## CHAPTER 5

## Activities of the International Council of Scientific Unions (ICSU)

The major issues of environmental concern and management cut across the boundaries of established scientific disciplines. Constructive responses to them rest upon analysis and synthesis of evidence flowing from research in all those sectors of physical, biological, and social science applicable to environmental systems. Because none of the issues is the exclusive province of a single discipline, the scientist from a variety of fields must find improved modes of collaboration if the responses by professional groups and governments are to be sound and balanced. In this chapter we review the activities already in progress under ICSU auspices. In the concluding chapter we suggest initiatives which ICSU should take in strengthening those efforts.

The wide-ranging work of the ICSU family encompasses the individual international unions such as the International Union of Pure and Applied Chemistry (IUPAC), its scientific associates such as the International Society of Soil Science (ISSS), and its special and scientific committees, such as the Scientific Committee on Oceanic Research (SCOR), that deal with problems of particular areas or are multidisciplinary. Mention of parts of the SCOPE effort was made in passing in the preceding chapters. It is placed here in the perspective of the whole, diversified concern of ICSU. The programmes of the chief ICSU activities in the environmental field are summarized in Appendix B, and the participants in the SCOPE Mid-term Programme are listed in Appendix C. Without presenting the details that may be found in those appendices and without a fully deadening array of acronyms, it is useful to show how the programmes of unions, associates, and committees are related to the issues presented in this report, and which research topics currently receive attention.

The basic concern with world and climate change among scientists is central to the Global Atmospheric Research Programme (GARP) as it has developed as a joint enterprise of the World Meteorological Organisation (WMO) and ICSU. Through GARP's initiative, long-term studies are directed at those physical processes of the atmosphere that are essential to understanding large-scale fluctuations which control changes in weather. This includes collaboration in the modelling of atmospheric systems, and the planning of observations in areas where data are lacking. For these purposes major computational and weather observation facilities and mobilized among governments and research institutions, and special symposia are directed at the questions outlined in Chapter 3C.

In addition to the GARP efforts, the Special Committee on Solar-Terrestrial Physics (SCOSTEP) sponsors the investigation of possible correlations between

solar-terrestrial physical phenomena and meteorological and climatological patterns. The capacity to make meteorological observations at lower costs and with greater comparability is enlarged by the work of a panel of the Committee on Space Research (COSPAR) which evaluates the utility of space-based measurements. The question of what accounts for the photochemical equilibrium of the ozone layer receives attention from another COSPAR working group.

For two large areas of international concern, multidisciplinary groups are pressing for more refined understanding of climate. In the southern polar region the Scientific Committee on Antarctic Research (SCAR) brings together groups of specialists on meteorological, geological, and glaciological processes related to climate, including changes that occurred during the late Cenozoic period. In the oceans, the Scientific Committee on Oceanic Research (SCOR), sponsors exchange of data and scientific analysis dealing with climate, air-sea interactions, and tropospheric transport of contaminants.

The International Union of Geodesy and Geophysics (IUGG) and especially its affiliated Associations of Meteorology and Atmospheric Physics (IAMAP), of Geomagnetism and Aeronomy (IAGA) and of Hydrological Sciences (IAHS) are active in these scientific areas.

The nature of the great cycles of chemical constituents in air, water, soil, and organisms commands the interest of several unions and committees. Beyond the initiatives taken by SCOPE in a general symposium on biogeochemical cycles sponsored by its USSR national committee, special reviews of nitrogen, phosphorus, and sulphur were made under the auspices of the Swedish national committee (described in Chapter 3B), and carbon and oxygen balance were examined in a preliminary fashion by the US national committee. All such activities draw upon the knowledge of magnitudes and rates of material flows that is fostered by the International Union of Theoretical and Applied Mechanics (IUTAM). Because of deficiencies of both data and knowledge of the transport processes, it is difficult to construct mass flow models, but the Swedish report on sources, sinks, and flows of nitrogen, phosphorus, and sulphur illustrates the directions to be followed in quantifying nutrient cycles on a regional or global basis. Criteria and methods for the accurate description of spatial distribution of the macro- and micro-elements in the biogeochemical landscape are the subject of a review sponsored by the Belgian national committee.

Concern for pollutants in the environment extends from consideration of the basic processes of transport to examination of evidence on effects in organisms. IUTAM is involved in appraisal of mathematical modelling of the dispersion of contaminants, including noise, from sources to receptors, through air, water, and ground. The International Association on Water Pollution Research (IAWPR) fosters examination of all aspects of water pollution control or abatement in surface, underground, and marine waters. Long-term changes in water quality are assessed by the Scientific Committee on Water Research (COWAR), and the pollution of the Baltic and tropospheric transport of pollutants are subjects of SCOR activities. Possibilities of using space-based facilities to detect various pollutants and the distribution of biological indicators that are sensitive to

pollution are investigated by COSPAR. The International Association of Acoustics of IUPAP co-ordinates acoustic research on noise pollution problems.

A state-of-the-art review of ecotoxicology, as illustrated in Chapter 3D, is under way by SCOPE with support from the national committee of the Federal Republic of Germany and of the Commission of the European Communities. This concentrates on principles in planning research projects in ecotoxicology, and covers the environmental behaviour of pollutants, experimental toxicology, field observations, dose-effect relations, and overall estimation of ecosystem effects.

Growing out of early SCOPE investigations, a plan for an International Registry of Potentially Toxic Substances was developed, and later incorporated in the United Nations Environment Programme (Levinthal 1976). The discussion by the US national committee of lack of solid information as to movement of toxic substances in the environment, led to initiation of a programme for monitoring of ocean and coastal pollution through analysis of accumulator organisms, chiefly *Mytilus* sp. (Goldberg 1975). Thus, reviews of state of knowledge of contaminants can stimulate new research, new outlines of research procedure, and enlargement of the presently small data base.

In seeking understanding of human impact upon renewable natural resources, the ability to assess dynamic change in ecosystems is pursued by various sections of the International Union of Biological Sciences (IUBS). Work which helps specify population structure and tolerance to perturbation of component species yields useful information. Under commissions of the International Geographical Union (IGU), evaluations are going forward on rates of geomorphic change in various environments, on the advance or recession of the world's shorelines, and on desertification processes. Possible impacts of mineral or other exploitation on the Antarctic environment are studied by working groups of SCAR.

Integrative views of ecosystem change are sponsored by the International Association for Ecology (INTECOL). These focus on agro-ecosystems within the total landscape. The evaluation of current knowledge of ecosystem processes (Chapter 3E) grew out of a workshop sponsored by MAB in co-operation with SCOPE, and with partial support from the Ford Foundation. It reviewed present concepts regarding ecological succession, methods of modelling and prediction, and applications to management of forests, rangelands, and other near-natural ecological systems.

The International Society of Soil Science (ISSS), in collaboration with FAO, UNEP, and UNESCO, conducts a global assessment of land degradation in cultivated and grazed areas. Under a collaborative arrangement among UNESCO, SCOPE, and COWAR a joint working group prepared an appraisal of what is known concerning environmental effects of irrigation and drainage, as reported in Chapter 3E. In a broader framework, SCOPE in co-operation with its Canadian national committee carried out a review of the scientific issues involved in assessment of environmental impacts. This resulted in a report which examines available techniques, their strengths and limitations (SCOPE 5).

An aspect of renewable resource management of vital importance to future land use is the conservation of genetic diversity. Currently or recently used cultivars and special genetic stocks are generally adequately represented in collections. Obsolete cultivars need more attention, but the greatest problem is posed by the perpetuation of primitive varieties and of related wild species as sources of resistance to diseases and pests. Reasonably representative samples of the variation in crop cultivars can be conserved economically as seed since the optimum storing condition for many seeds is known. Gene banks have been established all over the world under FAO auspices to preserve most important crop plant varieties and their wild relatives. With the Consultative Group on International Agricultural Research (CGIAR) a plan is under way for a worldwide network of genetic resource centres co-ordinated by the International Board for Plant Genetic Resources (IBPGR).

The greatest problem of genetic resource conservation is gene erosion, or genetic drift. The genetic variation of sexually reproducing wild species is extremely large, and if this variability is to be maintained, millions of individuals would have to be preserved in gene banks. Such large-scale preservation is clearly impossible. An alternative solution is in situ conservation in national parks and biosphere reserves established under MAB. Perhaps one half of the wild species of the world might be included in such reserves. Keeping their genetic diversity, they would be able to evolve in response to environmental change and remain available for scientific studies or breeding programmes.

As noted in Chapter 4A, problem identification and monitoring embraces a large variety of activities joining scientific research with environmental decision-making. On the methodological side, the statistical aspects of monitoring network design and sampling grids receive attention from IUTAM, and COSPAR examines the feasibility of space-based observation systems for atmospheric phenomena, natural resources, and pollutants. The selection of appropriate sites for observations in Antarctica and the oceans is investigated by SCAR and SCOR.

On the data side, several global efforts have sprung from planning by ICSU units. The Middle Atmosphere Programme provides a co-ordinated observation of the region from the tropopause to the top of the mesosphere. Another programme monitors solar-terrestrial physics data. A plan for monitoring human malnutrition is in course of preparation by the International Union of Nutritional Sciences (IUNS).

Under the auspices of SCOPE, a group of scientists have joined at Chelsea College, University of London to provide capability for problem identification and monitoring as outlined in Chapter 4A. Known as the Monitoring and Assessment Research Centre (MARC), the group pursues several themes developed in workshops at Stockholm and London during 1974. It is occupied with the characterization of monitoring data, the concept of environmental dose commitment, the concept of resilience, cost-effective analysis of monitoring systems, the time perspective of environmental change, indices of environmental quality, and related training. MARC is supported by UNEP, the Department of the Environment of the United Kingdom, and the Rockefeller Foundation.

Modelling of environmental systems claims the interest of working groups throughout the ICSU family. For example, the simulation of physical and biological processes by high-speed computing methods, and mathematical modelling of dispersion of pollutants are topics for IUTAM units. The GARP concern with global atmospheric modelling includes programmes on numerical experimentation and parameterization techniques in numerical models. Modelling of oceanic processes is addressed by SCAR. Agricultural systems are modelled by a commission of the IGU.

To bridge some of these compartments, SCOPE is carrying out a state-of-the-art assessment of environmental models for use in policy decisions. This activity, reported in part in Chapter 4B, draws upon workshops held in Indianapolis and Moscow, and incorporates experience from Australia, Canada, Egypt, the Federal Republic of Germany, Japan, Nigeria, the UK, the USA, the USSR, and Venezuela. It is supported by the Holcomb Research Institute.

Risk estimation probably has been developed most fully in connection with the hazards from radiation. A commission of the International Union of Pure and Applied Biophysics (IUPAB) is engaged in assessing biological hazards with a view to a comparative statement on organism tolerances and maximum permissible levels of radiation. A more general comparative analysis of risk assessment methods was prepared by SCOPE with the support of UNEP and the Electric Power Research Institute (SCOPE 8 1976). Based upon a workshop at Woods Hole, the analysis deals with problem identification, risk estimates, and evaluation, as noted in Chapter 4C and D.

Problems of evaluation and communication of scientific findings on environmental matters tend to receive only incidental attention in ICSU activities. For the reasons outlined in Chapter 4D the scientist tends to assume that the new information somehow will reach the right people who will use it intelligently. SCOPE's Project VII brings together research workers and people involved in policy formation to examine the difficulties attached to the actual use of scientific evidence in decisions on the environment. In this it builds upon earlier experience with examination of public policy implications of knowledge as to ecosystem modifications by man-made lakes (SCOPE 2), and of environmental impact assessment (SCOPE 5).

Aspects of standard setting, like other processes of environmental decisionmaking, are receiving critical review. The IUPAB appraisal of radiation standards is one such effort. Another is the periodic examination of water quality standards by IAWPR. The problem of suitability of housing design requirements for developing countries, as reported in Chapter 4E, is studied by SCOPE working with research institutes in Argentina, India, and Nigeria. Other standards are touched upon in the course of ICSU activities in the fields of biology, chemistry, and pharmacology, but systematic appraisals of their suitability to conditions in developing countries rarely are made.

The above review omits numerous details which may be found in Appendices B and C or in publications cited from the responsible ICSU units. Albeit brief, it serves to outline the diversity and extent of ICSU activities in the environmental field. The bulk of them are in the basic disciplines represented by the unions. To an increasing degree, in investigating oceans, the Antarctic, or atmosphere, they take interdisciplinary approaches.