

SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH



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INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

**SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH
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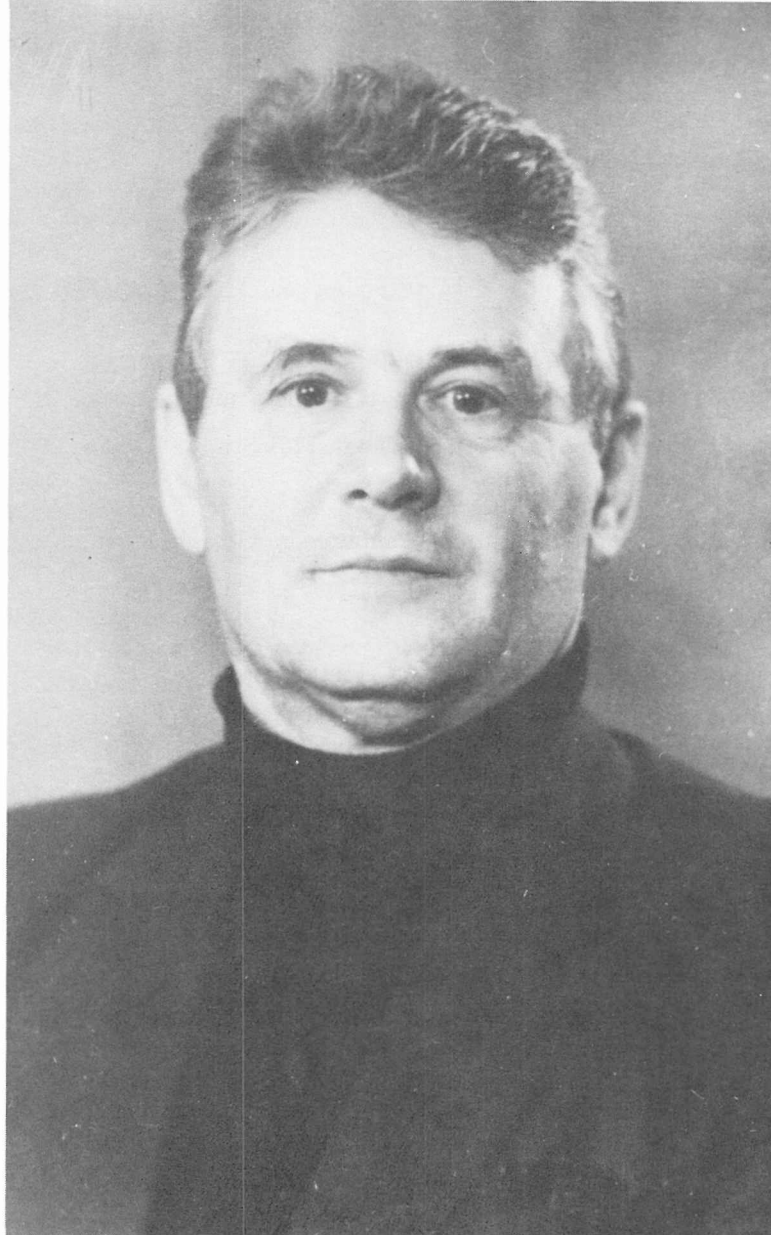
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DEDICATION

KONSTANTIN NIKOLAEVICH FEDOROV
1927 - 1988

Only a short time after the end of the Joint Oceanographic Assembly and the Nineteenth General Meeting of SCOR in Acapulco, we received word that Konstantin Fedorov died suddenly on September 21, 1988. Many of us had just been with him in Mexico, where he was as active and energetic as ever. The first thing I remembered when I received the message was meeting with him towards the end of our stay in Mexico. He came along and asked us to join him in celebrating the first day of school for his young son, Anton. Certainly, Konstantin left all of us much too soon.

He was born on December 17, 1927 in Leningrad, USSR. In 1947 he received a diploma in meteorology and, in 1953, a diploma in oceanography in Leningrad. In 1955 he earned a Ph.D. in physical oceanography at the Institute of Oceanology in Moscow. With the help of a Unesco grant, he visited the Department of Oceanography of the University of Liverpool and the Department of Meteorology of the Imperial College in London, UK, in 1958/59.

His international career started in 1961 when he joined Unesco in Paris, as a Programme Specialist. He served as Secretary of the Intergovernmental Oceanographic Commission (IOC) of Unesco from 1963 to 1969 and then returned to the USSR. From 1976 to 1980 he was President of the Scientific Committee on Oceanic Research (SCOR) and then served as Past-President of SCOR until 1988. The General Meeting in Acapulco was his last as a member of the Executive Committee and this was recognized at a special gathering in his honour. During the last few years he was also Chairman of SCOR Working Group 69 on "Small-Scale Turbulence and Mixing in the Ocean", which successfully completed its tasks in 1988 and was disbanded by the General Meeting.

Most of his scientific work was related to fine-scale thermohaline structure and mixing in the ocean. There is a long list of achievements and publications on thermohaline fine structure and inversions, convection, intrusion processes and the transformation of water masses, from his early paper of 1967, written jointly with Henry Stommel, on small-scale structure near Timor and Mindanao, to the book "The Thermohaline Finestructure of the Ocean" published in Russian in 1976 and in English in 1978, and to his most recent book, "The Near Surface Layer of the Ocean", (in Russian) which he published jointly with his wife, Anna Ginzburg, in 1988. Much of his research was based on ship observations and he himself had a lot of experience in work at sea on research vessels.

Konstantin Fedorov has considerably expanded our understanding of mixing processes in the ocean. He was committed to research, and he was also a key figure in international marine science during the last three decades. Due to his experience and knowledge, he was able to draw intergovernmental and non-governmental organizations together, and he helped considerably to promote the scientific communication between east and west. He was important to SCOR, and I always felt that SCOR was important to him.

The international oceanographic community has lost one of its prominent scientists, SCOR has lost one of its most committed members, and many of us have lost a friend. Konstantin will be missed.

Gerold Siedler
Past-President of SCOR

REPORT OF THE NINETEENTH GENERAL MEETING OF SCOR

Acapulco, Mexico

August 27 and September 1, 1988

1.0 OPENING

The Nineteenth General Meeting of SCOR was held in two sessions during the Joint Oceanographic Assembly which took place from August 23 to 31 at the International Center of Acapulco, Mexico. The President of SCOR, Professor Gerold Siedler, presided over the meeting. A list of participants is given in Annex I.

The Joint Oceanographic Assembly was organized, under the auspices of SCOR, by the Mexican Committee for SCOR and its Chairman, Dr. A. Ayala-Castanares. In accordance with its usual practice, SCOR held the General Meeting in conjunction with the JOA. The Scientific Programme of the JOA is given in Annex II.

1.1 Opening Remarks and Administrative Arrangements

In opening the General Meeting, Professor Siedler welcomed the participants, making special note of the presence of the newly-elected President of IAMAP, Dr. G.B. Tucker, as a member of the SCOR Executive Committee. He welcomed the Chairmen of ICES and IOC, Drs. Ostvedt and Lie, and the representatives of the UNESCO Division of Marine Science and the IOC Secretariat. The attendance of the Secretary of the newly-established Spanish SCOR Committee and the presence of many observers from countries not actively involved in SCOR was noted with pleasure.

The Executive Secretary reviewed the arrangements for the meeting.

1.2 Approval of the Agenda

Various changes were made in the order of items in the Agenda for the General Meeting in accordance with the availability of individuals for the discussions required. One item was dropped owing to the lack of any report or information from the organization involved. The Agenda was then approved.

1.3 Report of the President of SCOR

The President of SCOR, Professor Gerold Siedler, made the following statement in which he reviewed the major activities of his term of office which concluded at the General Meeting:

"In the course of individual agenda items, most of the activities of SCOR since the last General Meeting in 1986 in Hobart will be discussed, and I do not wish to lengthen our discussion by reporting on these items separately now. Since after the end of the Acapulco General Meeting on 1 September, I will have reached the end of my term as President, I thought I would try, instead, to single out some activities and events of these five years of my presidency and indicate the directions I think SCOR may take in the future. This will necessarily be a subjective view, and I will try not to take up much time of the meeting for this report.

When I stepped in suddenly in 1983, I found that the matter which had long occupied much of Eric Simpson's time and energy again required immediate attention. This was the question of finding an appropriate mode of operation between IOC and SCOR regarding the work of CCCO. It turned out to be a complex task, and Dr. Stewart will remember the numerous discussions that were necessary to solve the problems with which we were faced. The matter was resolved by the signature of Principles of Agreement between ICSU and Unesco and a Memorandum of Understanding between SCOR and IOC on CCCO. These documents have since successfully provided the basis for our cooperation with the IOC in the climate program. The work related to TOGA and WOCE has

been one of the major activities of SCOR together with other organizations in recent years, and will be so in the future.

CCCO, however, despite its great importance, is not a typical example of SCOR's mode of operation, which had previously taken place through Working Groups. In 1983, we had a peculiar situation with respect to these WG's: there were physically and chemically oriented groups, a few biological groups, but no geological groups at all. We tried hard to obtain a better balance in disciplines in the following years, and when you look at the list of our present groups, you will find a noticeable addition of WG's in the fields of geoscience, especially marine geology, and of biological oceanography.

At the last General Meeting in Hobart the proposal was made to convene a meeting of experts interested in global flux studies. It led to the establishment of the JGOFS Committee at the Executive Committee meeting in Zurich last year. This can be expected to be the start of a major new international program in oceanography, and in spite of uncertainties with respect to the science plan and funding, many exciting questions are being posed. I am pleased SCOR was able to respond so quickly in setting up the international framework for JGOFS.

SCOR's work can only be successful if sufficient funding is available to provide the necessary seed money for projects and programmes. When you look at the budget later in this meeting you will find that SCOR has a good financial base, despite some of the recent problems other organizations have had to face in the wake of the United Nations financial situation. It is to the credit of the Executive Secretary that arrears in membership fees are no longer a problem in the SCOR budget.

I was particularly pleased to be involved with two events concerning SCOR membership. It took a considerable effort and the understanding and help of the participants in the Roscoff General Meeting to change the SCOR Constitution to make the membership of China possible, without losing our colleagues in Taiwan. The Chinese SCOR Committee has been amazingly active and quick in its response to SCOR initiatives, and I consider the involvement of the Chinese scientists to be a major asset to SCOR. The second event is the renewed membership of Spain. Following the formal establishment of a Spanish SCOR Committee, and with the authorization of the Executive Committee meeting, I was recently able to welcome our Spanish colleagues again in SCOR after a long absence.

What directions might SCOR take in the future? What might have to change in SCOR's approach in the future? I will only make a few points.

Changes may develop in the operation of SCOR. Getting people together may no longer always be necessary with the new means of communication available today. Telemail and Fax have already changed completely the day-to-day work of the SCOR Officers and Secretariat, and in a time when scientists use electronic communication to do science together, it is foreseeable that the operations of SCOR WG's and Committees will be considerably influenced by computer links. Unfortunately, the availability of such links today is restricted mostly to western industrialized countries, but we can hope for advances on a larger scale during the forthcoming years.

I believe it will be important to preserve a good balance of short-lived, specific task-oriented groups and longer-term committees directly related to the major international programs. I think we should not let all SCOR activities become part of these big programs.

But the most important requirement is the commitment of first-rate scientists to SCOR activities. This is our main strength, and only if this commitment can be preserved in the future, will SCOR be able to continue to contribute to international marine science"

1.4 Appointment of an *ad hoc* Finance Committee

In accordance with the SCOR Constitution, the General Meeting appointed an *ad hoc* Finance Committee to review the state of SCOR finances and to prepare a budget for 1989, taking into account the decisions of the General Meeting with regard to requests from subsidiary bodies for financial support. The Committee

members were Sir Anthony Laughton, Chairman (UK), Professor B. d'Anglejan (Canada) and Professor J. Nihoul (Belgium). See item 3.3 for the report of the *ad hoc* Finance Committee.

1.5 Election of Officers

A Nominations Committee was appointed by the Executive Committee at its 28th Meeting (Zurich, October 1987) in order to prepare for the election of new SCOR Officers at the XIX General Meeting. This Committee consisted of Professor J. O'Brien, Chairman (USA), Professors K. Hsu (Switzerland) and P. Lasserre (France) and Dr. K. Voigt (GDR). In making his report, Professor O'Brien reviewed the SCOR Constitution which states that the President of SCOR shall serve for one four year term only and that the three Vice-Presidents and the Secretary are elected for two year terms with the possibility of serving three such terms consecutively. He also noted that a number of nominations had been received by the Committee in response to a request sent to all Committees for SCOR.

The Nominations Committee proposed the following slate of nominees for election as SCOR Officers:

President	Prof. J.-O. Stromberg (Sweden)
Secretary	Prof. R. O. Fournier (Canada)
Vice-Presidents	Prof. G. R. Heath (USA)
	Prof. T. Asai (Japan)
	Dr. A. P. Kuznetsov (USSR)

The General Meeting accepted this proposal with pleasure and it was noted that the terms of office of the new members of the Executive Committee would begin at the end of the meeting.

At an informal meeting during the JOA, the Executive Committee, in accordance with the Constitution of SCOR, agreed to co-opt two members to the Executive. The Officers concurred with the recommendation of the Nominations Committee and invited Dr. A. Ayala-Castanares (Mexico) to continue to serve as a co-opted member of the Executive Committee, and Dr. Su Jilan (China) to join in the same capacity. These decisions were approved by the General Meeting during the second day of its session.

2.0 SUBSIDIARY BODIES

2.1 Arising from Former Working Groups

The Executive Secretary reported that the final reports of the following working groups had been published during the 1987-88 period:

WG 51 – Evaluation of CTD Data – Final Report, “The Acquisition, Calibration and Analysis of CTD Data.” *Unesco Technical Papers in Marine Science* No. 54, 1988.

WG 56 – Equatorial Upwelling Processes – “Vertical Motion in the Equatorial Upper Ocean: Proceedings of the International Symposium on Vertical Motion in the Equatorial Upper Ocean and its Effects Upon Living Resources and the Atmosphere” Unesco, Paris, France, 6-10 May 1985. *Oceanologica Acta* Special Volume No. 6. 1987.

WG 65 – Coastal – Offshore Ecosystems Relationships – “Coastal Offshore Ecosystem Interactions: Proceedings of a Symposium sponsored by SCOR, UNESCO, San Francisco Society, California Sea Grant Program and U.S. Dept. of Interior, Mineral Management Service held at San Francisco State University, Tiburon California, April 7-22, 1986.” Springer-Verlag *Lecture Notes on Coastal and Estuarine Studies* No. 22. 1988.

In addition to these publications, the following are in the final stages of preparation:

WG 46 – River Inputs to Ocean Systems – the final report of this group is in press at Unesco and will appear as “River Inputs to Ocean Systems: Status and Recommendations for Research” in the series *Unesco Technical Papers in Marine Science*.

WG 73 – Ecological Theory in Relation to Biological Oceanography – the proceedings of a workshop

will be published in early 1989 in the Springer-Verlag *Lecture Notes on Coastal and Estuarine Studies* with the title "Flows of Energy and Materials in Marine Ecosystems: Network Analysis".

2.2 Current Working Groups

WG 69 Small-scale Turbulence and Mixing in the Ocean (with IOC)

The Chairman of WG 69, Dr. K.N. Fedorov, presented information on the final activities of his working group. He noted that its tasks had been fulfilled with the publication of the Proceedings of the 1987 Liege Colloquium and the preparation of the final report which will be published by SCOR in the near future. Dr. Fedorov noted that many divergent points of view had been aired among the members of the WG during the discussion of certain terms related to the turbulent diffusivities of temperature, salinity and momentum, but that these had eventually been resolved during the preparation of the glossary of terms and definitions used in turbulence studies. He urged the adoption of these terms by scientists in this field.

The General Meeting agreed to disband WG 69 after congratulating its Chairman on the successful completion of a challenging assignment.

WG 71 Particulate Biogeochemical Processes (with UNESCO)

The report of WG 71 was presented by its Chairman, Dr. S. Krishnaswami, who reported on the group's activities, especially the final meeting which had taken place in France shortly before the General Meeting. A summary report of the activities of the group is given in Annex III, however, the final report of WG 71 has been submitted to the SCOR Secretariat and will be published in the near future.

The Working Group proposed that SCOR consider the establishment of two new groups; one on the role of ocean margins in the marine geochemical cycles of carbon and other elements, and another on the use of satellite ocean colour imagery to derive estimates of standing crops and rates of primary/new production. It was acknowledged that such groups would be very closely related to JGOFS' interests, however, the General Meeting was also of the opinion that such topics could also be addressed by independent SCOR subsidiary bodies. Dr. Krishnaswami accepted the request of the General Meeting that he take the lead in developing these two proposals for further consideration by SCOR.

The General Meeting thanked Dr. Krishnaswami for his report, and, noting that a comprehensive final report from WG 71 was ready for publication, agreed to disband the group.

WG 72 The Ocean as a Source and Sink for Atmospheric Constituents (with IOC)

Professor Heath, as Executive Committee Reporter for WG 72, informed the General Meeting that the group's final meeting had been held in November 1987 at Schloss Ringberg, Bavaria.

The group conducted a discussion of the micrometeorological methods suitable for measuring air-sea exchange fluxes. It was emphasized that the complexity of the wet deposition process to the oceans is usually underestimated, and combined tower-aircraft-ship experiments to investigate gas exchange processes were recommended. For the determination of particle fluxes, size-dependent eddy correlation techniques together with studies of the chemical composition of the aerosol appear appropriate. The physiology of sulphur compounds in phytoplankton was also reviewed and potentially underestimated sources of sulphur gases, e.g. picoplankton, macrophytes and microbial mats were identified.

The Chairman of WG 72, Professor Andreae, presented an overview of the changes in our view of the air/sea exchange of sulphur since the last meeting. Of special interest here are recent determinations of H₂S and CS₂ in seawater and the marine atmosphere and the development of a hypothesis linking marine sulphur emissions and global climate.

Other topics discussed by WG 72 included:

- the role of carbon and nutrient fluxes to the ocean. For example, it was pointed out that the inputs of some nutrients, especially Fe, may be growth-limiting under some circumstances.
- the variability in time and space of particle fluxes to the ocean and the resulting problems of scaling and extrapolation.
- recent advances in our views of the role of the microlayer and the microbial communities in this layer for gas exchange.
- the processes responsible for the production of hydrocarbons and halogenated hydrocarbons in the sea. In view of the potential importance of some of these compounds for atmospheric chemistry, they deserve more intensive study.

Ongoing international scientific activities were reviewed by Professor Duce (GTCP, AEROCE, IGAC, IGBP) and Dr. Buat-Menard (WOCE, JGOFS, EUROTRAC/ASE, and other European activities).

The Working Group agreed to produce a final report containing a state-of-the-art review and a set of recommendations. Publication as a UNESCO Technical Report was found to be an appropriate medium. The report is to have the following outline:

Index

Summary and recommendations

Background papers, each with

Title

Author(s)

Discussion of scientific background

Recommendations

Bibliography

Names and addresses of group members and other contributors

Dr. Graeme Pearman, CSIRO Aspendale, the Chairman of the IGAC steering committee had requested that the group make recommendations on the research related to air/sea exchange to be conducted under IAMAP's International Global Atmospheric Chemistry Programme. The chairman was instructed to draft a letter to Dr. Pearman, expressing the enthusiastic support of the Working Group for the goals of IGAC and the recommendations of the group for future research.

The report of WG 72 which was before the General Meeting noted that although the group expected to be disbanded in the immediate future, it felt that in the current period of intensive scientific planning activity for international programmes in the marine and atmospheric community, there is a significant need for a group which acts as an information resource and as a kind of clearinghouse to help coordinate the research in those fields where atmospheric and oceanographic research overlap. Both the international Global Atmospheric Chemistry programme and the Joint Global Ocean Flux Study are aware of this need and have contacted WG 72, or some of its members, to participate in their planning activities. JGOFS has invited the chairman of WG 72 as a Corresponding Member of the JGOFS Steering Committee.

The group therefore proposed the formation of a new SCOR Working Group: "Biogeochemical Air/Sea Exchange Studies" (BASES) with the following terms of reference:

1. Identify research needs and define scientific planning approaches related to:
 - a) Emissions of biologically and photochemically produced trace species from the surface ocean.
 - b) Deposition of atmospheric materials to the ocean surface and its influence on marine chemistry and biology, including their use as tracers.
 - c) Measurement technologies for air/sea exchange fluxes.

2. To provide a means of interaction and guidance for the planning activities of the International Global Chemistry and the Joint Global Ocean Flux Studies programmes related to air/sea exchange.

It was proposed that the membership of such a group be comprised equally of atmospheric and marine scientists nominated by the JGOFS and IGAC planning committees.

In discussing this recommendation of WG 72, the General Meeting agreed that the proposal should go to the JGOFS Committee for detailed consideration at its meeting in September at which Dr. Andreae would be present.

The General Meeting agreed to disband WG 72 pending publication of its final report.

WG 75 Methodologies for Oceanic CO₂ Measurements (with UNESCO)

The Chairman of WG 75, Dr. C.S. Wong, informed the General Meeting that WG 75 has been working on the technical aspects of the world-wide implementation of a CO₂ measurement programme as part of the WOCE and JGOFS programmes. He noted that the group had held three meetings and that its final meeting would take place at Woods Hole in mid-October. He made special reference to the collaboration between WG 75, the JPOTS Sub-Panel on CO₂ Standards and the ICES Marine Chemistry WG on a CO₂ intercalibration exercise. The results of this will be discussed at the Woods Hole meeting; aliquots of homogenized seawater were distributed to a number of laboratories for intercalibration of the methodology for DIC and alkalinity.

Dr. Wong reviewed other items on the agenda for the final meeting of his Working Group and noted that a final report would be prepared which would incorporate a revision of previous WG 75 reports. Future activities in the field will depend very much on the discussion undertaken by the newly-established CCCO/JGOFS CO₂ Panel. Given the fact that WG 75 has already been in existence for the normal six years, the Executive Committee wished to recommend that the group be disbanded following submission of its final report.

WG 76 Deep-Sea Ecology (with IOC)

The Executive Committee Reporter for WG 76, Professor Stromberg, introduced the report submitted by the Chairman. He noted that the Working Group met for the second and last time in late June, 1988 immediately before the Fifth Deep Sea Biology Symposium in Brest, France. In accordance with the report submitted to SCOR in 1987, a discussion document had been prepared by Dr. Rice, based on submission from the WG members and this had been circulated several weeks prior to the meeting of WG 76. The earlier decision to divide the document into structural and functional aspects had proven to be impractical and discussions in Brest centered on a revised scheme. The final report of WG 76 will address the following topics:

Introduction: This section will define the problem, that is the need to be able to recognize and detect the effects on deep-sea communities of past perturbations and to forecast the likely consequences of future ones. The scale of the problem and the consequent need for international collaboration will be emphasized. Finally, this section will point out that while it may be necessary to study small scale/short term changes, the main interest is in large scale and long term perturbations resulting from anthropogenic impacts.

Natural variability of deep sea communities: This section will outline the background "noise" resulting from the known spatial and temporal variability of the deep sea and will review some of the factors known, or believed, to be responsible for this.

Sampling strategy: Taking into account the known or suspected variability, this section will emphasize the need to adopt an appropriate sampling strategy, the need for intercalibration of techniques and adequate descriptions of methods to validate the comparison of results.

Sample treatments:

1. **Taxonomic composition** – An outline of the importance of the specific identification of deep sea biological material and the difficulties associated with this. This section will also distinguish between what might be achieved in the short-term (months) and the long term (years).

2. Measurements – This section will review the attributes of a community which might be measured (abundance, biomass, chemical constituents (or organisms), metabolism etc.), and “taxonomic” level at which these might be partitioned (ranging from the species to the total community).

Specific objectives: All of the above could apply to the study of natural, unperturbed communities. This final section would focus on objectives specifically associated with expected or actual anthropogenic disturbances, distinguishing between predictive and retrospective activities.

1. Predictive – Controlled perturbation experiments to elucidate immediate and chronic effects on population structure and on the functioning of the ecosystem.

2. Retrospective – Assessment of the effects of mining or waste-disposal activities on natural populations ranging from (a) short-term, localized, high impact situations to (b) long-term, large scale, low impact scenarios. Specific examples of passed or planned impact studies will be reviewed, with an assessment of the results obtained and the difficulties anticipated.

The General Meeting approved of the intention of the group to complete the compilation of its directory of deep-sea biologists with the information received in response to a widely distributed questionnaire. Lastly, the meeting recommended that WG 76 be disbanded once these final tasks have been completed.

WG 77 Laboratory Tests Related to Basic Physical Measurements at Sea (with IOC)

Dr. Fedorov, the Executive Committee Reporter for WG 77, informed the General Meeting that it had, regrettably, been necessary to postpone the CTD intercalibration experiment which had been planned to take place in Kiel in June 1988, due to the inability of a number of members of the group to participate. This unprecedented laboratory intercomparison will now take place late in 1988 and involves the use of the high pressure laboratory of the Institute of Applied Physics at the University of Kiel to compare a number of CTD's supplied by several institutes around the world, both with reference instruments and with each other, under a wide range of temperature, pressure and salinity conditions. Planners of both the TOGA and WOCE experiments have expressed great interest in the results of this intercomparison, and Dr. Fedorov urged that it not be postponed again and that the results must be made available as quickly as possible.

In his report, the Chairman of WG 77, Dr. Striggow, had requested approval for two meetings of the group in 1989; one for working up the results of the intercomparison experiment, and another to begin planning of a “dynamic CTD-sensor intercomparison experiment” to take place in 1990 or 1991. While the 1988 experiment will test sensors under conditions of mechanical, thermal and electrical equilibrium, the most recent developments of these instruments have led to a dramatic increase in the speed of oceanographic measurements, and the response of the sensors to sudden changes in pressure, temperature and salinity requires more attention.

The General Meeting urged WG 77 to finalize the results of the first intercomparison experiment before proceeding to plan a second. It therefore gave approval for a single meeting of WG 77 in 1989 and urged the group to submit a slightly more detailed statement of its plans for other activities for consideration by the Executive Committee at its meeting in late 1989.

WG 78 Determination of Photosynthetic Pigments in Seawater (with UNESCO)

At its meeting in 1987, the Executive Committee gave approval for a three week pigment methodology workshop to be held in Hobart, Australia in late 1988. The purpose of this workshop was to: a) quantitatively compare existing spectrophotometric and fluorometric procedures with newer HPLC and thin layer chromatographic techniques for the determination of a variety of pigments; b) to conduct intercalibrations of HPLC's; and to standardize the current procedures for pigment analysis so as to permit the production of a reasonable pigment data set and the improved identification of detrital and pigment breakdown products in seawater samples.

Discussion between members of the group, however, had led to the conclusion that it would not be possible to achieve all of these goals in a single, large three week workshop involving all of the WG 78 members, equipment and technical support. The Chairman of WG 78 sought the approval of the General Meeting for a

series of three more restricted “mini-workshops” on chlorophylls, carotenoids and field applications in quick succession. After consideration of the financial implications of this change in plans, the General Meeting accepted this revised proposal, while urging the group to ensure that the results of workshops are disseminated as quickly as possible since they are of great interest to JGOFS which is attempting to develop sampling protocols for the Pilot Study in 1989 and to establish sea truths for a satellite ocean colour instrument to be launched in 1990 or 1991.

WG 79 Geological Variations in Carbon Dioxide and the Carbon Cycle

This working group was discussed together with WG 81. Please see below.

WG 80 Role of Phase Transfer Processes in the Cycling of Trace Metals in Estuaries (with UNESCO)

The report from the Chairman of WG 80, Dr. M. Whitfield, informed the General Meeting that the group has been working in correspondence for about eighteen months, conducting an evaluation of the state of knowledge of particle/water reactions for key metals and metalloids under a range of estuarine conditions, and defining the most useful properties for the characterization of estuarine particulates. These two topics correspond to two of the terms of reference of WG 80. Good progress has been made in a review of the knowledge of particle/water interactions driven by biological and geochemical processes, however, the review are not quite complete, especially with respect to the controlling processes in major Asian estuaries. The key papers related to the measurements of important properties of estuarine particles are still in preparation and will be required in order to provide a sound basis for discussion by WG 80 at its planned first meeting. In view of this, the Chairman proposed that the meeting planned for October 1988 be postponed until May 1989 in order to ensure the availability of a complete discussion document. This will permit completion of the last term of reference, which is to recommend experimental and theoretical research needed to develop models of particle/water interactions and to predict the behaviour of trace metals in various estuarine regimes. The General Meeting approved this request and suggested that WG 80 attempt to complete its work at the 1989 meeting.

WG 81 Deep Water Palaeoceanography and WG 79 Geological Variations in Carbon Dioxide and the Carbon Cycle (both with IOC)

At its meeting in 1987, the Executive Committee noted that the interests of WG's 79 and 81 appeared to be converging, particularly in the areas of the use of ice core records of variations in atmospheric CO₂ and in modelling. The Chairmen of these two groups were asked to consider whether the scientific objectives of their groups could be better achieved by constituting a new group which would combine the efforts of WG's 79 and 81. In response to this request, Dr. Shackleton (Chairman of WG 81) and Dr. Sundquist (Chairman of WG 79) met in May 1988 in Louvain-la-Neuve, Belgium, to consider ways in which the overlapping interests of the two groups might be combined. The two chairmen agreed that the Executive Committee's suggestions could best be answered by proposing a new Working Group on “Ocean/Atmosphere Palaeochemistry.”

The document submitted by Dr. Sundquist, in response to the Executive Committee's request, noted that the proposed Working Group would address scientific needs identified by both Working Groups 79 and 81, from consideration of recent developments in their respective and converging areas of interest. Much of WG 79's attention has concentrated on potential oceanic mechanisms that might have caused the late Pleistocene atmospheric CO₂ variations spectacularly documented in the ice core record. Likewise, WG 81's activities have emphasized the relationships between late pleistocene deep water palaeochemistry and changes in atmospheric CO₂. Both groups have identified modelling and data needs in the study of past carbon-cycle interactions between the oceans and the atmosphere, and have recognized that past ocean/atmosphere carbon-cycle interactions were inseparably bound to climate change and to the global palaeochemistry of other elements and processes. Finally, both groups have expressed a strong desire to effect recommendations for expanding the use of ocean/atmosphere palaeochemical information in interdisciplinary studies of modern biogeochemical cycles and their perturbation by human activities. These common interests form the basis for the proposed new Working Group.

The following activities were proposed:

(1) Sundquist and Shackleton will co-convene a special session on "Palaeoceanographic Implications of Ice Core Records" at the December 1988 meeting of the American Geophysical Union. This meeting was originally proposed as a joint activity of WG's 79 and 81. Data from ice cores – particularly the Vostok record – provide a natural focus for the first formal activity of the new Working Group. Variations in atmospheric carbon dioxide and methane are now known to have been closely associated with climatic change during the last 160,000 years. Atmospheric and oceanic components of the carbon cycle must have been closely linked throughout this period. Moreover, both ice core and marine sediment data suggest close coupling among the climate system, the carbon cycle, and the ocean/atmosphere palaeochemistry of other elements. For example, studies of aerosol constituents in ice cores are generating innovative hypotheses concerning the role of aerosols and trace metals in the global climate system. The proposed meeting will be a unique opportunity to enhance the interdisciplinary communication that is essential to understanding ocean/atmosphere palaeochemistry.

(2) Within its first year, the new Working Group would seek to initiate international activities focusing on the problem of stratigraphic correlation between marine sediment and ice core records. Because ice cores and marine sediments provide complementary palaeochemical and climatic information, it is very important that ice and marine sediment stratigraphies be precisely correlated. The Vostok ice record – because of its outstanding length and detail – has shown more starkly than ever before the difficulties inherent in correlating marine and ice core records. The new Working Group would identify and contact individuals and groups where expertise and interests might be organized to focus on this problem, perhaps through formation of an additional SCOR Working Group.

(3) The new Working Group would initiate a project to stimulate development of time-dependent carbon-cycle models appropriate to time scales of thousands to a few million years. The need for such models is conspicuous. Modelling of carbon-cycle changes over these time scales is almost exclusively limited to steady-state scenarios. The CO₂ and climate modelling communities are concentrating on coupled ocean/atmosphere general circulation models (GCM's) which will be difficult to extend to transients as long as a few years, let alone millennia. Both the steady-state and short-term-GCM approaches are inherently unable to examine the dynamic interactions among the long-term processes that are reflected in the geologic record of carbon-cycle and climate change. Although geologic analogs are frequently cited as powerful tests of climate and carbon-cycle models, these tests require an understanding of the long-term processes that brought about "analog" conditions. Appropriate time-dependent models are essential to acquiring this understanding.

Initial activities in this area would be conducted by correspondence. In approximately two years, the new Working Group would sponsor a data-modelling workshop focussing on particular problems of time-dependent modelling at time scales of thousands to a few million years. Specific topics might include ocean mixing, organic carbon sedimentation, marine and terrestrial productivity, carbonate dissolution, and sea level change. Because the carbon-cycle and climate systems are so closely interactive, climate modelling topics (such as ice sheets and ocean heat fluxes) should be included in this workshop. It was proposed that the climate modelling aspects of this project might be sponsored by the Committee on Climatic Changes and the Ocean. Proceedings of the workshop would be published in a special volume of an appropriate journal.

(4) The new Working Group would seek to identify modern biogeochemical processes that are not adequately understood for palaeo-oceanographic purposes, and palaeo-oceanographic data that are particularly relevant to understanding current and future global biogeochemical trends. These findings would comprise a basis for formal recommendations to groups such as JGOFS and IGBP concerning activities of particular palaeochemical interest that might be included in planned interdisciplinary studies of modern biogeochemical cycles. For example, Working Groups 79 and 81 both identified carbon and oxygen isotope measurements as needing greater attention in current programme planning. The study of sedimentation and burial processes might likewise require the kind of explicit advocacy that the new Working Group could provide.

The General Meeting agreed with Professor Heath that the terms of reference proposed for the new group did not sufficiently emphasize specific activities to be undertaken. They were revised by an *ad hoc* group of interested participants and subsequently approved by the General Meeting as follows:

To study past chemical interactions - particularly carbon-cycle interactions - between the oceans and atmosphere over time scales of 10³ to 10⁶ years.

To organize and publish the results of a meeting on the palaeoceanographic implications of ice core records.

To assess and recommend improved methods for the stratigraphic correlation of marine and ice core records, and for the development of appropriate time-dependent models of the carbon cycle on 10^3 to 10^6 year time scales.

The General Meeting agreed to disband both WG 79 and WG 81 and to establish the proposed new group as WG 92, under the Chairmanship of Dr. Sundquist, pending his acceptance of a list of suggested members and of the revised terms of reference as given above. Drs. Sundquist and Shackleton were urged to continue with their organization of the 1988 AGU special session on "Paleoceanographic Implications of Ice Core Records" as originally planned. Since the session will involve several individuals suggested for membership in WG 92, the occasion may also provide an opportunity for an organizational meeting of the new group.

WG 82 Polar Deep-Sea Palaeoenvironments (with IOC)

The Chairman of WG 82, Dr. J. Thiede, presented information on the status of the group's activities. He noted that progress in polar palaeoceanographic research had been reported in detail during the session on the "Polar seas Geological Record" organized by WG 82 during the Second International Conference on Palaeoceanography in Woods Hole in September 1986. The session addressed the unique properties and geological histories of polar oceans and documented that polar research is presently progressing rapidly because scientists from many nations are using new technologies to collect data in both Arctic and Antarctic waters and to define the differences between the polar environments and their biota from those of lower latitudes. The hostile environments of the high latitude areas present many technical challenges to deep sea drilling, however, the contributions of this session were seen as a major step forward in this field. The papers presented will be published in *Palaeoceanography*.

Dr. Thiede also reported that a conference on Polar Palaeoceanography and a workshop on Northern High Latitude Drilling, both being held in Bremen, FRG in October 1988, would provide a forum for detailed discussion of the feasibility of Arctic Ocean deep sea drilling under the aegis of an international cooperative project for 1993 to 1996 known as the Nansen Arctic Drilling Program. The conference itself will concentrate on the evolution of high-latitude oceans in both hemispheres in terms of plate tectonics, ancient and modern oceanography, and depositional and climatic environments. The final meeting of WG 82 will take place in conjunction with these events and it was expected that the final report of the group would take the form of a publication addressing many of these questions. It was agreed that the group should remain in existence until the next General Meeting of SCOR in order to bring this publication to completion.

WG 83 Wave Modelling (with IOC)

In response to the request of the Executive Committee, a report had been submitted to SCOR on the present status of various activities in surface wave research in order to clarify the relationships between the groups active in the field. The report was to focus on the topic of medium-range wave forecasting, which had been identified as an area in which WG 83 has special expertise, and it was to establish a plan of work for the group, leading to some final product. This report is given in Annex IV.

The Executive Committee Reporter for WG 83, Dr. Fedorov, advised the General Meeting that, in his view, the report was an appropriate response to the request of the Executive Committee at this stage of the group's existence. He noted that the group expects to achieve its goals in 1992, two years after the launch of the ERS-1 satellite. The Chairman's request for approval of a meeting of WG 83, again in conjunction with a meeting of the WAM group in May 1989, was accepted. It was, however, agreed that the group should use the period between its meetings to maintain the momentum of its activities by establishing more interaction between the members in correspondence. It was hoped that the report of the 1989 meeting would contain somewhat more scientific information and that WG 83 would prepare a more detailed summary report on the state-of-the-art of wave modelling towards the end of its term.

WG 84 Hydrothermal Emanations at Plate Boundaries (with IOC)

The Chairman of WG 84, Professor Suess, made a brief presentation to the General Meeting about the scientific issues of concern to his working group. While the first meeting of WG 84 had been planned to take place during the JOA, this had proved impossible to arrange and Prof. Suess sought approval for this meeting to be held in Kiel in May 1989.

Prof. Suess noted that fluid venting processes at plate boundaries is a current research frontier and that it was one of the most vigorously pursued fields of oceanic and marine geologic research in 1987 and 1988. Numerous project planning activities and exchange of scientific results are beginning to shape several national and international research efforts for the coming decade. All of these efforts touch on the mandate of SCOR Working Group 84.

As a first step, WG 84 has identified these project planning and research activities, documented institutions and participants, and has formally or informally established collaboration and joint programmes. A draft document was circulating among the working group members in order to synthesize the scientific objectives and accomplishments to date. The aim of the report is to select from the wealth of information those results and objectives which advance our knowledge specifically in the areas of fluid fluxes, fluid evolution, dissolved mass transport, physical controls on flow rates and source depths of fluids.

The second step for WG 84, according to Prof. Suess, is to have this report published by SCOR as a "white paper". It should summarize the current results, state-of-the-art experimental designs and field projects, and serve as a directory and bibliography of scientific and technical information on global fluid venting processes. The final editing of this report would take place during a WG meeting in the early summer of 1989, tentatively scheduled for May or June and hosted by the GEOMAR Research Centre for Marine Geoscience in Kiel/Federal Republic of Germany.

As a third and final step, WG 84 intends to seek funding from the Dahlem Foundation Berlin/Germany and to organize a conference on Fluid Venting at Plate Boundaries under the auspices of and utilizing the successful model of the Dahlem Konferenzen. The SCOR WG 84 members would function as the programme committee for this conference and the working group chairman as the conference organizer. Initial contacts with the Dahlem Konferenzen have already been established and the group was encouraged to submit a workshop proposal prior to August of 1989. Formulating this proposal would be another task of the meeting in 1989. Prof. Suess expected that if this effort were successful the conference could be held as soon as the spring of 1991 or later during the fall of that year.

Since two of the individuals invited to join WG 84 had been unable to do so, Prof. Suess' report contained suggestions for their replacement as well as for the addition of expertise in the areas of convergent margin tectonics, hydrogeology and in the thermal regimes of sedimented mid-ocean ridges. The General Meeting agreed that Dr. G. Westbrook (UK), Dr. H. Villinger (FRG) and Dr. P. Dietrich (GDR) be invited to join WG 84. In addition a member will be sought from the USSR. The General Meeting approved the activities described by Prof. Suess in his presentation and written report.

WG 85 Experimental Ecosystems (with UNESCO)

Professor Fournier informed the General Meeting that WG 85 had held its first meeting in Hamburg in June 1988. The report of this meeting appears in Annex V. Each member of the group had prepared a review paper addressing its first term of reference, "to examine previous studies involving experimental ecosystems; critically evaluate the results and the application of such techniques to estuarine, coastal and open sea problems." The final versions of these papers will be submitted to SCOR in a format suitable for publication in the primary scientific literature.

The second term of reference of WG 85 calls upon it to make recommendations regarding the application of experimental ecosystems to suitable research problems in biological oceanography. This topic was discussed in detail at the group's meeting, with three categories of scientific problems being identified which could be approached through experimental ecosystem research. These include process studies and flux measurements, aspects of resource studies, and investigations of the fates and effects of pollutants. Readers are referred to

Annex V for more detailed information on the discussions of WG 85 on this point.

Lastly, WG 85 began a consideration of its third term of reference which is to specify design criteria for experimental ecosystems to be used in a variety of conditions. Some preliminary recommendations are given in the report in Annex V. Among them, the group agreed to prepare an "Experimental Ecosystem Manual" to serve future users of these systems. The preparation of the draft of this manual will be the focus of activities for WG 85 during the next year. In addition, the group wishes to organize a colloquium on the most recent results from experimental ecosystems, possibly in conjunction with the Fifth International Congress on Ecology in Japan in August 1990.

WG 85 sought approval for a second meeting to be held, if possible, in Qingdao, China. While the General Meeting agreed that it was most desirable to hold this meeting in China, the costs involved were of considerable concern. The Executive Secretary was instructed to explore ways of reducing the expenses involved with such a meeting; if this proved to be impossible, the group would accept another invitation to meet at the University of Rhode Island.

WG 86 Sea Ice Ecology (with SCAR and AOSB)

Professor R.O. Fournier introduced the discussion of WG 86, one of the most recently established, and commended the group's Chairman, Professor C. Sullivan, for the promising start which his group has made. A preliminary report from the Chairman of WG 86 is given in Annex VI and includes a discussion of the scientific issues to be addressed by the group based on an informal exchange of ideas between some of its members. It is expected that the first formal meeting of WG 86 will take place in January, 1990. Finally, the nomination of a Soviet scientist which had been sought with the assistance of SCAR was received and Dr. I. Melnikov will be invited to join the working group.

WG 87 Fine-scale Distribution of Gelatinous Planktonic Animals (with UNESCO)

The Executive Committee Reporter for WG 87, Professor Stromberg, reminded the General Meeting that the Executive Committee at its last meeting had urged WG 87 to begin its work in correspondence and to submit a more detailed report on its plans for consideration by the General Meeting. The Executive Committee was especially concerned at the slow pace with which planning for WG 87 activities seemed to be proceeding. The report received from Dr. Harbison, the Chairman of WG 87, did not entirely alleviate these concerns. In particular, it noted that several members of the group had not actively participated in the preparation of written contributions to a document which would form the basis for the group's work. As a result, Dr. Harbison had sought contributions from a number of experts who were not members of his working group. He sought approval for a meeting of his group to be held in Messina, Italy in March or April 1989. The Officers of SCOR had discussed this proposal and were reluctant to endorse it unless the members of WG 87 had demonstrated their commitment by completing the draft document referred to above before February 1989. The General Meeting concurred with this point of view and agreed that the members of the Executive Committee with biological expertise should review the draft document and decide whether it provides sufficient justification for a full meeting of WG 87 to take place as requested. The General Meeting also agreed with Professor Stromberg that extensive changes to the working group membership should not be made at this time. Dr. Harbison had proposed a number of substitutions for those members who had not been active in the preparation of the draft document, however, these would have significantly reduced the international representation on the working group. The inactive members should be urged to fulfill their commitments in order to participate in the meeting of the group; one or two of them could be replaced from amongst the names suggested by the Chairman. It was suggested that the other individuals could be invited to become Corresponding Members of WG 87 and that the participation in the meeting be determined on the basis of contributions to the document to be submitted to SCOR.

WG 88 Intercalibration of Drifting Buoys (with IOC)

On behalf of WG 88, one of its members, Dr. G. Cresswell presented a brief report on the following topics of interest to the group:

examples of the use of satellite-tracked drifters in the tropical Pacific Ocean and in the waters around Australia

the standards to be met for drogue slippage and sensor accuracy

drifter designs that are presently being used and intercalibrated by the WG

an exciting study of the tropical Pacific Ocean that is about to commence.

The last item refers to the Pan Pacific Surface Current Study under the direction of WG 88 member, Prof. P. Niiler of Scripps, with the participation of WG members D. Hansen, G. Reverdin and G. Cresswell, as well as by Dr. K. Takeuchi. The study aims at understanding the changing SST pattern in the tropical Pacific, for which the competing hypotheses are horizontal advection and vertical mixing. Some 150 drifters will be deployed between October and December 1988. The study will run for two years and the desired grid spacing is 2° latitude by 10° longitude.

Dr. Cresswell concluded by pointing out that there will be benefits for many countries in the region through a better understanding of ocean currents. The study will contribute to TOGA and will assist in the planning of satellite drifter studies for WOCE.

Professor O'Brien noted that the first meeting of WG 88 which took place in 1987 had reached the conclusion that it was premature to carry out an intercalibration experiment on drifters at this time, but that the members are now agreed as to the importance of establishing quantitative error estimates and performance standards for measurements of currents with drifters. Four members of the group are now working on a comparison of several instruments, focussing on the direct measurement of slippage in a range of well-measured environments. The Chairman of WG 88, Dr. Hansen, noted in his report that he expected that the group would be able to formulate some design and performance standards of general applicability from these observations.

Dr. Hansen's report included a request for a meeting of WG 88 in 1989, but did not specify the timing, location or specific goals of this meeting. In view of the evident progress likely to be made within the next few months, it was agreed that more information should be sought from Dr. Hansen and that the President of SCOR should give his approval for the meeting in 1989, if it seemed likely to be productive.

WG 89 Sea Level and Erosion of the World's Coastlines

Professor Heath reminded the participants in the General Meeting that WG 89 had just been established at the last meeting of the Executive Committee and that the final selection of the membership from a long list of suggestions received from SCOR Committees was left to the Chairman and Vice-Chairman. They had submitted a list of seven names for approval by the General Meeting, keeping several vacancies available for additional members who would represent the great interest in this topic among scientists from developing countries. The representative of the New Zealand SCOR Committee drew attention to other programmes such as the IGCP study of coastal evolution, an IGU project on the dynamics of shoreline change and the SCOPE programme on coastal subsidence. He also reiterated the importance of a significant involvement of scientists from developing countries in WG 89 because of the critical importance of sea level changes in many regions with low-lying coastal areas. A number of other participants, including an observer from Nigeria referred to this point.

The Chairman of the UK SCOR Committee, Sir Anthony Laughton, noted that the terms of reference for WG 89 (see SCOR Proceedings, Vol. 23) have two distinct thrusts; sea level rise in general, and the effects of sea level rise on coastlines in particular. Following a brief discussion, the General Meeting agreed that the terms of reference should be revised as follows in order to provide a sharper focus for WG 89 and so as to avoid the possibility of overlap with the programmes mentioned above:

Examine the applicability of the existing models for prediction of coastal erosion dependent upon sea level rise, and formulate a programme of investigations for their verification or rejection.

To evaluate differences between short and long term sea level rises on beach erosion.

To recommend strategies for monitoring programmes on coastal erosion for coastlines which lack

a data base.

To produce a report for SCOR which addresses these questions.

The following individuals will be invited to join WG 89:

P. Komar	(USA)	Chairman
N. Lanfredi	(Argentina)	Vice-Chairman
R. Dean	(USA)	
T. Sunamura	(Japan)	
B. Thom	(Australia)	
K. Dyer	(UK)	
M. Baba	(India)	
T. Healy	(New Zealand)	
M.A. Ortez Perez	(Mexico)	
A. Ibe	(Nigeria)	

2.3 Committees and Panels

Joint SCOR/IOC Committee on Climatic Changes and the Ocean

The Past-Chairman of CCCO, Professor R.W. Stewart, made a verbal presentation on recent CCCO activities which supplemented the written report from the Chairman given in Annex VII. In particular, Professor Stewart highlighted the items arising from the ninth session of CCCO which took place in Paris in May 1988. He noted that the TOGA is progressing well and that WOCE is rapidly approaching the implementation phase. Both experiments are being planned and conducted under the aegis of strong, scientifically expert groups, the JSC/CCCO Scientific Steering Groups, or SSG's, for TOGA and WOCE. This has caused the CCCO itself to consider its future role in relation to these major experiments which it initiated. The results of this review will be the topic of discussion between the Committee's parent organizations, SCOR and IOC before the end of the year.

Professor Stewart reported that a great deal of progress is being made in TOGA and that the data obtained can actually be used in predictive, rather than hindcast, models, even if these are not yet perfected. He made special mention of developments in the Indian Ocean, an area of earlier concern to CCCO due to the poor availability of data, and for which groups from Florida State and Oxford Universities have recently made substantial progress in the modelling field. The TOGA observational programme in the Atlantic Ocean has been expanded since 1987 with the incorporation of USSR "Sections" data into near-real-time models by French oceanographers. The growing ability to use data immediately in such models to provide operational climate prediction, to test hypotheses and to feedback to the actual experimental design is an exciting development which can change the face of oceanographic science, according to Professor Stewart.

With regard to WOCE, he noted that the detailed WOCE Implementation Plan is now available and will be the subject of a detailed review at the International WOCE Scientific Conference which will take place at UNESCO Headquarters in Paris from November 28 to December 2, 1988. The sponsoring organizations of the CCCO and the WOCE SSG recognize that the organizational arrangements for the experiment must change as it moves from the intensive planning to the implementation phase. A primary concern is to develop a structure which allows the scientific community to continue to direct WOCE while at the same time providing appropriate mechanisms for the contribution of resources to the experiment by governments and by non-governmental organizations. Again, this will be a topic for discussion at the WOCE Conference.

Additional information on the items reviewed by Professor Stewart can be found in Annex VII. Professor Siedler, speaking as the Executive Committee Reporter for CCCO reiterated the importance of a redefinition of the Committee's role at this point in its existence. He noted that such matters will be considered by representatives of SCOR and IOC at a joint meeting just before the WOCE Conference.

The President of SCOR expressed his thanks to Professor Stewart for his presentation and the General Meeting gave its endorsement to the programme of CCCO's activities as described in Annex VII.

Committee for the Joint Global Ocean Flux Study

The President of SCOR reviewed the background to the decision taken at the 28th Executive Meeting of SCOR (Zurich, October 1987) to establish an international scientific planning Committee for the Joint Global Ocean Flux Study. Readers are referred to *SCOR Proceedings* Volume 23, pp. 23 to 25 and to Annex VIII for detailed information on the discussion of JGOFS at this meeting and for the terms of reference and membership of the Committee for JGOFS.

The Chairman of JGOFS, Professor B. Zeitzschel, made a presentation to the General Meeting in which he briefly described the scientific rationale for the newly-established Joint Global Ocean Flux Study. This presentation supplemented the written report which appears as Annex VIII.

Prof. Zeitzschel gave the main goals of JGOFS, in particular, the scientific aspects of the so called "biological pump" which is considered to be responsible for the "biological" removal of CO₂ from the atmosphere. He stressed the importance of the use of sophisticated instrumentation such as airborne platforms or satellite ocean colour scanners to monitor e.g. chlorophyll on a global scale. A great deal of effort has to be put into the development of suitable algorithms to convert the remotely sensed signal to the standing stock of phytoplankton and primary production. A valuable tool to monitor the dynamics of the euphotic zone/mixed layer might be satellite tracked drifting sediment traps with additional chemical and optical sensors. The collected material can be used to give information on the coupling between phyto- and zooplankton in this zone. Another field of intensive work will be the development of models of the global carbon budget.

The first meeting of the JGOFS Committee took place in Miami in January 1988. The meeting concentrated on two major items: the development of a Science Plan for JGOFS and the establishment of planning and management strategies for the Pilot Study.

The Science Plan, to be produced during 1988, will provide the scientific background and rationale for JGOFS, will identify and elaborate upon its detailed scientific objectives, discuss the technical problems to be solved in order to meet these objectives, and introduce preliminary proposals for strategies to meet them.

The Committee approved the recommendation of the North Atlantic Planning Workshop that there should be a coordinated programme on the 20° W transect (see above). The JGOFS North Atlantic Pilot Study, which will begin in early 1989, is being coordinated by a group of national chief scientists from the participating countries (Canada, FRG, The Netherlands, UK and USA).

At its first meeting the Committee established two working groups on topics which it considered needed to be addressed on an urgent basis; Data Management and Modelling. The Data Management group will give first priority to issues which can be resolved before the Pilot Study while the Modelling group will begin by reviewing existing models to determine which biogeochemical and physical parameters and fluxes appear to be most critical in controlling the global distribution of CO₂, nutrients and other biogeochemical tracers. This is expected to yield results which will influence the design of sampling strategies for JGOFS.

The JGOFS Committee has agreed that it should not be preoccupied with the Pilot Study at this early stage and should focus on the development of the Science Plan. There are, however, some existing plans for flux studies in the Pacific Ocean which may well benefit from coordination. Accordingly, an ad-hoc Pacific planning group has been working by correspondence towards a JGOFS Pacific Planning Workshop which is expected to take place in late 1989 after the Science Plan is published.

The representative of the Polish SCOR Committee and others urged that JGOFS take account of many other international programmes such as the Greenland Sea Project, BIOMASS, the European "Polarstern" Study, the International Global Atmospheric Chemistry Programme and the USSR Sections Programme which have some goals that overlap with those of JGOFS. Professor Zeitzschel assured the General Meeting that the JGOFS Committee is aware of the need for close liaison with existing programmes and that close cooperation is most desirable since it is likely to lead to a more truly "global" experiment.

Professor Siedler informed the General Meeting that close relationships are being formed between JGOFS and ICSU's International Geosphere-Biosphere Programme (IGBP - also known as A Study of Global Change). Discussions had taken place in Acapulco between the Officers of SCOR and the Chairman of ICSU's Special Committee for the IGBP, Professor McCarthy, who is also a Corresponding Member of

the JGOFS Committee. Clearly, JGOFS will be an essential contribution to the marine component of IGBP and it was agreed that close liaison must be maintained between these two programmes, but that the details of the formal relationship between JGOFS and IGBP should be discussed by the JGOFS Committee at its second meeting in September 1988 and specific recommendations forwarded to SCOR for action.

The financial support required for JGOFS was a matter of concern to the General Meeting and was discussed in detail by the ad hoc Finance Committee (see also item 3.3). It was agreed that a special request for financial contributions in support of JGOFS should be sent by SCOR to the major participating nations.

The General Meeting ratified the decision of the 28th Executive Committee Meeting to establish the JGOFS Committee and congratulated the Committee on the pace of its activities to date. It also agreed with the request of the Committee itself that its membership be increased by one individual from the Nordic JGOFS planning group which was expected to be established in the near future.

UNESCO/SCOR/ICES/IAPSO Joint Panel on Oceanographic Tables and Standards

Dr. Selim Morcos of the UNESCO Division of Marine Science informed the General Meeting that recent JPOTS activities have involved two of its sub-panels. The Editorial Panel on the Oceanographic Manual held its second meeting at the same time as the last meeting of SCOR in October 1987. A report of that session appears in SCOR Proceedings, Volume 23. In addition to its meeting, the panel has continued its work in the intersessional period, and several scientists were requested to contribute or comment on specific aspects of the manual. In preparation for a third meeting scheduled to take place in Tokyo, from 13 to 19 September 1988, a second draft had been circulated to the Panel members by Dr. H. Dooley (ICES), who will produce a third draft for editorial work during the forthcoming meeting. UNESCO is envisaging the publication of the manual in 1989 in its series "UNESCO Monographs in Oceanographic Methodology" provided the publication is in conformity with this series.

The JPOTS sub-panel on standards for CO₂ Measurements met first in August 13-17, 1987, i.e. during the IUGG General Assembly in Vancouver, Canada. The sub-panel discussed the current state of carbon dioxide measurements in seawater, i.e. the precision and likely accuracy of the best measurements available for measuring pH, fugacity of carbon dioxide (in equilibrium with a water sample), total alkalinity and total dissolved inorganic carbon. One of the decisions at this time was to endorse an intercomparison exercise initiated by SCOR Working Group 75 on Methodology for Oceanic Carbon Measurements. In this exercise, four duplicate samples of seawater of salinities ca. 38, 35, 30 and 8 were distributed to various laboratories for analysis (particularly for total alkalinity and total dissolved inorganic carbon).

The second meeting of the CO₂ sub-panel, August 29-31, 1988, was held during the Joint Oceanographic Assembly in Acapulco, Mexico. At this meeting Drs. Poisson and Culkin reported the preliminary results of the intercomparison exercise. About half the participants had responded and the results available at the time of the meeting indicated unexplained discrepancies that required further examination. The results also demonstrated that individual laboratories can achieve a high degree of precision whilst disagreeing substantially from each other in the values obtained.

The Panel agreed that these results further emphasize the need for certified reference materials (CRMs) for oceanic carbon dioxide measurements. The remainder of the 1988 meeting was devoted to formulating specific recommendations for the certification and proposing a timetable for the preparation and distribution of an interim reference material based on natural seawater. This material needs to be available in limited quantities by July 1990, i.e. at the start of the proposed decade long global carbon dioxide programme under WOCE and JGOFS. It will be necessary to have a further meeting of this sub-panel during 1989 so as to assess the progress towards achieving these goals and the recommendations which follow:

DRAFT RECOMMENDATIONS

1. Standard reference materials should be used by the workers involved in the global carbon dioxide programmes so as to ensure the quality control and coherence of the various data sets.
2. These reference materials should be available for total alkalinity and total dissolved inorganic carbon by July 1990.

3. To achieve the proposed target date, we recommend that SCOR and other international committees endorse the concept of using standard reference materials for the global carbon dioxide programmes.
4. Funds need to be secured by the appropriate global programmes to set up a mechanism to bottle, certify, and distribute these standard reference materials. The certification should be carried out by two or more selected laboratories.

Editorial Panel for the Ocean Modelling Newsletter

The General Meeting was pleased to note the continuing success of the Ocean Modelling Newsletter with the seventy-eighth issue having been published in July and distributed to more than seven hundred readers. Financial support from the U.S. Office of Naval Research has been renewed for a three year period.

2.4 Proposals for New Working Groups

Chemical and Biological Oceanographic Sensor Technology

This proposal was originally submitted to SCOR by the Australian Committee with the title "Methodologies Available for the Development of Biological Oceanographic Probes", was widely circulated for comments and was discussed by the SCOR Executive Committee at its 1987 meeting. It was deferred, however, due to the death of its author, until a replacement could be found for him as its main proponent and possible Chairman. The Executive Committee also recommended that the original proposal should be revised so that the working group could focus its attention on the most promising new technologies, possibly optics and microelectrodes.

Accordingly, the General Meeting had before it a revised proposal submitted by Dr. Denis Mackey on behalf of the Australian SCOR Committee, with more narrowly defined terms of reference and a list of membership suggestions which reflected the emphasis on optics and microelectrodes. It received broad support, especially from those participants who spoke of the need to improve the efficiency of acquisition of biological oceanographic data. There was considerable debate, however, about the basic approach to be taken by the group, with some participants urging that the group should review technologies that could speed up the acquisition of chemical and biological data with the ultimate objective of measuring rates of processes related to fluxes of energy and matter in marine ecosystems. While it was agreed that this point of view should be conveyed to the Chairman, the prevailing view was that this type of approach would limit the group to those topics where biologists and chemists had already identified a need for a particular technological advance, rather than taking full advantage of the potential for the application of new technologies in the entire range of problems faced by chemical and biological oceanographers. The General Meeting accepted revisions to the proposed terms of reference in order to reflect this approach, as follows:

To review current technologies that may be suitable for measuring chemical and biological properties with high resolution in time and space.

To assess which of these technologies holds most promise for wide spread deployment as oceanographic probes in the next five years.

To evaluate ways in which the data from such probes can be calibrated, standardized and integrated into the data base from standard hydrographic instruments.

In order to avoid the impression that the working group would be involved in the actual construction of instruments, the title proposed was changed to "Chemical and Biological Oceanographic Sensor Technology". It was agreed to establish this group as WG 90 and to invite Dr. D.J. Mackey (Australia) to serve as Chairman. The following tentative membership list was drawn up using some suggestions contained in the original proposal and others received from SCOR Committees and participants in the General Meeting:

A. Zirino	USA
M. Atkinson	USA
D. Turner	UK
H.P. Hansen	FRG

A. Herman	Canada
P. Williams	UK
Y.A. Sorokin	USSR

Chemical Evolution and Origin of Life in Marine Hydrothermal Systems

This proposal was also first considered by the Executive Committee at its meeting in 1987, having been submitted by the Swedish SCOR Committee with the title "Neo-Abiogenesis and the Origin of Life in Marine Hydrothermal Systems". The Executive Committee requested that the proposal be revised to make it more oceanographic in content, rather than purely chemical.

There was considerable discussion of the revised proposal which was presented by Professor Nils Holm (Sweden). As a result, an *ad hoc* group was formed in order to produce a more narrowly defined set of terms of reference with a clearly stated final objective for the proposed working group. These were presented by Professor Heath, who noted that the focus of the proposal had been changed to an emphasis on abiogenic chemical evolution. The General Meeting agreed to establish this group as WG 91 with the following terms of reference:

To determine likely constituents necessary for neoabiogenesis according to the state of art of the origin of life sciences and thermodynamic calculations.

To review available data concerning primordial organic monomers and polymers already observed in hydrothermal system (for example, carboxylic acids, amino acids, cyano- and heterocrylic compounds); compile a list of potential substances that have to be searched for; and differentiate compounds formed abiogenically and biogenically.

To evaluate the role of different classes of possible inorganic catalysts which may be required for the synthesis of organic compounds in hydrothermal systems.

To sponsor a symposium and published set of papers in 1992 summarizing the state of knowledge and identifying research opportunities in this field.

It was agreed that Professor Holm should be invited to chair WG 91 and that the membership list would include some names submitted with the original proposal and additional nominations received at the General Meeting, as follows:

R. M. Daniels	New Zealand
J.P. Ferris or B. Simoneit	USA
H. Yanagawa	Japan
G. Cairns-Smith	UK
R. Hennet	Switzerland

Dr. Kuznetsov agreed to identify an appropriate Soviet member for WG 91.

Pelagic Biogeography

The Committee for SCOR in The Netherlands submitted a proposal for this working group as a result of a recommendation of the International Conference on Pelagic Biogeography which took place in 1985. The proposal was presented to the General Meeting by Dr. A. Pierrot-Bults who noted that a knowledge of distribution patterns on a much larger scale than is available at present is required to assist with the development of a global model for the ocean and climate. She made a number of points in support of the proposal.

Firstly, that the study of pelagic biogeography cannot be limited to the pelagic realm but must include its connections with adjacent systems such as coastal zones, the atmosphere and the sediments. For example, certain organisms serve as important indices of air-sea interactions, and may, in some cases, have an important influence on such interactions. In addition, sedimentation, recirculation, and thermal vent processes link the bottom and benthos with the pelagic.

Secondly, since it is a system that is (and has been) essentially physically continuous over time, the open

ocean offers unique opportunities for studies ranging from the separation of populations to the development and maintenance of separable communities and ecosystems. There may be no other system which provides a better opportunity to employ, and thereby better define, both ecological and historical approaches to biogeography. This should result in enhanced opportunities to relate modern distribution patterns with patterns and changes found in the fossil record.

Finally, Dr. Pierrot-Bults stated that future progress in pelagic biogeography depends upon innovative approaches to synchronous study of the dynamics of ocean populations with the dynamics of physical and biological features of the open ocean environment. This calls for interaction among specialists in different disciplines such as ecology, systematics, genetics, physiology, as well as climatology, physical and chemical oceanography, and geology. Such interactions could be stimulated by the establishment of a SCOR working group.

In discussing this proposal, the General Meeting reached the conclusion that the original terms of reference were too broad to be practical for a SCOR working group. They were revised by Dr. Pierrot-Bults and others as follows:

To review recent developments in biogeographic theory and their application to oceanic pelagic biogeography.

To recommend new approaches to the future studies on pelagic biogeography emphasizing the mechanisms that result in observed distribution patterns and the interactions of organisms and their physical-chemical-biological environment and their impact on the observed patterns.

To examine the possibilities of more adequate sampling techniques and the interpretation of available data and the use of existing plankton and nekton collections for biogeographical studies.

To prepare a manual in 1992 of existing collections as a guide to all interested scientists. These collections are of extreme importance as they reflect conditions of the past, evidence of which could never be collected again.

To hold appropriate workshops, followed by a second international conference on pelagic biogeography in cooperation with other interested organizations.

The General Meeting had before it another, related proposal (see next item). There was concern expressed, not only about the possible overlap between these two proposals, but also with the OSLR programme of IOC and certain activities within ICES. Accordingly it was agreed that they should be referred to these organizations, and to JGOFS, for advice before proceeding to the decisions on their establishment.

Physical Processes Affecting Biological Variability

This proposal was sent to SCOR by the US Committee for SCOR just before the General Meeting and had not been circulated for review by SCOR Committees. It requested SCOR to consider the establishment of a working group to examine the interactions between population dynamics and ocean variability.

The proposal was considered in conjunction with the one on Pelagic Biogeography (see above item). It noted that a central problem in biological oceanography is the cause of variability in populations, especially the effects of changes in the physical environment. Questions about population dynamics and productivity are central to development of community and ecosystem concepts. The study of the relationship between physical processes in the ocean and biological variability is not a new topic, but it has greatly increased in significance in the context of the climate change/ocean flux programmes. The global emphasis of WOCE and JGOFS raise questions about the impact of physical and chemical change on the marine biosphere. The most sensitive indicators are species abundance and community structure but we require causal relations between the physics and biology if changes in these indicators are to be seen in the correct perspective. Further, changes in open ocean populations can in turn affect the biochemical fluxes and feedback to the problems of global changes. The emphasis proposed for the Working Group is broader than "living resources" but more focused than general "marine ecology". It is an important topic in its own right but would complement other SCOR WG's. There are many individual or regional studies of these physical/ecological interactions. These studies cover a wide range of species and environments. We need to bring together the workers in this

area to discover whether there are unifying concepts, what the needs are for new technology, and how field programmes in different regions and countries can be integrated.

The terms of reference proposed for the WG were:

to review existing case studies of physical/ecological interactions.

to examine the existing suite of population dynamics and ecological models and propose new opportunities for generalizations between environments.

to determine sampling and experimental technologies required to link theory and observations.

to assist in planning cooperative programmes at the international level.

to hold appropriate workshops and produce a report on strategies for international cooperation by 1991.

The General Meeting wished to know whether this proposal overlapped with the interests of the IOC's programme on Ocean Science in Relation to Living Resources. The representative of IOC, Dr. Kullenberg stated that while the OSLR programme could generate data of interest to the proposed group, it was primarily concerned with the coupling between physical processes and recruitment to marine populations. While some participants felt that there was considerable duplication between this proposal and the one on Pelagic Biogeography, since both appeared to be related to biological communities and physical processes in a continuum of scales. Others were of the opinion that they were quite distinct, with one concentrating on large-scale patterns of population distributions and the other addressing the effects of physical processes on population variability.

This debate resulted in a request that each proposal be revised to more clearly define the distinct nature of the questions to be addressed. As noted above, this proposal will also be sent to IOC, ICES and JGOFS for advice.

Readers are referred to item 7.2 for the discussion of a preliminary proposal for a working group on monitoring biological variability in the ocean which was prepared at the General Meeting in response to concerns over possible termination of the Continuous Plankton Recorder Survey.

At the conclusion of the General meeting, the new Executive Committee met in an informal session and agreed to the following assignments of Executive Committee Reporters:

Prof. J.-O. Stromberg	WG 76, 87, JGOFS
Prof. G. Siedler	WG 77, CCCO
Prof. R.O. Fournier	WG 78, 85, 86
Prof. G.R. Heath	WG 75, 84, 92
Prof. T. Asai	WG 83
Dr. A. Kuznetsov	WG 82, 91
Prof. J.J. O'Brien	WG 88, 89, JPOTS
Prof. P. Lasserre	WG 80, 90

3.0 ORGANIZATION AND FINANCE

3.1 Membership

The Executive Secretary informed the General Meeting that in accordance with the decision of the 28th Executive Committee Meeting, the formal application of the Consejo Superior de Investigaciones Cientificas of Spain for membership in SCOR was accepted by the President in May 1988.

She also noted that the Secretariat had been informed of the following membership changes since the 28th Executive Committee meeting:

Canada: Dr. M. Donelan has replaced Prof. A. Hay.

China: Dr. Su Jilan has replaced Dr. Luo Yuru as a Nominated Member of the Chinese Committee for

SCOR.

France: In addition to Dr. Chesselet, Dr. R. Schlich and Prof. P. Lasserre are newly appointed Members of SCOR.

India: All three Nominated Members have been replaced by Profs. J.S. Sastry, S. Krishnaswami and A. Choudhury.

New Zealand: Dr. T. Healy has replaced Dr. J. Bradford.

Spain: The Nominated Members representing the new Spanish SCOR Committee are Drs. J. Corral, A. Cruzado and A. Maldonado.

Sweden: Prof. N. Holm has replaced Prof. I. Hessland.

United Kingdom: Prof. R. Currie has retired and Dr. M. Whitfield will replace him as a UK Nominated Member.

USA: Dr. D. Ross has replaced Dr. J. Capuzzo.

IUBS: Prof. P. Lasserre is replacing Prof. G. Hempel as the Representative Member for IUBS.

3.2 Publications Arising from SCOR Activities

The Executive Secretary presented the following list of publications resulting from SCOR activities during the period from October 1987 to August 1988:

UNESCO Technical Papers in Marine Science

No.40 International Oceanographic Tables, Volume 4.

No.51 Thermodynamics of the Carbon Dioxide System in Seawater. Report by the Carbon Dioxide Sub-Panel of the Joint Panel on Oceanographic Tables and Standards.

No.52 Research on Coastal Marine Systems - Review and Recommendations for UNESCO Programme 1987-1989. Report of the fourth meeting of the UNESCO/SCOR/IABO consultative panel on coastal systems, Dakar 15-17 December 1986.

BIOMASS Report Series

No.53 Meeting of the BIOMASS Executive. Paris, 1 June, 1987.

No.54 Report of the Post-SIBEX Fish Data Evaluation Workshop: Phase 2, Evaluation. Cambridge, 17-28 August, 1987.

No.55 Phytoplankton/Zooplankton Relationships (I). Sao Paulo, 7-9 October, 1987.

No.56 Workshop on Antarctic Phytoplankton/Zooplankton Relationships (II) College Station, Texas. 14-16 October 1987.

BIOMASS Scientific Series

Vol.7 Symposium and Workshop on Recent Advances in Aquatic Antarctic Biology, with Special Reference to the Antarctic Peninsula Region, Bariloche, Argentina.

Vol.8 A Handbook for the Measurement of Chlorophyll a and Primary Productivity (1987).

SCOR/IOC CCCO Publications

WOCE Core Project 3 Planning Meeting on The Gyre Dynamics Experiment, London, U.K., 2-5 September 1986. WCP-139.

JSC/CCCO TOGA Scientific Steering Group, Report of the Sixth Session, Sidney, B.C., 3-7 August 1987. WCP - 141.

WOCE Core Project 1 Planning Meeting on The Global Description. Washington, 10-14 November, 1986. WCRP-2.

JSC/CCCO TOGA Numerical Experimentation Group. Report of the First Session. UNESCO, Paris, 25-26 June, 1987. WCRP-4.

Summary Report of the Eighth Session of the Joint SCOR/IOC Committee on Climatic Changes and the Ocean. Kiel. 25-29 May, 1987.

Report of the Fourth Meeting of the Ocean Observing System Development Programme Groups for the Committee on Climatic Changes and the Ocean, Ninth Session, Paris 11-17 May, 1988.

JGOFS Publications

Report of the North Atlantic Planning Workshop. Paris, September 7-11, 1987.

Report of the First Session of the SCOR Committee for the Joint Global Ocean Flux Study. Miami, January 25-28, 1988.

Report of the First Meeting of the JGOFS Pilot Study Cruise Coordinating Committee. Plymouth, UK, April 13-15, 1988.

Publications Arising from SCOR Working Groups

WG 56 Vertical Motion in the Equatorial Upper Ocean. *Oceanologia Acta* Volume Special No. 6, May 1987.

WG 65 Coastal-Offshore Ecosystem Interactions (Bengt-Owe Jansson, Ed.) – Proceedings of a Symposium sponsored by SCOR, UNESCO, San Francisco Society, California Sea Grant Program, and U.S. Dept. of Interior, Mineral Management Service held at San Francisco State University, Tiburon, California, April 7-22, 1986. Springer-Verlag Lecture Notes on Coastal and Estuarine Studies, No. 22.

WG 69 Small-Scale Turbulence and Mixing in the Ocean. Proceedings of the 19th International Liege Colloquium on Ocean Hydrodynamics. (J.C.J. Nihoul and B.M. Jamart, Eds.) Elsevier Oceanography Series, 46. 1988.

Publications Arising from Other SCOR Activities

The Benguela and Comparable Ecosystems. (A.I.L. Payne, J.A. Gulland and K.H. Brink, Eds.) *South African Journal of Marine Science* (5), 1987. Proceedings of an International Symposium on Population and Community Ecology in The Benguela Upwelling Region and Comparable Frontal Systems, Cosponsored by SCOR. Cape Town, 8-12 September, 1986.

CCAMLR/IOC/SCAR/SCOR Scientific Seminar on Antarctic Ocean Variability and its Influence on Marine Living Resources, particularly Krill. Paris, 2-6 June, 1987. IOC Workshop Report No. 50. 1988.

SCOR Proceedings, Vol. 23, Report of the 28th Meeting of the SCOR Executive Committee, Zurich, October 1987.

The Publications Officer, Professor R.O. Fournier, presented a report which responded to questions raised at the 1987 meeting of the Executive Committee. These included:

1. Standard covers for reports
2. Acquisition of ISSN and/or ISBN numbers for SCOR documents.
3. Development of a Report Series

With the publication of the recent JGOFS reports, a newly designed cover was employed which bears the SCOR rolling wave logo and a standard JGOFS title. Henceforth, it was agreed that a similar standard cover, possibly with a window, be used on all significant reports of SCOR Subsidiary Bodies (such as final reports of Working Groups) which are not published in other suitable series in the primary literature.

Inquires had been made as to the advisability of adopting ISSN and/or ISBN numbers for such SCOR reports. These are International Standard Serial Number and International Standard Book Number. The advantages resulting from such a move include: external recording and classification of SCOR output by other than immediately interested parties, thereby providing independent accessibility. Given the informal manner in which the so-called grey literature circulates this designation would improve availability of SCOR publications in those places where normal modes of movement are less assured. The only obvious disadvantage to such a move is apparently the obligation to furnish a small number of copies of each report to a designated national library and an ASFIS indexing centre. The ISSN and ISBN Numbers are assigned in Canada by the National Library. Some small delay may be involved in the designation of each book number, but would represent such a small percentage of the total preparation time that this would be a minor inconvenience in order to ensure a broader readership. Therefore, it was decided that all future SCOR reports will be assigned appropriate ISSN and/or ISBN classification numbers.

Professor Fournier's report did not explicitly resolve the issue of the creation a SCOR Report Series. However, he pointed out that the use of a standard cover, plus ISSN/ISBN classification is a *de facto* step in that direction. All that is lacking is the use of sequential enumeration by SCOR on the standard cover. The advantages would be the logical grouping of documents within libraries and greater ease in reference and record keeping. It was, therefore, agreed by the General Meeting that all future SCOR reports be sequentially numbered and identified as components of the SCOR Report Series.

3.3 Finance

The Executive Secretary provided a brief review of the state of SCOR finances. She presented the final financial statement for the 1987 fiscal year (see Annex IX) with a comparison to the approved budget for 1987, a revised budget for 1988 and an interim financial statement to August 1988 with projections for income and expenditure to the year end. These showed the finances to be in a healthy state with a continuation of the trend of growth in the funds available to SCOR. She expected that the relatively large balance which has been carried by SCOR for several years would be greatly reduced, to traditional levels, by the end of the 1988 fiscal year. Ms. Tidmarsh did note, however, that much of the increase in income to SCOR takes the form of non-discretionary funds to be used for specified purposes (such as the salary of the CCCO Secretary, for example). It was noted that the relative significance of Membership Contributions in the SCOR budget has dropped substantially in comparison to other types of income.

Sir Anthony Laughton presented a report on behalf of the *ad hoc* Finance Committee, which had examined in detail the 1987 financial documents reviewed by the Executive Secretary as well as the auditor's statement, and had accepted them as accurate. The Committee had paid particular attention to deviations from normal levels items of income and expense and made special note of several of these in regard to 1988 finances. Sir Anthony noted the substantial reduction in contract support from UNESCO, although it was hoped that this was a temporary effect of changes in that organization. The grants from the US National Science Foundation are used for two purposes: the provision of travel grants to scientists from developing countries attending meetings sponsored by SCOR; and for support to JGOFS and certain working groups relevant to the Foundation's geoscience programmes. US support for the CCCO secretariat in Paris is now being channelled through SCOR for administrative reasons and although it gives the appearance of a large increase in SCOR income, these are dedicated funds for corresponding expense items. Special mention was made of two or three unexpectedly large expense items. In particular, the high levels of expense of WG's 77 and 78 are related to the costs of carrying out lengthy practical workshops, such as the CTD intercalibration experiment and the pigment experimental standardization efforts of these two groups. There were also an unusually large number of working group meetings planned in 1988. In summary, however, the Finance Committee was pleased to note that the year-end balance was expected to be an amount much more appropriate for SCOR.

The Finance Committee was of the opinion that in view of the reduction of the cash balance and of the non-discretionary nature of much of SCOR's more recent income, special attention must be given to increasing real income which can be used for general support of scientific and other activities. It was agreed that there must be an increase in membership contributions in 1989. In addition to a basic increase in the level of contributions, it was felt that certain countries belong to SCOR in membership categories which are

inappropriate relative to the size of their oceanographic communities and that special approaches should be made to these SCOR Committees to consider upgrading their membership in SCOR. This recommendation was accepted by the General Meeting and a special appeal will be made to several countries by the President.

Funding for JGOFS, a major new activity for SCOR, was a serious concern to the Finance Committee. Only about sixty percent of the funds required for the activities planned by the JGOFS Committee for 1989 seemed likely to be available, although new sources of funds were being investigated by the Executive Secretary and members of the JGOFS Committee. The Finance Committee recommended that those countries formally involved in JGOFS should be requested to make contributions (financial or other kinds of support) specifically for the support of this programme. For example, the provision of a Secretariat for JGOFS would alleviate the shortage of funds for scientific activities.

The Chairman of the Finance Committee presented a budget for 1989 which predicted income of nearly \$530,000.00US and provided funds for all the working group activities which had been approved by the General Meeting as well as related items such as publications. Administrative costs were expected to be less than 12% of the total expenses. The balance predicted at the end of 1989 was only \$26,000.00 and the Finance Committee recognized that this was less than the desirable amount with which to enter the next fiscal year. It noted, however, that two of the working group meetings were not definite, having been approved only if certain conditions were met, and that in most years at least one or two approved meetings are postponed. In this eventuality, the balance would be at a more acceptable level. Sir Anthony cautioned the Executive Committee against SCOR becoming over-extended as a result of establishing too many working groups.

Finally, the Finance Committee recommended that there should be a general increase in the levels of SCOR Membership Contributions in 1990, but that this increase should not exceed that established by ICSU for its own members.

The report of the Finance Committee, and its recommendations, were accepted by the General Meeting. Professor Stromberg, speaking as incoming President, stated that he shares the concern expressed by the Finance Committee and some participants regarding the increasing expenditures for global programmes and urged all SCOR Committees to consider increasing their support for SCOR programmes such as CCCO and JGOFS. He thanked the US National Science Foundation for its continuing support to SCOR, in particular for CCCO, JGOFS and in providing funds for travel grants to oceanographers from developing countries.

3.4 Other Organizational Matters

Constitutional Review

The President of SCOR reviewed the discussion about the Constitution which took place during the 28th meeting of the Executive Committee. At that time it was agreed that a major revision was not required, but that certain minor changes were desirable in order to bring present practices, such as the frequency of meetings, into accord with the Constitution. The following changes were approved unanimously by the Members of SCOR in attendance at the General Meeting:

Paragraph 13 was amended to specify that there will usually be only one meeting (rather than two) of the Executive Committee between General Meetings of SCOR.

Paragraph 17 was changed to give the responsibility for preparation of annual budgets to the "President or Secretary, together with the Executive Secretary", rather than to the entire Executive Committee.

In Paragraph 18, the reference to financial reports being provided every eight months was deleted since the Executive Committee now meets at annual rather than eight-monthly intervals, and the subsequent change to Paragraph 19 ensures that a formal review of SCOR finances will be conducted on an annual basis.

Paragraph 19 was altered so that the appointment of an *ad hoc* Finance Committee is required at every meeting of SCOR, both General and Executive Committee meetings.

These changes will be sent to ICSU for approval. The entire Constitution with the above revisions, pending approval by ICSU, appears in Annex X.

Joint Oceanographic Assembly

The Chairman of the Scientific Programme Committee for the JOA, Professor Warren Wooster, agreed to serve as editor of the Proceedings volume, in collaboration with the Mexican Organizing Committee and its Chairman, Dr. Ayala-Castanares. Professor Wooster will identify referees for the papers to be published; it was agreed that these would include only those given in the four JOA General Sessions.

The General Meeting agreed with the Executive Committee that, while it was as yet premature to discuss JOA-88, SCOR should institute a review of the rationale and utility, not only of JOA's, but also of SCOR's role in relation to other large international meetings of interest to the oceanographic community. A small group of interested individuals including Dr. D. Halpern, Prof. T. Healy, Prof. J. Nihoul and Mr. B. Nicholls will undertake this task, with the assistance of the Executive Secretary and will report to the Executive Committee at its meeting in 1989.

In closing the discussion on the JOA, Professor Siedler expressed thanks on behalf of SCOR to Professor Wooster and Dr. Ayala for the great effort they had put into the organization of JOA-88.

4.0 RELATIONS WITH INTERGOVERNMENTAL ORGANIZATIONS

4.1 Intergovernmental Oceanographic Commission

The Chairman of the IOC, Professor U. Lie, referred to the development of IOC, the close relationship between SCOR and IOC and the importance of SCOR as a scientific advisory body to IOC. He also informed the meeting about the recent consultations between SCOR and IOC officers, in particular, the one in Zurich, October 1987, and the agreements reached there which included a joint appraisal of the future directions of CCCO. Dr. G. Kullenberg, Senior Assistant Secretary, then briefly reviewed the on-going IOC programmes referring to the report of the IOC Secretary on intersessional activities presented to the Twenty-first Session of the Executive Council of IOC, Paris, 7-15 March 1988 (Document IOC/EC-XXI/6). These IOC programmes include Ocean Dynamics and Climate, Ocean Science in Relation to Living and Non-Living Resources, Ocean Mapping, Marine Pollution Research and Monitoring, Ocean Services and TEMA. He emphasized the need for close interaction with many SCOR activities and use of their results *inter alia* for a sound scientific development of IOC programmes.

The 21st Session of the IOC Executive Council took note of the recommendation of the 2nd Session of the IOC-FAO Guiding Group of Experts on OSLR (FAO, Rome 8-12 June 1987) which states that common statistical methods for use in the analysis of recruitment variability and its relationship to the environment have not been universally adopted. The IOC Executive Council endorsed the suggestion that the IOC, in collaboration with SCOR, organize an Expert Consultation on the Statistical Analysis of Recruitment Time-Series including arrangements for preparation of a handbook of basic techniques.

It was therefore proposed by Dr. F. Robles of the IOC that these actions be jointly implemented by IOC and SCOR on a cost sharing basis and under the coordination of the SCOR representative to the 2nd Session of the Guiding Group of Experts on OSLR. Preparatory work will be done mainly by correspondence and the total number of experts to take part in the consultation will be about five. The General Meeting accepted this proposal and noted with pleasure the development of the OSLR programme which had its origin in the recommendations of the final report of SCOR WG 67, submitted at the request of IOC some years ago.

4.2 UNESCO Division of Marine Sciences

The representative of the UNESCO Division of Marine Sciences, Dr. Selim Morcos, reviewed the written report he had provided to the General Meeting. Many of the issues it raised had already been discussed in previous agenda items. He noted that the improved collaboration between the SCOR Publications Officer and the Division had resulted in more efficient production of publications resulting from SCOR activities in the UNESCO series, *Technical Papers in Marine Science*.

Dr. Morcos referred to the IAPSO SUN (Symbols, Units and Nomenclature in Physical Oceanography) Report and the efforts to encourage the use of SI units by oceanographers. A statement on this matter was endorsed by the Executive Committee at its last meeting, and was published by UNESCO in the IMS Newsletter. In spite of this, a number of papers presented at the JOA did not comply with the SUN recommendations. He urged SCOR to assist by requesting the publishers of major oceanographic journals to publish the statement and to insist that the authors of papers submitted for publication comply with its recommendations.

With regard to the unfortunate decrease in funding to SCOR from UNESCO in 1988, Dr. Morcos expressed his hope that the traditional levels of support would be restored in 1989.

Finally, Dr. Morcos noted that SCOR is a cosponsor of the UNESCO Consultative Panel on Coastal Systems and that the Panel would meet in Brazil in December 1988. He urged SCOR to designate a representative to this meeting.

In closing the discussion of this agenda item, the President of SCOR noted with great regret that Dr. Morcos would be retiring from his position in the Division of Marine Sciences in the near future. He extended the sincere appreciation of SCOR to Dr. Morcos for his efforts on behalf of marine science over many years, and, in particular, for the close working relationship he had maintained with SCOR.

4.3 International Council for the Exploration of the Sea

The President of ICES, Dr. Ostvedt, made a brief statement and referred to the written report provided by the Secretary-General of his organization which may be found in Annex XI. He noted that there are currently no jointly sponsored ICES-SCOR Working Groups and hoped that this type of cooperation would be restored in the near future. He reminded the participants that the annual ICES Statutory Meetings have a large scientific component (for example, the 1988 meeting will include more than three hundred scientific papers as well as a symposium on the Early Life History of Fish.

The President of SCOR extended an invitation to ICES to review the present scope of SCOR activities as manifested in its working groups and to propose areas where collaboration with SCOR would be beneficial.

4.4 World Meteorological Organization

A written report from WMO provided information on activities undertaken within or by WMO during the past year which might be of interest to SCOR. It is given in its entirety in Annex XII, however, the Executive Secretary briefly reviewed those points with particular relevance for SCOR activities, especially WG's 83 and 88 and CCCO.

The joint WMO/IOC Drifting Buoy Cooperation Panel held its third session in Paris in October 1987. At this session, the panel addressed a number of technical questions related to the operation of drifting buoys for meteorological and oceanographic purposes and to the collection and distribution of buoy data, including two matters specifically addressed to it by SCOR WG 88:

In response to a proposal from SCOR WG 88, the panel adopted a recommendation urging greater collaboration between meteorologists and oceanographers on buoy instrumentation.

Again in response to a request from SCOR WG 88, the technical coordinator for the panel has been instructed to investigate possibilities for continued funding of drifting buoys which were no longer of interest to their programme of origin.

A Technical Conference on Ocean Waves is to be held in Paris on 6 and 7 February 1989, in association with the tenth session of the WMO Commission for Marine Meteorology (CMM). The core of the conference papers will be presented by members of the CMM *ad hoc* Group of Rapporteurs on Numerical Wave Modelling, which has close association with SCOR WG 83. The conference will be open to all interested in the modelling, forecasting and application of ocean waves and will be accompanied by an exhibition of wave measuring and related equipment.

In response to actions called for by the Intergovernmental TOGA Board at its first session in November 1987 the International TOGA Project Office (ITPO) has been working to improve the effectiveness of several components of the TOGA observing and data management systems. As a result there has been a significant expansion of the TOGA tide gauge network in the Atlantic Ocean, especially in the West African region. There has been considerable improvement in the coverage of the Indian Ocean by vessels collecting sub-surface data. Lastly, the TOGA sub-surface data centre in Brest has made good progress in producing quality-controlled sub-surface thermal data set for the TOGA study area.

4.5 Commission for the Conservation of Marine Antarctic Living Resources

No written report from CCAMLR was available before the General meeting and no representative of the Commission was present. A report arrived at the SCOR Secretariat during the JOA, however, and is found in Annex XIII.

5.0 RELATIONS WITH NON-GOVERNMENTAL ORGANIZATIONS

5.1 Affiliated Organizations

Commission for Marine Geology

The Chairman of CMG, Professor K. Hsu, reviewed the recent activities of his organization which were of interest to SCOR. The Commission on Marine Geology has been very active on two fronts. First, the Chairman has been appointed the Chairman of a Task Group in charge of planning a long-range programme on Past Global Changes, and of coordinating the effort between the International Union of Geological Sciences and that of ICSU's IGBP. A workshop to organize the Past Global Change Programme will be held in April, 1989, at Interlaken, Switzerland. Prof. Hsu noted that CMG attaches great importance to its role in mobilizing the participation of earth scientists in IGBP. The Secretary of CMG, in cooperation with other organizations, is organizing a symposium on Global Change to be held in Hamburg, in December, 1989.

The General Secretary and Chairman of CMG are also organizing a Dahlem Conference on Use and Misuse of Seabed, to be held in 1989 in Berlin.

Prof. Hsu noted that CMG will be reorganized after July, 1989, when both the incumbent Chairman and Secretary will retire from the Commission. The President of SCOR expressed his gratitude to Prof. Hsu and Dr. Thiede for their many contributions to SCOR, in particular for the revitalization of SCOR activities in the field of marine geology through the establishment of several working groups in this field.

International Association for Meteorology and Atmospheric Physics

The President of IAMAP, Dr. G.B. Tucker, noted that the next General Assembly of IAMAP will take place in Reading, UK in August 1989 and that SCOR has indicated its interest in several of the scientific sessions being organized in conjunction with this meeting. While no reply has yet been received from the organizers, he expected that one would be forthcoming.

Dr. Tucker reported that IAMAP's Commission on Atmospheric Chemistry and Global Pollution is well underway with planning for the International Global Atmospheric Chemistry Programme (see discussion of WG 72) which will be a major atmospheric component of ICSU's IGBP. He also noted that interactions between IGAC and JGOFS would be discussed at the JGOFS Committee meeting in September. He reiterated the invitation to SCOR from IAMAP to send a representative to an IGAC Planning Meeting to be held in November in Melbourne. Another link between IGAC and JGOFS has been established since Dr. G. Pearman, Chairman of the IGAC Committee, has been invited to join the newly-established CCCO/JGOFS CO₂ Panel.

Dr. Tucker noted that governments and policy makers are applying mounting pressure on the scientific community to be more definite in its predictions of the likely effects of global warming and other types of global change. He presented the following proposal for a world conference at which scientists would be

expected to present a consensus view of the dependability of current predictions:

“As a result of the WCRP, the IGBP and a large number of component programmes and projects, core research into the “Greenhouse Effect” is now well established. In many cases this involves long-term programmes of observations and research.

At the same time, the problem has received an enormous amount of publicity and political interest. The latest example being the high level meeting at Toronto a short time ago [“The Changing Atmosphere: Implications for Global Security”, Toronto, 27-30 June 1988, sponsored by the Government of Canada, with support from WMO and UNEP]. While this interest may be expected to be the font for continued support for these programmes, more and more we are being asked to give a best estimate of what climate conditions are likely to exist in, say, 2030. Continued support for core research may well depend to a significant extent on the degree to which answers to this type of question converge.

In my opinion the time has passed when we can expect acceptance of a reply which says: “There is broad agreement on a general increase in global surface air temperatures but on not much else – nor can we expect this unless more resources are provided for (open-ended) long-term research and observational programmes”.

Accordingly, I propose that we consider the organization of a major World Conference for, say, 1991 which could perhaps be called “2030”. This would be aimed at providing a consensus of what can be agreed concerning global and regional climate in 2030, and what cannot obtain majority agreement.

With such advance notice, research over the intervening two years or so aimed at providing converging estimates would be fostered and a strong purpose given to model inter-comparisons. Of course, techniques other than GCM’s may be essential, especially to provide the set of quantities required for planning to adapt to change that are not direct outputs from models.

I have some ideas on detail for such a conference, including formal refereeing and selection of papers to be presented and the preparation of a Villach-type conference statement that sets out the consensus view. However, for the present, I seek your opinion on the merit of this broad proposal. Personally, I feel it is extremely important for the continuing credibility of our science.”

A number of participants in the General Meeting spoke in support of this proposal and of the desirability of the scientific community providing firmer statements as to which aspects of climate change are well understood, which are poorly known, and to what extent present predictive ability can be relied upon. It was agreed that this proposal should be explored in more detail in discussions between the Presidents of IAMAP and SCOR and that advice should be sought from CCCO and JGOFS on this matter.

International Association for the Physical Sciences of the Ocean

The President of IAPSO, Professor J. O’Brien, reported that his organization has entered a period of re-organization and revitalization since its General Assembly held in August 1987. At that time an Executive Session of IAPSO elected the following slate of officers:

President	Dr. James J. O’Brien, USA
Vice President	Dr. Artem Sarkisyan, USSR
Vice President	Dr. Ian Jones, Australia
Secretary General	Dr. Robert E. Stevenson, USA
Deputy Secretary General	Dr. David Cartwright, USA.

Additional members of the IAPSO Executive Committee include:

Dr. S. Krishnaswami, India

Dr. Ye Longfei, PRC

Dr. M. I. El-Sabh, Canada

Dr. J. Sundermann, FRG

IAPSO activities are carried out through a number of commissions:

Cooperation with Developing Countries: This commission is chaired by Dr. Eugene C. LaFond and has as its mandate "to foster and stimulate study of marine sciences in developing countries by initiating lectures, training programmes, and scientific meetings, by disseminating educational materials, and by reviewing and providing counsel, when requested, on research methods, training, and procedures.

Space Oceanography: Mr. Paul Scully-Power is the President of this commission which prepares reports for international distribution on the following topics:

Description of sensors, orbits, and lifetimes for each earth-resource spacecraft that will be in orbit by 1991;

Repositories of data sets, how the data may be obtained by oceanographers, and in what form;

All abstracts of projects being conducted, or planned, using the available data.

Determine the state-of-the-art of space oceanography; Prepare programme recommendations to fill the "knowledge gaps" in space oceanography through 1995;

To establish a Committee on Ocean Optics to be chaired by Dr. Andre Morel.

Sea Ice: The IAPSO Commission on Sea Ice was established to advise the IAPSO Executive Committee on the status of sea-ice research, to recommend that IAPSO sponsor and plan pertinent sea-ice symposia and to prepare reports and planning documents on the proceedings of workshops and meetings. Its President is Dr. Robin Muench.

Programmes and Assembly Planning: This Commission, under its Co-Presidents, Dr. Robert Knox and Dr. Joris Gieskes, is expected to assist the Office of the Secretariat in planning and organizing symposia for general and joint assemblies and to propose and evaluate proposals for workshops to be held during General Assemblies and at other times.

Mean Sea Level and Tides: Under the leadership of Dr. David Pugh, the Commission on Mean Sea Level and Tides has the following terms of reference:

To support and counsel the Permanent Service for Mean Sea Level;

To convene working groups;

To interact with other bodies interested in mean sea level and tides;

To facilitate communications between oceanographers and geodesists regarding variations in sea level and their implications.

The Commissions on Mean Sea Level and Tides and Sea Ice will have specific-subject meetings in 1988. The Commission on Scientific Support for Developing Countries held a workshop during the JOA, Acapulco. IAPSO is a cosponsor for two symposia scheduled for 1989; with the European Geophysical Society, March, Barcelona, Spain; and the IAMAP Fifth General Assembly, July-August, Reading, England.

Finally, Professor O'Brien's report noted that the IAPSO Secretariat has established a fund to support the travel of oceanography students to EGS annual meetings, as part of EGS's programme for student travel.

International Association for Biological Oceanography

The President of IABO, Professor P. Lasserre presented a verbal report in which he noted that IABO had held its General Assembly during JOA-88. IABO was undertaking a major review of its rules and statutes, and these were expected to be submitted to IUBS for approval in late 1988.

He reviewed the joint SCOR-IABO activities making special mention of IABO's involvement in WG 85 on Experimental Ecosystems. Finally, Professor Lasserre informed the General Meeting that symposia are presently being organized within IABO by its Coral Reef Group and the International Seaweed Society.

5.2 Corresponding Organizations

Arctic Ocean Sciences Board

The Secretary of AOSB, Mr. L.B. Brown, reviewed his report which is given in Annex XIV. He stated that the AOSB is now considering broadening its purview beyond the Greenland Sea Project to include a new study of polynyas. The next meeting of the AOSB will take place in Washington in January 1989.

Mr. Brown reported that organizational meetings have taken place involving the representatives of Arctic countries and have led to the suggestion that an International Arctic Sciences Committee be established. In the meantime, the AOSB continues to provide a forum for the discussion of Arctic marine science and expects that its relationships with the proposed new organization will be clarified in the near future.

In thanking Mr. Brown for his report, the President of SCOR expressed the view that any steps to improve conditions for international collaborative research in the Arctic should be encouraged.

Confederation Mondiale des Activites Subaquatiques (Scientific Committee)

The Executive Secretary reviewed the main points contained in a report from CMAS which had been sent to the Secretariat.

The Code of Practice for Scientific Diving: (Principles for the safe practice for scientific diving in different environments) compiled under the auspices of the Scientific Committee of CMAS was published by UNESCO in 1988. This code, which was edited by Dr. Nic Flemming (Institute of Oceanographic Sciences, Brook Road, Wormley, Godalming, Surrey, U.K.) and Dr. Mike Max (Department of the Navy, Naval Research Laboratory), Washington, D.C., U.S.A.), has been distributed free of charge to some 1000 scientific institutes world-wide. Such has been the demand for this code that present stocks are almost exhausted. A second hardback edition is presently being planned, which will be sold through UNESCO offices, at a competitive price. Drs. Flemming and Max would welcome any feedback on the first edition. To this end several copies were made available at the meeting in Acapulco for delegates to inspect.

The General Assembly of the CMAS Scientific Committee took place in Malta in 1987 and dealt with business in the following order of Commissions: Archaeology, Geology, Biology and Conservation; and Amateur-Professional cooperation. The Archaeology Commission discussed many projects throughout the world including archaeological surveys, conservation, archaeological data and sea level change and the CMAS-UNESCO global survey of archaeological sites. The Geology commission discussed cave diving, sulphur in Norwegian fjords and a possible UNESCO workshop on the scientific aspects of cave diving. The Biology Commission reported on work in progress on oceanic gelatinous plankton and marine parks. The Technical Commission received reports from many countries on aspects of diving techniques, legislation and safety. The Amateur Professional cooperation Committee discussed the matter of individual corresponding membership of the Scientific Committee.

The next General Assembly of the Scientific Committee is planned for the 22-29th October 1989 in Japan. This is to coincide with a symposium on scientific diving. Call for papers and initial publicity will be circulated in October 1988.

Engineering Committee on Oceanic Resources

The representative of ECOR, Mr. Brian Nicholls, reviewed the recent activities of his organization and distributed a descriptive brochure. In October 1987 the Sixth General Assembly of ECOR appointed new Officers to stand for a three-year term. They included:

President:	Professor Tom Patten	(UK)
Vice-President I:	John Brooke	(Canada)
Vice-President II:	Per Laheld	(Norway)
Past President:	Professor Ascensio Lara	(Argentina)
Honorary Treasurer:	Cees van der Burgy	(Netherlands)

This new team of Officers agreed that the necessary improvement in ECOR status was possible through positive, decisive action leading to early results. Various avenues to offer advice and secure cooperation have been explored, including the development of closer cooperation with IOC, such as the involvement of ECOR in the International Conference on Computer Modelling in Ocean Engineering (Venice 19-23 September 1988).

At present, ECOR has three Working Groups in the areas of:

Ocean Energy Systems

Ocean Engineering Education and Training

Reliability Methods for Design and Operation of Offshore Structures

Current ECOR publications include newsletters (2-3 per year), and the new descriptive brochure referred to above. Finally, Mr. Nicholls noted that ECOR is attempting to extend its membership, and that contacts have secured favourable consideration by USA, France and Finland.

The President, speaking on behalf of the Executive Committee, thanked Mr. Nicholls for his report and noted with great pleasure the progress made towards the revitalization of ECOR.

5.3 International Council of Scientific Unions

The Executive Secretary drew the attention of participants to the recent report of the Secretary General of ICSU which had been distributed in preparation for the ICSU General Assembly to take place in September, 1988. She noted that the main issues of interest to SCOR involve the International Geosphere-Biosphere Programme. This had been the topic of the keynote address by Professor J. McCarthy, Chairman of ICSU's Special Committee for the IGBP, at the opening ceremonies of the JOA. A status report by Prof. T. Rosswall, Executive Director of IGBP, is given in Annex XV and readers are referred to this for more detailed information on IGBP.

The Chairman of the IGBP Coordinating Panel on Marine Biosphere-Atmosphere Interactions, Professor T. Nemoto, made the following additional points in his statement to the General Meeting:

The Coordinating Panel on Marine Biosphere-Atmosphere Interactions has already met twice, and much correspondence has been exchanged and the draft document from the Panel which will be included in an IGBP "Plan for Action" is nearly complete. This draft stresses the importance of close cooperation with SCOR, SCAR, and other ICSU Scientific members and other national organizations.

The next important steps in the IGBP planning process are:

At the 22nd General Assembly of ICSU in Beijing in September the status report of each Panel and Working Group of the IGBP Special Committee will be discussed, and strong endorsement by ICSU is expected.

The first session of the IGBP Scientific Advisory Council, and the third meeting of the Special Committee will be held in Stockholm in October. All IGBP related ICSU scientific members and national committee members of IGBP will be invited. A lively discussion is expected among scientific bodies such as SCOR, SCAR, IUGG etc., and national organizations on future implementation and coordination of IGBP.

Professor Nemoto was pleased to report that more than 20 countries have already established national committees for IGBP.

The cooperation with JGOFS is, in Professor Nemoto's view, one of the most important issues addressed in the draft report of his Coordinating Panel. The Chairman of IGBP, Professor McCarthy, discussed this matter with SCOR Officers in Acapulco and it was also to be discussed at the meeting of the JGOFS Committee in September and at the Scientific Advisory Council in Stockholm in October.

The President of SCOR provided more information on these discussions with Professor McCarthy, noting that the Special Committee is looking to JGOFS to provide a major marine component of IGBP and is seeking more formal links between the two programmes. It had been concluded that the matter should

be passed to the JGOFS Committee for more detailed consideration at its forthcoming meeting and that a means should be found to ensure full cooperation between the two programmes while, at the same time, retaining separate identity of JGOFS with the focus for its planning within SCOR.

5.4 ICSU Unions and Committees

Written reports were requested from all ICSU organizations which are represented in SCOR. The Executive Secretary brought items of special interest to SCOR to the attention of the General Meeting.

Scientific Committee on Antarctic Research

While SCOR WG 54 Southern Ocean Ecosystems and their Living Resources was disbanded at the XVIII General Meeting, the follow-up activities of the BIOMASS programme are continuing under the leadership of SCAR during a period leading up to a final BIOMASS Evaluation Meeting to be held in 1990. In the meantime, SCOR has been continuing to provide an annual financial contribution to SCAR to support a series of BIOMASS Data Analysis Workshops. A report from the Chairman of the BIOMASS Executive Committee appears in Annex XVI.

A report on other SCAR activities of interest to SCOR was submitted by Mr. G. Hemmen, the Executive Secretary of SCAR. It noted that following the proposals from SCOR, Dr. A. Piola (Argentina) and Dr. Y. Gudoshnikov (U.S.S.R.) have been added to the membership of the SCAR Group of Specialists on Southern Ocean Ecology to represent the interests of physical and chemical oceanography. The first meeting of the group was held in May 1987 and its report has been distributed. This included identification of four major ecological systems in the marine Antarctic Sea ice, Continental shelf, open ocean pelagic zone and sub-Antarctic islands - and of the more important topics for research within each. The group believes the most profitable approach for the future Antarctic marine ecological research will be to identify and quantify energy fluxes within and between the major systems. It should be noted that Dr. Sullivan, the Chairman of SCOR WG 86 on the Ecology of Sea Ice is also a member of the SCAR Group of Specialists on Southern Ocean Ecology, so liaison is assured.

SCAR had invited the U.S.S.R. National Committee to nominate an expert in sea ice fauna for membership in SCOR WG 86 on the Ecology of Sea Ice which is cosponsored by SCAR. As a result, Dr. I. Melnikov will be invited to join WG 86.

The SCAR Group of Specialists on Antarctic Sea Ice is also cosponsored by SCOR. Soon after its formation, this group formulated the concept of promoting a long-term multi-disciplinary programme to further the study of Antarctic sea ice zone, particularly in the winter. The group has been working on developing this proposal taking into account requirements of programmes such as WCRP, WOCE, JGOFS and others and also the potential for utilizing a new generation of satellites that will become operational during the 1990's. The group was in the process of finalizing its proposal for an extensive multi-disciplinary programme from 1990-2000, covering two periods of extensive observations in the sea ice zone, including winter observations, in 1992 and 1996. The full proposal was expected to be available in late 1988 and will be made available to SCOR.

Scientific Committee on the Problems of the Environment

The SCOPE programme on Biogeochemical Cycles includes a study of global carbon and nutrient cycling in lakes and estuaries. One of its emphases is on "estuaries and coastal seas where organic material is trapped, mineralized and also produced, thus drastically altering the total flux of organic material to the ocean". This will be drawn to the attention of the JGOFS Committee.

Another SCOPE project relates to the interests of WG 89 on coastal erosion. In the face of growing interest in sea level rise, the study of subsiding coastal areas has as its aim to "draw attention to the impact of natural and accelerated subsidence on low-lying coastal areas" and an estimation of their impacts. SCOPE was planning an international workshop to be held in Bangkok in November 1988, at which questions related to sea level rise, coastal subsidence, and river flow would be addressed.

Committee on Space Research

The joint interests of SCOR and COSPAR lie mainly in the field of remote sensing and in the activities of COSPAR Commission A. A report to SCOR was compiled by Dr. J. Gower and Prof. G. Ohring on behalf of Commission A.

At the July 1986 COSPAR Plenary meeting in Toulouse, France, Topical Meeting A3, which was cosponsored by SCOR, discussed "Satellite Ocean Colour Observations for Dynamic and Biological Studies". The proceedings of this meeting have now been published as *Advances in Space Research*, Volume 7, Number 2, 1987.

In November 1986, COSPAR Commission A1 organized a workshop on Satellite Precipitation Measurements for the Global Precipitation Climatology Project in Washington D.C. The workshop discussed the problem of data-sparse areas over oceans, and the progress that is being made in developing remote sensing techniques to fill them. Proceedings of the workshop have now been published as WCRP Publication No. 1, in January 1988.

COSPAR's Ad Hoc Group on Remote Sensing for Global Change, formed at the request of ICSU has produced its report, *Potential of Remote Sensing for the Study of Global Change*, published as *Advances in Space Research*, Volume 7, Number 1, 1987. The publication surveys the potential space observations and makes recommendations on important trends and deficiencies. SCOR was represented in the group by Dr. J. Gower.

The COSPAR Plenary Meeting was held in July 1988 in Helsinki. A symposium (S1 on the Contribution of Space Observations to the World Climate Research Programme and Global Change) and two topical meetings (A1 on Latest Results on Space Observations for Meteorology and Oceanography, and A2 on Satellite Observations on Mesoscale Processes in the atmosphere and Oceans), of particular relevance to oceanographers, were all cosponsored by SCOR. Proceedings of these meetings will be published in *Advances in Space Research*.

The COSPAR report concluded with the observation that interest in satellite observations of the oceans remains high during the present period of relatively low ocean satellite activity. COSPAR activities may be expected to reflect a growing emphasis on the oceans with launch of ERS-1, Topex, and Radarsat.

6.0 FUTURE MEETINGS

6.1 Meetings of SCOR

The Executive Committee has accepted the invitation of Professor O'Brien to hold its 29th meeting at Florida State University, Tallahassee from 16 to 18 October 1989.

An invitation from the SCOR Committee of the German Democratic Republic to hold the XX General Meeting of SCOR at the Institut für Meereskunde in Rostock-Warnemünde was accepted by the Executive Committee in 1987. The meeting will take place from 1 to 3 October, 1990 and will, as usual be associated with a scientific symposium. The topic for this has yet to be determined and the President of SCOR noted that suggestions would be welcomed from SCOR Subsidiary Bodies, Committees or organizations associated with SCOR.

6.2 Other Meetings

Information was provided on the following meetings of interest to SCOR which had not been discussed under any other agenda items at the General Meeting.

Second International Liege Colloquium on Coupled Ocean-Atmosphere Models. Liege, Belgium, May 1989. This meeting is being cosponsored by SCOR.

Eleventh Symposium on Polar Biology. Tokyo, December 12-14, 1988.

The First International Marine Biotechnology Conference, Tokyo, September 4-6, 1989.

7.0 OTHER BUSINESS

7.1 Recommendations of the *ad hoc* Working Party on Enhancing Participation in SCOR

The Executive Secretary introduced this item, noting that the JOA had brought together scientists from a very large number of countries, some of them being non-members of SCOR. It had also provided an unusual opportunity for contacts with scientists from many of the developing countries. Thirdly, a number of scientists, from countries where the SCOR Committees are not very active, had availed themselves of the opportunity to attend the General Meeting during the JOA and to better familiarize themselves with SCOR activities.

These conditions had resulted in a number of inquiries to members of the Executive Committee and to the Executive Secretary about ways in which the involvement of the scientific community in SCOR could best be strengthened. Accordingly, an informal group consisting of representatives from about ten countries met to discuss these issues during the JOA. Dr. A. Cruzado (Spain) presented the recommendations of this group to the General Meeting.

1. The SCOR Executive Committee should make efforts to encourage non-member countries to join SCOR either individually or collectively.

The ICSU Statutes provide for such collective membership of small countries in ICSU - the Caribbean island states, for example. Dr. L. Awosika (Nigeria) noted that he had hopes of mobilizing some of the west African countries to join SCOR if such a joint membership were possible.

2. The SCOR Executive Committee should monitor the involvement of member countries and, where appropriate, should make efforts to revitalize national participation in SCOR activities.

The General Meeting recognized that the inaction of some SCOR Committees meant that the oceanographic communities in those countries were often very poorly informed about SCOR activities. Dr. Ayala-Castanares, Chairman of the Mexican SCOR Committee, stressed that the Committees should act as a strong link between SCOR and the scientific community and that one of the best ways to involve their scientists in international activities is to propose them for membership in SCOR working groups when proposals for new groups are circulated for suggestions.

Dr. Su Jilan noted that he has been given the responsibility to investigate this topic on behalf of the Executive Committee. He proposed to develop a questionnaire to be sent to all SCOR Committees in order to collect information on their procedures and types of operation.

Several members of the Executive Committee addressed this point, urging SCOR Committees to improve the channels of communication with the communities they represent, and, in particular, by ensuring that the reports, publications and other information resulting from working groups do, in fact, reach the scientists who can best benefit from them.

3. The SCOR Executive Committee and the Chairmen of SCOR scientific subsidiary bodies should make efforts to involve scientists and to plan activities in those member countries which so far have had limited, or no, involvement in SCOR activities.

Dr. Cruzado expanded upon this recommendation by suggesting that more consideration be given when the sites of working group meetings are chosen to the opportunities that these meetings may provide to involve groups of scientists from countries which may not be formally represented in the working groups concerned.

4. The SCOR Secretariat should make efforts to improve the dissemination of information to the scientific communities in member and non-member countries of SCOR.

The President of SCOR noted that efforts are already underway to increase the frequency with which information on SCOR appears in such publications as the IMS Newsletter of UNESCO. It was also suggested that correspondence which is presently distributed only to a single address for each SCOR Committee might also be sent to the three Nominated Members in each country belonging to SCOR.

Professor Siedler thanked Dr. Cruzado and the ad hoc group for its recommendations which would be considered in much more detail by the Executive Committee in conjunction with the information to be obtained as a result of Dr. Su's survey of the current modes of operation of SCOR Committees. He noted that this General Meeting, having been held in conjunction with the JOA, had attracted participants from an unusually large number of nations and had thereby provided SCOR with a unique opportunity to broaden its membership and to further develop relations with the existing members.

7.2 Continuous Plankton Recorder Survey

A number of biological oceanographers expressed concern during the General Meeting at the threatened discontinuation of the Continuous Plankton Recorder Survey in the North Atlantic and sought SCOR assistance in ensuring that it is maintained. Professor Wooster pointed out that such long time series may offer the only tool which permits biologists to distinguish natural changes in biota from those caused by anthropogenic change.

The following statement was prepared by Professor B. Zeitzschel and was endorsed by the General Meeting:

"The Continuous Plankton Recorder survey has produced one of the very few substantial data sets that show changes over time and space of plankton communities in the open ocean. Information that the survey may be significantly reduced or even discontinued has suggested that the oceanographic community should assess the impact of this on projected international programs, including JGOFS, IGBP, and IREP.

The CPR data set is unique in its temporal and spatial coverage in the North Atlantic and, apart from the CalCOFI data in the eastern north Pacific, in the world ocean. Otherwise only fishery statistics record the impact of climate change on ocean biota over periods as long as several decades. Such data sets are needed to establish a baseline of variability against which anthropogenic changes can be determined. This variability in plankton communities, as observed by the CPR survey, is related to the flux of organic materials to below the euphotic zone (JGOFS), to the impact on the marine biota of climate change (IGBP), and to climate effects on recruitment to fish stocks (IREP). Thus these programs will suffer severely from loss of continuing information from this source."

This statement will be forwarded to the JGOFS Committee, to ICES and to the UK SCOR Committee for consideration.

The discussion of the CPR survey led to the development of a preliminary proposal for the establishment of a SCOR working group on monitoring biological variability in the ocean. The General Meeting agreed that it could not consider such a proposal in detail at short notice, but that it should be circulated to SCOR Committees and relevant organizations for consideration and comments before the next meeting of SCOR.

The proposal, as submitted by Professor Wooster, the President of IABO and the Chairman of ICES, states that "In order to determine the effects of human activity on the marine biota, it is necessary to measure changes in the biota. Methods for this monitoring include measurements at coastal or inshore stations, surveys (e.g., CPR, CalCOFI), and catch statistics from commercial fisheries (eventually, suitable time series will also result from remote sensing). None of these methods is completely satisfactory, and some are threatened with being curtailed or discontinued. Yet several major international programs (e.g., JGOFS, IGBP, IREP) depend on adequate measures of biota variability for their success. Therefore, it is proposed to establish a working group on monitoring biological variability in the ocean with the following terms of reference:

- Identify and describe existing time series (10 years and longer) of biological variability in the ocean.
- Evaluate the significance, inadequacies, and methods used in interpreting these data sets.
- Consider cost-effective ways to increase the value of ongoing monitoring programs (e.g., sampling, analysis, accessibility).
- Consider alternative ways of monitoring biological variability in the ocean.

Report working group findings to SCOR and other relevant bodies.”

7.3 Pacific Science Association

Professor Siedler informed the General Meeting that a request had been received from the Pacific Science Association’s Committee on Marine Sciences that closer links be established between the PSA and SCOR. The participants in the General Meeting agreed with his suggestion that an informal liaison with the exchange of reports and other information between the Secretariats of the two organizations would be the most appropriate relationship for the time being.

8.0 CLOSING

In closing the General Meeting, Professor Siedler expressed his thanks to the many participants for their willingness to attend even after a long and very stimulating JOA. Since this was his last meeting as President, he gave his personal thanks to his colleagues on the Executive Committee for their support and encouragement during his term of office. He paid special tribute to Dr. Fedorov, the Past-President, who was attending his last meeting as a member of the SCOR Executive Committee, and to Dr. Roger Chesselet, who had been prevented from attending the General Meeting by poor health and whose term of office as Vice-President would also expire at the end of the meeting. Finally, Professor Siedler extended his best wishes to the incoming President, Professor Stromberg.

Professor Stromberg, speaking on behalf of everyone present, and of the entire SCOR community, thanked the outgoing President for his careful and tireless guidance of SCOR during the past five years and hoped that he would continue to play a very active role in his new position as Past-President.

ANNEX I

NINETEENTH GENERAL MEETING OF SCOR Acapulco, Mexico, August 27 and September 1, 1988

LIST OF PARTICIPANTS

Members of the Executive Committee

* Professor G. Siedler	F.R.G.	President
* Dr. R. Fournier	Canada	Secretary
* Dr. K.N. Fedorov	U.S.S.R.	Past President
* Dr. G.R. Heath	U.S.A.	Vice-President
* Professor J.-O. Stromberg	Sweden	Vice-President
* Dr. A. Ayala Castanares	Mexico	Co-opted Member
* Professor K. Hsu	Switzerland	Ex-Officio CMG
* Professor P. Lasserre	France	Ex-Officio / IABO
* Dr. J. O'Brien	U.S.A.	Ex-Officio / IAPSO
* Dr. G.B. Tucker	Australia	Ex-Officio IAMAP
E. Tidmarsh		Executive Secretary

Other Participants

Mr. M.A. Alatorre	Mexico	Prof. H. C. Liew	Malaysia
Dr. J.R. Apel	USA	Prof. Liu Riyu	China
Mr. A.K. Armah	Ghana	Dr. K. Lochte	FRG
*Prof. T. Asai	Japan	Prof. Hanli Mao	China
Mr. L. Awosika	Nigeria	*Dr. I. Martins	Brazil
Mr. G.W. Bailey	S. Africa	Prof. L.R. Martins	Brazil
*Prof. Dr. T. Balkas	Turkey	*Dr. A.D. McIntyre	UK
Dr. W. Balzer	FRG	Dr. L.D. Mee	Monaco
Mr. L.B. Brown	AOSB	Mr. M.R. Medina	USA
*Prof. Ju-Chin Chen	China	Dr. E.C. Monahan	USA
Dr. R. Corell	USA	Dr. S. Morcos	UNESCO
Dr. G. Cresswell	Australia	Dr. T. Mueller	FRG
*Dr. A. Cruzado	Spain	Prof. T. Nemoto	Japan
Prof. K. Curi	Turkey	Mr. Brian Nicholls	Canada
*Dr. B. d'Anglejan	Canada	*Prof. J. Nihoul	Belgium
Dr. A. de Freitas	S. Africa	Dr. J. Olafsson	Iceland
Prof. C. Dejak	Italy	Dr. J.-O. Ostvedt	ICES
Prof. A.G. Dickson	USA	*Dr. Ir. L. Otto	Netherlands
Dr. S.K. Dube	India	Dr. B. Patel	India
*Prof. C. Druet	Poland	Dr. R. Peinert	FRG
*Prof. J.C. Field	S. Africa	Dr. C. Peneda	Portugal
Dr. M. Fouda	Egypt	Dr. A. Pierrot-Bults	Netherlands
Mr. C. Fuentes-Yaco	Mexico	Prof. M. Pilson	USA
*Dr. R. Gammon	USA	Dr. R. Podgorny	USA
Mr. C. Garcia	UK	Dr. F. Robles	IOC
*Prof. E.D. Gomez	Philippines	Dr. Y. Schaeffer-Novelli	Brazil
Prof. Hongkan Gu	China	*Dr. R. Sengupta	India
Dr. A. Guille	France	Dr. R. Shankar	India
*Dr. T. Healy	New Zealand	Dr. M. Sibuet	France
*Dr. C. Heip	Belgium	Prof. A. Siripong	Thailand
Dr. R. Hennet	USA	Mr. P.S. Srivastava	India
Prof. L. Hernandez	Spain	Prof. E. Stanev	Bulgaria
*Professor N.G. Holm	Sweden	Prof. U. Stefansson	Iceland
Dr. B. Hsieh	USA	Dr. J.H. Stel	Netherlands
Dr. Dunxin Hu	China	*Dr. R.E. Stevenson	USA
*Dr. Tsu-Chang Hung	China	Dr. R.W. Stewart	Canada
*Prof. B.-O. Jansson	Sweden	*Dr. J. Stuardo	Chile
Rear Admir. M. Khan	Bangladesh	*Dr. Su Jilan	China
Prof. B. Kimor	Israel	*Dr. E. Suess	USA
Dr. D.C. Krause	UNESCO	Dr. Y. Suzuki	Japan
*Dr. S. Krishnaswami	India	*Dr. J. Thiede	FRG
Dr. G. Kullenberg	IOC	Prof. H. Thiel	FRG
Dr. N.P. Kurian	India	Dr. R. Trites	Canada
*Prof. A. Kuznetsov	USSR	*Dr. J. Van der Land	Neth
Dr. H.S. Kwak	Korea	Dr. I. Vukadin	Yugoslavia
Prof. Dieter Lange	GDR	Dr. M. Waldichuk	Canada
*Sir Anthony Laughton	UK	*Dr. C.S. Wong	Canada
Dr. J. Launiainen	Finland	*Prof. W.S. Wooster	USA
Mr. Liang Fengkui	China	Dr. W. Zenk	FRG
Prof. U. Lie	IOC	*Prof. B. Zeitzschel	FRG

* = member of SCOR

ANNEX II

SCIENTIFIC PROGRAMME OF THE JOINT OCEANOGRAPHIC ASSEMBLY Acapulco, Mexico, August 23 to 31, 1988

LIST OF SESSIONS

GENERAL SYMPOSIA

- G1. New Developments (Current topics of special interest)
Convenor: G. Siedler (FRG)
- G2. Ocean and Climate
Co-Convenors: J.C. Duplessy (France), R.W. Stewart (Canada)
- G3. Hydrothermal Processes
Co-Convenors: D. Desbruyeres (France), L.I. Moskalov (USSR)
- G4. State of the Art
Co-Convenors: K.N. Fedorov (USSR), W.S. Wooster (USA)

SPECIAL SYMPOSIA

- S1. Oceanography in Mexico
Co-Convenors: Julian Adem (Mexico), Agustin Ayala-Castanares (Mexico)
- S2. Physical and Ecosystem Models
Co-Convenors: J.C.J. Nihoul (Belgium), T. Platt (Canada), J. Pope (UK)
- S3. New Methods and Associated Data Problems
Co-Convenors: W. Alpers (FRG), R. Hekinian (France), M.J. Perry (USA)
- S4. ~~Large~~ Scale Changes from Human Activity
Co-Convenors: G. Seatersdal (Norway), A.D. McIntyre (UK), Zhou Jiayi (China)
- S5. Life Strategies in Extreme Conditions
Co-Convenors: T. Fenchel (Denmark), P.W. Hochachka (Canada), L.A. Melnikov (USSR)
- S6. ~~Small Scale~~ Ocean Processes in Surface Layer
Co-Convenors: K. Denman (Canada), V. Smetacek (FRG), Y. Toba (Japan)
- S7. ~~Tropical~~ Coastal Systems
Co-Convenors: E. Jordan (Mexico), L. Martins (Brazil), A.N. Rao (Singapore)
- S8. Global Ocean Storage and Fluxes
Co-Convenors: P. Brewer (USA), E. Degens (FRG), M. Whitfield (UK)
- S9. Deep Sea Floor
Co-Convenors: K. Hsu (Switzerland), S. Ohta (Japan), S.A. Thorpe (UK)
- S10. Ocean Variability and Biological Changes
Co-Convenors: R. Dickson (UK), A.P. Kuznetsov (USSR), A. Herbland (France)
- S11. Global Sea Level Change
Co-Convenors: H. Postma (Netherlands), S. Snedaker (USA)
- S12. Scientific Basis for Ocean Resources Use
Co-Convenors: T. Balkas (Turkey), S. Krishnaswami (India), J.P. Troadec (France)

ASSOCIATION SESSIONS

- A1. International Association for Biological Oceanography (IABO)
- A2. International Association of Meteorology and Atmospheric (IAMAP)
- A3. International Association for Physical Sciences of the Ocean (IAPSO)
- A4. Commission for Marine Geology (CMG)

ANNEX III

WORKING GROUP 71

PARTICULATE BIOGEOCHEMICAL PROCESSES

In August 1982 the Scientific Committee on Oceanic Research (SCOR) constituted a working group (WG 71) on "Particulate Biogeochemical Processes". This working group had the following terms of reference:

- (i) To delineate the principal particulate transport processes which control trace element and nutrient element distribution in the open ocean.
- (ii) To clarify the definition of terms and processes used to describe particulate material in the ocean and to suggest the most appropriate methodology for the study of the material defined above.
- (iii) To ascertain the possibility of determining particulate fluxes of elements and organic matter to different depths in the sea.
- (iv) To prepare a state-of-the-art report on the particulate processes.

The members of the working group were: S. Krishnaswami, India; (Chairman), M.P. Bacon, USA, P. Buat-Menard, France, S.W. Fowler, Monaco, D. Karl, USA, G.A. Knauer, USA, A. Lisitzyn, USSR, I. McCave, UK, Y. Nozaki, Japan, and R. Wollast, Belgium.

The working group held three meetings, one each during 1984, 1986 and 1988. The topics addressed by the group included: (i) sources of particles and methods of their study, (ii) determination of particle fluxes, (iii) particle transport and transportation processes and (iv) relationship between particles and trace elements. A report summarizing the discussions and recommendations of the group will be available from SCOR shortly.

Particulate matter in the ocean, comprised of both biogenic and abiogenic materials, is the major source of food for all marine organisms, and below the euphotic zone all communities depend on the downward flux of particles. During their descent from surface waters to the sediments, particles regulate the chemical composition of seawater. For example, the distribution of nutrients in seawater is primarily controlled by the settling and dissolution of biogenic particles. Similarly, the exchange of trace elements and radionuclides between seawater and particles is an important factor in determining their dissolved concentrations and vertical fluxes in the ocean. Likewise these exchange processes possibly dictate the fate of contaminants introduced into the ocean. Thus particulate matter, in spite of its very low abundance, significantly influences the chemical and biological make-up of seawater. These considerations make the study of marine particulate matter and its composition, fluxes and related processes important topics in the field of oceanography. The working group concluded that the study of particles and particle-associated processes is central to our understanding of the production and fate of biogenic materials in the sea and the biogeochemical cycling of elements in the ocean. It also recommended that programmes dealing with fluxes of materials through the water column should be encouraged by all countries.

There are several ongoing national and international programmes to determine quantitatively the fluxes of carbon and other materials in the ocean and the factors controlling these fluxes. SCOR has also been actively involved in this direction and has taken the leadership role in the coordination of a major international oceanographic programme, the Joint Global Ocean Flux Study (JGOFS). Many of these national studies have begun to yield valuable data on the temporal and spatial variations in material flux and its relation to primary productivity in the upper ocean and particle transformations and dynamics in the ocean interior. Important goals for research in this area of particle fluxes include construction of improved global maps of primary production, standing crop, and new production; understanding mechanisms and rates of particle transformation in the ocean; and refinements of the current sediment trap techniques. Specific recommendations on these topics are contained in the group's report.

The discussions of the working group were, by and large, restricted to the open ocean environment. However, the working group recognized that any programme on biogenic fluxes in the ocean would be incomplete without the study of coastal oceans and marginal seas. The ocean margins are the pathway for river-borne material which is to a large extent trapped in those areas or modified before being transferred to the open ocean. These areas also account for a significant fraction of the primary production. Another important topic not covered in this report is the role played by boundaries (air-sea, ocean margins and sediment-water) as sources or sinks of dissolved and particulate materials to the oceans. There is increasing evidence that these boundaries are important. The group has recommended the formation of a new working group to review the above mentioned aspects of biogeochemical cycling of carbon and other elements in the ocean.

The working group report should be useful to those interested in studying particles and particle-associated processes in the ocean. The report can be obtained from the Executive Secretary of SCOR.

ANNEX IV
WORKING GROUP 83
WAVE MODELLING

1. *State of the art of wave modelling*

There exists considerable interest in ocean wave research, and in the development and application of numerical wave modelling techniques. The interest is strongly stimulated by demand. World-wide off-shore and coastal engineering projects require good knowledge of local wave climates. In addition, shipping, fisheries and off-shore operations depend on the availability of accurate wave forecasts. These are usually made with the help of numerical wave prediction models, which are also used to reconstruct wave climates, where observations are lacking.

In recent years, important developments have been made in ocean wave modelling. Our understanding of the dynamics of surface waves has increased significantly as a result of a series of field programmes and because of experience with a sequence of first and second generation wave models (JONSWAP, SWAMP, SWIM). The increasing understanding has led to an increasing sophistication of methods which in turn had led to an increasing collaboration between different wave modelling groups. For example the SWAMP (1984) study involved six European, two American and two Japanese research teams.

The international wave modelling community has recently developed a new third generation wave model which may be expected to yield a further significant improvement in wave forecasting skill. Presently action is directed at further development of this third generation model, its real-time implementation in a global version on a central efficient vector processing computer and the development of regional versions of the model for regional use.

Wave prediction models are based on the integration of the radiative transfer equation for the two-dimensional wave spectrum. Simple empirical wave prediction tables relating wind or sea parameters such as the significant wave height and period to the wind speed, fetch and duration are still sometimes used in engineering applications, but they are often inadequate. The transfer equation describes the propagation of the different wave components of the spectrum with different frequencies and propagation directions at their appropriate group velocities, and the change in the energies of these components produced by wind forcing, dissipation and higher order nonlinear wave-wave interaction. The models predict the full two-dimensional wave spectrum at every timestep and gridpoint.

Present second generation wave models have to make *a priori* restrictions on the spectral shape, because an accurate representation of the nonlinear transfer process was not yet available. The third generation model is based on a complete representation of all source terms without any *a priori* restrictions on the spectral shape. The SWAMP study has clearly indicated that such an approach is essential for a correct description in the important situation of wind-sea to swell transition and in case of turning wind fields when directional relaxation is relevant.

The availability of an operational global wave model will be essential if one wants to make full use of the potential of the first European remote sensing satellite ERS-1. The high rate of surface winds and wave data to be produced by ERS-1 can be only effectively exploited if one makes use of a larger central facility. The task of processing and assimilating satellite data in a wave model will require research efforts exceeding the potential of individual countries. Therefore, this is being done in joint collaboration.

2. *Current activities of the working group*

Activities of the working group can be subdivided in three groups.

One activity concentrates on the practical problem of further developing, implementing and validating the new wave model. This comprises the following main items:

testing of the model in selected hindcasts; semi-operational implementation in global and regional modes model validation.

Another activity comprises more general wave dynamical problems. These problems have been clearly isolated in the SWAMP and SWIM studies. In fact, both studies suggested further research, and the time seems ripe to follow these suggestions.

The three problems that are being addressed are:

reanalyze existing data on fetch limited wave growth;

study directional properties of the wave spectrum;
investigate the nature of shallow water limitations to wind sea.

A third activity is related to the wave data assimilation problem. Here the problems are relatively new since no experience with wave-data assimilation exists so far. Apart from the technical problem of performing data-assimilation in a wave model (correlation scales, how to maintain spectral integrity), three important and interesting issues have been identified so far. First of all, it has been realized that assimilation of wave observations in a wave model can have an impact on the assimilation of winds in the driving atmospheric model. As a result the possibility of joint, real-time data-assimilation in coupled atmospheric models is considered. Secondly, it has been found that the sea state may affect the atmospheric boundary layer over sea. Finally, it is believed that having first guess real-time knowledge of the sea state can be used to improve the translation of raw scatterometer observations into useful wind estimates. All of these points will be actively pursued in the near future.

3. *Membership*

SCOR Working Group 83 has the following 10 members:

Mr. L. Cavaleri	Italy
Dr. V.J. Cardone	USA
Dr. M. Donelan	Canada
Dr. P. Francis	UK
Dr. J. Guddal	Norway
Dr. G.J. Komen (chairman)	The Netherlands
Dr. W.R. Rosenthal	FRG
Dr. W.J.P. de Voogt	The Netherlands
Dr. Yeli Yuan	PRC
Professor V.E. Zakharov	USSR

In addition 5 Corresponding Members have been nominated:

Dr. L. Behrendt	Denmark
Dr. A. Guillaume	France
Dr. H. Graber	USA
Professor K. Hasselmann	FRG
Dr. L. Holthuijsen	The Netherlands

4. *Request for 1989 meeting*

So far SCOR working group members have met in conjunction with meetings of the informal WAM (=Wave Modelling) group. The first meeting was in Woods Hole, in 1987. A second meeting was held in Paris in March 1988. Permission is requested for a third meeting, which has been tentatively scheduled for May 24, 1989 in Valencia, Spain.

5. *Relationship with other groups*

Several other international groups are active in related fields.

The WAM group, first of all, is a fairly large (about 60 people) international group of wave modellers, collaborating on the topics described above. Membership/observer status has never been well defined. Within WAM there are many subgroups. For example, some of the WAM institutes are funded for this research by the European Community. Some WAM individuals have obtained the right to use the WAM model software. An other group of WAM members has computer time on the CRAY-XMP/48 of the European Centre of the Medium Range Weather Forecasts under a Special Project arrangement. Most SCOR WG 83 members are from WAM.

A few WAM members have been nominated by the World Meteorological Organization as rapporteurs on Numerical Wave Modelling of the Commission for Marine Climatology's working group on Technical Problems.

Klaus Hasselmann is chairing a JSC/CCCO working group on Air/Sea Fluxes. This group will focus on what can be learned about air-sea fluxes from air-sea interface models, general circulation models (including wave models) and the use of satellites (sensor algorithms, field programmes). It is clear that the work described in section 2 is important input for their activity.

Finally, there are several WOCE groups (such as the WOCE working group on Numerical Experiments (WNEG of WGNE)), which will be primarily concerned with the effect that air-sea fluxes have on the ocean circulation.

6. *Final goals of WG 83*

The goals of WG 83 are contained in its terms of reference:

To jointly develop a third-generation wave model, based on a full description of the physical processes governing wave evolution;

To develop regional versions of the third-generation model to be nested with the global model;

To implement a global version of the model and to test medium range forecasting;

To perform physical studies of wave dynamical processes in order to extend our understanding of wave evolution, where needed;

To develop data assimilation techniques which will make it possible to make full use of satellite observations of the sea-state.

We expect to have reached these goals in 1992, two years after the launch of the ERS-1 satellite. By this time the third generation wave model will have proven its capabilities for sea state forecasting, and it will have demonstrated its usefulness as a tool for making optimum use of satellite wind and wave observations. The results will be published in the open scientific literature. Also, a summary report for SCOR Executive Committee will be prepared.

ANNEX V

WORKING GROUP 85 EXPERIMENTAL ECOSYSTEMS

The first meeting of WG 85 took place in Hamburg, FRG, June 6-10. 1988.

The terms of reference for SCOR WG 85 are as follows:

1. Examine previous studies involving experimental ecosystems; critically evaluate the results and the application of such techniques to estuarine, coastal and open sea problems.
2. Make recommendations for complete systems (mesocosms, field, laboratory and simulation modelling) approaches to current problems in biological oceanography.
3. Specify design criteria pertinent to studies in the range of estuarine, coastal and open sea conditions.

Persons attending the working group meeting were:

Chairman:	Professor Li Guanguo, Shandong College of Oceanography
Vice Chairman:	Professor T.R. Parsons, University of British Columbia Dr. P. DeWilde, Netherlands Institute of Sea Research
Rapporteur:	Dr. J. Gamble, Marine Laboratory, Aberdeen, U.K. Dr. M. Takahashi, Botany Department, University of Tokyo Professor P. Lasserre, Station de Biologie Marine, Roscoff, France Professor M. Pilson, University of Rhode Island, U.S.A.
Host:	Professor U.H. Brockmann, Universitaet Hamburg, F.R.G.
Corresponding Member: (for Dr. Oiestad)	Dr. T. Bakke, Norwegian Institute for Water Research Dr. E. Moksness, Flodivegan Biological Station, Norway
Corresponding member:	Dr. S. Schulz, Institut fur Meereskunde, GDR

Agenda Adopted

- June 6 Presentation and discussion of papers prepared prior to the meeting re the first term of reference.
- June 7 Continued discussion of the first term of reference. Second term of reference discussed - Discussion Leader: T. Bakke.
- June 8 Further discussion of second term of reference and draft report. Third term of reference discussed - Discussion Leader: P. De Wilde.
- June 9 Discussion of report for SCOR - Discussion Leader: J. Gamble.
- June 10 Discussion of purpose, time and place of second meeting. Finalization of report to SCOR.
- Participants departed p.m. June 10 or a.m. June 11.

Discussion of the First Term of Reference

The first day and a half of the meeting was taken up with the presentation of reviews covering the first term of reference. Each representation was followed by a discussion of the subject. It was agreed that final copies of these reviews would be sent to the Vice Chairman, T.R. Parsons not later than September 15, 1988. Reviews would then be collated and sent to SCOR as part of the work of our group. The following is a provisional list of authors and titles:

<u>Author</u>	<u>Title</u>
Gamble	Mesocosms: Statistical Considerations
Oiestad (Moskness)	Specific applications of meso- and macrocosms for solving problems in fisheries.
Lasserre	Microcosms
Pilson	Application of mesocosms for solving problems in pollution research.
Li Guanguo	Different types of ecosystem experiments.
Takahashi	Control and food chain analysis. I Pelagic Mesocosms.
Brockmann	Control and food chain analysis. II Processes.
Parsons	The use of mathematical models in conjunction with mesocosm research.
De Wilde	Benthic Mesocosms. I Soft Bottom - basic research.
Bakke	Benthic Mesocosms. II Hard bottom - basic research.

Discussion of the Second Term of Reference

“Make recommendations for complete systems (mesocosms, field laboratory, and simulation modelling) approaches to current problems in biological oceanography.”

Introduction

The aim of the following deliberations is to provide guidance for the future application of experimental ecosystem techniques and in particular to draw attention to those aspects of biological oceanography for which the techniques are considered to be most suitable.

To date, most research using experimental ecosystems has been carried out in the developed countries, but the Working Group feel that there is a need to apply the methodology to appropriate problems in biological oceanography in many regions throughout the world.

Fig. 1 illustrates the general connection between mesocosm research and studies in the natural environment and in the laboratory, using models as appropriate. This figure endorses both the holistic and reductionist approach to ocean research.

What are the current problems in biological oceanography which could be approached through experimental ecosystems research?

These fit into three broad categories:

1. General biological oceanography; particularly the need to understand processes and to measure fluxes.
2. Aspects of exploitation and management of resources.
3. Fates and effects of pollutants.

In considering the current problems in biological oceanography, the broad categories need to be focussed down to pertinent questions of the moment, such as the relationship between biological and physical processes in the sea. There is also a great need to induce biochemists and physiologists to work in mesocosms particularly on the more detailed ecosystem interrelationships which can only be followed in an enclosed situation.

Specifically experimental ecosystems must now be accepted as a valid tool in oceanographic research; a tool which is particularly useful for certain aspects, such as the estimation of benthic secondary production, the examination and validation of current descriptive ecosystem models, the detailing of processes determining succession including circumstances leading to algal blooms etc. However, scientists working with experimental ecosystems must be able to define the insufficiencies and short-comings of the method. If necessary, this must be done by parallel studies in the field. In fact, we must not expect mesocosm techniques to stand alone as methods of research, but they must be seen as an adjunct to surveys and studies in nature.

In this context experimental ecosystems are particularly useful for;

- (a) testing hypotheses, i.e. a true manipulative experiment,
- (b) carrying out carefully planned exploratory investigations
- (c) creating specifically designed experiments involving the use of hazardous substances.

Questions for which experimental ecosystems are thought appropriate

I. General Biological Oceanography

- I.1 The developments of populations and biological systems, such as succession or recruitment
- I.2 The transfer of organic carbon, nitrogen and phosphorus, for instance uptake and mineralization
- I.3 The role and biological significance of living and non-living particulate material and of dissolved organic matter
- I.4 The measurement and elucidation of ecosystem feedback and control mechanisms, for instance exchange kinetics and metabolic activities, pheromones, physiological succession, phasing and seasonal timing. These aspects lead directly into modelling and to the validation and testing of ecosystem models.
- I.5 Boundaries and fluxes; experimental ecosystems have a great potential for examining these most important aspects of biological oceanography:
 - the air/water interface; photochemical processes, surface film biology and chemistry;
 - water column vertical structure; to simulate the creation and destruction of stratification;
 - the benthic boundary; pelago-benthic coupling, bioturbation and physical disturbance.

II. *Exploitation and management of resources*

Where fisheries questions are concerned, mesocosms have been shown to be particularly useful for investigations on the biology of fish larvae with respect to feeding rates, growth rates, interactions between species and to the measurement of mortality through predation, toxic algae and other agencies. Such data have important implications for the understanding of recruitment mechanisms.

Very little is understood about the biology and significance of juvenile fish (i.e. postlarval stages). It should be possible to devise very large macrocosm-scale systems for such investigations. It should also be possible to apply aquacultural techniques both in the utilization of currently available large-scale systems and in the adoption of tried and tested engineering structures. There should also be much scope in investigating the use of man-modified lagoon environments for recruitment studies. This might be particularly relevant in tropical areas and raises the general question of interrelating comparison of ecosystems.

III. *Pollution*

Mesocosms must now be regarded as being an essential tool for studying marine pollution to bridge the gap between single species toxicity tests and the natural environment.

Emphasis should be directed toward:

- eutrophication, particularly with respect to algal blooms and truncated or enhanced succession;
- the fate and effects of complex pollutants such as harbour sludge, industrial effluents, river discharges and oil derivatives;
- the sequestering of pollutants into different phases; including bioavailability, food-chain transfer and biomagnification;
- the development of realistic simulated scenarios for specific purposes;
- the examination of long-term chronic effects of pollutants on ecosystems.

Discussion of the Third Term of Reference

“Specify design criteria pertinent to studies in the range of estuarine, coastal and open sea conditions”.

1. The Working Group thought it necessary to specify the definition of the term “experimental ecosystem”. The view was adopted that ideally an experimental ecosystem must meet the following criteria to fulfill its function proposed under the recommendations put forward in the second term of reference. It should be:

physically confined, self maintaining, multitrophic, have a duration exceeding the generation time to the highest trophic level present, have a size sufficient to enable pertinent sampling and measurements to be made without seriously influencing the structure and dynamics of the system.

For practical purposes we decided to split the “experimental ecosystems” into the following size groups:

- microcosms; $< 1 m^3$
- mesocosms; between $1 m^3$ and $10^4 m^3$
- macrocosms; $> 10^4 m^3$

On a two dimensional scale, $1 m^2$ surface area was a convenient way of delimiting the difference between benthos micro- and mesocosms.

2. Experimental ecosystem designs must meet the particular demands of the envisaged needs, i.e. the degree of complexity proposed must match the scientific objectives of the exercise. All potential users should first, however, ask the question “Is an experimental ecosystem really necessary?”

3. Designs can, however, be tailored to the needs and resources of local scientific communities, especially if such systems are to be used by developing countries. However, we must be aware that the level of construction can be simple but the analysis of results obtained will be complex and sophisticated and is highly dependent on skilled manpower.

4. Proposed designs should include an indication of the advantages and disadvantages of the recommended systems, particularly the scientific and operational limitations.

5. Future developments are likely to include new technology and we must expect that a new generation of mesocosms could be more sophisticated, ore automated and more expensive. Such developments might be pursued through industrial involvement.

6. Two specific designs were detailed for which future needs are envisaged.

(a) Free floating open water systems where the main problem is longevity and survival. Ideally such systems should be subsurface. This will create great sampling problems and for the present, unless advanced technology is to be applied systems can only be used for short periods in calm water. It must be emphasized, however, that there are many uses for such limited systems.

(b) Sublittoral benthic systems present great problems in the simulation and translocation of a representative deep water benthic community. From what depths can properly functioning samples be taken and how realistic are ambient pressure simulations of such systems?

7. Designs should include both structural aspects and a conceptual framework for the systems. Ideally experimental ecosystems should be part of a suite of techniques applied during an investigation. In particular, they should complement parallel field measurements. Similarly, when specific hypotheses are being tested, much attention should be applied to careful statistical and experimental designs.

8. It was decided to prepare an "Experimental Ecosystem Manual" in which all currently known systems would be illustrated and design features and uses described. Examples will be given of the application of environmental ecosystems to date in the investigation of specific problems in biological oceanography, pollution and fishery research. It is hoped that this manual will serve as the guideline for future users of experimental ecosystems emphasizing the relative merits and draw-backs of each system.

9. It was felt that a colloquium on the most recent results from Experimental Ecosystems should be held in about two years time. The 5th International Congress in Ecology (INTECOL) to be held in Yokohama (Japan) in August 1990 would seem to be an ideal forum.

Conclusions

The working group decided that its most useful mission during the coming year was to prepare a draft manual on experimental ecosystems together with examples of procedures which have been followed in integrating mesocosm research into oceanographic programmes. For these two purposes, T.R. Parsons will initiate questions on experimental ecosystems design and U. Brockmann will initiate a document on integrated proceedings. These documents will be prepared and circulated to WG members.

Next Meeting

Professor Li Guanguo offered to host the second meeting of the working group in Qingdao, PRC at the Shandong University of Oceanography. The meeting would last 5 days from June 5 - 9 1989 and all participants in the first meeting are invited to attend.

If financial arrangements can not be made for a meeting in Qingdao, Dr. M. Pilson offered the University of Rhode Island as an alternate site.

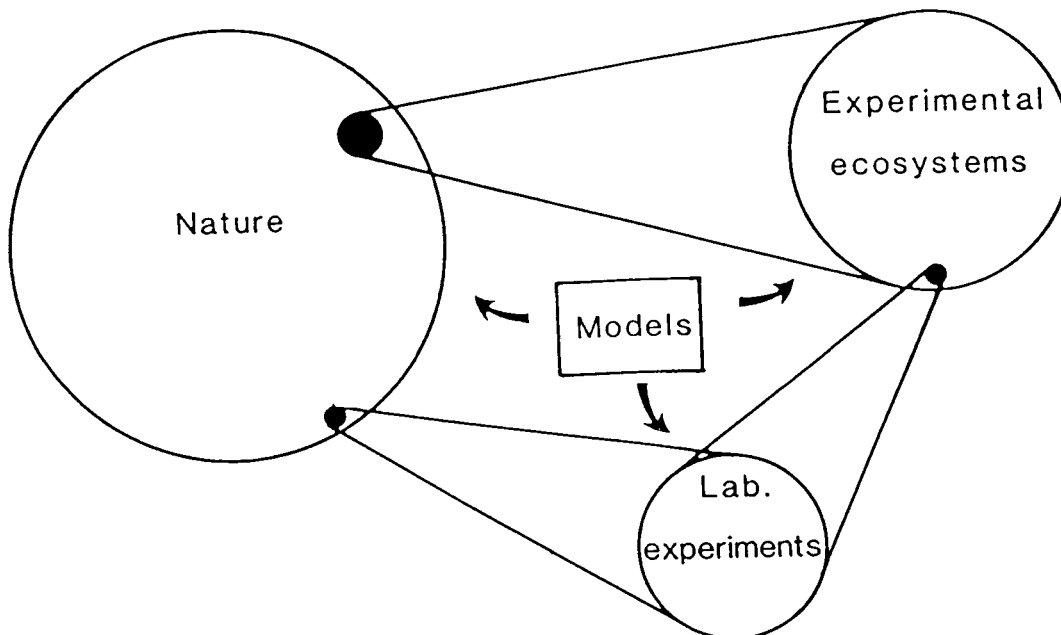


Figure 1: The position of experimental ecosystems in the framework of oceanographic research methodology.

ANNEX VI

WORKING GROUP 86

ECOLOGY OF SEA ICE

Sea-ice is a key Polar Ocean habitat. During its annual growth and decay it sweeps an area of approximately $16 \times 10^6 \text{ km}^2$ in the southern ocean and $7 \times 10^6 \text{ km}^2$ in Arctic seas. While interannual ice variability may be substantial for individual regions, the overall variability is probably less than 10%. The drifting pack ice comprises the majority of the ice cover with landfast ice making up less than 5%. Most of the ice in the southern ocean is less than one year old, while in the Arctic thick multiyear ice is a substantial fraction of total ice cover. Annual ice is about 0.5 to 1.5 meters thick and has a variable snow cover usually of less than 1 meter.

Multi-year pack ice has survived two summers and is predominantly thicker ($> 2\text{m}$) and less saline than annual ice. It is often rafted and overlain with snow from 0.5 to 2.5 meters in depth. Multi-year pack ice is confined predominantly to the western extremes of the Weddell Sea and the central Arctic basin. By contrast, continental fast-ice forms over relatively shallow waters and remains connected to the continent for most of its existence. Both pack ice and land-fast ice share common ice crystal structures, each containing large-grained (cm size) congelation ice and small-grained (mm size) frazil ice. Usually, southern ocean pack ice is composed primarily of frazil ice and fast ice of congelation ice. There is less frazil ice in the Arctic. Each ice type is formed in a different way. While the sea ice is often thought of as a "two dimensional" thin skin covering the surface of the ocean, in reality there can be considerable vertical relief both above and below the water as a result of the formation of pressure ridges and rafted ice floes. Ice topography is of considerable importance to the organisms associated with it. This is because the ice represents the largest quasi-continuous surface within the pelagic realm. The ice crystal surfaces and the structures they form create a substrate for the growth of microbial biofilms on the small scale and provides a foraging site for grazers and a refuge for prey organisms on larger scales.

For the purpose of the present discussion we define the *sea ice biota* as organisms at all trophic levels which live in, on, or are dependent upon the ice during part of all of their life cycles. Three groups of ice associated organisms can be identified: microbiota, macrobiota, and marine birds and mammals. The predominant group in terms of biomass is the microbiota (composed of bacteria, microalgae and protozoans). Macrobiota include: ctenophores, polychaete worms, copepods, amphipods, krill and several invertebrate larval forms. Adults of the fish *Pagothenia borchgrevinki* and *Boreogadus saida*, the Arctic cod, are known to live in the sea ice environment. Crabeater (*Lobodon carcinophagus*), Weddell (*Leptonychotes weddelli*), Ross (*Ommatophoca rossii*) and to a lesser extent, Leopard (*Hydrurga leptonyx*) seals spend most of their life associated with fast and pack ice. Of sea birds, only the Emperor penguin (*Aptenodytes forsteri*) breeds in this habitat, but Adelie penguins (*Pygoscelis adeliae*) and many flying birds - especially Snow and Antarctic petrels (*Paqodroma nivea* and *Thalassoica antarctica*) in the Antarctic and thick-billed murre (*Uria lomvia*) and black guillemots (*Cephus grylle*) in the Arctic - forage extensively in ice leads, polynyas and at the ice edge. Blue (*Balaenoptera musculus*) and Minke (*Balaenoptera acutorostrata*) whales are known to associate with the marginal ice zone and deeper pack ice, respectively.

Ice microbiota may become associated with ice by either passive (physical) or active biological processes. The microbiota found in fast and pack ice in part reflects the microbial assemblages present in the water column, or the benthos in shallow areas, over which the ice was formed. For instance, in continental pack ice areas neritic organisms and those associated with the benthos may be incorporated directly into the ice structure by physical processes such as ice nucleation scavenging and trapping. In shallow embayments at depths less than 30m , where anchor ice is present, large (m size) patches of sediments, and associated organisms can be lifted from the benthos by the buoyant forces of anchor ice to the overlying canopy of floating sea-ice. Subsequent to physical incorporation, further biological growth of individuals or populations may occur within the ice matrix, particularly in brine tubes, chambers and channels, but always in a liquid water microenvironment.

Mechanisms by which microbes adhere to ice crystals and colonize their surface are unknown at present, but presumably some extracellular adhesive substances permit attachment. Following the initial colonization by bacteria and microalgae, dense biofilms cover the ice surfaces at the ice-water interface. The mechanisms whereby ice is colonized by a variety of organisms constitute an important topic for future study.

All research on sea ice biota should ultimately contribute to answering the following question:

How does the growth, presence and recession of sea ice influence the biota of the Polar Oceans?

We need to understand how the presence of sea ice and seasonal ice dynamics influence community structure, specifically the seasonal changes in horizontal and vertical distribution of organisms (from microbes to whales). We must understand also how ice influences the nature and rates of biotic process in the ice, on the ice, and in the water column beneath or adjacent to the ice, in the open waters of the marginal ice zone and beyond to waters uncovered during the annual retreat.

Such an effort requires knowledge of the geophysical features of sea ice from mesoscale features to the microstructure of the ice fabric, the organic and inorganic chemistry of ice and brine inclusions and the optical properties of sea ice. While these topics are generally the domain of physicists and chemists, biologists must be aware of and focus on those aspects of these topics likely to influence the sea ice biota.

In general, there seem to be two types of processes which contribute to changes in the distribution of the biota. Physical processes appear to have significant influence on the lower trophic levels: ice nucleation, adsorption, and trapping of individual cells are examples of small-scale processes. At larger scales the melting of sea ice, stabilization of the water column and seeding of the water with actively growing microbes provide appropriate conditions for a subsequent ice-edge bloom. Waters seaward of the bloom and under the ice have lower biomass and biological activity. We need to determine the factors controlling the seasonal changes in the ice edge productivity in polar seas and large polynyas. We must understand how and how much ice edge blooms contribute to overall system production. Biological processes also influence the distribution of organisms with respect to the ice. Thus the range and densities of sea birds and seals vary seasonally with the waxing and waning of the pack ice habitat, but we know little about how their diet and foraging behaviour changes. The extent of the dependence of whales on the ice edge zone is particularly poorly known.

The rates and types of biological processes related to the carbon cycle are substantially influenced by the presence and dynamics of sea ice. This is best established for the microbiota, marine mammals and birds. Our knowledge is least for the ice macrobiota and we are still discovering what species, and in some cases phyla, are present in the ice.

Sea ice microbiota are likely to be of considerable importance seasonally, because they provide a source of microbial biomass which is highly concentrated and available to microbial and metazoan grazers.

Topics of interest include:

1. Interactions between ice bacteria and ice algae
2. Photobiology of sea ice microalgae
3. The dynamics of the microbial loop in ice

Primary and secondary microbial production is active seasonally even when under-ice water column production is nil. Fertile areas for research include how various physicochemical and biotic aspects of the sea ice habitat act in concert to control the growth and development of sea ice microbial communities.

Important physicochemical aspects are the influence of temperature, nutrients, light and salinity on rates of production. From the biological perspective we should investigate the physiological, biochemical, and molecular adaptations of the biota which have evolved to allow them to colonize and exploit the sea ice habitat.

Food web relations among the sea ice macrobiota are also unknown. The microbiota may be grazed by amphipods and krill. Ctenophores have been observed near ice floes actively feeding on small krill concentrated there. Little is known of the feeding ecology of the cryopelagic fauna or the behavioural adaptations of epipelagic fauna which exploit the resources of sea ice. Consequently there is little information on the diet and energy budgets of the seals, sea birds and whales characteristically associated with this zone. Dietary data from sea birds foraging in the pack ice zone will also provide valuable information on the distribution of sea macrobiota where conventional sampling methods have failed.

The group recognizes that much of the above information will not be collected without the development of suitable techniques for working in the ice. In particular, new methods are required for sampling the physical, chemical and biological properties in an under the pack ice. Conventional open sampling gear and methods are often totally inadequate for use in this zone. Future work is likely to rely increasingly on moored instruments (e.g., thermistors, optical instruments and current meters), on remote sensing from satellites and on specially designed packages, such as time-depth recorders which monitor diving behaviour of pack ice seals.

In conclusion, the group noted that there is now considerably enhanced research interest in Polar sea ice. The proposals by the SCAR Group of Specialists on Antarctic Sea Ice for an Antarctic Sea Ice Zone (ASIZ) research programme could offer considerable opportunities for research on biological processes. Interchange

of ideas between the SCOR Working Group 86 on Sea Ice Ecology and the Group of Specialists on Southern Ocean Ecology is of great importance.

As of late spring of this year the membership of WG 86 has been confirmed with the exception of a Soviet colleague whose appointment we await. The composition of WG 86 is as follows:

C. Sullivan (Chairman)	R. Horner
S. Ackley	T. Hoshiai
G. Dieckmann	L. Legendre
B. Gulliksen	M. Spindler

Our group has introduced itself by an exchange of vitae and collected reprints among its members. This will facilitate our getting to know one another through correspondence.

Four of our prospective members had an opportunity to meet briefly at the AGU Ocean Sciences Meeting in New Orleans. We discussed some plans for WG 86 and have begun to assemble a much needed "Bibliography of sea-ice organisms". At this time we have more than 300 citations in the bibliography.

Members of the group are currently charged with the following tasks:

1. Develop a list of major questions concerning the ecology of sea ice organisms which need to be addressed. Under each of the major questions (hypotheses) a listing of second order questions should be made. Each member is asked to elaborate an approach to address the questions posed.
2. Recommend experimental procedures for sampling sea ice and sea ice biota and analyzing samples with special consideration of problems related to their psychrophilic nature. Please point out what you perceive to be common pitfalls of published methods. Since sea ice ecologists are especially handicapped by a lack of suitable methods for sampling the ice environment to determine its physical, chemical and biological properties we can provide a great service to the community by "brainstorming" on the extant problems and possible solutions.
3. Develop recommendations for a terminology for sea ice biota and sea ice environments.
4. Describe Arctic and Antarctic facilities, platforms and research opportunities and their availability to scientists from other countries.

Future Meeting of WG 86

I propose to convene a meeting of Working Group 86 in Southern California or New Orleans (USA) for January 1990 to precede the ASLO/AGU Ocean Sciences Meeting. This meeting typically draws more than 1,000 oceanographers and, judging from recent meetings, we can expect at least 3 to 4 sessions related to polar ocean science. I would hope to complete the tasks described above and publish a report of the meeting within three months.

C. Sullivan

ANNEX VII

SCOR-IOC COMMITTEE ON CLIMATIC CHANGES AND THE OCEAN

The Ninth Session of the Joint Committee on Climatic Changes and the Ocean (CCCO) was held 11-17 May 1988 at Unesco, Paris, France. In contrast to CCCO-8 which was dominated by an assessment of the first two and a half years of TOGA, this session gave heavy emphasis to WOCE developments, particularly those relating to proposed institutional arrangements, the preparation of the Implementation Plan and the International WOCE Scientific Conference. Reports were provided to the Committee by its members, subsidiary bodies, and the Chairman of the WMO-ICSU Joint Scientific Committee (JSC).

The Committee recognized that the major thrust of CCCO activities up to the present has been to move WOCE and TOGA from the conceptual stage to implementation. With both of these programmes now actively progressing, CCCO has undertaken the task of re-examining its longer term goals. It was concluded at CCCO-9 that the terms of reference and the membership of its subsidiary bodies would have to be adjusted as these goals are clarified. The Committee planned to consider these changes during the intersessional period.

REPORT OF THE NINTH SESSION OF THE JSC

At its Ninth Session the JSC established a Global Energy and Water Cycle Experiment (GEWEX) as a major component of the WCRP and invited the CCCO to examine its implication from the oceanographic perspective as the JSC had done from the meteorological side. Though the programme is scheduled to start in 8-10 years it was considered a matter of some urgency that CCCO consider the systems for undertaking the GEWEX ocean component that WOCE will not. The JSC also established a study group which will focus on radiatively-active gases (RAGS). The JSC invited the CCCO's assistance in considering the exchange of CO₂ and other RAGS over the ocean. The Committee agreed to consider GEWEX at its tenth session.

TROPICAL OCEAN GLOBAL ATMOSPHERE (TOGA)

The Seventh Session of the TOGA Scientific Steering Group (SSG) was held in Cairns, Australia, 11-15 July, 1988. Progress continues to be made in developing the observation systems in all three oceans. The SSG's great interest in a preliminary proposal to vastly increase the number of ATLAS-type moored buoys by as many as 60 in the Pacific reflects the realisation that improved in-situ observations of the wind field and thermal substructure are required to quantify the net heat fluxes necessary to improve the performance of coupled models. In addition, it was agreed that effort should be devoted to improving analyses of the low-level atmosphere if atmospheric models are going to produce better surface fluxes. The potential benefits were considered for establishing means, perhaps ships of opportunity, for acquiring the surface salinity field (and later, with the new XCTD's, the subsurface structure) for deriving dynamic heights and for model calculations of heat fluxes. The SSG also endorsed an ambitious proposal by U.S. scientists, with possible support of Australian, Japanese, Chinese and French scientists, to carry out a Coupled Ocean Atmosphere Response Experiment (COARE) during 1991-1992. Its goal is to better understand the physical processes which maintain the mean and transient states of the warm pool regions of the western Pacific.

Operational near-real-time ocean modelling is now underway by French oceanographers for the Atlantic Ocean. Model runs assimilating FOCAL/SEQUAL data have compared well with USSR SECTIONS data. Beginning in 1989, it is planned, as part of TOGA, to run the model regularly to provide a "real-time" monthly description of oceanic conditions as is currently done in the Pacific.

Recent statistical studies fail to substantiate claims of correlations between the position of the Atlantic Inter-Tropical Convergence Zone (ITCZ) and Sahelian rainfall. Further work needs to be done to establish unambiguously the relationship of SST's to tropical droughts.

Impressive progress can be reported in the Indian Ocean with the near completion of the TOGA tide gauge network by Professor Wyrtki; the development of new XBT lines by Mauritius and Pakistan, USSR oceanographic studies of air-sea interaction; and the contributions of Australian and French regional studies. The Indonesian throughflow studies, however, were curtailed due to research vessel inaccessibility to Indonesian waters caused by an unsuccessful access request. The first attempts at numerical modelling in the Indian Ocean were initiated by Florida State University and the Oxford University Group. The results again emphasize that poor resolution of the heat fluxes is a major problem.

The SSG took an important philosophical step that took notice of the fact that TOGA has been largely Pacific Ocean and ENSO oriented. It decided to propose an enlarged charter for the JSC/CCCO TOGA

Numerical Experimentation Group (NEG) which would also encompass atmospheric variability on all TOGA time scales, including the 30-60 day oscillations. It was anticipated that this would aid in leading the focus of TOGA away from this limiting orientation. Another important step, often previously deferred, was taken with the decision to establish a study group that would plan for an eventual reanalysis of the entire ten-year TOGA data set, including all delayed data, using the most advanced models and algorithms. There is accumulating evidence that many initial analyses were flawed in ways that are now, or eventually will be correctable.

WORLD OCEAN CIRCULATION EXPERIMENT (WOCE)

The WOCE SSG met twice, once in Washington (17-20 Nov 1987) and once in Wormley (11-13 Apr 1988). The focus of both those meetings was to reach decisions regarding proposed institutional arrangements and the contents of the Implementation Plan. The Plan which includes a proposed management structure was prepared in two volumes. The first outlines the WOCE goals and a strategy for meeting them. Details on field programmes, modelling, data management, and resources required are presented as well. The second volume describes the three Core projects and the scientific rationale leading to the field programmes adopted in the Plan. The Plan was completed in July for subsequent printing and distribution and will be a key document for the jointly sponsored IOC-WMO-ICSU-SCOR International WOCE Scientific Conference.

As facilitating forerunners to the Conference, regional WOCE workshops were held in Qingdao, China (6-8 April 1988) and in Buenos Aires, Argentina (18-22 July 1988) to assist developing countries in the regions to organize themselves for making a coordinated contribution to WOCE. The success of these workshops has stimulated planning for others; the next one will likely be in Singapore in early 1989.

The International WOCE Scientific Conference will be held at Unesco, Paris (28 Nov-2 Dec 1988). Organizational arrangements including programme agenda, speaker invitations, and local administrative support are well underway.

The specific objectives of the Conference will be to:

- (i) review and explain the scientific purposes of WOCE;
- (ii) outline the plan for the implementation of WOCE
- (iii) identify means by which countries can contribute to WOCE;
- (iv) identify major resource commitments as well as gaps and how the latter can be overcome;
- (v) review additional requirements for WOCE, including data submission and distribution, access to ports and scientific data from Exclusive Economic Zones; and
- (vi) examine institutional arrangements for WOCE.

The subject of institutional arrangements for WOCE was actively debated at the Twenty-first Session of the Executive Council (Paris, 7-15 March 1988) where the IOC adopted resolution EX-XXI.1. The resolution requested or invited a series of actions regarding consultation and recommendations on institutional arrangements for WOCE. Included are:

- (i) a joint proposal by the Chairmen of the IOC Technical Committee on Ocean Processes and Climate (TC/OPC), SCOR-IOC CCCO, and JSC-CCCO WOCE SSG to the International WOCE Scientific Conference;
- (ii) consideration by the International WOCE Scientific Conference;
- (iii) consultation between the Chairman IOC and the President of SCOR prior to the Fifteenth Session of the IOC Assembly; and
- (iv) consideration and a report by the TC/OPC to the IOC Assembly for its consideration.

Institutional arrangements for WOCE have thus far been the subject of much discussion involving a number of complex issues.

The continuing uncertainty regarding an NSCAT launch and the issue of costs to WOCE investigators for ERS-1 data were areas of concern. Negotiations with Japan to orbit NSCAT on its ADEOS satellite and with ERS-1 managers on resolving the cost-of-data issue are on-going.

WOCE-TOGA ISSUES

Certain aspects of climate variability are not covered by either WOCE or TOGA, particularly climate variability on time scales up to a decade. WOCE is global but does not take into account variability, being mainly a "snapshot" description of ocean circulation. On the other hand, TOGA is focussed on the tropical ocean upper layer and its coupling to the atmosphere. The CCCO Tropical Atlantic Panel recognized

that additional efforts were needed to address this gap. Accordingly, the Panel is evolving plans for an experiment covering the whole Atlantic, that would complement existing WOCE and TOGA plans, and map the evolution of the ocean circulation at basin scale. Such an experiment would allow testing of hypotheses based on meridional heat transport that address unexplained long-term large-horizontal-scale SST anomalies that appear in the historical data.

OCEAN CARBON DIOXIDE PROGRAMME

It was agreed at CCCO-9 that the draft CO₂ proposed programme had already become outdated and that a revised version should be produced before distribution as a working document. It was further recognized that the terms of reference of the CO₂ Panel should be revised in light of the developing interrelationships with JGOFS. The principal change incorporates a statement to "work co-operatively with JGOFS to ensure adequate measurement of satellite ocean color, in-situ biological measurements, dissolved organic carbon and related carbon system measurements, and sediment flux". Membership changes were also planned. On the technical side, a gas extraction/coulometry approach was strongly endorsed. The method has been expedition-proven to yield a precision of \pm micro mole CO₂/kg making it possible to acquire a data set which meets the goals of the programme.

AIR SEA FLUXES

Following a meeting in New Orleans, 4-9 January 1988, the JSC/CCCO working group on Air Sea Fluxes developed a Global Data Assimilation Programme for Air Sea Fluxes. It consists of two phases. The preparatory phase (1988-1990) will be devoted to a series of studies on methods for assimilating data, particularly new forms of satellite data; the dependence of satellite sensor algorithms on the assimilation scheme; and the interdependence of wind and wave data on both the algorithms and the assimilation scheme. The second phase, the fully operational phase (1991 onwards), will produce 6-hourly flux fields at about 1° × 1° resolution, consistent with the then operational global forecast models. The assimilation scheme should encompass all relevant microwave data including both wind and wave information. This phase will be preceded by a test phase which would coincide with the calibration and validation phase of ERS-I.

The Committee noted that the working group was fulfilling its charge but expressed concern that certain questions were being left unaddressed. Japanese scientists, for example, have recently shown that the wave-stress relationship employed by the working group was clearly inconsistent with the results of careful field experiments. The working group will consider this and other field work that may have bearing on its work.

OCEAN OBSERVING SYSTEM DEVELOPMENT PROGRAMME (OOSDP)

The OOSDP Group met in New Orleans, 9 January 1988. The VOS pilot study, the initiation of which was stimulated by the Group, has developed a plan to establish a subset of at least 50 of the Voluntary Observing Ships (VOS) operating in the North Atlantic which have a good record of reporting. Recruitment of these ships is currently underway to include them in the VOS Special Observation Programme - North Atlantic (VSOP-NA). The objective is to quantify the improvement in data accuracy which could be achieved from the VOS fleet of the World Weather Watch. CCCO endorsed this effort and also endorsed the maintenance of a climate satellite data base which the Group began as a pilot effort. Some means needs to be found to maintain and distribute it regularly.

PALEOCLIMATOLOGY

The Paleoclimatology Panel reported on several noteworthy findings.

- (i) The Vostok record of atmospheric CO₂ indicates high CO₂ (280 ppm) during interglacial times and low CO₂ (200 ppm) during glacial maxima.
- (ii) A reconstruction of the global deep water circulation was deduced from the distribution of C-13 in the shells of benthic foraminifera. Deep water formation occurred in the North Atlantic but not in the Norwegian Sea which remained ice-covered year round. Intermediate water was formed in the North Atlantic from the Mediterranean outflow and from sinking waters south of the polar front. A deep front in the Indian Ocean separated well oxygenated intermediate waters from cold, poorly oxygenated deep water.
- (iii) Accelerator mass spectrometry offers a new way to obtain a C-14 age from the climatic record of deep sea sediments. Comparison of C-14 ages of benthic and planktonic foraminifera in Pacific cores indicates the ventilation rate of the ocean changed from about 2000 years during glacial times to about 1500 years during the last 10,000 years. A North Atlantic core indicates deglacial warming (10° off Portugal) occurred in less than four centuries about 12,000 years ago. Evidence of such an abrupt climate change is also being found in Pacific cores.

(iv) A time-dependent, two dimensional model of the climatic system with an interactive ocean, atmosphere, cryosphere, and continent was run with forcing by insolation varying according to the Milankovitch model. The continental ice volume simulated was in agreement with the geological and isotopic record.

CCCO MEMBERS

Several changes in the membership of CCCO have taken place or will take place in the next several months. R. Stewart, J. Barberan and G.P. Kurbatkin saw their terms end with the completion of CCCO-9. R. Stewart will continue as an officer by virtue of having been the ex-Chairman. J. Willebrand was elected as Vice-Chairman (replacing J. Barberan), with R. Chesselet continuing as the other Vice-Chairman.

WORK PROGRAMME AND RESOURCES

The planned CCCO Work Programme for 1989 (see attached table) will require a minimum of \$235,000.00. This estimate is based on the assumption that some of the participants in CCCO activities provide their own support. The CCCO Secretariat is supported by the U.S.A. (2) and France (1); the International WOCE Planning Office by Canada (1), U.K. (1) and FRG (1); the International TOGA Project Office by the U.S.A. (1), U.K. (1) and France (1).

In May 1988, CCCO was informed that the U.S.A. would terminate the secondment of Mr. Alexiou in August 1988 with no planned replacement. Arrangements are currently being pursued with the U.S. agencies involved and Mr Alexiou which would result in the extension of the U.S. secondment through November 1988 and the subsequent establishment of U.S. funded contractual staff support to the CCCO. Inquiries to other potential international sources of support are also being made. The Secretary CCCO was also informally notified that the French secondment (arranged via ICSU/SCOR) would likely be decreased from a full to half-time position commencing in October 1988. The projected staff reductions come at a time when increasing staff support could be justified to maintain support of existing CCCO programmes, advance WOCE into its implementation phase, and develop oceanographic components within JGOFS, GEWEX and other international programmes. The projected decrease in CCCO Secretariat staff will seriously impact the level and quality of support to the Committee.

ANNEX VIII

COMMITTEE FOR THE JOINT GLOBAL OCEAN FLUX STUDY (JGOFS)

During the twenty-eighth meeting of the SCOR Executive Committee in Zurich, October 19 and 20, 1987 it was agreed that SCOR should sponsor the Joint Global Ocean Flux Study (JGOFS) and should take lead in its planning and execution. It was agreed that the time-scale and the scope of topics to be addressed within JGOFS are too broad to be covered by a traditional SCOR working group. It was agreed that the planning for JGOFS required the establishment of a new SCOR Committee. Such a Committee would be able to establish sub-groups for specialized tasks, should consider the establishment of its own secretariat when necessary, and should have a rotational membership plan. A roster of fifteen members was approved; it was felt that this was the minimum size to ensure adequate representation of the scientific disciplines relevant to JGOFS and of the countries with established programmes of flux studies. The following terms of reference were approved by the Executive Committee.

- To identify the fundamental scientific issues and detailed goals and objectives for an international Joint Global Ocean Flux Study.
- To develop a scientific plan and to establish requirements for carrying it out.
- To recommend the necessary actions to be taken to implement the plan and coordinate and manage the resulting activities.
- To collaborate, as appropriate, with other related programmes and planning activities.
- To report regularly to SCOR and related bodies on the state of planning and accomplishment of JGOFS.

Finally, the SCOR Executive meeting agreed that these decisions should be ratified by the XIX General Meeting of SCOR in 1988 and that the Committee for JGOFS should be subject to the usual biennial review process provided for in the SCOR Constitution, beginning in 1990. Following the Executive Committee meeting, the membership of the Committee for JGOFS was finalized by the President in consultation with the SCOR Officers, as follows:

Chairman:	B. Zeitzschel	FRG
Vice-Chairman:	P. Brewer	USA
	H. de Baar	Netherlands
	O. Brown	USA
	S. Calvert	Canada
	K.L. Denman	Canada
	J.C. Duplessy	France
	H. Elderfield	UK
	R. Eppley	USA
	M. Fasham	UK
	I. Koike	Japan
	K. Kremling	FRG
	J.F. Minster	France
	T. Platt	Canada
	D. Hu	China
	S.B. Tambiev	USSR

For each meeting of the JGOFS Committee, an IOC/GIPME representative will be invited to ensure the liaison referred to above.

Corresponding Members:

J. McCarthy, Chairman	ICSU Scientific Committee on the Geosphere-Biosphere Programme.
T. Nemoto, Member	ICSU SCGB.
S. Krishnaswami, Chairman	SCOR WG 71, Particulate Biochemical Processes.
M. Andreae, Chairman	SCOR WG 72, The Ocean as a Source and Sink for Atmospheric Constituents.
C.S. Wong, Chairman	SCOR WG 75, Methodologies for Oceanic CO ₂ Measurements.
R.F.C. Mantoura, Chairman	SCOR WG 78, Determination of Photosynthetic Pigments in Seawater.
E. Sundquist, Chairman	SCOR WG 79, Geological Variation in Carbon Dioxide and the Carbon Cycle.

M. Whitfield, Chairman SCOR WG 80, Role of Phase Transfer Processes in the Cycling of Trace Metals in Estuaries.

A. McEwan, Chairman SCOR/IOC Joint Committee on Climatic Changes and the Ocean.

The SCOR Committee for the Joint Global Ocean Flux Study had its first session in January 1988 in Miami (Report of the First Session of the SCOR Committee for JGOFS, SCOR 1988). The meeting reviewed the individual and national programmes of flux studies as well as other programmes related to JGOFS such as the World Ocean Circulation Experiment (WOCE), the International Geosphere-Biosphere Programme (IGBP), the International Global Atmospheric Chemistry Programme (IGAC) as well as Satellites and Remote Sensing Programmes. The main discussion, however, concentrated on the development of a JGOFS Science Plan. It was agreed that the development of a Science Plan for JGOFS should be given very high priority. Such a document would be useful for presentation to the funding agencies in many countries, and more importantly, would provide the Committee itself with the necessary background information for the further development of detailed plans for JGOFS.

The format of the Science Plan for JGOFS was determined as follows:

(1) Introductory section with historical perspective, rationale and restatement of original goal.

(2) Expansion of the original goal into a series of detailed scientific objectives to be addressed by JGOFS. In addition to the improvement of estimates of new production, other examples of such problems may be the ways in which carbon is partitioned into various pools in the ocean, the relationships between total production and new and recycled production, the importance of secondary production, bacterial production and grazing in the carbon cycle, the effects of seasonality on fluxes, the effects of boundaries such as the ocean bottom (burial and resuspension) or continental margins on the global balances of biogenic substances, the effects of advection and mesoscale eddies on chemical cycles, etc.

(3) Definition of the technical problems which need to be solved in order to achieve the objectives outlined in (2). These may include such topics as the use of satellite data which provide an essentially two-dimensional view of the ocean, data assimilation, the constraints on modelling for JGOFS and the identification of location or time-dependent effects such as margins, upwelling, dust storms and monsoons.

(4) An inventory of the tools and resources which are available to solve the problems defined in (3).

(5) A discussion of gaps in available technologies for solution of the problems defined in (3). The Committee was of the opinion that some of these gaps may be filled in the near future as the development of certain instruments and methods progresses. A sub section of this chapter will deal with those technical problems for which the lack of appropriate tools will prove to be an obstacle to their solution in the foreseeable future.

(6) What are the appropriate strategies to meet the various scientific objectives of JGOFS? Some will require an emphasis on time series studies, while other aspects of JGOFS can best be addressed through a series of process studies. Still others will require larger-scale experiments at the ocean-basin level, or even extrapolation to the global scale as satellite ocean colour sensors are launched in the next decade. Many of the JGOFS objectives will necessitate the development of new or improved models and the Committee agreed that modelling activities should be emphasized in the Science Plan.

(7) The final chapter will present preliminary ideas on the implementation of the Science Plan and the logistics required to put the Plan into operation. In deciding to include such information in the Science Plan, the Committee felt that it should demonstrate immediately that JGOFS is operationally feasible, but recognized that detailed plans as to its actual implementation would be unrealistic and very premature at this stage.

The Committee reviewed the recommendation of the North Atlantic Planning Workshop (SCOR. Sept. 1987) that there should be a Pilot Study in 1989, taking advantage of various national plans for field programmes in the North East Atlantic along the 20 degree W transect. In reviewing these goals, it was agreed that the Pilot Study, while it is a very important activity, ought not to become the *raison d'être* for the JGOFS Committee itself in the critical early stage of its existence. It was recognized, however, that many issues such as data management, modelling and intercalibration will need to be addressed both *vis-a-vis* the Pilot Study and for JGOFS in general. An important function for the JGOFS Committee itself will be to ensure that the necessary post-cruise Pilot Study activities (such as data analysis workshops) are conducted and that rigorous evaluation of the Pilot Study takes place in 1990 in order that the lessons learned in the Pilot Study are transferred to other parts of JGOFS. The scientific objectives of the JGOFS North Atlantic Pilot Study were finalized at a Meeting of the Cruise Coordinating Committee in Plymouth in April 1988 (SCOR. Report of the First Meeting of the Cruise Coordinating, Plymouth, UK. 1988). The overall objective of the

Pilot Study will be to study aspects of the carbon cycle and related biochemical cycles with reference to the evolution of the spring phytoplankton bloom and its northward passage along 20 degree W, with the goals of:

- Laying the operational basis for a ten year international study of ocean biochemical fluxes (JGOFS).
- Working towards an essential set of core measurements for biochemical flux studies to be made by standardized procedures, thereby improving the compatibility of observations made by different national programmes.
- Testing and developing procedures at the international level for data management, archiving and exchange and incorporation of these data into the next generation of models.
- Development and testing of techniques for measuring essential biogeochemical properties not presently observable by routine methods.
- Collecting information required to improve assimilation of remotely-sensed data into oceanic biochemical flux studies.

During its first Meeting in Miami the Committee for JGOFS also discussed the establishment of JGOFS Working Groups.

DATA MANAGEMENT

The Committee agreed that a working group on data management was required immediately and that data issues relative to the Pilot Study must be addressed on an urgent basis. The following terms of reference were drafted for the JGOFS Working Group on Data Management:

- To develop, test, and implement timely data exchange methods between the national groups participating in the JGOFS North Atlantic Pilot Study.
- To formulate a strategy to develop and distribute a historical archive of global biogeochemical data for the ocean. A trial effort should focus on in situ and satellite surface pigment and primary productivity data for the global ocean.
- To liaise with international programmes and organizations such as WOCE, IGAC, IOC, SCGB, TOGA and appropriate data centers.
- To develop, test, and implement timely data exchange methods between the national groups participating in JGOFS studies.

Specifically, the WG will address the following issues and will recommend appropriate actions to the JGOFS Committee:

- Determine the need for a uniform data submission and access policy to facilitate JGOFS cooperative efforts.
- Select a format for JGOFS data exchange.
- As the need arises take special action to facilitate data exchange between JGOFS national groups.
- Evaluate data systems which would facilitate collection of, and access to, historical and newly collected observations of interest to JGOFS.
- Determine the utility of centralized JGOFS data center(s) versus a distributed data system architecture.

The following membership was established during discussions immediately after the JGOFS Committee meeting:

T. Platt	Canada (Chairman)
G. Flierl	USA
M. Jones	UK
G. White	Canada

In order that other countries participating in JGOFS will be represented, members of the JGOFS Committee from France, Japan, China, FRG and the Netherlands have been asked to make nominations to the Data Management Working Group.

MODELLING

The North Atlantic Planning Workshop had recommended the formation of a JGOFS WG on Modelling which should identify the types of models needed for JGOFS, explore the usefulness of theoretical models in JGOFS experimental design and promote the development of simple and more complex coupled biological, physical and chemical models for JGOFS. The meeting agreed that some modelling issues did demand the

attention of such a working group in the near future and that a fairly narrow set of terms of reference would be appropriate. These were approved in correspondence soon after the meeting:

- The Working Group will have the responsibility for identifying and fostering a community of modellers interested in modelling the biological and chemical fluxes of interest to the JGOFS enterprise, and for developing good two-way communication between modellers and observationalists. It will also have the responsibility of liaising with the modelling groups in the IGBP and WCRP programmes.
- In the short term, the WG should review existing models to determine which biogeochemical and physical parameters and fluxes appear to be most critical in controlling the global distribution of CO₂, nutrients and other biogenic tracers.
- In the longer term, the WG should investigate the shortcomings of models and identify the theoretical and observational requirements for the next generation of JGOFS models, including the interface with globally coupled ocean-atmosphere models.

The membership of the JGOFS WG on Modelling was determined as follows:

M. Fasham	UK (Chairman)
T. Platt	Canada
G. Evans	Canada
J. Sarmiento	USA
G. Radach	FRG
H.G. Fransz	The Netherlands

In order that other countries participating in JGOFS will be represented, members of the JGOFS Committee from France, Japan and the USSR have been asked to make nominations to the Working Group.

REMOTE SENSING

The North Atlantic Planning Workshop made a strong recommendation that the JGOFS Committee make a strong and persistent effort to convince space agencies of the necessity of approving the timely launch of a satellite ocean colour mission. In addition, the continued efforts to analyze and archive CZCS data and to develop associated algorithms should be encouraged. Dr. Otis Brown accepted the Committee's request to act as Rapporteur on satellite issues and invited members to forward information to him.

FUTURE ACTIVITIES

The Second Session of the Committee for JGOFS will be hosted by the Royal Netherlands Academy of Sciences in The Hague, The Netherlands from 13 through 15 Sept. 1988. Planning Meetings for the JGOFS Pilot Study are scheduled for the 16-17. Sept. in The Hague and for the 3-4. Dec. in Moss Landing USA. Scientific presentations were encouraged by the Committee on JGOFS at the ASLO-Meeting Jan. 1988 (New Orleans), JOA Aug. 1988 (Acapulco) and ASLO-Meeting Dec. 1988 (San Francisco).

Relevant SCOR Publications of the Joint Global Ocean Flux Study:

- Background, Goals, Organization, and next Steps. SCOR, February 1987, 42 pp
- North Atlantic Planning Workshop. SCOR, September 1987, 133pp
- Report of the First Session of the SCOR Committee for the Joint Global Ocean Flux Study Miami, January 1988, SCOR, 50pp
- Report of the first Meeting of the JGOFS Pilot Study Cruise Coordinating Committee Plymouth, U.K. April 1988, SCOR, 23pp

ANNEX IX

FINAL FINANCIAL STATEMENT, 1987

(U.S. dollars)

BALANCE, Jan. 1, 1987	110,740.00
INCOME	
Membership	120,737.00
IOC Contracts	16,000.00
UNESCO Contracts	14,000.00
Grant from ICSU	40,000.00
NSF Grants	68,780.00
Can. gov't contract	2,974.00
U.K. Subvention	16,469.00
U.S. grant re CCCO Sec.	40,000.00
Misc. & Interest	1,656.00
TOTAL INCOME	<u>320,616.00</u>
TOTAL CASH PLUS INCOME	<u>431,356.00</u>
EXPENSES	
WG 51	784.00
WG 54	5,000.00
WG 65	1,711.00
WG 69	11,282.00
WG 72	5,063.00
WG 73	(63.00)
WG 79	581.00
WG 83	3,780.00
WG 88	1,989.00
CCCO	56,768.00
CCCO Chmn's Travel	3,053.00
CCCO Secretariat	40,000.00
JPOTS	7,149.00
Total Subsidiary Bodies	137,097.00
Related Scientific Activities	
Exec. & Gen. Mtg.	13,298.00
Publications	9,345.00
Representation	11,043.00
JOA Planning	20,255.00
JGOFS Planning	28,488.00
Conferences	678.00
Travel Grants	31,201.00
	114,308.00
Administrative Expenses	
Salaries and Benefits	40,858.00
Communications	9,045.00
Audit	1,084.00
Office Equipment	869.00
Misc. Exp.	2,093.00
Bank Chgs. & Loss on Exch.	717.00
Total Admin. Expenses	<u>54,666.00</u>
TOTAL EXPENSES	<u>306,071.00</u>
BALANCE, Dec. 31, 1987	<u>125,285.00</u>
TOTAL CASH PLUS EXPENSES	<u>431,356.00</u>

ANNEX X

CONSTITUTION OF THE SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH

PURPOSE AND FUNCTIONS

1. SCOR is a Scientific Committee of ICSU. Its purpose is to further international scientific activity in all branches of oceanic research. To achieve this purpose, SCOR should perform the following functions:
 - (a) Examine problems of oceanic research and identify elements that would benefit from enhanced international action. For this purpose, organize scientific meetings on topics of broad interest and importance for progress in the marine sciences. Develop plans for appropriate kinds of international action and promote their implementation.
 - (b) Establish working groups or other kinds of subsidiary bodies, either alone or in conjunction with other appropriate organizations, for detailed examination of problems related to international ocean activities and studies of the marine environment, including improvement of scientific methods, design of critical experiments and measurement programs, and relevant aspects of science policy.
 - (c) Foster recognition of the contribution of individual marine scientists and laboratories, bringing to their attention specific problems requiring their consideration and encouraging an adequate level of support for their activities.
 - (d) Ascertain the views of marine scientists and interested ICSU bodies on scientific aspects of international ocean activities, and represent these views in appropriate international discussions. Develop support among marine scientists for international ocean research programs.
 - (e) Cooperate with national and international organizations concerned with scientific aspects of ocean affairs. Review and comment on scientific aspects of international ocean programmes. Co-operate with and support Affiliated Organizations and interrelate their activities with those of SCOR.

MEMBERSHIP

2. SCOR is composed of three categories of members:
 - (a) Nominated Members
 - (b) Representative Members
 - (c) Invited Members
3. Nominated Members are nominated by Committees for Oceanic Research, as defined in Article 6 (a). In order to provide broad disciplinary representation, each such body may nominate up to three scientists as Nominated Members.
4. Representative Members are the elected Presidents and Secretaries of Affiliated Organizations (ex-officio), the Chairmen of active SCOR Subsidiary Bodies (ex-officio), the SCOR Scientific Rapporteurs (ex-officio), and the nominees of ICSU and of its Scientific Unions and its Scientific and Special Committees that wish to participate in SCOR.
5. Invited Members are individual marine scientists who have been invited by the Executive Committee from countries that have not established a Committee for Oceanic Research.

ORGANIZATIONAL RELATIONSHIPS

6. In cooperation with organizations concerned with the scientific aspects of ocean affairs, SCOR will maintain particularly close relationships with the following kinds of organizations and will invite their representatives to appropriate meetings:
 - (a) Committees for Oceanic Research which have been accepted as appropriate adhering bodies to SCOR. Only one such adhering body per country or group of countries shall be admitted to SCOR except where a General Meeting decides otherwise.
 - (b) Affiliated Organizations as defined in Article 7.
 - (c) Sponsoring Organizations which are intergovernmental organizations that provide financial support and other services to SCOR or for which SCOR may perform functions specified by mutual agreement.
 - (d) Corresponding Organizations are other international organizations designated by SCOR and wishing to associate their activities with those of SCOR.

7. **Affiliated Organizations** are international non-governmental organizations devoted to some aspect of marine science and engineering and wishing to interrelate their activities with those of SCOR. Upon designation of such organizations by SCOR, their elected Presidents and Secretaries will become Representative Members of SCOR (Article 4); their Presidents will become ex-officio members of the Executive Committee (Article 8). These organizations will normally maintain their usual links with their parent bodies. They will collaborate with SCOR in organizing scientific meetings and other appropriate activities, will assist SCOR in evaluating scientific problems related to intergovernmental programs, and will help in identifying experts to serve on SCOR working groups and other subsidiary bodies. They will meet jointly with SCOR in oceanographic assemblies, in addition to holding their own meetings.

EXECUTIVE COMMITTEE

8. The Executive Committee of SCOR shall consist of elected, ex-officio and other members determined in the following manner:
 - (a) at General Meetings, SCOR shall elect from its Nominated Members a President, three Vice-Presidents and a Secretary;
 - (b) the Past President is a member of the Executive Committee;
 - (c) the President of each Affiliated Organization shall be an ex-officio member of the Executive Committee;
 - (d) the Executive Committee may co-opt up to two additional members to undertake specific responsibilities each for a period not exceeding four years.
9. The term of the office of the President is four years and he is not eligible for re-election for a consecutive term. The terms of office of the Vice-Presidents and Secretary are two years and they are eligible for re-election provided not more than three terms of office are served consecutively.
10. The Executive Committee shall be responsible for dealing with all matters concerning SCOR's work between General Meetings.

SUBSIDIARY BODIES

11. Working groups and other subsidiary bodies may be established at any General or Executive Meeting on the basis of proposals from Members, Committees for Oceanic Research, or Affiliated or Sponsoring Organizations. Subsidiary bodies may be sponsored by SCOR alone or jointly with other organizations prepared to contribute toward their support. In consultation with other sponsors, the Executive Committee is responsible for formulating appropriate terms of reference and for selecting members and chairmen.
12. At General Meetings, the progress of each subsidiary body will be reviewed, and a decision will be made on its continuation or reconstitution.

MEETINGS

13. General Meetings will normally be held at two-year intervals; between General Meetings, there will usually be one meeting of the Executive Committee. At appropriate intervals, the General Meeting of SCOR will be held in conjunction with a Joint Oceanographic Assembly, organized by SCOR in collaboration with the Affiliated Organizations and other appropriate bodies.
14. The agenda of General and Executive Meetings will normally be submitted to Members, Committees for Oceanic Research and Affiliated and Sponsoring Organizations at least two months in advance of the date of such meetings. Recipients may present additional items for inclusion in the agenda.
15. Authorized travel and subsistence expenses incurred by members of the Executive Committee in attending meetings of that body may be paid by SCOR. However, SCOR funds shall not normally be used to pay such expenses for the participation of Members in General Meetings.

FINANCE

16. Funds for the administration and activities of SCOR may be received from its Committees for Oceanic Research, ICSU and its constituent bodies, UNESCO and other Sponsoring Organizations, foundations and other sources. These funds may be deposited with ICSU or in designated SCOR accounts.
17. The President and/or Secretary, together with the Executive Secretary shall prepare budgets, which will include estimates of the contributions required from its Committees for Oceanic Research and Sponsoring Organizations; budgets shall be forwarded to ICSU for information.

18. The President or Secretary shall be responsible for budgetary control. The President or Secretary shall inform the Executive Committee of the financial situation of SCOR if necessitated by a foreseeable deficit. The Executive Committee shall be consulted on all questions concerning the search for additional resources.
19. At every annual meeting (General and Executive Committee), an *ad hoc* Finance Committee comprising two Nominated Members, not members of the Executive Committee, together with the Treasurer of ICSU ex-officio, shall be established to examine and to report on financial statements and budget estimates.
20. Accounts shall be maintained in accordance with regulations established by the officers of ICSU. Audited accounts shall be submitted annually to the Treasurer of ICSU.

GENERAL

21. For the purpose of elections and other occasions when a vote is taken at a General Meeting, only one Nominated Member from each Committee for Oceanic Research shall have a vote. One Representative Member from each Affiliated Organization may also vote.
22. For any questions not covered by this text, the ICSU Statutes and Rules for Scientific and Special Committees will apply.
23. This Constitution can be amended by agreement of the two-thirds of voting members, as defined in Article 21, present and voting at a General Meeting, with subsequent approval by ICSU.

Adopted at the Tenth General Meeting of SCOR in Tokyo, September 1970. Amended by the Thirteenth General Meeting of SCOR in Edinburgh, September 1976, by the Fifteenth General Meeting of SCOR in Woods Hole, September 1980 by the Seventeenth General Meeting of SCOR in Roscoff, France, October 1984 and the Nineteenth General Meeting in Acapulco, September 1988 (pending approval by ICSU).

ANNEX XI

ICES REPORT TO SCOR

Many ICES activities contribute to SCOR's purpose "to further international scientific activity in all branches of oceanic research". An occasional project is joint with SCOR (e.g., JPOTS) and others may overlap, compete with, or replace similar SCOR activities. Mutual knowledge of programmes should improve the effectiveness of both organizations.

ICES has long experience with organizing scientific meetings and publishing their results. ICES and AOSB sponsored the Symposium on Marine Sciences of the Arctic and Sub Arctic Regions in Santander, October 1987. The proceedings will be published by ICES in a volume of the *Rapports et Proces-Verbaux* with G. Hempel as Editor. A Symposium on Early Life History of Fish will be held in late September 1988 prior to the Statutory Meeting in Bergen. Also, ICES is a cosponsor of the Joint Oceanographic Assembly and has offered to publish papers from three of the JOA Symposia.

Much of ICES work is done through its working groups, an approach also favoured by SCOR. Titles of some current groups illustrate the similarity of interests: shelf seas oceanography, oceanic hydrography, marine data management, aerospace remote sensing, marine chemistry, Baltic Sea modelling, benthos ecology, primary production, ecology of algal blooms. In addition, there are numerous working groups concerned with applied problems of fish stock assessment and marine pollution in the eastern north Atlantic and adjacent seas.

IOC's programme in Ocean Science and Living Resources, including the International Recruitment Programme, have been of interest to both SCOR and ICES. Because of the important research on recruitment in laboratories of ICES members, the Council has been considering how best to focus its efforts in support of the global programme. A mini-symposium on factors influencing recruitment processes in marine ecosystems was held during the 1987 Statutory Meeting, and one on reproductive variability and its implications for the dynamics and well being of stocks is planned for 1989. An Inter-Committee Recruitment Group has been proposed to coordinate ICES activities on this subject.

A current ICES activity with which SCOR was associated in its planning stages is the Patchiness Experiment in the Baltic Sea (PEX). The basic aim of this project is to further the knowledge and understanding of small space and time scale variations in various physical, chemical and biological parameters and their ecological significance. Field work of this large experiment, involving 14 research vessels from 6 countries, took place in an area in the central Baltic about 100km southeast of the island of Gotland in April-May 1986, since when activities have been focussed on the analysis and collective evaluation of its large data collections. A first appraisal of PEX results was made at a workshop held at Vilnius, USSR in May 1987, at which plans were laid for their eventual publication.

ANNEX XII

WMO REPORT

The following paragraphs summarize briefly activities undertaken within or by WMO during the past year which may be of interest to SCOR.

Drifting buoys

The joint WMO/IOC Drifting Buoy Cooperation Panel held its third session in Paris in October 1987. At this session, the panel addressed a number of technical questions related to the operation of drifting buoys for meteorological and oceanographic purposes and to the collection and distribution of buoy data, including two matters specifically addressed to it by SCOR WG 88:

- (a) In response to a proposal from SCOR WG 88, the panel adopted a recommendation urging greater collaboration between meteorologists and oceanographers on buoy instrumentation. The text of this recommendation is annexed to this report. The substance of the recommendation has been endorsed by the fortieth session of the WMO Executive Council and its text transmitted to Member States of WMO and IOC and to buoy programme managers;
- (b) The panel adopted a second recommendation encouraging the enhanced submission of drifting buoy data for GTS distribution and for permanent archival, which was also endorsed by EC-XL (also given in the annex);
- (c) The panel authorized its technical coordinator to work towards the development of a global scheme for real-time quality control of drifting buoy data before GTS insertion (based on procedures now in place in the USA);
- (d) Actions were taken to improve the quality and flow of data received through Local User Terminal (LUT);
- (e) Improvements to the DRIBU code for real-time data distribution are being developed;
- (f) Again in response to a request from SCOR WG 88, the technical coordinator for the panel has been instructed to investigate possibilities for continued funding of drifting buoys which were no longer of interest to their programme of origin.

The technical coordinator for the DBCP took up his post in June 1987 and has already made a major impact in improving the quality and flow of buoy data on the GTS, as well as acting as a focal point for drifting buoy programmes. He has established contact with most major programme managers and with the chairman of SCOR WG 88.

Recent publications of interest relating to drifting buoys include:

- (a) A completely revised and updated edition of the Guide to Data Collection and Location Services Using Service Argos, published in 1988 by WMO as Report No. 10 in the series Marine Meteorology and Related Oceanographic Activities;
- (b) The IGOSS Guide to Drifting Buoys by G.D. Hamilton to be published by IOC in 1988.

Ocean Waves

A Technical Conference on Ocean Waves is to be held in Paris on 6 and 7 February 1989, in association with the tenth session of the WMO Commission for Marine Meteorology (CMM). The conference programme is annexed to this report. The core of the conference papers will be presented by members of the CMM *ad hoc* Group of Rapporteurs on Numerical Wave Modelling, which has close association with SCOR WG 83. The conference will be open to all interested in the modelling, forecasting and application of ocean waves and will be accompanied by an exhibition of wave measuring and related equipment.

Marine climatological data

In response to requirements expressed by the World Climate Research Programme for improvements in the quality of marine climatological data from the WMO Voluntary Observing Ships (VOS), a VOS Special Observing Project-North Atlantic (VSOP-NA) was established in late 1987. This project has, as a primary objective, to assemble a high-quality subset of marine meteorological data which may be used to determine if systematic biases in measurements of certain meteorological parameters can be quantified through the acquisition of additional ship information and, where possible, removed. The recruitment of ships to the project is now well advanced and the collection, archival and analysis of data has begun. Some results should be available during 1989. In addition, also in response to WCRP requirements, a Tropical Oceans and Global Atmosphere (TOGA) Marine Climatology Data Centre became operational in the United Kingdom on 1 January 1988.

Integrated Global Ocean Services System

The joint IOC/WMO Integrated Global Ocean Services System (IGOSS) is an essential element of the WCRP for the real-time collection, dissemination and processing of sub-surface oceanographic data, as well as serving a large variety of operational users. IGOSS data availability on the GTS (essentially BATHY and TESAC reports) has increased by more than 50% sea-level and sub-surface thermal structure in the Pacific are now being routinely prepared and distributed in near-real-time by IGOSS Specialized Oceanographic Centres (SOC). This may well be regarded as the start of the era of operational synoptic oceanography. Recent activities directed towards the overall strengthening of IGOSS include:

- the development by the IGOSS Group of Experts on Operations and Technical Applications of a new flexible coding scheme for the real-time transmission of all types of oceanographic data.
- the preparation and publication of an IGOSS Glossary.
- the preparation of the IGOSS General Plan and Implementation Programme 1989-1995 for consideration by the Joint IOC/WMO Working Committee for IGOSS at its fifth session (Paris, November 1988).
- the further improvement to the IGOSS/IODE data flow through a meeting of programme managers of IGOSS and IODE (Ottawa, January 1988).

WCRP-TOGA

In response to actions called for by the Intergovernmental TOGA Board at its first session in November 1987 the International TOGA Project Office (ITPO) has been working to improve the effectiveness of several components of the TOGA observing and data management systems. The status of three of these components of special interest to SCOR is:

TOGA Atlantic tide-gauge network

Sweden has agreed to provide ten tide-gauges for installation in developing countries in support of the Global Sea-level Observing System (GLOSS). The Federal Republic of Germany has agreed to provide technical support to the countries concerned to assist in the installation of these gauges. It has been agreed that one gauge will be allocated to each of five West African countries to support the TOGA Atlantic tide-gauge network.

CLS/Service Argos has conducted a study which has demonstrated the feasibility of transmitting data from the pressure gauges operated in the Atlantic by ORSTOM. France still has under active consideration a proposal to modify its existing network for transmission via Argos.

NOAA's National Ocean Service (NOS) is developing a New Generation Water Level Measurement System (NGWLMS) with a planned eventual installation of some 200 air acoustic water level sensors to acquire data which will be transmitted via GOES satellite. It is hoped that some, if not all, of the stations still required in the TOGA Atlantic tide-gauge network will be included in future NGWLMS plans.

Indian Ocean sub-surface data

- France has been operating the line from Marseilles to Malaysia since January 1988 and plans to cover it bi-monthly.
- France has recruited three additional vessels that ply the route Marseilles to La Reunion to increase coverage of this line to better than bi-monthly.
- Mauritius will receive equipment, probes and training from France and expects to be operating the two short lines Mauritius to Rodrigues and Mauritius to Agalega within the year.
- The ITPO is working with France and the USA to ensure that Pakistan will be able to operate the Karachi to Mombasa line before the end of 1988.
- The ITPO has been notified informally that Japan intends to operate an XBT line in the Indian Ocean, probably from the Gulf to Singapore.

TOGA Tropical Ocean Sub-Surface Data Centre - Brest

The Centre has made good progress towards producing a quality controlled Level II-B sub-surface thermal data set over the TOGA area with the appropriate flags and in the proper format that is being used increasingly. The rate of development of new products and the creation of analyses fields is critically dependent on the future level of staffing of the Centre. As a result of discussions between ITPO and the French member of the Intergovernmental TOGA Board, IFREMER is providing FF. 100.000.- for temporary programming support pending the appointment of an additional full-time programmer at end of 1988.

ANNEX XIII

COMMISSION FOR THE CONSERVATION OF ANTARCTIC MARINE LIVING RESOURCES

In previous years the main cooperation between CCAMLR and SCOR was through the BIOMASS programme, i.e. indirectly with SCOR WG 54 and WG 74. Recently a new Group of Specialists on Southern Ocean Ecology was established by SCAR and cosponsored by SCOR. Terms of reference of the new Group are logically connected with further development of research started within the BIOMASS programme. The Group will provide new opportunities for cooperation between our organizations and indirectly with SCOR WG 86.

Last year the CCAMLR/IOC Scientific Seminar on Antarctic Ocean variability and its influence on marine living resources, particularly krill, was held in Paris (2 - 6 June, 1987). The Seminar was also cosponsored by SCAR and SCOR. The Seminar called for close collaboration between meteorological, physical and biological oceanographers at all levels. The proceedings of the Seminar are being published by Springer-Verlag and should be available later this year.

At present CCAMLR and, in particular, its Scientific Committee is carrying out several projects which may be of interest to SCOR.

Conservation Strategy for Antarctic Marine Living Resources

The Commission has established a Working Group to develop a long-term strategy for achieving the objectives of the Convention. Working papers submitted for consideration by the Working Group have shown a common interpretation of the Convention as providing for the harvesting of Antarctic marine living resources on a sustainable basis. It also has been recognized that the requirement of the Convention to maintain ecological relationships may call for alternative scientific approaches to fisheries management.

The group will meet again before the next CCAMLR meeting and will focus its discussions on performance criteria for assessing different conservation strategies.

Assessment and Avoidance of Incidental Mortality of Antarctic Marine and Living Resources

This topic has been on Commission agendas since 1984. Over the past years, the Commission has given attention to the potential problems which could arise through the entanglement of animals in lost or discarded fishing gear or other man-made debris. It has concluded that there is presently no problem in the Convention area, but in view of the experience in other areas, the Commission has agreed to take steps to ensure that a problem of this nature does not develop. Members have initiated monitoring and education programmes, and reports on these activities are presented to the Commission at the annual meeting.

An information brochure and placard to advise fishermen, researchers, and others working in the Convention Area of the sources, fates and effects of potentially hazardous marine debris, has recently been published.

The CCAMLR Ecosystem Monitoring Programme

In 1987 the Commission endorsed recommendations of the Scientific Committee of implementation of the CCAMLR Ecosystem Monitoring Programme (CEMP). Monitoring of approved parameters of predators was to begin starting with the 1987/88 Antarctic season in the three integrated study areas:

- Antarctic peninsula;
- South Georgia
- Prydz Bay

The programme will be carried out on a national level by scientists of CCAMLR Members. The Scientific Committee will co-ordinate the programme. The objectives are:

- To detect and record significant changes in critical components of the ecosystem, to serve as a basis for the conservation of Antarctic marine living resources;

- To distinguish between changes due to the harvesting of commercial species and changes due to environmental variability, both physical and biological.

Resource Assessments

In recent years the Scientific Committee has focused attention on improving the overall coordination and integration of national programmes.

In the 1987/88 complementary studies on krill ecology, oceanography, and krill abundance in the Antarctic Peninsula area were undertaken by USA, Poland, USSR and Japan and joint studies on the use of acoustic

methods for estimating krill abundance were carried out by UK and Norway. In the 1987/88 field season, surveys of fish stocks in the Kerguelen shelf area were undertaken as a cooperative project by France and the USSR in the South Georgia shelf area by USA and Poland.

In total, during the 1987/88 season, fish stock assessment surveys were undertaken by six countries, krill abundance surveys and related studies by nine countries, marine mammal and bird studies by nine countries and environmental measurements and related studies by eight countries.

Krill CPUE Simulation Study

In 1986 the Scientific Committee decided to commission a special theoretical study to evaluate the possibility of using catch per unit effort (CPUE) from the krill fishery as an index of krill abundance. The relationships between various measures of CPUE with changes in simulated krill abundance based on an analysis of the Japanese and Soviet krill fisheries will be explored.

A Workshop to evaluate the Study results and formulate further recommendations is planned for early 1989.

CCAMLR Meetings in 1988

12-20 October, 1988
Hobart, Tasmania, Australia.

23 Oct.-4 November 1988
Hobart, Tasmania, Australia.

20-23 October, 1988
Hobart, Tasmania, Australia.

Working Group on Fish Stock Assessment –
Convenor, Dr. K.-H. Kock.

Seventh Annual Meetings of the Commission
and the Scientific Committee.

Working Group on Conservation Strategy
for Antarctic Marine Living Resources.

ANNEX XIV

ARCTIC OCEAN SCIENCES BOARD (AOSB)

The AOSB has been very active over the past year, beginning with its last annual meeting which was held on 1-2 October 1987 in Santander, Spain.

Since then, there have been two meetings sponsored by the AOSB. The Greenland Sea Project (GSP) Steering Committee met in early February of 1988 in Copenhagen and a planning meeting for an International Arctic Polynya Project (IAPP) was held in late February in Copenhagen. A follow-up meeting for planning an IAPP is scheduled for just after the JOA in Alaska.

Some SCOR members may have already received, separately, reports on or information regarding these activities. However, the following is intended to provide a brief summary of these.

The AOSB Seventh Meeting, 1-2 October 1987, Santander, Spain

The AOSB meeting was convened by Dr. G. Hempel of the Federal Republic of Germany who also agreed to continue as Chairman of the AOSB for another year. The meeting resulted in a series of action items, the most important of which are as follows:

The GSP Steering Group was asked to formulate a list of remote-sensing requirements in preparation for their February meeting.

It was recommended that plans for a possible polynyas project be developed.

The U.S. agreed to establish a formal Secretariat for the AOSB.

The GSP Steering Committee Meeting, February 1988

The GSP Steering Committee met in Copenhagen. The primary purpose of the meeting was to develop plans for research to be conducted in the Greenland Sea during the 1988 summer field season. This was done. The Committee also sponsored a special session on remote sensing needs for future Greenland Sea research. No report on the outcome of this session has yet been received by the Secretariat.

The First Planning Meeting for a Polynya Study, February 1988

Sixteen participants from eleven countries attended the first planning meeting for a polynya study. They prepared a strong scientific justification for such a study and specified a series of scientific objectives. Three possible study sites were also identified: the East Greenland Shelf, the North Water of Baffin Bay, and the Bering Sea near St. Lawrence Island.

Major scientific objectives include determination of physical and biological processes within polynyas and how these processes affect areas "downstream". It was recognized that close coordination would be required within these studies of measurements from moorings, ships, aircraft and satellites. It is expected that polynya studies will also include studies of mammal populations, birds, and algae. The report of the first meeting was distributed earlier this summer and has been reviewed by the participants.

The Second Planning Meeting for a Polynya Study, September 1988

The second planning meeting will be held in Alaska directly following the JOA to further refine plans for the proposed polynya study and will present recommendations for such a study to the AOSB at its Eighth Meeting.

The Eighth Meeting of the AOSB

The next meeting of AOSB is now tentatively scheduled for 18-20 January 1989 and is expected to be hosted by the U.S. National Science Foundation (NSF), the National Aeronautics and Space Administration (NASA) in Washington, D.C., and the National Academy of Sciences (NAS). The AOSB will hold its regular sessions at the NAS on the 18th and 19th and then visit the NASA Goddard Space Flight Center on the 20th.

Arrangements for an AOSB Secretariat

The United States has agreed to provide a Secretariat for the AOSB. The Secretary is Mr. Louis B. Brown, Division of Ocean Sciences, National Science Foundation, 1800 G. Street N.W., Washington, D.C., 20550; telephone: 202.357.9809; telex: 257653 NSFO ER; telemail: L.Brown. Mr. Brown is being assisted by: Ms. Martha Cutkosky at the Joint Oceanographic Institutions, Inc. They are working in close cooperation with the National Academy of Sciences, especially Ms. Mary Hope Katsouras of the staff of the NAS Ocean Studies Board.

ANNEX XV

REPORT OF THE ICSU SPECIAL COMMITTEE FOR THE INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAMME: A STUDY OF GLOBAL CHANGE (IGBP)

This report covers the period until 31 May, 1988.

Introduction

The ICSU 21st General Assembly decided to initiate an international Geosphere-Biosphere Programme: A Study of Global Change (IGBP). Professor T. Rosswall, Linköping University, Sweden was appointed Executive Director. The ICSU Executive Board also appointed a Special Committee for the IGBP, which at its first meeting in July 1987 elected Professor J.J. McCarthy, Harvard University, Cambridge, U.S.A., as its chairman. The other members of the Special Committee are: R. Herrera, Vice-Chairman (Venezuela), W.S. Fyfe, Treasurer (Canada), F.J. Crutzen (Federal Republic of Germany), V.M. Kotlyakov (U.S.S.R.), B. Bolin (Sweden), M.-L. Chanin (France), E.H.S. Diop (Senegal), S. Dyck (German Democratic Republic), J.A. Eddy (U.S.A.), T. Nemoto (Japan), H. Oeschger (Switzerland), S.I. Rasool (U.S.A.), J.S. Singh (India), V.A. Troitskaya (U.S.S.R.), B.H. Walker (Australia), J.D. Woods (U.K.) and D. Ye (China).

At its first meeting the SC-IGBP identified the following underlying themes for the IGBP:

A. Documenting and predicting global change by:

- i) Collecting and analyzing data to enable the identification of natural processes that lead to global change and the effects of such changes;
- ii) Including, in predictive models, the knowledge of past changes, understanding of couplings between biogeochemical processes and the physical climate system; and information about current plus anticipated anthropogenic impacts on the Earth system.

B. Observing and improving our understanding of dominant forcing functions by assessing:

- i) The magnitude and significance of external forcing by solar and orbital variations and earth crust-mantle phenomena;
- ii) Indeterminate natural forcing due to inherent short-term instabilities in the Earth system;
- iii) Anthropogenic forcing attributable to changes in atmospheric chemical composition as well as changes in land and water use.

C. Improving our understanding of transient phenomena in the total Earth system by:

- i) Developing descriptions of non-linear interactions among physical, chemical and biological components of this system, which have global consequences;
- ii) Quantifying their potential to generate rapid changes from slow forcing and sharp spatial gradients from large-scale forcing.

D. Assessing the effects of global change that would cause large-scale and important modifications affecting the availability of renewable and non-renewable resources by:

- i) Studying sensitive regions in which rapid changes are taking place because of man's exploitation of earth resources;
- ii) Using our improved knowledge of global change to understand and predict effects at the regional scale.

Constitution

In 1988, the ICSU Executive Board approved the constitution according to which:

"The objective of the International Geosphere-Biosphere Programme: A Study of Global Change (IGBP) and ICSU are to describe and understand the interactive physical, chemical and biological processes that regulate the total Earth system, the changes that are occurring in this system, and the manner in which they are influenced by human actions.

Priority in the Programme will fall on those areas of each of the fields involved that deal with key interactions and significant change on time scales of decades to centuries, that most affect the biosphere, that are most susceptible to human perturbation, and that will most likely lead to practical, predictive capability. In concentrating on interactive biological, chemical, and physical processes the Programme will of necessity put less emphasis on studies that, though they have great strengths and momentum of their own, are already being addressed in existing

initiatives, or that will less clearly contribute to our understanding of the changing nature of the environment of life on time scales of decades to centuries”.

Planning activities

At its first meeting, the SC-IGBP decided to set up Coordinating Panels in areas where the Special Committee has identified the need for development of research objectives and proposed contents of IGBP research projects. The Coordinating Panels are:

Terrestrial Biosphere - Atmospheric Chemistry Interactions

(Chairman: P.J. Crutzen)

Marine Biosphere - Atmosphere Interactions

(Chairman: T. Nemoto)

Biospheric Aspects of the Hydrological Cycle

(Chairman: S. Dyck)

Effects of Climate Change on Terrestrial Ecosystems

(Chairman: B.H. Walker)

Four Working Groups have also been established to assess current status of knowledge and future prospects for IGBP activities. The Working Groups are:

Global Geosphere-Biosphere Modelling

(Chairman: B. Bolin)

Data and Information Systems

(Chairman: S.I. Rasool)

Techniques for Extracting Environmental Data of the Past

(Chairman: H. Oeschger)

Geosphere-Biosphere Observatories

(Chairman: R. Herrera)

The first part of the planning phase will result in a draft report on the IGBP, which will be available at the ICSUU 22nd General Assembly.

Scientific Advisory Council

The first meeting of the IGBP Scientific Advisory Council is now being planned (Stockholm 24-27 October, 1988). National IGBP Committees, ICSU national and scientific members as well as a number of other organizations including UNESCO, UNEP, and WMO, have been invited to attend the meeting. This will be the first opportunity for the scientific community to discuss in detail the draft report on the IGBP as prepared by the Special Committee.

National Committees

National committees or *ad hoc* groups have been established in the following countries: Austria, Australia, Bangladesh, Canada, Chile, China (Beijing), Colombia, France, Federal Republic of Germany, Hungary, India, Israel, Japan, the Netherlands, Poland, South Africa, Sweden, Switzerland, United Kingdom, United States of America.

Publications

IGBP publishes a series of reports and three volumes have been published to date. The first issue of the Global Change: IGBP Newsletter will appear in June.

Finances

The planning of the IGBP is at present financed by grants from ICSU, the Swedish Government, the Andrew W. Mellon Foundation, UNESCO and national contributions.

ANNEX XVI

BIOMASS REPORT

I. Activities of the BIOMASS programme during July 1986-August 1988

- (A) Operation of the BIOMASS Data Centre
- (B) BIOMASS Data Analysis Workshops held since July 1986
- (C) BIOMASS Publications

Highlights of these activities are given below.

A. Operation of the BIOMASS Data Centre

The BIOMASS Data Centre, housed in the British Antarctic Survey, Cambridge, U.K., has been fully operational since 1985. The main aims of the Data Centre are to provide a central information store, to assist in the exchange of marine biological data between countries, and to enable the BIOMASS community to produce detailed analyses of biological stocks using the BIOMASS Computer base. This database allows data from several scientific disciplines to be interrelated in order to examine causes and effects in different parts of the marine ecosystems. This makes the BIOMASS Data Centre unique among world data centres, and the experience developed as a result is now available to other data centres who wish to emulate/adopt the Cambridge experience and to other large-scale programmes such as the International Geosphere- Biosphere Programme.

Since its establishment, the BIOMASS Data Centre has been the focal point of several workshops (see below). Assisting the BIOMASS Executive Committee in discharging its responsibility during this data analysis phase is the BIOMASS Data Advisory Group headed by Dr. W. Hiller of the Alfred Wegener Institute for Polar Research, Bremerhaven, F.R.G.

B. BIOMASS Data Analysis Workshops Held Since June 1986

To ensure that full advantage is taken of the enormous amount of data collected during the FIBEX and SIBEX, the BIOMASS Executive Committee approved a series of workshops to process the information and report on the findings. The workshops held since June 1986 are listed below.

<u>Workshop</u>	<u>Date</u>	<u>Venue</u>
Fish Age Determination	14-19 July 1986	Moscow, USSR
Krill Physiology and Bio-Chemistry	15-18 Sept. 1986	Rimouski, Quebec, Canada
Physical-Chemical Oceanography	9-27 March, 1987	Cambridge, UK
Post-SIBEX Fish Data Evaluation (Phase 1: Validation)	17-28 August, 1987	Cambridge, UK
Phytoplankton/Zooplankton Relation- (Atlantic Sector)	7-9 October, 1987	Sao Paulo, Brazil
Phytoplankton/Zooplankton Relation- (Pacific and Indian Sectors)	14-16 October, 1987	College Station, Texas, USA
First Planning Meeting for SIBEX Acoustic Validation	12-13 November, 1987	Cambridge, UK
Second Planning Meeting for Acoustic Data Analysis	3-4 May, 1988	Cambridge, UK
SIBEX Acoustic Data Validation	11-22 July, 1988	Cambridge, UK
Antarctic Fish Ecology	17-28 August, 1988	Cambridge, UK
Phytoplankton/Zooplankton (Data Analysis)	October/November 1988	Cambridge, UK

C. BIOMASS Publications

1. BIOMASS Report Series

No. 48	Meeting of the BIOMASS Executive	San Diego, CA, USA 19 June 1986
No. 49	Meeting of BIOMASS Data Centre Advisory Group	Bremerhaven, FRG 28-30 October, 1986
No. 50	Meeting of the SCAR Group of Specialists	San Diego, CA., USA

	on Seals	11-13 June, 1986
No. 51	Report of the Workshop on Krill Physiology	Rimouski, Quebec, Canada 15-17 Sept. 1986
No. 52	Post-SIBEX Fish Data Evaluation Workshop: Phase 1, Validation	Cambridge, UK 6-17 October, 1986
No. 53	Meeting of the BIOMASS Executive	Paris, France 1 June, 1987
No. 54	Report of the Post-SIBEX Fish Data Evaluation Workshop: Phase 2, Evaluation	Cambridge, UK 17-28 August, 1987
No. 55	Phytoplankton/Zooplankton Relationships (I)	Sao Paulo, Brazil 7-9 October, 1987
No. 56	Workshop on Antarctic Phytoplankton/ Zooplankton Relationships (II)	College Station, TX, USA 14-16 October, 1987

2. BIOMASS Scientific Series

Volume 7: Symposium and Workshop on Recent Advances in Aquatic Antarctic Biology, with Special Reference to the Antarctic Peninsula Region, Bariloche, Argentina.

Volume 8: A Handbook for the measurement of Chlorophyll *a* and Primary Productivity (1987).

Forthcoming:

Volume 9: Review of the Biology and Present Status of Antarctic Krill.

3. BIOMASS Newsletter

Volume 8, No. 1 - July 1986

Volume 8, No. 2 - December 1986

Volume 9, No. 1 - July 1987

Volume 9, No. 2 - December 1987

Volume 10, No. 1 - July 1988

II. Future Activities

Workshops planned for 1989

1. Acoustic Data Analysis
2. Phytoplankton/Zooplankton Relationships (Data Analysis)
3. Krill Catch Per Unit Effort (C.P.U.E.) Simulation
4. SIBEX Seabird Data Analysis
5. Physical/Chemical Oceanography
6. Fish Data Evaluation

The above workshops together with other meetings to be held in 1989 are preparatory to the final BIOMASS Evaluation Meeting in 1990 which will signal the termination of the BIOMASS Programme.

III. Finances

Current financial status shows that the BIOMASS Special Fund which has been built up from contributions from participating countries over the past years primarily to meet the cost of these data analysis workshops, is being rapidly depleted. It will be, therefore, very difficult to hold the 1989 workshops with the reserve we now have in the BIOMASS Special Fund. For this reason, it would be greatly appreciated if SCOR would make a contribution towards the 1989 workshops and a similar sum for the BIOMASS Evaluation Meeting in 1990.

ANNEX XVII

ACRONYMS AND ABBREVIATIONS

ADEOS	Japanese Satellite
AEROCE	Atmosphere Ocean Chemistry Experiment
AOSB	Arctic Ocean Sciences Board
ASE	Air Sea Exchange Studies
ASIZ	Antarctic Sea Ice Zone
BATHY	WMO Code Form for Temperature versus Depth Data
BIOMASS	Biological Investigations of Marine Antarctic Systems and Stocks
CalCOFI	California Cooperative Oceanic Fisheries Investigations
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CCCO	Committee on Climatic Changes and the Ocean (Joint SCOR/IOC)
CMAS	Confederation Mondiale des Activites Subaquatiques
CMG	Commission for Marine Geology (IUGS)
CMM	Commission for Marine Meteorology (WMO)
COARE	Coupled Ocean Atmosphere Response Experiment
COSPAR	Committee on Space Research (ICSU)
CPR	Continuous Plankton Recorder
CPUE	Catch Per Unit Effort
CSIRO	Commonwealth Scientific and Industrial Research Organization
CTD	Conductivity/Temperature/Depth
CZCS	Coastal Zone Colour Scanner
DBCP	Drifting Buoy Cooperation Panel (WMO/IOC)
DRIBU	WMO Code Form for Drifting Buoy Data
ECOR	Engineering Committee on Oceanic Research
EGS	European Geophysical Society
ENSO	El Nino - Southern Oscillation
ERS-1	ESA's Earth Remote Sensing Satellite - 1
ESA	European Space Agency
EUROTRAC	European Programme on the Transport of Atmospheric Constituents
FAO	Food and Agricultural Organization
FOCAL	French Equatorial Atlantic Ocean Climate Programme
FIBEX	First International BIOMASS Experiment
GCM	General Circulation Model
GEWEX	Global Energy and Water Cycle Experiment
GIPME	Global Investigation of Pollution in the Marine Environment (IOC)
GSP	Greenland Sea Project
GTS	Global Telecommunication System
GTCP	Global Tropospheric Chemistry Program (now IGAC)
HPLC	High Performance Liquid Chromatography
IABO	International Association for Biological Oceanography (IUBS)
IAMAP	International Association for Meteorology and Atmospheric Physics
IAPP	International Arctic Polynya Project
IAPSO	International Association for the Physical Sciences of the Ocean (IUGG)
ICES	International Council for the Exploration of the Sea
ICSU	International Council of Scientific Unions
IFREMER	Institut Francais pour Recherche a Exploitation de la Mer
IGAC	International Global Atmospheric Chemistry Programme (formerly GTCP)
IGBP	International Geosphere-Biosphere Programme (ICSU)
IGCP	International Geological Correlation Programme
IGOSS	Integrated Global Ocean Services System (IOC/WMO)
IGU	International Geographical Union
IMS	International Marine Science Newsletter (UNESCO)
INTECOL	International Association for Ecology
IOC	Intergovernmental Oceanographic Commission
IODE	Working Committee on International Oceanographic Data Exchange (IOC)

IREP	International Recruitment Experiment
ISBN	International Standard Book Number
ISSN	International Standard Serial Number
ITCZ	Inter-Tropical Convergence Zone
ITPO	International TOGA Project Office
IUGG	International Union of Geodesy and Geophysics
JGOFS	Joint Global Ocean Flux Study
JOA	Joint Oceanographic Assembly
JPOTS	Joint Panel on Oceanographic Tables and Standards
JSC	Joint Scientific Committee (for WCRP - ICSU/WMO)
LUT	Local User Terminal
NASA	National Aeronautics and Space Administration
NEG	Numerical Experimentation Group (JSC/CCCO/TOGA)
NSCAT	NASA Scatterometer
NSF	National Science Foundation
ORSTOM	Office de la Recherche Scientifique et Technique d'Outre Mer (France)
OSLR	Ocean Science in Relation to Living Resources (IOC)
PEX	Patchiness Experiment in the Baltic Sea
RAGS	Radiatively Active Gases
SCAR	Scientific Committee on Antarctic Research (ICSU)
SCGB	Special Committee for Geosphere/Biosphere (ICSU)
SCOPE	Scientific Committee on Problems of the Environment (ICSU)
SCOR	Scientific Committee of Oceanic Research (ICSU)
SEQUAL	Seasonal Equatorial Atlantic Experiment
SIBEX	Second International BIOMASS Experiment
SSG	Scientific Steering Group (WOCE, TOGA)
SST	Sea Surface Temperature
SUN	Symbols, Units and Nomenclature in Physical Oceanography
SWAMP	Sea Wave Modelling Project
TC/OPC	Technical Committee on Ocean Processes and Climate (IOC)
TEMA	Training, Education and Mutual Assistance (IOC)
TESAC	WMO Code for Temperature, Salinity and Current Data versus Depth
TOGA	Tropical Oceans and Global Atmosphere
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
VOS	Voluntary Observing Ships
VSOP-NA	VOS/Special Observation Programme - North Atlantic
WAM	Wave Modelling Group
WCRP	World Climate Research Programme (WMO/ICSU)
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment
XBT	Expendable Bathythermograph
XCTD	Expendable CTD