



International Earth Science in the 21st Century

Science and Organizational Strategies for the
International Union of Geological Sciences

By IUGS Strategic Planning Committee



International Union of Geological Sciences
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FOREWORD

The emergence of this strategic plan is an important event for the IUGS. It clearly proves, if proof were needed, that the IUGS is determined to be as relevant in the future as it has been in the past. That relevance has long been recognized by the earth-science community but has not been acknowledged to nearly the same extent by the community at large. This is perhaps inevitable given the nature of science (and scientists), but it is something that this plan seeks to address through its emphasis on interdisciplinary studies and applied earth science that addresses the needs of society. At the same time, the intent is to ensure that basic earth science is not neglected and that technology-transfer and education receive adequate attention.

The Strategic Planning Committee congratulates the IUGS Council for their wisdom and determination to initiate this important effort to begin charting the future of the Union.



Peter Cook, Chairman
for the Strategic Planning Committee

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EXECUTIVE SUMMARY

The International Union of Geological Sciences (IUGS) plays an effective and vital role in the conduct and maintenance of international geoscience; it is greatly valued by the geoscience community. However the Union has also recognized for some time that there is a need to change to reflect new circumstances including political developments, the needs of the developing world, the challenge of new areas in science, the opportunities provided by the internet, and the changing needs of the community at large. Along with these broader issues are the IUGS's concerns resulting from limited funding, complex organizational arrangements, and a ponderous decision-making process. In order to address these and related issues, a Strategic Planning Committee (SPC) was established to make recommendations on future directions.

In all, the SPC made 32 recommendations on scientific, organizational, and financial issues. Most of these are at a fairly high level, and the Committee did not attempt to deal with the details of implementation, for to have attempted to do so would have diverted the SPC from its strategic task. As a result, there will no doubt be some significant practical issues to be addressed by the Bureau and Executive Committee following consideration of the recommendations by the Council. Nonetheless, the SPC has provided a road map for the IUGS that should serve to define the direction of the Union for many years to come.

The formal deliberations of the SPC took place at a meeting held over three long days in Prague, Czech Republic, in September 1999. At that meeting, the Committee carefully reviewed the structure and effectiveness of the IUGS, concentrating particularly on its organization and operations, scientific programs, partnerships, communications and publications, and funding. Also considered were the responses to a lengthy questionnaire circulated prior to the meeting to seek the views of the IUGS "family" and the broader scientific community. These thoughtful opinions were very useful in helping the committee to identify organizational and programmatic strengths, weaknesses, and other issues upon which it should focus attention in the course of formulating a strategic plan.

The resulting strategic plan is presented in this report as a set of recommendations. These address issues, concerns, and problems identified in the topical areas (mentioned in the previous paragraph) where the SPC concentrated most of its attention and established the needs and the rationale for taking action. The recommendations, taken together, constitute a prescription to guide the IUGS in bringing about organizational change and renewal, leading to stronger, more diverse, and more effective basic and applied scientific programs, and to improved visibility and recognition in the scientific community at large.

Summary of Recommendations

General

1. The IUGS is of great value to the geoscience community; it must be maintained and strengthened.

A Mission Redefined

2. The mission of the IUGS is to unite the global geological community in (i) promoting development of the earth sciences through the support of broad-based scientific studies relevant to the entire earth-system, and (ii) applying the results of these and other studies to preserving Earth's natural environment, using all natural resources wisely, and improving the prosperity of nations and the quality of human life.

3. The goals of the IUGS should include the following:

- **Serve as an impartial international scientific union addressing global issues that involve the earth sciences.**
- **Contribute to the advancement of geological research throughout the world, including both fundamental earth science aimed at understanding the global earth system (a plexus of geological, geophysical, geochemical, and biological processes and their myriad complex interactions), and applied earth-science that uses the developing understanding of the earth system to address problems of particular relevance to the welfare of the earth's human population.**
- **Represent the geological sciences in governmental and non-governmental forums to inform, advise, and influence public policy and decision-makers.**
- **Encourage, in cooperation with other organizations, more interdisciplinary involvement within the broad spectrum of the geosciences in developing solutions to global problems.**
- **Foster collaboration between developed and developing countries in earth-science research, capacity building, and applications.**
- **Contribute to earth-science education and the advancement of public understanding of the earth sciences and their significance in solving societal problems.**
- **Encourage the career development of young earth scientists.**
- **Increase the relevance of IUGS publications to issues of truly global earth science and make these publications more widely available.**
- **Enhance the visibility of the earth sciences and demonstrate their profound influence in planning for rehabilitation and preservation of the future planetary environment by seeking greater involvement in public affairs and by publicizing the critical role that only the earth sciences can play.**

Strategic Issues: Science

4. *The IUGS should embark on new, high-priority earth-science activities of demonstrable relevance to society, including, but not limited to:*

- *Reducing vulnerability of communities to natural hazards.*
- *Mitigating the effects of waste and pollution.*
- *Understanding global environmental change.*
- *Biodiversity.*
- *Managing resources and sustaining the environment.*

5. *The ABRD should play a key role in identifying fruitful new scientific directions and research topics, evaluating submitted proposals seeking IUGS funding and other support, and recommending to the Executive Committee those proposals that are deemed most promising and relevant to the mission and goals of the Union.*

6. *Recognizing that the earth constitutes a system of interrelated physical, chemical, and biological processes and interactions, the IUGS's programs should include an appropriately balanced mixture of both basic and applied earth science, as well as inter-disciplinary and multi-disciplinary studies.*

7. *The IUGS should promptly enter in negotiations with other Unions, other ICSU entities, and other organizations to ascertain their willingness to participate as fully recognized team members in high-quality multi-disciplinary projects of obvious benefit to science or society and in which the expertise of the communities represented by these other unions is needed.*

8. *Standardization programs and projects should continue to be an important part of the IUGS portfolio of activities.*

9. *Technology-transfer and geological education focussing on developing countries should continue to be key activities of the IUGS.*

10. *All IUGS-funded scientific activities should be reviewed regularly to ensure that the pace of progress toward established goals is acceptable, that productivity is commensurate with the funding provided, and that an international perspective is maintained. The ABRD should review the work of IUGS bodies; Joint Programs should be reviewed by outside panels selected by the IUGS and the partner organization.*

11. *The results of all IUGS-supported scientific activities should be made public using appropriate formats and venues. These include, for example, mainstream scientific journals, book-length monographs, scientific meetings, thematic seminars and specialist conferences, and press conferences.*

Strategic Issues: Organization and Operations

12. *More effort should be made to involve scientists from under-represented groups, such as young scientists, women, and scientists from developing countries, in the work of the Union.*

13. *The decision-making process of the IUGS is far too slow, and is a major impediment to the effectiveness of the Union; it should be changed to allow necessary decisions by the Council to be made and put into effect between Council meetings.*

14. *The continued existence of a Permanent Secretariat is vital to the future of the IUGS; it should be maintained and, if possible, strengthened.*

15. *The full range of functions performed by the Advisory Board for Publications (ABP) is critical to the future of the IUGS. It should be redefined as a Publications Committee, its remit broadened, and it should be provided with additional resources as justified and required.*

16. *The Advisory Board for Research Development (ABRD) should take a rigorous approach to reviewing and recommending proposals for new programs, to requests for their extension, and to the evaluation of existing programs.*

17. *The mandate of the Advisory Board for Research and Development should be broadened to transform it also into an ad hoc "Strategic Planning Committee."*

18. *An Advisory Board for Finance (ABF) should be formally re-established with a clear remit to seek new external funds.*

19. *The Executive Committee should be strengthened and made more effective.*

- *The number of IUGS Vice-Presidents should be decreased from 8 to 2.*
- *The two Vice-Presidents should serve a single 4-year term, concurrent with the Bureau. They may, however, accept a nomination, for one additional term only, to the office of President or Secretary General or Treasurer.*
- *Four councilors should be elected, each to serve for a term of 4-years, but staggered (two take office immediately following election by the Council meeting, two take office two years after the Council meeting) in order to provide continuity. These councilors would be allocated specific roles, e.g., serving as chairpersons of advisory boards and committees, according to their expertise and experience.*
- *The Executive Committee should comprise the President, two Vice-Presidents, Secretary General, Treasurer, Past-President, and four Councilors.*

20. *Scientific work within the IUGS should continue to be carried out primarily by Commissions and Working Groups. However, the number of such enterprises should be strictly limited by the funding available to provide adequate support to enable these bodies to achieve significant results within the time frames specified for their respective endeavors, and their duration staged so as to create regular opportunities to redirect funds to new earth-science enterprises.*

21. Commissions should be established (or continued) for important scientific undertakings, the nature of which clearly requires long-term (8 to 12 years?) attention and funding. Working Groups should be project-oriented enterprises of shorter duration, typically funded for no more than 4 years. All funded entities annually shall transmit to the Executive Committee a report summarizing their activities and accomplishments.

Strategic Issues: IUGS Partners

22. Effective working partnerships should be forged with other ICSU Unions and greater emphasis placed on multi-disciplinary, socially relevant studies; together these will enhance the image of the earth sciences within the International Council for Science (ICSU) and improve the IUGS's prospects for significant ICSU funding.

23. The International Geological Correlation Program (IGCP) has been an outstanding success; IUGS support and involvement should continue as it is critical to the future success of the IGCP. However, a rigorous external review is now desirable as a basis for setting future aims, directions, and emphases. Such external review should also consider ways and means to ensure that the IUGS receives a fair share of recognition for its support of the IGCP and its significant, long-term contributions to the success of the Program.

24. The IUGS should explore cooperation with other UNESCO entities besides the Division of Earth Sciences, and also other UN agencies.

25. The IUGS should receive more recognition for its role as scientific sponsor of the quadrennial International Geological Congress (IGC); it should also receive a significant financial return for its role through the imposition of an IUGS levy on the proceeds of all future IGCs.

26. Current arrangements between the IUGS and its Affiliated Organizations are thoroughly unsatisfactory and should be drastically revamped. The present arrangements confer little benefit on the IUGS and even less on the Affiliates. New and financially more realistic arrangements are required, for example, to involve the Affiliated Organizations (albeit on a gradual rotational basis as funding permits) in joint scientific endeavors with the Union. Other avenues of involvement of the Affiliates should also be investigated.

A meeting between the senior officers of the IUGS and representatives of the Affiliated Organizations should take place as soon as possible to discuss ways and means to forge more effective working relationships among all involved. An ideal target venue for such a meeting is the forthcoming IGC in Rio de Janeiro. This report will be circulated throughout the IUGS family, including the Affiliates. Affiliates should be urged to consider carefully the recommendations herein and then asked to have a named representative present in Rio for the meeting. Thereafter, such meetings should take place periodically, certainly no less frequently than quadrennially in conjunction with the IGCs.

Strategic Issues: Communications and Publications

27. Episodes, the IUGS quarterly journal, is critical to the Union's communications and should be retained. Future emphasis should be placed on high-quality review articles, information about the IUGS's activities and programs, and the calendar of future international scientific events.

28. The IUGS should seek greater visibility and better financial returns from its program of publications. Regardless of the publisher, all publications stemming from IUGS-sponsored scientific work should carry the IUGS logo and be clearly identified in all respects as IUGS-sponsored publications.

29. The IUGS Web Site must be adequately supported and encouraged to continue its admirable growth in breadth and usefulness. It should become the electronic "hub" of the Union, and, as such, will contribute enormously to improving communications within the Union; disseminating data, information, reports, and policy positions; and reaching out to the general public and the education community world-wide to promote understanding of earth science matters, especially those of societal relevance.

30. The IUGS Bureau, Secretariat, and Executive Committee should seek to improve the timeliness and frequency of communications with the IUGS National Committees, and the National Committees should reciprocate. The National Committees constitute an under-used and mostly under-appreciated resource that should be more directly engaged to interact with the IUGS and support its activities.

Strategic Issues: Funding

31. Through the ABF, the IUGS should seek to significantly increase its level of funding by developing new sources. These should include recruiting more Associate Members and giving consideration to establishing a category of Individual Members.

32. The IUGS should increase its membership fees by a total of 10% over the next few years, and, based upon a relevant, standard measure of monetary inflation, then keep them at realistic levels from then on.

1 INTRODUCTION

In its 38-year history, the IUGS has never formulated a formal strategic plan to guide its broad scientific activities around the world, although President William W. Hutchison acted as an excellent one-man strategic planning committee during his tenure (1984-1987). Since 1961, when the IUGS was founded, the geosciences have changed considerably, as have the general scientific, and the political and social, environments in which they are conducted, funded and managed. This is true on all scales, from local to global. The constraints on international scientific collaboration imposed by the Cold War have receded, and the need for all countries, to do good science has become evermore important. Increasingly, scientists view the earth as an integrated system of dynamic processes – geological, physical, chemical, and biological – rather than as an array of seemingly unrelated phenomena amenable to study by a single scientific discipline. As a result, the earth sciences have become much more inter-disciplinary, cross-disciplinary, and multi-disciplinary, which has, in turn, fundamentally changed the character of scientific endeavors and re-enforced the need for international cooperation. International meetings have multiplied in number and grown larger in scope, reducing the primacy of the International Geological Congress. In light of the above, and at the dawn of a new millennium, it is imperative that the IUGS develop a strategic plan to serve as a guide for organizational change and renewal, and as a prescription for its future health and effectiveness.

The Council of the IUGS, at its meeting in Beijing, August, 1996, voted that a strategic plan be prepared for the IUGS "no later than the end of 1997." At that meeting and later, representatives of three countries offered financial support for the strategic planning exercise and to accommodate the planning meetings, but in the final analysis the financial support was not forthcoming. The IUGS Bureau then sought other support, but that too came to no effect. By early 1999, it was clear that the IUGS would have to fund the meeting itself, at which time resolute preparations got underway.

The President asked Dr. Peter J. Cook to chair the strategic planning initiative. Dr. Cook, the immediate past Director of the British Geological Survey and broadly experienced in dealing with strategic issues facing modern geoscience enterprises, with the help of the IUGS Bureau and Executive Committee, chose an *ad hoc* Strategic Planning Committee (SPC, and commonly referred to hereinafter by this acronym or simply by "the Committee"). Members were selected to achieve a balance of scientific breadth, regional and disciplinary expertise, and scientific wisdom. Some of those selected were relatively unfamiliar with the IUGS; others were very familiar with it. The membership of the committee included:

Dr. Peter Cook (Australia), Chairman
 Dr. Mohamed Bensaid (Morocco)
 Prof. Alan Green (Canada/Switzerland)
 Dr. Lewis Gustafson (U.S.A.)
 Dr. Petr Jakes (Czech Republic)
 Mr. David Murangari (Zimbabwe)

Prof. Jane Plant (U.K.)
 Prof. Victor Ramos (Argentina)
 Prof. Attilio Boriani (Italy), *Ex-officio*, IUGS
 Dr. Robin Brett (U.S.A.), *Ex-officio*, IUGS
 Dr. Zdenek Johan (France), *Ex-officio*, IUGS
 Dr. John Aaron (U.S.A.), *Rapporteur*.
 Dr. Wolfgang Eder (Germany/France), *Observer*, UNESCO.

The Committee met in Prague, Czech Republic, September 12-14, 1999. Unfortunately, at the last minute Mr. Murangari was unable to attend the meeting. The Committee spent three very full days carefully and candidly examining the IUGS's mission, organization, and programs. On nearly all points of discussion, agreement was unanimous.

Background

The International Union of Geological Sciences (IUGS) is one of the largest non-governmental, non-political, and non-profit-making scientific organizations in the world. It addresses earth-science problems of broadly international scope through its own activities and those co-sponsored with other agencies. The Union encourages the highest levels of international cooperation and participation in its activities, many of which deal increasingly with the intersections of earth-science and human welfare. Since its founding in 1961, IUGS has been a member of the International Council for Science (ICSU).

Membership in the IUGS is open to all countries, usually through a national academy, geological survey, or comparable institution. The Union has 112 national members. Associate membership is open to national and international bodies (governmental and non-governmental), private enterprises, and individuals with IUGS-related interests.

The IUGS conducts its day-to-day scientific work through its commissions (including their sub-commissions), its working groups, and its joint programs with other scientific organizations. It counts also on the international activities of affiliated organizations (currently 36) to help meet its objectives. The Union is the scientific sponsor of the quadrennial International Geological Congress and advises and assists the Congress organizers in formulating the scientific program for this important meeting. The IUGS also maintains continuity of activity between Congresses. The **Council** of the Union, composed of one representative of each active national member and selected other non-voting members, meets during each Congress.

Between quadrennial meetings of the Council, the IUGS **Executive Committee**, composed of the President, Secretary General, Treasurer, Past-President, and up to eight Vice-Presidents, directs the affairs of the Union. The IUGS **Bureau**, consisting of the President, Secretary General, and Treasurer, attends to day-to-day administrative matters, and the regular administration of the Union is handled by staff of the IUGS **Permanent Secretariat**, located in Trondheim, Norway.

Neither the Bureau nor the Permanent Secretariat uses IUGS funds for its operations, salaries, or travel. All of these expenses (approximately USD 550,000 annually) are borne by the governments of the respective members. The IUGS could not operate without this assistance. The very generous support of the current contributing countries, France, Italy, Norway, and the U.S.A., is praiseworthy.

Periodic replacement of the Union's senior executive officers is a responsibility of the Council, following consideration of the recommendations of a Nominating Committee. The Nominating Committee is appointed by the Council and consists of seven members, not more than three of whom, including the Past-President, may be members of the concurrent Executive Committee. From time to time, as needed, the Executive Committee establishes advisory boards and *ad hoc* Committees to deal with some key matters.

The working entities of the IUGS include commissions, working groups, joint programs, and advisory boards:

Commissions and their component **Sub-Commissions** address topics requiring long-term study because of their international applicability and world-wide importance. Currently, commissions exist on Comparative Planetology, Fossil Fuels, Environmental Planning, Global Sedimentary Geology, History of the Geological Sciences, Igneous and Metamorphic Petrogenesis, the handling of Geoscience Information, Stratigraphy, Systematics in Petrology, and Tectonics.

Working Groups address topics on which prompt action is needed or on which studies can be completed in the shorter term. Working Groups appointed directly by the Union currently deal with Geoscience Education and Training, Global Geosites, Global Continental Geochemical Baselines, Landslides, Public Affairs, and Isotope Decay Constants.

Joint Programs are sponsored by IUGS and one or more other organizations. Presently, five programs are active: the International Geological Correlation Program (IGCP), Scientific Committee on the Lithosphere (SCL), Geological Applications of Remote Sensing (GARS), Mineral and Energy Deposit Modeling Program (MDMP), and the International Geological Congress (IGC). All but SCL and IGC are co-sponsored by UNESCO. SCL is co-sponsored by ICSU and the International Union of Geodesy and Geophysics (IUGG); the IUGS is the scientific sponsor of the IGC, which is funded and managed by a local organizing committee.

Advisory Boards are empanelled to provide expert advice to the Executive Committee. Boards convene their own meetings, conduct reviews, and prepare reports. The Advisory Board on Research Development, for example, recommends new directions for scientific investigation and periodically reviews the scientific work of IUGS bodies and programs. The Advisory Board for Publications oversees all publications and other means of publicizing the Union's activities, including *Episodes*, the web site, and monographic works resulting from the scientific programs. The Advisory Board on Finance, which plans the financial well-being of the IUGS, has been dormant for many years.

Affiliated Organizations (primarily international professional scientific societies), provide a valuable link to a wide cross-section of the world's earth-science community. These organizations range in size from less than 100 to nearly 40,000 members.

The IUGS publicizes its work in four ways:

Firstly, the IUGS sustains the quarterly journal, *Episodes*, which publishes scientific articles and reviews, news about the Union, new book and map reviews, conference reports, and a calendar of events.

Secondly, the Union publishes **monographs** of various kinds, giving results of its scientific programs. Articles and monographs on IUGS-sponsored research also appear regularly in professional journals and governmental and private-sector publications.

Thirdly, the Union maintains a comprehensive, frequently up-dated, user-friendly world-wide **web site** – <http://www.iugs.org>. This provides all relevant, topical information about the Union, including the content of recent publications.

Fourthly, publications by IUGS entities and bearing the Union's logo, are published by a variety of commercial and academic publishers. These are mostly proceedings volumes.

IUGS Constituency

Public geoscience research organizations, such as geological surveys and university earth-science departments have a particular significance to IUGS. In some countries, national geological surveys provide the primary national contact with the Union and offer a great deal of support for its programs and activities. At the same time, the IUGS can provide advocacy support to surveys, as well as influence at the international level which can benefit national surveys. The IUGS offers access to a variety of broadly-based international earth-science projects and, potentially, some funding to research and academic institutions. All these organizations, therefore, have a vested interest in ensuring the continuing success of the IUGS.

Similarly, the resource industries, particularly as they become increasingly global, gain benefit through IUGS activities in education and training, technology transfer, and international cooperation and standardization. However, it is increasingly recognized that it is society as a whole that has the most to gain from IUGS activities, not only in resource issues but more and more in environmental issues. In other words, the IUGS constituency is broadly based and international.

Response to Questionnaire

There is, then, a broad international constituency that has much to gain from a successful and vigorous IUGS. The Union can take pride in the accomplishments of the last 38 years that have built this constituency. Regardless of this, the Union has been slow to respond to the multiplicity of changes in the global earth-science milieu which recently has come to have an impact upon it, and it is this more than any other factor

that has exposed the need and the timeliness of reassessing the Union's directions and goals, together with the effectiveness of its administrative structure. Any such review must consider internal and external opinions – the views of the IUGS "family" and those of the broader geoscientific community. To seek these opinions prior to the review, a lengthy questionnaire (Appendix 1) was circulated to all components of the IUGS (national committees, commissions, working groups, joint programs, associate members, affiliated organizations, advisory boards) and to selected individuals. The response was gratifying: 85 replies were received from about 200 questionnaires distributed, signifying considerable and widespread interest in the strategic planning exercise. Variation in the proportionate numbers of replies was much as anticipated and reflected levels of commitment and interest. For example, the response-level from commissions was high, that from national committees relatively low (even though, ironically, many of these national committees have been vocal in the past about the need for better communication from the IUGS).

Responses were candid; most were thoughtful and eminently useful in helping the Committee to identify organizational and programmatic strengths, weaknesses, and other issues upon which it should focus attention in the course of formulating a strategic plan. In some respects, the responses reinforced perceptions already held by many committee members; in others, the character, consistency, or intensity of the responses was surprising.

Briefly summarized, the responses revealed the following:

- Opinion was fairly evenly divided with respect to the effectiveness of IUGS as an organization. It was most positive among IUGS commissions, most negative among affiliated organizations.
- The greatest strengths of the IUGS include:
 - its work to promote international scientific collaboration and cooperation, especially involving developing countries;
 - its work in establishing global standards (stratigraphic boundaries and petrologic nomenclature);
 - its coordination and sponsorship of the IGC and the IGCP;
 - its role as an "umbrella" organization for international geoscientific representation and coordination; and
 - its efforts to improve the status of geosciences among the public at large.

Some respondents commended the IUGS for what it has accomplished over the years with the resources available to it, and thought that it deserved much more credit than it typically received.

- The greatest weaknesses of the IUGS include:
 - a perceived lack of focus in its scientific programs;

- poor visibility in the scientific community;
 - lack of money and influence;
 - lack of self-promotion;
 - a relative paucity of younger scientists and women scientists associated with its activities; and
 - poor communications inside and outside the organization.
- Some thought the IUGS too hierarchical and bureaucratic, its actions excessively constrained by tradition.
 - Much confusion is evident with respect to the IUGS's role in the IGC, especially among affiliates and others not closely tied to the Union. Some respondents thought that the IUGS was the *principle* organizer, others thought that it *should* be the principle organizer, and still others again suggested that it should be the *sole sponsor*. Currently it is the scientific sponsor of the Congress; a local organizing committee is responsible for the details of planning, operating, and funding the Congress.
 - IUGS Commissions see themselves as successful organizations doing good scientific work and disseminating useful results. If Commissions were abolished, the chief negative impacts would be loss of international coordinating activities, "chaos" in the case of those working to establish global standards, and loss of opportunities for international collaboration involving scientists in developing countries.
 - Most respondents thought that the IUGS should aim to achieve a higher profile in the geosciences. Some were quite outspoken, asserting that improving IUGS's visibility and clout is absolutely essential if the Union is to successfully fulfill its mission, meet its goals, and have any impact whatsoever in the geoscience community or in society at large.
 - Among those who receive *Episodes*, either by subscription or by virtue of position, most read it regularly and the majority find it useful, although opinion varied widely with respect to which sections were most useful. Many thought that the scientific content should be strengthened, and several felt that the best way to realize such improvement and establish a clear niche for *Episodes* would be to concentrate on state-of-the-science review articles. Others wanted to see more information on the work of IUGS commissions and other bodies.
 - With respect to monographs published by the IUGS, many respondents said that they see them infrequently. Some judged them to be too specialized (i.e., directed to a very narrow readership), and therefore of limited use. Opinions varied considerably on suggestions for improvement. Some wanted to see more effective promotion and distribution; others wanted lower prices or free distribution. One person, responding on behalf of a national committee, questioned the need for publishing monographs at all.

- Respondents from developed countries generally thought that the IUGS web site was essential and that it did a good job of presenting information about IUGS's organization, operations, programs, and personnel. One national member thought that it was the most visible part of the IUGS; another said that if there was no need for the web site, there was no need for the IUGS. On the other hand, despite the web site containing the most complete and up-to-date information about IUGS's history, programs, and activities in one place, at least two respondents wanted to see on the web site more information about the IUGS's reason to exist. Not surprisingly, scientists in developing countries frequently complained that they lacked means of access to the web site. Many respondents suggested ways to expand the site's utility and interactivity, some of which have already been implemented.

Despite this great diversity of views, the responses were overwhelmingly supportive of the IUGS and its continued existence.

The IUGS is of great value to the geoscience community; it must be maintained and strengthened.

2 A MISSION REDEFINED

Bearing in mind the views of the IUGS "family", together with what are discerned to be the present and future needs of the earth-science community and society at large, the mission of the IUGS is to unite the global geological community in (i) promoting development of the earth sciences through the support of broad-based scientific studies relevant to the entire earth-system, and (ii) applying the results of these and other studies to preserving Earth's natural environment, using all natural resources wisely, and improving the prosperity of nations and the quality of human life.

To further this mission, the IUGS should pursue the following goals:

Serve as an impartial international scientific union addressing global and regional issues that involve the earth sciences.

The IUGS is an international union with a membership of 112 countries (and growing) and 36 international affiliated associations. It covers most of the earth sciences and crosses socio-political boundaries around the world. In addressing global earth-science issues, it acts as an umbrella organization to coordinate the international activities of many geological organizations, and it promotes international cooperation and collaboration.

Contribute to the advancement of earth-science research throughout the world, including that with societal relevance.

The IUGS already has a creditable record of accomplishments in these respects, especially when measured in terms of what it has had to invest annually. One of its most successful programs has been (and remains) IGCP: since 1972, this joint program with UNESCO has generated and invested about USD 1,000 M on research in many different parts of the world. Other programs under the sole aegis of the Union have, of necessity, been less well funded but have still achieved remarkable results of global significance. The evolution by the Commission on Stratigraphy of a global chronostratigraphic standard for correlation is one obvious example.

In the future, the IUGS must strive to do more of this kind of broadly international research and place even greater emphasis on issues of 'Geoscience and Society', because it is needed, broadly and readily understood in its relevance, appealing in terms of attracting international funds, and well-suited to the Union's revised mandate.

Represent the earth sciences in governmental and non-governmental fora to inform, advise, and influence policy and decision-making.

The IUGS is a principal voice of the earth sciences in ICSU, has joint programs with UNESCO, and has contacts with the International Union of Geodesy and Geophysics (IUGG), the International Geographic Union (IGU), The International Atomic Energy Agency (IAEA), the World Conservation Union (IUCN), the World Heritage Center (WHC), and the Organization of Petroleum Exporting Countries (OPEC).

The Union should continue these important representational duties. It should also seek to expand its contacts and sphere of influence by reaching out to other organizations with which it might share common interests, especially in influencing public policy and decision-making.

Encourage, in cooperation with other organizations, interdisciplinary activities and interactions involving the broad spectrum of the earth sciences to develop solutions to global problems and issues.

Current examples include: the Mineral Deposit Modeling Program (MDMP), which develops the capacity for mineral-resource exploration and assessment in developing countries; the Scientific Committee on the Lithosphere (SCL), which, with the IUGG, has major programs involving megacities and natural geological hazards; Geological Applications of Remote Sensing (GARS), which provides for the transfer of remote-sensing technology to geologic hazard assessment in developing countries; the Commission on Geosciences for Environmental Planning (COGEOENVIRONMENT), which fosters applications of geology to the solution of environmental problems; Global Geochemical Baselines (GGB), which is building a database characterizing variations in the background levels of chemical elements in the earth's surface environment in order to provide a scientific basis for assessing global changes in the chemistry of the Earth's surface brought about by economic development, population growth, and other causes; and the Commission on Management and Application of Geological Information (COGEOINFO), which establishes earth-science data standards and facilitates and stimulates the full and wise use of geoscience information in the definition and solution of regional and global problems.

Future program activities involving the IUGS should incorporate both basic and applied earth science. Basic studies should focus on understanding the processes and events that characterize the earth-system. Applied studies should focus on societal issues with a strong earth-science component.

Foster collaboration between developed and developing countries in earth-science research, capacity building, and applications.

Earth sciences are particularly relevant in this respect, because they are essentially global in nature. Geologic phenomena and related earth-system processes transcend national boundaries. To be properly analyzed and understood they must be studied where they occur. Likewise, broadly speaking, the impacts of geologic hazards on humankind and the deleterious effects of population growth and unwise political decisions are rarely confined to a single country. Scientific collaboration benefits all participants: scientists from developing countries gain access to state-of-the-art science and technology; those from developed countries gain first-hand information about processes, environments, and conditions that adds to the body of knowledge and understanding of the earth-system.

Contribute to formal earth-science education in schools and universities, and to improved public awareness of the earth sciences in terms of their key roles in understanding many societal problems.

Past-President William S. Fyfe, who leads the IUGS Working Group on Geoscience Education, is very active in speaking to and interacting with student and faculty groups in high schools and universities, especially on matters in which the geosciences interface with societal issues and problems. He has also initiated a poster series (one published so far) intended to illustrate earth-science concepts, principles, and processes to students in the 10-12 age range. His devoted efforts have reached literally thousands of students and teachers in Canada and elsewhere in the world.

The IUGS needs more concerted effort and the active participation of many more scientists in order to have any significant global impact on the huge education community. One need look no further than the terms of reference of the WG (see the IUGS web site) for a catalog of useful initiatives. They are broad in their scope and bold in their thrust, but implementation will require many committed scientists and support personnel, and significant sums of money. In order to increase its leverage and advance its efforts in these respects, the Union should seek appropriate partners, such as ICSU, other earth-science unions, UNESCO, and affiliated organizations.

Encourage the career development of young earth scientists.

Many IUGS programs, particularly IGCP, but also MDMP, GARS, GGB, SCL, and IGC, provide opportunities for young scientists to broaden their experience and knowledge. The Hutchison Fund of the IUGS also contributes to this goal, although its beneficiaries are few and, so far, limited to participation in the quadrennial IGC.

In the future, the IUGS should consider expanding the scope of the Hutchison Fund beyond the IGC participation to support a larger number of young scientists in attending international meetings. This would require adding significantly to the invested principle or acquiring funds from other sources. Other possible approaches include actively trying to attract more young geoscientists to participate in IUGS activities, which would greatly benefit the Union; and using *Episodes* and the web site to advertize the availability of internships, opportunities to collaborate with senior scientists, training sessions, and similar developmental experiences.

Strengthen communications by expanding the web site and extending its outreach.

In the three years of its existence, the IUGS web site has provided scientists in over 110 countries with up-to-date information about the Union's history, programs, personnel, activities, and accomplishments. The site continues to grow in scope, capability, and interactivity, and attracts an increasing number of visitors from all over the world.

The number of internet users worldwide is growing at a rate that is truly staggering. Internet and web technology are transforming communications, information dissemination, and commerce as fundamentally as did the printing press and movable type more than 500 years ago. This transformation is far from complete. The web site should evolve into an electronic hub that can serve the Union and its traditional constituency in new, more effective ways, such as in management operations, data transfer, geologic inquiries, publication sales, secure financial transactions, and

dissemination of reports and policy positions. Moreover, the web site is the key instrument with which to reach the general public, as well as the education community world-wide, with well-conceived and well-designed electronic products tailored to their interests and needs. These could include general-interest publications; lecture notes and related graphics and reference materials; and charts, diagrams, photographs, and video clips illustrating geologic phenomena.

Increase the relevance and availability of IUGS publications.

The basic kinds of IUGS publications already in place – a quarterly journal, *Episodes*, and an irregular series of books (monographs) – are appropriate to the Union's needs. But changes need to be made in these publications to attract a better financial return and greater recognition to the Union.

Episodes needs to enhance its circulation and distribution and to publish a higher proportion of high-quality reviews of topical issues in international earth science. More monographs need to be published on broader subjects. While the publishing of these monographs through governmental or private-sector publishers is the current method, a partnership agreement with a single external publisher may be more successful if the publisher was prepared to subscribe to IUGS's aspirations, needs, and objectives.

Develop strategies to enhance the visibility and influence of the earth sciences in public affairs.

The goal of raising the public profile and influence of the earth sciences often has been voiced in IUGS councils. Currently, however, the IUGS's efforts in this direction have been mostly through the work of COGEOENVIRONMENT, which has achieved some notable successes in this endeavor.

Much more needs to be done. Opportunities abound for the IUGS to make enormous contributions to strengthening the role of the earth sciences in public affairs, especially in developing countries. The need is critical because the expanding world population will place inordinate demands on mineral, water, and land resources and potentially contribute significantly to environmental degradation. The earth sciences are in a unique position to illuminate the growing public debate about policy issues related to developing resources, minimizing environmental damage, and mitigating geological hazards, and thus help society to make wise decisions.

The mission of the IUGS is to unite the global geological community in (i) promoting development of the earth sciences through the support of broad-based scientific studies relevant to the entire earth-system, and (ii) applying the results of these and other studies to preserving Earth's natural environment, using all natural resources wisely, and improving the prosperity of nations and the quality of human life.

The IUGS should pursue the following goals:

Serve as an impartial international scientific union addressing global and regional issues that involve the earth sciences.

Contribute to the advancement of earth-science research throughout the world, including that with societal relevance.

Represent the earth sciences in governmental and non-governmental fora to inform, advise, and influence policy and decision-making.

Encourage, in cooperation with other organizations, interdisciplinary activities and interactions involving the broad spectrum of the earth sciences to develop solutions to global problems and issues.

Foster collaboration between developed and developing countries in earth-science research, capacity holding, and application.

Contribute to formal earth-science education in schools and universities, and to improved public awareness of the earth sciences in terms of their key roles in understanding many societal problems.

Encourage the career development of young earth scientists.

Strengthen communications by expanding the web site and extending its outreach.

Increase the relevance and availability of IUGS publications.

Develop strategies to enhance the visibility and influence of the earth sciences in public affairs.

3 STRATEGIC ISSUES

Science

The IUGS is at a cross-roads. Already it has more activities, organizational units, and programs than it can adequately support. At the same time, it has found it difficult to conclude activities that are less effective or no longer meet the needs of the Union. The net result is that it has been unable to initiate many new scientific endeavors. This in turn has given the impression of an unresponsive organization shackled by inertia. The reality is that the IUGS Bureau and Executive Committee are acutely conscious of the need to contribute the earth-science capability of the IUGS to the many challenges facing both the scientific community and society today.

New Directions

Despite the inevitable practical problems, the SPC considers it imperative that IUGS funds be marshaled and new sources of funds sought to enable the Union to embark on new high-priority activities in areas of both basic and applied earth science. Basic science is required to develop an understanding of the processes and events that operate on and within the Earth; applied science is needed to meet societal needs. Whereas it is demonstrably true that good scientific research benefits society, it is also true that new applied earth science will be possible only if there is new basic earth science to apply. Their relationship is essentially symbiotic because the needs of applied science often determine what new basic science is conducted. In considering any new programmatic direction, the IUGS must strive to maintain an appropriate balance between basic and applied earth science.

A number of topics were identified by the SPC as examples of high-priority issues in which the IUGS and other earth-science organizations could play a key role in funding, conducting, or coordinating research. Most of these topics involve elements of both basic and applied earth science.

The IUGS should embark on new, high-priority earth-science activities of demonstrable relevance to society, including, but not limited to:

- *Reducing vulnerability of communities to natural hazards.*
- *Mitigating the effects of waste and pollution.*
- *Understanding global environmental change.*
- *Biodiversity.*
- *Managing resources and sustaining the environment.*

Reducing vulnerability of communities to natural hazards:

Promoting cooperation among earth scientists, engineers, planners, sociologists, and others in assessing risks, and in mitigating the impact of natural hazards, such as

earthquakes, volcanic eruptions, landslides, tsunamis, flooding, and radon, methane, and other natural gas emissions.

Identifying areas of land instability, including coastal zones, caused by both human activity and natural geological processes.

Mitigating the effects of waste and pollution:

Understanding the processes involved in both anthropogenic and natural pollution of the terrestrial (including groundwater) and marine environments as a basis for mitigating impact on local ecosystems and human health. This will involve cooperation with chemists, hydrologists, and soil scientists, as well as with ecotoxicologists and medical and epidemiological specialists.

Encouraging commercial enterprises engaged in development of Earth resources to conduct their operations responsibly and ethically with respect to the affected lands and populations, regardless of where and under what conditions development occurs.

Developing methods and identifying criteria for the safe geological disposal of toxic and radioactive waste, greenhouse gases, and other unwanted products.

Understanding global environmental change:

Studying climatic and paleoclimatic changes to distinguish between anthropogenically and naturally-induced causes. The scientific community has mostly neglected studying the causes of climatic changes that occurred more than 200,000 years ago. These changes, however, may have considerable bearing on understanding modern climate change.

Studying the interactions among atmospheric and oceanic processes and those of global tectonics to determine how these trigger environmental changes in, atmospheric and oceanic circulation, sea-level, soil erosion and desertification, and coastal erosion and flooding.

Biodiversity:

Promoting cooperation among biologists, paleontologists, and stratigraphers in assessing past and present fluctuations in the Earth's biotas and the extent, magnitude, rates, and causes of these fluctuations. Particular attention needs to be paid to the mass-extinction events of the geological record with the aim of assessing modern trends in biodiversity and the likelihood of mass extinction in the future.

Managing resources and protecting the environment:

Developing and applying the earth sciences to land-use planning, including optimum land use and re-use.

Contributing to the sustainable management of soil and groundwater systems, coastal zones, and marine environments, in collaboration with agriculturalists, hydrologists, oceanographers, engineers, land-use planners, and sociologists.

Identifying non-renewable resources, including those used to produce energy, fertilizer, metallic and construction materials, to meet the needs of the increasing world population.

Developing methods of minimizing the environmental impacts of extracting crustal resources and mitigating the impacts of past activities of this kind.

Applications of the earth sciences to matters such as these, which are cited here only as examples, are urgently needed on a global basis. They would render an important service to society; they would be of notable interest to politicians in all levels of government and influential in their decision-making; and they would reflect well on the IUGS and on the global community of pure and applied scientists that it represents.

New Approaches

The view of the Committee was that investigations on the foregoing and similar topics of high scientific and public interest bearing the imprimatur of the IUGS would be valued by the scientific community and by society at the national and international levels. How should these and other new studies by the IUGS be initiated, organized, and funded? The SPC recommends the following general approach:

- The ABRD should recommend to the Executive Committee research topics and objectives that are of timely scientific interest or potentially of significant societal impact, compatible with the IUGS's mission and goals, and amenable to study at funding levels that the IUGS typically is able to offer.
- The Executive Committee will review the ABRD recommendations, choose any (or all) topics that it wishes to pursue, and advertize (using *Episodes*, the web site, and other venues) its desire to receive competitive proposals from qualified earth scientists and geoscience organizations, specifying the form, detail, expectations, and conditions that will govern submissions. The Union should also be willing to consider submitted proposals that seek support for worthy basic or applied earth-science investigations on topics that were not specifically solicited by Executive Committee.
- The ABRD will review the proposals, recommend to the Executive Committee those that it deems most promising, and suggest a range of funding and any amendments or conditions that it thinks are necessary or desirable. If the thrust of a worthy proposal is multi-disciplinary or cross-disciplinary, it is expected that the Working Group will acquire such discipline specialists and their supporting funds by forging partnerships with other scientific unions, affiliated organizations, national geological surveys, or other funding agencies. The nature, scope, and prospects for successfully establishing such partnerships should be evaluated by the ABRD and factored into its recommendations.
- The Executive Committee will decide which proposal(s) it will accept and fund, and on what terms, and set the budget level(s).

- Normally, new projects will be organized as Working Groups chartered and funded for a term of up to four years. If requested, the Executive Committee may extend the charter and funding of a Working Group beyond the normal 4-year term. Such extension must be strongly justified, however, and based on the recommendation of the ABRD, following a thorough review of the results achieved and future plans and objectives.
- In rare cases, a Working Group may in the course of its studies demonstrate a clear need for more comprehensive, longer term research activities that are more appropriately organized and funded as a Commission. Such a metamorphosis, with its many programmatic and budgetary implications, would require the approval of the IUGS Council, following the recommendation of the ABRD and endorsement by the Executive Committee. To some extent, it may be desirable to structure a Commission's work plans into four-year projects that can be funded incrementally as each project is completed. The degree to which this approach can succeed will depend on the nature of the Commission and its work.
- It is imperative that results of IUGS-supported investigations be made public using appropriate formats and venues. Normally these would include widely-distributed, mainstream scientific journals and well-integrated, book-length monographs published and marketed by an IUGS publishing partner (see section on "Communications and Publications) or commercial publishers. Other means for highlighting and drawing attention to the IUGS and its work should be actively pursued. Examples include sponsoring or convening topical seminars and specialist conferences, which could be held at the IGC or in conjunction with meetings of Affiliated Organizations; or developing an IUGS position on various national or international public policy matters, and, with appropriate fanfare, announcing it at a press conference or scientific meeting; or disseminating a position paper using *Episodes* or the web site.

The above discussion outlines the recommended general procedure by which the IUGS should initiate and conduct new scientific undertakings by assessing current needs and opportunities in basic and applied geoscience and seeking proposals from qualified scientists and organizations that wish to compete for IUGS financial support to address those needs.

The ABRD should play a key role in identifying fruitful new scientific directions and research topics.

The IUGS's programs should include an appropriately balanced mixture of both basic and applied earth science, as well as inter-disciplinary and multi-disciplinary studies.

The IUGS should promptly enter in negotiations with other Unions, other ICSU entities, and other organizations to ascertain their willingness to participate as fully recognized team members in high-quality multi-disciplinary projects of obvious benefit to science or society and in which the expertise of the communities represented by these other unions is needed.

Following are the kinds of proposals the SPC believes the IUGS should consider in undertaking new scientific enterprises or directions.

- Proposals to support studies in areas of **basic earth science** aimed at furthering scientific understanding of the fundamental nature and history of the processes and their myriad interactions that constitute the whole earth-system. Such studies may be intra-disciplinary, inter-disciplinary or multi-disciplinary, as befits the needs of the proposed work. Partnerships with other scientific unions, affiliated organizations, or other funding sources should be established to engage and support needed specialists from disciplines outside the traditional constituency of the IUGS.
- Proposals to support work in **applied earth science**, chiefly inter-disciplinary, multi-disciplinary, or cross-disciplinary studies that examine earth-science topics with compelling relevance to societal problems. Such initiatives, which should address issues of regional or global importance, will probably involve discipline specialists from outside the earth sciences and may also require the expertise of social scientists and public officials. Such projects must be capable of attracting additional support from outside the IUGS, as mentioned in the foregoing paragraph.
- Proposals to perform the necessary function of **correlation or standardization** within the geological sciences, which are of use to a broad community. Examples could include classification and nomenclature, and determination of markers having critical importance in worldwide stratigraphic correlation. Such studies provide a necessary service to international geology, and only an international organization with the credibility of IUGS can sponsor them.
- Proposals that promote **technology transfer and/or geologic education** to geologists in developing countries. The best of these would also involve education of geologists from the developed world who participate in the program. A good example of such a project is the IUGS-UNESCO Mineral Deposit Modeling Program.

Standardization programs and projects should continue to be an important part of the IUGS portfolio of activities.

Technology-transfer and geological education focussing on developing countries should continue to be key activities of the IUGS.

Critical Assessment

The SPC regards regular critical assessment of all IUGS-sponsored investigations as necessary to ensure that (a) progress is being made at an acceptable pace towards the declared and approved goals of the projects, (b) productivity is commensurate with these same goals and with the level of approved funding, and (c) an international perspective is maintained (i.e., not national, institutional, or individual).

At present, the Advisory Board for Research Development (ABRD) discharges this responsibility to some degree by reviewing the accomplishments of each Commission at least once in every four years and of other scientific bodies as required. Although the ABRD has met its responsibilities in a more than competent fashion, the Committee

believes that an intensified program of periodic critical assessments of **all** IUGS-sponsored scientific activities is justified to ensure that the Union receives the highest possible returns on its investments. The Committee believes that all investigations funded by the IUGS alone should be subject to a brief review after two years and a detailed review after four years, by which time most of them should have been completed, or a new proposal submitted seeking extension of the investigation along modified lines as well as further funding. In advocating that the ABRD assume responsibility for this intensified program of reviews, the Committee acknowledges that this is not part of the original function assigned to the ABRD, but it does fall within the statutory definition of what an advisory board may be asked to undertake and is in keeping with the ABRD's current practices. The proposal formally to assign this expanded function to the ABRD should be seen as part of a larger package of related responsibilities which an expanded and reconstituted ABRD will be asked to assume (see below for further details).

Joint programs between the IUGS and UNESCO or between the IUGS and other organizations also should be subject to periodic appraisal through rigorous reviews conducted every four years, and brief reviews after the intervening two years. These reviews should be conducted by *ad hoc* committees, the members of which are selected by the IUGS and the partner organization, unless the partner organization were to agree that this function could be discharged by the ABRD. Reports on these reviews of joint programs should be sent to the Executive Committee of the IUGS and circulated among all members of the IUGS Council.

The Committee also recommends that the ABRD undertake the role of an *ad hoc* Strategic Planning Committee for the IUGS, providing the Union with the best outgoing advice on future trends in the pure and applied earth sciences and on how to keep itself current with new developments.

All IUGS-funded scientific activities should be reviewed regularly.

The results of all IUGS-supported scientific activities should be made public using appropriate formats and venues. These include, for example, mainstream scientific journals, book-length monographs, scientific meetings, thematic seminars and specialist conferences, and press conferences.

Also, the Committee recommends that the ABRD undertake the role of an *ad hoc* Strategic Planning Committee for the IUGS. It makes this proposal firmly in the belief that the Union must take steps to ensure that it is provided, not on a periodic but on a continuous basis, with the best advice it can get on future trends in the pure and applied earth sciences and on how to keep itself current with new developments.

The Committee realizes that if the ABRD is to assume all of these responsibilities it must be expanded and reconstituted, to include the best available group of internationally-minded earth scientists, given at least part-time support staff to undertake much of the routine administrative work associated with its new range of assigned tasks, and provided (if necessary) with access to modern electronic means of communication and

with funds to meet as a Board to the extent necessary. The Committee considered splitting the package of functions recommended for the revamped ABRD, but finally decided for many scientific reasons that the collectivity of functions was a "package" that is best kept together. Moreover, the IUGS can ill-afford to proliferate committees.

Finally, the SPC trusts that, in critically assessing new proposals and the status of continuing investigations, the ABRD will endeavour to develop a system that is effective, yet simple and bureaucratically restrained. Good and bad examples exist among existing granting councils or foundations and information on these is readily available. Although advocating a general tightening of managerial responsibility for how IUGS spends its limited funds, the Committee is all too conscious that in this modern age procedures for such activities readily can get out of hand. The time of practicing scientists is a precious commodity: it should not be wasted in meeting unnecessary requirements, nor should these requirements stifle the creativity or entrepreneurship that these scientists exhibit. The key to all of this, the Committee asserts, lies in the quality of the "core appointees" to the reconstituted ABRD.

Organization and Operations

Generally speaking, any organization that functions efficiently has an administrative structure that allows for effective managerial control and supervision but yet does not stifle creativity and productivity. In the thirty-eight years of its existence, the IUGS has been well served by its administrative structure, and the dedicated people who have served in it. In that same period, however, there have been sweeping changes in the sciences that the Union exists to promote: traditional geology, although still central in its role, has come to embrace, in increasingly integrative fashion, the interdisciplinary fields between geology and the other sciences, and increasingly also to draw upon other branches of pure and applied science that deal with the Earth, thereby forming the disciplinary plexus that today is commonly referred to as the geosciences. Quite naturally, all of this has generated a progressively stronger emphasis on inter-disciplinarity. The IUGS has struggled to cope with these changes using an increasingly outmoded administrative structure. Other factors too have compounded the problem, notable among them the belated rise to prominence of the whole suite of issues that UNESCO has dubbed "Geoscience and Society" and the realization that highly relevant studies being done in developing countries deserve stronger encouragement and support. With all of this in mind, the Committee concluded that some changes were needed in how the IUGS operates to allow it more effectively to respond to the demands and expectations of what have become the "geological sciences" of the present day.

More effort should be made to involve scientists from under-represented groups, such as young scientists, women, and scientists from developing countries, in the work of the Union.

The decision-making process of the IUGS is far too slow, and is a major impediment to the effectiveness of the Union.

The continued existence of a Permanent Secretariat is vital to the future of the IUGS; it should be maintained and, if possible, strengthened.

The full range of functions performed by the Advisory Board for Publications (ABP) is critical to the future of the IUGS. It should be redefined as a Publications Committee, its remit broadened.

The Advisory Board for Research Development (ABRD) should take a rigorous approach to reviewing and recommending proposals for new programs, to requests for their extension, and to the evaluation of existing programs.

The mandate of the Advisory Board for Research and Development should be broadened to transform it also into an ad hoc "Strategic Planning Committee".

An Advisory Board for Finance (ABF) should be formally re-established with a clear remit to seek new external funds.

Relevant comments on key parts of the administrative structure and its *modus operandi* are offered below.

Organization and Staffing

The IUGS would benefit from a better balance of age, ethnicity, gender, and geography in its organization and scientific activities. In particular, the IUGS should make special efforts to involve younger scientists, women scientists, and scientists from the developing countries to play greater roles in IUGS programs.

Decision-making

At the present time, significant decisions by the Bureau and Executive Committee must be ratified by the IUGS Council, but the Council meets only quadrennially. For example, four years from the time of application may elapse before a country can attain full membership or other geological organizations gain formal affiliation. In the same way, an IUGS program which has become ineffective may remain in existence for several years before it can be formally terminated. This "built-in" slowness of action is inconsistent with the rapid pace of change in today's scientific world and is damaging to the Union. Therefore, whereas the role of the Council will continue to be vital, the Union must streamline its procedures to facilitate decision-making in a timely manner.

For example, Council should conduct votes by fax or e-mail and use regular mail only when electronic means are not available. Statutes should be amended accordingly. As

part of this streamlining, delegates should be required to vote within an agreed-upon time, which should be no more than one month.

Permanent Secretariat

The Committee commends and thanks the Norwegian Government for generously providing a Permanent Secretariat to the Union. Without the Secretariat, the Union would not be able to function effectively, and particularly so in matters of communication with its constituency. But since its inception in 1989, the workload of the Secretariat has steadily increased to the point where staff is unable to complete some of its work in a timely manner. Although this is a product of the success of the Union, it will also be a cause for grave concern if the workload continues to expand. It is essential, therefore, that the Permanent Secretariat be maintained and, if possible, enlarged.

Advisory Boards

In providing expert advice to the Executive Committee, the Advisory Boards convene meetings, conduct reviews, and prepare reports and recommendations, generally on an annual basis. The IUGS currently maintains Advisory Boards for Publications, Research Development, and Finance.

By statute, the role of the **Advisory Board for Publications (ABP)** is to provide advice on publications to the Executive Committee. Over the years, however, the needs of the IUGS publications program have increasingly required the ABP to function in an operational mode as well, an activity that continues to escalate and require more and more of the Board's time and attention. The SPC concluded that there was a demonstrable need to formally recognize the changing character of the ABP's activities by renaming it simply the "Board on Publications" or the "Publications Committee" (the latter draws a clearer distinction with the roles of the other advisory boards). The IUGS statutes should be amended accordingly.

The Board will need to continue with its extremely important role of advising the Executive Committee, the Editor of *Episodes*, and the Webmaster on publications (in any medium) and related policy matters, and determining the disposition of manuscripts that are submitted to the IUGS for possible publication. However, the SPC believes that the Board must also continue its operational duties, which include its current efforts to explore and evaluate options to improve the scope, visibility, marketing and distribution of non-serial publications, and working directly to define what kind of journal *Episodes* should be in order to improve its circulation and utility to the IUGS constituency and beyond.

Managing IUGS publications affairs could change dramatically if the Union were to commission a single entity to publish all approved works resulting from IUGS scientific activities. Clearly, the ABP would be responsible for researching and recommending such an initiative to the Executive Committee and advising it on related policy matters.

Whereas such an arrangement undoubtedly would have the desirable and much-needed effect of enhancing recognition of the Union's work, and its contribution to international science, it could lead also to a dramatic increase in the complexity and number of formal IUGS publications that might require the services of one or two, paid editorial staff.

As previously detailed (see the section on "Critical Assessment"), the **Advisory Board for Research Development** should play an essential dual role as an *ad hoc* "strategic planning committee" and as a committee that regularly reviews the IUGS's active scientific programs and proposals to initiate new ones. Whereas it is not the role of the SPC to present a detailed plan for how the expanded and reconstituted ABRD should go about its work, the Committee suggests that the Executive Committee give careful thought to deciding such matters as the number of scientists who should serve on the board and how the board's membership should be constituted. For example, "core members," should be distinguished, internationally recognized earth scientists noted for their breadth and depth of understanding, their experience and judgement, and their commitment to promoting the earth sciences internationally or globally. But the Executive Committee should then also authorize the ABRD to co-opt such additional members as are necessary on a *pro tem* basis to ensure adequate disciplinary representation for a fair and informed judgment of any new proposal or informed review of any extant investigation. In addition to the regular cycling of the ABRD membership provided for by the IUGS Statutes, the co-opting of *pro tem* members would ensure that the ABRD was continuously exposed to a broad spectrum of knowledgeable opinion.

In its project-assessment and reviewing responsibilities, the ABRD may find the need to:

- develop standard sets of application forms for different kinds of proposals which would ensure that the Board has on hand comparable information from each applicant or group of applicants to permit fair and even assessment of their requests, and other kinds of standard forms which would ensure comparable processing of these requests; adopt an external referee system to assist the Board in evaluating, such as, the appropriateness, originality, topicality, scientific promise, feasibility, and budgetary requirements of proposals, and the prior productivity record of the applicants;
- employ a committee system for, such as, the preliminary evaluation of new proposals (although with all final recommendations requiring approval of the entire Board).

The **Advisory Board for Finance** has been inactive for several years and must be revitalized. The IUGS has never seriously searched for outside funding, and clearly it should do so. It is the strongly held view of the SPC that a powerful, influential ABF should be empanelled and authorized to seek external funds by, among other things, promoting the value of worthy IUGS projects to interested partners.

Executive Committee

The administration of the Union is carried out by the Executive Committee, with the assistance of the Advisory Boards, under the general direction of the Council. Day-to-day operations are carried out by the Bureau. In practice, however, because of the administrative structure of the Union itself, the geographical dispersal of its organizational components and key personnel, the infrequency of meetings of the Council (quadrennial) and of the Executive Committee (annual), the limitations of the central budget and the varying economic means of individual members, this arrangement has not worked satisfactorily. Changes to strengthen the effectiveness of the Executive Committee are seen by the SPC as a high-priority requirement.

Accordingly, the SPC recommends that, instead of eight Vice-Presidents as at present, the position of Vice-President should be limited to two highly qualified individuals willing to assume significant responsibilities to assist in managing the Union, such duties to be determined by the Executive Committee. Each Vice-President will attend one Bureau meeting per year in addition to those at the annual meeting of the Executive Committee. The Vice-Presidents will serve a single four-year term concurrent with the terms of the Bureau members; they may, however, accept nomination to an additional four-year term as a member of the Bureau (i.e., President, Secretary General, or Treasurer). The rationale underlying this recommendation is three-fold: 1) a Vice-President who is eligible for nomination to an additional term in a position with greater responsibility has a strong, forward-looking incentive to work diligently to advance the interests of the Union and to perform the duties of the office effectively; 2) Vice-Presidents who do advance to a position in the Bureau provide management continuity and bring to the job first-hand knowledge of the workings of the Union and hands-on experience in dealing with them; and 3) the Bureau can use additional expertise to assist in managing the day-to-day affairs of the Union.

The rest of the Executive Committee should include the Bureau, Past-President, and four Councilors, each representing, to the extent possible, different regions of the world and different sub-fields of the geological sciences. The proposed new office of Councilor is intended to be filled by distinguished earth scientists who are expected to work to advance the best interests of the Union; represent the Union to the National Committees of member countries in their respective regions; offer the Executive Committee advice and opinion in their respective areas of disciplinary and regional expertise, and undertake such tasks and responsibilities as are delegated to them by the Committee. The position is similar in all respects to that of the current Vice-Presidents. The new title is necessary to clearly distinguish the different roles and responsibilities of the Councilors and the proposed two new Vice-Presidents. The Councilors will serve a single four-year term, staggered for continuity (two assume office immediately following election by the Council and two take office mid-way between the quadrennial meetings of the Council). Councilors will be assigned duties compatible with their expertise and, like other members of the Executive Committee, will submit an annual report on their work and accomplishments on behalf of the IUGS.

At present, the Past-President, who serves a four-year term, provides much-needed continuity from one administration to the next. In the future, after the Bye-Laws are amended and the recommended changes are implemented through one term, the staggered terms of the Councilors and likelihood that at least one of the Vice-Presidents may succeed to a position in the Bureau will provide the necessary continuity such that the position of Past-President can be eliminated.

The SPC believes that such a streamlined and reconfigured Executive Committee having specific duties will accomplish more for IUGS. It might also cost less, particularly if at least some Committee members were able to support some of their IUGS travel costs from sources other than the Union.

The Executive Committee should be strengthened and made more effective.

- ***The number of IUGS Vice-Presidents should be decreased from 8 to 2.***
- ***The two Vice-Presidents should serve a single 4-year term, concurrent with the Bureau. They may, however, accept a nomination, for one additional term only, to the office of President or Secretary General or Treasurer.***
- ***Four councilors should be elected, each to serve for a term of 4-years, but staggered (two take office immediately following election by the Council meeting, two take office two years after the Council meeting) in order to provide continuity. These councilors would be allocated specific roles, e.g., serving as chairpersons of advisory boards and committees, according to their expertise and experience.***
- ***The Executive Committee should comprise the President, two Vice-Presidents, Secretary General, Treasurer, Past-President, and four Councilors.***

Commissions

The International Union of Pure and Applied Chemistry (IUPAC) recently concluded that "commissions are an impediment to the development of new approaches" (President's Report on the State of the Union, 40th IUPAC Council, 13-14 August, 1999, Berlin, Germany). It commended the past work of its 37 current Commissions, but decided to set up a project-driven system based on short-term Task Groups with membership open to the entire community. The International Union for Quaternary Research, the Scientific Committee for the Lithosphere, ICSU, and other Unions have also adopted this mechanism for accomplishing much of their work. The main rationale is that support of standing Commissions uses most available funding, so that there is little latitude for funding new enterprises.

The SPC considered recommending the IUPAC approach to redirecting scarce IUGS financial resources to new scientific undertakings. The IUGS supports many fewer commissions, however, which collectively receive only about 27 percent of the IUGS's annual allocation to scientific enterprises. Moreover, for most, if not all, the continuing long-term commitment of support is clearly justified by the nature and scope of their work, which typically does not lend itself to fragmentation into parcels of short-term tasks (each of which presumably would have to be submitted as a proposal that would

compete for funds with many other proposals for short-term tasks). Therefore, the SPC concluded that, *in principle*, Commissions are appropriate bodies to conduct earth-science studies of broad scope or unusual complexity in which a long period of time is required to plan, coordinate, and implement tasks necessary to meet defined goals and objectives, and integrate the results. This statement does not imply, however, that the IUGS should necessarily continue to maintain and support financially *all* of its existing Commissions. Indeed, for several reasons, it should not:-

First and foremost, as has been pointed out previously in this report, given the lack of significant new funds from external sources, the IUGS has no choice but to redirect some of its funds in order to respond to changing times and conditions and move in new scientific directions. Its future health and welfare, if not its very survival, will depend on its ability and will to adapt, realign, or renew its organization and programs to function effectively in the fast-changing operating climate of modern science.

Second, the existing Commissions differ from each other in significant ways that offer the IUGS reasonable criteria by which to judge whether to dissolve a commission or redefine its terms of reference. For example, some Commissions could probably function very effectively with no financial support from the IUGS, because the nature of their scientific work or mode of operation generates income or attracts funds from external sources. One Commission (Igneous and Metamorphic Mineralogy) has performed successfully in this fashion for several years. In this case and others, the sanction and imprimatur of the IUGS lend essential organizational credibility and assist in raising funds. On the other hand, some Commissions appear to be doing work that probably could be done much better by government agencies (e.g., national geological surveys), academic institutions, or private sector organizations; or they potentially overlap the work of affiliated organizations; or they are involved in programmatic environments where IUGS-funded activities can have little or no impact. Other Commissions fit into none these categories and either should continue to do what they are doing or be modified, if appropriate, to sharpen their focus, tighten managerial control, eliminate overlap, increase the pace of their work, or improve productivity.

Scientific work within the IUGS should continue to be carried out primarily by Commissions and Working Groups. However, the number of such enterprises should be strictly limited by the funding available.

Commissions should be established (or continued) for important scientific undertakings, the nature of which clearly requires long-term (8 to 12 years?) attention and funding. Working Groups should be project-oriented enterprises of shorter duration, typically funded for no more than 4 years.

Clearly, commitments to support bodies funded to conduct long-term studies (Commissions) must be carefully staged, and balanced by earth-science initiatives of limited duration (Working Groups). Given the lack of substantial new external financial resources, the IUGS must routinely aim to conclude work in one or more endeavors in order to redirect funds to new initiatives.

Recommendations concerning the future of specific Commissions are well outside the purview of the SPC. These decisions will require consultation with the Commissions and careful, thoughtful deliberations involving the ABRD and the Executive Committee. Moreover, how the IUGS decides to reconfigure and improve its relationships with its affiliated organizations (see the following section on "IUGS Partners") may dramatically affect its plans with respect to the Commissions.

IUGS Partners

ICSU

The Committee firmly believes that, within ICSU, the perception of the earth sciences, represented by the IUGS (and by the IUGG and IGU) needs to be changed insofar as there seems to be an inadequate and unrealistic appreciation of the roles that the earth sciences - and indeed, only the earth sciences - can and must play in advancing science, and particularly in applying science globally to the benefit of humankind. In this respect, the greater emphasis on multi-disciplinary and socially-relevant studies now proposed for the IUGS should be helpful in changing the perception of the IUGS within ICSU.

ICSU's funding process, at least for significant grants, now strongly favors research proposals involving two or more ICSU unions. For that reason, the IUGS must establish working relationships with other unions well before project proposals are initiated. Also, given the widening relationships between the earth sciences and other sciences, a number of non-traditional links need also be sought; for example, with the medical sciences and other social sciences. The growing interface of aspects of geochemistry and mineralogy with human health illustrates this point.

UNESCO

UNESCO is an important partner with IUGS in several projects, especially the IGCP, but on a yearly basis UNESCO funding continues to be uncertain. The IGCP is critically dependent on both UNESCO and the IUGS for its administration as well as its financial support. A further limitation on the IUGS's current relationship with UNESCO is that it is confined to the latter's Division of Earth Sciences. The IUGS should expand its UNESCO (and other UN) contacts, for example, to include the disaster mitigation and the hydrological, soil, and social science directorates. Other areas of UNESCO could be also relevant to IUGS activities.

The 30-year old International Geological Correlation Programme (IGCP) is recognized broadly as the most important and successful IUGS project and the most important large scale and truly international program in the earth sciences. It is considered valuable to a wide spectrum of earth scientists (e.g., university researchers and government geologists, especially those in developing countries) and is widely acknowledged as such.

Recognition of the IUGS's role in the IGCP needs to be improved, and in this matter much greater effort has to be made in the future by all parties involved. Calls for new proposals and accounts of findings from existing projects should be published regularly

in the IUGS quarterly journal, *Episodes*. The ABP should take steps to secure a higher proportion of book-length works on IGCP projects for its monograph series. All official communications, from publications to web-site entries, should acknowledge the IUGS as an equal partner with UNESCO in the IGCP program.

Through its network of extensive contacts, the IUGS should continue to encourage the submission of high-quality proposals for consideration as IGCP projects, and increasingly those of social relevance. Project proposals that include multi-disciplinary and high-technology approaches aimed at resolving process-oriented problems need to be encouraged, particularly where they have the added benefit of transferring technology from developed to developing countries.

The SPC also concluded that the name of IGCP should be changed so as to represent more accurately its present mandate. One attractive possibility would be to produce a title that would allow the original well-known acronym to be continued. Possibilities include "International Geoscience Cooperation Program," or "...Geoscientific Cooperative..." or "...Collaboration Program." Any change of name should indicate to the earth science community the true scope of the program and, thus, may lead to a broader spectrum of grant proposals.

The SPC also considers that there should be a broad-based review of the IGCP by an independent international panel. In addition to reviewing the scientific aspects of the IGCP, the independent panel should consider the role that the IUGS-UNESCO Scientific Board for the IGCP would play if a peer-review system were introduced to the processing of all applications. The SPC concluded that, if this were done, the IGCP Board could be reduced from sixteen members to eight, thereby increasing the program's cost effectiveness.

The objectives and scope of the IUGS/UNESCO programs on the Geological Applications of Remote Sensing (GARS) and Mineral-Deposit Modeling (MDMP) should be externally reviewed in the same manner as the IGCP. This could well lead to the identification of potential sources of additional funding.

Effective working partnerships should be forged with other ICSU Unions and greater emphasis placed on multi-disciplinary, socially relevant studies.

The International Geological Correlation Program (IGCP) has been an outstanding success; IUGS support and involvement should continue as it is critical to the future success of the IGCP. However, a rigorous external review is now desirable as a basis for setting future aims, directions, and emphases.

The IUGS should explore cooperation with other UNESCO entities besides the Division of Earth Sciences, and also other UN agencies.

Other UN Agencies

There is need for the IUGS to explore the possibility of cooperating with other UN agencies, for example, the World Health Organization (WHO), the United Nations

Development Programme (UNDP), the United Nations Industrial Development Organization (UNIDO), and the United Nations University (UNU). Areas of potential cooperation include geochemistry, soil sciences, natural hazards, raw materials, and water (especially related to improving the well-being of developing countries).

International Geological Congresses

The International Geological Congress (IGC) is widely viewed as the premier world geological conference of interest to the entire earth science community. It is especially important to scientists from developing countries, but is also greatly valued by those from the developed world. The broad range of geological field trips is particularly appealing to many participants. The IGC is also the premier forum for presentation of results from IUGS programs and provides a singular occasion on which its commissions, committees, and like bodies may meet and interact. The IUGS Executive Committee plays a major role in guiding the IGC. Despite all of this, the IUGS's involvement in the Congress commonly receives little acknowledgment from the local organizing committee of the meetings. The SPC believes that this is an unsatisfactory situation. A number of steps need to be taken:

The IUGS should receive more recognition for its role as scientific sponsor of the quadrennial International Geological Congress (IGC); it should also receive a significant financial return for its role through the imposition of an IUGS levy on the proceeds of all future IGCs.

Through the *Hutchison Fund*, the IUGS should partly financially support promising young scientists to attend the IGC. Through discussion with IGC, the IUGS should seek additional support for these young scientists from the Geohost program and also request that registration fees for them be waived.

The IGC should be more clearly identified with the IUGS as its sponsor. The IUGS should play a stronger role in organizing these congresses, particularly in working with the host country choosing themes, establishing priorities, and selecting conveners. For these services, there should be a financial return to the IUGS from each IGC of the order of 20% of all registration fees.

Affiliated Organizations

After carefully considering the current arrangements governing the relationships between the IUGS and its Affiliated Organizations, the SPC concluded that the Affiliates probably find these as unsatisfactory as does the Union and believes that they need to be changed. Part of the problem in effecting change, however, stems from the notable variation among the thirty-six Affiliated Organizations: they range from the large and relatively wealthy American Geophysical Union with 36,000 members to others which are small (only a few hundred members) and subsist on very meagre annual dues from their members. Under the present arrangements, the Affiliated Organizations have representation through the IUGS in ICSU, receive complimentary copies of *Episodes*, the IUGS Directory, the minutes of the IUGS Executive Committee meetings, and other occasional communications. A few have received funds from the IUGS to support the

attendance of scientists from developing countries at their meetings abroad. In return, the Affiliated Organizations are expected to prepare an annual report on their activities for consideration by the IUGS Executive Committee. These are reviewed, but rarely can any action be taken on them because the Union recognizes the Affiliated Organizations to be autonomous bodies. The information provided in the reports is largely for information, and the all-too-common requests for funding from the Union cannot be granted for the simple reason that the IUGS does not have funds to make many, or any, awards. The SPC also concluded it was inappropriate for the IUGS, an organization with only limited funding, to be providing services etc at no cost to wealthy affiliates, when there was no obvious benefit to the Union.

Current arrangements between the IUGS and its Affiliated Organizations are thoroughly unsatisfactory and should be drastically revamped. The present arrangements confer little benefit on the IUGS and even less on the Affiliates.

Difficult as it may be to change the present largely unsatisfactory bureaucratic arrangements, the SPC is persuaded that both the IUGS and the Affiliates must strive to do so in the interest of solidifying relationships and better harmonizing the power of the Affiliates, and utilizing the skills and talents of their members, in a more unified attempt to deal with the current issues of international earth science.

The SPC suggests that the following possibilities be explored jointly by the IUGS and its Affiliated Organizations: that

- The IUGS engage in joint projects with its Affiliated Organizations. If this were to prove viable, then clearly only one, or at best a few, Affiliated Organizations could expect to benefit in any single project. With time, however, an effort would be made to spread the involvement of the Affiliates;
- The IUGS and its Affiliated Organizations jointly sponsor symposia or workshops on topics of common interest. This would enhance the visibility of the Union and underscore the relationship between the sponsors;
- The IUGS make Affiliated Organizations eligible to apply for IUGS project grants;
- The IUGS accord the Affiliated Organizations a vote at Council meetings;
- The IUGS continue to represent the interests of the Affiliated Organizations within ICSU;
- The IUGS not only continue to send the Affiliated Organizations complimentary copies of *Episodes* but offer these organizations subsidized advertising space in *Episodes* for their forthcoming events and further encourage them to use *Episodes* as a vehicle for publishing high-quality articles and reviews on their work;
- The IUGS offer some Affiliated Organizations the status of official IUGS Associations;
- In keeping with the arrangements prevailing in other international scientific unions, and in return for these privileges, the Affiliated Organizations pay to the IUGS an annual fee, which would vary with the size and financial condition of the Affiliate.

Communications and Publications

Communication within the IUGS, with the broader geoscience community, and with the public is an important priority. This is achieved through traditional and electronic methods of communication and publication.

Episodes

Episodes is recognized as a vital component of communications within IUGS. The improved appearance and quality achieved by the current Chinese publication team are commendable.

The Committee recommends that *Episodes*, publish authoritative review articles on subjects of broad interest to earth scientists, other scientists, and, whenever possible, the lay public rather than trying to compete with other more specialized journals for articles on leading-edge earth-science research. The journal should also continue to publish relevant information about the scientific programs of the IUGS and its partner organizations, such as the Commissions, Working Groups, and the IGCP.

Other featured sections, such as those on discussions of topical issues, book and map reviews, and the calendar of forthcoming events, should be continued.

Episodes, the IUGS quarterly journal, is critical to the Union's communications and should be retained. Future emphasis should be placed on high-quality review articles, information about the IUGS's activities and programs, and the calendar of future international scientific events.

There is a need for continuing with an Advisory Board on Publications and a strong Editorial Board to advise the editor of *Episodes*. A significant increase in circulation and readership will be aided by continued enhancement of the quality of content and presentation.

Stronger effort should also be made to promote advertising in order to offset production costs to IUGS.

Web Site

The webmaster is to be commended for developing an excellent site. However, the utility of the web site is limited by its poor accessibility in many developing countries. There is no easy, instant solution to this problem; it will become less and less important as computer and telephone networks extend their geographic range and density of coverage in the developing world, thus offering much improved access to the Internet.

The IUGS Web Site must be adequately supported and encouraged to continue its admirable growth in breadth and usefulness. It should become the electronic "hub" of the Union, and, as such, will contribute enormously to improving communications within the Union; disseminating data, information, reports, and policy positions; and reaching out to the general public and the education community world-wide to promote understanding of earth science matters, especially those of societal relevance.

In the interests of promoting the Union's commitment to earth-science education and training, efforts should be made to solicit from within the Union, its "family", and its partners, relevant materials that can be downloaded from the IUGS web site – articles, reports, lecture- and short-course notes, and the like. Such material would be welcome in many parts of the world, would enhance the IUGS's visibility in the educational arena, and could contribute to greater public awareness of the earth sciences.

Other Publications

The SPC sees a notable need to increase the visibility of, and credit given to, the IUGS in publications that stem from activities it has sponsored. All monographs should bear the IUGS logo, name, and publication number, as well as an ISBN number assigned by the Union, and they should be identified as IUGS-sponsored publications in the catalogues and advertizing literature of any external publishing houses who may produce them. The Union should seek to improve royalty agreements in order to increase funds available to meet the production costs of other publications or enhance revenues generally.

The IUGS should seek greater visibility and better financial returns from its program of publications. Regardless of the publisher, all publications stemming from IUGS-sponsored scientific work should carry the IUGS logo and be clearly identified in all respects as IUGS-sponsored publications.

While continuing to publish monographs by earth scientists directed primarily at other specialized groups of earth scientists, the IUGS should attempt to publish monographs and other works of broader educational value, particularly ones that would contribute to greater public awareness of the pressing issues relating geoscience and global society. A commercial publishing partner, prepared to subsidize the costs and share in the profits of these larger monographic and related works, would be a great asset.

Communications within the IUGS

The IUGS Bureau, Secretariat, and Executive Committee should seek to improve the timeliness and frequency of communications with the IUGS National Committees, and the National Committees should reciprocate. The National Committees constitute an under-used and mostly under-appreciated resource that should be more directly engaged to interact with the IUGS and support its activities.

In an organization in which the administration is, of necessity, widely distributed geographically, good communication links are imperative. "Lack of communication by the central administration" is a common complaint among the various sectors of the Union; the complaint has some validity and it needs to be rectified. But communication is a two-way activity, and much improved communication with the central administration is also called for. The SPC believes that the Bureau should take greater advantage of both traditional and new, fast, electronic means of communication to improve its links with all sectors of the Union, most particularly with National Committees. Conversely, all of these sectors should be more assiduous in communicating

with the Bureau by the same means. The mention of National Committees in particular stems from responses to the questionnaire issued preparatory to this strategic planning exercise. Only 26% of the National Committees bothered to respond to their questionnaires compared to 100% for other IUGS bodies and partnership agencies.

Funding

As pointed out earlier, the IUGS has insufficient funding to adequately support its current range of activities. It must therefore seek to improve its current level of income and be more selective in its expenditure.

Advisory Board for Finance

The SPC concluded that an operational Advisory Board for Finance (ABF) must be re-established as soon as possible. There is an urgent need to broaden the funding base of the IUGS to pay for its proposed new activities. A primary duty of the ABF would be to actively seek additional finances. Possible new sources of funding are identified below. Under normal circumstances the Chairman of the ABF would be a member of the IUGS Executive Committee. Members of the ABF should include representatives of potential contributors and donors and geoscientists who have a good network of contacts with industry and public-sector funding agencies. An additional responsibility of the ABF would be to offer advice on income and expenditure policy to the IUGS Executive Committee. Specific items to be considered by an ABF would be:

- investment of IUGS funds in high grade bonds and other vehicles that offer low risk and liquidity;
- a policy for electronic commerce involving IUGS products; and
- review of the policies with respect to royalties that arise from commercial sales of IUGS publications.

Income Strategy

It should be the responsibility of the ABF to recommend an income and expenditure policy that will be presented to the IUGS Executive and Council for approval. The SPC saw the proposed new financial arrangements for the IGC as an important source of income in the future. Currently, nine member countries are contributing approximately 70% of income available for discretionary purposes. It is imperative, therefore, that the IUGS remains attractive to the participation of these countries, while at the same time expanding its funding base. A contingency budget should be maintained to cover the eventuality of delay or non-payment by any of these nine member countries. Most similar organizations that are financially healthy maintain a reserve equivalent of 12 to 18 months of income. For specific high-profile and innovative projects and thematic symposia and workshops, financial support should be solicited from industry, foundations, and private and public funding agencies. Although several of the IUGS Commissions and Affiliates have been successful in obtaining such additional support,

there are many more potential sources to be tapped. The ABF should provide advice on how to procure funding for specific activities. It is conceivable that well-organized and sharply focused symposia and workshops would generate revenue for IUGS.

Through the ABF, the IUGS should seek to significantly increase its level of funding by developing new sources. These should include recruiting more Associate Members and giving consideration to establishing a category of Individual Members.

The IUGS should increase its membership fees by a total of 10% over the next few years, and, based upon a relevant, standard measure of monetary inflation, then keep them at realistic levels from then on.

Because of its increasing concern for the financial situation within IUGS over the years, the Executive Committee has considered the possibility of recommending an increase in membership fees for all categories. The last increase in fees occurred in 1989. Since that time, inflation has eroded IUGS's financial capabilities. However, considering the present financial climate, it would seem inappropriate to demand a substantial increase in fees that bring about an effective "100% catch-up" relative to 1989 levels. A large increase would undoubtedly result in loss of total contributions from some countries and other countries choosing to move to a lower fee category. Nevertheless, the SPC recommends that the IUGS Council should consider a modest increase in fees of the order of no more than 10%, which could be phased-in incrementally over several years. Thereafter, dues should be maintained at a realistic level based upon a relevant, standard measure of monetary inflation.

Presently, there are only a few Associate members of the IUGS. An Associate member may be a person, or a private or public institution that care sufficiently about the importance of the geological sciences and the work done by IUGS that they pay an annual subscription. In other words they are the IUGS "angels"! It will be the responsibility of the ABF to encourage additional organizations, agencies, and institutions to become IUGS Associate members. Benefits of IUGS Associate membership would include receiving minutes of Executive Committee meetings and *Episodes*, being recognized as Associate members in one issue per year of *Episodes* and on the IUGS web site (links between the web sites of the IUGS and the Associate members would be possible), observer status at IUGS Council meetings, and offering them (through the IUGS) representation at ICSU and other important international organizations.

Consideration should also be given to establishing a category of Individual Members. Benefits of IUGS Individual membership might include *Episodes* and being on a membership list maintained on the IUGS web site.

In addition to supporting financially the IGCP and other joint programs, the IUGS will fund its Commissions, Working Groups, and any "special projects" that may be undertaken. One item requiring particular attention from the ABF would be establishing an appropriate mechanism to fund high-profile and innovative projects.

4 CONCLUSIONS

Over the relatively short period of three days, the SPC was able to define the major issues facing the IUGS and make a series of recommendations (32 in all) to help address those issues. The SPC is in no doubt that to do nothing and avoid making any changes will result in threats to the viability and very existence of the Union in the future. What it did not do, and could not do, was produce an implementation plan for all its recommendations. This is a task for the IUGS Bureau and Executive Committee to do. But before an implementation plan can be developed, the IUGS Council must come to a view on the strategic plan presented here. There are clearly some difficult decisions to be made by the Council and the Executive Committee and, inevitably, not everyone will agree with all of the recommendations, particularly those which perhaps impact on a favored area of science. The SPC hopes, however, that the recommendations will be viewed within the broader context of what is best for the IUGS overall. The Union is too important an organization to be allowed to fail. The SPC believes that adoption of its recommendation will help IUGS to succeed.

Acknowledgments

The SPC is most grateful to the very many people who completed the IUGS questionnaire. The candid views of these respondents were absolutely critical to the deliberations of the Committee. We also extend our sincere thanks to Dr. Petr Jakes, who helped with logistics in Prague and was a wonderful host. We also thank Glen Caldwell for a most thorough and constructive review of the report, in his capacity of Chairman of the IUGS Advisory Board for Publications. Karen Alarcon of the APCRC, Canberra, typeset this publication. Finally, particular acknowledgement must be made of the outstanding work of John Aaron in compiling and editing this report.

APPENDICES

Appendix 1

Questionnaire Seeking Opinions Concerning the IUGS

QUESTIONNAIRE

Please write your answers on a separate sheet, keyed to the question numbers. Please also note that the questions under E should be answered by everybody. Thank you.

This response is submitted on behalf of

- A IUGS National Committee**
- or **B IUGS Commission, Board, Joint Program, Working Group, etc.**
- or **C Affiliated organizations**
- or **D Individual**
- or **E Member of the Executive Committee**

This response is completed by:

Name

Address

Phone

Fax

E-mail

Position in organization

QUESTIONS:

- A For National Committees**
- A 1 How significant is IUGS to geoscience in your country?
- A 2 What would be the impact if IUGS were to be abolished?
- A 3 What is your annual national IUGS budget? US\$
- A 4 Did your country pay its annual membership dues this year?
- A 5 If not, why not?
- A 6 If yes, did you get value for money?
- A 7 If for any reason your country withdrew from (or were suspended from) membership of IUGS, what would be the impact?

B For IUGS Working Groups, Boards, Commissions, etc.

- B 1 How successful has your "organization" been over the past 5 years in achieving its mission (give examples of tangible achievements).
- B 2 What are your 3 or 4 most important goals over the next 5 years?
- B 3 Number of participating countries.
- B 4 Size of governing committee.
- B 5 Number of meetings per annum.
- B 6 Annual budget (a) \$ cash and source of funds (b) in kind support.
- B 7 What would be the impact on geoscience if your "organization" were to be abolished?
- B 8 What would be the impact if IUGS funding to your "organization" were to be doubled?
- B 9 What would be the impact on your "organization" if IUGS were to be abolished?

C For affiliated and related organizations

- C 1 What is the nature of your links with IUGS?
- C 2 How important are these links?
- C 3 What would be the impact if IUGS were to be abolished?

D For individuals

- D 1 What is your area of geoscience?
- D 2 What is the nature of your current or past linkage with IUGS?

E For completion by all respondents

- E 1 How effective do you feel IUGS is as an organization?
- E 2 What are the strengths of IUGS?
- E 3 What are the weaknesses of IUGS?
- E 4 What should be the future role of IUGS?
- E 5 What should be the future priorities of IUGS?
- E 6 What role should IUGS have in future IGCs?
- E 7 How do you see the role of IUGS vis a vis other national and international bodies?
- E 8 What organizational and financial changes should be made to IUGS to make it into a more effective organization?
- E 9 Should IUGS aim to have a higher profile, or is it about right?
- E10 Do you have any general rules on how funding should be apportioned between the different IUGS entities?
- E 11 Is this answer your own, or that of part or all the Committee?
- E 12 Any other comments and suggestions regarding IUGS.

- E 13 Do you subscribe to *"Episodes"*? Do you receive it as a consequence of your position or involvement with the IUGS?
- E 14 Do you read it regularly?
- E 15 Do you think it contains useful, interesting articles and other material?
- E 16 What, in your view, is the most valuable or useful information contained in *"Episodes"*?
- E 17 What suggestions can you offer for improving *"Episodes"* and making it more valuable and useful as the scientific journal of the IUGS and also more relevant to your work and needs?
- E 18 What would be the impact on you, your work, or your organization if *"Episodes"* ceased to be published?
- E 19 Do you see and use other IUGS publications (Monographs)?
- E 20 Do you find IUGS monographs useful or relevant to your work, or relevant to the needs of geoscience in general?
- E 21 What suggestions can you offer to improve the visibility, vitality, and utility of IUGS monographs?
- E 22 Do you visit the IUGS web site (www.iugs.org)? If so, how frequently?
- E 23 Do you find the information on the web site interesting and useful?
- E 24 Do you think that the information on the web site gives you a proper sense of the scope and effect of IUGS scientific activities?
- E 25 What suggestions can you offer for improving the web site (content or presentation) and making it more useful and relevant to the information needs of your work or the work of your organization?
- E 26 Would it matter to you if the web site ceased to exist?

Please return your response by 15 July 1999 to:
IUGS Secretariat, Geological Survey of Norway

Appendix 2

Respondents to Questionnaire

The following individuals and organizations responded to IUGS's request for feedback to provide perspective to the Strategic Planning Committee. The IUGS and the Strategic Planning Committee deeply appreciate the candor and thoughtfulness of those who offered opinions and suggestions.

Member Countries

Argentina	Dr. Alberto C. Riccardi
Austria	Dr. Werner R. Janoschek
Azerbaijan	Prof. Ismail-Zadeh Arif
Belarus	Dr. Anatoly Aleksandrovich Makhnach
Belgium	Prof. Maurice Streel
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Appendix 3

Glossary of acronyms

ABF	Advisory Board for Finance (IUGS)
ABP	Advisory Board for Publications (IUGS)
ABRD	Advisory Board for Research Development (IUGS)
AGU	American Geophysical Union
CGMW	Commission for the Geological Map of the World
COGEOENVIRONMENT	Commission on Geosciences for Environmental Planning
COGEOINFO	Commission on Management and Application of Geological Information
CSP	Commission on Systematics in Petrology
GARS	Geological Applications of Remote Sensing
GGB	Global Geochemical Baselines (IUGS Working Group)
IAEA	International Atomic Energy Agency
ICL	Inter-Union Commission on the Lithosphere
ICS	International Commission on Stratigraphy
ICSU	International Council for Science
IGC	International Geological Congress
IGCP	International Geological Correlation Program
IGU	International Geographical Union
INHIGEO	International Commission on History of Geological Sciences
IUCN	The World Conservation Union
IUGG	International Union of Geodesy and Geophysics
IUGS	International Union of Geological Sciences
IUPAC	International Union of Pure and Applied Chemistry
MDMP	Mineral and Energy Deposit Modeling Program
OPEC	Organization of Petroleum Exporting Countries
SCL	Scientific Committee on the Lithosphere (formerly ICL)
SPC	Strategic Planning Committee

- UNDPUnited Nations Development Programme
- UNESCOUnited Nations Educational, Scientific and Cultural
Organization
- UNIDOUnited Nations Industrial Development Organization
- UNUUnited Nations University
- WHCWorld Heritage Center (UNESCO)
- WHOWorld Health Organization