

FINAL REPORT
ICSU ASSESSMENT PANEL

October 1996

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PREFACE

This report is submitted to the 25th General Assembly of the International Council of Scientific Unions (ICSU) by a Panel established by the ICSU Executive Board to conduct an independent assessment of ICSU. Given the widely dispersed membership of the ICSU Assessment Panel and the short time (less than 12 months) in which to do the study, we have been able to meet, as a Panel, only two times. However, individual Panel Members did a great deal of work, both in direct contact with knowledgeable persons in their home countries or regions, and in addressing selected issues by contributing their own essays. In addition, we received a great deal of written input from the various ICSU constituents in response to questionnaires (a complete description of the assessment methodology is provided in chapter 3). For all of this information and advice, we are grateful.

While a longer period of study would have allowed us to refine our conclusions and recommendations, and perhaps allowed us to argue them more cogently and fully, we are reasonably confident that they would not have changed substantially. The decisions and efforts to follow our recommendations must be made by ICSU's General Assembly and Executive Board, respectively, using processes which, as we note in the report, may operate too slowly to match the changing conditions of world science today. In addition, many of our proposals have cost implications which will have to be considered by the Standing Finance Committee and the Executive Board. We have made a few remarks on the implementation of our recommendations, but details must still be worked out. The time allotted for this study was too brief to permit the panel to develop detailed implementation plans. But, we are confident that all of our recommendations are feasible if ICSU wishes to adopt them. Also, we realize that making changes will mean modification of the ICSU statutes. However, we believe that it is important not to wait until the 26th General Assembly in 1999 before these ideas become realities. *Therefore, we hope that the 25th General Assembly will adopt a resolution that shows a commitment to move in new directions, and give the Executive Board of ICSU the authority to move forward with some of the most important changes.*

The world of international science has changed dramatically since ICSU was founded in 1931. It is much larger, more diverse, more central to the interests of citizens and their governments, more important to international trade and commerce, more dispersed (less concentrated) among nations, and, yet, is better linked through modern modes of transportation and communication. Moreover, several key trends seem to be more or less universal:

Past		Future
Expanding	=>	Contracting
Public Sector	=>	Private Sector
Individual Enterprises	=>	Partnerships
Defense	=>	Civilian
Local Issues	=>	Regional & Global Issues

In many nations, science budgets are meeting sharpened competition for government support. Such support has often been the only source of funding for science in developing countries. While private sector support may be strong and even growing, especially in the developing countries, the focus of such science is not usually on forefront, pioneering work and is generally limited to direct commercial interests. Further, a number of forces, including the increasing importance of interdisciplinary efforts, are moving science more and more toward partnership efforts. The end of the Cold War is also causing shifts in both the issues to be addressed and the sources of support for science. Newly emerging areas, like biotechnology,

telecommunications, and computer science hardly existed when ICSU was established. Finally, the number of scientific issues of regional or global significance has also grown.

ICSU needs to be responsive to all of these shifts in science and science support. While ICSU has done remarkably well in adapting to new challenges, the time is right to take a comprehensive look at what it can do to be even more productive in the modern world. Thus, we are pleased that ICSU decided to request that this study be undertaken and hope that the steps we recommend will help it become even more effective in the years ahead.

Although we considered the question of whether ICSU should be disbanded, it was very clear that this was not an option favored by the vast majority of solicited and unsolicited respondents. While there were the usual concerns about process, programs, and other issues related to ICSU governance, almost all respondents felt that ICSU should continue to exist, and, indeed many enthusiastically endorsed the strengthening of ICSU to enable it to become more relevant in taking on the challenges and opportunities of changing international circumstances.

We group our proposals into five major recommendations, with several supporting recommendations for each. These are stated in Chapter 1 (Summary of Recommendations). We have provided this distillation hoping that it will be helpful to the General Assembly delegates in reading our report. Because of the time constraints, the Panel was only able to make the final report available to participants upon registration. Many readers, because of their familiarity with ICSU, will appreciate the reasons for each recommendation. In Chapter 2 we support each of these recommendations with our findings and reasoning. This is followed with some background information regarding ICSU and the operation of the Panel. Finally, we set ICSU in a historical and future context, posing questions about international scientific cooperation in the next century and about ICSU's capacity to manage the additional load.

When the Panel mentions "ICSU" in this report, we are referring to the totality of the organization--e.g., the aggregate of its members, bodies, and programs. In making recommendations about the programs or activities of ICSU, we are not dismissing the many disciplinary scientific activities and programs carried out by the Scientific Union Members or the many programs of the National Scientific Members. We are speaking only about the areas of intersection between the members and international science.

We recognize that the implementation of our recommendations will have budgetary implications. Some suggestions will result in increased expenditures and others will cause reductions. Although a shortfall may result in the short term given ICSU's current budget, we believe that the longer term effect of our suggestions will be greater visibility of ICSU in the global scientific community, increasing responsiveness and clearer priority setting, expanding partnerships and relationships with industry, and a steady emergence of innovative and fresh ideas, which collectively should result in opportunities for income generation.

The Panel is grateful for the financial support provided for its activities by the Science Council of Japan, the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) of Brazil, the Deutsche Forschungsgemeinschaft, and the U.S. National Academy of Sciences. I wish to acknowledge the gracious support of both the NAS in providing substantial staff support for me and the ICSU Secretariat for its assistance with the logistics and for its many substantive inputs.

Roland W. Schmitt
Chairman, ICSU Assessment Panel

I. SUMMARY OF RECOMMENDATIONS

We make recommendations in five areas: core activities and priorities, science policy, voice and outreach, governance, and membership. These are encapsulated below.

1. ICSU should be an incubator of "entrepreneurial" activities at the nexus of interdisciplinary, international scientific activities. It should generate essential new scientific programs and sound advice on science to guide policy formulation.

*The ICSU Grants Program should be converted into a seed fund to launch new initiatives. Procedures for promoting proposals, reviewing them, overseeing on-going programs, and terminating old ones should be codified and put into practice.

*ICSU should establish clear policies and processes for conducting high quality, authoritative "science for policy" studies at the request of intergovernmental bodies or by governments through their National Member or private agencies who would pay for them. ICSU should solicit such activities in areas where it has the competence to do so.

*ICSU should consolidate and enhance its activities for promoting science in the developing countries, and should call upon the extensive human resources in developing countries to assist in programs of sustainable development and to identify appropriate partners in regional and global collaborative scientific ventures."

*ICSU should conduct a comprehensive, rigorous comparative review of existing bodies and programs with the objective of restructuring them to conform to current needs.

*ICSU should establish a "sunset" provision for committees and programs.

2. ICSU should be the umbrella for concerns of "policy for science" in the international arena.

*ICSU should continue to provide advice, guidance and recommendations on policies that affect the integrity and effectiveness of the conduct of science (e.g., freedom of inquiry, movement, and communications: ethics in science; intellectual property rights; etc.).

*ICSU should address issues that affect the vigor and utility of science (e.g., science education; balance of basic and applied science; public understanding of science; capacity building, etc.).

*ICSU should issue timely "white papers" on such topics of "policy for science."

3. ICSU should strive to be a strong voice for international science through an aggressive outreach campaign.

*ICSU should review its current array of publications and restructure them, including: (i) reducing the portion devoted to "cataloguing", perhaps using electronic modes of distribution for such information; (ii) improving and making more widely appealing

and available information about programs, activities and issues addressed by ICSU; (iii) establishing an editorial board of experts in public relations and publishing to guide ICSU in making these changes.

*ICSU should have a public relations/publications expert on its staff, charged with strengthening and broadening knowledge of ICSU and its activities in the global scientific community.

4. The governance system of ICSU should be streamlined and restructured to reduce overlapping responsibilities of existing bodies, to cut costs, and to speed up actions.

*The General Committee should be discontinued and its functions transferred to an enlarged Executive Board.

*The name of ICSU should be changed to reflect more accurately its structure and function. The Executive Board should be charged with recommending such a change to the membership.

**Ad hoc* groups should replace "standing" committees for common concerns and services, giving more flexibility to growing or shrinking committees to fit needs. Many of the present standing bodies could operate as subsidiary bodies of the General Assembly, and could be convened concurrently with the Assembly.

*The Executive Board should institute a formal system of succession planning to ensure both the quality and the continuity of future staffing of the Secretariat. The positions within the Secretariat should be re-evaluated to grant responsibility and relevant authority to staff members according to agreed portfolios, based on programmatic rather than administrative needs, linked with advisors from among the officers, and supervised by the Executive Director.

5. The membership of ICSU should be reviewed to consider the role and balance of small and large National Members and Union Members, the increasing fragmentation and proliferation of "disciplines", the potential role of disciplines not now represented, and the character of national scientific bodies.

* Representatives selected by National Members and Union Members to serve on ICSU bodies and to launch new ICSU interdisciplinary programs should be accomplished scientists who also understand the international landscape of science, including the role that organizations can play in scientific cooperation. Both National and Union members should stress the scientific credentials of their representatives in ICSU activities, and seek scientists with breadth of vision and executive competence.

* ICSU should not solicit enlargement of the Union Member representation from the social sciences, until it is clear these disciplines decide how best to organize internationally, but should find the best ways of cooperation on critical concerns to build bridges between the natural and social sciences, and should welcome national representation by individuals from these disciplines.

- * ICSU should encourage membership by unions representing the engineering, medical, and agricultural sciences.
- * ICSU should make an effort to increase its capabilities and membership in recently emerging and growing areas of science such as telecommunications, computer science, and biotechnology.
- * ICSU should encourage participation in its activities by scientists from private industry and institutions.
- * ICSU should encourage the participation of scientists from developing nations in its activities.
- * The Officers and Executive Board of ICSU should further study the feasibility and desirability of a new (non-voting) class of membership that could improve the linkages with national funding agencies, other national scientific bodies (e.g., professional organizations), and corporations with interest in the development and application of science.
- * ICSU should encourage each National Member to set up mechanisms for sharing information between national representatives and other of its participants in Union Member activities, as there is a critical need for enhanced national coordination.
- * ICSU should develop criteria for membership with a view to avoiding redundant representation of disciplines; discouraging the fragmentation of disciplines, especially in the biological sciences; avoiding undue proliferation of members in general; and overcoming the perception that Associate status is an automatic step toward full membership. It should solve the existing dichotomy among the National Members and Union Members carrying equality of votes of the two categories of membership in the General Assembly, but not having equal capacities within their own members (some represent small communities; others are large) or in their dues contributions.

We are aware that our proposals have budgetary implications. Some will save money, but others may be costly. We believe that the cost savings incurred by eliminating the General Committee will more than offset the expense of additional personnel and of more resources devoted to fueling new initiatives. In the short term these may appear expensive, but in the long run, these should have a net positive effect on the overall budget of ICSU.

II. RECOMMENDATIONS AND DISCUSSION

1. RECOMMENDATIONS CONCERNED WITH CORE ACTIVITIES AND PRIORITIES

ICSU should promote selected projects and programs at the nexus of interdisciplinary, international science, continuing to identify societal problems where new scientific knowledge is essential, and using the limited amount of seed money currently made available through the ICSU Grants Program for new initiatives, after a careful review and setting of priorities. It should be both an incubator of important new programs and a source of sound scientific advice. It should seek new partnerships with organizations, especially in the private sector, to generate that knowledge.

The "core competency" of ICSU, the heart of its activities, and the object of greatest added value to ICSU and its members is in activities that are both international in scope and interdisciplinary in character. ICSU is an autonomous, non-profit, independent organization that brings together a broad and representative array of international organizations of scientific disciplines and national organizations of multi-disciplines, to address important scientific issues. In defining an interdisciplinary activity or program, ICSU serves as a catalyst for new activity, promotes cooperation among scientists worldwide, builds linkages at the interface of disciplines, establishes partners, and serves as an "honest broker" of scientific consensus before inter-governmental and governmental agencies and in confronting problems where scientific and technological knowledge is an important part of social, economic and political considerations.

There are many kinds of programs in the domain of interdisciplinarity or internationality, or both. Examples include:

- * Issues that are global or regional in scope, e.g. climate change, environment and development, population, widespread environmental impacts, large scale geologic phenomena, regional or global health, capacity building in science, etc.
- * Interdisciplinary issues which, though local in nature, are common to many countries, e.g. environmental impact of industrial activities, desertification.
- * Policy issues of common concern, e.g. intellectual property, ethics in science, electronic publishing, world-wide scientific resources, and megascience.

Setting Priorities and Recasting Program Development

Among the many background documents provided the Panel was a copy of the ICSU Yearbook 1996, which displays vividly the fact that ICSU is engaged in an impressively wide array of activities. The mandate of ICSU is broad and flexible, and permits innovative, adaptive responses to the issues that ICSU addresses. While this feature should be preserved, it also puts a high premium on carefully choosing the areas where ICSU might make a difference from among the very large number of things that it could do.

In confronting the increasingly stringent constraints on resources for science, ICSU and its members need to formulate an innovative process for determining future directions, and for identifying new initiatives of value that would attract appropriate funding from

outside as well as inside the traditional governmental and intergovernmental sponsors. ICSU must also improve the process for shutting down completed, failed, or marginal activities.

Having reviewed the organizational structural, operational modes and fiscal realities of ICSU programs, the Panel feels that some practical measures could be undertaken in the short term to emphasize a more "entrepreneurial" approach to program development. The ICSU Grants Program should be discontinued in its present form and recast to provide seed money for new initiatives and creative partnerships, to develop new programs with potential for catalyzing external funding. This will require procedures for setting priorities, reviewing proposals, allocating funds, overseeing funded projects, and, when appropriate, terminating activities.

Generally, successful ventures should be expected to develop other, much larger sources of support after a reasonable period and ICSU funds should be phased out to be used on other start-ups. Failed ventures will have to be terminated by ICSU after an appropriate time. This "entrepreneurial" approach for launching ICSU generated programs is not unlike the manner in which research is supported by many public and private entities today - e.g., by the submission of good new ideas after careful review of the literature, by an investigator to a sponsor. Another advantage of this mode of operation is to enhance ICSU's outreach. The existence of a grants program devoted to the initiation of programs in the interdisciplinary, international regime could get widespread notice and contribute to ICSU's outreach. The effort, if known to be open to scientists from third world countries, might also help offset the criticism heard by the Panel that ICSU now seems too dominated by the West.

Recognizing the very large gap between the developed and developing countries in S&T infrastructure, knowledge, and competence base, ICSU should consolidate and enhance its activities for promoting science in the developing countries. It also should focus on the need to utilize this large pool of human resources in the S&T enterprise to contribute effectively to programs of sustainable development and to identify reliable partners in regional and global collaborative scientific ventures.

Among the "Interdisciplinary ICSU Bodies" listed in the 1996 Yearbook are 14 scientific and special committees, 2 permanent services and panels, and 3 inter-union commissions. The rationale for supporting this panoply of committees and activities on a continuing basis is not self-evident to the Panel. *Therefore, the Panel recommends that a more rigorous and comprehensive review of these existing bodies and programs (that is, in comparison with one another rather than independent evaluations as currently performed by the General Committee) be undertaken with a view to limiting the duration of projects and committees. Also, the Panel recommends that when a scientific committee is created to manage a program approved by the General Assembly, the committee and the program should have a "sunset" provision--that is a date on which they are terminated unless a new, positive vote to continue them is made.*

The "entrepreneurial" approach does not represent a radical departure from the current processes of originating and developing proposals, except that we are suggesting that the Grants Program be modified to be strongly linked to the process and that it be codified, put into practice, and made widely known. The idea is to stimulate more widespread, innovative sources of ideas and to make it possible to choose and pursue the best.

Also, the approach is consistent with fiscal realities in general and with the precarious funding arrangements for the Grants Program specifically. For example, the U.S. special

contribution via the National Academy of Sciences, which in 1995 provided one-third of the total funds available, and which was broadly targeted toward scientific activities consonant with UNESCO programs and interests in ICSU, will be dramatically cut in 1996. Encouraging more innovation and improving links with industry and other private partners should broaden the resource base beyond the dependency on governments and intergovernmental agencies.

Providing Scientific Advice

We distinguish between "science for policy", that is, science that informs and influences the policies of governments or private organizations, and "policy for science", that is, policies of governments or private organizations that affect the well-being and effectiveness of science and scientists. The latter will be covered later.

The impact of science on policy is multifaceted and complex and depends on a number of factors: the degree of scientific certainty about the issue, the social and political context in which the science must be used, the scope of the science relevant to the issue, the impact of social and political factors on science itself, the balance of scientific and non-scientific factors important for the policy, and, perhaps, many more. Thus, answering the question of how ICSU should address science-relevant policy issues is not easy.

ICSU's involvement in science for policy, the use of science and technology for human purposes - economic, social, environmental, etc. - should depend on the degree of certainty of the relevant scientific knowledge, and on the specific needs of the policy-maker. Policy decisions are ultimately in the hands of legislators. But science can and should inform policy formulation. What policy makers need from advisors, such as ICSU, is authoritative statements which identify the limits of scientific knowledge that are relevant to the particular issue. Frequently, there will not be a consensus, but this equivocation in all its dimensions is necessary for the policy makers to understand. ICSU could provide a major service by setting out the different points of view on an issue in an objective way, and it should not shirk controversial issues. It should help clarify the issues and contribute to public debate about them.

ICSU should refrain from advising on the policy decisions themselves unless explicitly asked to do so by appropriate bodies, and then only under conditions where the authoritative body has not abandoned its own responsibility for the consequences of the policy - i.e. ICSU must in all circumstances be "held harmless" for policies that use its advice. The successive steps from science to policy that ICSU might take, depending on needs, are:

- * provide advice on scientific consensus, including conclusions and uncertainties, and the degree of assurance about the unknowns.
- * advise on the potential impact that alternative, plausible outcomes may have based on scientific evidence.
- * evaluate alternative policies and advise on the scientific pros and cons of each.
- * recommend a particular policy with scientifically based arguments for it.

In moving down this chain toward more policy-driven, less science-driven steps, ICSU would need to establish procedures to keep away from ideologically-based arguments and to

maintain its reputation as a source of sound, authoritative scientific advice. In the past, ICSU has made recommendations about a particular policy based on scientific arguments (e.g., opposing gene patenting, opposing a data system under the World Meteorological Organization which would have contravened the principle of open access to data, and promoting the appropriate use of animals in research).

In preserving the capacity to provide authoritative guidance on science, it is essential that ICSU, like most of its members, be governed by scientists, not politicians. Many National Members of ICSU and all Union Members are institutions governed for and by scientists. These members should seek to ensure that ICSU maintains its scientific credentials while scaling up its advisory capabilities.

Many of the National Members, in particular the academies of science, are set up in such a way that they are able to provide independent scientific advice to their governments. Many of these institutions have joined together in the InterAcademy Panel on International Issues to provide a forum for advising governments and international organizations. One ICSU member, the U.S. National Academy of Sciences, was chartered by the U.S. Congress with a mandate that requires it to advise the federal government on scientific and technical matters. Several Panel members mentioned that the NAS provides a good example of a productive relationship between a government and a non-governmental organization in which studies involving "science for policy" are carried out by an organization established by the NAS for this purpose (the National Research Council) in response to requests by the government. The Research Council has established procedures to select broad participation from the scientific community in addition to the elected membership of the NAS, to ensure the absence (or balance) of interests of the participants in each of its studies, and to subject each report to stringent peer review. The system produces rigorous and reliable scientific and technological advice. Although it would be unlikely that ICSU could operate on an international scale in the same way as the NRC and other similar institutions can nationally, many of the procedures could be used to effect a similar credible advisory mechanism.

ICSU has participated to some extent in "science for policy" activities. The Scientific Committee on Problems of the Environment has issued assessments of nuclear winter, ultraviolet radiation effects on biological systems, environmental monitoring, and others. In addition, ICSU was invited to serve as a principal scientific advisor to the U.N. Conference on Environment and

Development, and, in preparation, produced a consensus statement on An Agenda of Science for Environment and Development for the 21st Century which not only informed the intergovernmental process on the science but also produced a mandate for science for environment and development into the future.

These "science for policy" activities have been either self-initiated or responsive to external requests. This should continue. However, requests for ICSU's advice by governments, by international bodies, and, perhaps, by private organizations might grow significantly if ICSU's capabilities were better developed and better known. In preparation for future policy work, the rules for initiating, generating and ensuring the quality of such work need to be adequately codified.

Thus, the issuance of statements representing scientific consensus is an important aspect of "science for policy," which ICSU should undertake. Although ICSU has agreed on a process for issuing statements by the Executive Board on behalf of ICSU, this needs to be reviewed and reshaped into a mechanism for providing timely guidance to intergovernmental forums or for informing national policy with international consensus via the national membership (e.g., the ICSU Statement on Gene Patenting appears to have been handled in this manner). The Panel recommends that such a process be constructed and that ICSU should actively develop this line of activity.

It should be stressed that by analogy with the U.S.'s National Research Council, this activity, properly developed, might become a significant source of income for ICSU.

Implementation

The Executive Board should develop both a long-term action plan for approval by 26th General Assembly (including an analysis of existing and possible activities, the identification of priorities, and a proposal for new procedures for review and assessment of programs), and an interim plan for the next three years. Because making the allocations from the Grants Program do not require approval by the General Assembly, the conversion to a seed fund could happen more rapidly. A "policy" committee could be chaired by the Secretary General, and be comprised of representatives from the ICSU members, the officers (including the Treasurer), the chairman of the Standing Finance Committee, the partner organizations, and others as necessary.

2. RECOMMENDATIONS CONCERNED WITH POLICY FOR SCIENCE

ICSU should be the umbrella for concerns of "policy for science" in the international arena.

"Policy for science" covers all aspects of governmental and intergovernmental policies and agreements that affect the pursuit of science and the validity of its results. It is a common interest of all research institutions and disciplines and is thus a necessary focal point of ICSU's interest. There is strong consensus in the scientific community about many features needed for the integrity of the scientific process: freedom of inquiry; freedom of movement and communication and freedom to hold non-conventional scientific views; the independence of science and scientists from political and religious pressures; peer review; ethics in science, including intolerance of plagiarism, fabrication, appropriation or sabotage of other's work. The scientific community has a vital interest in such issues and other emerging concerns of the scientific enterprise, such as intellectual property rights, the balance of basic and applied

research, scientific literacy, public understanding of science, capacity building in science. The end of the Cold War has changed the policy environment, but the emergence of other impediments to the universality of science, especially economic or social influences and conditions, make these issues just as compelling today. However, there are issues beyond the edge of the integrity of science and the rights of scientists to conduct their work, e.g., modes of individual behavior or regimes of regulation that do not directly affect the integrity of science, where different nations may have varying policies. These generally lie outside the bounds of ICSU interest.

ICSU should continue to provide advice, guidance, and recommendations on policies that affect the integrity and effectiveness of the conduct of science. ICSU should also give consideration to the international dimensions of such matters as the science literacy of the public, the quality of science education, the relationship between and balance of basic and applied science, capacity building, and others which influence the vigor and utility of science. Timely issuance of "white papers" on such matters is recommended.

Implementation

The Executive Board should review the existing standing committees on common concerns and interdisciplinary committees, to determine how to recast the committees to suit best the changing outside circumstances. A productive and efficient mechanism for running these activities on an *ad hoc* basis should be established, making use of electronic communications and other means to cut costs without reducing effectiveness. The emphasis should be placed on broadening the reach of these activities into, and making them useful to, all ICSU members, while drawing on the expertise and visibility of key international spokespersons. There should be a direct link established between the leadership of these activities, the ICSU officers, and the Secretariat, and among these groups and the ICSU members, to achieve a better flow of information, ideas, and decisions.

3. RECOMMENDATIONS CONCERNED WITH VOICE AND OUTREACH

ICSU should strive to be a strong voice for international science through an aggressive outreach campaign.

In today's pluralistic, multiconstituent world, no one organization or institution can become the sole voice for international science. But ICSU can speak, authoritatively, about many facets of international science and contribute greatly to discussions of relevant issues. The basic question is "on what issues should it speak?" Clearly it should speak strongly on the need for international cooperation in addressing many important scientific problems of today, especially those which fall within the scope of ICSU that we have delineated elsewhere in this report. *ICSU should be an advocate for and promoter of appropriate international participation of science in international affairs. Furthermore, ICSU should speak on policy issues in a manner consistent with our recommendations on policy: comprehensively on policies for science; more constrained but authoritatively on science for policy.*

There are many voices for international science that will wish to be heard: ICSU member-unions, UNESCO, national governments on science for diplomacy, etc. ICSU should welcome these voices and join them in a way that makes best use of the authority of individual voices and the audience who will hear them. When they are in harmony, they will likely be heard. When they are discordant, further discussions will be needed and ICSU should contribute strongly to such discussions.

An important function of ICSU's work on a global scale is to help set the agenda for science. *This will require the production of "white papers" or their equivalent to stimulate funding agencies around the world to see the utility in setting priorities in international science that balance national interests with major global needs.*

Publications

In responding to its member's requirements, ICSU produces a number of useful, informative publications (Yearbook, Annual Report, Science International, etc.) which are catalogs of activities, of the status of programs, of the communities and leaders involved, and of contacts. *Given the greater employment of electronic means for publication, ICSU should consider the costs and benefits of printing hard copies of these routine publications less frequently, but making annual updates available via the World Wide Web or by other electronic means.*

Another form of publication has been the research planning document, such as the series of reports on the International Geosphere-Biosphere Program. These are particularly relevant to funding agencies and to principal investigators or consortia of investigators interested in mounting a contributing research activity. As noted above, reports of the Scientific Committee on Problems of the Environment have contributed in-depth assessments of topics such as nuclear winter, environmental monitoring, effects of ultraviolet radiation, biogeochemical cycles, which have both informed policy and guided research efforts. Occasionally a publication, e.g., "Understanding Our Own Planet", has summarized the rationale for ICSU programs in a more general context. *This latter form of publication, which delivers a message within grasp of the general public, should be considered for future documentation, as it has the ability both to inform on science and to publicize ICSU to a broader community.*

Implementation

ICSU should consider establishing an editorial board, with experts in public relations and publishing (including electronic media), as well as science, to review the publications and determine within the budget available how best to turn ICSU documents into resources on ICSU programs which can be used in fundraising as well as in informing members and scientists of the directions of ICSU and of major international issues in science. In all circumstances, the editorial board should consider how best to distribute ICSU publications for maximum effect, whether broadly to inform a wide audience about ICSU or narrowly to target a particular group or groups.

Including a public relations/outreach/publications expert on the staff, connected with members of the Executive Board and relevant committees, would help to take full advantage of opportunities.

4. RECOMMENDATIONS CONCERNED WITH GOVERNANCE

The governance system of ICSU should be streamlined and restructured, to reduce overlapping responsibilities of existing bodies, to cut costs, to encourage accountability, and to speed up actions. The restructuring should include a change in name to associate the "core competency" described in the mandate with the totality of the membership and to induce the climate necessary for refocusing on entrepreneurial efforts and "science for policy" studies; demonstrate ICSU's "independent" and "non-political" status; and clarify membership. As the highest priority, we recommend the elimination of the General Committee and the transfer of its responsibilities and functions to an enlarged Executive Board.

Governing Bodies

Although the administration of ICSU is marked by simplicity, the governance of ICSU is too complex to enable timely decision-making and priority-setting. The Panel is particularly concerned that the decisions on budget appear to be made independently of the agreement by the General Committee on scientific programs, and that duplication in the discussions and decision-making of the Executive Board and the General Committee result in less than optimum linkage of priorities, programs and budgets, and not enough oversight of program expenditures downstream. The Panel discussed a suggested reorganization of the governance structure (see Figure 1), giving consideration to suggestions put forward by the ICSU Officers at its first meeting (see chapter on Assessment Methodology).

With increasing numbers of National and Union members, the General Committee has become increasingly cumbersome as a decision-making body on scientific issues, and has become inefficient and duplicative. The General Committee has also grown too large to have meaningful discussions of issues. In addition, it is clear that annual meetings are both a drain on ICSU's resources and an unnecessary duplication of decision-making. Most of the individual interventions could be handled electronically by ICSU members as input into the Executive Board's discussions. The Panel recommends the immediate elimination of the General Committee and the transfer of its functions to the Executive Board, thereby expanding its role and authority over the scientific as well as budgetary and routine decision making necessary to oversee the day-to-day operations of the organization. This would require assigning specific tasks to elected Board members (together with an identified staff member in the Secretariat), e.g., overseeing outreach or science programs, as recommended by the Officers, but the emphasis should be on identifying tasks suitable to both the needs of ICSU and the talents of the officers.

If our earlier recommendations are carried out, the executive leadership will need added capacity and strength, perhaps by adding members to help discharge its expanded role and authority or by finding ways of augmenting the professional staff of the Secretariat. Two of the "lines of work" recommended above could become major activities requiring this added strength:

- * stimulating and launching international, interdisciplinary programs much along the lines of ICSU's current principal mode of operation, but with a shift to a more entrepreneurial, incubator approach. Each of these programs and interdisciplinary scientific committees that oversees them should have an agreed time horizon for operation, assessment, and renewal under compelling conditions.
- * conducting studies and generating reports and advice in response to requests from governmental bodies, similar to the U.S. NRC. In this mode, ICSU would sometimes initiate suggestions to appropriate governmental entities for such studies.

Also, with a change in governance structure, there will need to be changes made to the modalities of interaction among ICSU and its Union Members, ICSU and its National Members, ICSU and its Associates, and ICSU and its partners. ICSU must participate more visibly in the congresses and other activities of the scientific Union Members and in the activities of the National Members, either individually, or regionally (through many of the regional academies it has helped to form), or multilaterally (for example, working with the Third World Academy of Sciences, the InterAcademy Panel on International Issues, and other similar bodies). Re-evaluating the relationships with partners in which there is a shared governance structure or oversight of a program (e.g., the recent co-sponsorship with the International Social Science Council of the International Human Dimensions Program on Global Environmental Change will be necessary as these continue to evolve.

Standing Bodies

Ad hoc groups should replace "standing" committees, giving more flexibility to growing or shrinking committees to fit the needs. Where possible committees should communicate using electronic and other means, and only meet around a substantive, problem-oriented agenda. Thus, ad hoc committees would meet as needed, not on a routine or annual basis.

Secretariat

The ICSU Secretariat was regarded by those who knew it as highly productive and very efficient; its capacity limited by size, not potential. Significant expansion of ICSU's activities in any dimension would require more staff, as we have noted. Nevertheless, the Panel strongly endorses the operating principle of a lean administrative structure, and believes this should be preserved in the future. We agree that attention should be given to setting of priorities and, within the constraints of the budget, to carrying out the most important activities. This would have a regulating effect on the size required of the Secretariat.

The distinct impression of the Panel is that the effectiveness of the Secretariat derives from both the talent of the incumbents and their long experience. However, we find it alarming that there is no apparent effort toward succession planning. *Part of prudent governance should be to ensure that an organization does not unduly suffer because of either an unexpected or regular change in leadership or in staffing. The issue of leadership succession*

is well handled in the statutes. We strongly urge the Executive Board to attend to the issue of staffing succession.

Renaming ICSU

ICSU's name - the International Council of Scientific Unions - is more symbolic of the organization's origin than it is of current composition and mission. Its mandate, which we regard as broad enough to cover what ICSU must do in the future, separately identifies two different types of members and says that ICSU will coordinate appropriate activities of each. The name reflects the existence of only one of these - the Union Members - but not the other - the National Members. Given the vision of what ICSU should become, as we describe it in this document, we believe that a change of name is appropriate.

In selecting a name, consideration should be given to the pros and cons of the present acronym with respect to name recognition, the need to cover the full scope of membership, and the desire to project the international, interdisciplinary expertise. The Executive Board should be charged with recommending such a change in the name.

Implementation

We recognize that recommendations concerning governance will require changes in the statutes, and, therefore, would take 3 more years for full implementation. However, we believe that the 25th General Assembly should adopt resolutions to begin this process, granting the Executive Board the authority to begin carrying out agreed recommendations and to set in place plans for changing the statutes.

5. RECOMMENDATIONS CONCERNED WITH MEMBERSHIP

The membership of ICSU should be reviewed to consider the role and balance of small and large National Members and Union Members, the increasing fragmentation and proliferation of "disciplines", the potential role of disciplines not now represented, and the character of national scientific bodies.

ICSU's membership is of two types: (1) international disciplinary scientific unions, the Scientific Union Members; and (2) national bodies (normally an academy or research council), the National Scientific Members. Scientific Union Members represent the totality of the discipline internationally, while National Scientific Members bring a national perspective of interdisciplinary, international research. Union members have to concern themselves with the international boundaries of their disciplines. Their reach into the scientific community is generally through academies, other research institutes, and government laboratories, and the interactions with industry or applied science are in most cases not very significant (except for IUPAC, IUBMB, and IUPHAR). National members are national academies or research councils, whose members often represent the scientific elite in a country.

Changes in the international scientific scene that suggest a fresh look at membership issues include:

- * a proliferation of disciplines and sub-disciplines
- * the emergence of entirely new disciplines
- * the mix of disciplines needed to address international scientific problems

- * the need for strengthening science and technology in all nations, especially in the developing countries
- * the increasing involvement of industry and the private sector in international scientific activities
- * the need for greater coordination and cooperation among scientific organizations in the non-governmental, governmental, and private sectors in forging an international research agenda within each nation

The panel pursued two lines of inquiry: Who should be the representatives of National and Union members in ICSU programs, committees, and activities? What should be the membership structure of ICSU? If ICSU is to maximize its representativeness of the global scientific community it must seek expertise from a wide range of institutions and fields (hence the question of membership).

Extending Representation

The question of representation is the easier of the two and is one that the members must answer both individually and collectively. The character, quality, and balance of ICSU's programs and activities will be determined in large measure by the representation within ICSU from the members. In choosing the representation, ICSU's members should consider both the needs of their own organization and those of ICSU. Participation in the aggregate will determine ICSU's capacity for representing global science.

ICSU needs member representatives who are accomplished scientists and who also understand the broad needs of their unions or their nations, and of international science. This implies that Union Members, who should be choosing accomplished scientists, should also weigh the breadth of vision and executive competence of their representatives, while constantly renewing leadership and representation with new faces and new ideas. National Members, who might tend to select representatives from a scientific elite with executive experience, should also weigh the ability of their representatives to command the authority within their country necessary to translate ICSU programs into national action and to bring national initiatives to the ICSU leadership. This balance of executive potential and scientific credentials has by and large been achieved in the past. But, an explicit recognition of the value of this balance will insure vigorous ICSU representation of its members, and will serve both well.

ICSU has conducted several workshops and meetings to evaluate and improve the interaction with partners, particularly with the private sector. It should continue to search for new and effective venues to get the perspective and talent of industrial scientists into its activities. This should be a priority of ICSU in developing programs which match industry interests or which could attract additional resources.

Further, the shift in balance of support for science from the public to the private sector has important implications for ICSU, in terms of both the representativeness of its National and Union Members and the potential for stagnation of funding. For example, most of ICSU's National Members comprise academies or research councils, whose own members were selected largely from the academic or government research establishment. Several Union Members of ICSU have close ties to industry (e.g., within the last decade IUPAC has sought greater representation and support from the chemical industry through dues contributions as well as human resources). Cultivation of relations with the private sector can be handled

through a variety of channels (e.g., workshops, improvements of memberships on national committees).

ICSU should make a major push toward involving accomplished and qualified scientists from developing nations in its activities, as well as toward cultivating the younger community of scientists to succeed the present generation of contributors. This has the twofold advantage of using talent that may otherwise be overlooked and of providing to these nations an important channel of access to the global scientific community.

Membership Structure

According to the ICSU statutes, only one Union Member within a discipline and only one National Member from a country can become members.

The question of membership structure involves subsidiary questions:

- Should ICSU strive to have its membership cover all the major established scientific disciplines?
 - * Should ICSU continue to include the social sciences? The engineering sciences?
 - * Should ICSU avoid or encourage redundancy of disciplinary coverage?
 - * Should ICSU accept membership of sub-disciplinary unions, permitting or even encouraging the proliferation of many small unions as members?
- Should new categories of membership be established to better ensure links to primary funding agencies and better coordination of the various national constituencies?
- How should ICSU balance the voting power of larger, stronger members (Union Members or National Members) and smaller members? How should it balance the voting power of unions and nations?

The basic principle that should govern the answer to these questions is, first, each member of ICSU should add to ICSU's capabilities in addressing the international interdisciplinary issues within ICSU's purview and, second, its association with ICSU should add to its own effectiveness and strength.

Disciplinary Scope

The present Union Members are comprised largely of the natural science disciplines whose fields of study, methods of inquiry and of verification, enable them to reach a high degree of consensus about the underlying facts, principles, laws, and theories of the field. While there may be disagreements among the practitioners of the field, especially at times of shifting paradigms, these fields are still characterized by strong confidence that the differences will be resolved through their methods of inquiry and verification. Disciplines that would not fit well into the ICSU family are those split into persistent schools of scholarship that rely to a large extent on *ad hoc* concepts or schemes as unifying principles of each school. It is the opinion of Panelists that some of the branches of the social sciences would fit into this category. However, it is clear that the ICSU members felt that the above criteria were met when the International Union for Psychological Science, the International Union on the History and Philosophy of Science, the International Geographical Union, and the International Union for Anthropological and Ethnological Studies were accepted as members. In addition, over 50% of the National Members of ICSU have membership from among the social science disciplines.

In our efforts to solicit the views of the social science community about membership in ICSU, we discovered that there is little consensus about what to do about it. There is general agreement that facing the many scientific challenges of the future which have social, political, and economic dimensions will require consultation and collaboration between the natural science and social science communities.

In the near term, the Panel believes that, when called for by the issues being addressed, ICSU should undertake joint activities with these communities, as a means of working to establish a parallel form of operations. Moreover, if these National Members emphasize scientific distinction in choosing their representatives to ICSU, as we urge elsewhere, they will be able to infuse talent in the social sciences into the ICSU programs and leadership, thereby broadening ICSU's perspective in the social science contributions to international, interdisciplinary activities. In short, we are saying that while the scope of ICSU interests and activities requires the support of the disciplines of the social sciences, ICSU can obtain this support through the inputs of its National Members and through forming alliances with appropriate bodies, but that membership should continue to concentrate on the physical, biological, and natural sciences, until such time as the social science community determines how it wants to organize internationally.

We do, however, believe that unions representing the scientific side of engineering, medicine, agriculture, etc. can be quite appropriate members of ICSU. Their norms conform to those of the natural sciences.

ICSU is underrepresented in many dynamic areas of S&T today, especially in telecommunications, computing, and software, though the panel noted the important initiative to establish a new union in informatics.

Membership review

The rules regarding membership do not seem to be applied consistently, according to the expectation of a "non-governmental" body. The Panel feels that the criteria for membership need to be reviewed and revised. Some countries are represented by governmental bodies and others by non-governmental organizations. It is desirable to allow each country to adapt

its membership to its own scientific structure and choices. With regard to Union Members, ICSU should avoid undue duplication, overlap, or proliferation of such membership. As noted above, the question that should be asked is whether the discipline and expertise offered by a new union applicant adds to ICSU's capabilities in addressing the international, interdisciplinary issues within its purview, and whether association with ICSU can add to its own effectiveness and strength.

Tensions between National and Union members have arisen because of their differing perspectives. National Members look for ICSU's contributions to their national interest while Union Members look for benefits to their disciplines. National members are responsible for paying dues to ICSU and to the individual unions, and have, in the past, felt somewhat removed from the scientific decision-making. In 1993, the General Committee was expanded to provide parity between the national and Union Members, enabling the selection of 23 National Members to serve with the 23 Union Members. However, the voting privileges are not equal. All members of the General Assembly vote on the national representation on the General Committee, whereas the selection of union representatives on the general committee is made by the individual Union Member. In addition, the present voting procedure provides one vote for each National Member and 3.3 votes for each Union Member, according to the formula whereby the "...number of votes (per Union Member) is equal to the number of National Scientific Members divided by the number of Scientific Union Members, except in votes concerning finance, in which case each Member has one vote." (Statute VII. 24(a)) This means that in all matters except finance, the Union Members have more say in the affairs of ICSU. Thus, the perception of the National Members can be that they have responsibility for the financial health of ICSU with little authority over activities whereas the Union Members have authority over the directions of ICSU without fiscal responsibility.

This balance of representation between Union Members and National Members will have to be addressed anew if ICSU abolishes the General Committee, as we recommend. ICSU's Executive Board should be charged with recommending the necessary changes in By-Laws and Rules of Procedure.

There was a concern expressed by many involved in the assessment process that proliferation in numbers of Union and National members needed consideration. Many specialized or smaller unions seek ICSU membership because of the prestige conferred on them. Many national bodies seek membership because ICSU provides a means for institution building.

The identity of the Union Members for the most part is clear and many of the oldest unions have become strong on their own. Many of the specialized unions rely on ICSU for assisting coordination and cooperation and none could unilaterally initiate the global, interdisciplinary programs of ICSU without interaction under the ICSU umbrella with the other disciplines and the National Members.

The identity of the National Members is mixed between academies of science and research councils which are funding agencies. The Panel considered a proposal to expand the representation per National Member to two bodies. The rationale for increasing national membership—e.g., including a category for representation of national funding agencies or other organizations to provide opportunities for wider reach of ICSU into national scientific communities, increased funding, or improved coordination of global programs—needs further evaluation. The Panel is ambivalent about whether a new (non-voting) class of membership encompassing the national funding agencies should be established. While advocated in some form by the ICSU Officers, it is not certain that such a limited form of "membership" would

be highly regarded by funding agencies themselves nor that it would significantly contribute to more stable funding. The issue needs further study and we were unable to provide it. The Officers and Executive Board should reflect upon and provide guidance on criteria for membership if more than one body were to have membership per country, and the National Scientific Members should provide an analysis of the situation within their country, the effect that increasing the national membership would have on the current member, on the dues contributions, on participation in ICSU, and on increasing the flow of information between ICSU, national scientific bodies, and on representatives of the scientific community.

Involvement of members

ICSU's income from dues ostensibly comes from both National Members and Union Members. However, the dues contribution of Union Members is only about 10% that of the National Members. Moreover, the Union Members, collectively, receive grants from ICSU that are about double their dues, although the distribution of these grants may change if our recommendations - elsewhere - are followed. In many nations the ultimate source of funds for both sets of dues may be the same: a government agency. Moreover, a nation may have scientists participating in a number of ICSU activities and programs which may also be receiving separate funding, often from the same ultimate source as the dues.

Two issues are of concern: first, that adequate information is not flowing back through the system all the way to the source of funds and second, that there is less than optimum communication and coordination among all ICSU related activities.

Expanding the reach within countries is critical, especially with respect to sharing information between the National Members and the relevant national bodies or scientists. The structure for ICSU adherence at the country level has evolved to become equally as complex as at the international level. In many countries, there are national committees for each Union Member and for each scientific committee within the ICSU structure. *For this reason, the Panel strongly recommends that each nation form a coordinating body for ICSU activities with the responsibility of ensuring widespread dissemination of information about ICSU activities and continuity of funding.*

Both the National and the Union Members need to be more active in ICSU, sharing in both the responsibility and the authority over programs, and especially in reaching more deeply into their communities for continual renewal of committee memberships and for innovative ideas. In addition, ICSU officers or their representatives need to become more involved in meetings of National Members on a periodic basis and to participate on some level in all Union Member meetings (e.g., Congresses, General Assemblies, relevant scientific symposia).

Membership and "Power Balance"

The present dual membership - National Members and Union Members - is logical and effective in that it can draw scientific talent from two sources with two perspectives that are complementary: national interdisciplinary bodies and disciplinary international bodies. The current practice of affording more votes per Union Members than per National Member in the General Committee was instituted to insure the predominance of scientific over national interests. To the extent that National Members bring with them strong scientific credentials - as is mostly the case today - the basis for this voting rule may be less now than in the past. Moreover, our report urges National Members to consider strong scientific credentials as an

important requirement for its representation. Thus, the need for the voting rule may be diminished even further in the future, especially if the General Committee is eliminated, as we recommend. But, the rule does not seem to have been a problem.

A potentially serious issue is the equal voting power of large and small unions, large and small National Members. As ICSU has grown it has attracted a number of smaller, specialized unions and a number of smaller nations whose scientific strength may still be limited. Some of those surveyed by our Panel question the efficacy of equal voting for all. The argument can be made both ways: the stronger, larger members should have more votes to ensure voting proportionate to scientific strength or, alternatively, the smaller entities should have equal voting power to assure their interests are adequately considered.

The normal solution of such a problem is to have two "houses" of the governing body; one that votes proportionately, one individually. An alternative is to require two votes on every issue, one conducted by proportionate voting rules, the other by individual voting rules. Such procedures ensure that any issue approved by such votes passes both tests: general efficacy for the institution without submerging minority interests. It would be relatively simple to institute such a dual vote in the General Assembly if concern over the issue of voting power grows. At present, the concern does not seem sufficiently widespread to warrant the change, but we have discussed it so those uncomfortable with the present situation are aware of the alternative if their discomfort grows.

III. ASSESSMENT METHODOLOGY

In October 1994, the General Committee of the International Council of Scientific Unions (ICSU) recommended that an independent assessment be made of "...the mandate, the organizational structure, and the operational modes of ICSU...", taking into consideration the past and the future needs and opportunities of international scientific cooperation to meet the needs of society. This required understanding both the internal world of ICSU (members, Associates, interdisciplinary bodies set up by ICSU) and the external world in which it functions (partner inter- and non-governmental organizations, governments, the international climate of science). The Committee further recommended that the results of the assessment be made available to the 25th General Assembly of ICSU in September 1996.

The ICSU Assessment Panel was appointed by the ICSU Executive Board in 1995. Members were selected on the basis of experience with international science in general but without an existing connection to ICSU, thereby preserving the independence of the panel's deliberations. A list of members is attached. Two formal meetings of the Panel were held in Paris: the first devoted to developing an understanding of ICSU and narrowing the evaluation to selected issues; the second focused on forming more in-depth views of the selected issues and consensus statements.

The Board asked the Panel to consider the following set of questions in its review:

1. Taking into account the present and likely future evolution of science in the international context, should ICSU's mandate be modified, and if so, how?
2. To what extent has ICSU achieved its objectives and what are its potentials for further results? To what extent can ICSU be considered to be the voice of international science?
3. Are the bodies which are presently Members or Associates of ICSU appropriate ones? What should be their relationship to ICSU and to each other?
4. To what extent is ICSU's work relevant to its Members, to scientists, to partner organizations and governments, and how can this be improved?
5. Is the current method of financing ICSU, the Unions and the ICSU interdisciplinary bodies the most appropriate one? Does the rationale for ICSU's own grants program need to be revised?
6. Has effective collaboration been achieved with relevant partners? Is it helpful for ICSU to be identified as an "International NonGovernmental Organization", or should it be defined differently, e.g., "international professional organization"?
7. How much impact has the work of ICSU on the policy sector?
8. What is the relationship of ICSU with the work of global or regional bodies with overlapping objectives?

Because the Panel was unable to hold its first meeting until February 1996, most of its initial work was handled by correspondence. Each member was provided a list of colleagues within

his or her country or region from whom to seek advice on the methodology and the content of the review. Panelists contributed a summary of these communications before the first meeting. In addition, the ICSU Secretariat prepared summaries of ICSU membership.

At its first meeting, the Panel reviewed and considered:

- (1) The background leading to the General Committee recommendation for an assessment; the preliminary observations and conclusions of the ICSU Executive Board meeting in October 1994 to the initial inquiry and questions eventually posed to the Panel; and the results of two previous conferences to examine the Agenda for Science and for ICSU, Ringberg, 1985, and Visegrad, 1990, respectively.
- (2) The terms of reference of the panel (see Attachment C).
- (3) Reports on the structure and functioning of ICSU, the fiscal realities in which it operates, and the programs and partnerships it has undertaken.
- (4) A report of a recent workshop arranged by the New York Academy of Sciences, in Bellagio, in October 1995, on "Global Cooperation in Science, Engineering, and Medicine." The workshop participants felt that the existing organizations for facilitating international collaboration in science, engineering and medicine were no longer adequate for the needs, because the rationale for most of these organizations had fit different circumstances than today; and that there was a need for a substantial review of the system for international S&T cooperation.
- (5) A paper prepared by the ICSU Officers on suggestions for the reorganization of ICSU.

In order to prepare for the second meeting, it was agreed that a wider net would be cast to obtain the views of the ICSU family and partners on the eight questions put to the committee, with the request that respondents focus on Nos. 1, 4 and 8 (see above). In addition, each member would prepare for the next meeting a short paper on a selected issue (participation of developing countries, representation of engineering organizations, organization and structural concerns, outreach and communications, the fit of ICSU within the international S&T system, the effect of trends toward telecommunications and computers on the future work and membership of ICSU, policy vs. science, "sunset" (termination dates) of committees and programs, possible role of ICSU in issuance of "white papers", relationship of ICSU with private sector). Also, National Scientific Members of ICSU with representation of members from the natural and social sciences were invited to provide information on the process for selecting members and the number of members.

IV. THE PAST AND FUTURE CONTEXT OF ICSU

The international setting for science has changed in almost every dimension--geopolitical, social, environmental, economic--since ICSU was established. More than ever before the ability to obtain and use scientific and technological knowledge is critical to the solutions of the problems of humanity, to the economic development of nations, and to the decisions of individuals facing an increasingly complex world. The scientific community must concern itself with the formidable challenges of poverty, nutrition, emerging infectious diseases, natural disasters, global environmental changes, population growth, sustainable development. The list goes on and on. We did not expect this much from science in the past. Nor did we anticipate that in a period of boundless interest in scientific understanding there would be so many constraints imposed on scientific cooperation because of competition, declining human and fiscal resources, and other pressures.

The forces encouraging and discouraging scientific cooperation are complex. As a way of thinking about these issues, it is useful to characterize the questions of current needs around the tension which exists between collaboration and competition.

The scientific enterprise calls for openness and free circulation of ideas, scientists and data. It leads automatically to collaboration. There are some impediments to this openness. Scientific reputations and rewards depend on being first to publish and this can lead to secrecy and lack of openness and competitiveness. But for the most part, the scientific community thrives on collaboration. International organizations, such as ICSU, which came into existence 50 or more years ago were mainly designed to foster, encourage, and facilitate this type of collaboration.

In recent years, the competitive dimension in science has become more evident. There are much clearer, and increasingly shorter, links between scientific research and technological developments. This has implications for commercial competitive advantage of firms, nations and regions. All of this leads to the needs for secrecy and the protection of intellectual property. The matter has become even more complex as new alliances are being forged between universities, government institutions and industry. The issue of intellectual property rights will become even more important in the future. But just as in the scientific enterprise, there are forces which lead to secrecy, so too within the domain of competition there are forces which lead to collaboration. The Framework program of the European Union demonstrates the extent to which precompetitive research, involving competitive firms, is possible. It also shows that it is possible to find a *modus vivendi* between the pressures for collaboration and those for competition.

The challenge to international scientific organizations in the twenty first century will be to facilitate forms of collaboration which strike an appropriate balance between the pressures for openness and those for secrecy. In the past, ICSU has concerned itself with the "universality of science" and the problems of openness in science by focusing on the free circulation of scientists and scientific materials. This has been a successful enterprise for ICSU and we give it more attention below, providing some examples of future concerns. The way that ICSU has worked in building scientific consensus has also had an important influence on the structure of international cooperation. We discuss this as well as the ways in which this collaboration helps to build national constituencies. Finally, we describe in more detail the changing circumstances encouraging improved relationships with the private sector, with developing countries, and with new fields and organizations in science.

The Universality of Science

When ICSU was founded in 1931, one of its primary goals was to promote open international collaboration among scientists. In pursuing its objectives, ICSU adopted the principle of the universality of science, which "...entails freedom of association, expression, information, communication and movement in connection with international scientific activities, without any discrimination on the basis of such factors as citizenship, religion, creed, political stance, ethnic origin, race, colour, language, age or sex." (Statute number II.5) The Committee on the Free Circulation of Scientists (SCFCS) was established in 1963 to oversee assistance with the solution of specific problems that could arise over the free circulation of scientists and scientific materials and the free collaboration among scientists.

Over the years ICSU has maintained a strong and welcome stand in the area of freedom of movement and participation of scientists. This has carried particular weight when scientists of certain National Members were impeded by the political relations of their countries. In upholding the principle of free circulation, ICSU has been able to facilitate participation of scientists all over the world in meetings sponsored by ICSU. This is just one element of the important function that an international independent body like ICSU can undertake in the broad area of nurturing the scientific community (by moral support, etc.) world wide, and it has been a major area of success acknowledged by many persons who contributed to the Panel's deliberations.

Renamed in 1993, the Committee for the Freedom in the Conduct of Science aims to "...safeguard and promote the free circulation of scientists...promote freedom to pursue science and to publish the results, freedom to communicate among scientists and disseminate scientific information, and freedom of movement of scientific materials." Several new impediments to free circulation have been discussed by the SCFCS, including the effect of U.N. sanctions on communication, cooperation, and circulation. Other issues that are pressing or may escalate in the future include the assassination of scientists--purely because they are scientists--by militant Fundamentalists; economic embargoes and their effect on cooperation among scientists and scientific research; detention of scientists for publishing or speaking out, as a matter of conscience, against hazards to public health and safety. These, in addition to concerns about responsibility and ethics in science, may continue to present challenges and barriers to full communication and coordination in international science.

International Cooperation in Science

International coordination of science enables tackling problems on a global and regional scale, as well as sharing of unevenly distributed resources and facilities. It also contributes in a number of important ways to national programs. For example, the international framework provides problem definition, agenda-setting, intellectual synergy, access to unique data and facilities, opportunities for economies, and stability of programmatic structure.

When there is enough critical mass in the world to define a scientific problem, the planning process for an international program moves ahead. The setting of bureaucratic agendas in countries with National Members adhering to ICSU becomes possible through presenting an item that forces paperwork to flow across desks of scientists and science managers all around the world. The forum of international exchange produces intellectual synergy in a field and emerges in setting standards, in deciding on nomenclature, etc. Science is not bounded by nationalities or politics. For science to proceed unfettered, data and facilities must be open in

all areas of the world. The international system also provides opportunities for economies, because international programs remain outside the scope and capacity of any individual nation. National programs, linked to the international system and community, gain access to human and financial resources unavailable on a national level.

Finally, the inertia of the international structure provides some tangible benefits for science, particularly for national activities embedded in the international programs. They have a longer life because of the existence of the structure which outlives bureaucrats and oftentimes governments. Without the existence of the international structure, many scientists from developing countries and from countries with transitioning economies would not be able to take part. For example, the International Geosphere-Biosphere Program of ICSU has provided a framework through which bright young scientists around the world could become involved.

But the international structure depends crucially upon national inputs, where the real work is done. Because there are little or no international financial resources, the actual research must be done by the nations that collect taxes. The international structure must respond to national interests and needs if it is to be supported. To be successful, it must entrain the willing and enthusiastic participation of scientists. Consequently, the bottom-up approach to scientific program development, guided by a top-down vision of issues and priorities, on an international scale has been the most productive. The comparative advantage of ICSU is the linkage of individual scientists through many channels, unions, academies, associates, etc. Its advantage which has

contributed to its ultimate success in producing reputable global programs has been its independence from governments--that is, ICSU has served as an "honest broker" for science. In the cases whereby the National Member is an agent of the government, individuals working on panels or committees of ICSU have been seen as independent.

How an Idea Becomes an International Program

ICSU's most notable success in international, interdisciplinary programs has been in the area of environmental science. Beginning with the International Geophysical Year in 1957-58, ICSU was able to mobilize the international scientific community in a global effort to rebuild the network of international scientific collaboration which had been shattered by World War II. There were many scientific achievements of the IGY series of geophysical measurements that inspired the world in space research and in deep-drilling, etc., a bevy of institutions (e.g., the World Data Centers, the Scientific Committee on Antarctic Research), and a critical geopolitical instrument, in the form of the Antarctic Treaty, which established as its central tenet the spirit of scientific cooperation. These legacies continue to this day to provide the framework for cooperation.

Following on the successful IGY, the Global Atmospheric Research Program (GARP) in the 1960's brought the intellectual challenge of individuals who purported that the bad news about weather was there was a lack of predictability in the system, whereas the good news about weather was that given the inaccuracy and inconsistency of weather prediction in the system, the predictive capability was improving. Working with the global leaders generated the political will necessary for the emergence of GARP. This was followed by a partnership between ICSU and the World Meteorological Organization, which resulted in a program less bureaucratic and more science-driven than had ICSU not been involved. Also in the 1960s, the International Biological Program (not bottom up) was initiated as a decade long series of measurements of terrestrial ecosystems, produced some 30 volumes (Cambridge University Press) of synthesis of world-wide programs on biomes, on the human impacts on nature, on basic ecological processes, and is credited by many as providing a solid scientific basis for focusing worldwide attention on environmental matters.

Finally, in the 1980's ICSU launched the International Geosphere-Biosphere Program: A Study of Global Change (IGBP), which aims "...to describe and understand the interactive physical, chemical and biological processes that regulate the total Earth system, the unique environment that it provides for life, the changes that are occurring in the system, and the manner in which they are influenced by human activities." The IGBP is a complex matrix of core programs and projects which have evolved their own management structure. The establishment of the Global Change System for Analysis, Research and Training (START), which is cosponsored by the International Human Dimensions Program on Global Environmental Change and the World Climate Research Program, enabled translating global science to the regional level and regional inputs into the global system, as well as providing a means for regional capacity building. The challenge for the 1990's will be to bring the programs to the local level, linking local and national environmental needs and goals with the aspirations of sustainable development.

In general the pattern for developing such international, interdisciplinary programs has been the genesis of an idea by an individual or collection of individuals followed by building of a national constituency around the idea; planting an international seed for constituency; getting international endorsement of the idea; developing the international consensus, constituency, and framework; and implementing research activities at the national level. Thus, the

programs grow from a small group of individuals to build larger and larger international constituencies as well as national linkages. The advantage of ICSU is in working with individuals who primarily give their allegiance to particular institutions, thereby bringing institutional consensus into the system.

The success of ICSU in environmental programs has had a lot to do with the organization-building capabilities of ICSU. For each of the major global initiatives in the environment (e.g., global change, oceans research, antarctic research) there have been major structures established to provide the framework for cooperation. This has produced a global network for designing, planning and conducting research. In the future, this network must be expanded, prodded, reworked, and challenged to take on more ambitious (e.g., the proposed ICSU global program in capacity building in science) and more innovative tasks to improve the generation and transfer of knowledge for human development.

Another key link in the environmental chain of ICSU projects has been the ICSU Scientific Committee on Problems of the Environment (SCOPE). Since its establishment prior to the U.N. Conference on the Human Environment in 1972, SCOPE has provided a mechanism and forum for producing credible assessments of environmental concerns, e.g., studies of the ecological consequences of nuclear war, of the biological effects of increased ultraviolet radiation, and others. The scientific consensus embodied in SCOPE reports and the process of conducting these studies involving all regions of the world, have been instrumental in affecting public policy. For example, the nuclear winter report is credited with having helped steer the super-power policies away from the likelihood of nuclear war.

The earth system research program is expected to reduce the uncertainties about climate change while improving the predictive capabilities as well as to link the natural system with the human system that is inducing or responding to global environmental change. There is a need for scientific-based assessments to undergird the mega-agreements on environment. There is also an increasing need for science for environmental management.

These examples are merely samples of ICSU's work. They show the important roles that ICSU should continue to play in science and society. The world needs a body to provide unbiased leadership of the scientific community.

Changing Circumstances of International Scientific Cooperation and Science Needs

The landscape of international cooperation undulates with new challenges and opportunities for science. The emergence of a global economy, the opening of markets, the breaking down of national borders, the advances in telecommunications, the concerns about the global environment and sustainable development, the declining interest of students in science, and the increasing demands on science in serving society in a period of declining budgets for science, all alter its form and process. These external influences not only affect what science should be done, but also how it should be carried out, how it should be supported, and what types of relationships and partnerships are needed to produce results.

Science has become more heavily politicized than in the past while at the same time many societal problems and decisions about them depend on science. For example, a multimillion dollar industry is riding on climate change. The political pressure means that the independent, non-governmental character of ICSU is essential to delivering a balanced message to policy makers. The social concerns dictate that ICSU's "voice" is more important

than ever before in establishing consensus on issues of both the "science policy" and the "science for policy."

There is increasing evidence that the funding agencies driven by political and financial exigencies are setting the scientific agenda, rather than the scientists themselves. Support for science in general is declining around the world. Also, the infrastructure for science--observatories, laboratories, other facilities--is deteriorating in many areas of the world.

Another pressure on science in general and on science in developing countries, in particular, is the increasing emphasis on applied research. In periods of austerity, governments generally shift emphasis from the long term (e.g., basic research) to the short term (e.g., applied research focused on industrial science), though the perception of short and long term varies from industry to industry and from country to country. A general solution is not the answer because of these differences. There will be an increasing need to include science ministers in the planning discussions. For example, the Committee for Science in Central and Eastern Europe and the former Soviet Union (COMSCEE) has conducted several workshops intending to bring the concerns of rebuilding and restructuring science to the attention of economic and science ministers in these countries.

Relationship with the private sector

The private sector plays a fundamental role in research: in many industrialized countries, it accounts for between 50 and 70% of the overall research effort. This is understandable given that the best way to remain competitive in a worldwide economy is to create new wealth through

innovation. Exports, in particular, are fueled by innovations, which enable corporations to create jobs through development of new products requiring diversification of skills. Certainly, innovation and research development are not unrelated concepts. Economic development requires a revolution in knowledge and creativity.

If science as described by Rousseau had relatively little impact on the basic conditions of existence, to the extent that it fell within the realm of philosophy, it has since exploded. The number of researchers worldwide currently exceeds three million. In contrast, on the eve of World War II there were fewer than 100,000. Nearly two-thirds of the products sold today did not exist five years ago, and the volume of scientific activity doubles every ten years. Research has become a strategic resource which determines whether or not corporations can make the on-going adjustments to their environment which give them an edge over their competitors.

Economists know that there is a correlation between the ratio of research development to a nation's gross national product and that the latter affects the long-term evolution of the former. This explains why efforts in research development have been considerable in the past, especially in the industrial sector. These considerations provide ample argument for recognizing excellence in research, and hence for optimizing resources devoted to R&D by both the public and the private sectors. In addition, they warrant encouraging greater interaction between these two research categories, with the public fostering the private.

Nevertheless, it is not realistic to expect a continuing significant increase in research and development by the private sector, because the desired time horizon for a net positive effect on the bottom line is too short. The number of small- to mid-sized firms engaged in research is also small, as these companies are looking for short-term growth rather than longer term investments in research and in scientific or engineering staff. Many of the problems are the same in service industries.

ICSU could play an important role in this area by communicating these imperatives, in the form of a dialogue with the business world. This dialogue could include the various employers' federations, unions, or even groups composed of the most progressive and dynamic corporations or a few large corporations known for the importance they accord to research and development (and not only in high-tech areas), and engineering associations (such as ICET, UATI, WFEO, CAETS), especially those including engineers and researchers which already exist in many countries.

ICSU could serve as a springboard for debates on many topics such as:

- * Is there still a clear separation between basic and applied research?
- * What is the role of the government in the two areas?
- * How could cooperation between public and private research be improved?
- * With disarmament programs underway, how should defense research be reoriented, especially given the important role played by such research in a number of countries?

A role for ICSU might be to help clarify concerns, and to raise awareness in the research communities. In the process, ICSU could build closer ties with the private sector with potential sources for new funding.

Science in Developing Countries

There is no equivocation about the critical need for science and technology assistance in the developing countries, and ICSU has embarked on several paths. The Committee on Science and Technology in Developing Countries (COSTED) was set up as a Special Scientific Committee of ICSU at the General Assembly in Bombay in 1966 and the International Biosciences Networks (IBN) were established as a joint program between the bio-unions of ICSU and UNESCO in 1979. The 24th General Assembly in 1993 decided that these should be merged. In addition to COSTED-IBN, many joint activities with the Third World Academy of Sciences, e.g., the Lectureships/Professorships in Science and Sustainable Development and the UNESCO/ICSU TWAS Short-Term Fellowship Program in the Basic Sciences, have promoted North-South and South-North contacts. COSTED-IBN networks have begun discussions of South-South cooperation. In addition, the ASCEND 21 process undertaken to prepare for the U.N. Conference on Environment and Development, established a research agenda for environment and development, and the earth system research agenda, including START and IGBP core programs provide many research and capacity building opportunities. Also, the Union Members have established many special programs to assist scientists in developing countries, such as workshops to reduce the gap between teaching and the practice of a discipline, research programs, many teaching fellowship programs, and student fellowships to enable participation in scientific meetings.

Nevertheless, there is a general feeling that the participation of developing countries in ICSU remains very modest. Participation should entail (a) effective contribution to the development of policies and plans of the ICSU family, (b) benefits obtained from membership, that is, impacts of ICSU programs and activities on national science (its performance and development) and on national scientific communities.

Emerging Areas of Science

ICSU is underrepresented in many dynamic areas of S&T today, especially in telecommunications and computer science, though the panel noted the proposed establishment of a new union concerned with informatics. In addition, the shift in balance of support for science from the public to the private sector has important implications for ICSU, in terms of both the representativeness of its National and Union Members and the potential for stagnation of funding.

There is a class of problems of systemic changes that are clearly local but are the same around the world (e.g., water quality, toxicology, land degradation, desertification, etc.) but these have not been attended to by ICSU. In addition, ICSU has not been a major player in the human genome project or in the science of epidemiology and the whole area of emerging infectious disease.

Information technology involving computing, telecommunications and microelectronics, plays a crucial role in every aspect of our daily life. Faster, more sophisticated computers and data networks will dominate the systems which we use to work and play. The remarkable development in the area has been brought mainly by the efforts of scientists and engineers in the relevant industries where key inventions such as the telephone, wireless telegraphy,

transistors, integrated circuits, semiconductor lasers, optical fiber communications and computer-programming languages were made. The invention of the transistor nearly fifty years ago at Bell Telephone Laboratories was indeed an epoch-making event that has most significantly impacted human civilization in the second half of this century, sparking the computer revolution which has transformed our society into one that is information-oriented.

The participation of ICSU in the recent technological developments appears to be rather limited, although the International Union of Radio Science (URSI) was created in 1919, and the International Federation for Information Processing (IFIP) was established in 1960 as one of its scientific associates. The former organization aims to stimulate scientific studies in the fields of radio, telecommunication and electronic sciences, while the latter promotes information science and technology. In order to strengthen ICSU's position in the world technical community, ICSU will need to open its doors more widely to industrial scientists who are playing an ever-increasing role nationally in applied sciences but also in basic research.

Expanding Partnerships

ICSU has conducted several workshops and meetings to evaluate and improve the interaction with partners, particularly mechanisms to forge closer relations with the private sector. The panel discussed direct and indirect ways of strengthening these relationships, including conducting a study on ways to build an international federation for industrial research institutes or a one-day meeting with representation from the World Bank, industry, and scientific to address the question of what are and should be the relationships between science and industry on an international level. These would be indirect methods. Encouraging National Members to organize national workshops to involve the private sector in ICSU activities would be a more direct method.

V. CONCLUDING REMARKS

The objective of ICSU is to promote S&T for the benefit of humanity. The major influence ICSU should have in the international arena is in setting the agenda for science that cannot be done by governments because of political or other related reasons. A good measure of ICSU's success, other than in establishing effective programs, should be the attraction of those who do not believe they need it. Looking back from the year 2020 to today, we should feel confident that humanity has indeed benefitted from science because of ICSU's interventions.

Figure 1

Appendix A**ICSU ASSESSMENT PANEL MEMBERS**

Dr. Leo Esaki, Japan, Nobel Laureate, President, Tsukuba University

Mr. Bernard Esambert, France, Chairman, Institut Pasteur, former Chair, Rothschild Bank, and former President Ecole Polytechnique

Dr. Jose Goldemberg, Brazil, former Minister of Science and Technology

Dr. Rose Johnstone, Canada, Professor and former Chairman, Department of Biochemistry, McGill University

Professor Mohammed Kassas, Egypt, former President IUCN

Professor Lydia Makhubu, Swaziland, Head of University of Swaziland, President, TWOS (invited but not able to serve)

Professor Geoffrey Oldham, UK, former Director, Science Policy Research Unit, University of Sussex, presently with IDRC

The Rt. Hon. Lord Porter, UK, former President, Royal Society of London, former Director, Royal Institution, Nobel Laureate

Professor Erno Pungor, Hungary, former President, National Board for Technical Development, present Director, Board of Baj Zoltan Foundation

Dr. Roland W. Schmitt, CHAIRMAN, USA, President Emeritus of Rensselaer Polytechnic Institute, former Senior Vice President for Research at General Electric (USA), former chair, National Science Board

Dr. Herwig Franz Schopper, Germany, former Director General, CERN

Professor P.N. Tandon, India, past President, Indian National Science Academy, Co-chair, Inter-Academy Panel on International Issues

Appendix B**ICSU MANDATE**

The International Council of Scientific Unions was established in 1931 and its mission is stated in its present Statute 3, as follows:

- to encourage and promote international scientific and technological activity for the benefit and well-being of humanity;
- to facilitate coordination of the activities of the Scientific Union Members;
- to facilitate coordination of the international scientific activities of its National Scientific Members;
- to stimulate, design, coordinate or participate in the implementation of international interdisciplinary scientific programs;
- to act as a consultative body on scientific issues that have an international dimension;
- to engage in any related activities.

ICSU ASSESSMENT PANEL TERMS OF REFERENCE

I. BACKGROUND

The recommendation of the 33rd meeting of the General Committee (October 1994) stated that:

The General Committee recommends to the Executive Board that an independent assessment be made of the mission, the organizational structure, and the operational modes of ICSU. The assessment should be both retrospective and prospective in considering ICSU's role in international science to meet the needs of society. The Executive Board is charged with establishing the terms of reference for, and selecting the membership of, an independent, high level, well balanced team to conduct the assessment and to provide a report of its findings and conclusions to the 25th General Assembly of ICSU in 1996.

II. TERMS OF REFERENCE

The International Council of Scientific Unions was established in 1931 and its mission is stated in its present Statute 3, as follows:

- to encourage and promote international scientific and technological activity for the benefit and well-being of humanity;
- to facilitate coordination of the activities of the Scientific Union Members;
- to facilitate coordination of the international scientific activities of its National Members;
- to stimulate, design, coordinate or participate in the implementation of international interdisciplinary scientific programmes;
- to act as a consultative body on scientific issues that have an international dimension;
- to engage in any related activities.

The Assessment Panel will be expected to review the mandate of ICSU and the structure which has evolved over the years to carry out this mandate, and to make recommendations as to how the mandate and structure should be modified, if necessary, in order to serve science and society in the most appropriate manner. In order to carry out this task, the Assessment Panel will be expected to understand both the internal world of ICSU (Members, Associates, interdisciplinary bodies set up by ICSU) and the external world in which ICSU functions (partner inter- and non-governmental organizations, governments, the international climate of science).

The assessment should address, *inter alia*, the following questions, each of which should focus on the past and present situation and how this can be improved:

1. Taking into account the present and likely future evolution of science in the international context, should ICSU's mandate be modified, and if so, how?
2. To what extent has ICSU achieved its objectives and what are its potentials for further results? To what extent can ICSU be considered to be the voice of international science ?
3. Are the bodies which are presently Members or Associates of ICSU appropriate ones? What should be their relationship to ICSU and to each other?
4. To what extent is ICSU's work relevant to its Members, to scientists, to partner organizations and governments, and how can this be improved?
5. Is the current method of financing ICSU, the Unions and the ICSU interdisciplinary bodies the most appropriate one? Does the rationale for ICSU's own grants programme need to be revised?
6. Has effective collaboration been achieved with relevant partners? Is it helpful for ICSU to be identified as an "International Non-Governmental Organization", or should it be defined differently, e.g. "international professional organization"?
7. How much impact has the work of ICSU on the policy sector?
8. What is the relationship of ICSU with the work of global or regional bodies with overlapping objectives?