

**SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH**



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**INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS**

SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH

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## SCOR Proceedings, Volume 26

### CONTENTS

Members of the SCOR Executive Committee	Inside Front Cover
Report of the XX General Meeting of SCOR	1
Annex I List of Participants	33
Annex II Symposium Program	41
Annex III Welcoming Addresses	42
Annex IV Polar Deep Sea Paleoenvironments, Report of SCOR WG 82	44
Annex V Wave Modelling, Report of SCOR WG 83	47
Annex VI Ecology of Sea Ice Biota, Report of SCOR WG 86	52
Annex VII Intercalibration of Drifting Buoys, Final Report of SCOR WG 88	54
Annex VIII SCOR/IOC Committee on Climatic Changes and the Ocean	56
Annex IX Committee for the Joint Global Ocean Flux Study	64
Annex X International Council for the Exploration of the Sea	70
Annex XI World Meteorological Organization	71
Annex XII International Geosphere-Biosphere Programme	75
Annex XIII Arctic Ocean Sciences Board	79
Annex XIV 1989 Final Financial Statement	81
Annex XV Acronyms and Abbreviations	82

# **REPORT OF THE TWENTIETH GENERAL MEETING OF SCOR**

**Institut für Meereskunde  
Rostock-Warnemünde  
Germany**

**October 1 to 3, 1990**

## **1.0 OPENING**

### **1.1 Introductory Remarks**

The Twentieth General Meeting of SCOR was held at the Institut für Meereskunde of the Academy of Sciences of the German Democratic Republic in Warnemünde from October 1 to 3, 1990. The President of SCOR, Professor J-O. Stromberg, chaired the meeting. A list of participants is given in Annex I and a list of acronyms and abbreviations used in this report appears on the final page. In accordance with tradition, there was a scientific symposium organized in conjunction with the General Meeting. This symposium, entitled "Microstructure and its influence on mixing processes and marine biota", took place on October 4 and 5 and was organized by the host GDR Committee for SCOR to honour the life and work of Konstantin N. Fedorov, a former President of SCOR who died very suddenly shortly after the previous SCOR General Meeting in 1988. The program of the symposium is given in Annex II.

The General Meeting was formally opened by the President of the GDR Academy of Sciences, Professor Klinkmann and by the Chairman of the GDR SCOR Committee and Director of the Institut für Meereskunde, Professor Lange. They both noted the significant changes which would take place with German unification on October 3 and welcomed the participants to Warnemünde at this especially interesting and historic time. The texts of their remarks may be found in Annex III.

The President of SCOR thanked Professors Klinkmann and Lange for their welcoming remarks and expressed his best wishes, on behalf of the SCOR Executive Committee, for the active and continuing development of the Institut für Meereskunde. He welcomed all participants, particularly the observers from Korea, Pakistan and Bulgaria.

Professor Stromberg extended a special welcome to Dr. Anne Ginzburg, wife of the late Konstantin Fedorov, who was attending the General Meeting in her personal scientific capacity and who presented a lecture at the accompanying symposium. He also noted the recent and untimely death of Dr. Takahisa Nemoto, Director of the Ocean Research Institute of the University of Tokyo, Chairman of the IOC Regional Committee for the Western Pacific, and long-time friend of SCOR. The participants observed a moment of silence in his honour.

### **1.2 Approval of the Agenda**

The Agenda for the meeting was adopted as distributed. This report follows the format of the approved Agenda.

*SCOR now has 37 member countries and at this General Meeting we are happy to see two new applicants, Korea and Pakistan. Decisions will be taken about their membership here. Almost simultaneously we will lose one member because of the unification of the two Germanies. Although a happy and long awaited event from most aspects this means a small reduction in income for our activities in SCOR.*

*Membership fees are of importance to SCOR and we have encouraged national SCOR committees to look into the possibility of increasing their contribution by stepping up one category level. During this recessionary period we have had one such change with Japan moving to a higher member category. We are grateful for that and hope other national committees will follow suit.*

*Coming to the various activities of SCOR. We now have 17 working groups, most of which are carrying out their tasks very well. The work of such WG's, has all through the existence of SCOR, formed the backbone of its activity. This is what has given SCOR such a good reputation within the marine scientific community. We work with the active scientists with a minimum of bureaucracy and results are produced within relative short periods of time.*

*As we see marine science change towards global or ocean basin studies, new demands are placed on the organizations which initiate and coordinate research, not to mention the funding agencies. This has of course also affected SCOR which has always devoted its attention to problems that need international cooperation especially those of an interdisciplinary nature. In fact such provisions are clearly stated in the first paragraph of our statutes.*

*At this meeting we will discuss the role of SCOR in this changing world.*

*First I would like, however, to devote a few minutes to a couple of these large-scale programs in which SCOR has been active in the period since the last General Meeting.*

*The Committee on Climatic Changes and the Ocean (CCCCO) was established by SCOR in 1979 and somewhat later the IOC agreed to cosponsor it as a Joint Committee. Two major programmes have developed under CCCCCO, the TOGA (Tropical Ocean and the Global Atmosphere) and WOCE (World Ocean Circulation Experiment).*

*Since our last General Meeting in Acapulco in 1988, the first half of the implementation phase of TOGA (5 years 1985-1990) was evaluated at the International TOGA Scientific Conference in Honolulu in July this year. The programme has come a long way towards understanding and modelling the interannual variation and links between the tropical upper ocean and the atmosphere.*

*As to the other programme, WOCE, an International WOCE Scientific Conference was held in Paris from 28 Nov - 2 Dec 1988. Our past president, Prof. Siedler, represented SCOR's Executive Committee and acted as Chairman of the Conference. The focus of WOCE is, among other problems, to both understand and model the circulation in the world ocean in an attempt to predict the effect of global warming on major circulation patterns and the feedback of changes in these patterns on the climate. The implementation phase of this programme started in January this year and involves the use of satellites, research vessels and ships-of-opportunity. This marks the beginning of an intensive field period of 5 years.*

*The SCOR initiative of the Joint Global Ocean Flux Study became a core project of the IGBP (International Geosphere - Biosphere Programme) when an agreement between the SC-IGBP and SCOR was signed by Professor McCarthy and myself in May of 1989.*

*The main goal of JGOFS is to determine and understand on a global scale the processes controlling the time-varying fluxes of carbon and associated important biogenic elements (N, P, S, and others) in the ocean and to evaluate the related exchanges with the atmosphere, the sea floor and the continental*

*boundaries. A long-term goal is to develop strategies for observing changes in ocean biogeochemical cycles in relation to climate change.*

*The Committee for JGOFS has held four meetings, the last two being in Hawaii in Sept. 1989 and in Kiel in March 1990. I have had the opportunity to follow the development of the programme at close range by being present at these two meetings and it is a pleasure to be able to tell you that the Committee has worked hard and has completed its work on an International JGOFS Science Plan which was published about two months ago.*

*The JGOFS field programme started in 1989 with a pilot study in the North Atlantic, "The North Atlantic Bloom Experiment", which was followed up by a workshop in Kiel last March and with continued observations in the same study area this year.*

*The planning for the second JGOFS Process Study, in the equatorial Pacific Ocean in 1991-92 is well advanced and plans for activities in the Southern Ocean have also started, e.g. at a meeting in Brest last July - in conjunction with a SCOR and SCAR sponsored symposium on "The Biogeochemistry and the Circulation of Water Masses in the Southern Ocean". Plans for a JGOFS initiative in the Indian Ocean will begin to take shape at a meeting in Goa in January next year (1991).*

*The many global-scale scientific programmes now in place and more emerging, coalescing under the theme of Global Change, have raised serious questions about the adequacy of the existing international mechanisms for the provision and coordination of resources. Both the member of operational and proposed programmes, and their complexity already strain current procedures and therefore exhaust the scientists and administrators who must cope with them. After all we are talking of limited resources both in terms of money, manpower, ships and other heavy and expensive equipment. ICSU has started discussions on this with the goal of developing a structure for the coordination and implementation of international Global Change research programmes.*

*In order to further these discussions SCOR convened a planning meeting in Paris (ICSU Headquarters) on May 22-23 this year (1990) where such issues could be discussed between representatives of the International JGOFS Committee, scientists from some of the most advanced national JGOFS programmes and representatives of the supporting agencies of the same countries. This meeting was chaired by Dr. R. Corell of the US National Science Foundation and both our Executive Secretary and I took part.*

*The meeting recommended the formation of a JGOFS Interagency Resources Panel whose members would be drawn from the resource-providing community. This body would be responsible both to the SCOR Committee for JGOFS and to an earlier proposed Interagency Resources Committee for Global Change. At later discussions in Bonn (July 1990) between funding agencies, it was agreed to take a broad view on the various global programmes before any decision on special programmes, like JGOFS, were taken.*

*SCOR's relations with other non-governmental bodies and with intergovernmental organizations are in most cases excellent. We now have regular consultation between SCOR and the IOC of UNESCO. Two such consultations have been held this year, one in March and one in early September. Topics then discussed have included CCCO, JGOFS, SCOR WGs of common interest, and joint sponsorship of symposiums and workshops. You will hear more about this during our meeting. Cooperation with the Division of Marine Sciences of Unesco has always been good and we foresee no change in this even though the Division is now merged with the IOC. So far as we understand, its activities will be carried on within the new structure. Cooperation also continues in less formal, but useful ways with ICES and WMO.*

*The relationship with SCOR's parent organization, ICSU, is of particular importance. You may recall that at our Executive Committee meeting in Tallahassee in 1989, I spoke of my impressions of this relationship*

*having just come from the ICSU General Committee Meeting in Lisbon. Since then our Executive Secretary and I have participated in the Scientific Advisory Council Meeting of our now sister operation within ICSU - the Scientific Committee on IGBP. During this meeting it became very clear that SCOR had raised its profile considerably, mainly through the activities in CCCO (TOGA and WOCE), but above all because of JGOFS. Thus, when what is in IGBP terminology called a "potential project" like the GOEZS (Global Ocean Euphotic Zone Study) was discussed, it was recommended that "the plans for GOEZS be developed further with a wider scientific community and in consultation with SCOR..."*

*I have only touched upon a few of the items I could have brought up here but during the course of the meeting and from the documents in front of you, you will get a more detailed view of SCOR's activities.*

*Thus, rather than taking up more of our valuable time with this introduction, I would like to see us get started with the agenda.*

#### **1.4 Appointment of an ad hoc Finance Committee**

In accordance with the SCOR Constitution, an *ad hoc* Finance Committee was appointed to review the state of SCOR finances, draw up a budget for 1991 and report to the General Meeting under agenda item 3.3. The Finance Committee members were Prof. J. Field (South Africa), Dr. I. Jones (Australia) and Dr. L. Martins (Brazil) with the Executive Secretary providing information as needed.

## **2.0 SUBSIDIARY BODIES**

Many SCOR Working Groups are cosponsored by UNESCO and its Intergovernmental Oceanographic Commission. SCOR gratefully acknowledges the support received for some of the activities described here from the IOC, UNESCO, the International Council of Scientific Unions, the Royal Society and the US National Science Foundation.

### **2.1 Arising from Former Working Groups**

#### *WG 54 - Southern Ocean Ecosystems and Their Living Resources*

The General Meeting reviewed a report received from the Chairman of the BIOMASS program (Biological Investigations of Marine Antarctic Systems and Stocks) which had been cosponsored by SCOR. While the field program had been completed during the 1980s, a period of data synthesis and evaluation, including a number of workshops for which SCOR had provided support, was continuing. Preparations were under way for a final BIOMASS evaluation meeting, known as the BIOMASS Colloquium, which will take place in Bremerhaven, FRG from 18 to 21 September 1991. The General Meeting reiterated the commitment of SCOR (made at the 29th Executive Committee meeting) to provide financial support for this last BIOMASS activity. Detailed information on the program for the BIOMASS Colloquium, or on other related activities, may be obtained from the SCOR Secretariat.

### **2.2 Current Working Groups**

Participants were reminded that the SCOR Constitution and the Objectives and Procedures for SCOR Working Groups specify that the tenure of working groups automatically expires at each General Meeting and that their reports must demonstrate adequate justification for their re-establishment for an additional two years. The Executive Committee Reporter responsible for each Working Group introduced the relevant report

and lead the discussion.

*WG 75 - Methodologies for Oceanic CO<sub>2</sub> Measurements*

Professor Heath reported that the final report of WG 75 had been delayed due to the heavy involvement of some working group members in JGOFS activities, but that it would be completed in correspondence during 1991 under the leadership of C.S. Wong and C.D. Keeling. The General Meeting agreed that WG 75 should be disbanded, pending submission of its final report.

*WG 76 - Ecology of the Deep Sea Floor*

No report had been received from the Chairman of WG 76, although it had been expected that the group's final report would be available to the General Meeting. Professor Stromberg will urge the Chairman to complete this task as soon as possible. The working group was disbanded by the General Meeting, pending completion of this final task.

*WG 77 - Laboratory Tests Related to Basic Physical Measurements at Sea*

The Chairman of WG 77, Dr. K. Striggow was a participant in the General meeting and he presented a verbal report which included a summary of the results of the CTD intercomparison experiment carried out by the group in 1989. Eight CTDs were tested under a variety of temperature and pressure conditions. Only the analysis of the data collected in the pressure tank remains to be completed in order for the final report to be prepared. Professor Striggow requested approval for an editorial group of three WG 77 members to be established and provided with a small amount of support in order to complete this task in 1991.

Several participants expressed concern that WG 77 did not intend to identify the instruments tested in the intercalibration experiment and that this would make the results less useful to users of CTDs. It was recognized that the instruments contributed for the experiment in Kiel were in varying condition; some were provided new from the manufacturers while others had been used extensively. The group had therefore decided that the technicians and engineers who had accompanied the instruments would take the experience gained back to their institutions, but that the final report on the experiment should contain only generalized results. The General Meeting concluded that WG 77 should identify the instruments tested in its report, but that appropriate qualifying comments as to their condition, special instructions to technicians, and so on, could accompany the identifications. This was felt to be necessary in order to maximize the usefulness of the report to the scientific community.

It was agreed that WG 77 should be disbanded and that an editorial group consisting of Dr. Striggow, Dr. H.P. Mahrt and Dr. P. Saunders be established and urged to complete the report as quickly as possible.

*WG 78 - Determination of Photosynthetic Pigments in Seawater*

Professor Fournier informed the Meeting that the final report of WG 78 is well under way, although its publication had been delayed for reasons beyond the control of the editors. Following the concerns expressed at the SCOR Executive Committee meeting in 1989, UNESCO had agreed to publish the report in its series *Unesco Technical Papers in Marine Science* in order to avoid the delay which would result if it were to be published in the hard cover monograph series. The report will summarize the results of three methodological workshops organized by WG 78 and will make recommendations about laboratory and field techniques for the analysis of a variety of photosynthetic pigments. The General Meeting agreed to disband WG 78, but to charge an editorial group consisting of the Chairman, Dr. Mantoura and members Dr. S. Jeffrey and Dr. D. Rapeta with the completion of the report in early 1991.

### *WG 80 - Role of Phase Transfer Processes in the Cycling of Trace Metals in Estuaries*

Professor Heath introduced the written report from WG 80. Following its meeting in Plymouth, UK in October 1989, the Working Group has continued to work by correspondence. Its final report is being prepared with the working papers from the Plymouth meeting providing a series of detailed technical annexes to the final report. A full draft of the Report should be available early in 1991.

The report in preparation should provide a good basis for meeting the requirements of the first two terms of reference given to the Working Group. However, before meeting the third term of reference, the development of strategies for the preparation of predictive models, it will be necessary to consider in more detail the problems associated with the experimental and theoretical characterisation of particle-water interactions.

The second International Symposium on the Biogeochemistry of Model Estuaries is to be held at the Skidaway Oceanographic Institute in Savannah, Georgia on 14 to 21 April 1991 with an organising committee composed largely of SCOR WG 80 members. This Symposium will have the theme 'Effects of Global Change on Estuarine Processes' and will provide an excellent context for the Working Group to address its third and final term of reference. The support of the SCOR General Meeting was, therefore, sought for a second meeting of SCOR Working Group 80 on April 22 to 24, 1991 immediately following the International Symposium to focus attention on the experimental and theoretical problems associated with the determination and utilisation of partition functions and exchange kinetics to describe particle-water interactions in natural waters. The definition of these parameters was considered, at the Plymouth meeting, to present the main obstacle to the understanding of trace metal interactions in estuaries. The General Meeting approved this request. It also agreed to the addition of Dr. V. Gordeev (USSR) to the membership of WG 80.

### *WG 82 - Polar Deep Sea Palaeoenvironments*

Dr. Kuznetsov reviewed the accomplishments of WG 82 and the final report of its Chairman, Professor J. Thiede (FRG), which is given in Annex IV. Several publications have resulted from the activities of WG 82, among them is "Geological History of the Polar Oceans: Arctic versus Antarctic", the proceedings of a NATO Advanced Science Institute held in October 1988 to which several members of WG 82 had contributed. It had been agreed at the final meeting of WG 82 in September 1989 that this publication should constitute the main part of the final report to SCOR. The General Meeting accepted this decision and the report from Prof. Thiede and agreed to disband WG 82, with thanks to its Chairman and membership.

### *WG 83 - Wave Modelling*

The Chairman of WG 83, Dr. G. Komen (The Netherlands), presented a verbal report on the scientific issues confronting the group. The central approach to wave modelling chosen by WG 83 is to solve the so-called energy transfer equation numerically. This is an equation for the rate of change of the wave spectrum. The wave spectrum gives for each time and position the energy distribution over frequency and direction of different wave components. Its change is determined by three so-called source terms. The first describes the transfer of energy from atmosphere to the waves, the second gives the redistribution among waves due to resonant 4-wave interaction, and the third describes dissipation due to whitecapping and other processes. This last term represents coupling to the oceanic mixed layer.

So far work has resulted in a (modular) computer code for the solution of the energy transfer equation, and to global and regional implementation. This model has been validated by comparing predictions with observations. Physical research has focused on a reanalysis of existing fetch limited observations. This analysis took into account stability, coastal geometry and wind field variations in a consistent way, and has resulted in a consistent estimate of the fetch laws. On the theoretical side it was found that waves may affect the boundary layer over sea. Further work concentrated on directional change and shallow water aspects. The availability of satellite observations has stimulated data-assimilation research. A hierarchy of methods is available, the

most simple one is ready for real time implementation at the time of launch of ERS-1. In this way optimal use of satellite observations will be made. The method allows also for cross-validation between observations by altimeter (wave heights and winds), scatterometer (winds) and SAR (image spectra).

The Executive Committee Reporter, Dr. Asai, reviewed a progress report from WG 83 which included a report of its meeting in June, 1990, a statement on the specific role of SCOR's support of the group, a summary of its goals for 1992, and an outline for its final report. These last three items had been requested by the Executive Committee meeting in late 1989. This report appears in Annex V.

The General Meeting complimented Dr. Komen on his scientific presentation and approved his request for support for a meeting of WG 83 in May 1991, in conjunction with a meeting of the European wave modelling group. As noted at previous SCOR meetings, WG 83 is expected to complete its tasks in 1992, one and-a-half years after the launch of the ERS-1 satellite.

#### *WG 84 - Hydrothermal Emanations at Plate Boundaries*

Professor Heath reviewed the history of WG 84, noting the absence of a report which was due to the unfortunate resignation of the Chairman following his move to a new institute. The General Committee agreed that it would be extremely difficult to revitalize this group without an enthusiastic Chairman, in spite of the importance of the topic. It concurred with the recommendation of the Executive Committee that WG 84 be disbanded.

#### *WG 85 - Experimental Ecosystems*

Professor Fournier introduced the two final products of WG 85 which had been completed just before the General Meeting. The first of these is "Enclosed Experimental Marine Ecosystems: A Review and Recommendations" published as No. 37 in the Springer-Verlag series, *Coastal and Estuarine Studies*. The manuscript for a laboratory manual "A Manual of Marine Experimental Ecosystems" had just been sent to the Secretariat for publication as No. 2 in the SCOR Report Series. The representative of UNESCO, Dr. Marc Steyaert, expressed his interest in arranging a wider distribution for this manual by having it published in an appropriate UNESCO series. The Executive Committee recommendation that WG 85 be disbanded was confirmed with the thanks of the General Meeting for the timely and efficient manner in which WG 85 had completed its terms of reference.

#### *WG 86 - Ecology of Sea Ice*

A report of the first meeting of WG 86 which took place in Bremerhaven, September 3-7, 1990 appears in Annex VI. In reviewing this document, Professor Fournier emphasized that WG 86 has decided to focus on three categories of interactions within the sea ice ecosystem and will produce three papers for publication in *Polar Biology* based on the discussion papers and presentations prepared for the Bremerhaven meeting by each WG member. WG 86 has undertaken to expand the existing bibliography of sea ice biota, including the relevant Japanese and Soviet literature, for publication in 1991. Finally, WG 86 sought approval to organize an international symposium on the ecology of sea ice biota in 1992 or 1993. Plans for this will be developed in correspondence. The General Meeting endorsed these various activities and commended WG 86 and its Chairman for the enthusiasm with which it is addressing its task.

#### *WG 87 - Fine-scale Distribution of Gelatinous Planktonic Animals*

The 29th Executive Committee meeting recommended that this WG, as constituted, should be disbanded by the General Meeting since no significant progress had been made. Professor Stromberg had notified the Chairman of this discussion and the WG membership was encouraged to consider submitting a proposal for

a new group with revised terms of reference. Since no such proposal had been received, the General Meeting agreed to disband WG 87.

#### *WG 88 - Intercalibration of Drifting Buoys*

The 29th Executive Committee meeting recommended that WG 88 be disbanded following its preliminary activities since it had concluded at its first meeting that its terms of reference were premature. This was communicated to the Chairman by the Reporter, Professor O'Brien, with the suggestion that a plan of action would be required if the group were to continue. He acknowledged that the task assigned to WG 88 had been a problematical one, i.e. to assess the current-following effectiveness of drifting buoys, and that some other aspects of this subject area were being addressed by a WOCE group in which members of WG 88 are active. The General Meeting accepted these points and agreed to disband WG 88. A final report from the Chairman of WG 88, received immediately after the General Meeting, is given in Annex VII.

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

Professor O'Brien, observing that WG 89 had made an excellent start at its first meeting in mid-1990, reviewed a report from the Chairman, Professor P. Komar. The meeting was held in conjunction with the 22nd International Conference on Coastal Engineering in The Netherlands where there are active research programs relating to the coastal impacts of sea level rise. The main activity of the meeting was to review a preliminary draft of a report which is entitled "The Response of Beaches to Sea-Level Changes: A Review of Predictive Models" and which is expected to be published in mid-1991 in the *Journal of Coastal Research*. The Chairman requested that SCOR arrange to publish a fuller version of this report to include appendices, a literature survey and detailed recommendations for future research which might not be appropriate for journal publication. This could be done in the *SCOR Report Series*. He also requested approval for a meeting in early 1991 if it proved to be necessary in order to complete the report and to conduct a detailed consideration of the final term of reference which is "to recommend strategies for monitoring programs for coastlines which lack a data base". He did expect, however, that this might be accomplished in correspondence. The General Meeting agreed to provide support to WG 89 for a meeting in 1991 if needed, noting that the group would have achieved its objectives in an unusually short time period.

The report from the UNESCO Marine Coastal Program (see agenda item 6) indicated the interest of COMAR in WG 89 in relation to its activities with ICSU's IGBP on the impact of sea level rise on the coastal zone.

#### *WG 90 - Chemical and Biological Oceanographic Sensor Technology*

Professor Fournier recalled that the 29th Executive Committee meeting in late 1989 had endorsed the plans of the Chairman of WG 90, Dr. Mackey, to organize its first meeting in early 1991 in Hobart. During 1990, the group had worked in correspondence to review current technologies which may be suitable for measuring biological and chemical properties with a high resolution in time and space. The general conclusions of the members of WG 90 were that there is scope for considerable advances in most of the technologies currently in use and that the techniques holding the most promise for the future seem to be those based on solid state sensors, lasers and fibre optics. They have each been charged with the preparation of presentations for the WG 90 meeting which will take place in Hobart, Australia, in June 1991. The General Meeting approved these plans and was pleased to note the progress being made by WG 90.

#### *WG 91 - Chemical Evolution and Origin of Life in Marine Hydrothermal Systems*

The Chairman of WG 91, Professor Nils Holm, presented a verbal report to the General Meeting. The first official meeting of WG 91 took place in June 1990 at the Kristineberg Marine Biological Station in Sweden. The terms of reference of the group specify that a symposium is to be organized in 1992, followed by the

publication of the papers presented. It was the consensus among WG 91 members that this publication should constitute the group's final report and that it should be in the form of a book entitled "Hydrothermal Systems and the Origin of Life". Professor Holm presented a tentative outline for such a publication, noting that some preliminary draft chapters would be circulated to group members before a meeting in June 1991 for which he requested the approval of the General Meeting. This was granted.

#### *WG 92 - Ocean/Atmosphere Paleochemistry*

Professor Heath introduced a report from the Chairman of WG 92, Dr. Sundquist.

Following the recommendations of the last meeting of the Executive Committee, WG 92 undertook a revision of the plans submitted in its 1989 report. This redirection of its efforts had proceeded somewhat slowly because of the extensive commitments of the members to other international planning activities. However, the revised plans do take into account the recent emergence of several other international groups whose interests and activities overlap those specified in our terms of reference, such as the Past Global Changes (PAGES) initiative of the IGBP.

Working Group 92 believes that its most effective contribution would be to provide leadership in organizing a multi-sponsored, interdisciplinary workshop on interactions between marine sediments and atmospheric CO<sub>2</sub>. This workshop would focus on the presentation and exchange of scientific information rather than on the planning of programs. It would bring together overlapping research interests in three areas of carbon-cycle research: 1) ocean and atmosphere paleochemistry, 2) carbon exchange through marine benthic processes, and 3) interactions between marine sediments and anthropogenic CO<sub>2</sub>. Recognizing that these topics extend well beyond its terms of reference, WG 92 initiated discussions with other international groups with complementary interests. They include JGOFS (which has recently established task teams focusing on benthic processes and on the use of the historical record), PAGES (which has identified glacial-interglacial cycles as one of its two foci), and the U.S. National Academy of Sciences Ocean CO<sub>2</sub> Panel (which has initiated a topical focus on relationships between marine sediments and anthropogenic CO<sub>2</sub>).

These discussions and the overlapping memberships within these groups have identified a need for an interdisciplinary research meeting that would combine their various interests in a way not likely to be accomplished by the activities of one group alone. For example, a central problem is the need for an improved understanding of the manner in which past changes in oceanic and atmospheric chemistry are reflected in the ice core and sediment records. Resolution of this problem requires a fundamental knowledge of the benthic processes which control the preservation and burial of marine carbonates and organic carbon. These questions also have a direct bearing on anthropogenic CO<sub>2</sub>. The marine sediment record provides important clues to how and when anthropogenic CO<sub>2</sub> will be buffered by dissolution of marine carbonates. Although such an interdisciplinary focus explicitly emphasizes primary linkages between the study of ocean/atmosphere paleochemistry and present-day societal concerns, WG 92 did not believe that any of the above groups can provide such a focus alone. By working in concert with other groups, it believes that the proposed meeting is the most timely way of addressing not only its own terms of reference, but also the interdisciplinary research focus that has been identified as a need by other groups as well.

Since cooperative planning with other groups is just beginning, Dr. Sundquist was unable to propose a specific meeting venue and budget to the General Meeting. An effective meeting will require the following:

- identification of a steering committee representing the various groups involved,
- refinement of the meeting's topical focus (to be sure that it includes, for example, the issues of time-dependent modelling and ice core/sediment stratigraphic correlation,
- finalization of logistic details: size, format, time, place, sponsorship, and sources of support, and
- identification of an appropriate outlet for publication of proceedings.

He expected that the planning process would require a full year and sought the General Meeting's endorsement of these plans. This was granted with a request that detailed plans be submitted to SCOR and the other proposed co-sponsoring organizations within one year. It was also expected that publication of the meeting proceedings will be Working Group 92's last activity, and that this publication will constitute its final report.

### *WG 93 - Pelagic Biogeography*

The Chairman of WG 93, Dr. A.C. Pierrot-Bults was a participant in the General Meeting and presented a very brief verbal report on the status of the group since its establishment which had been approved in late 1989. The following individuals accepted SCOR's invitation to join WG 93:

M.V. Angel	UK
D. Boltovskoy	Argentina
J. Bradford	New Zealand
G. Evans	JGOFS
R.K. Johnson	USA
D. Olson	USA
M. Omori	Japan
M.M. Sinclair	ICES
J. Thiede	FRG
D.G. Troost	UNESCO
S. van der Spoel	The Netherlands
M. Vinogradov	USSR
P. Wiebe	USA
B.J. Zahuranec	USA

The group was to hold its first meeting in Amsterdam in November 1990 and Dr. Pierrot-Bults expected that progress would be made in considering the following topics:

- theory and methods in pelagic biogeography,
- distribution patterns and the physical-chemical environment, and
- the need for a manual of existing plankton collections.

The representative of UNESCO, Dr. Steyaert, noting the proposal of WG 93 to prepare a manual of plankton collections, indicated the interest of his organization in publishing this manual in its series *Monographs on Oceanographic Methodology*.

### **2.3 Committees and Panels**

#### *Joint SCOR/IOC Committee on Climatic Changes and the Ocean*

The Chairman of the CCCO, Professor J. O'Brien, introduced the report of his Committee which appears in Annex VIII. He reviewed the decisions of the Eleventh Session of CCCO which had identified six new themes of scientific importance which the Committee will address during 1990 and 1991. These are:

- Ocean observing system development
- CO<sub>2</sub> exchange on gyre to global scales
- Review of the IPCC report on the scientific assessment of climate change
- Fresh water budget
- Improving predictions of the regional impact of climate change on the coastal environment
- Control of thermohaline circulation

The rationale for the selection of each of these topics for international attention is given in Annex VIII; they are not being addressed under existing international programs. The mandate of CCCO, approved by its sponsoring organizations, calls upon it to promote the importance of an understanding of the role of the ocean in global climate change.

Professor O'Brien reviewed the activities of CCCO during 1989 and 1990, particularly the reconstitution of a CCCO/JSC Ocean Observing System Development Panel which is taking the lead in developing the scientific strategy for an operational system for the long term monitoring of the ocean, primarily for the observation and prediction of climate change. The World Ocean Circulation Experiment (WOCE) entered its implementation phase at the beginning of 1990. The WOCE SSG and its International Project Office had conducted a detailed assessment of the resource commitments to WOCE and of the requirements which must still be met if the program is to fulfil its scientific objectives. Readers are referred to the CCCO report in Annex VIII for information on these needs. The Tropical Ocean and Global Atmosphere (TOGA) Program passed its half-way point in 1990. This was marked by a major international scientific conference at which results were presented, the achievements of TOGA assessed and the scientific plan for the remainder of the program was evaluated. The science plan for the TOGA Coupled Ocean-Atmosphere Response Experiment (COARE) has been endorsed. TOGA modelling activities have achieved some successes, especially in the development and use of coupled models of intermediate complexity for predictive purposes. The Atlantic Ocean Climate Studies Panel has provided a forum for international discussions of the NOAA Atlantic Climate Change Program (ACCP) and is developing collaboration between itself, ACCP and WOCE. The Indian Ocean Climate Studies Panel has drawn attention to the need for improved coordination of regional activities with WOCE planning with the goal of improved predictions of monsoon variability. The Pacific Ocean Climate Studies Panel will consider the regional effects of sea level rise and is conducting an inventory and assessment of various types of routine ocean observations in the Pacific. The terms of reference and membership of the joint CCCO/JGOFS CO<sub>2</sub> Advisory Panel have been revised in accordance with the need to develop a global survey of oceanic CO<sub>2</sub> which will meet both WCRP and JGOFS goals and can be implemented in collaboration with WOCE. Finally, Professor O'Brien reviewed the changes in the membership of CCCO which included the retirement of Dr. Angus McEwan as Chairman in May 1990 and the elections of himself as Chairman and of Dr. Killworth (UK) and Dr. Lass (GDR) as Vice-Chairmen. The terms of several members had expired and SCOR and IOC have agreed to membership changes as shown in Annex VIII.

The representative of IOC, Dr. Voigt, urged SCOR to continue its strong support of CCCO in partnership with the IOC. He planned to attend the forthcoming Second World Climate Conference, but expected (judging from the preparatory material) that it would include very little recognition of the oceans and their role in climate change. In his view, the CCCO has an important function to fulfil in ensuring that studies of the ocean are incorporated in global change programs.

The Executive Committee Reporter for CCCO, Professor Siedler, reiterated this view and introduced a proposal to expand the membership of the Joint Scientific Committee for the WCRP by the addition of four members comprising a CCCO Executive Committee. This was endorsed by the General Meeting in the hope that the additional oceanographic expertise in the JSC would serve to increase the awareness of the need for oceanographic input to programs such as GEWEX which are being planned largely by meteorologists. Professor Siedler complimented Professor O'Brien on his efforts to forge new directions for the CCCO, particularly through the six topics selected for action during this intersessional period.

In conclusion, the General Meeting approved the program of activities planned for CCCO during the year to come. The success of the Committee in fulfilling its new role and in addressing new topics will be reviewed by SCOR at its Executive Committee meeting in 1991 and at the XXI General Meeting in 1992. The President closed the discussion on CCCO by assuring the Chairman of CCCO of the full support of SCOR as the Committee's founding organization.

#### *Committee for the Joint Global Ocean Flux Study*

The Chairman of JGOFS, Professor Bernt Zeitzschel (FRG) gave a review of the scientific progress in JGOFS to supplement the written report to the General Meeting which appears in Annex IX. He presented a brief description of the oceanic carbon cycle and its various components, indicating the major gaps in understanding and the new view of some of the important processes involved that is being derived from satellite remote sensing, especially through analysis of ocean colour data. He also showed that progress has been made in incorporating biogeochemical models in physical models of the ocean and that the results obtained from these models can make important contributions to experimental design for JGOFS. Readers are referred to Annex IX for information on the goals and basic scientific strategies of JGOFS.

The Joint Global Ocean Flux Study was being formally reviewed by the SCOR General Meeting for the first time since its establishment in 1988. Important milestones have included the designation of JGOFS as a Core Project of the IGBP, the successful completion of the first major field activity, the publication of the JGOFS Science Plan, planning for process studies in the equatorial Pacific, Indian and Antarctic Oceans, an important modelling workshop and a unique data analysis and interpretation workshop. Immediate plans included an international scientific symposium (November 1990) at which the first JGOFS field results were to be presented.

The JGOFS Committee met in March 1990 (Kiel) and was to meet in Washington in November. The Science Plan was approved at the Kiel meeting and was published in August 1990. Each of the two goals of JGOFS are developed into a series of more detailed scientific objectives which emphasize the scientific questions which need to be resolved to meet these goals. The strategies to address these problems are described. A condensed, glossy version of the Science Plan was in press at the time of the General Meeting. Entitled "Oceans, Carbon and Climate Change; an Introduction to JGOFS", it provides a brief overview of the scientific problems being addressed by JGOFS, its goals, the strategies for meeting them and some of the plans for the implementation of the programme.

At the time of the 29th Executive Committee meeting in 1989, the first major JGOFS field programme, the North Atlantic Pilot Study, also known as the North Atlantic Bloom Experiment (NABE), was just being completed. The year since then has been an intense period of data analysis and interpretation. Professor Zeitzschel reviewed the very successful data workshop which took place in Kiel in March 1990, and the plans for the NABE scientific symposium in November.

The Committee has drafted a schedule for future JGOFS process studies, as shown in Annex IX and plans for a field program in the equatorial Pacific Ocean in 1992-1993, are now well advanced. Similarly, plans are beginning to be made for process studies in the Southern Ocean and the Indian Ocean. Planning Groups for each of these studies have been established and will hold their first meetings during 1990 and early 1991.

During 1990 the JGOFS Committee began to translate its International Science Plan into a detailed Implementation Plan. A preliminary schedule of JGOFS Process Studies for the decade was discussed. The first four (the North Atlantic Bloom Experiment, the equatorial Pacific study, the Southern Ocean and the Indian Ocean) have a firm basis in current national plans. The JGOFS Committee has also undertaken to ensure that a global survey of oceanic CO<sub>2</sub> is conducted by assuming the responsibility, through the

JGOFS/CCCO CO<sub>2</sub> Panel, for placing JGOFS scientists on the WOCE Hydrographic Programme cruises in accordance with an agreement between the two programmes. The development of a detailed JGOFS Implementation Plan will be achieved through a set of strategy-oriented Task Teams on Process Studies, Global Survey, Time Series Stations, Historical Record, Benthic Processes, Modelling and Data Management.

In 1989 the JGOFS Committee had requested SCOR to convene a meeting at which issues of the international coordination of resources for JGOFS could be discussed among representatives of the major supporting agencies in the participating nations. This meeting took place at ICSU Headquarters in May 1990, under the Chairmanship of Dr. R.W. Corell (USA). The meeting recommended the establishment of an *ad hoc* international inter-agency resource panel for JGOFS with links to an international group involving senior agency representatives with responsibilities for resources for global change research programs. It was expected that such a group, which had already met once informally, would be formally established under the auspices of ICSU at a meeting in July 1990. This did not happen and the informal International Group of Funding Agencies for Global Change (IGFA) did not wish to establish direct links to individual research programs. As a result, it was not clear how the members of a resource panel for JGOFS could be identified and how such a panel could best be established. The General Meeting requested Dr. Neil Andersen of the US National Science Foundation to investigate this matter, in consultation with his colleagues in funding agencies in other nations, and make recommendations about the mechanisms required to SCOR for consideration at the Executive Committee meeting in 1991.

Professor Zeitzschel noted that for the first time, the terms of a large number of the members of the JGOFS Committee would expire at the end of 1990, including his own term as Chairman. The Committee wished to recommend that Dr. Trevor Platt (Canada) be invited by SCOR to succeed him as Chairman of JGOFS. It also sought the approval of the General Meeting to submit its recommendations for new members of the JGOFS Committee in correspondence after its meeting in November 1990 at which a number of nominations would be considered.

In response to a question from Dr. McCave about the apparent lack of benthic studies in JGOFS, the Chairman stated that only a few countries have the capability to study the processes involved in the burial of carbon in deep sea sediments. He acknowledged that the Science Plan does not emphasize these processes in comparison with those in the upper ocean. Dr. Andersen pointed out, however, that NABE had been, in part, a feasibility study for JGOFS and it had not been possible to include all desirable measurements: he noted that benthic studies feature much more prominently in plans for the Equatorial Pacific Process Study. Dr. Otto (The Netherlands) urged JGOFS to develop a detailed schedule for achieving its ambitious and complex objectives. Professor Zeitzschel responded that this is one of the main purposes of the Implementation Plan.

In his capacity as Reporter for JGOFS, the SCOR President expressed his support for the plans for JGOFS activities as described by Professor Zeitzschel, the nomination of Dr. Piatt as incoming Chairman, and the recommendations of the JGOFS Resource Coordination Planning Meeting. The Meeting agreed with these suggestions.

#### *SCOR/UNESCO/ICES/LAPSO Joint Panel on Oceanographic Tables and Standards*

The report from received from the Chairman the Chairman of JPOTS, Dr. Gieskes, indicated that the Panel had been relatively inactive, but that two of its three sub-panels had made progress. These include:

- the sub-panel on standards for the measurement of CO<sub>2</sub> in sea water which had submitted its report to Unesco for publication. Its Chairman, Dr. Andrew Dickson, has begun to work closely with the group involved in the planning of a global survey of oceanic CO<sub>2</sub> in JGOFS and WOCE which includes several members of his sub-panel. The final meeting of this sub-panel was to take place in December 1990.

the editorial panel on a Manual for Processing of Oceanographic Data was about to complete its task. The manual was felt to be a natural outcome of the early work of JPOTS in developing the International Equation of State of Sea Water. Some members of the sub-panel would meet to finalize the manual in December 1990.

the sub-panel on the thermodynamics of the CO<sub>2</sub> system in sea water had been inactive in 1990, although it was expected that its recommendations regarding measurements of the equilibrium constants of the CO<sub>2</sub> system in sea water would be finalized at a meeting to take place during the IUGG Assembly in August 1991.

In response to a request from the SCOR Executive Committee, Professor Gieskes' report included a statement on the need for the continued existence of the JPOTS panel itself. He felt that questions which may arise regarding the use of the equation of state could be resolved by JPOTS members. He was of the opinion that the Panel should remain in existence in order to take up new topics which may be proposed by its sponsors. It was his view that JPOTS should react to such proposals and should not generate its own tasks.

In reviewing the JPOTS report, Professor O'Brien recalled the discussion of these issues at several SCOR meetings in recent years. He noted that the virtually permanent status of JPOTS as a standing panel is not in conformity with the established procedures for SCOR subsidiary bodies. In view of the continuing dormancy for JPOTS since its last formal meeting in 1984 and in the absence of significant new tasks for JPOTS, he recommended that SCOR's cosponsorship of the Panel be discontinued. The General Meeting agreed with this suggestion, noting that representatives of all of the other sponsors were present when this matter was discussed in 1988 and 1989, and that this decision need not affect their continued sponsorship of JPOTS. It was agreed that SCOR would support the two sub-panel meetings already planned for late 1990.

#### *Editorial Panel for the Ocean Modelling Newsletter*

The eighty-eighth issue of the Ocean Modelling Newsletter was published in June 1990. The General Meeting was pleased to note the continuing success of this publication which originated in 1976 as a result of the activities of SCOR WG 79.

#### **2.4 Proposals for New Working Groups**

The General Meeting had before it the following proposals for new working groups:

##### *Sea ice, convection and climate change modelling*

This proposal had been submitted by the Canadian Committee for SCOR and was circulated for comments from other Committees before the General Meeting. It was introduced by Professor O'Brien who noted that there are already a number of international groups working on sea ice and that even these existing groups have significantly overlapping memberships. He mentioned, for example, groups working under the auspices of SCAR, IAPSO and the CCCO. While there was widespread support for the scientific quality of the proposal, the General Meeting concurred with Professor O'Brien's concerns about the potential for overlap with existing groups. It was agreed that he should contact these groups to determine whether the proposed working group might fill a need which is not already being met.

##### *The impact of world fisheries harvest on the stability and diversity of marine ecosystems*

Professor Stromberg introduced this proposal which was also submitted by the Canadian SCOR Committee. It addresses the problems of the impacts which overfishing or exploitation of marine resource populations can

have on many other levels in marine ecosystems. For example, it has been shown that the removal of Atlantic lobsters in coastal areas of eastern Canada resulted in an increase in the sea urchin population and a consequent decrease in the kelp canopy which is important for many other populations in the region. He noted that the Executive Committee had discussed this proposal and wished to recommend that a strong Chairman be identified before the group is established. Dr. van der Land (The Netherlands) urged that the terms of reference be more specific and be restricted to well documented examples of fisheries. A number of participants made additional membership suggestions. The representative of IOC, Dr. Klaus Voigt, indicated that the Commission wished to co-sponsor this WG when it is established due to its relevance to IOC activities in Ocean Science in Relation to Living Resources (OSLR). He also noted that FAO will propose a draft convention to protect biodiversity, including marine diversity, in preparation for the 1992 United Nations Conference on Environment and Development (UNCED), and that well documented scientific advice is badly needed in support of such a convention. The General Meeting agreed that Professor Fournier should approach the Canadian scientists who had prepared this proposal with a view to refining it for reconsideration by the Executive Committee at its meeting in 1991.

#### *Physiological ecology of atypical algal blooms*

Professor Fournier introduced this proposal which was received from the Canadian Committee for SCOR and had been circulated for review before the General Meeting. He suggested that such a WG, if established, might begin its work with an international symposium (rather than ending with one as proposed) to bring out current ideas and the state of understanding. He expressed concern at the breadth of the terms of reference proposed and suggested that these ought to be narrowed, with the membership being adjusted accordingly. It was agreed that Professor Fournier would discuss this proposal with representatives of the Canadian SCOR Committee and that it should be presented for reconsideration at the next meeting of SCOR.

#### *Altimeter data and in situ current observations*

The FRG SCOR Committee submitted this proposal which was presented to the General Meeting by Professor Siedler. He noted that Seasat and Geosat have provided the first altimeter data sets which could be used to examine the variability of geostrophic currents at the ocean surface. Because of the uncertainties introduced by the geoid determinations, no absolute currents can be obtained at this time. First comparison of deviations from appropriate means in altimeter and *in-situ* data sets indicate a better consistency of the remote sensing data output and sets from ship-borne Acoustic Doppler Profilers, moored current meters and hydrographic data than had originally been expected. It is desirable to bring together altimeter data experts and sea-going oceanographers from different countries to ensure an optimum use of the existing altimeter data and of the future data expected from ERS-1 and TOPEX/Poseidon. The main aim of this group should be to improve the joint interpretation of altimeter and various *in-situ* methods, taking into account the different space-time properties and the different instrumental errors. Steps in that direction involve:

- explicitly stating the variables measured, sampling and corrections,
- direct comparisons with comparable smoothing,
- simple inverse methods with geostrophy, to make data consistent over suitable time scales, and
- assimilation into increasingly sophisticated numerical models.

The General Meeting agreed to establish Working Group 94 with the following terms of reference:

- To review the methods of altimeter and *in-situ* data intercomparison, and assess the more promising paths.
- To review the usefulness of existing altimeter data sets for this goal.
- To identify model requirements for determining currents from altimeter data.
- To identify problems in this context requiring further study and international collaboration.
- To prepare a summary report on the results.

It was agreed that Dr. V. Zlotnicki (USA) be invited to serve as Chairman of WG 94. Following the General Meeting, he and Professor Siedler finalized the membership from a list including suggestions made by participants in the meeting. The following individuals have been invited to join WG 94:

John Church	Australia
Karen Heywood	U.K.
Shirō Imawaki	Japan
Terry Joyce	USA
Oleg Mamayev	USSR
Detlef Stammer	FRG
Joel Picaut	France
Martin Grundlingh	South Africa
Moto Ikeda	Canada

Jean François Minster (France) will be invited to participate in WG 94 as a Corresponding Member.

*Particle fluxes between sediment and near-bottom turbidity zones*

A representative of the FRG SCOR Committee, Professor G. Graf, introduced this proposal which was intended to resolve problems which are not being addressed by the Joint Global Ocean Flux Study (JGOFS). Its aim is to discuss physical, biological and chemical processes which determine the exchange and dissolution of particulate matter between sediment and near-bottom water. The following fluxes and rates need to be considered: sedimentation, biodeposition, resuspension, lateral advection, bioentrainment, sediment mixing rate, and burial rate.

These fluxes can maintain individual particles in a resuspension loop for many years - in the deep sea up to several thousand years. In traversing this loop a particle experiences diverse chemical conditions such as those prevailing in the nepheloid layer, in anoxic pore water, and in various types of animal gut. The fate of particles arriving in sedimentation pulses can be quite different from those settling out individually. A major mass flux from the sediment into the near-bottom water and vice versa has to be expected. This is not the same as the net flux to the sea floor measured in a sediment trap deployed above the turbidity zone. Thus, processes in this zone will determine the magnitude and composition of particles eventually buried in the sediments.

Professors Heath, Healy and McCave all expressed concern as to the breadth of the proposed terms of reference which seemed to address all sedimentation processes, while Professor Graf responded that it was intended to focus on the particle processes. These individuals met during the General Meeting and revised the terms of reference which were presented under a new title, *Sediment Suspension and Sea Bed Properties*, and accepted as follows:

- To review and summarise the information available on the changes that occur to suspended material in the region of resuspension close to the sea bed.
- To identify the conflicts shown by the data and propose approaches for their resolution.
- To assess the impact of these processes and changes on the properties of the sea bed.
- To prepare and convene a symposium to present the working group's results and current research in the field.

The General Meeting agreed that Professor Graf should be asked to chair this group which will be WG 95. The following scientists will be invited to join WG 95:

R. Aller	USA
T.H. Blackburn	Denmark
B.P. Boudreau	Canada
T. Brattegard	Norway
F. Nyffeler	Switzerland
R. Rosenberg	FRG
M. Rutgers v.d. Loeff	FRG
S. Wainwright	USA

### *World Ocean Acoustic Monitoring*

A proposal with this title had been sent to the SCOR Secretariat by the USSR SCOR Committee shortly before the General Meeting and there had been insufficient time to circulate it to other committees for comments as required under SCOR procedures. It was presented by Dr. Kuznetsov who stated that sound waves of intermediate frequency can propagate in the ocean over long distances. Investigation of different characteristics of sound propagation in the ocean, which are significantly determined by the medium, can give valuable information about the structure of temperature and current fields in the interior of the ocean. Various uses of ocean acoustic tomography are applications of these principles. Large-scale investigation of the ocean by acoustic methods has started only recently and international cooperation in this field is very desirable.

Professor O'Brien wished to support this proposal in principle, referring to the well publicized Heard Island experiment being conducted by Dr. Walter Munk and colleagues and to the exciting new concept of using long distance sound propagation as a tool for monitoring the ocean. A number of comments regarding the terms of reference resulted in their revision by a small group of participants in the General Meeting as follows:

- To study the existing methods of large-scale acoustic tomography of the ocean and to identify those which can benefit from international collaboration.
- To evaluate the opportunities for international collaboration in the use of acoustic techniques for monitoring global climate change in the ocean.
- To assess other methods and theories relating to investigation of the ocean by means of observations of sound propagation over long distances.
- To prepare a report to SCOR on the scientific prospects for large-scale acoustic tomography.

It was agreed that Dr. Guan Dinghua (China) should be invited to act as Chairman of this group which will be WG 96, but that the proposal must be circulated to SCOR Committees for comments and additional membership suggestions. Following this, the membership will be finalized in consultation between Dr. Guan and Professor O'Brien.

The IOC representative, Dr. Voigt, reported that the Commission had held a workshop on marine acoustics (in a broader sense) in China in March 1990 and that a proposal to establish an IOC group of experts in this field would be considered at the IOC Assembly in March 1991. He looked forward to cooperation with SCOR

in this area.

The following proposals had been tabled for further action by the 29th Executive Committee meeting:

*Role of Continental Margins on the Distribution and Fluxes of Materials in the Ocean Interior*

This proposal originated from the final recommendations of WG 71 on Particulate Biogeochemical Processes and had been referred to the former Chairman, Dr. Krishnaswami, for revision. In the meantime, however, it had become apparent that the proposed topic was likely to fall within the purview of the IGBP Core Project Land-Ocean Interactions in the Coastal Zone. The links between this program and JGOFS were under discussion and it was agreed that no further action should be taken on this proposal.

*Ocean Experiments to Create a Chemical Model to Predict Future Changes in Carbon Dioxide and the Carbon Cycle in Seawater*

The Executive Committee had referred this proposal (which arose from SCOR WG 75) to the CCCO/JGOFS CO<sub>2</sub> Panel for consideration since it seemed to overlap with the interests of the Panel. The Chairman of the Panel responded that many of the activities proposed had been overtaken by the needs to plan the JGOFS/WOCE CO<sub>2</sub> survey and the forthcoming international dissemination of information on standard reference materials developed in the USA. In view of these remarks, the General Meeting agreed that no new group should be established.

*Monitoring Biological Variability in the Ocean*

The Executive Committee had tabled this proposal in 1989 since it was not accompanied by a well developed list of potential members and a nomination for Chairman. It recognized that a strong and committed Chairman is essential to the success of any WG from the time of its establishment. Despite several enquiries, no such individual had been identified. In the meantime, SCOR had taken an initiative with IOC to consider the need for a program of studies in marine ecosystems dynamics, including the processes affecting biological variability (see item 6.1). A joint workshop in 1991 seemed likely to address the topics proposed and it was agreed that this proposal should not receive further consideration by SCOR until the recommendations of this workshop were received.

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

Prof. J.-O. Stromberg	WG 76, JGOFS
Prof. G. Siedler	WG 77, 94, CCCO
Prof. R.O. Fournier	WG 78, 86, 93
Prof. T. Asai	WG 83
Dr. A. Kuznetsov	WG 91
Prof. T. Healy	WG 75
Prof. J. O'Brien	WG 89
Prof. I.N. McCave	WG 92, 95
Prof. P. Lasserre	WG 80, 90
Dr. Su Jilan	WG 96

### 3.0 ORGANIZATION AND FINANCE

#### 3.1 Membership

The President informed the General Meeting that in April 1990, he had given provisional acceptance to an application from the Republic of Korea for membership in SCOR. A Korean SCOR Committee has been formed under the Chairmanship of Dr. B.K. Park and it includes representatives from a large number of universities, research agencies and the Academy of Sciences. Dr. Park gave a brief review of Korea's commitment to oceanic research, noting that these activities are expanding from the coastal areas into the East China Sea, the Equatorial Pacific and the Southern Ocean. The General Meeting confirmed the acceptance of the application from Korea which will adhere to SCOR as a Category II member.

Dr. Abul Farah presented an application from Pakistan for SCOR membership through its existing National Commission for Oceanographic Research. He noted that during recent years his country has made a concerted effort to acquire the capabilities and infrastructure required for modern oceanographic research. It is an active participant in many of the programs sponsored by the IOC. Dr. Farah assured the General Meeting that, in its capacity as a national adhering body to SCOR, the Commission would ensure the involvement of active scientists, especially younger ones, from academic institutions as well as government research agencies. The General Meeting approved the acceptance of Pakistan as a Category I member of SCOR.

The Past-President, Professor Gerold Siedler, informed the General Meeting that with the reunification of Germany occurring this same day, the SCOR Committee of the former German Democratic Republic would be amalgamated with that of the FRG which would be expanded to include representatives from the eastern part of Germany.

#### *Nominated Members:*

The Executive Secretary presented information on changes in Nominated Members of SCOR since the 29th Executive Committee meeting:

- Australia - J.H. Middleton and J. Veron have been replaced by I. Jones and I. Parslow.
- Korea - The first three Nominated Members from the Korean Committee will be B.K. Park, J.H. Shim and J.Y. Na.
- Thailand - C. Vashrangsi has been nominated to replace C. Swasdiyakorn.
- UK - The Royal Society has re-structured its committees for ICSU bodies, amalgamating many of them. Responsibility for SCOR matters falls under the new Environmental Research Committee. Sir Anthony Laughton is the only UK Nominated Member of SCOR who is a member of this Committee. It has been agreed with the Secretary of the Committee, Mr. L. Mole, that SCOR should continue to seek advice from M. Whitfield and H. Charnock and that they should continue as UK members of SCOR.
- USA - P. Brewer, J. O'Brien and E. Hofmann replace G.R. Heath, R. Gammon and D.A. Ross as Nominated Members from the Ocean Studies Board of the National Academy of Sciences, which serves as the US SCOR Committee.

#### *Representative Members:*

H. Beiersdorf has replaced K. Hsü as the representative of the International Union of Geological Sciences.

### **3.2 Publications Arising from SCOR Activities**

The Executive Secretary presented a list of publications arising from SCOR activities since the 29th Executive Committee meeting.:

#### **UNESCO Technical Papers in Marine Science**

No. 57 Coastal marine systems: Review and research recommendations 1988-1990. Unesco/SCOR/LABO consultative panel on coastal systems, 15-20 December 1988, São Luis, Maranhao, Brazil. (Unesco 1989)

#### **BIOMASS Report Series**

No. 60 Meeting of the BIOMASS Executive, Barcelona, Spain, July, 1989.

No. 61 Meeting of the BIOMASS Executive, Paris, France, 18-19 January, 1990.

No. 62 SIBEX Physical Oceanography Workshop, Cambridge, U.K., 9-27 March 1987.

No. 63 Planning Meeting on Future BIOMASS Workshops, Cambridge, U.K., 4-5 April 1990

No. 64 Meeting of the BIOMASS Executive, São Paulo, Brazil, 21 July 1990

#### **BIOMASS Scientific Series**

No. 10 Identification key and catalogue of larval Antarctic fishes. (September 1989)

#### **SCOR/IOC CCCO Publications**

WCRP Publications Series, No. 3 Addendum. Scientific Plan for the TOGA Coupled Ocean-Atmosphere Response Experiment. WMO/TD - No. 64 Addendum.

World Ocean Circulation Experiment. WOCE Surface Flux Determinations - A Strategy for *in situ* Measurements. WCRP-23. WMO/TD No. 304.

JSC/CCCO TOGA Numerical Experimentation Group. Report of the Second Session. WCRP-24. WMO/TD No. 307.

World Ocean Circulation Experiment. Report of the CCCO/WOCE Workshop on Inversion of Ocean General Circulation Models. WCRP-28. WMO/TD No. 331.

JSC/CCCO TOGA Scientific Steering Group. Report of the Eighth Session. WCRP-31. WMO/TD No. 338.

JSC/CCCO TOGA Numerical Experimentation Group. Report of the Third Session. WCRP-32. WMO/TD No. 339.

TOGA Monsoon Climate Research. Report of the First Session of The Monsoon Numerical Experimentation Group. WCRP-33. WMO/TD No. 349. (February 1990)

WMO/IOC Inter-Governmental TOGA Board, Report of the Third Session, Geneva, 9-12 January 1990. WCRP Special Report. WMO/TD - No. 357.

Report of the Sixth Session of the SCOR-IOC/CCCO Tropical Atlantic Ocean Climate Studies Panel. Kiev, USSR, 15-18 May 1989.

SCOR-IOC/CCCO-X. Committee on Climatic Changes and the Ocean, Tenth Session, Halifax, 14-20 June 1989, Summary Report.

#### **JGOFS Publications**

JGOFS Report No. 1, Report of the Second Session of the SCOR Committee for JGOFS, The Hague, September 1988.

JGOFS Report No. 2, Report of the Third Session of the SCOR Committee for JGOFS, Honolulu, September 1989.

JGOFS Report No. 3, Report of the JGOFS Pacific Planning Workshop, Honolulu, September 1989.

JGOFS Report No. 4, North Atlantic Bloom Experiment Report of the First Data Workshop, Kiel, March 1990.

JGOFS Report No. 5, Science Plan, August 1990.

#### **Publications Arising from SCOR Working Groups**

WG 85 A Contribution of the Scientific Committee on Oceanic Research. Coastal and Estuarine Studies, C.M. Lalli (Ed.) Enclosed Experimental Marine Ecosystems: A Review and Recommendations. Springer-Verlag, New York 1990.

WG 85 A Manual of Marine Experimental Ecosystems, prepared by SCOR WG 85. SCOR Report Series No. 2. Technical Editor: Barbara E. Rokeby.

#### **Publications Arising from Other SCOR Activities**

SCOR Proceedings, Volume 25. Report of the 29th Meeting of the SCOR Executive Committee, Tallahassee, USA, September, 1989. (July 1990)

Ocean Modelling Newsletter - issue nos. 84-88 were published between October 1989 and October 1990.

Tidmarsh, E., 1990. SCOR, The Scientific Committee on Oceanic Research. Science International, No. 39, pp 8-9.

Tidmarsh, E., 1990. Global Change, The Oceans and SCOR. Science International, No. 41, pp 34-37.

### 3.3 Finance

The Executive Secretary presented a brief review of the 1989 final financial statement, and an interim report on the 1990 financial situation. This was followed by a more detailed report by Prof. John Field (South Africa) speaking for the *ad hoc* Finance Committee which was appointed at the beginning of the meeting.

Professor Field stated that the Finance Committee had thoroughly compared the 1989 financial documents prepared by the Executive Secretary with the audited accounts submitted by Chandler and Davis, Chartered Accountants, in accordance with ICSU regulations. There had been only slight deviations from the budget approved for 1989. The postponement or cancellation of three working group meetings had reduced expenses on scientific activities. While income for 1989 was nearly \$467,000.00, expenses were slightly less at just over \$455,000.00. The year end balance for 1989 was over \$80,000.00 which provided ample funds for activities early in 1990 and represented a small reduction from the 1988 level. The final financial statement for 1989 is presented in Annex XIV.

The *ad hoc* Finance Committee had also reviewed the state of SCOR finances in 1990, based on interim statements and budget information provided by the Executive Secretary. Income for the year was expected to be somewhat higher, but this would be offset by increased commitments to JGOFS, the CCCO secretariat support, the expense of the General Meeting and several other items. It was expected that expenses would be higher than income, resulting in a reduction of the year-end balance to between \$50,000.00 and \$60,000.00 which has traditionally been accepted as the minimum amount with which SCOR could expect to begin its activities in the new year.

With respect to 1991, Professor Field indicated that the *ad hoc* Finance Committee had carefully reviewed the expected income and the requests for support received from Working Groups and Committees as well as other commitments made during the General Meeting. He noted that the Executive Committee meeting in 1989 had already established an eight per cent increase in membership contributions to SCOR for 1991. Taking this into account, the committee had drafted a budget for activities in 1991. While this had proved to be extremely difficult, it was possible to support those Working Group meetings and Committee activities which were approved by the General Meeting. Expenses on scientific activities will require the major portion of the available funds. Overall expenses will again exceed income and great care will be required in order that the year end balance not be further reduced.

In closing, Professor Field, announced that the *ad hoc* Finance Committee wished to recommend that membership contributions again be increased by eight percent in 1992. This would be in accordance with a similar increase being recommended to the ICSU General Assembly which was taking place at the same time as the SCOR General Meeting. During recent years, SCOR has kept such increases in line with those instituted by ICSU. Professor Siedler responded that the FRG Committee would require a detailed statement justifying the need for such an increase which would be greater than the rate of inflation. It was agreed that such a statement should be provided. [Note from the Executive Secretary: the ICSU General Assembly did not accept the recommendation of the ICSU Finance Committee for an eight percent increase in national membership fees. It approved a five percent increase for 1992. The SCOR increase was adjusted accordingly and announced to SCOR Committees in a letter dated December 17, 1990.]

The General Meeting accepted the report of the *ad hoc* Finance Committee and thanked its members for their diligence in reviewing the financial situation.

### 3.4 Election of SCOR Officers

A Nominations Committee was appointed by the 29th Executive Committee meeting. It was chaired by Professor Heath and included J. Stromberg, I.N. McCave and A. Ayala-Castafiores. Prof. Heath reported to the General Meeting, recalling that the terms of the three Vice-President and the Secretary expired at the meeting. Professor Heath was himself ineligible for re-election, under the terms of the Constitution. Dr. Asai and Dr. Kuznetsov had both indicated their willingness to serve again as Vice-Presidents and Dr. Fournier wished to complete a final term as Secretary. SCOR Committees were invited to submit nominations for the vacant position. Speaking on behalf of the Committee, Professor Heath recommended the nomination of Professor Terry Healy (New Zealand) as Vice-President. The General Meeting accepted this nomination and Professor Healy was elected by acclamation.

At an informal meeting of the Executive Committee following the General Meeting it was agreed that change the title of the Executive Secretary to Executive Director in order to more appropriately reflect the role that this position plays in the administration of SCOR.

## 4.0 THE ROLE AND FUTURE DIRECTIONS OF SCOR

The 29th Executive Committee meeting appointed an *ad hoc* Committee to Review the Role and Future Directions of SCOR as a result of its discussion of a survey of SCOR Committees which was conducted by Dr. Su Jilan in 1989. The Chairman of the *ad hoc* Committee, Prof. G.R. Heath, presented its report and recommendations for consideration by the General Meeting.

### *SCOR as facilitator of large-scale programs*

The General Meeting concluded that SCOR has demonstrated a strong leadership role in the initiation and planning of international programs in oceanography. The most recent example of this is the Joint Global Ocean Flux Study. As these programs mature, however, they become more complex and the coordination activity threatens to overstrain the resources of SCOR and its secretariat, to the detriment of traditional SCOR activities such as Working Groups. The participants agreed that SCOR should maintain its flexibility in order that it can continue to respond to new international initiatives which have the potential to result in new programs. Given its present resources, it seemed unlikely that SCOR could be effective as the motivator for more than one such program at the same time. The experience with JGOFS seemed to indicate that SCOR's involvement is required for about five years to ensure that a new program progresses through the initial planning phases to a point at which it should become fairly independent with strong support from participating nations. The first three years would require the intense involvement of the SCOR secretariat and some members of the Executive, followed by two years of reduction of routine involvement. By this point in their development, large-scale programs should have established their own project offices. SCOR sponsorship would, of course, continue, as it has for programs such as TOGA, WOCE and JGOFS.

### *SCOR Working Groups*

The General Meeting agreed with Professor Heath's Committee that working groups must continue to be a major focus of SCOR's activities. The process of the submission and review of proposals for new working groups requires improvement, however. Such proposals will be invited at an earlier date in future and each will be assigned to a member of the Executive Committee for review and revision as needed, in consultation with the proponent, before they are considered by a SCOR meeting. It was hoped that this would result in better defined terms of reference and would result in fewer proposals being tabled for revision, or being rejected as inappropriate.

Working groups must involve more scientists from developing countries and younger scientists, and an effort must be made to encourage this through the working group Chairmen and through SCOR Committees, when they are invited to nominate members.

Various means of disseminating information on the achievements of working groups were discussed. As each group completes its tasks, the Chairman should be asked to provide a very brief summary of its results for wide distribution through such publications as EOS, the IMS Newsletter or the Oceanography Society magazine. The scientific sessions at General Meetings would be a very effective forum for the presentation of a final symposium by such groups, and working group meetings and presentations could also be held in conjunction with Executive Committee meetings.

Several other points were made:

- Groups should be encouraged to complete their tasks in four years if this is practical.
- The most successful groups seem to be those undertaking a synthesis or state of the art review, a comparison of geographic regions, or a methodological problem.
- Personal reports from Chairmen at General Meetings have been very effective and should be encouraged.

#### *Greater participation in SCOR by individual scientists*

The *ad hoc* Committee had considered whether SCOR should try to forge contacts with individual scientists, possibly through the publication of a newsletter or magazine, such as "Episodes" of the IUGG. It did not agree that this was an appropriate use of SCOR resources, but felt that better use could be made of existing channels of communication (newsletters, national societies, etc.). SCOR Committees will be requested to provide suitable addresses for the dissemination of information on SCOR activities. Professor Healy agreed to undertake responsibility for producing a brochure about SCOR for wide distribution. Dr. Steyaert of UNESCO suggested that the IMS Newsletter be used more effectively in this regard.

#### *Recruitment of new members*

The General Meeting endorsed the suggestion that there should be a continuing effort to increase the number of countries involved in SCOR and agreed that a member of the Executive Committee should be assigned responsibility for membership issues. In addition, an effort will be made to invite observers from non-member countries to participate in SCOR meetings.

#### *Meetings*

SCOR meetings should be advertised well in advance in order to permit potential participants to make allowances in their travel budgets. Many other issues relating to scientific meetings were discussed under the following agenda item (JOA).

#### *Infrastructure*

The basic budget for the SCOR Secretariat should include, as a minimum, support for the salary of a full-time Executive Secretary and a half-time secretarial assistant. If new program activities are undertaken, additional funds must be sought to provide extra staff support in the Secretariat.

## *Linkages*

The links between SCOR and other organizations, such as IOC, were reviewed briefly, and found to be appropriate.

### **5.0 JOINT OCEANOGRAPHIC ASSEMBLY**

The 29th Executive Committee meeting had a detailed discussion of a report presented by Prof. Terry Healy, Chairman of an *ad hoc* Committee to review the Joint Oceanographic Assembly and SCOR's role in relation to large international scientific meetings. It was agreed to recommend to the General Meeting that the traditional JOA be discontinued in favour of more frequent, more focused interdisciplinary meetings (see *SCOR Proceedings* Vol. 25). This recommendation was forwarded to SCOR Committees for comments which were presented to the General Meeting by the Secretary of SCOR, Professor Fournier.

The majority of comments received were in favour of discontinuation of the JOA and in support of the suggestion that the scientific events held in conjunction with General Meetings be strengthened as suggested during the discussion of the preceding agenda item. SCOR should also explore more opportunities for the cosponsorship of meetings with other organizations such as IOC and UNESCO. The General Meeting accepted the recommendation from the Executive Committee.

Professor Siedler, representing the FRG SCOR Committee, introduced several topics for interdisciplinary meetings which could be organized by SCOR. He presented a more detailed proposal for an international meeting on "The South Atlantic Ocean: Present and Past Circulation" at which the results from WOCE cruises in the South Atlantic, and from several other activities such as the Ocean Drilling Program could be presented to an interdisciplinary audience. The schedules for these programs suggest that such a meeting would be most effective if it were held in late 1993. It was agreed that the possibility of organizing such an event in Europe, jointly with the Oceanography Society, should be explored in some detail. The Society's representative, Dr. Andersen, confirmed that his organization is interested in such a joint effort.

### **6.0 RELATIONS WITH INTERGOVERNMENTAL ORGANIZATIONS**

#### **6.1 Intergovernmental Oceanographic Commission**

The Deputy Secretary of IOC, Dr. Klaus Voigt, reviewed some events and activities of mutual interest to the Commission and SCOR. Two consultations had taken place between representatives of SCOR and IOC (March and September 1990) and these had reviewed areas of existing cooperation and explored various new fields where joint initiatives would be effective. For example, now that the JGOFS Science Plan has been published, SCOR and IOC are discussing ways in which the IOC can contribute to JGOFS. The JGOFS Indian Ocean Process Study, which is in the preliminary planning phase, seems to offer an ideal opportunity for such collaboration and some specific suggestions will be explored at a meeting to be held in Goa, India in January 1991.

At the IOC Executive Council Meeting in March 1990, the President of SCOR invited IOC to cosponsor a workshop on marine ecosystems dynamics. This arose from the converging interests of the two organizations in this topic and the recognition that there is a gap in existing oceanic global change research programs. This gap relates to the linkages between physical processes in the ocean and its biological variability, especially in those processes such as secondary production and recruitment which are critical to the maintenance of populations of economically important resource species. A number of national programmes do exist and the IOC through its programme on Ocean Sciences in Relation to Living Resources (OSLR) had recognized the

existence of these national activities and was considering the development of a component of OSLR on marine ecosystems dynamics. At the same time, SCOR had been approached by representatives of GLOBEC to take the lead in convening a scientific workshop to seek the advice of experts active in these various programmes on the matter of formulating an internationally coordinated study and an appropriate framework for scientific cooperation and collaboration.

The General Meeting expressed its support for this new joint activity between SCOR and the IOC. The workshop was expected to take place in Paris in February 1991.

Dr. Voigt reported that significant progress had been made towards the development of a plan for a Global Ocean Observing System (GOOS). This system, strongly recommended by the Intergovernmental Panel on Climate Change (IPCC), has as its goal to provide an evolving global ocean observing network to meet the needs of the international community for operational ocean forecasting and for long-term ocean climate monitoring. It will commence with improved coordination and strengthening of existing observational systems and will be upgraded as new technologies and methodologies are adopted. It is hoped that a convention regarding a global climate observing system, of which GOOS will be a component, will be signed at the United Nations Conference on the Environment and Development (UNCED) in 1992. However, the field of marine science has not been well represented in preparatory meetings for UNCED and Dr. Voigt appealed to SCOR for assistance in bringing this matter to the attention of the oceanographic community.

It was noted that ICSU has been invited by the UN to take the lead in providing scientific input to the UNCED preparatory process. ICSU, in turn, has invited SCOR to name a representative for this activity. The General Meeting agreed to nominate Professor James O'Brien to participate in ICSU activities relating to UNCED and urged him to do as much as possible to ensure that the importance of the role of the ocean in climate change is emphasized in the deliberations leading up to UNCED. Professor O'Brien will also be of assistance to IOC in this effort in his capacity as Chairman of the Joint SCOR/IOC CCCO. It was suggested that a joint IOC-SCOR statement to members states would be an effective means of communicating the concern of the two organizations about the need to ensure that ocean science is well incorporated into the scientific components of the preparations for UNCED.

The Executive Secretary noted that SCOR has agreed to join IOC as a cosponsor of its developing program on Ocean Dynamics and Circulation on the Continental Shelf. This will begin with a workshop entitled "Coastal Ocean Circulation, Dynamics and Fluxes", to be held in 1991. Dr. Ken Brink (USA) has represented SCOR at an organizational meeting for this workshop and SCOR provided input on the draft program and list of participants.

## **6.2 UNESCO Marine Coastal Programme (now IOC/MRI)**

The representative of the UNESCO Marine Coastal Programme (formerly the Division of Marine Science), Dr. Steyaert, reviewed the state of plans for the Interregional Scientific COMAR Conference, "Coastal System Studies and Sustainable Development" which SCOR will cosponsor and which will take place in Paris in May 1991. Major programme headings for the conference include: global change and the coastal zone; coastal zone research; the human society in the coastal zone; COMAR, UNESCO's major project on coastal systems, and; case studies of coastal impacts and possible solutions. The representative of the Brazilian SCOR Committee, Dr. Martins, urged that the results of the coastal components other UNESCO programs (e.g., OSLR and OSNLR) be included in the conference where appropriate.

## **6.3 International Council for the Exploration of the Sea**

The representative of ICES, Dr. A.C. Pierrot-Bults drew attention to a written report which had been submitted to SCOR by the ICES Secretary-General (see Annex X). Although there are no formal jointly sponsored activities at present, she drew attention to a number of ICES activities of interest to SCOR. Dr.

Pierrot-Bults was to represent SCOR at the ICES 1990 Statutory Meetings in Copenhagen immediately after the SCOR General Meeting. ICES does provide a regional forum for the involvement of North Atlantic marine scientists active in international programs such as IOC's International Recruitment Project and WOCE. In addition, ICES has indicated its interest in WG 93, Pelagic Biogeography, and has named an observer to the group. Finally, Dr. Pierrot-Bults mentioned the plans for a symposium on "Measurement of Phytoplankton Primary Production: From Molecular Base up to Global Space" in 1992.

#### 6.4 World Meteorological Organization

In the absence of a representative from WMO, Professor O'Brien briefly reviewed the written report which appears as Annex XI. He elaborated especially upon the topic of TOGA Predictions. The new understanding of the El Niño-Southern Oscillation Phenomenon which has been achieved through TOGA is now leading to improved predictive capability of the TOGA models. They are being used to provide seasonal prediction: for example, agricultural authorities in northern Peru can provide advice to farmers about whether they should plant corn or rice, based on the expectation of an El Niño event.

### 7.0 RELATIONS WITH NON-GOVERNMENTAL ORGANIZATIONS

#### 7.1 International Council of Scientific Unions

##### *The International Geosphere-Biosphere Programme*

The Chairman of JGOFS has been made an *ex-officio* member of the ICSU Special Committee for the IGBP. Professor Zeitzschel reported to the General Meeting on the state of planning for this ambitious program. He reported that about forty nations had been represented at the recent Second Scientific Advisory Council (SAC) meeting for the IGBP at which the overall science plan was presented and discussed. A press release from the SAC meeting which describes the ten Core Projects is given in Annex XII. The IGBP Core Projects fall into three categories:

##### Established Core Projects (with steering committees and well-developed science plans):

- International Global Atmospheric Chemistry Program
- Joint Global Ocean Flux Study
- Biospheric Aspects of the Hydrological Cycles
- Global Change and Terrestrial Ecosystems
- Past Global Changes

##### Proposed Core Projects (with steering committees, but with science plans not yet completely developed):

- Stratosphere Troposphere Interactions and the Biosphere
- Global Analysis, Interpretation and Modelling
- Land-Ocean Interactions in the Coastal Zone

##### Potential Core Projects (in early stages of development)

- Global Ocean Euphotic Zone Study
- Global Change and Ecological Complexity

The Scientific Advisory Council approved the plans for all of the Established Core Projects. It recommended that SCOR be involved in the planning of the program on Land-Ocean Interactions in the Coastal Zone which will have overlapping interests with JGOFS. It was also strongly recommended that SCOR be consulted in the development of the Global Ocean Euphotic Zone Study. The field phase of this project would not start until about 1997 and would follow on WOCE and JGOFS, using their results and new technologies in an integrated

physical and biological study of the upper ocean.

## **7.2 ICSU Unions and Committees**

Reports were sought from all ICSU organizations represented in SCOR. The following matters of interest were brought to the attention of the General Meeting.

### *Committee on Space Research*

At the XXVII COSPAR Plenary Meeting at The Hague (June 25 to July 6, 1990), SCOR cosponsored the following scientific symposia, providing travel awards for scientists from developing countries:

- Symposium on Global Change and Relevant Space Observations
- Scientific Meeting on Ice and Cloud Motions Deduced from Satellite Imagery.

Plans for several scientific sessions of interest to SCOR at the 1992 COSPAR Plenary Meeting were noted and it was expected that requests for SCOR cosponsorship of these events would be forthcoming.

### *International Union of Geodesy and Geophysics*

A written report from IUGG arrived too late to be presented to the General Meeting. It provided information primarily on the activities of IAPSO (see agenda item 7.3). SCOR has indicated its interest in cosponsoring a number of sessions at the IUGG Assembly which will take place in Vienna in August 1991.

## **7.3 Affiliated Organizations**

Written reports were requested from the Affiliated Organizations of SCOR. *Ex officio* members of the Executive Committee (the Chairmen of these organizations) who were present at the General Meeting gave brief verbal reports:

### *Commission for Marine Geology*

In 1989 and 1990 the activities of CMG were hampered by funding difficulties. Nevertheless, there has been a good level of activity. In particular, several symposia on marine sedimentation were held at the 13th International Sedimentological Congress, including topics on deep-sea contourites, shallow marine sedimentation and deposition in tectonically active continental margin settings. In addition, the Past-Chairman and Secretary of CMG have been active in planning the Dahlem Conference on the Use and Misuse of the Sea Floor to be held in Berlin in March 1991.

Future activities will include symposia on Island Arcs and Marginal Basins, and on Ocean Transform Faults/Mid Ocean Ridges to be held at the European Union of Geosciences meeting in Strasbourg. As plans for the U.S. RIDGE and U.K. BRIDGE (and other planned national activities on mid ocean ridges) develop, the CMG anticipates that SCOR may be expected to take a lead in international coordination of an "Inter-ridge" Program. However this will depend on critical funding decisions yet to be taken. The CMG will also remain active in promoting marine geological concerns and activities within JGOFS and other IGBP projects such as PAGES.

### *International Association for Biological Oceanography*

The report from IABO noted that a new International Society for Mangrove Ecosystems has been affiliated to IABO and held its first General Assembly in August 1990. IABO and UNESCO are collaborating in the

consideration of the interest and feasibility of an international program for long-term monitoring of marine biodiversity as an indicator of change. A meeting held in conjunction with the International Congress of Systematics and Evolutionary Biology concluded that the spatial and temporal dimensions of marine biodiversity need clarifications, but that there is little hard evidence linking species diversity and ecosystem function. The role of high diversity marine ecosystems in the global carbon cycle was also considered. The meeting recommended accurate comparative studies in various climatic regions using a chain of long-term ecological observatories, especially in coastal regions. It was expected that this would be further developed at an IABO/UNESCO meeting to be held in November 1990.

#### *International Association for the Physical Sciences of the Ocean*

Professor James O'Brien, president of IAPSO, presented the plans for IAPSO participation in the IUGG Assembly in Vienna 1991. He reviewed the various IUGG symposia and IAPSO sessions planned for this conference. He noted, in particular, that IAPSO PS-01 "Nonlinearity, Chaos and Fractals in Oceanic and Atmospheric Flows" will be held in honour of Dr. Konstantin Fedorov, former President of SCOR. The convenors include Dr. A.D. Kerwan (USA) and Dr. Anne Ginzburg (USSR). He noted that IAPSO is experiencing a problem which has also been noted by SCOR, namely the reluctance of national correspondents to effectively distribute information regarding IAPSO meetings. The various Commissions of IAPSO are healthy, having been reorganized during the past two years. During the year since the previous SCOR meeting, the Commission on Sea Ice and the Commission on Space Oceanography have both organized scientific meetings.

#### **7.4 Corresponding Organizations**

##### *Arctic Ocean Sciences Board*

The Secretary of AOSB reviewed the written report which was distributed to participants and appears in full as Annex XIII. He noted in particular that the initial results of the first intensive field phase of the Greenland Sea Project were being processed and that a second phase is being planned. The GSP is primarily a physical and chemical program with a focus on the movements of water and ice in the European Sub-Arctic Seas. The AOSB has established a new International Arctic Polynya Program which will coordinate three ongoing polynya projects and will focus on studies of water movements and heat flux, carbon dioxide flux, and community structure and productivity. The relationship between the AOSB and the newly-established International Arctic Sciences Council is not yet clear, although Mr. Brown expected that there would be a continuing need for the AOSB to maintain and develop marine science programs in the Arctic Ocean.

##### *Confederation Mondiale des Activites Subaquatiques*

The observer from Ireland, Dr. Orren, presented the CMAS report on behalf of the President of the CMAS Scientific Committee, Dr. Ryan. The CMAS-UNESCO Code of Practice for Scientific Diving is being prepared for commercial publication and will be available from the Florida Sea Grant Program or from CMAS headquarters. A committee has been established to revise the code which is being adopted in a growing number of countries, and SCOR members were invited to contribute to this effort. CMAS is planning to produce a Worldwide Directory of Diving Scientists in collaboration with UNESCO during 1991.

##### *Engineering Committee on Oceanic Resources*

Mr. Brian Nicholls reported on a meeting which had taken place between the Secretary and Executive Secretary of SCOR and several representatives of ECOR in Halifax in conjunction with the ECOR General Assembly in September 1990. Several areas with potential for future cooperation between the two organizations were identified, especially in relation to the activities of working groups. The five newly-established working groups of ECOR are: Marine Robotics; Large-scale Cleansing of Polluted Seabeds; Small-

scale Ocean Energy Systems; Marine Pollution, and; Self-burial of Subsea Pipelines and Cables. These were in various stages of development with the first two having held their first meetings. At the General Assembly of ECOR Mr. John Brooke (Canada) was elected President.

## **7.5 Other Organizations**

### *The Oceanography Society*

The Executive Secretary reported that SCOR will cosponsor the second scientific meeting of TOS, to be held in St. Petersburg, Florida, March 25-28, 1990. Discussions regarding areas in which the two organizations might collaborate have taken place between representatives of SCOR and TOS on several occasions. In particular, SCOR might assist TOS in broadening its exposure in the international community. It has also been suggested that joint sponsorship of international scientific meetings would make effective use of the strengths of the two organizations. The representative of TOS, Dr. Andersen, indicated that TOS hopes to have a European meeting in 1992 and would welcome SCOR's cosponsorship and involvement in such an event. The General Meeting encouraged the officers of SCOR to explore the various possibilities for TOS-SCOR cooperation when the opportunity arises.

### *Commission on Marine Geography of the International Geographical Union (ICSU)*

The Commission on Marine Geography had sought cosponsorship of a meeting on ocean management and global change (see item 8.2). It has also enquired about the possibility of establishing contacts and cooperation with SCOR. The nature of CMG was not clear, although it appeared to be largely non-scientific, emphasizing the social sciences, and the General Meeting felt that until additional information was available it could not decide on the appropriateness of formal links to CMG. Professor Healy agreed to investigate this matter and to report to the next meeting of SCOR.

## **8.0 FUTURE MEETINGS**

### **8.1 Meetings of SCOR**

The 29th Executive Committee meeting accepted the invitation of Professor Healy of the New Zealand SCOR Committee to hold its 30th meeting at the University of Waikato in Hamilton, New Zealand. Professor Healy reported that the meeting take place during the week of 11 to 15 November 1991 in order to make use of University facilities.

The XXI General Meeting of SCOR should take place during the final quarter of 1992. SCOR Committees had been requested to consider hosting this event. Professor Stromberg indicated that he would arrange for the General Meeting to take place in Sweden, probably at the University of Göteborg. The possibility of holding this meeting at about the same time as the International Paleooceanographic Congress (Kiel, September 1992) was considered. It was also agreed that working groups 91 and 92 should be approached regarding their plans to organize meetings which might form the scientific component of the General Meeting.

### **8.2 Other Meetings**

The Executive Secretary presented information on international meetings of interest to SCOR which had not been discussed under previous agenda items:

**1990**

Oct. 29-Nov. 7	WMO/UNEP UNESCO/ ICSU	Geneva	Second World Climate Conference
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**1991**

Jan. 11-13	ASLO	San Diego	What Controls Phytoplankton Production In Nutrient-Rich Areas Of The Open Sea?
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Jan. 14-16	NIO	Goa, India	International Symposium on the Oceanography of the Indian Ocean
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Jan. 14-24	IOC	Paris	Global Investigation of Pollution in the Marine Environment, 7th session
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Jan. 17-18	SCOR	Goa, India	JGOFS Indian Ocean Process Study Planning Group Meeting
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Feb. 24-28	IOC	Paris	Committee for Ocean Processes and Climate, 4th Session
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Mar. 7-22	IOC	Paris	IOC Assembly, 16th Session
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April 21-27	Int'l Natural Hazards Society	Cairo	Geophysical hazards in developing countries & their environmental impacts
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May 6-10		Liege	Modelling the Interaction of the Deep Ocean and the Shelf and Coastal Seas
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May 27-31	UNESCO/ SCOR/IABO	Paris	Inter-Regional Scientific Conference on COMAR
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May 27-June 2	PSA	Honolulu	XVII Pacific Science Congress
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June 2-6	NASA/NSF ONR/DOA	Brookhaven New York	Primary Productivity and Biogeochemical Cycles in the sea
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July 8-12	NOAA	Long Beach California	Seventh symposium on coastal and ocean management
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Sept.	UNESCO/ SCOR/IABO	Paris	Consultative Panel on Coastal Systems
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Sept. 8-12		Cape Town	Resource Utilization from an Ecosystem Perspective
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Sept. 9-13	SCAR	Saitama Japan	6th Antarctic Earth Sciences Symposium
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Sept. 18-20	SCAR/SCOR	Bremerhaven	BIOMASS Colloquium
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Sept. 23-28	SCAR	Bremen	Antarctic Science Conference
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The General Meeting approved SCOR cosponsorship for the following events:

- Symposium on Benguela Trophic Functioning: Resource Utilization from an Ecosystem Perspective. Cape Town, South Africa, 8-12 September, 1991.
- Sessions at the IUGG General Assembly, Vienna, August 1991.

## 9.0 CLOSING

A number of participants congratulated Professor Stromberg and SCOR on the program of activities which was reviewed during the General Meeting. They expressed satisfaction that SCOR is playing a strong role in international oceanographic activities related to global change research while, at the same time, the traditional working group mechanism which fosters international collaboration on very fundamental oceanographic topics retains its place at the heart of SCOR activities.

In closing the XX General Meeting of SCOR, the President extended thanks on behalf of all members of SCOR, to Professor G. Ross Heath (USA) and to Dr. Agustin Ayala-Castafias (Mexico) who were retiring from the Executive Committee. He expressed special thanks to Dr. D. Lange, Director of the Institut für Meereskunde, and his staff for their efforts in making all of the local arrangements for the General Meeting. This had been a special experience for all of the participants who had been in Warnemünde on the historic occasion of the reunification of Germany.

## ANNEX I

### XX General Meeting of SCOR

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**ANNEX II**  
**SYMPOSIUM**

**Microstructure and its Influence on Mixing Processes and Marine Biota**  
October 4-5, 1990  
Program

Thursday, 4 October 1990

Opening of the Symposium

Prof. K. Voigt, IOC, Prof. D. Lange, director of the Institut für Meereskunde Warnemünde

L.M. Brekhovskikh, I.O. Mamayev: Konstantin Fedorov - short review of his scientific, international and educational activities.

A. Ginzburg: Mushroom-shaped currents (Fedorov's structures) in the ocean.

Lunch Break

R.V. Ozmidov: Mixing in the condition of the intermittent turbulence.

H. Prandke: Dyapycnal mixing under the condition of strong density stratification: a model of turbulence patches in Baltic pycnoclines.

M. Schröder: Mixing processes under the ice of the Weddell Sea - problems and first results.

Friday, 5 October 1990

H. Behrendt, B. Nixdorf: Influences of small and large scale mixing on the phytoplankton production and loss processes.

Coffee Break

T. Jacobsen: Ship induced mixing in a two-layer flow.

U. Lips, Laanemets: On the fine structure of meddies.

V. Zhurbas: Classification of the fine structure in the ocean.

Closing of the symposium

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## ANNEX III

### WELCOME ADDRESS

**President of the Academy of Sciences of the GDR  
Prof. Dr. D. Klinkmann**

Mr. President, Professor Stromberg, Members of the Scientific Committee on Oceanic Research, distinguished Observers and Guests at this 20th General Meeting,

On behalf of the Academy of Sciences in Berlin, I am very pleased to welcome you all to Rostock-Warnemünde during this first week of October 1990.

Your very substantial agenda of work during this meeting - as in recent years - will serve to guide the SCOR committees and working groups and to enhance the scientific understanding of the role of the oceans in the maintenance of the life supporting system of our globe as a whole. Humanity may for the first time in history face destruction of the global environment as a consequence of human activities. The activities of your organization provide important elements of the global environmental research programmes under preparation by ICSU in the decade ahead, such as the World Ocean Circulation Experiment and the Joint Global Ocean Flux Study.

I am also pleased that your Executive Committee, at its last session at the Florida State University in Tallahassee in October 1989, accepted the proposal of our Academy's Oceanographic Commission, to organize jointly with your important General Meeting a symposium on "Microstructure and its influences on mixing processes and marine biota". Our Academy is offering to support the publication of the scientific proceedings of this symposium, if you so recommend, in the series *Contributions to Marine Scientific Research* (Beiträge zur Meereskunde) produced by the Academic Publishing House in Berlin.

I wish your Meeting full success and productive debates in this week of the third of October, when five German Laender, which in 1949 formed the German Democratic Republic after the most destructive war in Europe, join the Federal Republic of Germany. Our Academy, as a Learned Society with nearly 300 years of history, will certainly continue in the future to support the development of the marine sciences in this region, as it has done in the past.

You may recall that, in the 18th century, Reinhold and Georg Forster accompanied Captain Cook on his second voyage of discovery. They became members of the then Brandenburgischen Sozietät der Wissenschaften under Frederic the Great. Later in the 19th century Alexander von Humboldt was supported by the Academy in his travels of scientific discovery, in particular to Latin America, and he was called the second discoverer of Cuba.

Earlier in this century, the Oceanographic Commission of the former Prussian Academy supported - through its members like Albrecht Penck and Albert Defant - many German ocean research projects. The main building of our Academy in Berlin moved, in this century, into the former Seehandelsabteilung of the Prussian State Bank. With this and other historic developments, the Academy was also called upon to advise the German Democratic Republic in the field of marine sciences and its application, and in 1960 it was decided to build a Marine Scientific Research Institute in Rostock-Warnemünde. In 1965, the new building was ready and the late Prof. Pannikar from Goa, India, then Chairman of the Intergovernmental Oceanographic Commission of Unesco, inaugurated the new German marine laboratory in Rostock-Warnemünde with his visit.

Our Academy is also pleased to recall, that in 1967 the SCOR Executive chose the new institute as the place for its eleventh session. Let me, therefore, express the thanks and acknowledgement of our scientific community to you, the members of SCOR, for your early establishment of those important links with the young team of marine scientists here in Rostock, formed after World War Two by Professor Erich Bruns and then later guided by our Member Klaus Voigt, whom I also welcome here now in his new task as Deputy Secretary of the Unesco Intergovernmental Oceanographic Commission.

In closing, I regret not to be able to follow your interesting debate and considerations due to other necessary business in this historic week for Germany, Europe and Peace on Earth, and therefore I must at this time also wish you all a safe journey home to your institutes and places of work after the 20th SCOR General Meeting.

## **WELCOME ADDRESS**

**Director, Institut für Meereskunde  
Prof. Dr. D. Lange**

President Professor Stromberg, Members of the Scientific Committee on Oceanic Research, Dear Guests,

As the head of this Institute, which has the honour to host the 20th General Meeting of SCOR, I welcome you here to the Institute of Marine Research at Warnemünde.

As you see, our institute is located very close to the Baltic Sea, which has always, since the early days of our research activities, been a link for us to other scientists working in this area. In addition we played an active role in collaboration with marine scientists given in other areas of the world ocean, for example in the equatorial Atlantic Ocean and in the upwelling zones off Northwest and Southwest Africa during SENECA, during GARP/GATE and more recently in the World Climate Research Programme. On this occasion I should also mention that since the GDR became a member of the Scientific Committee on Oceanic Research in 1964 the Institute of Marine Research was closely involved in SCOR activities.

Distinguished guests, I wish you, first of all, a successful meeting, but also an interesting time in Warnemünde during these historic days for Germany.

## ANNEX IV

### **Final Report from the Chairman of SCOR Working Group 82 Polar Deep Sea Paleoenvironments J. Thiede**

The Scientific Committee on Oceanic Research agreed at its 17th general meeting in 1984 to establish the new Working Group on Polar Deep-Sea Paleoenvironments. The proposal for this working group had been formulated in close collaboration with the IUGS Commission for Marine Geology. After refinement and revision of the terms of reference the Executive Committee of SCOR met in late 1985 in Seattle and gave its approval to the revised terms of reference and to the suggested membership.

Working Group 82 was assigned to following terms of reference:

1. To assess Mesozoic and Cenozoic Polar deep-sea paleoenvironments with emphasis on processes in the northern and in the southern hemisphere.
2. To draw the attention of the scientific oceanographic community to the largely unknown and poorly understood dynamics of relatively warm Mesozoic and early Cenozoic northern and southern oceans.
3. To evaluate the paleoclimatic asymmetry between the evolution of a glacial climate in the northern and in the southern hemisphere.
4. To evaluate possibilities to assess and study the evolution and adaptation of polar marine faunas and floras under the influence of Cenozoic climatic changes in the Arctic and Antarctic and to consider the question of "bi-polar" species.

The membership of the working group (see enclosure 1) consisted of colleagues from U.S.A., Norway, F.R.G., Australia, Canada, India. Several attempts have been made to include a member from the USSR. Towards the final years the connection to the USSR scientific community was established through Dr. A. P. Kuznetsov, one of the new Vice Presidents of SCOR and the new Executive Committee Reporter for WG 82.

Besides communication by correspondence WG 82 has held three formal business meetings which were used to further scientific discussions around the topic of Polar Deep-Sea Paleoenvironments:

September 9, 1986 at the occasion of the 2nd International Conference on Paleoceanography in Woods Hole, Massachusetts U.S.A.;

October 13, 1988 at the occasion of the Advanced Research Workshop on the Geologic History of the Polar Oceans: Arctic versus Antarctic in Bremen/F.R.G.;

September 13, 1989 at the occasion of the 3rd International Conference on Paleoceanography in Cambridge/UK.

Each of the scientific conferences were sponsored by SCOR WG 82. Specific sessions either of scientific talks or of poster presentations were conducted with the specific polar emphasis. Copies of the table of contents of the sessions are enclosed with this report if they had not been communicated to SCOR at a prior occasion. For the conference proceedings describing the polar issues discussed have been published in the Journal PALEOCEANOGRAPHY and in special conference proceedings (see enclosures 2, 3 and 4).

The scientific focus of the discussions of the working group are predefined by the terms of reference. The 4

topics have been discussed at each of the meetings and in particular during the scientific sessions as well as they are addressed in the subsequent publications of the International Conference on Paleooceanography (PALEOCEANOGRAPHY, vol. 3, no. 5) and the conference proceedings after the Bremen meeting. The combination of talents in the working group were particularly well suited to address the topics because the members included polar oceanographers, paleontologists, geologists as well as colleagues from developing countries, covering Arctic and Antarctic research interests. Guests comprising chemists, biologists and meteorologists added to the success of the working group meetings.

Achievements and progress can be noted for both polar regions. Expeditions of research vessels have been carried out successfully both in the Arctic and Antarctic polar and subpolar deep sea basins pursuing interests of the working group. The Ocean Drilling Program (ODP) has realized successfully scientific drilling in the subpolar areas of the northern and the southern hemisphere (guided by the scientific advice of this working group of IUGS CMG and of the JOIDES advisory structure). The activities resulted in enhanced knowledge of the geological properties and the history of evolution of both polar deep-sea areas, even though the rate of success is distributed unevenly between the Arctic and the Antarctic. Aided also by WG 82, a major international expedition of ice breakers to the central Arctic is in the planning stage: TRAPOLEX will bring ice breakers from the US, Sweden, F.R.G. and possibly the USSR to the central Arctic in the period of August to October 1991.

Progress in relation to the terms of references has been achieved by the following results:

1. Detailed description of the Arctic and the Antarctic late Cenozoic paleoenvironments including their comparison (Term 1).
2. The achievement of the documentation of the initiation of glacial deep-sea paleoenvironments in Paleogene time on the southern hemisphere and in mid-Neogene times on the northern hemisphere (Term 2).
3. First attempts to compare the evolution of glacial climates on the northern and on the southern hemisphere. Studies to pursue the idea of the comparison of the paleoclimatic evolution of both polar regions are getting momentum and will be in the scientific focus for a number of years to come, as dating techniques and availability of sampling material improve. The question of comparability of the continental (in particular ice core) late Cenozoic paleoclimate record to the deep-sea record intriguing and should be pursued with great vigor.
4. Little progress has been achieved in attempting to address the problem of the evolution of polar-marine faunas and floras under the influence of the Cenozoic climatic changes on both hemispheres. The problem of the bipolar marine biota has been addressed but not satisfactorily described or solved.

The form of a final report of the working group was discussed at several of its business meetings. The activities during the 2nd International Conference of Paleooceanography have found their documentation in the issue of PALEOCEANOGRAPHY. The advanced study institute in Bremen 1988 was considered a major undertaking for the working group; since the meeting of the working group in Bremen it was apparent that the proceedings of this conference would be a major product of our working group; the conference had been shaped by the opinions of many of the working group members. The volume is comprehensive and compares Arctic and Antarctic much as it was the aim of expressed in the terms of reference of the working group. The final version went to the printer in spring 1990 and has been published right afterwards in a very timely (but very expensive) fashion.

The program of the 3rd International Conference on Paleooceanography in Cambridge 1989 contains many polar sessions as documented in enclosure 4. We are in the moment in the process of preparing the 4th International Conference on Paleooceanography which will be held in Kiel 1992 (draft of the program is available to SCOR Working Group 82 which was held on September 13, 1989 in Cambridge the few working

group members present discussed a long agenda and came to the conclusion that the conference volume after the Bremen meeting was to be the final report of the working group. Also no proposals for new working groups were proposed at that time.

Major items of unfinished business of this working group are related to discussions on deep-sea drilling in ice-covered Arctic waters. The problem of the long-term evolution of southern and northern subpolar paleoenvironments has been pursued through the Ocean Drilling Program (see above). In the moment several proposals for drilling the Bering Sea and North Atlantic Norwegian-Greenland Sea sections (in particular east of Greenland) are discussed by the JOIDES advisory structure; these proposals address paleoenvironmental questions related to the early glacial environments on the northern hemisphere. Since its early beginning the SCOR WG 82 has also pursued possibilities of high northern latitude deep-sea drilling in permanently ice-covered Arctic areas. In 1986 a workshop on Arctic Deep-Sea Drilling technology was convened at the Bedford Institute of Oceanography, Halifax (December 15-17). This workshop sponsored by this working group and by the IUGS Commission for Marine Geology came to the conclusion that Arctic deep-sea drilling was feasible (see enclosure 5).

At the occasion of the International Geological Congress in Washington D.C. 1989 a new structure was formed following the proposal of several WG 82 members to pursue the item of Arctic deep-sea drilling. NAD (Nansen Arctic Drilling) has established executive, science and technology committees which are to formulate documents in preparation of the execution of Arctic deep-sea drilling. The report defining scientific priorities is expected to be finalized in the course of late 1990 to be presented to AOSB and IASC in early 1991. NAD is headed by T. Vorren (Univ. Tromsø/NORWAY).

Personal impressions of the performance of the Working Group 82: As a chairman I had the opportunity to influence group members and of the tasks of the working group in relation to the terms of reference. It was a very positive aspect of the WG to combine talents of colleagues from various disciplines and countries. As long as one was able to mobilize these colleagues their input was fine and productive. However, sometimes I have been frustrated because of the lack of response from individual working group members; it is my advice to SCOR to lean heavily on junior colleagues in the composition of future working groups.

Research in the polar deep-sea basins is gaining momentum at the present time as new countries become interested in polar research and as new advances in technology allow to penetrate deeper into the sea floor of the polar deep-sea basins. SCOR has contributed to this progress through the establishment of this working group and I want to take the opportunity on behalf of WG 82 to express our gratitude towards SCOR for establishing the working group and for providing partial funding for the activities of the working group.

## ANNEX V

### Report from the Chairman of SCOR Working Group 83 Wave Modelling G. Komen

#### 1. Background

SCOR WG 83 was established in 1987, when need was felt to foster, coordinate and focus activities of an ad-hoc group of wave researchers. A central idea was the development of a third generation wave model, and its use in relation with ocean-observing satellites. The state-of-the art at that moment indicated (See e.g. Ocean Wave Modelling, by The SWAMP group, Plenum 1985) a general inadequacy of all existing wave models to properly describe the physics of wind generated surface wave. Satellite related work was timely in relation to a new generation of satellites, such as GEOSAT, ERS-1, etc.

The aims of the working group were defined in a concise fashion. The working group held annual meetings in which progress was discussed and arrangements for further work were made. In 1988 a progress report was presented to the XIX General Meeting, summing up activities, membership and final goals of the working group, and giving 1992 as possible end date of the work.

#### 2. Recent progress

Recent progress was reviewed during a meeting near Toronto, Canada. The program of scientific presentations and the draft minutes of the "business" meeting are enclosed. The scientific meeting consisted of five main sessions. The model implementation session showed the following:

The WAM model is now used by a large number of institutes, ECMWF and MPIM. Especially impressive are efforts in the China and the USA by FNO, NMC and at Tsinghua University.

Since so many institutes are involved we need a mechanism to exchange experiences with the model. Although a suggestion to use the bulletin board of e.g. TELEMAIL was not well-received, it is clear that we have to resolve this problem one way or the other in the very near future.

Interesting results regarding current-ocean wave interactions were noted. A problem was found to properly treat long period well. This raises (again) questions whether the WAM model is dealing with the advection of energy.

There are clearly problems with the stress in the surface layer.

WAM model cycle 3 will become an efficient tool to do data assimilation + cross validation (as was done in the Mediterranean Sea e.g.) of satellite observations and to do coupled ocean-circulation/atmosphere experiments.

The physics session addressed the problem of growth curve analysis and source term balance. De Voogt summarized this session as follows:

Regarding integrated effects of source terms, there are no major problems anymore, but there still is

debate about scaling ( $u_{10}$ ,  $u^*$ , wave age).

Our understanding of wind input has increased greatly. Kahma clearly showed the important role of stability. Janssen demonstrated the influence of sea state on drag coefficient. Finally, it was also found that gustiness and turbulence have an influence on wave growth.

In the field of nonlinear interactions it was noted that there is room for improvements in the numerical algorithms. (Perrie/v. Vledder/Young) and Need for faster routines. Van Vledder will study Resio's approach.

There is clear evidence of wave attenuation by opposing winds. Is more evidence needed? Sin will have to be adapted for  $u/c < 1$ .

In general there is much progress in understanding physics. SWADE and Bight of Abaco II provide us with a unique opportunity to test some of the ideas. It is suggested that the SWAMP cases are repeated and that the results of these tests are reported for general use.

Donelan summarized the results of the directions effects session:

Integral parameters ( $H_s$  and  $f_{mean}$ ) are not sensitive indicators of model fidelity. In LEWEX nine models gave disparate directional results although mean wave parameters were often similar (Beal).

Mean properties of wave field may be highly misleading; e.g. several different sources may produce the effect of turning mean direction as balance shifts in the spectrum (Gerling).

Spectral partitioning as introduced by Gerling is a valuable tool. We need standardized form of partitioning.

Relaxation of waves in turning wind is valuable tool to explore dynamics of evolution of wave field (Masson). Need to avoid mixing up of separate wave systems - good directions resolution is a necessity.

Directions spreading increases significantly from peak. High frequency waves approach 80 deg. in rms spread (Donelan).

Energy density in peak direction follows  $f^{-5}$  law. Continuous spreading leads to  $f^{-4}$  law.

The shallow water aspect session was chaired and reviewed by Rosenthal:

Wang showed software and prediction capabilities in the Peoples Republic of China. The 3GWAM version is operational there and the results are published daily on television.

Wolf discussed the modern trend in wave research to couple the hydrodynamical models (waves, currents, water level) in order to meet public demands for simulation of environmental processes and possible responses of regional climate on global changes. Plans were announced to couple hydrography, including waves were compared with 3GWAM 2-D spectra. Interesting results can be expected from further research on the 2-D spectral balance of wave spectra.

There is still controversy debate what is the correct physics in wave dissipation (deep and shallow water). The main difficulty is the lack of consistent data sets to study dissipation mechanisms under well controlled conditions, e.g. in reasonable homogenous and/or stationary field situations.

S. Hasselmann gave the following summary of the data assimilation session:

The so-called simple scheme approach showed:

- Swell assimilation improved through conservation of wave slope
- Real cases need to be run
- Scale and mean directions parameters of SAR inversion should be incorporated

Combined wind and wave data assimilation scheme have been studied at several places: The encouraging adjoint method results by Delft Hydraulics are currently being transferred to KNMI

With the Green's function approach also progress was made:

- \* the analyzed point wind field disturbance seems to work
- \* synthetic data cases need to be run to test behaviour
- \* real data cases need to be run

SAR (Synthetic aperture radar) studies showed that there is agreement between forward mapping calculations using Monte Carlo method and closed nonlinear integral relation. There are two models for the inversion problem:

- \* both models use energy scaling, rotation and stretching
  - \* additional features at ECMWF; calibration of SAR through clutter spectrum MPI; full plane inversion
- A number of tasks (merging both methods, optimizing programs, incorporation into simple scheme, setting up environment, testing the system for ERS-1) will now be carried out.

First indication from one case study indicate that the altimeter underestimates the wave height for high waves. The Geosat winds seem to be reliable.

On the basis of all of these summaries tasks were distributed among participants.

### 3. Specific role of SCOR support

The SCOR involvement made the following specific contributions to wave modelling:

- a. it has focused work started by a (mainly European) ad hoc group of researchers
  - b. it has greatly enlarged the basis for the project; in particular it has enabled participation from China, the Soviet Union and developing countries
  - c. concrete final products (for 1992) will be the software of the wave model and a final report
4. Work plan for final report

Work towards the final product will continue. In parallel work on the final report has started. The global lay-out of the report has been discussed (see annex A4). For each chapter a lead author has been selected from among the working group members. They have now made detailed outlines for these chapters and are in the process of contacting co-authors. The draft report should be ready for discussion in 1991, to ensure its completion by 1992.

## **5. Request for 1991 meeting**

Next year the working group would like to meet in conjunction with a WAM meeting which will be held at Sylt (Germany) from 28 - 31 May and the JONSWAP anniversary reunion.

### **SCOR WG 83 - AIMS FOR 1992**

SCOR WG 83 has been set up with a finite lifetime. The year 1992 has always figured as an end for the project. This is coming nearer now.

It is suggested that we consider in some detail what we should want to reach by that time, this in relation to the terms of reference, which are reproduced below. Each item is followed by brief considerations.

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

Cycle 2 meets these criteria already. It is suggested that we form a clear idea about the amount of physical updates achievable.

- Can we update the source terms e.g. with input/dissipation from Janssen or others?
- Should we consider another treatment of the nonlinear transfer?
- Do we want the second order propagation?
- Are we happy with the present treatment of shallow water effects?

Also we should agree on the amount of standardization

- Do we want a universal code, suitable for all machines, environments, purposes or can we agree about standardization of core routines? (See also SC 90-07 for a discussion)

It is suggested that these issues are referred to the meeting of the Wave Model Development group, with the request that they come up with an outline for the WAM code in 1992, together with a work plan.

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

The WAM model runs at ECMWF in a global version. Are other global implementations envisaged?

**To implement regional versions**

Do we want nesting? There are many regional implementations available already. Shouldn't we simply list them "for the record"?

**To perform physical studies of wave dynamical processes ...**

- Are we happy enough with the re-analysis of growth data by Kahma and Calkoen?

- Has the work of van Vledder, Donelan, Lewex shed enough light on the directional problem?
- Is the work on TMA scaling, bottom dissipation and refraction at a stages where we could present it in a final report?
- How much wave current interaction do we want?

**To develop data-assimilation techniques ...**

To what extent would we like to use the WAM model for ERS-1 applications. Note that, in principle, it can

- provide guess fields for improved algorithm ERS-1 scatterometer (winds) and Synthetic Aperture Radar (wave spectrum)
- provide guess fields for validation of incoming ERS-1 observations, cross-validation of altimeter (significant wave height) and scatterometer (winds)
- provide improved roughness estimate from sea state for atmosphere boundary layer necessary

Do we consider all of these applications equally important? What centers are considering the use of ERS-1 in wave models? It is suggested that these are identified and that from each center priorities and aims for 1992 are requested.

Since human resources are limited, can we agree about relative priorities on the above mentioned topics?

**FINAL REPORT SCOR WG 83**

**OUTLINE**

1. 3G Model developments. Lead author: Klaus Hasselmann. Possible co-authors: Janssen, Cardone (wind input), Guillaume (model validation).
2. Global implementation. Lead author: Heinz Gunther. Possible co-authors from NMC and FNOC.
3. Regional models. Lead author: Luigi Cavaleri. Possible co-authors: Yeli Yuan, Burgers.
4. Physics. Lead author: Mark Donelan. Possible co-authors: de Voogt/Kahma, Holthuijsen, Rosenthal (shallow water), Zakharov?
5. Data assimilation. Lead authors: S. Hasselmann. Possible co-authors: Lionello, Schilperoort, Foreman.

## ANNEX VI

### Report of SCOR Working Group 86 Ecology of Sea Ice Biota

Working group 86 met in Bremerhaven, Germany, at the Alfred-Wegener-Institut für Polarforschung during the week of September 3-7, 1990, to review the present state of knowledge of the ecology of sea ice biota and to make recommendations for future research activities in this emerging field of study.

Previous correspondence and several meetings of small groups of our members established a theme and agenda for our workshop so that we could address the terms of reference of the group in an intellectually stimulating and productive fashion.

During the months before the meeting, our ten members, divided into three subgroups, prepared 3-5 page position papers on the subject of interactions in the ice ecosystem. Papers were circulated among all members in advance of the Bremerhaven meeting. The subgroups focused on: physical-biological, chemical-biological or biological-biological interactions that occur within the sea ice ecosystem. Members presented 30-60 minute illustrated talks on new ideas that emerged from their preparations for the meeting and previous work and focused on relevant questions that need to be addressed in future research in the field. Fruitful discussions followed each of the presentations and contributed to a sense of real learning by all members.

After two days of presentations and discussions among members of the working group, it was decided that three manuscripts would be prepared for publication in *Polar Biology* under the working group authorship. The manuscripts would address the three major themes the group believed would contribute most to investigations of sea ice ecology. Titles and abstracts of the manuscripts follow:

#### I. ECOLOGY OF SEA ICE BIOTA: TERMINOLOGY AND METHODS (R. Horner, et al.)

Polar regions are covered by extensive sea ice which is inhabited by a variety of plants and animals. The environments where the organisms live vary depending on the structure and age of the ice. Many terms have been used to describe the habitats and the organisms. We here suggest some standard terms for the habitats and the organisms, and suggest reporting units for measurements of biological, chemical, and physical parameters.

#### II. ECOLOGY OF SEA ICE BIOTA: PROCESSES AND INTERACTIONS AMONG PHYSICAL, CHEMICAL AND BIOLOGICAL FEATURES (C.W. Sullivan, et al.)

Studies in Arctic and Antarctic regions have revealed associations between physical processes that form, evolve and deteriorate sea ice and the incorporation, colonization and growth of biological communities in association with ice. Chemical features of the ice environment develop and change seasonally as the result of physical chemistry associated with freezing and melting processes and brine formation, but growth of sea ice biota also influences the chemistry of ice microenvironments as well as of the atmosphere above and the oceans beneath the ice habitat. Biological interactions among the ice biota constitute ice associated food webs of considerable significance for polar oceans ecology, but coupling of biological productivity from sea ice communities to those of the water column and benthos may be of greater importance.

#### III. ECOLOGY OF SEA ICE BIOTA: GLOBAL SIGNIFICANCE (L. Legendre, et al.)

A fraction of the carbon fixed by microalgae that grow in the sea ice or in relation to it is exported out of the production zone. This includes particulate material sinking out of the euphotic zone, and also material passed on to the food web.

Pathways through which ice algal production does reach various components of the pelagic and benthic food webs, and through them such top predators as marine mammals and birds, are discussed. Concerning Global Change, not all export pathways from the euphotic zone result in the sequestration of carbon for periods of 100 years or more. This is because various processes that take place in both the ice and the water column contribute to mineralize organic carbon into CO<sub>2</sub> before it becomes sequestered.

Processes that favor the production and accumulation of biogenic carbon as well as its export and sequestration are discussed, together with those that influence mineralization in the upper ice-covered ocean.

First drafts of these manuscripts were developed and discussed by the members. We agreed to an agenda for further development, authorship and a submission date of 30 January 1991. Authors will be identified as members of SCOR/IOC working group 86 on Ecology of Sea Ice Biota.

In addition, we expanded the already extensive Sea Ice Biota Bibliography and laid plans for the inclusion of more of the Japanese and Soviet literature that had been difficult to obtain before the addition of Professors Takao Hoshiai and I.A. Melnikov to our group.

#### FUTURE OBJECTIVES

Because of the extensive number of international groups of scientists conducting or planning investigations in the sea ice zone of polar oceans, we anticipate a continued role for WG 86. We plan to complete work on the manuscripts noted above and to see them through to publication in a peer reviewed journal. The bibliography of sea ice biota, currently with more than 300 citations, will be brought up to date before the bibliography is published as a Cold Regions Research and Engineering Laboratory (CRREL) Report in early 1991 as a contribution from SCOR WG 86.

Most importantly, we wish to plan and host an international symposium on the Ecology of Sea Ice Biota in the two to three year time frame. We anticipate inviting 40-50 scientists from areas including physics, chemistry, biology, sedimentology, modeling and remote sensing as related to sea ice ecology. We wish to make a special effort to obtain support for young scientists at the pre- and post-doctoral levels as well as for more senior scientists to attend the workshop. Details of the format, agenda and venue for this meeting continue to be discussed by members of WG 86 by correspondence. Recommendations will be communicated to the SCOR Executive during the coming year.

## ANNEX VII

### Final Report of SCOR Working Group 88 Intercalibration of Drifting Buoys

#### Introduction

At the Eighteenth General Meeting of SCOR (1986), Working Group 66, Oceanographic Applications of Drifting Buoys, was reconstituted as Working Group 88, Intercalibration of Drifting Buoys. The terms of reference for WG88 were:

- To design procedures for determining the current-following effectiveness of various drifting buoy systems.
- To analyze and report on the results of applying such procedures by investigators world wide.
- To identify recent scientific and technological advances with drifting buoys.

It was suggested that these terms of reference could be achieved by means of an "intercalibration experiment" conducted from a research vessel equipped for accurate surface wind and acoustic doppler current measurements.

#### Accomplishments

The WG held a single meeting, in 1987. Discussions focused on the terms of reference for the WG. The first two of the terms of reference were considered to comprise the substance of the charge to the WG. Succinctly, these might be interpreted as either to conduct a "drift-off" from which the performance of a variety of buoys of different design can be compared, or to define a test procedure that could be used by various investigators to quantify the performance of buoys of any particular design. The consensus was that it was not viable to focus on a singular field project. The range of buoy designs, strategies, and objectives of drifter measurements, and range of environmental conditions are too broad to permit a definitive result on a singular basis. Clearly, buoys that are drogued at different levels are not comparable. Similarly, horizontal variations of current structures often make pairs of buoys drogued at the same level incomparable after very short time. Rather it appeared to be more promising to concentrate on obtaining direct in situ measurements of the performance of some individual buoy and drogue designs, in a range of oceanic conditions, to establish design parameters that can be used to build buoys to meet specific performance requirements. Members of the WG have taken the lead in obtaining, analyzing, and reporting such information.

The greatest amount of work and progress has been completed on evaluation of drifters for use in measuring movement of the surface mixed layer. The method employed was direct measurement of drogue slippage in a range of ocean environments. Difficulty was encountered in obtaining such measurements in higher wind speed conditions, but it was possible to obtain a simple empirical relationship between slippage of the drogues through the water and the ratio of the cross-sectional area of the drogues to the sum of that of the other drag elements, and the wind speed. An acoustic doppler current profiler was operated in support of the tests, but these data were of little value because the spatial resolution and accuracy of this instrument are a little too coarse, and no data are available for the critical upper few meters of the ocean.

A different approach, one of measuring forces experienced on the various components of the buoy system in

oceanic environments, was taken to evaluation of slippages of drogues of drifting buoys intended to measure the geostrophic current beneath the surface mixed layer. This method has some residual ambiguity associated with the difficulty of making measurements of component forces in the ocean environment. Measurements in a relatively large force range must be extrapolated to the small rates of slippage that are required. The choice of model for making the extrapolation cannot be justified quantitatively.

A short bibliography of reports on the drifting buoy slippage calibration problem recently published in the scientific literature, many of them by members of the WG, is appended.

#### **Recommendation**

WG 88 has provided a forum, and a focus, for development of ideas concerning calibration of the Lagrangian performance of drifting buoys, and this has contributed to progress on this important question. Most of what has been accomplished however has not been strongly dependent upon international coordination. Furthermore, the consensus of the WG members is that further progress anticipated in the near future will not require the international or intergovernmental assistance of SCOR. Our recommendation therefore is that the automatic expiration of WG 88 at the time of the SCOR General Meeting should be allowed to stand.

#### **Appendix: Bibliography of recent publications on drift calibration of drifting buoys.**

Bitterman, D.S. and D.V. Hansen\*, Direct measurements of current shear in the tropical Pacific Ocean and its effect on drift buoy performance, *J. Atmos. Oceanic Technol.*, 6, 274-279, 1989.

Geyer, W.R., Field calibration of mixed layer drifters, *J. Atmos. Oceanic Technol.*, 6, 333-342, 1989.

Chereskin, T.K., P.P. Niiler\*, and P.M. Poulain, A numerical study of the effect of upper ocean shear on flexible drogued drifters, *J. Atmos. Oceanic Technol.*, 6, 243-253, 1989.

Krauss, W.\*, J. Dengg, and H.-H. Hinrichsen, The response of drifting buoys to currents and wind, *J. Geophys. Res.*, 94 (C3), 3201-3210, 1989.

Poulain, P.-M., and P.P. Niiler\*, Comment on "The response of drifting buoys to currents and wind" by Krauss *et al.*, *J. Geophys. Res.*, 95 (C1), 797-799, 1990.

Krauss, W.\*, J. Dengg, and H.-H. Hinrichsen, Reply, *J. Geophys. Res.*, 95 (C1), 801-803, 1990.

\*\*Bitterman, D.S., P.P. Niiler\*, Y. Aoustin, A. du Chaffaut, Drift buoy intercomparison test results; Data Report, ERL AOML-17, NOAA, Atlantic Oceanogr. Met. Lab., Miami, FL 33149, 1990.

\* Member of SCOR WG 88

\*\* Refereed publication based on these data is in preparation; completion expected late 1990.

## ANNEX VIII

### Report of the SCOR-IOC Committee on Climatic Changes and the Ocean

Prepared by: Raymond H. Godin  
Secretary, CCCO

The Eleventh Session of the CCCO took place in Paris (May 28 -1 June 1990). The Committee addressed scientific planning, intergovernmental climate initiatives, and the implementation of its WOCE, TOGA, and ocean observing system development activities.

The Committee sought to identify current gaps not covered by existing international programmes (e.g., WOCE, TOGA, JGOFS, and GEWEX) but which CCCO had a responsibility to address under its existing mandate, and to recommend means of addressing them through the formation of feasibility study groups, review by specified Committee members, and by referring to its subsidiary bodies.

The following themes emerged as being scientifically important and international in scope upon which the Committee should focus its intercessional efforts:

#### 1. Ocean Observing System Development.

The development of a scientifically based plan for climate related ocean observations was identified as a matter requiring urgent attention. The highest priority should be given to elements necessary for operational modelling and the prediction of events such as ENSO. The Committee requested its CCCO-JSC Ocean Observing System Development Panel to map out a relevant draft plan for an observing system based on conventional upper ocean measurements before September 1990. It was also perceived that in order to address the needs of the JSC GEWEX, the fact that there is no existing method of routinely monitoring near-surface salinity had to receive urgent attention.

#### 2. Carbon Dioxide Gas Exchange on Gyre-Global Scale.

The design of a plan to acquire a global oceanic data set, including pCO<sub>2</sub>, total CO<sub>2</sub>, and alkalinity was addressed as an important international priority. The Committee has proposed to JGOFS that the joint JGOFS-CCCO Carbon Dioxide Panel address this matter through reconstituted terms of reference and membership.

#### 3. Review of IPCC Working Group-I Report on the Scientific Assessment of Climate Change.

Recognizing the report as a summary of the understanding by its authors as of early 1990, and the IPCC WG-I's stated need to update at frequent intervals, the Committee established a working group to undertake a review of the relevant ocean related sections of the IPCC WG-I report, including source references, and new material as appropriate. The group will assess the degree to which the report is an accurate and comprehensive summary of current knowledge of ocean dynamics, ocean-atmosphere interaction and ocean chemistry in relation to global climate prediction and change, and propose appropriate action to be undertaken by the CCCO.

#### 4. Fresh Water Budget.

With regards to global energy and water cycle research, the cycles must be closed by information on the energy and mass exchanges with the ocean surface and the upper ocean transports of heat and salt. Ocean general circulation models will need to be developed to assimilate satellite data with in situ surface and subsurface measurements. There is a gap in the availability of observations of heat and freshwater content in the upper ocean which are required to narrow the uncertainty on the surface fluxes and in methods to determine the surface fluxes as constraints on the energy and water

cycles. The CCCO officers will address what role is needed and report at the next session.

5. Improving Predictions of Regional Impact of Climate Change on Coastal Environment.

There is a need to encourage further investigation on how a global rise in mean sea level would be manifested in steric heights, and how changes in ocean currents would affect regional sea level. The three CCCO Atlantic, Indian and Pacific Ocean Climate Studies Panels have been asked to examine the questions and to report to the CCCO on the feasibility of improving predictions on a regional basis and identifying potential studies toward this end.

6. Control of Thermohaline Circulation.

Consideration of the influence of the Arctic Ocean on climate represents a gap in the programmes being conducted within the WCRP. It is not included in WOCE. The feasibility of an Arctic experiment regarding the relation between circulation, salinity structure, freezing and melting, and freshwater budget in the Arctic Ocean and the deepwater production on the North Atlantic needs to be investigated. The recently formed JSC-CCCO Working Group on Sea-Ice and Climate was requested to address and present a report at the next meetings of the CCCO and JSC.

Of present intergovernmental climate activity, the most significant CCCO involvement was with the WMO-UNEP Intergovernmental Panel on Climate Change (IPCC). Although no formal linkage between CCCO and IPCC could be developed, the CCCO was able to provide inputs on Working Group I's draft report.

**Collaboration with the JSC**

There has been continued collaboration with the JSC on the development of the WCRP. In addition to CCCO-JSC OOSDP, a joint JSC-CCCO Working Group on Sea-Ice and Climate has been formed, the International TOGA Scientific Conference (Hawaii, July 90) organized and the JSC-CCCO TOGA Coupled Ocean and Atmosphere Response Experiment (COARE) formed. Committee meetings have been attended jointly.

**CCCO-JSC Ocean Observing System Development Panel (OOSDP)**

At CCCO-X, it had been agreed to reconstitute the Ocean Observing System Development Panel (OOSDP) as a joint activity with the JSC. It was also decided to involve an IOC Ocean Processes Committee (OPC) Ad Hoc Group of experts on ocean observing systems.

The IOC Ad Hoc Group of experts met for the first time in Washington DC (September 6-7, 1990) under the chairmanship of Dr. Geoffrey Holland (Canada). The ad hoc group understood OOSDP's role to be to formulate the conceptual design of an operational [ocean] observing system to monitor and predict climate; and its own, to facilitate the implementation of that design and to provide expert advice to OOSDP. The group would also review the adequacy of the present data services (e.g. IGOSS, GLOSS, DBCP, etc) to meet the present and potential needs of TOGA, WOCE, JGOFS, etc.

The first session of the OOSDP was held in Washington, D.C. (September 12-14, 1990) under the Chairmanship of Dr. Worth Nowlin. The Panel reviewed its terms of reference and agreed to interact with the IOC ad hoc group. The OOSDP proceeded to develop its strategy, an outline report was drafted and members' writing assignments were agreed upon. The Panel will address the scientific needs and requirements for observations of ocean surface conditions, atmosphere-ocean flux fields, hydrographic measurements, transports, time scales-tracers, velocities, biogeochemical and CO<sub>2</sub> systems. Liaison membership was expanded to include Dr. George Needler for WOCE and Dr. Alain F. Vezina for JGOFS. The next session is tentatively scheduled for 3-5 April 91 (Villefranche, France).

**World Ocean Circulation Experiment**

The results of the first Assessment of WOCE, produced by the IPO and published in WOCE Newsletter

No 9 was reviewed by the SSG. In general, WOCE is well underway. The first components of the field-programmes have been put into the water, major funding has been committed to others and the necessary WOCE facilities are slowly evolving and taking up their work. While some delays will occur due to funding constraints, the promise is that WOCE will be a lively and well-focussed experiment.

The Core Project Working Groups had met and all are sufficiently endowed so that science can proceed. Attention was drawn to the need for continued scatterometer and altimeter coverage during WOCE. Some concern was raised by Core Project 1, the Global Description, over float coverage timing, particularly in deep equatorial regions, and moorings of the Eastern Boundary Current arrays. The Heat Flux Lines still need additional resources. Core Project 2, the Southern Ocean, identified gaps in drifter and float coverage and in the deployment schedule. It will soon address design requirements for the Choke Point Arrays. Core Project 3, the Gyre Dynamics Experiment, has shortfalls in the sub-tropical gyre. The density of drifter and float deployment does not approach the requirements of global coverage, nor for the enhanced coverage. Evolving discussions between WOCE and the national US Atlantic Climate Change Programme (ACCP) show prospects, that a balanced Core Project 3 programme can be achieved.

WOCE facilities have been opened at the required pace. The WOCE Hydrographic Programme (WHP) Office and the WHP Special Analysis Centre are operational. The Global Drifter Centre started at the beginning of this year. The two Sea Level Centres and the groups forming the Upper Ocean Thermal Centre are tuning their activities to WOCE requirements. The Voluntary Observing Ship (VOS) programme has introduced a joint WOCE, TOGA and IGOSS coding system. The Data Information Unit (DIU) collaborates closely with the WOCE IPO.

The necessary WOCE facilities are evolving. At the recent SSG meeting short-falls and their impact on the programme were discussed. The drifter and float programmes still need additional resources. It might be necessary to discuss different deployment strategies. The WOCE Hydrographic programme needs additional analytical capacities "across the fleet". These might also be required to enhance the tracer capacity. Some Moored Array sites have not yet been subscribed. A review mechanism is being developed to assess each contribution in view of specific requirements and already existing data sets.

The VOS programme shows good initial coverage, additional resources are needed and involvement of operational agencies has to be encouraged. The unavailability of XCTDs has a severe impact on the VOS programme in higher latitudes. Alternatively, WOCE has to solicit additional CTD measurements to determine heat and freshwater storage in the upper ocean.

Heat Flux Lines were also reviewed. The SSG placed high priority on the heat flux sections, although it felt that the simultaneity requirements could be relaxed.

The Sea Level Programme is oversubscribed, details are being collated and will be assessed within the two centres involved.

Concern was voiced about the uncertainty of continued scatterometer and altimeter coverage for WOCE, particularly through ERS-2 and also about the apparent slip of the launch-date for Topex/Poseidon. The SSG endorsed the objectives of a special gravity mission, e.g., ESA's Aristoteles mission.

WOCE will need a gravity mission to define the geoid. It will not be possible to discern whether the circulation is changing on the basis of altimeter measurements without knowing what is happening to the geoid. The Committee reiterated its concern over measurement of salinity on a global basis and agreed to consider this further. The Committee agreed that the WOCE Data Information Unit (DIU) might serve JGOFS and TOGA as well, once it is operating smoothly.

## **Tropical Ocean and Global Atmosphere (TOGA) Programme**

### *TOGA Coupled Ocean-Atmosphere Response Experiment (COARE)*

The Scientific Plan for TOGA COARE has been endorsed by the TOGA SSG, JSC, and the CCCO. The plan was presented to the third session of the WMO-IOC Intergovernmental TOGA Board (ITB) (Geneva, January 1990).

To implement the necessary non-conventional observing systems, SSG considers it will be necessary to establish a separate TOGA COARE Project Office, as soon as possible. The TOGA Board welcomed the USA efforts to establish such an Office and requested members to consider nominating suitable professional staff for secondment and making budgetary provision for future contributions to the TOGA COARE Project Office.

### *TOGA Numerical Experimentation Group*

There has been a substantial increase in the number of coupled models in development or running. Models of intermediate complexity appear to be the most successful to date. Some of these have been formulated as perturbation models, so avoiding inconsistency in the mean climate state.

Although there are serious limitations in present coupled models, TOGA NEG takes the view that there is much that is right. There are encouraging similarities to the 82/83 ENSO in the development of the SST field from a warm phase and a cold phase of the Philander-Seigal model simulation of that event. The Group will consider their development with more than just wind forcing, with minimum imposed constraints, and over larger domains. A meeting on TOGA modelling is scheduled at Lamont Doherty Geological Observatory in the U.S. in June, to review progress outline strategy, TOGA Numerical Experimentation Group (NEG) will hold its annual meeting in conjunction.

Many more modelling and data assimilation studies need to be carried out. One action to facilitate this would be to make easily accessible comprehensive sets of all observational data collected in support of TOGA, for use in assimilation and model verification studies. The inclusion of a meteorologist on TOGA NEG is being considered. The Committee found the modelling progress encouraging.

### *ENSO Phenomena*

The predictability of ENSO phenomena was one of the main themes of the eighth session of the SSG in Hamburg in September 1989 and motivated the joint meetings with the WGNE, the TOGA-NEG and the TOGA-MONEG. The SSG concluded that, while significant progress has been made, the achievements still fall short of TOGA scientific objectives. Accordingly, the SSG recommended that:

- more attention and resources should be allocated basic research into coupled ocean-atmosphere models,
- more attention needs to be focused on the incorporation of ocean data into ocean models,
- the major focus of the second half of TOGA should be the investigation of the predictability of ENSO and ENSO-related phenomena, i.e. the second and third scientific objectives of TOGA.

While important scientific contributions to predictability are expected from individuals or small groups, the SSG considered that a wide range of scientific and technical tasks remain which can only be addressed in a coordinated fashion by integrated teams. To achieve this, the SSG recommended creation of a Centre or Centres for the study of climate predictability and development of quasi-operational prediction schemes. These centres would require the same sort of capability as national meteorological centres or the European Centre for Medium Range Weather Forecasting. In response, the ITB during its January 1990 session, recommended its Members give consideration to the best ways of achieving a multinational capability for

experimental climate prediction on seasonal to interannual time-scales, based on strengthening the existing international scientific infrastructure. Board members agreed to address this task during 1990 and to present national findings at the Board's next session (Geneva, 8-11 Jan 1991).

#### *TOGA Ocean Observing Systems*

The third edition of the TOGA Implementation Plan was published in March 1990. New material about ocean and surface observing systems reflects the latest evaluation of requirements by the TOGA SSG at its meeting in September 1989.

#### *TOGA International Scientific Conference 1990*

The TOGA International Scientific Conference, sponsored by WMO, ICSU, IOC and SCOR was held in the Ilikai Hotel, Honolulu, 16-20 July 1990 with participation by over 300 scientists from 27 different countries. WMO, ICSU, IOC, and SCOR were able to support, wholly or partially, the participation of 60 scientists from developing countries.

#### *TOGA Pilot Compact Disk Project (TOGA CD-ROM)*

The TOGA Pilot Compact Disk project is being implemented by NASA's Ocean Data Services (NODS) Group at JPL, Pasadena, under the leadership of Dr. David Halpern. The first disk will contain all the TOGA data for 1985 and 1986 with appropriate software for accessing and manipulating the data. The discs will be made available free of charge.

#### *Summary of CCCO Actions*

The Committee endorsed the formation of a TOGA COARE Panel (TCP) under the SSG and establishment of a Project Office; also that the air-sea calibration sites for COARE be kept for at least one year.

The Committee also endorsed the proposal by the JSC to reorganize membership of TOGA SSG to consist of a Chairman plus two general members, plus chairman and one member each from the COARE Panel, the NEG, and the MONEG to give a maximum membership of nine. Dr. Peter Webster informed the CCCO that it would be timely for a new chairman to be nominated for the reconstituted SSG. The CCCO acknowledged the outstanding contribution which had been made by Professor Webster since 1986.

#### **CCCO Ocean Climate Studies Panels**

##### *Atlantic Ocean Climate Studies Panel*

A joint session of the NOAA/Atlantic Climate Change Programme and the CCCO Atlantic Ocean Climate Studies Panel was held in Princeton, 1-3 May 1990. Observational and modelling results were presented to show that interaction of the Atlantic Ocean with its overlying atmosphere generates significant climatic variations with interannual, decadal, and perhaps centennial timescales. These can be clearly distinguished from ENSO-induced climatic variations.

In order to understand Atlantic processes in more detail the ACCP has three main objectives:

- To determine the response of the global atmosphere to persistent SST and sea-ice anomalies in the Atlantic Ocean and to develop coupled ocean-atmosphere models to simulate and predict seasonal to decadal change over and around the Atlantic Basin.
- To monitor, describe, and model the space-time variability of the meridional circulation of the Atlantic and its relation to variability of SST, sea ice, and salinity over the Atlantic Ocean on seasonal, annual and interannual time scales.
- To design an observing programme to monitor changes in the Atlantic thermohaline "conveyor

belt", and to develop a suitable modelling programme to assimilate available observations and help understand their mechanisms.

The ACCP has three major elements:

(1) Develop and analyse historical data sets to:

- a. execute purely data-based studies of the ocean, atmosphere and cryosphere, providing insight on the interaction between the Atlantic thermohaline circulation and regional climate phenomena.
- b. prepare data sets that can be used to supply initial and boundary conditions for numerical models of the atmosphere and the ocean.
- c. validate ocean and atmosphere modelling experiments using historical data sets.

(2) Conduct model experiments with atmosphere, ocean, coupled ocean-atmosphere and operational models. The short available historical data and long lead times required to collect new data make it clear that modelling must play a central role in the ACCP. Previous experience indicates that the entire suite of models will be required.

(3) Observe and monitor the thermohaline circulation. Measurements are planned in the Fram Strait, to monitor the outflow from the Polar Ocean; at about 50°N, at the boundary between the subpolar and the subtropical gyres; along 26.5°N at the latitude of maximum meridional heat flow; along the equator, because of the cross equatorial fluxes; and at 30°S, to monitor the thermohaline exchange between the Atlantic with the Pacific and Indian Oceans. The programme is expected to begin in the early 1990s.

The CCCO Atlantic Ocean Climate Studies Panel met in Princeton (May 4, 1990). Scientists from Brazil, France, the USSR, and the UK expressed interest in the ACCP and considered that the Atlantic Panel could be an option for contributions to the ACCP.

The Committee encouraged relations between WOCE, the ACCP, and the CCCO Atlantic Panel be as positive and productive as possible.

#### *Indian Ocean Climate Studies Panel*

The 6th session of the CCCO Indian Ocean Climate Studies Panel (Honolulu, 10-14 July 1990) brought together oceanographers, meteorologists and modellers to assess the needs of the region in the light of forthcoming WOCE activities. This co-operation was extended by joint meetings with the Pacific Panel and between both Panels and the TOGA COARE group.

Sea surface fluxes, temperatures and levels from the Arabian Sea, Bay of Bengal and Western Pacific were reviewed in the light of monsoon data and heat balance considerations. The Panel noted agreement between hydrographic and modelling results. It was apparent that the Indian Ocean was not a "slave" to the Pacific but exerts its own significant influence upon the climate of the region. The Panel drew attention to the needs for co-ordination with WOCE planning, for deployment of ATLAS-type moorings in the Indian Ocean and for more measurements of sea levels and inter-basin through-flows.

Given the impetus and integration of WOCE measurements, the Panel saw good prospects for progress in predictions of monsoon variability.

#### *Pacific Ocean Climate Studies Panel*

The Eighth Session of the CCCO Pacific Ocean Climate Studies Panel met under new terms of reference broadened beyond the tropics in Honolulu. There were separate sessions on 10-11 July and on 11 July, joint sessions with the CCCO Indian Ocean Panel. On 12 July both Panels met with the TOGA-COARE Panel.

In separate session, the meeting focussed on:

a. Past Recommendations:

b. National Accomplishments - Reports were presented by scientists from Japan, China, Peru, Australia, France, U.S., and Chile. It was suggested that the U.S. JGOFS section around 140°W be extended from 9° to 11°N to capture the North Equatorial counter current. It was evident that countries that have installed TOGA moorings will have to coordinate ship schedules for their servicing.

c. New Technologies - Of interest was U.S. real time salinity and current measurements, the latter on moorings reporting via ARGOS. France is employing GEOSAT data to derive geostrophic currents, also experimenting with a humidity/salinity recorder for VOS ships, and a delta pCO<sub>2</sub> device for drifters.

d. Regional Effects of Global Sea Level Rise - The Panel will consider the question further, intersessionally.

e. Initiation of Regular Inventory of Ocean Observations and "Grey" Literature Report - The Panel decided to begin quantifying the numbers of various types of ocean observations to develop a track record of progress against plans and concluded that a current bibliography of technical reports and unrefereed literature would be valuable for scientists from Pacific Rim countries.

f. Joint Session - In joint session with the Indian Ocean Panel, the meeting focussed on the role of the Indian and Pacific Oceans in the Asian-Australasian Monsoon System. A number of research questions were identified which will help form a more coherent approach to Indian Ocean climate research. In joint session with the TOGA COARE planners, plans and potential resources in support of COARE were identified.

**JSC-CCCO Working Group on Air Sea Fluxes (WGASF)**

The Committee reviewed the progress of the JSC-CCCO Air Sea Fluxes Working Group, endorsed the proposal to install surface pressure transducers in WOCE drifters, and to equip buoys planned for the air-sea flux calibration/validation exercise with surface wave instrumentation. CCCO members were concerned that the sub group for proposed in situ flux measurements had not yet been formed. They recognized that the small community of scientists capable of undertaking this task was fully committed for the foreseeable future. However, CCCO considers this effort one of very high priority if the satellite scatterometer and altimeter data are to be exploited fully. Accordingly, it will review the situation next year. The Committee agreed to recommend to JSC the addition of an individual on the WGASF who was sensitive to this issue, to ensure that the Working Group's interest in the calibration/validation question does not flag.

**JGOFS-CCCO CO<sub>2</sub> Advisory Panel**

With the completion of his term on CCCO, Dr Peter Brewer relinquished the chairmanship of the joint CO<sub>2</sub> Panel. After discussion of the CO<sub>2</sub> data acquisition issue, the CCCO agreed to changes in the terms of reference and membership to be recommended to JGOFS. The proposed new terms of reference are:

- (i) Develop a plan to acquire a global oceanic carbon data set suitable for use in meeting WCRP goals.
- (ii) Recommend and implement a measurement strategy for oceanic pCO<sub>2</sub>, total CO<sub>2</sub>, alkalinity, and pH using WOCE platforms.
- (iii) Work cooperatively with JGOFS to ensure adequate measurement of (1) satellite ocean color, (2) in situ biological measurements, (3) dissolved organic carbon and related carbon system measurements, and (4) sediment flux.
- (iv) Develop and implement a methodology to derive large scale CO<sub>2</sub> fluxes based on wave field/SST/wind field parameterization, and data archived under terms (ii) and (iii).
- (v) Ensure that data assimilation and modelling programmes are in place to provide the necessary

climatic linkages and scientific understanding.

- (vi) Monitor the implementation of (i) to (v) above, and advise CCCO on problems and progress.

New candidates for chairmanship and membership have been forwarded to JGOFS for their consideration.

### **CCCO Membership**

Dr McEwan advised that he had decided to step down from the Chair at the conclusion of CCCO-11. He would remain an Officer as Immediate Past Chairman, Professor Stewart would retire. Dr O'Brien was elected to succeed Dr McEwan as Chairman. Drs Peter Killworth and Hans Lass were elected to fill the Vice-Chairman vacancies. Drs P. Brewer (USA), J. Chao (PRC), R. Chesselet (FR), and J. Willebrand (FRG) retired and Dr. Y. Toba (JA) retired. Members expressed their appreciation for Dr McEwan's, Professor Stewart's, and the other departing members' service. The Chairman, IOC and President, SCOR have agreed to grant a two year extension of membership to Dr. J. O'Brien and to extend invitations for CCCO membership to Dr. G. Philander (USA), Dr. L. Myzak (CA), Dr. K. Denman (CA), Dr. J. Su (PRC), and Dr. T. Yamagata (JA).

### **Work Programme and Resources**

The planned CCCO Work Programme for 1990 will require a minimum of \$ 240,000 (includes IOC & SCOR support for the WOCE IPO which passes through the CCCO Secretariat). Staffing support for the CCCO Secretariat is supported by the USA (2), Australia (1) and Unesco/IOC (1); The International WOCE Project UK (2.5), FRG (1), USA (1.5); the WOCE Chief Scientist CAN (1); and the International TOGA Project Office by the USA (1), UK (1), and WMO (1).

## ANNEX IX

### Report of the Committee for the Joint Global Ocean Flux Study

#### **Background:**

Plans for the Joint Global Ocean Flux Study of SCOR are now well advanced. An International Science Plan has just been published and the JGOFS Committee is beginning to develop an Implementation Plan for the programme.

In February 1987, the Scientific Committee on Oceanic Research (SCOR) of the International Council of Scientific Unions (ICSU) agreed to the request of a number of national and international organizations and convened a meeting to discuss the status of planning for various studies of oceanic biogeochemical cycles and to decide whether a coordinated international programme of ocean flux studies was desirable. The recommendation of this meeting was that there should be an internationally coordinated, decade-long Joint Global Ocean Flux Study (JGOFS) whose main goal should be to determine and understand on a global scale the processes controlling the time-varying fluxes of carbon and associated biogenic fluxes in the ocean and to evaluate the related exchanges with the atmosphere, sea floor and continental boundaries. A long term aim of JGOFS was also established; to develop strategies for observing, on long time scales, changes in ocean biogeochemical cycles in relation to climatic change. There was a strong consensus that JGOFS should be planned and carried out under the auspices of SCOR.

Accordingly, in October 1987, formal steps were taken by SCOR to adopt these recommendations and to establish an international scientific planning Committee for JGOFS. This Committee held its first meeting in January 1988 (SCOR 1988) and has met regularly since then. In early 1989, an agreement was reached between SCOR and the ICSU Special Committee for the IGBP by which JGOFS was designated a Core Project of the IGBP with SCOR continuing to take the lead responsibility for its planning and implementation. The JGOFS programme has advanced quickly and a great deal has been achieved in the short time since its establishment.

#### **The JGOFS Goals and Strategies:**

The JGOFS Committee has established the two goals of JGOFS and has developed a series of more detailed scientific objectives which emphasize the scientific questions which need to be resolved to meet these goals. These are discussed in detail in the JGOFS Science Plan which will be available at the General Meeting.

**Goal 1:** To determine and understand on a global scale the processes controlling the time-varying fluxes of carbon and associated biogenic elements in the ocean, and to evaluate the related exchanges with the atmosphere, sea floor, and continental boundaries.

- 1.1 To characterize the present geographical distribution of key biogeochemical properties and rate processes pertinent to the oceanic carbon system, as a necessary prerequisite to predicting change in the system.
- 1.2 To quantify factors that control how carbon moves with, and through the water, via ocean currents, mixing, diffusion and particle sinking.
- 1.3 To determine the response of the ocean carbon system to physical and chemical forcing from sub-seasonal events to decadal changes.
- 1.4 To estimate the exchange at ocean boundaries. These include air-sea exchanges (those most directly related to the rationale for JGOFS), exchanges at the bottom (between both benthic communities and buried sediments), and exchanges at continental margins.

**Goal 2: To develop a capability to predict on a global scale the response of oceanic biogeochemical processes to anthropogenic perturbations, in particular, those related to climate change.**

- 2.1 To determine the role of the ocean in modifying the atmospheric increase in anthropogenic CO<sub>2</sub> and other gases affecting climate.
- 2.2 To develop coupled physical and biogeochemical models of the ocean for the purposes of testing our understanding and improving our ability to predict future climate-related change.
- 2.3 To establish strategies for detecting, above the background of natural seasonal and event-scale variability, longer term changes in ocean biogeochemical cycles in relation to climate change.
- 2.4 To examine the late Quaternary palaeoceanographic record to determine the relationship between ocean circulation, paleoproductivity, and CO<sub>2</sub> content in the atmosphere, to aid in the prediction of future CO<sub>2</sub>-related climate change.

In order to achieve these goals, JGOFS proposes a five-part scientific strategy; a chapter of the Science Plan is devoted to a discussion of the way in which each of these components meets the needs of the programme:

- A number of process studies to elucidate the mechanisms controlling the carbon cycle in different parts of the world ocean.
- A large scale, global, survey activity using remote sensing plus ship observations on a global set of transects, and a long time series observation programme at key sites, to improve basic descriptions of biogeochemical variability.
- Model studies to identify critical processes and variables, to assimilate observed parameters into basin and global scale fields, and to predict the future state of the ocean,
- A study of the past climatic record by means of biogeochemical sampling of deep-sea and continental shelf sediments, and,
- An international data archiving effort to assimilate and use effectively the vast amount of high quality data that will be obtained during the JGOFS observational period.

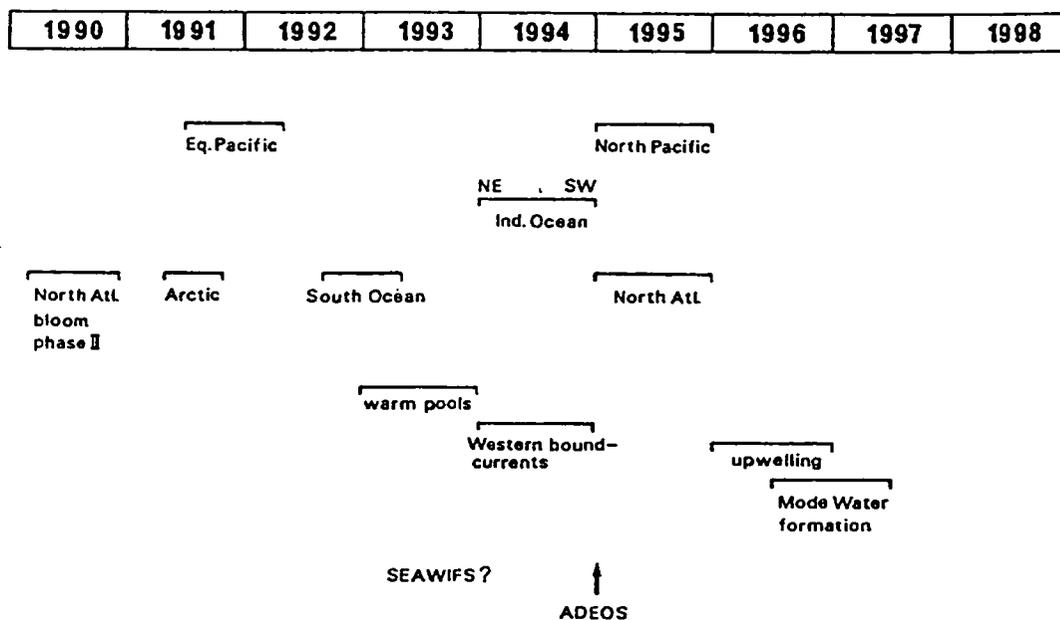
#### **Activities in 1989-1990:**

JGOFS planning has continued at a rapid pace during the period since the last report to SCOR. A series of meetings in March included the first joint JGOFS-IGBP activity, a Workshop on Modelling the Physics, Biology and Chemistry of the Upper Ocean and its Interactions with the Atmosphere which took place at the Royal Society and attracted well over one hundred participants. This was followed by a data analysis workshop (see below) and the Fourth Session of the JGOFS Committee in Kiel.

The JGOFS Committee meeting reviewed and approved a draft of the JGOFS Science Plan and the Plan was published by the SCOR Secretariat in August 1990. It sets out the core scientific problems and detailed objectives for JGOFS and puts forward plans for the research strategies required to advance our understanding of these problems. The plan is also intended to provide a framework within which to develop the international cooperation and collaboration which will be essential if this large set of research problems is to be addressed successfully.

The JGOFS Committee also began to discuss in a more detailed manner the schedule and means for implementation of the programme outlined in the plan. A tentative timetable for the series of process studies which will form the core of JGOFS was developed, with the first four having a fairly firm foundation in existing national plans. This schedule is shown in Figure 1.

Figure 1



Since its establishment, the JGOFS Committee has devoted a great deal of its attention to its first major field programme, the JGOFS North Atlantic Pilot Study, also known as the North Atlantic Bloom Experiment, the first phase of which took place in 1989. The Pilot Study grew out of the fortuitous convergence of plans in five nations for work in the northeast Atlantic during 1989 and it came to be regarded as a prototype for future JGOFS Process Studies. Its focus was a detailed examination of the development, evolution and decay of the annual phytoplankton bloom and associated phenomena during its northward progression along transect at 20°W. This study involved six research vessels and more than 250 scientists, as well as a NASA remote sensing aircraft. The benefits of the international cooperation promoted by the JGOFS Committee became obvious as agreements were crafted on a set of core measurements and the related protocols and levels of accuracy to be achieved. This collaboration also made possible extensive intercalibration exercises on several occasions when more than one research vessel was present at the same station. This spirit of cooperation was evident at a JGOFS Pilot Study Data Workshop (Kiel, March 1990) at which about 150 participants shared their data and merged them to create truly international data sets for the Study. A mechanism for the submission, archiving and sharing of these data was established. The final formal activity related to the Pilot Study will be the JGOFS North Atlantic Bloom Experiment Science Symposium which will take place at the US National Academy of Sciences from November 26-19, 1990.

The planning for the second major JGOFS field effort, the Equatorial Pacific Ocean Process Study in 1991-1992, is now well advanced as the result of a workshop held in Tokyo in April 1990. The equatorial Pacific is the largest single oceanographic province and it has been suggested that this region may supply as much as half of the global new production. The province differs from most oceanic systems in that its interannual variability, which results from its response to the El Niño-Southern Oscillation phenomenon, is greater than its seasonal variability, and appears to dominate the controls on biological fluxes. A Planning Team for the Equatorial Pacific study has been established under the Chairmanship of Dr. Margaret Leinen (USA). National cruise plans presented at the Tokyo meeting have permitted the preliminary design of a field program with transects from 10°N to 10°S at a maximum of 10° (and, in some areas, 5°) intervals across the entire equatorial Pacific. The first cruises will take place in late 1991.

Similarly, plans are beginning to be made for process studies in the Southern Ocean and the Indian Ocean. Southern Ocean JGOFS research was the focus of discussions at a meeting in Brest in July 1990. Six countries have plans to mount JGOFS programs in the Southern Ocean and a Planning Team for a JGOFS Southern Ocean Process Study to take place in 1992-93 is being established by the JGOFS Committee and will hold its first formal meeting in November 1990. Three countries already have definite intentions to send research vessels to the Indian Ocean in 1994 to conduct JGOFS-type studies. A JGOFS Indian Ocean Process Study will focus on the variations in primary and new production and export fluxes that arise from the seasonally reversing monsoonal circulation. An initial planning meeting will take place in Goa, India in January 1991.

Another important component of the JGOFS strategy is the global survey. To a large extent, JGOFS' needs for a global survey are being met through collaboration with the WOCE Hydrographic Programme. The CO<sub>2</sub> global survey which is required by both JGOFS and WOCE is being achieved through an agreement by which JGOFS CO<sub>2</sub> scientists have two berths on the WOCE Hydrographic Programme cruises. The CO<sub>2</sub> programme is being planned and implemented by a joint JGOFS/CCCO CO<sub>2</sub> working group and through direct liaison with the WHP Office at Woods Hole. JGOFS global survey must also include a programme of pigment and optics measurements, again to be carried out in collaboration with WOCE. The plans for this aspect of the global survey will be developed at a meeting of a sub-group of the JGOFS Global Survey Task Team late in 1990. The further needs of JGOFS for a global survey will be discussed in more detail at the next JGOFS Committee meeting.

#### **Towards a JGOFS Implementation Plan:**

As noted above, the JGOFS Committee has begun to translate the international Science Plan into a detailed Implementation Plan. This requires a concerted effort, but is necessary in order to demonstrate that the JGOFS scientific goals are achievable and that the programme is realistic and feasible. The Implementation Plan will provide the framework for the international collaboration required if JGOFS is to be a truly integrated study rather than a collection of unconnected activities. The Implementation Plan will also provide information on the resources (ship time, manpower, time series stations, computing facilities, etc.) required for JGOFS.

The JGOFS Committee has established a series of strategy-oriented Task Teams:

- Process Studies
- Global Survey
- Time Series Stations
- Sedimentary Record
- Benthic Processes
- Modelling
- Data Management

Their first responsibility will be to provide the various chapters of the draft Implementation Plan; the incorporation of these into an overall JGOFS Implementation Plan, taking national efforts into account, will be the responsibility of the JGOFS Executive Scientist.

Following this effort, the Task Teams will review each component of JGOFS during its implementation to ensure that it continues to meet JGOFS scientific objectives.

#### **Activities in 1991:**

The plans described in general above will determine the specific activities to be carried out by JGOFS during 1991. The Committee will meet in Washington, DC in late November 1990 and will decide on the precise details of its program of work for 1991. These are certain to include:

- one or two meetings of the JGOFS Committee
- meetings of three or four JGOFS Task Teams:
- meetings of JGOFS Process Study Planning Teams
  - Equatorial Pacific Ocean (study starts late 1991)
  - Indian Ocean (meeting Goa, India, January 1991)
  - Southern Ocean
- special events may include 2 NATO Advanced Study Workshops. NATO has made new funds available for a series of 70 workshops related to global change over the next five years. Applications have been submitted for a modelling workshop by the JGOFS Modelling Task Team and one on biogeochemical air-sea exchanges to be organized jointly by JGOFS and IGAC (International Global Atmospheric Chemistry Programme, another IGBP Core Project).

#### **Coordination of Resources for JGOFS:**

In accordance with the decision taken at its last Executive Committee meeting, SCOR convened a meeting in May 1990 to consider how the resources required for JGOFS could best be coordinated. Information on the needs of the programme for resources such as ship-time, computing facilities, funding and manpower and on scheduling must be provided to national supporting agencies. This meeting was chaired by Dr. R. Corell of the US National Science Foundation and its report to SCOR has been submitted as a separate document. In summary, it proposes the establishment of an *ad hoc* international, interagency resources panel for JGOFS which should have links to an international funding agencies group which may be established to deal with resources for global change research programmes.

#### **Membership:**

When the JGOFS Committee was established in late 1987, SCOR decided that members should serve three year terms, with the possibility of being invited to serve an additional two years. The initial memberships all took effect on January 1, 1988, and the Committee is now facing the first major rotation of its members on December 31, 1990. In particular, the term of the Chairman, Professor B. Zeitzschel, will expire. In recent discussions with the President of SCOR, it was agreed that the JGOFS Committee would recommend a new Chairman for appointment by the SCOR General Meeting. The Committee will consider its membership in the period leading up to its next meeting and will then agree upon a set of recommendations and nominations to be forwarded to SCOR for consideration by the Executive in correspondence. The current membership of the JGOFS Committee is shown in Figure 2. An \* indicates that action must be taken before the end of 1990.

#### **Secretariats:**

In early 1990, the JGOFS Science Secretariat was formally established at the Institut für Meereskunde of Kiel University. Thanks are due to Dr. C. Stienen and other members of the institute staff for their valuable assistance to JGOFS, particularly in planning the Data Analysis Workshop. Dr. G.T. Evans has assumed the position of JGOFS Executive Scientist and is supported through a secondment by the Government of Canada. Support for the operating expenses of the Science Secretariat is provided by the FRG. Administrative support for the JGOFS programme (funding, budgets, publications, reports, organization of meetings, etc.) continues to be the responsibility of the Executive Secretary of SCOR acting, on a part-time basis, as the Executive Secretary of JGOFS.

**Figure 2.**

----- = initial membership term    - - - - = renewal

	88	89	90	91	92
* Zeitzschel (FRG) Chairman				-----	
Fasham (UK) Vice-Chairman				-----	
* de Baar (Neth)				-----	
Brewer (USA)				-----	
* Brown (US)				-----	
* Calvert (Canada)				-----	
* Denman (Canada)				-----	
Dandonneau (France)					-----
Ducklow (USA)					-----
* Elderfield (UK)				-----	
* Hu (China)				-----	
* Koike (Japan)				-----	
* Minster (France)				-----	
Pearman (Australia)					-----
* Platt (Canada)				-----	
Shaffer (Sweden)					-----
Tambiev (USSR)					-----
Wefer (FRG)					-----

**Publications:**

A JGOFS Report Series was established in early 1990 and seven numbers will have been published (or in press) at the time of the General meeting:

- No. 1 Report of the Second Session of the SCOR Committee for JGOFS. The Hague, September 1988.
- No. 2 Report of the Third Session of the SCOR Committee for JGOFS. Honolulu, September 1989.
- No. 3 Report of the JGOFS Pacific Planning Workshop, Honolulu, September 1989.
- No. 4 North Atlantic bloom Experiment. Report of the First Data Workshop. Kiel, March 1990.
- No. 5 The Science Plan.
- No. 6 Core Measurement Protocols. The Reports of the Core Measurement Working Groups. (in press)
- No. 7 The Report of the JGOFS Equatorial Pacific Planning Workshop. Tokyo, April 1990. (in press)

**Budget:**

As noted above, the budgetary and financial responsibility for JGOFS international planning activities rests with the SCOR Secretariat. Support for the programme comes from a number of sources including a grant from ICSU, one from the US National Science Foundation, the SCOR budget, and contributions to a JGOFS Special Fund. The detailed programme of activities for 1991 will be established at the JGOFS Committee meeting in late November, however a preliminary estimate of the needs for financial support (not including the Canadian and FRG support of the Science Secretariat in Kiel) is about \$200,000.00.

## ANNEX X

### Report of the International Council for the Exploration of the Sea

ICES Report to SCOR - 1990

In last year's report a number of activities of relevance to SCOR were described. ICES maintains an active involvement in all of these, and the past year has seen significant progress in some of them.

Notable progress has been made in the coordination of activities in connection with the International Recruitment Project of IOC following the establishment of a small Inter-Committee Recruitment Group (IRG). IRG was established in order to establish a joint ICES-IOC study all over the world. A prime concern of the group was to consider ways to stimulate multidisciplinary dialogue amongst modellers and field workers. It is hoped that this will encourage the development of models that could form the basis for recruitment research to meet both long and short term fisheries management needs. The group's conclusions are expected to be debated in a special mini symposium in conjunction with the 1991 ICES Statutory Meeting.

The Skagerrak Experiment (SKAGEX) has now been completed. It attracted the participation of 18 ships from most Baltic countries as well as countries surrounding Skagerrak. A considerable quantity of high quality oceanographic data was collected during the 5 week period of the experiment and these are now being submitted to the ICES oceanographic data centre for compilation, quality control and distribution to the SKAGEX scientists. A detailed report on the results of this exercise is expected within one year.

ICES continues to provide a forum for North Atlantic scientists active in WOCE, the Greenland Sea Project, and the NANSEN project. In the case of the latter two, ICES continues to act as project data centre. These activities are mainly coordinated through the working group to request the establishment of a sub group on North Atlantic WOCE. It has hoped that this will lead to a more efficient coordination of activities, at least as far as the North Atlantic is concerned. This working group also publishes, annually, through the ICES Secretariat, an inventory of activities in the Oceanic ICES area, and attracts contributions from several hundred physical oceanographers.

ICES has been kept informed concerning the proposal within SCOR for the formation of a working group on Pelagic biogeography. ICES, through its Biological Oceanography Committee, has great interest in this activity and hopes to have the opportunity to define its role in the work of this group during the 1990 Statutory meeting.

ICES continues to play a major role in the preparation of the new Unesco/ICES/SCOR/IAPSO manual on oceanographic data processing. In last year's report it was mentioned that it was expected that work on the manual would be completed during 1990, but this is now unlikely because it has proven necessary to hold another meeting of the JPOTS editorial panel in order to finalize the manual. It is hoped that this can take place in Copenhagen and Paris, probably at the end of November. ICES also continues to provide support to the JPOTS sub-panel on CO<sub>2</sub>.

At the 1989 Statutory Meeting, 2 symposia of direct interest to SCOR were approved. These were (1) "Patchiness in the Baltic" which is to be held in conjunction with the previously announced symposium on "Hydrobiological Variability in the ICES area, 1980-1989" at Mariehamn, Finland in June 1991; and (2) "Measurement of Phytoplankton Primary Production: From Molecular Base up to Global Space", which is scheduled for 1992.

## ANNEX XI

### Report of the World Meteorological Organization

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

#### Drifting buoys and other ODAS

The joint WMO/IOC Drifting Buoy Co-operation Panel held its fifth session in Geneva in October 1989 and its sixth session is scheduled for Melbourne, 16-19 October 1990. The panel, acting in particular through its technical co-ordinator, has continued to effect improvements in the quality, quantity and timeliness of drifting buoy data available on the Global Telecommunication System (GTS). Notably, there has been a gradual increase in the proportion of all drifting buoys deployed with at least a part of their geophysical data included in reports distributed on the GTS - 36% in July 1990, representing almost 250 buoys.

These and other developments have resulted primarily from the work of the technical co-ordinator, Mr. Etienne Charpentier, who is located within Service Argos Inc. in Landover, Maryland, USA. He has established close contacts with the majority of buoy programme managers and has provided advice and assistance to them in the use of the Argos system, in arranging for GTS data distribution, in monitoring buoy and sensor performance and in a variety of other ways.

The technical co-ordinator has also been working closely with scientists involved in the WOCE/TOGA Surface Velocity Programme on aspects of the new WOCE low-cost drifter. They have jointly developed a small brochure on the project, which primarily is to be used in a campaign to interest national Meteorological Services in the installation and operation of air pressure sensors on the buoys. This matter will be discussed further at the sixth panel session.

The panel has been closely involved, with CLS/Service Argos, in the specification and implementation of a new GTS processing chain within the Argos system. This new chain is expected to be particularly beneficial to programmes which deploy buoys primarily for research purposes, in a variety of ways. The implementation of the chain is being funded largely by panel Members and details of its specific features may be provided by the technical co-ordinator.

A Guide to Moored Buoys and other ODAS, by Dr. G. D. Hamilton, is now in the process of being published by WMO. It is expected to be available in late 1990 as No. 16 in the WMO series Reports on Marine Science Affairs. The Drifting Buoy Co-operation Panel publishes an annual report on its activities, a copy of which is sent to the SCOR Secretariat. Additional copies may be obtained from either the WMO or IOC Secretariats.

#### Marine climatological data

The active data collection phase of the Voluntary Observing Ships Special Observing Project-North Atlantic (VSOP-NA) is now effectively completed, with eventually over 30,000 reports from almost 50 ships, covering a full year of observation from the North Atlantic, expected to be archived in the project data bank. Detailed analysis is now underway and the final project report is expected in the first half of 1991.

## Sea ice

Plans for a global digital sea-ice data bank in support of climate monitoring and research as well as operational sea-ice services are now well advanced. The bank is to be established jointly within World Data Centre-A for Glaciology, Boulder, Colorado, USA and the Arctic and Antarctic Research Institute, Leningrad, USSR, with all data archived ten years of sea-ice data covering the format. The archive will then be extended both backwards and forwards in time, with the eventual aim of having at least 30 years of global sea-ice data.

A seminar on the remote sensing of sea ice is to be held in September 1991 in Ottawa, Canada, sponsored jointly by the Canadian Sea Ice Branch and WMO. WMO has recently published a summary report on Methods of Sea Ice Forecasting (No. 23 in the series Marine Meteorology and Related Oceanographic Activities) and preparation of a comprehensive Handbook on the Analysis and Forecasting of Sea Ice is underway.

## Ocean Waves

The WMO Guide to Wave Analysis and Forecasting (WMO-No. 702) is now available in four languages and the Proceedings of the CMM Technical Conference on Ocean Waves published as Report No. 24 in the series Marine Meteorology and Related Oceanographic Activities. Contacts have been developed between the WMO Commission for Marine Meteorology and the embryonic Latin American wave modelling group GLAMO, the chairman of which is also a member of the CMM ad hoc group on numerical wave modelling.

## Global ocean observing system

Detailed information on developments with the GOOS will probably be provided by IOC and CCCD. WMO has continued to participate actively in these developments and the WMO Executive Council has reiterated its belief in the concept and practical value of the system in support of climate monitoring, research and prediction. WMO has also collaborated actively with IOC and UNEP in preparing a preliminary proposal for a project for monitoring climate-related changes in the coastal environment.

## GESAMP

WMO is taking the lead role in the newly/established GESAMP Working Group on Global Change and the Sea/Air Exchange of Chemicals, which will study a variety of problems related to the exchange of pollutants between atmosphere and oceans.

## Tropical Ocean and Global Atmosphere (TOGA) Programme

Having now passed the half-way point in its planned ten-year life, the past twelve months have seen continued high activity and a number of significant developments in the TOGA programme, of which the following are some highlights:

### International TOGA Scientific Conference 1990

WMO, IOC, and SCOR sponsored the International TOGA Scientific Conference in Honolulu 16-20 July 1990, the primary objective of which was to take stock of the scientific achievements of TOGA in the period 1985-1990 and to look ahead to what might be achieved in the period 1990 to 1995 and beyond in the post-TOGA era. Financial support for the Conference facilities and organization was provided by the US TOGA Project Office. WMO, IOC and SCOR provided financial support to a total of 60 participants from developing countries, in the case of SCOR three from China and one from India. The Conference Programme was organized by a Scientific Committee under the Chairmanship of Professor Klaus Wyrtki of the University of Hawaii and included about 100 papers, of which 30 were by invited speakers, and over 100 posters. At the

opening Ceremony, Professor J. O'Brien welcomed participants on behalf of the President of ICSU and the President of SCOR. Approximately 300 scientists from 27 different countries participated in what the Chairman of the TOGA Scientific Steering Group described as a highly successful Conference that was buoyant scientifically and which had a fine spirit. The papers presented by the invited speakers will be published by WMO as the Conference Proceedings.

### Restructuring of the TOGA Scientific Steering Group (SSG)

At their meetings earlier this year (1990) the JSC and CCCO formally endorsed the concept of the TOGA COARE Panel to be the third sub-group supporting the SSG, i.e. in addition to the TOGA Numerical Experimentation Group (TOGA-NEG) and the TOGA Monsoon Numerical Experimentation Group (TOGA-MONEG). The JSC and CCCO also agreed to restructure the SSG so that its future composition would consist of two representatives of each of the TOGA COARE Panel, the TOGA NEG and the TOGA MONEG, plus up to three others, to give a maximum membership of nine. At its ninth session in July 1990 the SSG agreed that the restructuring introduced by the JSC and CCCO was well suited to the task of steering the main future activities of the TOGA programme, namely:

- the prediction of ENSO and related short-term climate variations; (TOGA NEG)
- the study of the predictability of monsoonal flow; (TOGA MONEG)
- the Coupled Ocean-Atmosphere Response Experiment; (TOGA COARE).

### TOGA Predictions

Following the advice of the SSG, the Intergovernmental TOGA Board at its third session in January 1990 agreed that its member nations should give consideration to the best ways of achieving a multi-national capability for experimental climate prediction on seasonal to interannual time-scales. Board members agreed to address this task during 1990 and to present their findings at the Board's next session in 1991. Subsequently, within the USA the NOAA Office of Global Programmes requested Drs M. Cane and E. Sarachik to coordinate the assessment of the current opportunities for TOGA prediction and recommend the best way to start the process that will lead to a TOGA prediction facility. A meeting was convened in New York, in June 1990 to discuss and revise the draft assessment which had been prepared by Drs Cane and Sarachik. This meeting was coordinated with the fourth session of the TOGA-NEG and thus achieved international as well as wide national representation. The meeting concluded that there is evidence of skill in making ENSO forecasts a year or more in advance; that there are additional problems to be solved, the solving of which would improve the skill of these forecasts but which is beyond the capabilities of any of the individual groups currently active, and that opportunities now exist for a focused effort to solve these problems. The provisional working group established at this meeting recommended that a Working Group be set up immediately to:

- prepare the longest possible climate data needed to initialize and validate prospective ENSO forecasts;
- make a series of ENSO hindcasts using the data;
- make end-to-end ENSO predictions using an initialized coupled model and deliver these predictions to NOAA for dissemination;

- produce a design for a final TOGA Prediction Facility.

The provisional working group also recommended that a research program be set up to address:

- the issues of ENSO prediction;
- the problems involved, particularly in model development, in expanding the activity to global TOGA predictions.

The provisional working group noted that although its prospectus was for a US TOGA Prediction Program, it had benefited from the contributions of the TOGA-NEG and that it was envisaged that any future US program would continue to be part of an international effort. It is encouraging to the SSG that the TOGA-NEG was able to contribute to this US initiative and to see the very positive approach being adopted within the US. The outcome of the work that has now started is likely to be of fundamental significance to the future deliberations of the Intergovernmental TOGA Board on this important topic.

#### TOGA Coupled Ocean-Atmosphere Response Experiment (COARE)

In January 1990 WMO published the Scientific Plan for the TOGA Coupled Ocean-Atmosphere Response Experiment as an Addendum to the Scientific Plan for TOGA (WMO Technical Document No. 64 Addendum). Dr. J. Kuettner has been appointed as the Interim Director of the TOGA COARE Project Office (TCPO), working from an Interim TCPO at UCAR in Boulder, Colorado. The post of Director of the TCPO has been advertised with a deadline of 14 September 1990 for the receipt of applications. Bi-lateral negotiations that are underway are expected to lead to the secondment of at least two scientists from other countries. A site survey was conducted in February 1990 as a result of which Guam has been identified as the best available location for the COARE Operations Centre and Honiara (Guadalcanal) and Pohnpei have been identified as possible COARE Flight Centres. The IOP Flux Array will be centred at 2°S possible between 155°E and 165°E. At a joint meeting in July 1990 the US COARE Science Working Group (SWG) and the TOGA COARE Panel considered the advantages and disadvantages of keeping to the 92/93 timeframe for the COARE Intensive Observing period (IOP), as opposed to delaying the IOP to the 93/4, or even 94/5, timeframe. Consensus was reached that the overall balance of advantage lies with keeping to the 92/3 timeframe and that this should be the basis for planning and for coordinating the allocation of resources between COARE and competing programmes. On this basis, participation is being planned by Australia, China, France, Japan and New Zealand as well as by the United States and participation is being considered by Indonesia, Korea, UK and the USSR.

## **ANNEX XII**

### **Report of the International Geosphere-Biosphere Programme**

Press Release, August 13, 1990

#### **GLOBAL CHANGE SCIENCE PLAN DEFINED**

##### **Introduction**

**The International Geosphere-Biosphere Programme: A Study of Global Change (IGBP)**, under the auspices of the International Council of Scientific Unions (ICSU), has today published a report (IGBP Report No. 12, IGBP - The Initial Core Projects, 312 pp.) describing the initial projects to be launched internationally in response to society's need for better understanding of the Earth system. Such an understanding is a prerequisite for assessing the future of our planet, what global changes are likely to occur and what their impacts will be on the life support system that is of such crucial importance to our future.

This research plan marks the end of the planning phase for the IGBP and the transition after three years into implementing the research that addresses the IGBP objective: "to describe and understand the interactive physical, chemical, and biological processes that regulate the total Earth system, the unique environment that it provides for life, the changes that are occurring in this system, and the manner in which they are influenced by human activities".

The planning phase has involved a large number of scientists from many nations around the world in a truly international effort.

The IGBP and the World Climate Research Programme (WCRP; jointly sponsored by ICSU and the World Meteorological Organization) are the two principal international programmes addressing the urgent issue of global environmental change. The two programmes have been recognized by the United Nations as the key to further scientific understanding, and a General Assembly resolution (December 1989) called upon all nations to support and increase their contributions to the IGBP and the WCRP. These two organizations have written the chapter on research needs for narrowing uncertainties in climate predictions in the report of the Intergovernmental Panel on Climate Change (IPCC), which will be discussed at the Second World Climate Conference later this year.

##### **IGBP Core Projects**

The special committee for the IGBP, consisting of 19 scientists from 15 countries, has been charged by ICSU with the development of a science plan for the IGBP. The Committee has identified seven key questions that need to be answered to narrow the uncertainties in global change predictions. The development of an international research programme to address these questions is very timely in view of the increased political interest in global environmental problems.

The IGBP implementation phase will consist of about ten research projects to be carried out over the next one to two decades. The plans for these projects have been developed during numerous planning meetings arranged by the IGBP over the past three years with the participation of more than 500 scientists. As a result of this planning effort, five of the ten projects have already been established and detailed science plans are ready for implementation. These projects are:

### **Established IGBP Core Projects**

**The International Global Atmospheric Chemistry Project (IGAC;** developed together with the Commission of Atmospheric Chemistry and Global Pollution of the International Union of Geodesy and Geophysics of ICSU) will focus on the processes that determine the chemical composition of the atmosphere and its relationship to the climate system. Special focus will also be given to biotic sources and sinks of greenhouse gases.

**The Joint Global Ocean Flux Study (JGOFS)** of ICSU's Scientific Committee for Oceanic Research (SCOR). This project, which conducted its first pilot field experiment in the Atlantic in 1989, will address the question of the role of oceans in controlling the flux of carbon and other biogenic elements and to develop a capability to predict the effects of global changes on ocean biogeochemical cycles.

**Biospheric Aspects of the Hydrological Cycle (BAHC)** is a complement to the Global Energy and Water Cycle Experiment (GEWEX) of WCRP. It will address the biospheric regulation of the hydrological cycle and will, together with GEWEX, develop large-scale field experiments in different bioclimatic zones. As an example, a major field experiment will be carried out in Niger in the Sahel zone in 1991-1994 with the collaboration of at least France, UK, USA and the CEC.

**Global Change and Terrestrial Ecosystems (GCTE)** will develop the capability to predict the effects of changes in climate, atmospheric CO<sub>2</sub> and land use on terrestrial ecosystems, and how these changes can lead to feedbacks to the physical climate system. The project will have three main foci: (i) the physiology of ecosystems, (ii) the dynamics of ecosystems, and (iii) impacts on agriculture and forestry.

**Past Global Changes (PAGES)** will be organized in two streams: (i) reconstruction of the detailed history of climatic and environmental change for the globe for the period since 2,000 B. P. with temporal resolution that is at least decadal, and ideally, annual and seasonal, and (ii) reconstruction of past global changes through a full glacial-interglacial cycle.

### **Proposed IGBP Core Projects**

For these three projects, detailed science plans have yet to be developed and implementation will thus start later than for the five already established projects:

**Stratosphere-Troposphere Interactions and the Biosphere (STIB)** has been developed with the participation of IAMAP (International Association of Meteorology and Atmospheric Physics), IAGA (International Association of Geomagnetism and Aeronomy) and SCOSTEP (Scientific Committee of Solar-Terrestrial Physics; all three organizations part of ICSU). The project planning will especially address the importance of stratosphere-troposphere interactions and the link to the climate system. It will also consider biological processes and how they affect the stratosphere and how changes in the stratosphere (especially increased UV-B radiation) will affect the biosphere.

**Land-Ocean Interactions in the Coastal Zone (LOICZ)** will develop research plans to address how a predictive understanding can be developed to address the effects of climate change, land use and sea-level change on the global functioning and sustainability of coastal ecosystems, with emphasis on the interactions between changing conditions on land and sea, and on possible feedback effects to the physical environment.

**Global Analysis, Interpretation and Modelling (GAIM)** will, with the aid of models, synthesize a fundamental, quantitative understanding of the global physical, chemical and biological interactions in the Earth system during the past 100,000 years and assess possible effects of future changes.

### **Potential IGBP Core Projects**

Two projects are still at early stages of development and future planning will further define their contents: **Global Ocean Euphotic Zone Study** (planned together with SCOR) will address a need for an integrated upper ocean project to be based on the experiences of JGOFS and WOCE (World Ocean Circulation Experiment of WCRP) and implemented after those projects have been completed. **Global Change and Ecological Complexity** will address the possible impact of global change on genetic, populational and community diversity and if the expected changes are functionally important in a global context. A review of the scientific basis for a possible project will be carried out by SCOPE (Scientific Committee on Problems of the Environment of ICSU), IUBS (International Union of Biological Sciences of ICSU) and MAB (Man and the Biosphere programme of Unesco).

### **Other Key Activities**

Two key activities relate to the needs of all Core Projects and are thus managed separately:

The development of a global **Data and Information System** that will provide immediate and open access to all researchers, that will provide information needed for Earth system models, and that will define and sustain the long-term observations needed to detect global changes. Remote sensing from space will be an essential component in such an observational network.

The establishment of a set of **Regional Research Centres** in developing countries, where strong synthesis and modelling projects of relevance to overall IGBP objectives and regional priorities will be developed, in close cooperation with existing research networks. Training and exchange programmes will be one of the mechanisms to involve the scientists from the region in IGBP Core Projects. The links between research centres in developing and developed countries will also be fostered.

### **Implementation**

ICSU has recently appointed a Scientific Committee for the IGBP, which, under the chairmanship of Professor James J. McCarthy from the Museum of Comparative Zoology, Harvard University, Cambridge, MA, USA, will be charged with guiding the early implementation phase of the IGBP. National programmes are also being developed and links between the international and national efforts are primarily through the 44 national IGBP committees. It is expected that additional committees will be established in the near future. The links to the other scientific organizations within ICSU are primarily through joint agreements (see examples above) but also through liaison members of ICSU's scientific bodies to the IGBP. Of the other ICSU organizations, 19 have so far decided to appoint such liaison persons.

The international activities within each Core Project will be coordinated by a Core Project Office. A CPO has been established in Kiel (FRG) for JGOFS and other CPOs include BAHC (Berlin), PAGES (Berne), IGBP-DIS (Paris) and a planning office for GOEZS in Wormley (UK).

The further planning and international coordination of the early implementation of the IGBP are hampered by lack of financial resources despite the very generous support from many national and other sources. The 1990 budget target of USD 1,600,000 has not been met and it has been necessary to reduce planned expenditure by at least USD 500,000. As a consequence, a number of crucial activities will have to be postponed. In view of the political importance of global change, the SC-IGBP is dismayed that it has been impossible to secure enough funds to keep the momentum of the international planning activity now entering the crucial early implementation phase.

## **Second IGBP Advisory Council Meeting**

At the invitation of the French Minister for Science and Technology, Dr. H. Curien, the Second IGBP Advisory Council meeting will be held in Paris from 3 to 7 September 1990. This meeting will provide an excellent opportunity for national IGBP committees, other ICSU organizations and representatives from other governmental and non-governmental bodies to review the IGBP science plan as it is described in IGBP Report No. 12 (1990). The meeting will review national plans for participation in the international effort and review the timeliness of establishing additional Core Projects based on the scientific rationale in Report 12. The needs for additional efforts to further involve scientists in developing countries will be another important point for discussion. The SAC meeting will also provide an opportunity for the science community to further develop the dialogue with national funding agencies responsible for global changes research.

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## ANNEX XIII

### Report of the Arctic Ocean Sciences Board

The Arctic Ocean Sciences Board (AOSB) held its Ninth Session on 15-17 January 1990 at the Scott Polar Research Institute in Cambridge. A brief summary of this Session and of other recent AOSB activities follows.

#### The Greenland Sea Program (GSP):

The Board received at its Ninth Session reports on results of the first intensive field phase of the Greenland Sea Program (GSP) which had been completed late in 1989 and on the meeting of the Scientific Steering Group for the GSP, 8-9 October 1989 in The Hague. The first intensive field study under the GSP focussed on physical and chemical oceanography complemented by phytoplankton and zooplankton studies.

Scientists are now processing and analyzing the collected data and preparing results, combining the data from in situ observations with remotely-sensed data and numerical modelling. Among the most noteworthy of the initial results is an analysis of convection during the consecutive winters of 1986/87, 1987/88 and 1988/89. The processing and analysis of data is expected to continue for another year or more.

The SSO/GSP decided to continue observations in the Greenland Sea on a long-term basis, especially to measure the transport of water and ice within the convective system of the European Sub-Arctic seas. This monitoring will include hydrographic sections, long-term moored arrays (including current meters, upward-looking sonars, acoustic Doppler current profilers, etc.), and remote sensing systems. A major objective of this monitoring will be to improve understanding of convective processes in the Greenland Sea by obtaining regular high quality measurements of stratification at key locations.

The SSG/GSP is now planning for a second intensive field study, centered on the period February - April 1993. Specialized groups will be set up to consider needs in physical oceanography, meteorology, glaciology, biology, geochemistry, and remote sensing. These groups will present recommendations in these areas for inclusion in a comprehensive plan for a second intensive field program to be considered by the SSG/GSP at its next meeting in the autumn of 1990.

#### The International Arctic Polynya Program (IAPP)

The AOSB established a Scientific Coordinating Group (SCG) for the IAPP (SCG/ IAPP). The objectives of the Group are to: establish and update an overall scientific mission statement for the IAPP; suggest a core program that should be carried out in each of the selected locations to identify and interpret the processes taking place; review the scientific plans produced for individual polynya research projects in comparison with the overall scientific mission statement; insure that the IAPP is developed in the context of other related national and international programs (e.g., the IGBP); and prepare recommendations to the AOSB on matters related to the IAPP.

The Group is composed of scientists chosen by the AOSB for their interest and expertise and includes the chairpersons of the Northwater (NOW), North East Water (NEW), and St. Lawrence Island (SLIP) polynya projects. The SCG/IAPP met for the first time in May 1990 and developed a mission statement for an International Arctic Polynya Program (copy attached). The Group is expected to meet at least once a year hereafter.

## Other Activities

The AOSB reviewed the progress made in discussions of geosciences in the Arctic Basins, especially with respect to paleoceanography. The Board encouraged further scientific planning for marine geological and geophysical research in the Arctic Ocean and for development of technology (including both coring and drilling) needed to support such research. The Board considered marine geology and geophysics a potential area for future AOSB emphasis.

The Board recognized that, while a significant portion of Arctic Ocean research in many countries is related to global change, little in the way of funding is allocated specifically to support of research under this umbrella. The Board concluded it would be useful to specifically direct some funds in each country to Arctic Ocean research which is directly related to global change research.

The Board agreed that it would be useful to provide for exchange of information on activities of research vessels, including icebreakers, in the Arctic by arranging for the schedules of these vessels to be included in a new database called "OCEANIC". This database is being developed under the aegis of the International Ship Operators Group (ISOM) to track international research vessel activities.

The Board recognized that the expected conclusion and signing of an agreement to set up an IASC could provide new impetus to Arctic research. However, the Board concluded that its recent experience, especially with respect to the Greenland Sea Program, had indicated that effective international cooperation in Arctic Ocean science is essential to the success of such science. Therefore, the Board decided it should continue to maintain and develop sound ocean science programs in the Arctic. The Board is also considering how it might best work with the IASC over the next few years.

Dr. Eileen Buttle (United Kingdom) was elected Chairman and Dr. Robert Corell (United States) was elected Vice-Chairman. The Board accepted the invitation extended to hold AOSB-10 in Copenhagen, Denmark, 8-10 January 1991. The Board expressed its appreciation to Professor Gotthilf Hempel under whose very effective leadership the Board had developed.

**ANNEX XIV**  
**1989 Final Financial Statement**  
(U.S. Dollars)

<b>Starting Balance Jan. 1/89</b>		<b>\$ 84,125.00</b>
<b>INCOME:</b>		
Membership	137,190.00	
ICSU Grants re CCCO & JGOFS	56,000.00	
NSF Grant/travel awards	27,966.00	
NSF Grant/geosciences	69,180.00	
UK Subvention	17,618.00	
IOC and UNESCO Contracts	39,000.00	
US Grant/CCCO Sec't	105,000.00	
Misc. plus interest	15.00	
JGOFS Special Fund	<u>15,000.00</u>	
<b>TOTAL INCOME</b>		<u>466,969.00</u>
<b>TOTAL CASH PLUS INCOME</b>		<u>551,094.00</u>
<b>EXPENSES / SCIENTIFIC ACTIVITIES</b>		
WG54 (BIOMASS)	5,000.00	
WG77	6,942.00	
WG78	15,412.00	
WG80	11,206.00	
WG82	3,000.00	
WG83	6,200.00	
WG85	15,673.00	
CCCO	50,415.00	
JGOFS	38,720.00	
JPOTS	<u>8,861.00</u>	
<b>TOTAL Subsidiary Bodies</b>		161,902.00
<b>Related Activities:</b>		
Exec. Comm. Meeting	18,136.00	
Publications	7,841.00	
Representation	15,415.00	
Travel Awards	28,250.00	
Liege Colloquium	4,000.00	
OSLR Consultation	2,729.00	
JOA refunds	<u>(2,984.00)</u>	
Total		<u>73,387.00</u>
<b>TOTAL SCIENTIFIC EXPENSE</b>		235,289.00
<b>ADMINISTRATIVE EXPENSES</b>		
<b>SCOR:</b>		
Salaries	49,498.00	
Communication	8,117.00	
Audit	1,500.00	
Miscellaneous off. exp.	2,006.00	
Bank chgs. & loss on exch.	<u>1,617.00</u>	
Total SCOR	62,738.00	
CCCO Secretariat support	105,033.00	
JGOFS Administration	<u>52,203.00</u>	
<b>TOTAL ADMINISTRATION EXPENSE</b>		219,974.00
<b>TOTAL EXPENSES</b>		455,263.00
<b>BALANCE, Dec. 31, 1989</b>		95,831.00
<b>TOTAL CASH PLUS EXPENSES</b>		<u>551,094.00</u>
Less held in reserve in JGOFS Special Fund		<u>15,000.00</u>
<b>Ending Balance, Dec. 31, 1989</b>		<b>\$80,831.00</b>

## ANNEX XV

### Acronyms and Abbreviations

3GWAM	Third Generation Wave Model
ACCP	Atlantic Climate Change Program (of NOAA)
AOSB	Arctic Ocean Sciences Board
ARGOS	Satellite location and data collection system
ASLO	American Society for Limnology and Oceanography
BIOMASS	Biological Investigations of Marine Antarctic Systems and Stocks
CCCO	Committee on Climatic Changes and the Ocean (SCOR and IOC)
CD-ROM	TOGA Pilot Compact Disk Project
CLS	Collecte Localisation Satellites (Service ARGOS)
CMAS	Confederation Mondiale des Activites Subaquatiques
CMG	Commission for Marine Geology
COARE	Coupled Ocean-Atmosphere Response Experiment (of WOCE)
COMAR	Coastal Marine Research (programme of UNESCO)
COSPAR	Committee on Space Research
CRREL	Cold Regions Research and Engineering Laboratory
CTD	Conductivity, Temperature, Depth (Profiler)
DBCP	Drifting Buoy Cooperation Panel (of WMO and IOC)
DIU	Data Information Unit (WOCE)
DOE	Department of Energy (USA)
EC	Executive Committee (SCOR) or Executive Council (IOC)
ECMWF	European Centre for Medium Range Weather Forecasting
ECOR	Engineering Committee on Oceanic Resources
ENSO	El Nino Southern Oscillation
EOS	Earth Observing System (NASA, USA)
ERS-1	Earth Resources Satellite - 1 (of ESA)
ERS-2	Earth Resources Satellite - 2 (of ESA)
ESA	European Space Agency
FAO	Food and Agriculture Organization
FNOC	Fleet Numerical Oceanographic Center (USA)
GAIM	Global Analysis, Interpretation and Modelling
GARP	Global Atmospheric Research Program
GATE	GARP Atlantic Tropical Experiment
GEOSAT	Geodetic Satellite (launched March 1985 USA)
GESAMP	Group of Experts on the Scientific Aspects of Marine Pollution
GEWEX	Global Energy and Water Cycle Experiment
GLOBEC	Global Ocean Ecosystems
GLOSS	Global Sea Level Observing System (of IOC)
GOEZ	Global Ocean Euphotic Zone Study
GOOS	Global Ocean Observing System
GSP	Greenland Sea Project
GTS	Global Telecommunication System
IABO	International Association for Biological Oceanography (ICSU)
IAGA	International Association of Geomagnetism and Aeronomy (ICSU)
IAMAP	International Association of Meteorology and Atmospheric Physics (ICSU)
IAPP	International Arctic Polynya Program
IAPSO	International Association for the Physical Sciences of the Ocean (ICSU)

IASC	International Arctic Sciences Council
ICES	International Council for the Exploration of the Sea
ICSU	International Council of Scientific Unions
IGAC	International Global Atmosphere Chemistry Programme
IGBP	International Geosphere - Biosphere Programme
IGFA	International Group of Funding Agencies for Global Change
IGOSS	Integrated Global Ocean Services System (of IOC and WMO)
IMS	International Marine Science Newsletter (UNESCO)
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
IOP	Intensive Observing Period
IPCC	Intergovernmental Panel on Climate Change
IPO	International Project Office
IRG	Inter-Committee Recruitment Group (IOC)
ISOM	International Ship Operators Group
ITB	Intergovernmental TOGA Board
IUBS	International Union of Biological Sciences of ICSU
IUGG	International Union of Geodesy and Geophysics (ICSU)
IUGS	International Union of Geological Sciences
JGOFS	Joint Global Ocean Flux Study
JOA	Joint Oceanographic Assembly
JOIDES	Joint Oceanographic Institutions for Deep Earth Sampling
JONSWAP	Joint North Sea Wave Analysis Project
JPOTS	Joint Panel on Oceanographic Tables and Standards
JSC	Joint Scientific Committee, World Climate Research Program
KNMI	Royal Netherlands Meteorological Institute
LOICZ	Land-Ocean Interactions in the Coastal Zone
MAB	Man and the Biosphere programme of UNESCO
MONEG	TOGA Monsoon Numerical Experimentation Group
MPIM	Max-Planck Institute for Meteorology (FRG)
MRI	Marine Coastal Programme
NABE	North Atlantic Bloom Experiment
NAD	Nansen Arctic Drilling
NANSEN	North Atlantic Norwegian Sea Exchange
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NEG	TOGA Numerical Experimentation Group
NEW	North East Water polynya project
NIO	National Institute of Oceanography (India)
NMC	National Meteorological Centre
NOAA	National Oceanic and Atmospheric Administration (USA)
NODS	NASA's Ocean Data Services
NOW	Northwater polynya project
NSF	National Science Foundation (USA)
ODAS	Ocean Data Acquisition Systems
ODP	Ocean Drilling Program
OOSDP	Ocean Observing System Development Panel
OPC	Ocean Processes Committee
ONR	Office of Naval Research (USA)
OSLR	Ocean Science in Relation to Living Resources (IOC)
OSNLR	Ocean Science in Relation to Non-living Resources (IOC)
PAGES	Past Global Changes (of IGBP)
PSA	Pacific Science Association

SAC	Scientific Advisory Council
SAR	Synthetic Aperture Radar (Satellite)
SCAR	Scientific Committee on Antarctic Research (ICSU)
SC-IGBP	Special Committee for the IGBP (ICSU)
SCOPE	Scientific Committee on Problems of the Environment (ICSU)
SCOR	Scientific Committee on Oceanic Research (of ICSU)
SCOSTEP	Scientific Committee of Solar-Terrestrial Physics (ICSU)
SEAS	Shipboard Environmental Data Acquisition System (of NOS, USA)
SIBEX	Second International BIOMASS Experiment
SKAGEX	The Skagerrak Experiment
SLIP	St. Lawrence Island polynya project
SSG	Scientific Steering Group for WOCE (of JSC/CCCO)
SST	Sea Surface Temperature
STIB	Stratosphere-Troposphere Interactions and the Biosphere
SWADE	Surface Wave Dynamics Experiment
SWAMP	Sea Wave Modelling Project
SWCC	Second World Climate Conference
TCP	TOGA COARE Panel
TCPO	TOGA COARE Project Office
TOGA	Tropical Ocean and Global Atmosphere
TOPEX/Poseidon	Ocean Topography Experiment (NASA/CNES satellite program)
TOS	The Oceanography Society
UCAR	University Corporation for Atmospheric Research
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environmental Program
UNESCO	United Nations Educational, Scientific, and Cultural Organization
VOS	Voluntary Observing Ship
VSOP-NA	Voluntary Observing Ships Special Observing Project-North Atlantic
WAM	Wave Modelling Group
WCRP	World Climate Research Program (of WMO, ICSU)
WGASF	JSC-CCCO Working Group on Air-Sea Fluxes
WGNE	Working Group Numerical Experimentation (WMO/JSC)
WHP	WOCE Hydrographie Programme
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment
XBT	Expendable Bathythermograph
XCTD	Expendable Conductivity, Temperature, Depth