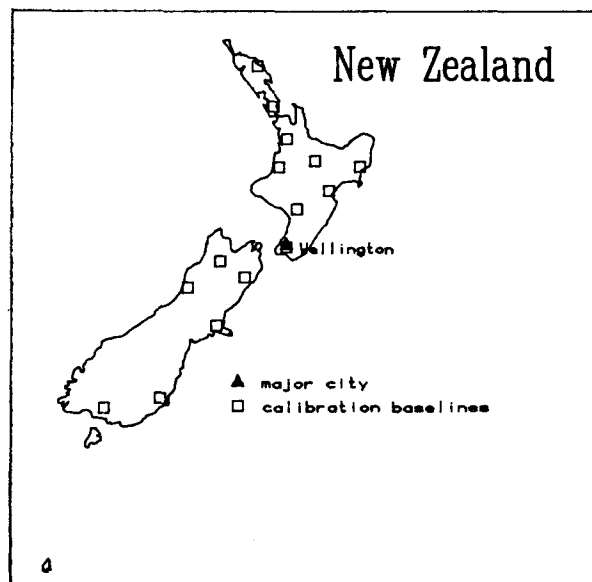


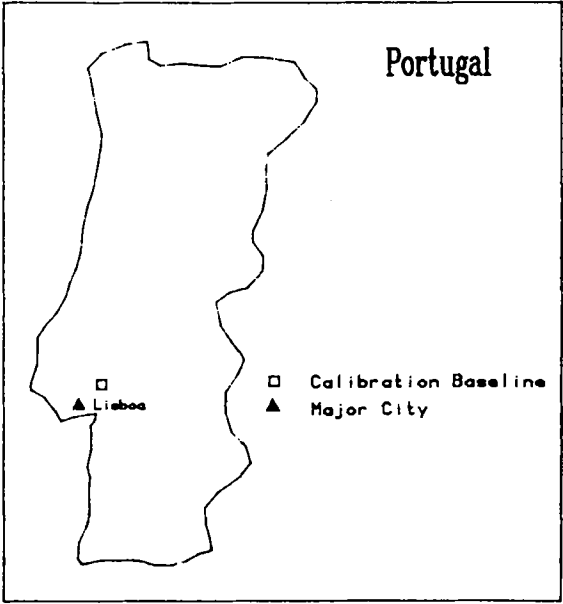
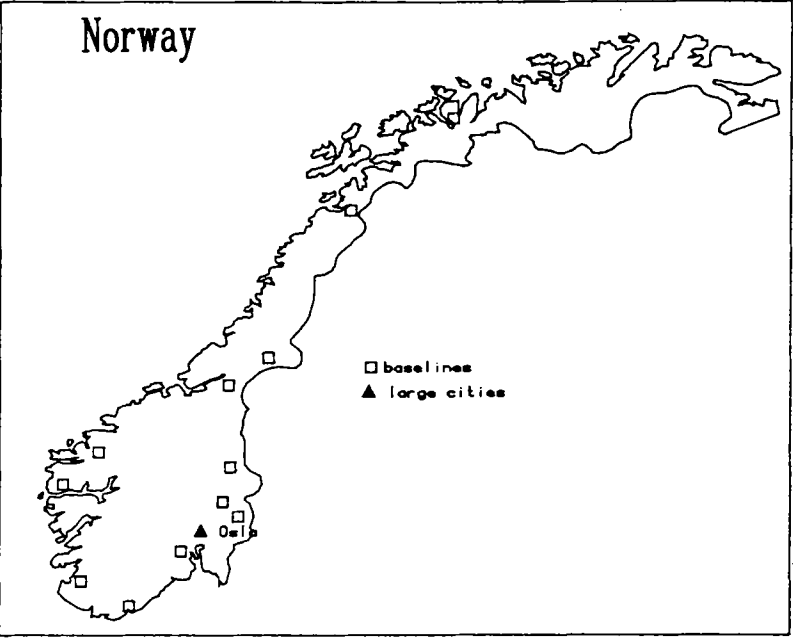


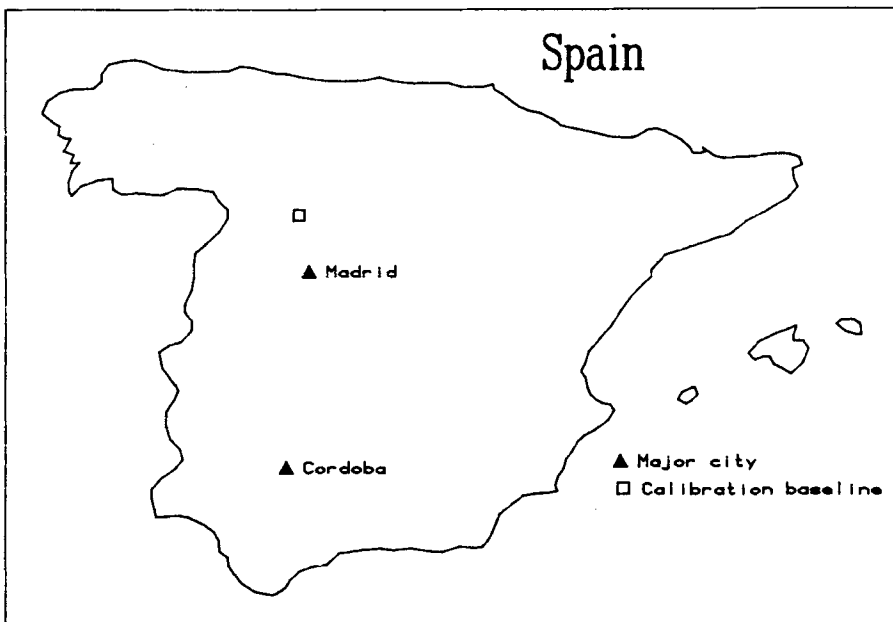
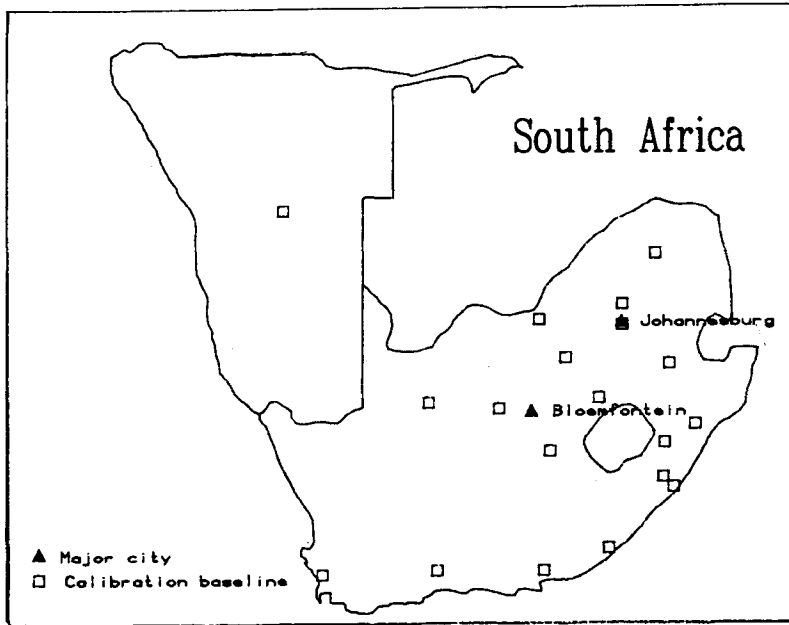


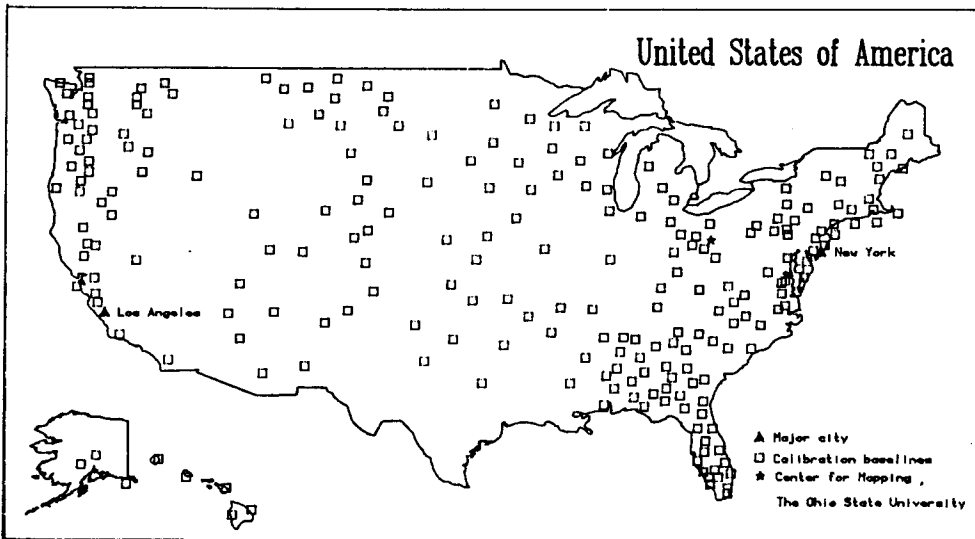
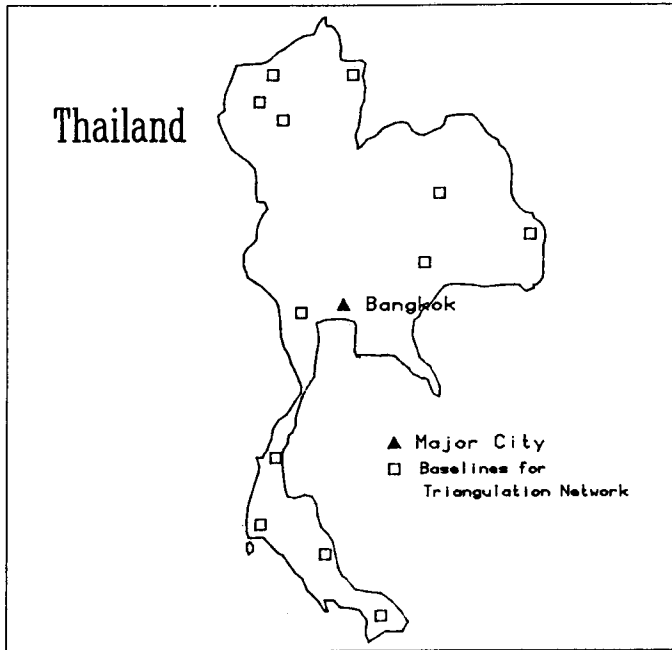












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- . subscribers to the Bulletin Géodésique whose addresses do not appear in the preceding items.

This list seems to be a very useful tool for all our readers, if you note some *errors, omissions, changes*, etc..., please send information immediately to the Bureau Central of I.A.G., 140 rue de Grenelle, 75700 Paris. *Corrections* and *additions* will be published at least *once a year* in the normal issues of the Bulletin Géodésique.

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