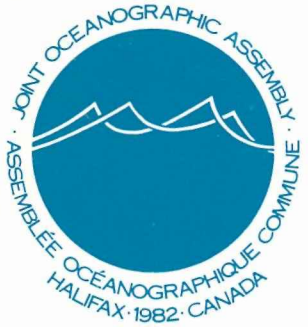

SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH

SCOR
Proceedings
Vol. 18

Halifax
August, 1982

INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH

THE EXECUTIVE COMMITTEE

President:	Professor E.S.W. Simpson Department of Oceanography University of Cape Town Rondebosch 7700 SOUTH AFRICA	Tel: 21-66-3811 Telex: 5722208 Telegrams: Alumni CAPETOWN
Past President:	Dr. K.N. Fedorov Institute of Oceanology Academy of Sciences of the USSR 23 Krasikova Street Moscow 117218 U.S.S.R.	Tel: (95) 124 5996 Telex: 411968 Telegrams: OKEANOLGIA MOSCOW
Vice-Presidents:	Dr. R. Chesselet Director PIRO-CNRS 15 Quai Anatole France Paris 75700 FRANCE	Telex: NMR 260034
	Professor G. Siedler Institüt für Meereskunde Universitat Kiel Düsternbrooker Weg 20 2300 Kiel FEDERAL REPUBLIC OF GERMANY	Tel: Kiel (0431) 597 4501 Telex: 0292619 ifmk d Telegrams: MEERESKUNDE KIEL
	Dr. Torben Wolff Director Danmarks Akvarium 2920 Charlottenlund DENMARK	Telefon: (01-43) HE 3283
Secretary:	Dr. A.R. Longhurst Director General Bedford Institute of Oceanography P.O. Box 1006 Dartmouth, Nova Scotia B2Y 4A2 CANADA	Tel: (902) 426-3492 Telex: 019-31552 Telegrams: BIO DRT
Co-opted Member:	Professor H. Charnock Department of Oceanography The University Southampton S09 5NH UNITED KINGDOM	Tel: Southampton (703) 55 9122 Telex: 47661
Ex officio: CMG	Professor K. Hsü Swiss Federal Institute of Technology Geological Institute Sonneggstrasse 5 8006 Zurich SWITZERLAND	Tel: (01) 256-3669 Telex: 53178 ETH bi
IABO	Professor P. Lasserre Institut Universite de Biologie Marine de Bordeaux 2 Rue du Professeur Jolyet 33120 Arcachon FRANCE	
IAPSO	Professor D. Lal Physical Research Laboratory Navrangpura Ahmedabad 380 009 Gujarat INDIA	Tel: 44803 or 440550 Telex: 012397 Telegrams: RESEARCH NAVRANGPURA AHMEDABAD
IAMAP	Dr. W.L. Godson Atmospheric Environment Service 4905 Dufferin Street Downsview Ontario M3H 5T4 CANADA	Tel: Toronto (416) 667 4919 Telex: 06 964582 Telegrams: DOE HQAES TOR
Executive Secretary:	Mrs. E. Tidmarsh Department of Oceanography Dalhousie University Halifax, Nova Scotia B3H 4J1 CANADA	Tel: Halifax (902) 424-3558 Telex: 01921863 Telegrams: OCEANOGRAPHY DALHOUSIE HALIFAX

INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

PROCEEDINGS

OF THE

SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH

December 1982

Halifax, Nova Scotia, Canada

SCOR Proceedings, Vol. 18

CONTENTS

REPORT OF THE SIXTEENTH GENERAL MEETING OF SCOR (INCORPORATING A REPORT OF THE TWENTY-FOURTH MEETING OF THE SCOR EXECUTIVE COMMITTEE)

Halifax, Nova Scotia

August 7, 1982

The Sixteenth General Meeting of SCOR was held at Dalhousie University, Halifax, Nova Scotia on August 7, 1982. The Twenty-fourth Meeting of the SCOR Executive Committee took place on July 29-31 in preparation for the General Meeting. Professor E.S.W. Simpson presided over both meetings which were held in conjunction with the Joint Oceanographic Assembly, 1982. The report of the Executive Committee Meeting was presented to the General Meeting: the reports of both meetings are incorporated in this issue of *SCOR Proceedings*. A list of participants is given in Annex I. A summary of the Scientific Programme of the JOA appears as Annex II.

The Executive Committee had noted with great regret the death in 1981, of Dr. G. Böhnecke, the first Secretary of SCOR. In addition, attention was drawn to the deaths of Dr. M. Uda who had been instrumental in the organization of the JOA in Tokyo, and of Dr. K. Sugawara who had played a major role in the SCOR/ICES Nutrient Intercalibration Experiment (1969).

The President welcomed participants to the General Meeting and noted with pleasure the unusually large number of National Delegates who were present. He also noted that this occasion was, in fact, the twenty-fifth anniversary of SCOR, the first meeting having been held in Woods Hole in August, 1957.

Professor Simpson reported on some SCOR activities since the Fifteenth General Meeting. Two volumes of *SCOR Proceedings* and a Handbook have been issued. He remarked upon his visits to the IOC and UNESCO Division of Marine Science which have resulted in closer ties between SCOR and these organizations. One full meeting of the SCOR Executive Committee was held in April, 1981 and the officers (President, Secretary and Executive Secretary) met in February, 1982 to conduct routine business. Reports of these meetings had been widely distributed.

1.0 ORGANIZATION AND FINANCE

1.1 MEMBERSHIP

National Members:

Egypt has formed a National Committee for SCOR and has become a SCOR member in Category I as of January 1, 1982. Egypt will be represented by Dr. A.R. Bayoumi, Dr. A.A. Latiff and Dr. S. El-Sayed Selim.

The Canadian National Committee for SCOR has changed its category of adherence from III to IV, effective January 1982.

The Executive Secretary reported the following changes in Nominated Members:

Australia; Dr. J.S. Bunt, Dr. A.D. McEwan, and Prof. J.S. Turner.

Brazil; R.Adm. V.L. de Figueiredo, Prof. J.L. Martins, and Prof. P. Moreira.

India; Dr. R. Sen Gupta, Dr. V.V. Sastri, Dr. B.L.K. Somayajulu.

Japan; Prof. T. Kawasaki replaces Dr. Y. Toba.

Poland; Prof. J. Dera replaces Prof. S. Szymborski.

South Africa; Prof. J. Field replaces Mr. J.P. de Wit.

Turkey; Prof. K. Kafali replaces Dr. H. Oranc.

The question of the membership of the People's Republic of China in SCOR will not be resolved until after the ICSU General Assembly in September, 1982. At this meeting the topic of Chinese membership in ICSU will be debated.

Affiliated Member:

Professor Pierre Lasserre replaced Professor T.R. Parsons as President of IABO at an IABO General Meeting held in Halifax on August 5. Dr. A.D. McIntyre became Secretary of IABO on the same occasion.

Organizational Members:

IUB and IUPAB have informed SCOR that they will no longer be represented.

1.2 PUBLICATIONS

The Publications Officer, Professor H. Charnock, reported on the status of publications arising from SCOR activities. He expressed appreciation to the staff of UNESCO for their assistance in producing the following documents:

i) UNESCO Technical Papers in Marine Science

No. 32, *Guidelines for research on coastal lagoons.* Report of a seminar sponsored by UNESCO/IABO/Duke University, September 1978, published in 1981.

No. 33, *Coastal lagoons : present and future research.* Proceedings of a seminar sponsored by UNESCO/IABO/Duke University, September 1978, published in 1981.

No. 34, *The carbon budget of the ocean.* Report of a meeting of WG 62, November 1979. Published December 1980.

No. 35, *Determination of chlorophyll in seawater* is a report of inter-calibration tests sponsored by SCOR and carried out by C.J. Lorenzen and S.W. Jeffrey, September-October 1978. Published December 1980.

No. 36, *Tenth report of the joint panel on oceanographic tables and standards*. 1981.

No. 37, *Background papers and supporting data on the International Equation of State of Seawater*. 1981.

No. 38, *Background papers and supporting data on the Practical Salinity Scale 1978*. 1981.

No. 39, *International Oceanographic Tables, Vol. 3. 1981.*

No. 41, Report and recommendations of the November 1979 meeting of WG 44, *Ocean-Atmosphere Materials Exchange*. Published in 1982.

Future issues:

No. 40, *International Oceanographic Tables, Vol. 4.*

The possibility of reprinting some issues of this series which are now unavailable will be discussed between representatives of SCOR and UNESCO.

ii) UNESCO Monographs on Oceanographic Methodology

No. 7, *Mathematical Models in Biological Oceanography* arises from the activities of WG 59. Published in 1981. This monograph is also being translated into Russian by UNESCO.

Future issues:

Mangrove ecosystem research methods. This monograph arises from the work of WG 60 and the final manuscript is expected to be submitted to UNESCO in summer 1982.

iii) IOC Workshop Report Series

The following issues have been published:

No. 27, *CCOP SOPAC-IOC Second International Workshop on Geology, Mineral Resources and Geophysics of the South Pacific*, Nouméa, 9-15 October 1980.

No. 28, *Workshop on the Effects of Environmental Variation on the Survival of Larval Pelagic Fishes*, Lima, 20 April - 5 May 1980.

No. 29, *WESTPAC Workshop on Marine Biological Methodology.*

No. 30, *International Workshop on Marine Pollution in the Southwest Atlantic.*

iv) Other UNESCO/IOC Publications

River Inputs to Ocean Systems, papers presented at the IOC workshop, March 1979. Published in 1981. This volume has been printed for IOC by UNEP.

Bibliography on Mangrove Research. Published in 1981.

v) Other Publications Arising from SCOR Activities

Assault on the largest unknown - the International Indian Ocean Expedition 1956-1965 by Daniel Behrman: English version published. Translation into Russian, Spanish, Arabic and French is being considered.

The following CCCO publications in the JSC "White Cover" Series which have not previously been recorded by SCOR were brought to the attention of the Secretariat:

CCCO/JSC - Meeting on the Coordination of Plans for future Satellite Observing Systems and Ocean Experiments to be organized within the WCRP, January 1981 (WCP-8).

CCCO/JSC - Time Series of Ocean Measurements, Meeting Report, Tokyo, May 1981 (WCP-11).

CCCO/JSC - Time Series of Ocean Measurements. (Papers edited by D. Ellett). Tokyo, May 1981 (WCP-21).

CCCO/JSC - Study Conference on Large-Scale Oceanographic Experiments in the WCRP. Report in preparation for release in late 1982.

CCCO/JSC - Study Conference on Large-Scale Oceanographic Experiments in the WCRP. Presented Papers. In preparation for release in mid-1983.

CCCO/JSC - Feasibility Study-Atlantic Ocean Heat Flux Experiment (CAGE). Released July, 1982 (WCO-22).

Professor Lasserre reported that the *Proceedings of the UNESCO/SCOR International Symposium on Coastal Lagoons* (Bordeaux, 1981) will be published in *Oceanologia Acta.* This volume is in press and will be available for sale in late 1982.

Other publications arising from the activities of SCOR working groups were discussed under subsequent agenda items.

The role of the Publications Officer was discussed by the Executive Committee. It was agreed that he should be kept informed by Chairmen of Working Groups of their plans for publications and that any manuscript being submitted for publication in an unrefereed series (eg. UNESCO publications) should first be sent to the Publications Officer who will in turn submit it to the publishing agency. The Publications Officer will ensure that the manuscript is presented in the appropriate format for the series in question. The Executive Secretary will inform all Chairmen of this procedure.

1.3 FINANCE

The final financial statement for 1981 is given in Annex III. The Executive Committee had appointed an *ad hoc* Finance Committee consisting of Professor R.I. Currie (Chairman) and Dr. J.H. Steele. This committee consulted with the Executive Secretary and examined the financial records of SCOR in preparing the following report which was presented to the General Meeting by Professor Currie:

The Finance Committee had before them the audited statement of income and expenditures for the year ended 31st December, 1981 and recommend this to the General Meeting for acceptance. The accumulated balance as at 31st December, 1981 ($56,657) showed a small decrease over that at 1st January, 1981 ($58,552).

The Committee also examined the statement of current expenditures for the six months from January 1 to June 30, 1982 and the estimate for the remainder of 1982. A number of variations from the original budget for 1982, were noted, some from new contracts for specific purposes, but mostly arising from delays or postponement of working group meetings and the inevitable escalation of costs.

The committee were satisfied, however, that the planned programme of work could be accomplished. Nevertheless, it was clear that there would be an appreciable drop in reserves by the end of the year and the balance anticipated was estimated at $45,000. In view of the inevitable delays in recovering income it was considered by the committee that a balance of this order was the minimum with which it was prudent to enter the new financial year.

The committee then drew up a draft budget for 1983 taking into account anticipated income and the expenditure associated with the proposed activities. Although eleven working groups have been disbanded and by assigning the minimum allocations to activities, the cost of the planned direct scientific activities, WG's, etc. is estimated to be $105,500, 56% of the anticipated budget. (It was 44% in 1981.) The CCCO accounts for more than one quarter of this. Administration will amount to 18%, (the increase, largely because of increased postage costs) and other activities, publications etc., 13%. This would leave a balance of $15,000 at the end of the 1983 fiscal year. No provision has been made for any new UNESCO contract which may be acquired particularly for WG 65 and WG 70 expenses.

Furthermore, it should be noted that arrears in National Contributions continue to represent a problem. Two countries, for example, Spain and Colombia are now 5 years in arrears.

The committee are of the view that if present plans are to be fulfilled and adequate provision is to be made for commencing activities in 1984, then an increase in the level of National Contributions of the order of 12% should be sought.

This report was accepted by the General Meeting. The President endorsed the recommendation of the Finance Committee for a 12% increase in National Contributions on January 1, 1983, and noted that many other international organizations have adopted similar increases. The meeting approved this recommendation.

1.4 ELECTION OF OFFICERS

The President noted that the terms of the Secretary and Vice-Presidents were all due to expire at the General Meeting, although all incumbents were eligible for re-election. A Nominating Committee consisting of Dr. R. Stewart (Chairman), Dr. K.H. Mann and Dr. J. van der Land was established by the Executive Committee at its meeting.This committee reported to the General Meeting that it would be desirable to attempt to avoid a large change of the Executive Committee (as had occurred in 1980) at the next General Meeting. To this end, it presented the following nominations:

Secretary:	Dr. A.R. Longhurst
Vice-Presidents:	Dr. R. Chesselet
	Prof. G. Siedler
	Dr. T. Wolff.

The report of the Nominating Committee was unanimously approved. The President expressed thanks, on behalf of SCOR to Professor H. Charnock for his many services to SCOR as Secretary and, latterly as Vice-President. He also extended thanks to Dr. W.W. Hay who retired as a co-opted member of the Executive Committee of SCOR having discharged his special responsibility for the organization of the scientific programme of the JOA. The Executive Committee subsequently agreed to co-opt Professor Charnock to the Executive Committee with special responsibilities as Publications Officer.

1.5 WORKING PROCEDURES OF SCOR

At its twenty-third meeting (April, 1981), the Executive Committee had agreed that a revision of the "*Objectives and Procedures*" for SCOR Working Groups was required. A preliminary draft was prepared by the Executive Secretary and circulated to all Chairmen of working groups for comment. These comments were discussed by the Executive Committee at some length and a summary of the substantial points raised was presented to the General Meeting by Dr. Longhurst. Some amendments to the text which had been distributed were approved and it was agreed that Dr. Longhurst would edit the document further without making substantive changes. The final version of "*Objectives and Procedures*" for SCOR Working Groups is given as Annex IV and will be circulated separately to all Chairmen of Working Groups. In general, the changes which were approved are expected to make working groups more effective by limiting their existence to a six year period, but giving them better defined tasks to accomplish. There was a wide consensus that "open ended" working groups must be avoided and that the importance of working group meetings should be emphasized. A working group meeting should be a significant event in the group's plan of activities in order that SCOR funds can be most effectively utilized. Approval will not usually be given for more than one meeting of a working group in any two year period.

The question of whether the publication of reports of SCOR working groups should automatically imply SCOR approval of the contents of these reports or any recommendations put forward, gave rise to a detailed discussion.

It was generally agreed that such reports should have SCOR approval since they have usually been presented at a SCOR business meeting or to the appropriate Executive Committee Reporter. The appropriate Section (10.2) of the "*Objectives and Procedures*" was amended as given in Annex IV.

2.0 SUBSIDIARY BODIES

2.1 ARISING FROM FORMER WORKING GROUPS

It is hoped that the final report of SCOR WG 36, which will be a volume entitled "*Physical Aspects of Coastal Upwelling*" will be published during 1983. The volume is now being edited by Professor R.L. Smith who has received most of the manuscripts and they will be published together as an issue of "*Progress in Oceanography*".

2.2 EXISTING WORKING GROUPS

WG 34, *Internal Dynamics of the Ocean*

Professor Charnock reported that WG 34 had met on August 1 and 2 in Halifax. The meeting received a report from the Chairman on the status of the book "*Eddies in Marine Science*", together with a final contents list. The bulk of the material had been with the publisher for some months and was at an advanced stage. The remaining three sections would be available shortly; publication was expected about the end of 1982.

Taking into account the earlier drafts of chapters for the "*Eddies in Marine Science*" volume, together with related material being prepared elsewhere, the group had a full discussion of the status of eddy science and prepared a paper summarizing their view on desirable future developments. It is hoped that this paper (which is given in Annex V) will be of use to SCOR and to others concerned with the incorporation of the effects of eddies and similar smaller-scale motions into numerical models of the ocean.

After careful consideration of Section 5 of the paper the Working Group wished to recommend that SCOR establish a Working Group on Data Assimilation in Ocean Models. The Executive Secretary will obtain a proposal for consideration at the next meeting of the Executive Committee.

Section 2 of the paper emphasizes the probable need, in some years time, for an observational study of eddy-mean field interactions which could appropriately be made in the region of the Gulf Stream and its extension region. The Working Group foresees a possible need for SCOR support of such a project, perhaps by creation of a new Working Group to plan and coordinate the work. It was agreed that this recommendation should be forwarded to WG 68 for consideration.

With the publication of the book and the preparation of the paper on future directions the immediate objectives of the group have been accomplished. Observational, theoretical and computational work on ocean eddies and other aspects of the internal dynamics of the ocean will continue but a large majority of the Working Group considered that the initial phase of their work has been completed and it was agreed that the Working Group be discharged. As this seemed likely to be the final meeting, the Working Group wished to record its thanks to the Chairman for his considerable contribution to their work.

WG 42, *Pollution of the Baltic*

Dr. Wolff reported on a meeting of WG 42 held in early 1982. The full report is available from the Executive Secretary or from ICES. Amongst other items discussed were: the unusually low oxygen concentrations found in certain areas of the Baltic during the autumn of 1981; the patchiness of physical, chemical and biological parameters in the Baltic and the definition of major elements of pilot studies related to small-scale variability in these parameters as well as to variability with time; the biogeochemical cycling of selected substances and related modelling activities; fluxes of several significant substances including some pollutants; the relationship between biological productivity and the CO_2 cycle; biological effects studies; and a request from ICES for the group to develop a plan for a research programme on sediments and sediment-water exchange. The progress with summaries of the results of the 1977 Baltic Open Sea Experiment was reviewed and it was recommended that these summaries be published by ICES.

Lastly, the group discussed the work of the ICES WG on Marine Pollution Baseline and Monitoring Studies in the North Atlantic and its proposal to carry out, in 1983, a baseline survey of contaminant levels in fish and shellfish over a wide area. WG 42 considered a proposal to coordinate this with a similar study in the Baltic Sea and agreed to implement such a study provided that it is postponed to 1984 or later and that it emphasizes cod and herring and is limited to certain contaminants.

The Executive Commitee had approved a request from WG 42 for a meeting in Tallinn in early 1983. This meeting will follow a two day workshop on patchiness in the Baltic Sea which will be convened by Dr. B. Dybern.

In view of the long-term plan activities for WG 42 and its purely regional nature, the Executive Committee had considered whether continued SCOR sponsorship of the group was appropriate. This question was discussed in Halifax with Professor G. Hempel, the President of ICES, and he reminded the General Meeting that WG 42 had been cosponsored by SCOR and ICES partly because at the time of its establishment one of the major countries concerned was not a member of ICES. His proposal that SCOR continue its sponsorship of WG 42 until after the report of the Tallinn meeting was approved.

WG 44, *Ocean-Atmosphere Materials Exchange*

The Excutive Committee had considered a report from the Chairman of WG 44 which reviewed recent WG 44 activities in particular the plans for a JOA symposium. The papers presented were expected to review recent work, taking into account the recommendations issued by WG 44 at its meeting in November, 1979. Data from several national and international programmes were to be evaluated. The symposium plans also included a paper in a new and rapidly developing field, the photochemistry of the air/sea interface.

While WG 44 has not been particularly active since its 1979 meeting, the Chairman's report noted the strong interactions between members of the group in other activities related to OAMEX. The report did, however, recommend a substantial revision of the membership of WG 44 and the appointment of a new Chairman.

The Executive Committee Reporter for WG 44, Dr. W. Godson, expressed the opinion that this group would have special significance in the near future in view of the growing international concern over problems related to acid rain. There was agreement that this group should be urged to become more active. Dr. Siedler met with the Chairman, Dr. Chesselet during the first week of the JOA to determine whether the proposal from the F.R.G. National Committee for a new WG on marine photochemistry might be incorporated into the revision of the terms of reference of WG 44.

Following these discussions, and a meeting of WG 44 which took place during the JOA, the General Meeting agreed to reconstitute WG 44 with the following title, terms of reference and membership:

"*The Ocean as a Source and Sink for Atmospheric Constituents*"

To review present knowledge of processes and measurements related to:

1. the flux of gases and particles across the air/sea interface.
2. photochemical processes at the air/sea interface.
3. microbiological processes at the air/sea interface.

Proposed membership:

Chairman:	Professor W. Seiler	F.R.G.
Members:	O. Zafiriou	U.S.A.
	P. Liss	U.K.
	S. Tsyban	U.S.S.R.
	M. Andreae	U.S.A.
	R. Duce	U.S.A.
	R. Chesselet	France
	S. Wofsy	U.S.A.

This group will begin its work by correspondence and should submit a detailed report on its achievements and planned activities for careful review at the next General Meeting. The second term of reference was considered to obviate the need for discussion of the F.R.G. proposal for a new working group on marine photochemistry.

It was agreed that the revisions to WG 44 which had been approved by the General Meeting were substantial enough to warrant the assignment of a new number and WG 44 was reconstituted as WG 72.

WG 46, *River Inputs to Ocean Systems*

Professor Postma, the Executive Committee Reporter for WG 46, reported on the plans of the group for a meeting in late 1982. The membership of WG 46 had been revised following the approval of new terms of reference in 1980.

The group now plans to meet in conjunction with a Workshop on "Estuarine Processes: an Application to the Tagus River" being organized by UNDP in Lisbon on December 13-16, 1982. Professor Postma recommended approval of these plans, especially in view of the savings to be recognized since several members of WG 46 have been invited to participate in the Workshop. He also urged SCOR to continue its efforts to avoid duplication of the activities of WG 46 and those of SCOPE in its programme Chemical Chamges in the Coastal Zone. The representatives of UNESCO and IOC reiterated the interests of their organizations in the work of WG 46. It was suggested that the group should prepare a final report after its meeting in Lisbon. The scope of this report might necessitate the continuation of the group for some time during its preparation, but no further meetings of WG 46 were approved.

WG 47, *Oceanographic Programmes During FGGE*

A brief final report from the Chairman of the Working Group on Oceanographic Programmes during FGGE was received soon after the publication of the report of WG 47's final meeting which was held in April, 1981. This report was entitled "*Recent Progress in Equatorial Oceanography*" and was printed by NOAA and Nova University in December, 1981. WG 47 was officially disbanded by the General Meeting.

WG 51, *Evaluation of CTD Data*

An informal meeting of some of the members of WG 51 was held during the JOA. The Chairman has received a number of contributions for a methodological handbook for CTD users which would be suitable for publication in the *UNESCO Technical Papers in Marine Science*. A volume of related algorithms is ready for publication in the same series. Dr. Charnock recommended that WG 51 be urged to proceed with these publications as quickly as possible and that the group could then be disbanded at the next meeting of the Executive Committee.

WG 52, *Estimation of Micro-nekton Abundance*

A series of papers arising from a workshop organized by WG 52 have been reviewed and will be published in the *Biological Oceanography Journal*. In response to a question raised by a participant from Chile, Dr. Stuardo, the Chairman of WG 52 noted that an extensive section at the beginning of the volume will deal with methods and recommendations of the group. The General Meeting approved the termination of WG 52.

WG 54, *Southern Ocean Ecosystems and their Living Resources*

A report on the SCOR/SCAR working group on Southern Ocean Ecosystems and their Living Resources was submitted by Professor El-Sayed and was summarized at the Executive Committee Meeting by the WG 54 Executive Committee Reporter, Dr. Wolff. This report is given in Annex VI. As a follow-up to the First International BIOMASS Experiment (see *SCOR Proceedings, Vol. 17:2)*, a post-FIBEX Data Interpretation Workshop was held in Hamburg in late 1981. The workshop was particularly significant in that scientists from 12 countries involved in BIOMASS met to share unpublished data from the FIBEX cruises in an attempt to jointly analyze physical, chemical, hydro-acoustic and biological data using an advanced computer system. A small scientific advisory group was formed to begin planning for SIBEX and to recommend the action required in order to fully exploit FIBEX data.

WG 54 met in Nikko, Japan in the spring of 1982. BIOMASS priorities were reviewed and the following key topics for investigation were restated: growth and mortality in different areas; spawning success and recruitment mechanisms; stock separation and migration patterns; krill survival in and underneath the ice. The primary objective of SIBEX will be to obtain a deeper understanding of the dynamics of the krill-dominated parts of the Southern Ocean ecosystem. Special attention will be devoted to questions related to the pack ice.

The Scientific Advisory Group for SIBEX has recommended that research during SIBEX be concentrated on the study of mesoscale processes in the Southern Ocean. It was suggested that this could best be done by multi-ship operations in certain selected areas to study the interactions and processes within the ecosystem over all seasons, with particular emphasis on early spring and winter.

The problems of management of BIOMASS data were discussed and it was concluded that the establishment of a BIOMASS Data Centre is critical for the success of the Programme. A small *ad hoc* committee was set up to investigate the possibility of the establishment of a centre and the related data management problems and to report to WG 54 before the end of 1982.

A BIOMASS Executive group was established in order to provide more rapid and effective advice on BIOMASS affairs as the structure of the group has become quite complex. The membership of WG 54 was not changed and the three Technical Groups were retained (Programme Implementation and Coordination; Methods and Data Management and Ecosystems Analysis), although their terms of reference were revised. Five Working Parties were established or reconstituted (a Working Party each on Bird Ecology, Fish Ecology, Krill Ecology, Pack Ice Zone Studies and Acoustics). Short term *ad hoc* groups were established on Squid Ecology, Modelling and Scientific Planning for SIBEX.

Plans for 1983 activities were finalized and include several workshops and symposia as well as meetings of SIBEX Chief Scientists and a meeting of the BIOMASS Executive.

In response to a question on the relationship between the proposed BIOMASS Data Centre and the one which is proposed by the Commission on Antarctic Marine Living Resources, the Chairman of WG 54, Dr. El-Sayed, stated that their respective roles are not yet clear but that every effort will be made to facilitate cooperation between the two centres if this is feasible.

The representative of SCAR remarked that SCAR has not yet established formal relations with the Commission on Antarctic Marine Living Resources since the rules of procedure for this organization have not yet been decided, however, SCAR has expressed its wish to be represented at all meetings of the Scientific Committee of the Commission. Mr. Hemmen suggested that SCOR might wish to follow this course of action as well but recommended that an observer represent SCOR at the next meeting of the Scientific Committee of the Commission.

Dr. Ruivo noted the involvement of the IOC through its Working Committee on IODE in the establishment of a BIOMASS Data Centre. He reminded those present of the meeting of the IOC Programme Group for the Southern Ocean which is to be held in Paris in March, 1983. This group will invite discussion of many ongoing activities in the Southern Ocean and SCOR representation at this meeting would be most desirable.

It was pointed out that the introduction of a limited life span for working groups (c.f. item 1.5) might lead to the termination of WG 54 before its activities have been completed. Mr. Hemmen reminded SCOR that in any case, the BIOMASS programme, as presently conceived, will be completed in 1986 and discussions regarding subsequent programmes will then be necessary.

Sir George Deacon appealed to WG 54, and similar groups working in the Southern Ocean to place a greater emphasis on interdisciplinary activities in this region.

WG 55, *Prediction of El Niño*

A meeting of the working group on Prediction of El Niño is planned for September, 1982. It is anticipated that this meeting will lead to recommendations on parameters needing observation (and in what areas) in order that the most promising prediction schemes may be routinely used. The Executive Committee was of the opinion that this should be the final meeting of WG 55 unless a clear need for its continuation can be established by the group or by CCCO, and this opinion was supported by the General Meeting.

WG 56, *Equatorial Upwelling Processes*

A report from WG 56 was discussed by the Executive Committee. A meeting of WG 56 originally planned for late 1982, had been brought forward so that it could be held in conjunction with the "Gulf of Guinea Days" in June. This plan was cancelled when most members were unable to attend. The WG has identified a need for publication of an evaluation of our knowledge of the process of equatorial upwelling prior to the undertaking its third term of reference, the recommendation of future multi-disciplinary approaches to problems of equatorial upwelling. The group will, therefore, work by correspondence to prepare a critical review of recent papers in the field, and proposes to hold a workshop in late 1983 or early 1984. The aim of this workshop would be the production of a detailed report. At the request of WG 56, an invitation to join the group had been extended to Dr. Fomin (USSR). It has not been accepted and a suitable replacement for Dr. Hughes has yet to be identified.

WG 57, *Coastal and Estuarine Regimes*

The working group on Coastal and Estuarine Regimes has been collaborating with the AGU in the production of a series of monographs on coastal problems. The first volume has been published and schedules for the preparation of others have been established. The Executive Committee took note of the "Summary notes on Open Lateral Boundary Problems in Oceanography" which had been prepared by WG 57, but it was felt that the investigation of boundary problems did not clearly fall within the group's terms of reference. The representative of UNESCO (a cosponsor of WG 57) urged that groups such as WG 57 attempt to tailor their output somewhat more closely to UNESCO's needs, probably through closer liaison with the Division of Marine Science. The UNESCO/SCOR Consultative Panel on Coastal Systems has concurred with the WG 57's suggestion that its next meeting (Hamburg, August 1983) be its last, but has stated that a need exists for a new group to work specifically on the physical oceanography of coastal areas. Dr. Krause was invited to discuss this with Professor Postma and to make recommendations on the matter to the next meeting of the SCOR Executive Committee, at which time WG 57 will probably be disbanded.

WG 58, *Arctic Ocean Heat Budget*

The Executive Committee concurred with a request received from the Chairman of WG 58 ("Arctic Ocean Heat Budget") that the group remain in existence in order that recommendations for future action may be formulated for presentation to the next SCOR Executive Committee meeting. Since CCCO has decided to rely on WG 58 and not to form its own Panel on Arctic Ice, it may be appropriate, as has been suggested, to include ice dynamics and modelling in WG 58's terms of reference. A firm proposal from the group will be expected in 1983.

WG 59, *Mathematical Models in Biological Oceanography*

At the Executive Committee Meeting, Professor Parsons reviewed the recent activities of WG 59, including the publication of a monograph on "Mathematical Models in Biological Oceanography" and the organization of a very successful symposium on "Flows of Energy and Materials in Marine Ecosystems : Theory and Practice". A brief report from the convenor of this meeting appears as Annex VII. The volume resulting from this meeting will be published by Plenum Press. A meeting of WG 59 was also held in conjunction with the symposium and several recommendations were presented in the report from the Chairman. The first proposed that a workshop be convened to consider new developments in community-level ecological theory and on how biological sampling programmes could be initiated or amended in order to test selected hypotheses. The second recommendation of WG 59 involved the consideration of opportunities for the development of international collaborative experiments and/or new technology to yield data about ecosystem-level events. Finally, WG 59 wished to continue to play a role in encouraging dialogue and collaboration between physical and biological oceanographers in preparation for large-scale international experiments.

The Executive Committee welcomed the recommendation of WG 59 but noted that the proposed new activities of the group required changes in its terms of reference and title. Dr. Parsons conferred with the Chairman and presented the proposals given below to the General Meeting.

1 - That the title of Working Group 59 should be changed to "*Ecological Theory in Relation to Biological Oceanography*"

2 - That the terms of reference be amended to read:

To consider recent developments in community-level ecological theory and their application to biological oceanography.

To make recommendations on the way in which biological oceanographic sampling might be initiated or amended to provide evidence for testing selected hypotheses, including recommendations for developing new technology.

To initiate discussions with physical oceanographers on the need for joint work on ecosystem-level events and to recommend international collaborative experiments that could advance our understanding of ecosystem function in the marine environment.

To work with senior officials of SCOR and IABO to foster a spirit of cohesiveness among biological oceanographers so that they can present a common front when discussing major experiments with physical oceanographers.

3 - That the opportunity be taken to make changes in membership of WG 59 to reflect changes in the terms of reference.

4 - That WG 59 be granted financial support in 1983 for a meeting on community level ecological theory, as described in the report of the Chairman.

These proposals were approved and it was agreed that, in view of the extent of the changes, that WG 59 be disbanded and reconstituted as WG 73.

WG 60, *Mangrove Ecosystems*

The Executive Committee Reporter, Dr. Torben Wolff, noted that the Mangrove Ecosystems Working Group appears to have fulfilled its obligations. The handbook on *Mangrove Research Methodology* will be finalized at a meeting of the group in Halifax and will be published as the next issue in the series *UNESCO Monographs in Oceanographic Methodology*. *The Inventory of Mangrove Forest Lands* which was to have appeared as a single volume will now be published as a series of separate journal articles. The Executive Committee recommended the termination of WG 60 by the General Meeting, but wished to encourage the formation of an international mangrove association which had been approved at the IABO General Meeting on August 5.

It was agreed that WG 60 should be disbanded pending receipt of a final report which should include references to the various articles arising from the work of the group which have been published in the scientific literature. Concern was expressed about the continual reduction (by about 10% per year) of the extent of mangrove forests due to development. It was hoped that the new association might work with IUCN and appropriate international agencies to combat this trend and to encourage rehabilitation of mangrove lands.

WG 61, *Sedimentation Processes at Continental Margins*

The Working Group on Sedimentation Processes at Continental Margins presented a symposium at JOA which was followed by a meeting of the group. It is expected that this meeting will yield a series of recommendations for future work in the field. WG 61 will publish a volume of *Progress in Oceanography* consisting of the papers given at the JOA symposium and other contributions. It was agreed that WG 61 remain in existence during this editing process and that it will be disbanded at the next meeting of the Executive Committee in 1983. The recommendations of the group will be published in the *SCOR Proceedings* which arises from that meeting.

WG 62, *Carbon Budget of the Oceans*

This group has been inactive since the publication of its report in the *UNESCO Technical Papers in Marine Science* in 1980. In view of proposals for new working groups in related areas and of the expressed wish of the Chairman, it was agreed to disband WG 62.

WG 63, *Marine Geochronological Methods*

The Chairman, Dr. W.W. Hay reported that WG 63 had met in Boulder, Colorado in September, 1981 for discussions and to organize a symposium for the JOA.

Several of the WG members had attended other relevant meetings in recent months, notably "Quo Vadis Stratigraphy?", organized by Eugen Seibold and held in Bad Honeff in February, 1982, and the Geological Society's (London) symposium on revision of the geologic time scale, held in May in London.

Since papers prepared by members of the WG will appear in several other symposium volumes, it is not feasible for the JOA symposium to be published as a unit. Papers from the symposium will be submitted to appropriate journals, and the final report of the WG will include a bibliography.

The WG met after the symposium at the JOA, and may submit to SCOR a proposal for the formation of another WG with more focussed terms of reference to examine a particular aspect of marine stratigraphy or geochronology. A final report with recommendations from WG 63 will be presented to the next meeting of the Executive Commitee. The WG was disbanded by the General Meeting.

WG 64, *Oceanic Atoll Drilling*

A symposium was presented at the 1980 meeting of the Geological Society of America. The papers given on this occasion are appearing in the scientific literature. The Executive Secretary will ask WG 64 to submit a final report to SCOR which should include references to the various journal articles arising from its symposium. The Executive Committee suggested that the group be disbanded at the General Meeting. Dr. Hsü, the Reporter for WG 64, emphasized that while there is reduced financial support for very deep atoll drilling projects, there is a great deal of information to be obtained from more modest drilling projects on atolls and reefs. This information may be particularly useful to UNESCO in its coral reef programmes and it may be appropriate to pursue this topic in more detail in the near future. WG 64 was disbanded by the General Meeting.

WG 65, *Coastal - Offshore Ecosystems Relationships*

Since its first meeting in Bordeaux in September 1981, of which a full report was prepared and forwarded to SCOR and UNESCO, the group proceeded to work by correspondence. An exchange was started of documented accounts on the issues considered for some selected onshore-offshore situations, familiar to the members of the group. Together with literature information, it was expected that these accounts should enable the WG to make generalizations about coastal-offshore relationships and to identify common problems.

At present the WG is trying to identify some principal questions, relevant to its terms of reference, to be addressed for each well studied coastal-offshore situation. Such principal questions might concern the nutrient exchange between coastal and offshore ecosystems, the question of whether coastal ecosystems act as a source or a sink for organic material and, whether coastal areas have special functions as nurseries or spawning grounds for offshore species.

In his report the Chairman of WG 65 noted that the group felt it lacked expertise on tropical ecosystems such as mangrove areas. Moreover, the group wanted additional support on the hydrodynamic aspects of import/export problems. It therefore advocated an extension of the WG by two extra members. For expertise on tropical ecosystems the Chairman of WG 60 had been approached, and had indicated his willingness to assist, either personally or through one of the members of his group. For expertise on the hydrodynamic aspects, the Working Group proposed to try to recruit Professor B.J. Kjerve (University of South Carolina), who has a long experience on coastal processes.

In its first report, WG 65 had proposed, in an attempt to make up for its lack of experience on tropical systems, to have its second meeting in conjunction with the UNESCO Workshop on mangroves, etc. held on the Virgin Islands in May, 1982. However, this opportunity was considered to be less desirable for various reasons by UNESCO, and the group suggested that an alternative meeting place could be found in Puerto Rico, where groups active in studying tropical-subtropical coastal ecosystems are present. A suitable period for the meeting would be late winter-early spring of 1983, but firm arrangements, both about the actual venue and dates of the meeting, were still to be made. The meeting would be devoted to:

1. - Addressing agreed principle questions, formulated in advance of the meeting by correspondence, generalizing from case-studies and reviewing our knowledge and formulating common problems and gaps in our knowledge.
2. - Discuss the organization of a workshop, designed to concentrate on the problem fields and questions identified.

The Executive Committee agreed with the opinion expressed by Dr. Parsons that WG 65 appears to be digressing from its original terms of reference especially in its detailed attention to specific case studies of coastal systems. It was felt that the group should be encouraged to focus more on the general problems common to all coastal systems. The Executive Committee approved the addition of a hydrodynamics expert to the group, but could not support the need to add a mangrove specialist. It was also felt that the group should be asked to meet in Europe in view of the savings to be obtained by this.

These recommendations received support at the General Meeting. It was agreed that WG 65 should proceed to investigate the problems of coastal-offshore ecosystems in a more general sense especially since a number of specialized areas have already been studied by other working groups (mangroves, coral reefs, lagoons, etc.).

WG 66, *Oceanographic Applications of Drifting Buoys*

The working group on Oceanographic Applications of Drifting Buoys submitted a report which indicated that it has not been very active owing to other obligations of its Chairman. It has, however, completed a bibliography on the use of drifting buoys since 1972 and WG 66 has been represented by the Chairman at a number of meetings (CCCO, ARGOS Joint Tariff Negotiations and IOC/SCOR/ECOR Consultative Meetings on Drifting Buoys).

The immediate concern of the Executive Committee was that the IOC request for a report to its Twelfth Assembly be fulfilled. The Chairman was consulted and agreed to draft a report for submission to the IOC. He was to chair the Second IOC/SCOR/ECOR Consultative Meeting on Drifting Buoys in Sidney, B.C. in September, 1982 and agreed to remain as Chairman of WG 66 until after this meeting and the IOC Assembly in November.

The Executive Committee Reporter, Dr. Siedler, reported to the General Meeting on his discussions with the Chairman and other members of WG 66 present in Halifax. Dr. George Cresswell agreed to become Chairman of the group in late 1982 and this change was approved by the General Meeting. The following new terms of reference for WG 66 were also approved:

1 - Review and summarize technological and scientific programmes in the use of drifting buoys.

2 - Identify the technological problems with the highest priority for further investigation.

3 - Identify opportunities for coordination of experimental programmes using drifting buoys, and recommend mechanisms for coordination.

4 - Prepare to respond to the needs of other agencies, either by providing advice as requested, or by identifying and recommending more appropriate avenues.

5 - To consider methods for archiving and the international exchange of drifting buoys.

WG 66, will meet in April or May of 1983 to begin work on its new terms of reference.

WG 67, *Oceanography, Marine Ecology and Living Resources*

The draft report on Ocean Science and Living Resources prepared by WG 67 for submission to the IOC after the JOA was introduced by the Secretary and was available to participants at the SCOR General Meeting. It is given in full as Annex VIII. It was prepared in response to a request from the IOC for assistance in the planning of a major programme on "Oceanographic studies of the marine ecological conditions in relation to fish stocks". In summary the report of WG 67 recommends:

> That a set of experiments collectively called the International Recruitment Experiment (IREX) is proposed to investigate the relationships between environmental variability and fluctuations of living resources.
>
> That a separate working group be set up to determine the feasibility of IREX application to high diversity ecosystems.
>
> The Committee on Climatic Chamges and the Ocean (CCCO) support the IREX activities through Time Series Study Group of the Biology Panel.

The Secretary reported that the document emphasizes the variable recruitment found in fish stocks as mediated by environmental variability. While it is generally agreed that this can best be studied in a single fish stock over a long time-scale, time does not permit such lengthy investigations. Consequently, WG 67 has proposed in IREX, a set of comprehensive but unified experiments on a number of carefully selected fish stocks, mostly in the medium and high latitudes. The second recommendation of WG 67 applies to the multispecies fisheries of the low latitudes and asks for a separate study to establish whether the same hypotheses apply in tropical stocks where it is felt by some that inter-specific relations may be of greater importance than environmental variation.

The Executive Committee recognized that the recommendations made by WG 67 do not reflect all of the scientifically appropriate approaches to the problems of investigation of variability in stocks of living resources. In particular, proposals for long term monitoring projects were not thought to be feasible in view of the time constraints imposed by IOC Resolution XI.17. Some reservations as to the breadth of the WG 67 report were expressed, however, delegates to the General Meeting agreed that SCOR should express its willingness to cooperate with the IOC on future programmes related to OSLR should IOC request further advice from SCOR in this field. In the meantime, WG 67 has discharged its terms of reference and the General Meeting concurred with the recommendation of the Executive Committee that it be terminated. The Secretary agreed to transmit the various comments on the OSLR Report which were received at the Executive Committee and General Meetings to the IOC in his covering letter which will accompany the document.

WG 68, *North Atlantic Circulation*

The Working Group on North Atlantic Circulation held its first meeting in Miami in March, 1982. An informal meeting of those members of WG 68 who were present at the JOA was held in Halifax to discuss the question of water mass transformation in the North Atlantic. The members of the working group were also invited to comment on the oceanographic components of the CAGE experiment proposed by CCCO. The working group requested the approval of the Executive Committee for a meeting in Europe during 1983. It was suggested that the scheduling of this meeting in conjunction with the IUGG Assembly in Hamburg would yield considerable savings to SCOR. A full report of the first meeting of WG 68 appears as Annex IX.

WG 69, *Small-Scale Oceanic Turbulence*

The group started its work through correspondence in late 1981. There are presently several issues under discussion. One of them is a set of criteria (proposed by C. Gibson) to differentiate between fossil and active turbulence when dealing with the results of microstructure measurements in the ocean. Related to this issue are the problems of undersampling by the existing types of measuring devices and the question of real intermittency of active turbulent events in the ocean. There may also be a choice (recently suggested by J.D. Woods) for the group between dealing with the small-scale turbulence in the oceanic interior (pycnocline) and concentrating on turbulence in the upper ocean layer, as generated by atmospheric influence (wind and waves). It is clear, however, that the latter task would require a different set of members for the group. For that reason and also because at the start this choice had already been made in favour of the oceanic interior, the Chairman of the group intends to stick to the original terms of reference. The JOA gave an opportunity to have an informal discussion of these topics amongst the members of the group attending the Assembly. A meeting of the entire Working Group is being planned for early summer of 1983 in Halifax, an alternative being Hamburg in August 1983 during the IUGG Assembly.

WG 70, *Remote Measurement of the Oceans from Satellites*

A meeting of WG 70 was held in Halifax during the JOA. The group began to draft a report at this meeting and plans to assemble a completed version at a working meeting in March, 1983 and to hold its final meeting at the IUGG Assembly in August, 1983. The Executive Committee agreed that the group should be expanded to include scientists from the USSR and specific suggestions were made by the representative of ICSU at the General Meeting. It was agreed to amend the first term of reference for WG 70 to read as follows (addition underlined):

"To assess critically resolution and precision requirements for satellite instrumentation systems <u>and orbital requirements</u> to ensure adequacy of remotely sensed data for oceanographic tasks".

The respresentative of UNESCO, Dr. Krause, reiterated the interest of his agency in the work of WG 70 and agreed that UNESCO would cosponsor the working group. COSPAR has also confirmed its intention to cosponsor the group and to contribute towards the cost of its meeting.

2.3 COMMITTEES

SCOR/IOC Committee on Climatic Changes and the Ocean

A status report from CCCO appears as Annex X and the Chairman of CCCO, Professor Roger Revelle, presented a verbal report to the General Meeting.

The main activity of CCCO scheduled for 1982 was the Conference on Large-Scale Oceanographic Experiments in the WCRP which was held in Tokyo in May. This successful conference involved eighty-one oceanographers and meteorologists in the establishment of a scientific basis for an experimental research strategy and a review of critical experimental components of the proposed programme. Three major experiments were discussed in detail:

-World Ocean Circulation Experiment (WOCE) will lead to an understanding of very large-scale oceanic movements. This experiment will be critically dependent upon ocean scanning by satellites which are to be launched by various national and international agencies in the late 1980's. Through remote measurments of SST, wind stress and other parameters, it is hoped

that estimates of mean circulation will be obtained for the first time. In addition, other, more traditional, methods will be used to measure temperature, salinity and water measurements from ships. Professor Revelle stressed the importance of early planning for WOCE and reported that CCCO will be establishing a planning group for this purpose in the near future.

- Studies of meridional heat transport in the Atlantic (CAGE) and Pacific (PATHS) for which the rate of transport is not well understood and is known to flow in opposite directions in the two oceans. The experiments now appear to be quite feasible, but they will require extremely close cooperation between oceanographers and meteorologists for their ultimate success.
- The influence of the Tropical Oceans on Global Atmosphere (TOGA) will be assessed through a study of the phenomenon known as the Southern Oscillation in the three tropical oceans. The Southern Oscillation appears to have a significant influence on variations in the timing and intensity of such major climatic phenomena as the Indian Ocean monsoons, and is the most clearly established link between atmospheric and oceanic events.

Three subgroups have been established to carry out the planning for TOGA (a panel each for the Atlantic, Pacific and Indian Oceans). It is hoped that TOGA will provide more knowledge of the connections between oceanic events at low latitudes and certain climatological events at higher latitudes.

Another major task of CCCO in 1982 was the planning of an ocean monitoring programme. The major elements of this programme are given in the CCCO report in Annex X. The first element of this programme to be implemented will be a North Atlantic XBT programme. The Chairman of CCCO expressed the hope that many functions of ocean monitoring can be undertaken by the lesser developed countries, thereby affirming their involvement in the oceanographic component of the World Climate Research Programme for which the IOC is responsible.

CCCO is attempting to encourage the continuation of existing time series measurements and the establishment of new ones. CCCO and ICES have agreed to collaborate in the production of an annual newsletter for scientists involved in making time series measurements.

The third session of CCCO was held in Split in March 1982. The report of that meeting has been issued as document SCOR-IOC/CCCO - III/3. It was noted that a CCCO Steering Committee has been established to deal with administrative matters. An appeal to IOC Member States has been initiated in order to encourage financial support for CCCO. The Executive Committee accepted the nomination of Drs. H. Oeschger and A. McEwan and Mr. J. Barberan-Falcon to CCCO and also approved a plan for a rotational membership of CCCO. The Split meeting recognized that processes of ocean-sea ice interaction were significant for the world climate problem and had invited the WMO/CAS-JSC-CCCO Meeting of Experts on the Role of Sea Ice in Climate (June 1982) to advise on appropriate initiatives for CCCO. This meeting had recommended that the terms of reference of SCOR WG 58 be broadened to include Arctic sea ice studies and modelling (c.f. item 2.2), and that CCCO form a group to identify needs for investigations of this topic in the Antarctic. A proposal to establish a joint SCOR/SCAR panel to promote multidisciplinary studies in the Antarctic sea ice zone was also discussed by the Executive Committee (c.f. item 4.4).

Professor Revelle noted that this was his last report as Chairman of CCCO. He remarked that CCCO is beginning to enter its operational phase and that a change in leadership had seemed appropriate. His successor, after January 1, 1983 will be Dr. R.W. Stewart. The SCOR President extended his thanks and those of all the SCOR members to Professor Revelle for his efforts in establishing CCCO and guiding the committee through its formative years when so many activities have been successfully completed and plans laid for many more.

The Executive Committee had agreed that SCOR National Committees should be invited to urge their national delegates to IOC and UNESCO to support increased financial commitments to CCCO by the intergovernmental agencies. The representatives of IOC and UNESCO reiterated their support for CCCO and emphasized the importance of mobilizing increased financial support for the activities of the committee.

Joint Panel on Oceanographic Tables and Standards

During 1981 - 1982, the Joint Panel on Oceanographic Tables and Standards has been active in two main areas; the completion of work on the Equation of State of Seawater and the Practical Salinity Scale, and the work of the JPOTS CO_2 subgroup. The report of JPOTS appears as Annex XI and its recommendations were approved by the Executive Committee, including a request for a second meeting of the CO_2 subgroup in Paris in August, 1983. The Publications Officer expressed thanks to UNESCO for its efforts in producing the various reports and publications arising from the work of JPOTS in 1981. Some concern was expressed, however, over delays in the production of Number 40 of the *UNESCO Technical Papers in Marine Science* which is to be Volume 4 of the *International Oceanographic Tables*. It was agreed that the Chairman of JPOTS should be asked to urge the scientists involved with the production of these tables to complete their task possibly by convening a small *ad hoc* meeting for this purpose.

Antarctic Review Group

The report of the SCOR/SCAR Workshop on the Enhancement of Interactions Between Physical, Chemical and Biological Oceanographers working in the Southern Ocean which was held in Tokyo in May, 1982 had been submitted to SCOR (see Annex XII) and was discussed. The ARG convened a follow-up session to this workshop during the JOA. A decision on the continuation of the ARG now that the workshop has taken place was deferred pending discussion of certain SCAR proposals (c.f. item 4.4 and 2.4).

It was subsequently agreed that the ARG should be disbanded since the establishment of WG 74 (General Circulation of the Southern Ocean) would enhance SCOR's involvement in the studies of physical and chemical oceanography in the Southern Ocean.

Editorial Panel for the Ocean Modelling Newsletter

Dr. Gill reported to the SCOR Secretariat that forty-four issues of this newsletter have been published and that funding in support of this publication has been renewed by ONR until mid-1985. The Executive Committee expressed its thanks to ONR for its continuing support of this most useful publication.

Editorial Panel on Eddy Dynamics

The meeting was informed by Dr. K.N. Fedorov of the imminent publication of "*Synoptic Eddies in the Ocean*". This volume has been edited by Drs. A.S. Monin, U.M. Kamenkovitch and M.N. Koshlyakov of the USSR and it includes a preface by the President of SCOR. [This volume has subsequently been published and is available in Russian from Hydrometeoizdat Publishers, Leningrad.] An English translation is being prepared.

2.4 PROPOSALS FOR NEW WORKING GROUPS

Marginal Ice Zone Studies

A preliminary proposal submitted to SCOR in early 1982 by an existing group working on marginal ice zone studies has been dropped since no detailed proposal on terms of reference, etc. was submitted and since SCOR working group status may not be appropriate for a group which appears to be largely of an operational nature, and is already functional.

Oceanic CO_2 Monitoring

A proposal from the Canadian National Committee for SCOR (CNC/SCOR) had been submitted to SCOR in 1981 and had been circulated for comments by the Executive Committee and other interested groups, especially CCCO. As a result of this review, the Executive Committee wished to encourage the proposal put forward by CNC/SCOR and will suggest certain changes to the terms of reference to be made in consultation with the suggested Chairman, Dr. C.S. Wong. The General Meeting agreed to the establishment of the group following these consultations. The membership should be limited to ten individuals and should include as wide an international representation as possible. The group may begin to work by correspondence in 1983, and will be known as WG 75. After the General Meeting, the following terms of reference were developed in correspondence between Dr. Wong and the Secretary of SCOR, Dr. Longhurst.

1 - To discuss and summarize the state-of-the-art knowledge of the CO_2 absorbing capacity of the ocean in order to develop the best strategy for CO_2 monitoring in the world ocean.

2 - The scope of the review will cover the following topics:

(i) Scientific requirements on ocean CO_2 monitoring, its signal/noise/time-scale problem as affected by variabilities of atmospheric and oceanic processes, and the scientific basis for selection of CO_2 monitoring parameters.

(ii) Technical requirements on ocean CO_2 monitoring and problems related to tools and logistics:

(a) network of platforms; islands, ships-of-opportunity, oceanography cruises and buoys.

(b) ocean CO_2 standards for data quality control and compatibility of measurements, especially for long-term time-series.

(c) CO_2 monitoring equipment development and automation.

(d) supporting oceanographic and atmospheric data to assist interpretation of ocean CO_2 monitoring data.

(e) data archiving and distribution format.

(iii) Existing scientific capacity and future requirements to carry out the best strategy for an international ocean CO_2 monitoring programme.

Natural Variation in Carbon Dioxide and Carbon Cycles

This proposal was submitted through CMG and was introduced at the Executive Committee Meeting by Dr. K. Hsü. The proposal did not include terms of reference and the suggested membership had rather limited international representation. The proposal will be re-drafted to take these considerations into account and to clarify the topics covered in order to avoid overlap with other groups (e.g. SCOPE, UNEP, etc.). The Executive Committee welcomed the proposal in general and will consider it in further detail at its next meeting. It is hoped that the revised proposal will be received in early 1983 so that adequate time will remain for review by National Committees before the 25th Executive Committee Meeting.

Marine Photochemistry

A brief proposal for a working group on marine photochemistry was submitted by the F.R.G. National Committee for SCOR It was considered by the Executive Committee in conjunction with the discussions on WG 44 (c.f. item 2.2). The revised terms of reference for WG 44 (now WG 72) include work on marine photochemistry and it was considered that the interest of the FRG proposal had been satisfied.

Developments in Ecological Studies of the Deep Ocean Floor

This proposal was also submitted by the F.R.G. Committee for SCOR. The Executive Committee was concerned that potential uses of the sea floor for mining and waste disposal could seriously influence the work of such a group and agreed that the proposal must be submitted in much more detailed form. Dr. Wolff will discuss the concept of a working group on deep sea ecology with colleagues in the field in order to assist the Executive Committee in considering a detailed proposal at its next meeting. The need for a group should be clearly established in view of the active collaboration which already exists between many deep sea biologists.

Particulate Biogeochemical Processes

The establishment of this working group, which had previously been discussed at the 23rd Executive Committee Meeting was approved. The proposal was widely circulated to National Committees in 1981 and the terms of reference and prospective membership are given below:

1 - To attempt to delineate the principal particulate transport processes which control the trace element and nutrient elements' distribution in the open ocean.

2 - To clarify the definition of terms and processes used to describe particulate material in the ocean and to suggest the most appropriate methodology for the study of the material defined above.

3 - To ascertain the possibility of determining particulate fluxes of elements and organic matter to different depths in the sea.

4 - To prepare within two years a state-of-the-art report on the particulate processes.

Membership:

S. Krishnaswami	India - Chairman
M. Bacon	U.S.A.
P. Buat-Menard	France
S. Fowler	Monaco
J.M. Gieskes	U.S.A.
G. Knauer	U.S.A.
Y. Nozaki	Japan
I. McCave	U.K.

(plus one scientist from USSR to be nominated in consultation with Dr. Lisitzin).

This will be Working Group 71.

General Circulation of the Southern Ocean

The representative of SCAR, Mr. George Hemmen presented proposals arising from a recent SCAR General Meeting (c.f. Annex XVIII). These are described in more detail under item 4.4. In particular, one proposal invited SCOR to assume responsibility for providing "an international focus for discussion of problems and programme planning in physical and chemical oceanography of the Southern Ocean". It was agreed that there was an immediate need for an

international group to provide scientific input for the meeting of the IOC Programme Group for the Southern Ocean scheduled for Spring, 1983. In view of this urgency, the General Meeting approved the immediate establishment of a working group (WG 74) entitled "General Circulation of the Southern Ocean". A list of about thirty possible members for WG 74 was drawn up by interested participants at the JOA and the General Meeting. From these, the Executive Committee subsequently selected Dr. W. Nowlin (USA) to chair the new working group and Dr. A.F. Treshnikov (USSR) to be Vice-Chairman. It was expected that a group of about ten scientists would be selected (with an appropriate international and interdisciplinary representation) by the Chairman, if possible in consultation with the Vice-Chairman, to begin work as soon as possible. WG 74 may wish to meet in late 1982 or early 1983 in order to prepare a report or proposals for the IOC PG/SOC meeting. The terms of reference which were approved for WG 74 are:

1 - To identify major gaps in the knowledge of the general circulation of the Southern Ocean, bearing in mind its relevance to biology and climate.

2 - To specify physical and chemical programmes to investigate these problems.

A number of participants urged that links be forged between WG 74 and other SCOR groups, especially WG 54 and WG 58. Sir George Deacon wished to emphasize that the role of circulation in relation to the distribution of ice and climatic problems should not be overlooked by the new group.

At a brief informal meeting of the Executive Committee following the General Meeting, the following assignments as Executive Committee Reporters were made:

Dr. A. Longhurst	67
Dr. K.N. Fedorov	56, 74
Prof. G. Siedler	66, 68, 69, 70
Prof. T. Wolff	42, 54, 65
Dr. R. Chesselet	46, 71, 75
Dr. W.L. Godson	72, 55, 58
Prof. D. Lal	JPOTS
Prof. K. Hsü	61
Prof. P. Lasserre	73
Prof. H. Charnock	Publications, 51, CCCO

In addition, Professor H. Postma agreed to continue to serve on the IOC Scientific Review Board and the SCOR/UNESCO Consultative Panel on Coastal Systems and to report on WG 57 until it is disbanded in 1983.

In summary, the new groups which were established are as follows:

WG 71 *Particulate Biogeochemical Processes*
WG 72 *The Oceans as a Source and Sink for Atmospheric Constituents* (former WG 44).
WG 73 *Ecological Theory in Relation to Biological Oceanography* (former WG 59).
WG 74 *General Circulation of the Southern Ocean*
WG 75 *Oceanic CO_2 Monitoring*

2.5 SCOR SCIENTIFIC RAPPORTEURS

The report of the Rapporteur for Marine Pollution appears as Annex XIII.

The Rapporteur for Coastal Research, Dr. H. Postma, presented his report, which is given in full as Annex XIV, to the General Meeting. He reviewed the activities of several SCOR Working Groups involved in coastal studies, notably WG 57 and WG 65. He mentioned the successful UNESCO/SCOR International Symposium on Coastal Lagoons which he had attended in Bordeaux in September, 1981 and the second meeting of the UNESCO/SCOR Consultative Panel on Coastal Systems of which he is a member. More detailed reports of these activities are given in item 3.2.

The Executive Committee wished to propose that SCOR appoint a Rapporteur on the Law of the Sea in order that SCOR be kept informed and advised as to the implications of the Law of the Sea Treaty which has been signed recently. It is expected that the implementation of this treaty will have a considerable impact on the conduct of oceanographic research. The meeting approved the appointment of Professor Warren Wooster as Rapporteur for the Law of the Sea.

3.0 RELATIONS WITH INTERGOVERNMENTAL ORGANIZATIONS

3.1 *IOC*

The Executive Secretary presented a report summarizing SCOR's activities as an advisory body of the IOC since 1979. This report had been prepared and sent to IOC for the Twelfth Session of the IOC Assembly. It appears in Annex XV.

The IOC Secretary, Dr. Mario Ruivo, commented on the most productive relationship which has developed between SCOR and IOC in the last few years. He encouraged further moves to involve active scientists in the working programmes of his organization. He noted the challenges for marine science which are arising from the rapid development of new technologies and urged that every possible means of mobilizing financial support for scientific programmes be explored.

Dr. Ruivo expressed some concern that SCOR should attempt to increase its presence in appropriate developing countries where there is a marine scientific community. In addition, he felt that in some other countries, SCOR National Committees may not adequately represent the full scientific community. The Secretary of the IOC, in bringing these questions to the attention of the General Meeting, urged SCOR to consider them at the next opportunity and to encourage National Committees to facilitate dialogue between governmental and non-governmental bodies in marine science and related fields at the national levels.

Professor Simpson noted that the IOC science programmes are being reorganized along four main lines: Ocean Mapping, Ocean Science and Living Resources, Ocean Science and Non-Living Resources, and Ocean Dynamics and Climate. Three of these involve SCOR activities. The work done by WG 67 in the production of a report on OSLR for the IOC was reported under item 2.2. A major portion of the Ocean Dynamics and Climate Programme is the work of CCCO. Finally, in response to a request from the IOC, Professor Simpson, in cooperation with other experts in the field had prepared a report on OSNLR. This also incorporated the recommendations of the Third Marine Geoscience Workshop held in Heidelberg in July, 1982. The OSLR and OSNLR reports make proposals for scientific programmes and will be discussed at the Twelfth Session of the IOC Assembly. They have been distributed to National Committees.

Professor Simpson introduced the report entitled "*Future Ocean Research*" which has been prepared by SCOR in response to a request from the IOC for assistance in the identification of major trends in ocean science up to the year 2000. The report was prepared by a group of experts in each of the fields of oceanography and reviewed and revised at a consultation organized for this

purpose in Villefranche in April. The four scientific chapters of the report were distributed to all of the delegates at the JOA and were the subject of a round table discussion on August 5th. The report, (with a summary of the comments received in Halifax, and an additional chapter on implementation and planning) were submitted to the IOC for presentation at the 12th Assembly in November.

The additional chapter on implementation and planning (known as the "Villefranche Chapter") gave rise to considerable discussion since time had not been available for general distribution of this document. Its contents were summarized by Professor Simpson. The main sections of the Villefranche Chapter are:

On the Nature of Science:

- The Question of Scales
- The Union of Disciplines

Application and Implementation:

- Marine Science and Society
- International Marine Science
- Ocean Uses and Research
- On the Need for Trained Personnel
- Ships, Facilities and Equipment
- On the Role of Institutions

Dr. Ruivo reminded the General Meeting that the original request to SCOR was for the four scientific chapters of the FORE report. The production of the additional chapter was very much appreciated by the IOC since it constitutes a logical development of the task assigned to the Expert Consultations which took place in Villefranche. The question of SCOR endorsement of the FORE Report and the Villefranche Chapter was resolved by an agreement that the covering letter to the IOC will record that the scientific chapters of the report were discussed at the JOA and endorsed by the SCOR General Meeting, but that the implementation chapter did not have SCOR endorsement due to a lack of opportunity for a full discussion of its contents. The Executive Secretary will ensure that both parts of the FORE Report are distributed to all SCOR National Committees.

The election of the IOC Scientific Review Board took place at the meeting of the IOC Executive Council which was held in Paris in March, 1982. SCOR has confirmed that Professor H. Postma will continue as its representative on the SRB.

SCOR has been invited to designate a representative on the IOC Working Committee on International Oceanographic Data Exchange Task Team on Standard Criteria for Physical Oceanographic Data. Mr. James Crease, Chairman of WG 61, has agreed to join the task team on behalf of SCOR, and this nomination will be forwarded to the IOC.

3.2 *UNESCO*

Dr. Krause, the representative of UNESCO, reviewed the recommendation of the second meeting of the SCOR/UNESCO Consultative Panel on Coastal Systems which was held in Paris in early 1982. The report of this meeting will be published as a Technical Paper in Marine Science. The main recommendations of interest to SCOR are:

- that WG 60 (or the mangrove association to be formed as a continuation of WG 60) serve in an advisory capacity, offering assistance to UNESCO in its field of expertise, namely mangrove research.

- that the terms of reference (revised) of WG 46 be approved - this had been done at a previous meeting of the SCOR Executive Committee.
- that WG 57 be disbanded (see item 2.2).
- that SCOR consider the establishment of a new working group charged with the task of developing proposals for the study of the physical oceanography of coastal systems.

There was a lengthy discussion at the Executive Committee meeting of a suggestion from the Consultative Panel that a new international scientific body on coastal research should be established. This concept was discussed at more length between members of the Executive Committee, Dr. Krause, Dr. Postma, and Dr. Lasserre and the results of these discussions were considered at the General Meeting.

The Past-President of SCOR, Dr. Fedorov, noted the natural tendency of oceanographers to specialize, but both he and Sir George Deacon wished to stress the importance of interdisciplinary communication such as occurs within SCOR. Several participants in the General Meeting expressed concern over any move to subdivide oceanographers into narrow groups especially when other means (workshops, symposia, conferences etc.) already exist to promote communication among scientists in specialized fields. Several active national groups for coastal and estuarine scientists were also cited by Dr. N. Flemming as fulfilling this need. Another concern voiced by some participants was that the creation of a new international body might further dilute the funds available for scientific programmes. The discussion was inconclusive and it was agreed that Dr. Krause will explore the proposal of the Consultative Panel further in discussions with Professors Lasserre and Postma.

The Director of the Division of Marine Science of UNESCO noted with appreciation the cooperative relationship which exists between SCOR and his Division.

3.3 *ICES*

Professor Simpson welcomed the President of ICES, Dr. Gotthilf Hempel, to the General Meeting. The main item for discussion between SCOR and ICES was the sponsorship of WG 42 (*Pollution of the Baltic*) which had been dealt with previously (item 2.2).

3.4 *ACMRR/FAO*

Dr. Gary Sharp, the representative of FAO reported that the reconstitution of the ACMRR has lead to improved working relationships between FAO and IOC/UNESCO. He discussed FAO's role in the translation of advances in scientific knowledge in the field of marine resources into practical solutions to fisheries problems wherever possible, and particularly in developing areas. The work of SCOR groups such as WG's 54, 56, 57, 59 and 65 were mentioned as being of fundamental interest to living resource managers and he urged a greater involvement of intergovernmental bodies such as FAO in these activities. Dr. Sharp suggested that this might be achieved through invitations to participate in appropriate meetings or other working group activities being extended to representatives of FAO.

Dr. Sharp reiterated the interests of FAO in the work of CCCO. A revision of the FAO Atlas of Living Marine Resources has shown that the influence of climate-ocean interactions on the distribution, abundance and species composition of many regional fisheries is much larger than previously recognized. He urged a return to more fundamental studies of marine resource population structure in order that the effects of nature and of man on these populations can be properly assessed. He cited as an example of FAO's attempts to stimulate such studies, a "Technical Consultation to Examine Chamges in Abundance and

and Species Composition of Neritic Stocks" which will be held in Costa Rica in April, 1983. Dr. Sharp expressed his hope for more extensive cooperation with SCOR in these types of studies.

Dr. Sharp was asked to urge FAO to publish the new edition of the Directory of Marine Scientists as quickly as possible.

4.0 RELATIONS WITH NON-GOVERNMENTAL ORGANIZATIONS

4.1 AFFILIATED ORGANIZATIONS

CMG

Professor Hsü had presented a report from CMG to the Executive Committee and Professor Simpson reviewed this report at the General Meeting. A major activity of CMG in 1982 has been the organization of the Third International Marine Geoscience Workshop in Heidelberg in July, 1982. The workshop covered four main subjects: Ocean Science and Non-Living Resources; the Oceanic Lithosphere; Geological History of the Oceans; and Ocean Margins. The report of the workshop will be distributed by CMG and will be sent to IOC for use in the development of programmes in the field of marine geology and geophysics.

IABO

The new President of IABO, Professor Pierre Lasserre was welcomed to the SCOR General Meeting. He has replaced Professor Parsons as an *ex-officio* member of the SCOR Executive Committee. Professor Lasserre reported that a meeting of IABO had been held on August 5th and that Dr. A.D. McIntyre had been elected to the post of Secretary-Treasurer of IABO. The formation of a new International Mangrove Association within IABO was approved. The presidents of this association and of the International Seaweed Association and the International Coral Reef Association were all made *ex-officio* members of the IABO Executive Committee.

IAMAP

Dr. W.L. Godson, the President of IAMAP, drew attention to the IUGG General Assembly which will take place in August 1983. IAMAP is cosponsoring a number of symposia on this occasion (see Annex XVI) for more details. He reported that a joint IAMAP/IAPSO Assembly will be held in Hawaii in 1985 and that an organizing committee has been established for this event.

IAPSO

The Secretary of IAPSO, Dr. E. LaFond gave a report on IAPSO activities (see Annex XVI) and noted that the IAPSO Executive Committee met in Halifax on August 3. IAPSO has appointed a Climate Committee and a Working Group to study sea level as affected by climate during the last 150,000 years. This group will attempt to define our state of knowledge of the factors which have controlled sea level. IAPSO is organizing a workshop on the Oceanography of Straits which will be convened by Dr. G. Kullenberg in Hamburg in January, 1983.

4.2 CORRESPONDING ORGANIZATIONS

ECOR

There has been a considerable increase in the amount of contact between ECOR (Engineering Committee on Oceanic Resources) and SCOR over the past year. There appears to be a need for a more formal and closer relationship between the two organizations and this was discussed in Halifax between the Presidents of SCOR and ECOR. The ECOR Council met in Halifax, and an informal meeting between members of the ECOR Council and the SCOR Executive Committee also took place.

Topics of mutual interest (drifting buoys, remote sensing, etc.) were discussed on this occasion. The admission of ECOR as an Affiliated Organization of SCOR was approved in principle at the General Meeting and will be discussed in detail by ECOR at its next meeting.

CMAS (SC)

The Chairman of the CMAS Scientific Committee, Dr. N.C. Flemming, presented a report which appears as Annex XVII.

4.3 *ICSU*

The Executive Secretary presented a report which she had submitted to ICSU in preparation for the ICSU General Assembly which will be held in Cambridge in September, 1982. Professor Simpson will attend that meeting.

The Publications Officer, Professor Charnock, discussed a proposal (still in preliminary stages) for an ICSU Press. He suggested that such a proposal will not have much relevance for SCOR since SCOR does not produce any publications other than the SCOR Proceedings which are prepared "in house". The proposal involves the establishment of a cooperative relationship between ICSU and a commercial publishing house which would enable the publication of scientific journals and books arising from the work of ICSU Organizations. It will be discussed in more detail in Cambridge.

4.4 ICSU UNIONS AND COMMITTEES

COSPAR

SCOR was represented at the 24th Plenary Meeting of COSPAR by Professor James Gower (Chairman, WG 70) who noted that COSPAR is definitely emphasizing satellite observations for climate studies and requested that SCOR consider cosponsoring the symposium on "Climate Parameters as seen from Space" which will be presented at the next COSPAR Plenary Meeting in Graz, Austria in 1984. The Executive Committee agreed to this suggestion and COSPAR will be contacted for further details.

IUPAC

A meeting which had been planned between representatives of IUPAC and SCOR to discuss liaison between the two organizations has not yet taken place. In the meantime, SCOR has been asked to participate in the planning for CHEMRAWN IV, a conference on "Chemistry and Resources of the Global Ocean" which will be held in Woods Hole in 1985. The Executive Committee recommended that Dr. P. Brewer of WHOI be asked to represent SCOR in the planning for this conference, and this was approved by the General Meeting.

SCAR

Mr. George Hemmen, the Executive Secretary of SCAR, presented proposals arising from a recent SCAR meeting to the Executive Committee (see Annex XVIII). They were discussed in more detail at the General Meeting after consultations between representatives of SCOR and SCAR and other scientists involved in work in the Southern Ocean who were present at the JOA.

The first recommendation from SCAR is that SCOR and SCAR jointly establish a group (including representatives of other organizations) of individuals having interests in the study of the Antarctic pack ice zone. The group is envisioned as a practical or operational group rather than a study group such as the BIOMASS Working Party on Pack Ice Zone Studies. It is intended that the proposed group will respond to the needs of CCCO and BIOMASS in Antarctic ice zone studies. The General Meeting approved the cosponsorship, by SCOR, of such a group when a more detailed proposal is received from SCAR.

SCAR's second proposal is that SCOR undertake the responsibility for studies in the field of Antarctic Physical and Chemical Oceanography. This proposal would mean that SCOR, rather than SCAR, would provide the focus for promotion of these fields of study, in the area of the Southern Ocean and would be the appropriate body to facilitate collaboration between the countries interested in working in the Southern Ocean on problems of physical or chemical oceanography. The discussion of this proposal by the SCOR General Meeting resulted in the formation of WG 74 (c.f. item 2.4) on the General Circulation of the Southern Ocean.

SCOPE

It was agreed that Dr. E.D. Goldberg should represent SCOR to SCOPE in addition to his role as SCOPE representative to SCOR. He will be invited to keep SCOR informed of various SCOPE programmes, especially its coastal programme.

URSI

Dr. John Apel, Vice-Chairman of WG 70 and representative of URSI noted that IUCRM has been disbanded. This organization had interests in remote measurement of the oceans and URSI will discuss the need for a new organization with similar interests at the IUGG Assembly in 1983.

5.0 FUTURE MEETINGS

5.1 XVII GENERAL MEETING

National Committees were requested to send invitations to hold the next General Meeting of SCOR in their countries to the SCOR Secretariat. This meeting should be held in August or September of 1984, preferably in conjunction with an appropriate scientific meeting.

5.2 25th EXECUTIVE COMMITTEE MEETING

A number of possible locations for the next meeting of the Executive Committee were discussed although no formal invitations had been received from any National Committees. It was agreed that it would only be necessary to hold one full meeting of the Executive Committee before the XVII General Meeting. If necessary, an Officers' meeting might be convened to conduct routine business. The General Meeting agreed that the timing and location of the 25th Executive Committee Meeting should be decided by the Executive Committee when more details of the various informal suggestions received are known.

5.3 OTHER MEETINGS

Sandy Beaches as Ecosystems - Port Elizabeth, South Africa, January, 17-21,1983.

15th Pacific Science Congress - Conservation, Development and Utilization of the Resources of the Pacific - Dunedin, New Zealand, February 1-11, 1983.

6.0 OTHER BUSINESS

The Publication Officer discussed a proposal which had been received by SCOR which suggested that SCOR endorse the use of Marsden Square Numbers in the oceanographic literature as a means of making retrieval of journal articles related to precise areas of the oceans simpler. It was the opinion of the Executive Committee that this proposal should more properly be addressed to ASFIS or to editors of the major scientific journals. This was endorsed by the General Meeting.

The XVI General Meeting of SCOR was adjourned by the President who repeated his thanks, on behalf of all members of SCOR, to Professor H. Charnock, Dr. W.W. Hay and Dr. H. Postma for their service as members of the Executive Committee. He also extended the appreciation of SCOR to the Canadian National Organizing Committee for its efforts over several years in planning and holding the Joint Oceanographic Assembly, and to CNC/SCOR, Dalhousie University and the Bedford Institute of Oceanography for hosting the JOA and the provision of numerous facilities for the assembly and associated events.

ANNEX I (A)

TWENTY-FOURTH EXECUTIVE COMMITTEE MEETING OF SCOR

Halifax, Canada, 29 - 31 July, 1982

Participants

Members of the Executive Committee

*	Professor E.S.W. Simpson	South Africa	President
*	Dr. K.N. Fedorov	U.S.S.R.	Past President
*	Professor H. Charnock	United Kingdom	Vice-President
*	Professor T. Wolff	Denmark	Vice-President
*	Professor G. Siedler	Fed. Rep. of Germany	Vice-President
*	Dr. A.R. Longhurst	Canada	Secretary
*	Professor T.R. Parsons	Canada / IABO	Ex-Officio
*	Professor K. Hsü	Switzerland / CMG	Ex-Officio
*	Dr. W.L. Godson	Canada / IAMAP	Ex-Officio
*	Professor D. Lal	India / IAPSO	Ex-Officio
*	Professor H. Postma	The Netherlands	Co-opted Member
*	Dr. W.W. Hay	U.S.A.	Co-opted Member
	Mrs. E. Tidmarsh		Executive Secretary

Other Participants

	Mr. G.E. Hemmen	United Kingdom
	Dr. D. Krause	UNESCO
*	Dr. J. Van der Land	The Netherlands
	Mr. L.D. O'Quinn	Canada
	Mr. B. Thompson	CCCO
	Dr. J. Stel	The Netherlands
*	Dr. R. Revelle	CCCO
*	Dr. R. Chesselet	France
*	Professor R. Currie	United Kingdom
	Professor Tsu-Chung Hung	Taiwan
*	Dr. V.C. Juan	Taiwan

* = SCOR members

ANNEX I (B)

SIXTEENTH GENERAL MEETING OF SCOR

August 7, 1982

Participants

Members of the Executive Committee

*	Professor E.S.W. Simpson	South Africa	President
*	Dr. K.N. Fedorov	U.S.S.R.	Past President
*	Professor H. Charnock	U.K.	Vice-President
*	Professor G. Siedler	F.R.G.	Vice-President
*	Dr. T. Wolff	Denmark	Vice-President
*	Dr. A.R. Longhurst	Canada	Secretary
*	Professor H. Postma	Netherlands	Co-opted Member
*	Dr. W.W. Hay	U.S.A.	Co-opted Member
*	Professor T.R. Parsons	Canada/IABO	Ex-officio
*	Dr. W.L. Godson	Canada/IAMAP	Ex-officio
	Mrs. E. Tidmarsh		Executive Secretary

Other Participants

	Dr. K. Al-Kaisi (Bahrain)		Mr. G. Hemmen (UK)
*	Mr. F. Anderson (South Africa)	*	Prof. G. Hempel (ICES)
*	Dr. J. Apel (URSI)		Prof. I. Hessland (Sweden)
*	Dr. D.J. Baker (USA)		Dr. H. Hill (UK)
*	Prof. B. Battaglia (Italy)		Dr. T.C. Hung (Taiwan)
*	Prof. A.R. Bayoumi (Egypt)	*	Dr. D. Hurley (New Zealand)
	Dr. D. Behrman (USA)	*	Dr. V.C. Juan (Taiwan)
	Dr. M. Boisson (Monaco)		Prof. P. Jumars (USA)
*	Acad. L. Brekhovskikh (ICSU)		Dr. D. Krause (UNESCO)
	Mr. J. Brooke (Canada)		Dr. W. Krauss (FRG)
	Mr. L. Brown (USA)	*	Dr. E.C. LaFond (IAPSO)
*	Dr. J. Bunt (Australia)		Mrs. K. LaFond (USA)
*	Prof. S.E. Calvert (Canada)		Miss C. Lalou (France)
	Prof. G. Cadeño (Mexico)	*	Prof. P. Lasserre (IABO)
*	Prof. R. Chesselet (France)		Dr. R. Lasker (USA)
*	Prof. R.I. Currie (UK)	*	Dr. A.S. Laughton (UK)
	Sir George Deacon (UK)		Dr. E.L. Lewis (Canada)
	Prof. D. Ellis (Canada)		Dr. P. Malkki (Finland)
	Prof. M.I. El-Sabh (Canada)	*	Dr. K.H. Mann (Canada)
*	Prof. S.Z. El-Sayed (USA)	*	Prof. R. Marumo (Japan)
*	Prof. J. Field (South Africa)		Dr. M. Melguen (France)
	Mr. A. Fiuza (Portugal)		Dr. J. Monteiro (Portugal)
*	Prof. A. Foldvik (Norway)		Dr. S. Morcos (UNESCO)
*	Prof. T.D. Foster (ARG)		Prof. T. Nemoto (Japan)
	Prof. R. Fournier (Canada)		Dr. T. Okuda (Venezuela)
	Dr. N. Freeman (Canada)		Mr. L. O'Quinn (Canada)
*	Dr. N.C. Flemming (CMAS)	*	Prof. C. Palomo (Spain)
	Prof. G.E. Fogg (UK)		Dr. B. Patel (India)
*	Dr. J. Garrett (Canada)		Prof. W.G. Pearcy (USA)
	Dr. J.A. Gonella (France)	*	Prof. T. Piyakarnchana (Thailand)
*	Dr. J. Gower (Canada)		Dr. T. Platt (Canada)
	Dr. R.G.M. Hanna (Egypt)	*	R.Adm. T. Pongsapipatt (Thailand)

*	Prof. R. Revelle (CCCO)
	Prof. B. Rothschild (USA)
	Dr. W. Roether (FRG)
	Dr. P.A. Rona (USA)
	Dr. M. Ruivo (IOC)
	Dr. B. Saint-Guily (France)
	Dr. M. Sarnthein (FRG)
	Dr. D. Satyanarayana (India)
	Dr. E. Seibold (FRG)
	Dr. R. Shankar (India)
	Prof. S.H. Sharafeldin (Egypt)
	Dr. G.D. Sharp (FAO)
	Dr. L. Soto (Mexico)
	Dr. J. Soyer (France)
*	Dr. J. Steele (USA)
	Dr. J. Stel (Netherlands)
	Dr. R. Stewart (Canada)
*	Dr. K. Striggow (GDR)
*	Prof. J.O. Stromberg (Sweden)
*	Dr. J. Stuardo (Chile)
	Dr. C.W. Sullivan (USA)
	Dr. S. Taguchi (USA)
	Prof. K. Taira (Japan)
	Mr. B. Thompson (CCCO)
*	Prof. J.S. Turner (Australia)
*	Prof. R. Vaissiere (Monaco)
*	Dr. J. Van der Land (Netherlands)
	Prof. G. Vasilikiotis (Greece)
	Mr. R. Vetter (USA)
	Dr. A. v.d. Westhuysen (South Africa)
*	Prof. R. Wollast (Belgium)
	Dr. A. Yahez-Arancibia (Mexico)

* = SCOR members

ANNEX II

SCIENTIFIC PROGRAMME OF THE JOINT OCEANOGRAPHIC ASSEMBLY

Halifax, Nova Scotia, 2 - 13 August, 1982

List of Sessions

First Week

Monday		Opening Session Keynote Address: Climate and the Oceans - K. Hare
	G.1.	Major Advances in Oceanography Convenor - W.W. Hay
Tuesday	G.2.	The Ocean and Climate Convenor - K. Hasselman
	A.1.	Results of the first GARP Global Experiment (IAMAP/IAPSO) Convenor - P. Hisard
	A.2.	Sea-level Changes and Coast/Ocean Interaction (CMG) Convenor - W.C. Pitman III
	A.3.	Productivity and Determinants of the Structure of Seaweed Communities (IABO/ISA) Convenor - J.L. McLachlan
Wednesday	S.1.	North Atlantic Circulation (IAPSO) Convenor - F. Schott
	S.2.	Deep-sea Biology, the Role of Physical and Chemical Variability (IABO) Convenor - P. Jumars
	A.4.	Ocean/Atmosphere Material Exchange (IABO/WG44) (IAPSO/IAMAP) Convenor - R. Chesselet
	A.6.	Physiological Ecology of Plankton at High Latitudes (IABO) Convenor - T. Platt
	A.7.	Mangrove Ecosystems (IABO/WG60) Convenor - S.C. Snedaker
Thursday	G.3.	Ocean Resources Convenors - B. Rothschild and P.A. Moiseev
	S.3.	The Southern Ocean (IAPSO/IABO/CMG) Convenor - G. Hempel
	A.5.	Convergent Plate Boundaries (CMG) Convenors - S. Uyeda and T.W.C. Hilde

Friday	S.4.	The CO_2 Problem (IAPSO/IAMAP/CMG/IABO) Convenor - W. Roether
	S.5.	Evolution of Passive Margins (CMG) Convenor - C. Keen
	A.8.	Ocean Crust and Mineralization at Plate Boundaries (CMG) Convenor - D.S. Cronan
	A.9.	Velocity Fine and Microstructure in the Oceans (IAPSO) Convenor - T. Sanford
	S.6.	Sedimentation at Continental Margins (CMG) Convenor - I.N. McCave

Second Week

Monday	G.4.	Transient Tracers Convenor - C.H.G. Rooth
	A.10.	Eddy Dynamics (IAPSO) Convenor - P.B. Rhines
	A.11.	Experiment Design in Submarine Scientific Observation by Divers (CMAS) Convenor - N.C. Flemming
	A.12.	Developments in Fisheries and Exploitation of Multispecies Systems (IABO) Convenor - M. Ishino
Tuesday	S.7.	Bottom Boundary Layer (IAPSO/CMG/IABO) Convenor - R. Wollast
	S.8.	Polar Year and the IGY (IAPSO/IAMAP) Convenor - G. Deacon
	A.13.	Suspended Matter in Open Seas (IAPSO/IABO/CMG) Convenor - S. Honjo
	A.14.	High Energy Coastal Environment (ECOR/CMG) Convenor - L.D. Wright
	A.15.	Cross-Frontal Mixing (IAPSO) Convenor - K.N. Fedorov
Wednesday	G.5.	Paleoceanography Convenor - J. Thiede
	S.9.	Marine Pollution (IABO/IAPSO/CMG/ECOR) Convenor - G.B. Kullenberg
	S.10.	Oceanography from Space (COSPAR) Convenor - R. Stewart
Thursday	S.11.	Arctic Ocean Research (IABO/IAPSO/CMG) Convenor - A. Foldvik
	S.12	Variability in Primary Productivity (IABO) Convenor - O.J. Koblentz-Mishke
	A.16.	Geochronological Methods (CMG) Convenor - V.A. Krasheninnikov
	A.17.	Oceanography of Continental Shelves (IAPSO/IABO/CMG) Convenor - J. Simpson
	A.18.	Arctic Ocean Engineering (ECOR) Convenor - K. Croasdale

Friday G.6. Summary and Closing Session

G = General symposia
S = Special symposia
A = Association symposia

In addition about three hundred Poster Sessions were presented.

Further details on the papers presented in each session, abstracts, and information on the poster sessions are available from the Executive Secretary.

ANNEX III

SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH

FINANCIAL STATEMENT 1981

BALANCE: January 1, 1981			
London	10,003.43		
Paris	2,355.16		
Halifax	46,193.60	58,552.19	
INCOME:			
National Contributions	66,600.00		
Arrears	10,287.00	78,887.00	
Contracts and Grants:			
IOC Regular Contract 1980	3,000.00		
UNESCO Reg. Contract 1980	1.000.00		
IOC Regular Contract 1981	17,000.00		
UNESCO Reg. Contract 1981	11,000.00		
UNESCO Contract WG 65	11,500.00		
UNESCO Subvention to ICSU	10,000.00		
ICSU Grant	10,000.00	63,500.00	
Miscellaneous Income		19.75	
Total Income			140,406.75
TOTAL CASH PLUS INCOME			198,958.94
EXPENSES:			
Working Group 42	196.66		
46	551.73		
47	7,000.00		
51	2,700.12		
54	10,000.00		
55	5,310.75		
56	6,596.77		
57	4,971.46		
63	2,809.97		
65	6,834.47		
67	4,011.76		
JPOTS	640.47		
CCCO	36,000.00	87,624.16	
Publications	6,934.76		
Representation	7,445.36		
Executive Committee Meeting	10,170.79		
Cephalopod Beak Workshop	3,500.00	28,050.91	
Administration		26,627.40	
TOTAL EXPENSES			142,302.47
BALANCE: December 31, 1981			
Paris		15,710.46	
Halifax		40,946.01	56,656.47
TOTAL CASH PLUS EXPENSES			198,958.94

ANNEX IV

SCOR WORKING GROUPS

OBJECTIVES AND PROCEDURES

1. General Purpose

A working group of SCOR is created to stimulate or focus interest in a particular field of research. Since working groups must be limited, the choice of field must be rigorously selected and may be chosen for a number of reasons, such as:

1.1 That a particular subject will benefit significantly from international study, or when it is desirable to plan a collaborative activity, such as a field experiment or laboratory exercise.

1.2 When it is timely and profitable to review a particular field.

1.3 When it is desirable to resolve, compare or standardize particular instruments and techniques.

1.4 When the advice of SCOR is requested and when this calls for an "in depth" study by specialists.

1.5 When it is necessary to meet special needs of the scientific community by stimulating intergovernmental action.

2. Creation of Working Groups

2.1 Proposals for SCOR working groups normally come from SCOR National Committees; affiliated organizations of SCOR; existing working groups; ICSU; international scientific unions, associations or committees of ICSU; IOC; UNESCO; ICES.

2.2 Proposals are first examined by the SCOR Executive Committee and referred if necessary to specialists for advice. This referral may be to one or more of the affiliated organizations, to selected individual scientists or to another appropriate group.

2.3 Proposals are then usually considered by General Meetings of SCOR which, evaluating the advice taken in 2.2, may decide to form a working group.

2.4 In some cases where the need for setting up a working group is indisputable, action to create it may be taken at Executive Meetings.

2.5 All proposals must be received by the SCOR Secretariat at least three months before an Executive or General Meeting to allow for the necessary consultations.

2.6 Proposals should include draft terms of reference (which may be subsequently altered, by the Executive Committee after consultation).

2.7 A suggested list of members, known to be interested in the subject, should accompany the proposal.

3. Membership

3.1 Occasionally membership of a new working group is decided at an Executive or General Meeting of SCOR, but National Committees should also be consulted before a decision is reached. In other cases, nominees are selected later by the President in consultation with the Chairman and the Executive Committee Reporter for the group (see 5.2).

3.2 In all cases, National Committees are entitled to nominate Corresponding Members and the Executive Committee may invite international organizations to nominate Observers. Corresponding Members and Observers may participate in meetings, at the expense of their nominating bodies.

3.3 SCOR working groups are established in cooperation with appropriate affiliated organizations which usually join with SCOR in nominating members.

3.4 Some working groups may be established in co-sponsorship with other bodies such as UNESCO, ACMRR, ICES, etc. In such cases SCOR will nominate a part of the membership and provide their support, or decisions on membership may be made in consultation with the other co-sponsors. Other special arrangements may occasionally be made for the division of costs when members are not regarded as nominees of a particular body.

3.5 In general, working groups operate most satisfactorily when they are comparatively small and memberhsip is, therefore, normally limited to eight to ten people.

4. Chairman

4.1 A likely candidate for chairmanship of the group is approved by SCOR, or the SCOR Executive, at the time when the working group is established. The proposed terms of reference are then communicated to him, together with a formal letter of invitation.

4.2 If the Chairman-designate declines the invitation, appropriate alternatives shall be sought and one appointed by the President after consultation with the Executive Committee Reporter, the Executive Committee and any other sponsoring organization.

5. Executive Committee Reporter

5.1 The SCOR Executive Committee shall nominate one of its members to be a reporter for each working group. A member of the Executive Committee who is a member of a group in a personal capacity, may not normally be appointed reporter for that group.

5.2 The duties of the Executive Committee Reporter are:

a) To assist the President, as required, in selecting the Chairman, SCOR nominees and in corresponding with other nominating bodies.

b) To assist the Chairman, as necessary, in planning the activities of the group and in preparing estimates of expenses for submission to the SCOR Secretariat.

c) To advise the SCOR Executive Committee on the activities of the group, in particular, activities which may require financial support; and to represent the interests of the group at SCOR Executive Meetings.

d) To obtain reports from the group as appropriate, summarize salient points for SCOR, to evaluate recommendations of the group and to suggest the action which might be taken by SCOR.

e) To recommend what material should be published in SCOR Proceedings or elsewhere.

f) To inform the Chairman of the group and, where appropriate, other nominating bodies, of decisions of SCOR meetings, and to interpret to the Chairman views expressed at SCOR meetings.

g) When groups are disbanded, to assist the President as required in the preparation of letters of gratitude.

6. Terms of Reference

6.1 The terms of reference of each working group should be concise and clearly define the tasks to be accomplished. They should take into consideration the purpose and functions of SCOR (SCOR Constitution, paragraph 1) and should not go beyond these functions.

6.2 Terms of reference are approved or modified by SCOR in a General or Executive Committee Meeting, after the necessary consultations for advice (see 2.2).

7. Mode of Operation

7.1 Most of the work assigned to a working group and the planning of its activities, should be performed through correspondence as far as feasible. Such correspondence should be initiated and monitored by the Group's Chairman. Nevertheless, members of working groups are encouraged to discuss problems of common interest informally on suitable occasions when two or more can meet together.

The Executive Committee Reporter should be kept fully informed on progress and consulted about future plans.

7.2 Meetings of working groups should be regarded as a decisive or the final point of their activities, and require the prior approval of the SCOR Executive Committee although, in special cases a meeting can be authorized by the President. Only in unusual circumstances will approval be given for more than one meeting of a working group within two years.

7.3 The request for approval to hold a working group meeting must be accompanied by a work plan for the meeting and by a detailed estimate of the cost of the meeting.

7.4 The Executive Committee, if it grants approval for a working group meeting, shall also ensure that an appropriate budgetary allocation is made.

7.5 The Chairman must request that all working group members seek financial support for their attendance at the meeting from national or other appropriate sources. They must inform him at least two months before the meeting whether or not they require support from SCOR funds (partial or full assistance with travel and/or subsistence costs). The Chairman should then submit a summary of the requirements for SCOR support together with his recommendations to the Executive Secretary. If these requirements exceed the budgetary allocation, the approval of the President must be sought before proceeding with the meeting.

7.6 Working group members shall normally make their own travel arrangements and seek reimbursement from the Executive Secretary after the meeting. If necessary, an advance payment may be issued. In very occasional cases, prepaid airline tickets may be arranged by the Executive Secretary.

7.7 The cost of meetings should be kept to a minimum by the use of reduced fares, and the careful selection of venue. Every attempt should be made to take advantage of "meetings of opportunity" even for part of the Working Group, and assistance in the provision of facilities should be sought from SCOR National Committees.

8. Reporting Procedures

8.1 Chairmen of all working groups are requested to submit to every meeting of the SCOR Executive Committee, and to the General Meetings, a short note on the current status of the group's activities, progress with reports, and future plans. Such reports should, where appropriate, include requests for approval for future meetings or other support required from SCOR, e.g., assistance with publications, etc. These reports must be received by the Secretariat not later than one month prior to the appropriate meeting and should be copied to the Executive Committee Reporter. Chairmen should be prepared to attend the appropriate meeting when their final report is presented, if so requested.

Chairmen of working groups are Category 2 members of SCOR and are entitled to attend all SCOR General and Executive meetings. However, their expenses will only be covered by SCOR if they are specifically required to attend by the President.

8.2 A full report of each working group meeting shall be submitted to the Executive Committee within three months. When a working group has discharged its terms of reference, it shall submit a final report to SCOR. Reports should be regarded as a major scientific outcome of each group's work and, therefore, should contain mostly scientific material. They are distributed to National Committees for dissemination to the oceanographic community; they may also be published in *SCOR Proceedings* or in another appropriate publication.

9. Termination of a Working Group

9.1 The tenure of working groups automatically expires at each SCOR General Meeting and shall in no case be extended beyond a six year period. The reports from Chairmen (see 8.2) should help SCOR to decide whether the working group should be renewed with, or without, changes in membership, title, and terms of reference. For joint working groups, disbanding, reforming and reporting will be made in consultaiton with the representatives of other nominating bodies.

9.2 When a group is discharged, the President shall address a letter of thanks to the Chairman of the group, conveying through him SCOR's gratitude for services to all members.

10. Follow-up Action by SCOR from Working Group Activities

10.1 The SCOR Secretariat will convey reports and recommendations to the relevant organizations.

10.2 Working group reports may be published by SCOR, UNESCO or other sponsoring bodies, as appropriate. Unless otherwise stated, such publication implies SCOR approval, but SCOR does not necessarily agree to act on any recommendation. SCOR may summarize or adapt the working group report for its own purposes.

10.3 SCOR will decide on the most appropriate and feasible steps to take, to make the best use of the working group's activity. This may involve:

a) forming further working groups;

b) requesting or arranging, but not financing, laboratory and field studies;

c) referring particular needs to SCOR National Committees for further action.

ANNEX V

FINAL REPORT - WORKING GROUP 34

INTERNAL DYNAMICS OF THE OCEAN

1. INTRODUCTION

Ocean currents are now known to be highly variable in both space and time with a great deal of energy occurring on temporal scales of weeks to months and spatial scales of tens to hundreds of kilometers. Such variability is prevalent throughout the world's ocean, occurring almost everywhere that observations exist with sampling adequate to resolve the phenomena. The variability is heterogeneous with energy levels and dominant scales varying widely from place to place in the ocean. Moreover, the structure of the variability takes many forms including: the meandering of narrow currents, semi-attached and cast-off ring currents, advective vortices which extend throughout all or part of the water column and which may occur in isolation or in groups, planetary and topographic waves, etc. All of these forms of variable form are commonly referred by the generic term 'eddies'. For more than a decade physical oceanographers have devoted a very large and vigorous international research effort towards the description of eddies, towards the discovery of their kinematics, statistics, and local dynamics, and towards an understanding of their role in the general circulation of the ocean. Although many of the fundamental questions remain to be answered and vast areas of the world ocean remain unexplored, substantial and definitive results have been obtained. The conceptualization of the dynamics of ocean currents and circulation is now more realistic, and the term 'eddy science' is used to identify knowledge and study of the variability phenomena.

The dynamics of eddies is first of all characterized by a nearly geostrophic balance of horizontal momentum and the term 'geostrophic eddies' is sometimes used generically. They are also often called 'quasigeostrophic eddies' but this term, as used by theoreticians, has a precise dynamical meaning; that the stretching term in the quasigeostrophic potential vorticity of the eddy field be generally comparable to the relative vorticity and that advections be approximately horizontal. This is the case for motions which have a horizontal scale on the order of the Rossby internal deformation radius (i.e. the vertical scale of the motion multiplied by the ratio of the Brunt-Vaisala buoyancy frequency to the Coriolis parameter). In the atmosphere, midlatitude cyclones and anticyclones which are thousands of kilometers in extent have this property and are often referred to as synoptic scale motions. By dynamic analogy then many authors refer generically to ocean eddies as 'synoptic eddies'. On the other hand, because the variability is of intermediate scale (i.e. less than gyre scale) the descriptive term 'mesoscale eddies' is very commonly used generically. At this time it seems best to designate the general phenomenon simply as 'eddies'. As more is learned about distinct kinds of eddy motions, more special general terms such as rings, planetary waves, etc. will naturally occur and generizeable dynamical processes and their dependencies on critical non-dimensional parameters will hopefully emerge.

This report constitutes the final report of Working Group 34 and deals with research dircetions for eddy science as indicated by the present status of eddy science and its relationship to ocean science generally. It is based upon the major review volume *"Eddies in Marine Science"* prepared during the past three years under the auspices of WG 34 which is being published in book form. *"Eddies in Marine Science"* summarizes and overviews our experimental and observational knowledge of eddies

throughout the world ocean, the modelling of eddies, and the opportunities for application of that knowledge in marine science generally. The reader is referred to that volume as background material and for its comprehensive bibliography. Ideas and information from that volume have been used throughout this report with no attempt at specific citations. The brief reference list at the end of this report includesonly a few review articles and general sources for information on research related to recently finished field experiments. Working Group 34 has been active since 1971 in providing a forum for the discussion of problems in eddy science and the means of dissemination of timely information, in the planning and coordination of international experimentation and modelling. A list of the relevant meetings of WG 34 is appended.

2. Eddies and the Dynamics of the General Ocean Circulation

a. Eddy-Mean Field Interactions.

A major significant result of the research of the past decade has been the identification of a primary mechanism for eddy generation by internal non-linear processes, finite amplitude processes related conceptually to baroclinic, barotropic, and mixed instability mechanisms. These processes occur in limited regions of the ocean, notably in the Gulf Stream System (separated current, extension, and recirculation regions) and the eddy energy generated there is exported by transport and radiative mechanisms to populate large regions of the sub-tropical and sub-polar gyres with eddies. This knowledge is not the result of direct measurement of eddy-mean field interaction terms and fluxes in the Gulf Stream System, but it is arrived at from the synthesis of the general analysis of numerical experiments carried out with eddy-resolving general circulation models (EGCM's) with the picture emerging of the observed geographical distribution of low-order statistics (e.g. eddy kinetic energy). The eddy-mean field interactions are believed to be complicated, heterogeneous, and highly variable in space and time. They are believed to be processes which lie at the heart of the question of the effect of eddies on the general ocean circulation, effects which include both direct eddy fluxes and also the transports by mean currents whose very structure and strength relate to the existence of the eddy field. The actual interaction processes that occur in the real ocean are essentially unknown but are expected to occur in all western boundary current systems as well as suspected to occur in other special regions of relatively strong current such as exist near the equator, eastern boundaries and polar regions. The Antarctic Circumpolar Current processes are known to be baroclinic and the resultant eddies to transport a significant amount of heat.

Because of the central importance of these processes, the scope of research required to resolve them and the relatively large amount of related information in the North Atlantic, WG 34 strongly recommends a dedicated and coordinated research programme for the Gulf Stream System (separate current, extension, and recirculation regions) to be undertaken and initiated in the second half of the 1980's with the general objective of determining the eddy-mean field interaction processes. The availability of satellite altimetry and other sensors should be exploited if possible. In any case, a mix of instruments and dedicated modelling should be utilized. In order to make this programme possible and successful the interim period should be devoted to the vigorous pursuits of model development and numerical experimentation including observation system simulations in EGCM's. During this period experimental and instrument and deployment system development (moored and free floating instruments) are also essential to allow for adequate data gathering capability in the strongest current regions.

b. Global and Regional Distribution of Kinematics and Dynamics

Much progress has been made in determining the geographical distribution of low order eddy statistics, i.e. amplitudes and scales, and in developing the taxonomy of eddies, i.e. identifying types of variability such as rings, mid-ocean mesoscale

eddies, and smaller geostrophic blobs and lenses. Some regions, however, are essentially unexplored, vast gaps exist in maps of the distribution of eddy properties, and it must be expected that new eddy types will be discovered in unexpected places. Longer time scales need to be examined since some of the few existing spectra of relatively long time series are "red". There are regions of the World Ocean which have vigorous eddy activity and others which are relatively weak. As noted above, consideration of the distributions of eddies and with that of strong currents indicates regions of internal production. Similarly, the geography of wind forcing, bottom topography, and thermohaline processes, etc. is indicative of other eddy energy production and conversion processes and their location. External wind forcing is thought to produce significant eddy energy in special and/or weak regions but this process is more poorly understood than are the internal production processes and additional research is required.

The transitional zone between the region dominated by equatorial scales and processes and the higher latitude region of the non-linear mesoscale eddies should be identified and investigated.

SCOR WG 34 recognizes the critical importance of a continuing research activity towards defining the global distribution of eddy kinematics and dynamics. In unknown regions even single moorings such as used in the NEADS programme provide valuable information. Ships of opportunity should be used for XBT lines with mesoscale sampling especially in remote areas. In this activity the cooperation of the CCCO which is planning an XBT programme for climate research purposes, could be of great help (i) to individual eddy scientists in facilitating arrangements and (ii) to eddy scientific research with mesoscale sampling along tracks sponsored by the CCCO. The IGOSS programme could serve as a basis for a dedicated XBT programme and WG 34 requests the SCOR Executive Committee to consider forwarding this report to IGOSS.

Ships of opportunity have been and can in the future be used to deploy drifting instrumentation trackable from satellites. Remote-sensed global coverage from satellite altimetry and other sensors will ultimately be of the greatest importance to this type of research and other new large-scale techniques such as acoustic tomography also hold promise for the future. Regional dynamical studies, such as POLYMODE and Tourbillon, have provided the basis for major research advances and such studies with various levels of effort must be continued in selected regions. Tailored regional and process models need continued development and their relationships to intensive regional data sets, for the testing of physical hypotheses and for optimal field estimation will become more intimate via new techniques of data analysis and assimilation (c.f. Section 5).

3. Eddies and their Interaction with Smaller-Scale Phenomena

The eddy models of the 1970's concentrated almost entirely on the dynamics of the internal radius of deformation scale motions themselves. The mechanisms whereby energy was finally lost were treated by ad hoc diffusion terms (typically of fourth or sixth order), just as the eddies themselves were and are parameterized in coarse resolution models. This situation needs improvement during the next decade. Ideas from models must still be regarded as preliminary since frictional parameterizations are probably oversimplified. The effect of phenomena like intrusions, double diffusion, and breaking internal waves will all have to be studied and included in the diffusive terms. A basic problem here is that there is no satisfactory model of mixing along isopycnals. Indeed, in models without eddies, fluid tends to spread only about one deformation radius from its source unless mixing or frictional terms are included to aid the spreading process. Both the mixing by internal waves, and the interaction between eddies and internal waves, also need study. The stirring by eddy and larger scales along isopycnal surfaces and the possibility of significant subsequent diapycnal mixing because of smaller-scale processes is another important research topic.

The effects of fronts need to be studied and parameterized. Fronts of all sizes tend to be unstable and shed eddies, each of which has its own small deformation field and front associated with it. Much of the dissipation by eddies may be due to this frontal hierarchy. Some known examples include the violent frontal eddying in the West Spitzbergen current, and the observed intrusions and double diffusion on strong fronts like the Mediterranean outflow. Even lenses like the "meddy" may have their own unstable fronts.

Studies are only just beginning on 'blobs' or lenses of water (tens of kilometers in the horizontal and a few hundred meters vertically), which seem to be able to propagate long distances in the ocean. This phenomenon appears in a variety of forms and sizes, usually with a surprisingly gradual change in water mass properties. Some lenses appear to have produced their own water mass by some form of vertical circulation and/or mixing over lengths of a few hundred meters, with little signature above and below those depths. Some, like the meddy, have carried a water mass from some far-distant origin. It would be useful, but difficult, to follow one or more lenses to watch their evolution. Each of these must have very different fluxes of buoyancy, momentum, and vorticity, and require urgent study. The statistics of such lenses should also be studied.

Scientists now know that previous methods of data quality control have removed evidence of real physical phenomena from data sets; we recommend the examination of older data sources for evidence of small-scale phenomena. The problem of differing length (e.g. in the Tourbillon experiment, there was a distinct 10 km central mass within a 100 km eddy) will require further attention to finely-spaced observations.

4. Eddies and the Large-Scale Distribution of Properties

During the decade of the 1970's there was a rapid development in numerical models of basin scale ocean circulation, particularly models with fine horizontal resolution suitable for resolving the eddies explicitly in the larger scale flow. These have been called eddy-resolved general circulation models - EGCM's. This class of model came along to supplement earlier coarse resolution models that had been developed to examine the time-averaged World Ocean circulation in which the effect of eddies is completely parameterized (ocean general circulation models - OGCM's). Most recently, the EGCM's have begun to show the ability to simulate realistically the geography of variability in an ocean basin, reproducing the multiple sources of eddy energy in the North Atlantic basin. This work needs to be continued and the comparison with observation refined to determine how well such models can do in simulating real ocean transients, including the mean flow and a whole host of eddy statistics.

The development stage of eddy-resolved models is far from complete. Future studies will require more vertical resolution and the inclusion of more realistic thermodynamics and thermohaline forcing. The role of bottom topography and the influence of realistic wind forcing (with observed space and time scales) need exploration. An understanding of the role of parameterized friction and boundary conditions is also needed. All of this implies a vast amount of work and development of additional kinds of models in the next few years.

This kind of modelling activity should be expanded to other basins, like the North Pacific, where comparable data for comparison is becoming available and where presumably a somewhat different physical environment will provide new tests of the models. An immediate objective, in support of observational programmes in the North Pacific, would be to compare and contrast the amplitudes and patterns of eddy variability in the North Atlantic and North Pacific oceans with the view of understanding basic differences between the basins.

Other subregions of the World Ocean are, of course, also of interest, e.g. the Southern Hemisphere oceans with their very different geometrical constraints. These are particularly important since little is known about their variability, particularly in the South Atlantic and South Pacific. In this regard there can be a particularly useful handshake between the modellers and the observationalists. Data gaps (in mean quantities as well as eddy variability) need to be filled. This would allow critical tests of the models, while the models would produce predicted distribution of eddy variability for these data sparse regions, pinpointing critical areas for observation.

The current class of efficient high resolution eddy-resolving models, based upon quasigeostrophic dynamics, is not suitable for the study of density outcrop regions, i.e. the high latitude regions where water masses have their origins. Therefore it seems necessary to develop new models as well as to bring earlier primitive equation models to bear on this problem. This is critical in particular for the understanding of the distribution of properties, as well as of the rates and mechanisms by which such water masses are produced. The hypothesis that along isopycnal mixing is the fundamental mixing process in the ocean will require new studies and perhaps new models if we are to understand this critical mechanism for water mass production. This is particularly true for the study of transient tracers, such as tritium and the fluorcarbons, which are currently showing us some of the basic time scales and pathways for deep water production and thermocline ventilation.

A research topic of great importance for which progress may be expected during the next decade is the parameterization of eddy effects in coarse resolution (non eddy resolving) general, ocean circulation models. Empirically the unexpected result is emerging that the diffusivity is directly proportional to eddy kinetic energy. Schemes must be tested by reproducing mean EGCM results via a correctly parameterized OGCM, including the indirect effects of eddies, (e.g. the existence of deep currents which are not locally supported by Reynolds-stress-like processes.

5. Techniques, Methods, and Resources

We recognize the important and growing contributions of satellite remote sensing of the ocean, especially when combined with the array of existing and newly developed in situ measurement systems. Satellite sensors have several unique characteristics, combining global repetitive coverage and good resolution with the consistency deriveable from a single or limited number of instruments. For eddy science, radar altimetry will play a major role when future systems, based on the Seasat results, become available in five to ten years. At the same time, surface wind stress obtained from scatterometry will be providing an essential input to the accurate wind fields needed to drive realistic numerical models. At the present, visible infrared, and microwave radiometers for sea surface colour and temperature, as well as satellite-tracked drifters, play a useful and unique role in the investigation of the global geographic distribution of eddies and currents. When repeatedly deployed from ships-of-opportunity, drifters with lifetimes exceeding one year represent a cost-effective means of obtaining daily surface velocity information. The radiometer data are also proving to be extremely useful for providing guidance to research vessels before and during experiments such as the Gulf Stream warm rings project.

Special problems arise in the management of satellite data, requiring special computer facilities to help speed, handle, and reduce the data volume, while retaining information content. We recognize the efforts of NASA and CNES in providing systems to address these porblems for oceanographers, and encourage similar efforts by others planning to launch satellites.

For several decades meteorologists have recognized the important problem of data assimilation, i.e. the construction of regular fields from irregularly spaced observations of mixed type and quality. In the last ten years, the essential role of interpretive numerical models in the utilization and the assimilation process has also become widely appreciated by atmospheric scientists and carefully explored. As ocean satellite systems develop over the next ten years, it will be important to benefit from past meteorological experience. For example, an interpretative model can use SST to estimate upper layer and thermocline positions. The best field estimates comes from a combination of data and dynamical models (the dynamic-stochastic method). For example, future altimeter systems will provide surface geostrophic current along lines spaced perhaps 200 km apart, every ten days. Sparse measurements from individual ships, moorings and drifting buoys will provide crucial additional subsurface temperature and velocity information. Driven by wind stress fields mostly derived from satellites, numerical models with correct dynamics and properly constrained by these data must be used for spatial and temporal interpolation and extrapolation, including hindcasting and forecasting. As meteorologists have come to learn, this type of approach is the only practical means by which diverse data can be analyzed over regional and global dimensions, in a manner consistent with the known but complex physical processes. Although we have stressed satellite measurements in this paragraph, data assimilation methods are of great importance now for mixed in situ data sets. In particular, we mention the value for eddy research of continually-seeded Lagrangian drifter arrays.

Computer resource availability has placed limitations on the development and testing of eddy-resolving general circulation models, as well as the processing of large volumes of satellite-derived data. As has occurred in meteorology, we expect in ocean science a convergence of these two separate problems, as stochastic-dynamic model techniques evolve. We therefore recommend that the new SCOR Working Group dealing with satellites and future groups that may address synoptic scale oceanography, data assimilation, and numerical modelling, not operate in isolation from each other.

6. Applications and Implications

The preceeding discussion has dealt with the progress and problems in the physical science of eddies themselves and of their interactions with other physical phenomena on other (shorter and longer) time and space scales. However, the existence of the eddies as the dominant flow over much of the world oceans has profound implications on other branches of marine science (e.g. biological, chemical and coastal oceanography) and on technical questions of a practical nature associated with the management of the sea and the exploitation of its resources, which are of great concern to society.

Most importantly, the various types of eddy motions provide a variety of direct and indirect transport mechanisms for dissolved substances and other particles which are totally or partially forced to drift with the currents. Such substances, often referred to as tracers, include naturally occurring and anthropogenic chemical tracers, (oxygen, tritium, etc.), biological nutrients and organisms (e.g. phytoplankton. fish larvae), and pollutants or waste materials either accidentally or intentionally released into the oceans (e.g. oil, chemical and nuclear wastes). Observing the distribution and redistribution of geochemical tracers such as tritium, helium and freon can be used to infer the oceanic general circulation, and the next several years should see an enhanced and vigorous interaction between geochemists and physical oceanographers involving the application of numerical modelling.

Biological productivity in many areas of the world's oceans is closely linked to eddy-related transport of nutrients or of the organisms themselves. Strong mesoscale features such as rings and fronts which are advective are known to provide distinct boundaries for biological variables. The biological consequences of mid-ocean eddies and situations where planetary wave-like propogation effects dominate

are essentially unknown. Factors which are now known to vary across mesoscale boundaries include characteristics, concentrations and structures of populations, mixed layer properties, the diurnal vertical migration within a species and the partitioning of the standing crop between species. Much research is needed in this general area involving biological sampling on the mesoscale with simultaneous chemical and physical measurements.

The climate of the earth and its change from year to year and on larger time scales is thought to be governed in large part by oceanic processes. Eddies play a role directly via eddy heat flux in some areas (e.g. Antarctic Circumpolar Current, the Gulf Stream System) and also indirectly through their effects on general circulation features and large scale air-sea exchange at the boundary with the atmosphere. Near coastal boundaries, eddies generate topographic waves which are, in part, radiated to the rise, shelf and slope regions; providing a dissipation mechanism for mesoscale features. Eddies can induce upwelling, maintain long-shore pressure gradients via momentum flux, and onshore eddy fluxes of heat, salt and nutrients can contribute importantly to shelf-wide budgets.

Forecasting of the synoptic/mesoscale variable currents is becoming feasible and will be of considerable utility for commercial and management purposes such as fisheries, transportation and resource exploration and acquisition. Moreover, the transmission of sound through the sea is known to be significantly affected both by advective effects of eddy currents and most importantly by the range dependent environment caused by eddy induced variability of sound speed. Eddy currents, their statistics and transports bear on a number of planetary scale management issues such as chemical waste dumping and seabed or sub-seabed disposal of nuclear waste material. Eddy transport may influence the degree to which the ocean acts as a reservoir for anthropogenic CO_2 (and the time scale of the process) which has a significant impact on world climate modification due to human industrial activity. Eddy exchange processes across the shelf break impact questions of coastal zone pollution and management.

Many fruitful areas of scientific and practical application of the growing body of knowledge of eddy science are now ripe for research and development activity. At this point in time if expert physical scientists work hand in hand with other marine scientists, engineers and managers, rapid progress can be expected in a number of important problem areas.

APPENDIX I

Meetings of SCOR WG 34

9 August,	1971	-	Moscow. SCOR Proc. Vol. 8 No.1 1972. Planning for Mid Ocean Dynamic Experiment and New Models.
23, 24, 28 June	1974	-	Melbourne and Canberra. SCOR Proc. Vol. 10 No. 1 1974. Plans for US-USSR POLYMODE programme and broader international cooperation.
5 Sept.	1975	-	Grenoble. SCOR Proc. Vol. 11 1976. Discuss POLYMODE, recommend NEADS, and modelling parameterization study.
30, 31 March	1976	-	Wormley. SCOR Proc. Vol. 12 1976. NEADS subgroup plans field programme.
23, 27, May	1977	-	Helsinki. SCOR Proc. Vol. 12 1976 and Vol. 13 1977. Modelling study conference jointly with JOC/WGNE

12 Dec. 1979 - Canberra SCOR Proc. Vol. 16 1980.
Plans for 'Eddies in Marine Science'.

29 July,
1 August, 1982 - Halifax.
Discuss future directions for eddy science.

APPENDIX II

Conduct of WG 34 Meeting in Halifax, NS. August 1982.

Sunday, August 1: SCOR Working Group 34 meeting held from 9:00 am to 6:00 pm. The following SCOR members participated in the meetings:

Professor A. Robinson	Chairman	
Dr. L. Fomin	USSR	
Dr. R. Bernstein	USA	
Professor G. Siedler	FRG	
Dr. W. Holland	USA	
Professor G. Needler	CAN	
Dr. J. Gonella	France	
Dr. C. de Verdiere	France	
Dr. P. Killworth	UK	(alternate for A. Gill)
Professor B. Nelepo	USSR	
Professor H. Charnock	Executive Reporter	

Present as observers and also as participants:

Dr. K. Fedorov	Inst. of Oceanology, USSR.
Dr. T. Spence	ONR, Washington, D.C. USA.

Monday, August 2: The morning prior to the day's meetings, members spent drafting materials; afternoon was opening session of JOA. From 6:00 pm to 9:00 pm, the second meeting of WG 34 was held. All above were present, with the exception of the two observers.

In the course of these two meetings, the status of eddy research was drafted and discussed.

APPENDIX III

References

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ANNEX VI

WORKING GROUP 54

SOUTHERN OCEAN ECOSYSTEMS AND THEIR LIVING RESOURCES

Report from Chairman - Prof. Sayed Z. El-Sayed

Considerable progress has been made by the Working Group on Southern Ocean Ecosystems and Their Living Resources and its subsidiary bodies in preparation for the implementation of the Second International BIOMASS Experiment (SIBEX) and with the analysis of the data collected during the First International BIOMASS Experiment (FIBEX). These activities are summarized below.

1. FIBEX EXPERIMENT COMPLETED

FIBEX, the largest multi-ship experiment in biological oceanography ever mounted, was successfully completed in March, 1981. FIBEX involved the research efforts of twelve participating vessels which concentrated on a detailed study of the physical, chemical, and biological properties of the western Atlantic, western Indian and Pacific sectors of the Southern Ocean during February of 1981.

2. POST-FIBEX DATA INTERPRETATION WORKSHOP

From 21 September to 9 October 1981, scientists from Argentina, Australia, Chile, France, the Federal Republic of Germany, Japan, Poland, South Africa, the USSR, U.K. and U.S.A. met at the University of Hamburg to compare and analyze the data gathered during FIBEX. The workshop was particularly significant in that scientists from the above countries met to share unpublished data from their research cruises of only nine months earlier in an attempt to jointly analyze physical, chemical, hydro-acoustic and biological data using an advanced computer system. This system was an experimental fisheries database developed by the Information Management System Research Group of the Computer Department (Fachbereich Informatik) of the University of Hamburg from their relational database management system PASCAL/R. The significant findings, which demonstrated the powerful potential of the system for processing large quantities of complex data, included important biological information, especially on krill stock size, with variance estimates, from the survey areas. These and other findings are contained in BIOMASS Report Series No. 20.

3. SIBEX PLANNING

With the experience gained during FIBEX and the Post-FIBEX Data Interpretation Workshop, planning is now underway for SIBEX, scheduled for 1983-85. A small scientific advisory Group for SIBEX was formed to recommend, to the Group of Specialists, action needed to fully exploit FIBEX data, and to indicate priorities and the necessary time scales for adequate planning and implementation of SIBEX. This group was also requested to advise on the scientific content of the program and the needs of post-SIBEX data analysis (see details below). This group met in Cambridge from 21 - 23 April, 1982, and their report will soon be published as *BIOMASS Report Series No. 23.*

4. MEETING OF WORKING GROUP 54 IN NIKKO, JAPAN

The Group met in Nikko between 30 May and 4 June, 1982. Results and highlights of that meeting are summarized below.

4.(a) Scientific Objectives of BIOMASS and SIBEX

Working Group 54 discussed whether the general objectives of BIOMASS, as laid down in Woods Hole, Mass., in 1976 required revision. It was felt that there is no need for any change except for pointing out that some of the Antarctic living resources are already being exploited. The group also noted that the biology of the krill and its relation to the environment continue to be a research field of high priority, and the group identified the following among key topics which need to be investigated:

i Growth and mortality in different areas.
ii Spawning success and recruitment mechanisms.
iii Stock separation and migration patterns.
iv Krill survival in and underneath the ice.

Thus, while FIBEX gave a synoptic picture of krill, the primary SIBEX objective is to obtain a deeper understanding of the dynamics of the krill-dominated part of the Antarctic ecosystem. The group also noted that studies of the biology of fish, birds, mammals in the East Wind Drift should be investigated as parts of SIBEX, because of their role in the krill-dominated system. Further, the group considered that a study of the pack-ice was of vital importance in understanding the Antarctic marine ecosystem. The group, therefore, proposed that SIBEX should give special attention to questions related to the pack-ice.

4.(b) Research Planning for SIBEX

The Scientific Advisory Group for SIBEX (see above) recommended that research during SIBEX be concentrated on the study of mesoscale processes in the Southern Ocean rather than on a circumpolar study. They recommend that this could best be achieved by multi-ship operations in selected areas (e.g. western approaches of the Antarctic Peninsula and Bransfield Strait to the Scotian Ridge and South Orkney Islands in the Atlantic sector; the area of the East Wind Drift between 60°E and 80°E, with special reference to the Prydz Bay in the Indian sector, and the area of oceanic gyres about 160°E in the Pacific sector), to study the interactions and processes within the ecosystem over all seasons. The group considered that early spring, and if possible, winter work should be particularly important. The group is now formulating a detailed research plan designed to answer the key questions which it has identified.

4.(c) BIOMASS Data Centre

The Working Group held extensive discussions on the management and analysis of data within the BIOMASS program. The principal conclusion was that the establishment of a Data Centre was critical to the future of BIOMASS.

The group agreed that it would be useful to re-examine FIBEX data in small specialists' groups, rather than to hold another large workshop in the near future. The group considered two aspects of the longer-term data processing needs for BIOMASS: first, the types of computing facilities required for the analysis of FIBEX and SIBEX, and second, the relationship of BIOMASS data to the data system of the Scientific Committee of the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR). The group concluded that a Data Centre for BIOMASS should be established as soon as a suitable system could be implemented.

It should be pointed out that the Data Centre is envisaged primarily as a data bank under the control of Working Group 54, interfaced with a wide range of analytical software and serviced by a small support staff. It is now expected that the BIOMASS facility would be associated with an existing institute rather than being an entirely self-contained organization. The group considered possible localities for the BIOMASS data bank but had insufficient information to make a recommendation. The group agreed that the possibility of the establishment of a BIOMASS Data Centre should be investigated without delay. To this end it was agreed that:

4.(c) contd.

i a small *ad hoc* sub-committee be established to do this, and that its report and recommendations for action be submitted to the Working Group not later than December 1982;

ii after consideration of the report and its recommendation, the BIOMASS Executive should recommend appropriate action to the SCOR and SCAR Executives.

4.(d) Reorganization of the Structure of Working Group 54

The Working Group discussed the organization of its subsidiary units to advise on different aspects of the BIOMASS Program and reviewed its own role and composition in light of the views expressed by the SCAR Executive at its October 1981 meeting. The group felt that it was desirable to retain the group as presently constituted with 14 members, but in order to provide for more rapid and effective advice on the conduct of BIOMASS affairs, it was agreed that a smaller BIOMASS Executive group (composed of Drs. S.Z. El-Sayed, G. Hempel, R.M. Laws, T. Nemoto and G.G. Newman) be established. It was recommended that Working Group 54 meet every three years and that the Executive meet at least annually in the interval between the meetings of the Working Group.

4.(d) 1. BIOMASS Technical Groups

While it was agreed that the three Technical Groups be maintained, they would operate under new/revised terms of reference. These Technical Groups are: Programme Implementation and Coordination; Methods, and Data Management and Ecosystems Analysis.

4.(d) 2. BIOMASS Working Parties

The BIOMASS Working Parties were considered to have been terminated at the Nikko meeting and proposals for the re-establishment of some groups and the creation of new groups were discussed. It was recommended that the following be established:

Working Party on Bird Ecology

The terms of reference of this Working Party remain unchanged; the membership will be reviewed.

Working Party on Fish Ecology

Revised terms of reference for this Working Party were approved. A revised membership was also approved.

Working Party on Krill Ecology

New terms of reference for this Working Party were approved and membership is being finalized.

Working Party on Pack Ice Zone Studies

Terms of reference for this newly established Working Party were approved. Its membership is still under consideration.

Working Party on Acoustics

Terms of reference for this Working Party were approved, and a list of members is being considered.

The Working Group adopted rules for the above-mentioned Working Parties; these pertain to annual reports on their past activities, future plans and proposals to help meetings/workshops, and financial assistance that might be required.

4.(d) 2. contd.

Ad Hoc Groups -

These *ad hoc* Groups are considered to have more limited life span than the Working Parties. The rules for their operation will be the same as for the Working Parties. The new *ad hoc* Groups established are:

i *ad hoc* Group on Squid Ecology

ii *ad hoc* Group on Modelling

iii *ad hoc* Group on Scientific Planning for SIBEX

The terms of reference for the above *ad hoc* Groups were approved; however, suggestions for membership are still under consideration.

4.(e) BIOMASS Fund and Secretariat

At XVI SCAR in Queenstown, N.Z., in October 1980, it was recommended that a separate BIOMASS Fund of 150,000 U.S. dollars ($50,000 from SCAR/SCOR funds, and $100,000 to be made up of contributions from participating organizations at $7,700 per country) be established to cover the costs associated with the activities of the Group of Specialists on the Southern Ocean Ecosystems and their Living Resources, and to contribute toward the establishment of a BIOMASS Secretariat. To date only five countries have contributed to the BIOMASS Fund, and thus it has not been possible at this time to proceed with the establishment of the BIOMASS Secretariat as originally envisaged. The funds which have been contributed are being held by SCAR and will only be spent with the agreement of the countries concerned.

However, additional funding is still required in order to maintain the overall impetus of the BIOMASS Program and to provide for the data interpretation so that an adequate scientific basis may be established upon which decisions concerning the exploitation of the living resources can be based. These funds are needed to support the Convenor (whose office, in effect, has carried out the functions of a BIOMASS Secretariat) and to assist in the establishment of a BIOMASS Data Centre. With this in mind the Working Group recommended that the special BIOMASS Fund be used to support both of these needs.

4.(f) BIOMASS Budget

The Working Group recommended that one of its members serve as treasurer and that an annual budget for the period 1982-84 be prepared as soon as possible and circulated to the group and the sponsoring organizations.

To enable the Working Group to continue on with its various activities, financial support is requested from SCOR to supplement the funds received from the other co-sponsors, most notably SCAR.

5. BIOMASS PUBLICATIONS

5.(a) BIOMASS Report Series

To date 22 reports have been printed and distributed in this series. The following reports are in preparation: BRS No. 23: *Report of the BIOMASS Scientific Advisory Group for SIBEX*; BRS No. 24: *Report of the Group of Specialists, Nikko, Japan, 30 May-4 June, 1982.*

5.(b) BIOMASS Handbook Series

Twenty BIOMASS Handbooks have been printed and distributed.

5.(c) BIOMASS Volumes 1 and II (these were published in 1977 and 1981, respectively).

Vol.III: *Swimming Behaviour, Swimming, Performance and Energy Balance of Antarctic Krill, Euphausia superba.* (Publication, late 1982).

Vol. IV: *Review of Current State of Knowledge of the Southern Ocean Ecosystem.* (Publication, 1983).

5.(d) BIOMASS Brochure (Published in 1981).

5.(e) BIOMASS Newsletter (Published irregularly; semi-annually).

6. MEETINGS/WORKSHOPS/SYMPOSIA HELD IN 1982

20-23 April:	Meeting of Scientific Advisory Group for SIBEX (Cambridge).
24-26 May:	SCOR/SCAR Workshop on Enhancement of Interaction between Physical, Chemical and Biological Oceanographers (Tokyo).
27-28 May:	BIOMASS Colloquium (Tokyo, Japan).
30 May - 4 June:	Meeting of Working Group 54 (Nikko, Japan).
7 - 10 June:	Workshop on Aging of Antarctic Fish (Maine, U.S.A.).

7. FUTURE MEETINGS OF THE WORKING GROUP AND ITS SPECIALIZED BODIES

1982:	
August:	Meeting of Bird Ecology Working Party (Cambridge, U.K.).
20-25 September:	*ad hoc* Meeting of the Fish Ecology Working Party (Hamburg, F.R.G.).
27 Sept. - 1 Oct.:	Meeting of the *ad hoc* Group for Scientific Planning of SIBEX (Bremerhaven, F.R.G.).
	Meeting of the Technical Group on Programme Implementation and Coordination (Bremerhaven, F.R.G.).
20-26 September:	FIBEX Oceanographic Data Workshop (Hamburg, F.R.G.).
1983:	
February/March:	Workshop on Problems of Interpretation of Hydroacoustic Data (Location to be arranged).
April:	Regional Symposium on Recent Advances in Antarctic Aquatic Biology with Special Reference to the Antarctic Peninsula Region (Buenos Aires, Argentina).
May:	Workshop on Krill Biology (Bremerhaven).
July:	Acoustic Data Workshop (Hamburg, F.R.G.).
	Krill Data Worskshop (Hamburg, F.R.G.).
	Bird Data Workshop (Hamburg, F.R.G.).
	Meeting of SIBEX Chief Scientists (Atlantic Sector) Bremerhaven, F.R.G.).
September:	International Workshop to Analyze Southern Ocean Seabird Data (South Africa in conjunction with the Fourth Antarctic Biology Symposium) in Wilderness, S. Africa.
	Meeting of BIOMASS Executive (South Africa in conjunction with the Fourth Antarctic Biology Symposium).
October:	Meeting of SIBEX Chief Scientists (Indian Sector) in Wilderness, S. Africa.

8. RECOMMENDATION FOR RETAINING WORKING GROUP 54 AND SUBSIDIARY BODIES

It is clear from the above summary of the activities of Working Group 54 and its subsidiary bodies that the following contributions have been made to the oceanographic community and to marine research:

i the largest international, cooperative, biological oceanographic expedition ever undertaken (FIBEX) was successfully planned, organized and executed.

ii the data gathered during the FIBEX expedition was compiled, processed, shared and analyzed by the participating nations.

iii these data are furthermore available for more detailed analysis and comparison with data from other scientific sources.

iv the planning of SIBEX, the Second International BIOMASS Experiment has begun.

v the activities of Working Group 54 have helped and will continue to help with coordination of the scientific efforts of its several sponsors (SCAR and SCOR, IABO and ACMRR). Furthermore, it has contributed to and will continue to contribute to cooperation among its sponsoring organizations and other scientific bodies.

It is therefore recommended that the Working Group be allowed to continue its invaluable work.

ANNEX VII

"FLOWS OF ENERGY AND MATERIALS IN MARINE ECOSYSTEMS: THEORY AND PRACTICE"

Report of a conference organized by Dr. M.J.R. Fasham on behalf of SCOR WG 59

Bombannes 12-19th May 1982

The conference consisted of a mix of keynote lectures and working groups which studied the problems and future perspectives in measuring fluxes for seven processes that, as a whole, make up a marine ecosystem. These processes were a) Autotrophy b) Respiration c) Herbivory d) Carnivory e) Detritivory f) Mineralization and excretion and g) Bacterial production and bactivory.

The discussions in the groups were extremely stimulating and each group presented a report at the meeting which will be published in the proceedings of the conference. These reports are still being edited but for the information of the SCOR Executive some of the key recommendations of the working groups are listed below. It is hoped that these may be of assistance in future decisions on the setting up of SCOR working groups or organizing international collaborative research.

RECOMMENDATIONS

1. A workshop should be held, initially in a shore-based laboratory and subsequently during a cruise, to ascertain which of the variants of the commonly used methods for measuring primary production and pigments are of trivial significance for the results and which have more far-reaching implications. The ultimate aims would be to find a consensus on the optimal procedure.
2. Multi-disciplinary programs should be organized to study identified processes in terms of the forcing functions and mechanisms acting upon autotrophs; these programs could bring together specialists in different experimental and analytical techniques, to simultaneously study a series of sites located along gradients in the forcing variables. There is also a need to provide a modern comprehensive set of data on the seasonal variation of phytoplankton in the open ocean with which to critically test recently developed models of this process.
3. More attention needs to be given to fluxes involving small organisms (bacteria, ciliates, microflagellates) and to fluxes involving large zooplankton (gelatinous forms, large crustacea) and herbivorous fish.
4. A number of short-cut methods of measuring herbivore production were discussed and thought worth pursuing. However, it was also considered that these methods should be calibrated against the standard cohort analysis method.
5. Copepods have recently been shown to eat their own faecal pellets and it was recommended that an investigation be made of whether a given population might migrate downwards at dawn to ingest its own faecal pellets. If this is a significant process it would change our estimate of the ecological efficiency of herbivore populations.
6. It was recognized that there are some important components of the marine ecosystem (e.g. higher carnivores, micro-zooplankton, bacteria) for which biomass data are still very scanty. Properly analyzed, with information on size distribution, species composition or functional groupings, biomass data will continue to be essential information for ecosystem studies.

7. The biological complexity of carnivory necessitates closer integration of ecological research with other fields, notably physiology and ethology.

8. The subject of detritivory has recently been transformed by the development of simple parameterisation of the detritus feeding process and it is recommended that future experimental work be planned to test the conclusions of this model and if necessary extend and develop it.

9. More experimental work is required into the role of zooplankton excretion in nutrient regeneration, especially in sub-tropical and tropical zones.

10. It was considered that the "microbial loop" from bacteria - flagellates - micro-zooplankton is quantitatively comparable to the phytoplankton - herbivore route in the flux of energy and materials and is important for the rapid, large scale remineralization in the mixed layer. This loop is closely coupled to phyto-plankton production and the rate of bactivory by flagellates may control the outcome of competition for limiting nutrients between phytoplankton and bacteria. In view of the importance of this process it is recommended that a workshop be held to inter-calibrate methods for estimating bacterial standing stock and production, rates of bactivory and the coupling between processes in the microbial loop.

11. Many biological processes are critically affected by physical processes (such as wind mixing, advection and diffusive flow across the thermocline) which are often poorly understood or parameterized, especially in the open oceans. There is therfore a need for joint physical-biological research and it is recommended that whenever large physical oceanographic programmes are being planned greater consideration be given to the possibility of biological contributions.

ANNEX VIII

WORKING GROUP 67

OCEANOGRAPHY, MARINE ECOLOGY AND LIVING RESOURCES

Report prepared for the IOC

SUMMARY AND RECOMMENDATIONS:

1. A set of experiments collectively called the International Recruitment Experiment (IREX) is proposed to investigate the relationships between environmental variability and fluctuations of living resources.
2. It is recommended that a separate working group be set up to determine the feasibility of IREX application to high diversity ecosystems.
3. It is recommended that the Committee on Climate Changes and the Ocean (CCCO) support the IREX activities through the Time Series Study Group of the Biology Panel.

BACKGROUND

Marine fisheries have changed dramatically in recent years. World fish landings increased from 19 million tons in 1950 to 61 million tons in 1980, and the expected rate of growth of the world population indicates that there will be continuous pressure to increase fish catches. Technological improvements and innovations in fishing gear, fish finding and capture techniques, fishing vessels, and fish processing equipment have greatly increased the ability to catch fish throughout the ocean. While overfishing was an actual or potential problem in merely a few limited areas a couple of decades ago, the capabilities for increased harvesting now exist on a broad enough scale for over-exploitation to be an actual or potential problem virtually anywhere in the world ocean.

Even where this is not a problem, exploited stocks are under heavier fishing pressure than ever before. Management techniques must be applied now or in the near future in most fisheries to conserve the resources and maximize the economic and societal benefits. Proper management requires a foundation of research on both the fish and on the ocean environment in which they live. Where regulation is not yet a prime concern, there is usually a need for fisheries development programmes to make use of the available living resources. Unfortunately, neither the capability to conduct research in living resources and other ocean sciences nor the scientific infrastructure to do it has kept pace with the ability to catch fish.

On the other hand, the authority and responsibility of coastal states over fisheries and other marine resources have changed dramatically, particularly in the last decade, as a result of extended jurisdiction by coastal states and advances made in the Third United Nations Conference on the Law of the Sea. Until a few decades ago most coastal states asserted authority over fisheries in only a narrow band along their coasts, generally three to twelve nautical miles. Limited authority over fisheries was exercised through a few international fisheries commissions in areas beyond this narrow band in only a few regions where a strong scientific capability existed to support the regulatory efforts. Now, however, most coastal states have extended their fisheries authority two hundred miles out from their coasts. Thus, the area for which coastal states are responsible for management, conservation and development has increased tremendously, encompassing most of the world's prime fishing grounds. While extended jurisdiction over most of the world's fishing areas is now recognized, so too is the need for a better understanding of what goes on in those areas. This is illustrated by the obligations as well as the

rights set out in the Law of the Sea treaty regarding the exclusive economic zone. There is now a clear need, as well as a clear obligation, for coastal nations to pay close attention to the interactions within their extended economic zones of climate, ocean variability, the activities of society and variability of living resources.

Nations have responded to this situation through various national, bilateral, and multilateral approaches to expanding and improving the basic and applied fisheries and other ocean science infrastructure. For example, the Food and Agriculture Organization of the United Nations (FAO) has launched an Exclusive Economic Zone (EEZ) Programme to assist developing countries in exercising their new responsibilities for fisheries in their expanded zones, particularly the applied aspects of fisheries development and conservation. At the same time, the Intergovernmental Oceanographic Commission (IOC), through a study of the Future Role and Functions of the Commission, identified a clear need, inter alia, to expand basic research in marine resources, particularly ocean sciences as they apply to fisheries, and to improve and expand the infrastructure of developing countries in these fields. Such an expanded effort in basic research would provide the foundation necessary for conservation and development of fisheries. Consequently, the Member States of the IOC at the Eleventh Session of the Assembly adopted Resolution XI-17 "Ocean Sciences in Relation to Living Resources" (OSLR). A copy of the resolution is given in Appendix 1. Resolution XI-17 states that IOC has decided to plan a major program "on Oceanographic studies of the marine ecological conditions in relation to fish stocks" and asks the Advisory Committee on Marine Resources Research (ACMRR) of FAO and the Scientific Committee on Oceanic Research (SCOR) "to develop a comprehensive scientific programme plan and project proposals for research projects".

SCOR and ACMRR responded to the IOC request by forming Working Group 67, "Oceanography, Marine Ecology and Living Resources", with the following Terms of Reference:

1. Assess present understanding of the mechanisms through which variability in the physical-chemical marine environment affects the biological productivity of the ocean and the abundance and distribution of living marine resources.
2. Based on this assessment, identify promising directions and possible priorities for relevant research.
3. Consider appropriate regional research projects and related activities that are of interest and benefit to countries of these regions.
4. Provide advice for the Intergovernmental Oceanographic Commission on the above aspects of their Resolution XI-17 "Ocean Sciences in Relation to Living Resources".

WG 67 agrees with the SCOR Executive Committee that a particularly critical time has arrived because both society and exploited stocks are now more sensitive to ocean variability. The major reason is fishing itself; the more we fish, the more we depend on our fishing, and the more society is affected by fish stock variation. On the other hand, living resources are also likely to become more sensitive to ocean variability when they are under heavy exploitation. Thus, the more we fish a stock, the more vulnerable it is at times when environmental conditions are poor. Expansion of harvest of food from the sea, or even the maintenance of the present level of harvest, requires a much improved understanding of the relationship between ocean variability and stock variability. It would be clearly beneficial to all Member States of IOC if it were possible to draw for their own management needs on an intercomparison of various fisheries research programmes and to be able to extrapolate the research results from one area of the ocean to another.

ASSESSMENT OF THE PRESENT UNDERSTANDING

The first Term of Reference of WG 67 was: "assess the present understanding of the mechanisms through which variability in the physical-chemical marine environment affects the biological productivity of the ocean and the abundance and distribution of living marine resources".

WG 67 reviewed the available literature and noted that the vast majority of work related to effects of environmental variability on living resources is concerned with relatively low diversity ecosystems where ten or fewer species make up 90% of the biomass, as distinct from high diversity ecosystems where 100 or more species make up the bulk of the biomass. Several excellent synthesis papers have been written in regard to the former and we recognize the quality and merit of these assessments. One of the most recent is IOC Workshop Report 28, the report of an FAO-organized workshop held in 1980 entitled "Workshop on the Effects of Environmental Variation on the Survival of Larval Pelagic Species". WG 67 found the review, edited by Gary Sharp, to be particularly thorough and up-to-date for pelagic species. (A list of references is given in Appendix 2). An earlier synthesis we used is "Marine Ecosystems and Fisheries Oceanography" edited by Parsons, Jansson, Longhurst and Saetersdal which contains papers from four symposia of the 1976 Joint Oceanographic Assembly. We also acknowledge two books that are valuable syntheses; "Early Life History of Marine Fish, The Egg Stage", by Hempel and "Marine Fish Larvae" edited by Lasker.

WG 67 had available the IOC draft report on OSLR entitled "Meeting of Experts on Ocean Sciences in Relation to Living Resources (OSLR)," IOC/INF-438. In addition to the original and revised report we had comments by 22 marine scientists who reviewed the report and a summary of these comments. WG 67 feels that the revised report of the "Meeting of Experts on Ocean Sciences in Relation to Living Resources" (OSLR) stands on its own as a contribution to OSLR.

WG 67 discussed at great length the syntheses given in the papers mentioned above, and we note two aspects that emerge from an analysis of this literature. One is that there is evidence that year class and stock variations appear to be caused by environmental variability. It starts with Hjort's work early in the century and includes some excellent long time series such as the Soviet work by Elizarov on variations in temperature and year class yield of commercial species in the North Atlantic and Barents Sea. The phenomenon we seek to understand is clearly real, but what are the causal mechanisms? The volumes edited by Sharp, Lasker, Hempel, Parsons, Jansson, Longhurst and Saetersdal present hypotheses that relate the food or physical conditions at the critical early stage of a fish's life history to the success of a particular year class.

The second aspect is that it is not yet certain which of the environmental variables are most important in causing stock variability. There are a number of hypotheses available in the documents mentioned in the previous paragraph. Clearly, the next logical step is the testing of hypotheses. In the past, however, there were a number of obstacles to these tests, e.g. the lack of certain technology for sampling and analysis, the fact that the collection of fishery data has not been universal, and that the basic information on fish larvae which can be used in such tests has only become available in the last decade. WG 67 believes that oceanography, marine ecology, and fisheries research now have reached a stage in technical advancements, fishery sampling, time series collections, and the understanding of larval biology that allows us to test hypotheses which relate ocean variability to the abundance of living marine resources.

IREX, A PROPOSED FRAMEWORK FOR OSLR EXPERIMENTS

The second Term of Reference asks WG 67 to "identify promising directions and possible priorities for relevant research". We note here that variability in the physical-chemical marine environment is not the only factor affecting the abundance and distribution of living marine resources: variations in fishing effort and biological interactions can cause significant changes in stock abundance and recruitment.

However, in response to IOC Resolution XI-17, WG 67 proceeded on the conviction that it would be beneficial to consider an experimental framework in which fishing effort and biological interactions can be treated as external parameters and a significant part of the variation in recruitment is treated as a function of environmental variables. We believe that there is sufficient evidence from well studied species to support this approach; i.e., we are confident that environmental variability is responsible for a significant part of the observed variations in recruitment (for these species) and that it is possible to account for the effects of fishing effort and biological interactions. Our response to the second Term of Reference is therefore a proposal for a set of experiments, collectively called the International Recruitment Experiment (IREX).

The first step in the design of such an experiment is to identify the environmental variables which are likely to account for most of the biological variability. Five independent variables: temperature (T), turbulence (Tu), transport (Tr), food (F) and predation (P) are suggested. Biological responses are known to be related to population density in certain species and where this is the case the number of independent variables would be increased to six. Eight biological variables (BV) can be identified as dependent on these five environmental variables: fecundity or egg production, egg survival, larval growth, larval survival, juvenile growth, juvenile survival, adult growth and adult survival. Figure 1 (Sette, 1943) shows the interrelations that exist between environment and recruitment.

We propose a large-scale, multinational experiment based on the assumption that the functional dependence of biological responses on the environment can be expressed with the above five or six variables as shown below:

$$BV_i = f_i(T, Tu, Tr, F, P) + g_i \text{ (external parameters)} + \text{sampling error}$$

and that these functional relationships are the same for a given species group. A species group in this context is defined as closely related stocks which occur in geographically separated, but environmentally similar regions. There is evidence for some species groups to support the hypothesis, although it is admittedly limited. The great advantage of our hypothesis is that data points can be collected for different stocks simultaneously, so that the number of data points necessary for a test would become available in considerably shorter time than would be required for one stock. This makes a multinational research effort both warranted and manageable.

Based on this reasoning, WG 67 suggests comparative experiments to be done at many places around the world on a few species or species groups. A common suite of fisheries biology, marine ecology and oceanographic data should be collected simultaneously in each location participating in the OSLR effort. Two aspects of the experiment need careful consideration and judgement by fisheries experts of the participating Member States: 1) What species group should be studied? and 2) How broad should the definition of this species group be?

There are species groups for which the assumption underlying the experiment appear to be reasonable. At this writing (April 1982), the best candidates for species groups on which IREX can be conducted seem to be: anchovy, sardine, sardinella, hake, cod, haddock, mackerel, horse mackerel, herring, penaeid shrimp, and spiny lobster. Basic work on the feeding biology, distribution and population fluctuation is available for these species from a number of places in the world. A foundation of time series data is also available which can be used as complementary information in the comparative experiment. A variety of other species seem to be amenable to similar international, multi-site experiments; but for these species groups basic biological data may not yet be sufficient to design such an experiment. Clearly the background work is at different stages for different species groups and for many groups the major need at this time is further laboratory and descriptive work. These investigations will need to be done before an appropriate experiment can be designed.

The essence of the IREX experimental design is that ocean variability and biological response to that variability occurring at one location would be compared

with another location where another stock belonging to the same species group experiences different environmental conditions. The organizing element of the experiments is the species group rather than the geographic area. The species groups form a number of parallel elements in the OSLR effort; for example, an anchovy experiment might have 10 locations participating, while a cod experiment might have 15 locations participating. We believe that such an OSLR experiment can test hypotheses that relate variability in fish abundance to variability in the ocean as given in Figure 2.

The success of a complex exercise such as IREX is not entirely dependent on a hypothesis being true; there is the possibility that a hypothesis will not hold and the experiments would then confirm this sobering fact. This potentiality should not deter the scientific community from embarking on the proposed experiments. Even if as a result of the experiments a hypothesis is rejected, the information collected will not be less than the information that would have been collected in the uncoordinated fashion of the past, and we cannot see at present an alternative hypothesis that could be tested within the framework of a manageable multinational effort.

IREX OBSERVATIONS

The set of measurements for an IREX experiment is given below.

Biological Variables

1. Fecundity by:
   a) sampling spawning females
   b) determining modal number of yolked eggs

   Egg production by:
   a) plankton sampling
   b) aging and staging of eggs
   c) determined from adult fecundity and biomass

2. Egg survival by:
   a) plankton sampling
   b) at intervals count, age and stage eggs

3. Larval growth by:
   a) determining daily rings on otoliths
   b) measure larvae
   c) relate age to length

4. Larval survival by:
   a) collecting larvae at intervals
   b) measure larvae
   c) age larvae with otolith technique

5. Juvenile growth by:
   a) collecting juveniles
   b) determine growth from otolith daily rings and from progression of modal lengths

6. Juvenile survival by:
   a) collecting juveniles at intervals
   b) measure juveniles
   c) age juveniles with otolith technique and from progression of modal lengths

7. Adult growth by:
   a) conventional fishery sampling programme
   b) aging technique

8. Adult survival by:
   a) conventional fishery sampling programme
   b) survey techniques

Environment Variables

1. Temperature by:
    a) moored instruments for vertical microstructure
    b) bottom temperature time series
    c) hydrographic surveys
2. Turbulence by:
    a) microstructure studies for vertical components
    b) satellite infrared (IR) and coastal zone color scanner (CZCS) imagery for horizontal components
    c) wind field from existing and additional stations
3. Transport by:
    a) wind field from existing and additional stations
    b) sea level from existing and additional stations
    c) mass field from hydrographic surveys and satellite infrared (IR) and CZCS imagery
    d) tidal field characteristics (to be determined if not available)
    e) direct current measurements where needed
4. Food by:
    a) vertical sampling by pump or closely spaced bottles
    b) determination of quantity of food by particle counting, optical or fluorometric techniques.
    c) determination of species composition and numbers by conventional methods
    d) determination of quality by larval bioassays
5. Predation by:
    a) stomach contents of potential predators including cannibalism

Laboratory Studies

IREX is a comparative field experiment, but WG 67 recognizes that laboratory studies will be required for many species or species groups. We recommend that for each species group it be decided what information is needed from laboratory investigations. Examples of the needed studies are work on nutrition of larval fishes, threshold feeding levels, behavior of predators on eggs and larvae, and effects of physical factors on development. An advantage of the IREX framework is that it can be used to define and justify specific laboratory studies. When completed, these studies will be used in the OSLR effort.

IREX IN RELATION TO HIGH DIVERSITY ECOSYSTEMS

WG 67 had difficulty in deciding how useful the IREX concept would be for understanding variability in high-diversity, multi-species fisheries. These fisheries are based on ecosystems that are characterized by having a large number of species present, each contributing relatively little to the total abundance, as opposed to ecosystems where there is a dominance of a few species. In practical terms, we think of ecosystems where 100 or more species make up 90% of the biomass as being high-diversity, multi-species in character, while those where 10 or fewer constitute 90% of the biomass are considered as being at the other extreme. High-diversity fisheries, particularly in inshore regions, are especially important to developing countries; but the unique problem of managing high-diversity, multi-species fisheries is not necessarily related to the economic status of the country. Many high-diversity, multi-species fisheries occur in tropical and subtropical latitudes; but some high latitude, rocky coasts of the Americas and Eurasia also have high-diversity, inshore "reef" assemblages that closely parallel the community structure on true coral reefs in the tropics. WG 67 feels that the management concept should be based on the unique biological character of the ecosystems.

It is possible (and some scientists believe that it is indeed likely) that in high-diversity ecosystems biological interactions are more important than environmental variability in determining the abundance of individual species in the community structure. WG 67 feels that the potential usefulness of the IREX approach to understanding variability in high-diversity ecosystems needs careful consideration, and that effort should be directed at understanding the role of environmental variability in these ecosystmes. The effort should be of the same intensity, or perhaps even greater, as the effort spent on the low-diversity ecosystem.

WG 67 therefore recommends that a separate working group be formed to evaluate the IREX proposal in view of the specific problems of high-diversity ecosystems and to amend, adapt or, if necessary, replace it with the aim of drafting another OSLR proposal with particular reference to such ecosystems. We note that centers with the necessary expertise to serve in the implementation of a high-diversity OSLR programme are already in existence in the Indo-Pacific region, in the form of the International Center for Living Aquatic Resources Management (SEAFDEC) in Bangkok. We suggest that until the report of the proposed working group is produced and adopted, IREX experiments based on the framework developed in this document should be open to all participants from high-diversity, multi-species areas who feel that participation in IREX could be beneficial to understanding variability of their living resources.

Other OSLR Components

There is a considerable body of oceanographers and meteorological data as well as ongoing monitoring programmes which are of great value to the OSLR programme and many other current fisheries research programmes. WG 67 recommends that the responsibility of making this oceanographic and meteorological data available be assigned to the Time Series Study Group of the Committee on Climate Changes and the Ocean (CCCO) Biology Panel. It would be unfortunate if many separate and incompatible data bases were developed. Alternatively, the development of self-defining exchange formats should be encouraged, and WG 67 urges the CCCO and National Oceanographic Data Centers to do so through International Oceanographic Data Exchange (IODE).

Advantages of the Proposed Strategy

1. An advantage of the proposed IREX framework is that it is a defined intellectual exercise in which progress can be evaluated. This evaluation sets the stage for making progress on OSLR in recognizable steps.
2. Resolution improves with the number of countries participating. A critical mass of participants is required. If there are too few participants for any particular species group, IREX should not be carried out on that group.
3. The option of the long-term continuation exists. Once started, participating countries can continue the programme to start the critical long-time series. No country is likely to set out alone to start an experiment that will not pay off for many years; but, once started in the OSLR exercise and given repeated evaluation, countries may elect to continue the effort.
4. Existing fishery programmes would be supported and would become part of the experiment. An integral part of the IREX experiments depends on existing fishery data collection programmes. Each participating country would be encouraged to continue this data collection.
5. The rate of analysis of collected data will be increased. IOC and FAO coordination will aid analysis of data obtained simultaneously throughout the world, and countries sharing data will be stimulated to keep up-to-date on data analysis.

6. The IOC and FAO framework facilitates collaboration between countries on transboundary stocks.

7. The Committee on Climate Changes and the Ocean (CCCO) through its Time Series Study Group provides a supporting intellectual framework for this experiment.

8. Transfer of knowledge and technology in marine ecology and oceanography will take place.

9. Many of the techniques used in this IREX experiment can be used by the participating country to aid in biomass assessment of its marine resources.

10. New knowledge on recruitment, which will be useful for management, could be used for resource forecasting and thus be of future benefit.

11. Methods of data processing could be exchanged to the mutual benefit of participants.

12 IREX will encourage scientists with particular expertise to exchange ideas and perception on important problems in oceanogrpahy and fisheries.

APPENDIX I

Resolution XI-17

The Intergovernmental Oceanographic Commission

Recognizing the vital need for adequate understanding of the relationships between ocean environmental variability and fish stocks, and recognizing further that IOC activities in ocean science can enhance and complement the study of living resources,

Realizing the need for close collaboration among the Commission, the Food and Agriculture Organization and their advisory bodies in developing an appropriate scientific programme plan for ocean science activities in support of living resources research,

Decides to undertake development of plans for a major programme of the Commission on oceanographic studies of the marine ecological conditions in relation to fish stocks, as referred to in document IOC-XI/20;

Requests ACMRR and SCOR in consultation with the Vice-Chairman for Ocean Science to develop a comprehensive scientific programme plan and project proposals for research projects aimed at understanding the marine ecosystems to, and in support of, fisheries research and development as sponsored by the FAO.

Instructs the Secretary to:

(i) inform the FAO of this decision with a view to obtaining its agreement to collaborate in this initiative;

(ii) arrange for the appointment of a Rapporteur from IOC, and to discuss the appointment of a Rapporteur by FAO, to develop through correspondence an inventory of information on this subject;

(iii) arrange, in collaboration with FAO and interested countries, consultations of experts from ACMRR and SCOR and interested Member States in 1980 and 1981 in order to develop the scientific programme plan and initial project proposals to be submitted to the Commission prior to the twelfth session of the IOC Assembly (April 1982);

(iv) report to the Executive Council at its fourteenth session on the status of development of the scientific programme plan requested above;

(v) develop, publish and distribute guidelines for interested Member States to follow in submitting specific TEMA needs for participation in the programme area when the scientific programme plan is available; and

(vi) prepare proposals as to how these TEMA needs can be satisfied.

APPENDIX 2

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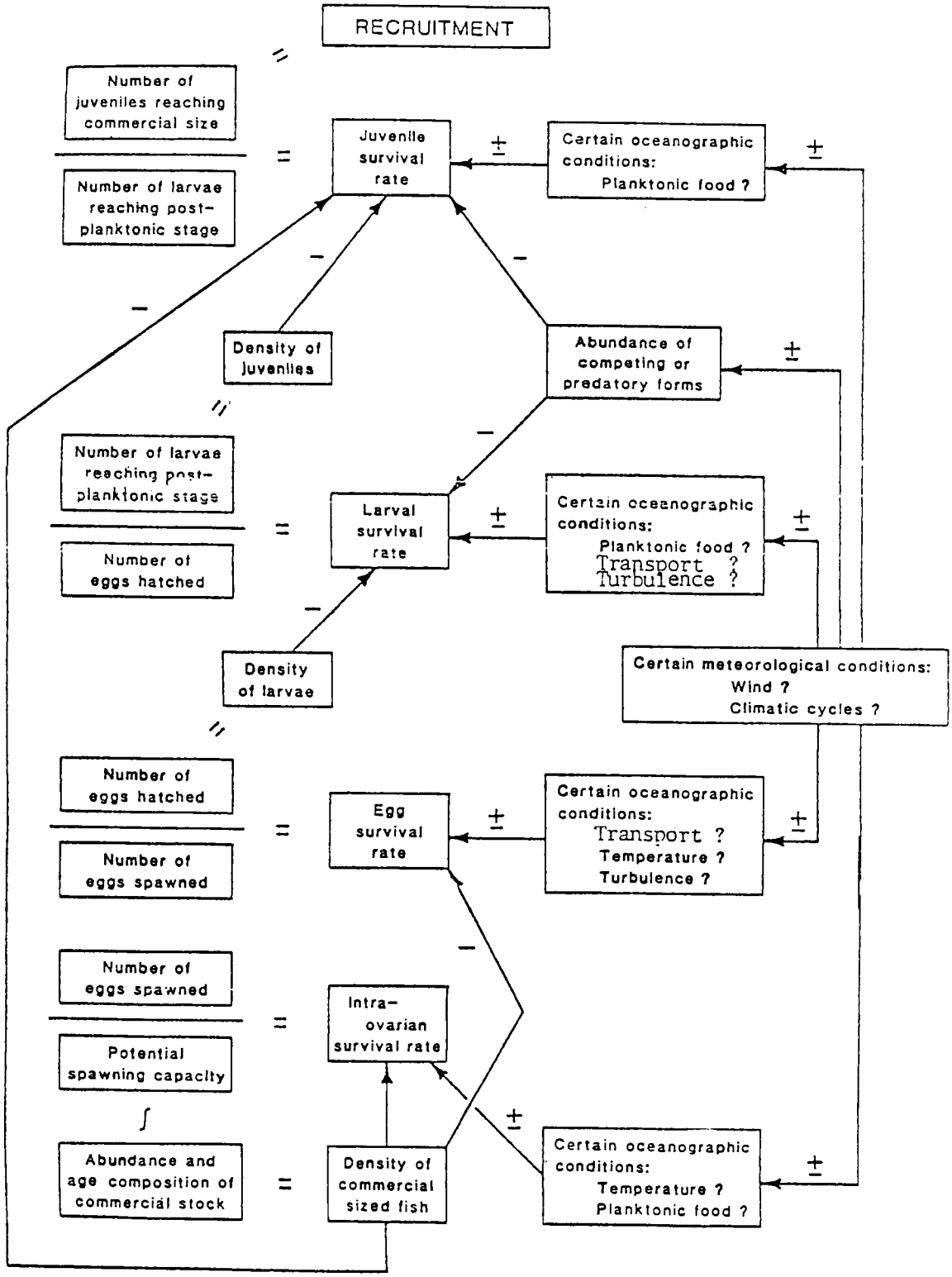


Figure 1. A conceptual model of the relationships between recruitment and the environment (modified after Sette, 1943).

Figure 2

Environmental variables and biological responses as studied in an OSLR experiment

Dependent (biological) variable $(BV)_i$		Independent (environmental) variables $(f)_i$		External Parameters $(g)_i$	
Fecundity or egg production	(1)				
Egg Survival	(2)				
Larval growth	(3)	f_i	Temperature (1)		
Larvae survival	(4)		Turbulence (2)	g_i	Genetic structure (1)
Juvenile growth	(5)		Transport (3)		Population density (2)
Juvenile survival	(6)		Food (4)		Biological interactions (3)
Adult growth	(7)		Predation (5)		
Adult survival	(8)				
$i = 1, 2, \ldots 8$		$i = 1, 2, \ldots 5$		$i = 1, 2, 3$	

ANNEX IX

WORKING GROUP 68

NORTH ATLANTIC CIRCULATION

Report from Chairman: Dr. Friedrich Schott

This working group is cosponsored by SCOR and ICES with the following membership (sponsorship): F. Schott (SCOR, Chairman), D. Anderson (SCOR), A. Clark (ICES), R. Dickson (ICES), J. Gould (ICES), W. Holland (SCOR), W. Krauss (SCOR), F. Madelain (ICES), J. Meincke (ICES), K. Reid (SCOR), P. Richardson (ICES), J.M.P. Saldanha (ICES), J. Sarmiento (SCOR), C. Wunsch (SCOR).

The first meeting was held on 9-10 March, 1982 at the Rosenstiel School of Marine and Atmospheric Science, University of Miami, which was attended by all of the above but Drs. Clark and Reid (at sea), and Saldanha.

The group reviewed on-going and planned work in the North Atlantic, recently proposed large projects, and new technical developments during the first day and discussed various questions to be studied in the North Atlantic during the second day.

1. Review of on-going and planned work on North Atlantic Circulation

1.1 Observational Program

A summary graph of on-going and planned large scale experimental work in the North Atlantic is presented in Fig.1. These experiments were reviewed by WG members involved in or familiar with them.

a) Gulf Stream System

An extensive programme has been started in 1982 by NOAA/AOML, University of Miami, and others to measure mass and heat transports of the Florida Current using moorings, tide gauges, cable inductions, PEGASUS current profiling and CODAR. Further downstream, off Cape Hatteras, T. Rossby (URI) is taking bi-monthly transport measurements with the PEGASUS profiler since 1981, to be continued through 1982, possibly into 1983. An array of inverted echosounders has been used since 1981 (URI) for meander studies downstream of Cape Hatteras and further work is proposed. That general area is also one of the sites (P3) of the USSR "sections" programme, with hydrographic surveys to start in 1982. As for all the USSR section programmes, P1-P4, seasonal repetition is intended. Forty floats have been deployed in 1980/81 WHOI/URI along a line along 55°W (FL) at depths of 700 and 2000m, to be tracked until 1985; 21 floats will be launched at 34°N, 70°W in 1982/83 at 700 m depth. An investigation of the Gulf Stream in the Newfoundland Basin with moored stations is proposed by a group at WHOI for around 1984. In that same area a USSR sections survey (P2) has begun in 1982.

b) Work along the mid-Atlantic Ridge and in the Eastern Basin

Two connected experiments are being carried out along the MAR to study the effect of the Ridge on the North Atlantic Current: the "Warmwatersphere" experiment by IFM Kiel which began in 1981 with surface drifters, moored station and hydrographic surveys and the French programme Topogulf which will be carried out in 1983/84 with 3 clusters of 3 moorings each, across the Ridge at 47°N, and two float clusters of 15 floats each west of the Ridge at 700m.

Water mass transports and meso-scale variability are being studied in the Canaries and Cape Verde Basins by another part of the "warmwatersphere" programme of IFM Kiel, including long-term moorings between the Canary Islands and Azores, surface drifters, current profiling and hydrographic surveys.

The British work in the Eastern Basin has mainly concentrated on deep flows. Extensive current meter records have been and are being collected by MAFF at many sites with near bottom instruments; aims are the description of eddy statistics and verification of numerical models. Hydrographic and radiochemical tracer work is carried out in different areas by IOS and MAFF. J. Gould described CTD temperature inaccuracies discovered in deep Eastern Basin work and suggested deployment of well calibrated moored temperature sensors for CTD intercalibration in areas of repeated CTD surveys. (The ICES Hydrographic Committee will pursue this further).

A group from WHOI plans a cluster of 26 floats to be released in 1984 around 32°N, 25°W for a study of advection and diffusion in the Mediterranean outflow.

c) Trans-Atlantic Sections

A number of basin-wide deep sections have been carried out or are planned. Zonal sections along 24°N, 35°N were carried out by Wunsch in 1981, along about 50°N by Hendry in 1982, and meridional sections are planned along 20°W by Wunsch, along 36°W by McCartney and along 50°W by Stommel et al., for 1983. No final results of the 1981 sections were available at the meeting, but first indications are that at 24°N not much changed since IGY and that at 36°N changes occurred at depth in both basins.

Further two meridional sections along 27°W and 33°W were obtained by Siedler et al. between 35°N and 10°N in March/April 1982, including CTD, nutrients, tritium and ^{3}He sampling.

d) Norwegian Sea

One of the USSR "section" surveys, encompassing the region of the Iceland Faroe overflow and the southeastern Norwegian Sea, was started in 1982. A programme aimed at studying the convection in the Greenland-Norwegian Sea with 6 cruises during 1981/82 is carried out by an international group of investigators, coordinated by ICES.

e) Equatorial Atlantic

Written summaries of the work intended in the FOCAL and SEQUAL programmes in the next few years were obtained by the Chairmen of these two groups, Drs. E. Katz and J. Merle, but not discussed in detail because the group agreed that tropical Atlantic processes should be excluded from the business of SCOR WG 68.

1.2 Modelling Efforts

Presentations on basinwide diagnostic modelling were made by J. Sarmiento, and on eddy resolving modelling by W. Holland. Modelling at IFM Kiel for studying the influence of the Mid-Atlantic Ridge was presented by W. Krauss and D.Anderson showed preliminary results of modelling the effects of time varying wind forcing on the western boundary currents, especially the Florida/Antilles Current partition. WG members felt that large-scale observational and modelling capabilities both are now at a stage where a fruitful interaction is possible. A candidate for such a cooperative effort would be the variability of the Gulf Stream recirculation, where large-scale long time measurements of several crucial subareas are in effect or planned and where modelling with realistic boundary conditions and stratification seems feasible. Wind fields available should be good enough for initial modelling purposes.

2. Future Large Scale Experiments under Discussion

a) CAGE

F. Dobson, Chairman of the CCCO Feasibility Study Working Group for CAGE, reported on the final conclusions of that study, namely that such an experiment is now considered feasible because of recently improved accuracy in atmospheric flux divergence calculations. The WG decided to defer a discussion of the oceanographhic component of such an experiment until such time when members have had a chance to study the feasibility study.

b) World Oceans Circulations Experiment (WOCE)

C. Wunsch, member of the JSC/CCCO design options study group for WOCE, reported on the results of the recent meeting in Paris of that group. The main focus of such an experiment would be a global assessment of water mass conversion but discussions on the scientific aspects have really only started. WOCE is intimately linked to the availability of altimetric satellites and attempts through that group are being made to up-grade the altimetric performance of one or several of the satellites presently under consideration. The WG agreed that within the frame of WOCE the North Atlantic might serve as a special focus area for process-oriented studies.

3. Development of New Techniques for Studying Large-Scale Circulation

a) Acoustic Tomography

C. Wunsch described preliminary results of the Local Tomography Experiment (LTE) in the western subtropical North Atlantic which was successful in mapping meso-scale eddies. A next experiment with reciprocal shooting is scheduled for the fall of 1982, south of the Gulf Stream. Large tomography arrays with scales of 2500 km are under discussion for the North Pacific and possibly also the North Atlantic. These arrays might allow determination of the vorticity balance. The WG suggested to investigate whether such arrays might not also be useful for three-dimensionsl mapping in convection areas.

b) Inverse Techniques

F. Schott and C. Wunsch reviewed merits and disadvantages of methods for absolute current calculations from hydrographic and other water mass properties. The test of such methods is still hampered by too few suitable available data. The basic lesson learned from application of these methods to non-synoptic data or mixtures of historical hydrographic data with recent current meter data is that more consistent data sets are needed for testing them. Further, specific questions have to be asked, which are suitable to these methods, e.g. the simplest circulation statement consistent with existing knowledge; or bounding values of transports, significance of diffusion terms, etc.

c) Satellites

The status and outlook of future satellites planned employing altimetry and scatterometry was reviewed, and the importance of both kinds of measurements for gyre scale North Atlantic variability studies was stressed. The efforts of the CCCO/WOCE group to upgrade altimetric accuracies of one or several satellites were strongly supported.

d) Transient Tracers

J. Sarmiento reviewed the TTO Programme and the impact of transient tracers, especially tritium, on modelling. The WG agreed that highest priority must be given to collection of more transient tracer data.

4. Major North Atlantic Circulation Questions

The WG discussed two major topics:

a) Water Mass Transformation

This problem is certainly the one with the most question marks and in need of big modelling and observational efforts. However, it was felt that additional expertise was needed for a sensible discussion of the subject and it was agreed that those present at the JOA in Halifax should get together with others working in that field and pursue the question further.

b) Variability of the Subtropical Gyre

In light of the substantial, though mostly coordinated, observational effort in the North Atlantic in the coming years (Fig. 1) and recent modelling progress - - with eddy resolving modelling now realistic enough to venture away from box model calculations and gyre-scale variable modelling already initiated - - the WG felt that this problem could be tackled now. The immediate step has to be progress in time varying modelling, the results of which guide future experiments and maybe help to make more efficient some of the experiments already planned now. First order questions need to be studied, e.g.:

The out-of-phase relation between the Florida Current transport (Max. in summer) and the Sverdrup recirculation between the Bahamas and Africa (max. in winter),

nature of the Gulf Stream Branching; is there a seasonal redistribution in the bifurcation?

influence of the mid-Atlantic Ridge and of the polar front on the North Atlantic Current.

to name only a few of those listed.

Wind requirements for the large scale variability studies will be firmed up later when more preliminary model results are coming out.

5. Recommendations

5.1 Transport Calculation and Tests of Inverse Methods

Obtain more synoptic data sets; escpecially, for hydrographic sections,

take profiles to the bottom and as close as possible to the lateral boundaries;

sample all tracers which can be obtained from small bottles; take freons etc. where possible.

5.2 Observations of Gyre Scale Variability

In addition to planned observational programmes (Fig. 1) it was recommended that;

repeated basin-wide hydrographic sections be taken to determine aliasing and seasonal cycle;

deep (1500 m) XBT's from ships of opportunity be launched across the subtropical North Atlantic gyre, by modifying the sampling scheme proposed by the CAGE group for circulation requirements;

tide gauges be installed along the Antilles-Bahamas Arc.

Both of the latter measurements may yield seasonal and interannual fluctuations at moderate costs.

5.3 Modelling of Gyre-Scale Variability

Acceleration of time-varying model efforts is asked for to support planned observational programmes and determine where the crucial areas for observation are.

5.4 Wind Data Base

Work on improved understanding of conventional wind field data which are routinely available over the North Atlantic.

5.5 Eddy Kinetic Energy Distributions

Fill gaps in EKE maps (compiled by Dickson); for new moored measurements, near or at topography, take topographic surveys around mooring sites for better evaluation of topographic effects on currents.

5.6 In Eastern Basin

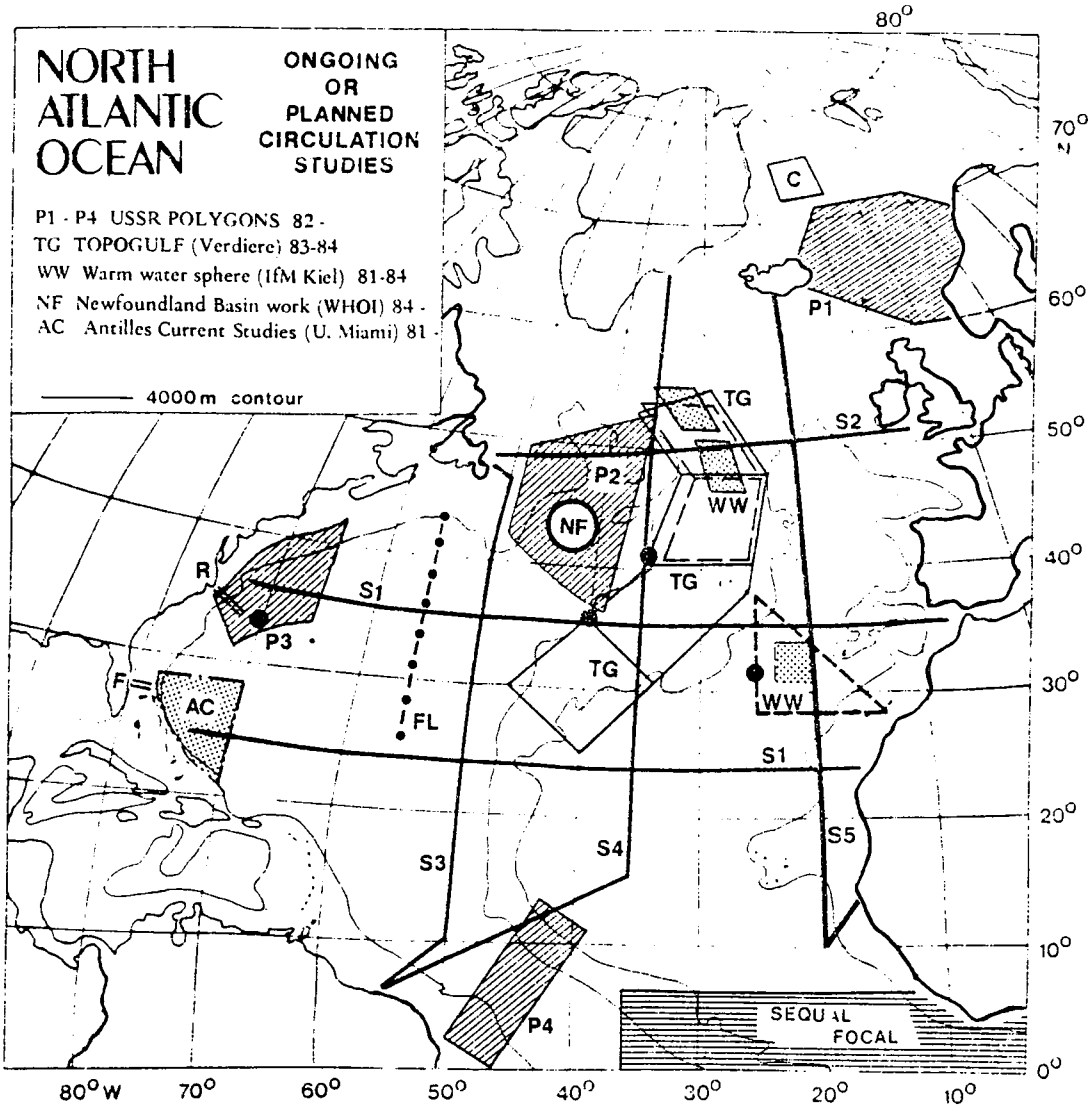
Further investigate indications for net northward deep flow in Eastern Basin seen in sections and moored stations;

Study nature of the observed eastern boundary current;

Study advections and diffusion in the vicinity of the Mediterranean salt tongue.

These preliminary recommendations will be upgraded, e.g. when the question of water mass transformation is better understood and when model results concerning gyre scale variability suggest specific observational efforts.

A focus of the WG in its further work will have to be what should be done in the North Atlantic in the time period between all the programmes presently carried out or planned and the World Ocean Circulation Experiment of the 1990's.


NORTH ATLANTIC OCEAN
ONGOING OR PLANNED CIRCULATION STUDIES
P1 - P4 USSR POLYGONS 82 -
TG TOPOGULF (Verdiere) 83-84
WW Warm water sphere (IfM Kiel) 81-84
NF Newfoundland Basin work (WHOI) 84 -
AC Antilles Current Studies (U. Miami) 81 -
4000m contour
80°
70° N
60°
50°
40°
30°
20°
10°
0°
80° W
70°
60°
50°
40°
30°
20°
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C
P1
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S2
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NF
WW
TG
R
S1
P3
TG
F
AC
FL
WW
S1
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S1 Wunsch 81
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C Convection Experiment (Reid/Clarke) 82
F Florida Straits Transports (U. Miami/NOAA) 82 -
R Rossby Gulf Stream Sections 81 - 82
FL Float Line (released 81)
Float clusters 82-84

FIGURE 1.

ANNEX X

REPORT OF THE SCOR/IOC COMMITTEE ON CLIMATIC CHANGES AND THE OCEAN

July 1982

LARGE-SCALE OCEANOGRAPHIC EXPERIMENTS IN THE WCRP:

A main function of the Committee has been to identify the types of research that are required to improve our understanding of the ocean's role in climate change and variability, and to identify the most important climatologically significant processes and means of their incorporation into physical mathematical models. Studies have been carried out under the joint aegis of CCCO and the Joint Scientific Committee (JSC) of a possible Heat Flux Experiment ("CAGE") headed by Dr. F. Dobson, a World Ocean Circulation Experiment (WOCE) headed by Dr. F. Bretherton, and the influence of the Tropical Oceans on the Global Atmosphere (TOGA) headed by Dr. A. Gill. A Pacific Ocean Heat Flux Experiment (PATHS) is presently being considered by a CCCO Study Group headed by Dr. G. McBean. National research proposals have been reviewed for their potential contributions and the scientific community has been invited to evaluate the international proposals ("CAGE", WOCE, etc.) and to provide independent research recommendations.

Eighty-one oceanographers and meteorologists met in Tokyo at the Japanese Meteorological Agency from 10 to 21 May (at the invitation of CCCO and JSC) to establish the scientific basis for an experimental research strategy and to review, assess and identify critical experimental components. The main conclusions and recommendations of the Conference are:

1. A world Ocean Circulation Experiment (WOCE) to understand quantitatively the present state of the general circulation, in order to assess the sensitivity of the climate system to change in external forcing, whether natural or anthropogenic, on time scales of decades to centuries should be implemented vigorously.

2. The establishment of reliable methods of measuring the meridional transport of heat and salt by the oceans is essential for the WCRP, and it is urgent to carry out experimental programmes designed to achieve that end by intercomparison of different methods. The Atlantic "CAGE" and Pacific "PATHS" heat flux programmes are capable of producing basin scale estimates of meridional fluxes which will be useful in constraining models, thus both were encouraged.

3. The physical basis for the influence of the Tropical Oceans on the Global Atmosphere (TOGA) on an interannual basis should be studied. It is, therefore, important to describe changes in the tropical ocean in response to atmospheric forcing; identify and describe those changes in the global atmospheric circulation which are related to changes in the tropical ocean; and to identify the physical causes of relationships between the Tropical Ocean and the Global Atmosphere.

4. All of the oceanographic experiments of the WCRP will require large-scale observational programmes, an essential element of which will be satellite systems. The Conference therefore defined requirements for satellite measurements and developed a work plan which addresses technical details (e.g., calibration, verification, relation to non-satellite observations, and information extraction algorithms). The main goal of the work is to create the best possible data set for the establishment and study of climatologies of the important variables; e.g. wind stress; sea level elevation, and SST.

The report of the Conference, which will be issued later this year, deals with many other aspects of the WCRP oceanography, in particular modelling, ocean monitoring, supporting National Programmes and the use of Transient Tracers in climate research.

The next steps are an evaluation of the Conference recommendations by CCCO and JSC in August and September and, if acceptable, the establishment of international scientific steering groups to organize and guide the design and implementation of each experiment.

OCEAN MONITORING:

The planning and implementation of an ocean observation programme for climate purposes have been addressed within CCCO in the context of the Pilot Ocean Monitoring Study. The JSC and CCCO jointly organized a POMS planning meeting (Miami, October, 1979) and a meeting on Time Series of Ocean Measurements (Tokyo, May 1981). Studies recommended by these meetings and endorsed by WMO and IOC are under way and the requirements for an ocean observing system are emerging. The WMO Executive Committee requested that the JSC prepare a specific action plan for an ocean observing system with emphasis on the observational programmes for the next two or three years. The IOC endorsed the WMO request and urged CCCO to cooperate with the JSC in preparing the action plan.

The action plan requested by WMO was prepared by CCCO (drafted by J. Donguy, G. Meyers, J. Sastry, R. Dickson). Its major elements, for which guidelines for implementation are defined, include:

i) Expendable bathythermograph (XBT) observations

ii) Surface salinity observations

iii) Sea level observations

iv) Surface wind observations

v) Monitoring straits and passages

vi) Sea surface temperature observations

vii) Radiation observations

The establishment of an international ocean observing system in a monitoring mode requires the following:

- A demonstration that the observations are clearly related to climate processes, or existence of a significant body of evidence showing that the observations will be useful to describe important climatic processes;
- The observing systems are technologically feasible;
- The establishment of appropriate calibration, accuracy and reliability criteria;
- A cost-benefit analysis to ensure that the benefits to be realized from the monitoring programme are commensurate with the costs incurred.

It is within this context, that CCCO through its panels, study groups and consultants, in cooperation with the WMO/IOC Working Committee for the Integrated Global Ocean Services System (IGOSS) and SCOR Working Groups, will assist in the design of the observation system. For example, a North Atlantic XBT programme is under study within the framework of "CAGE" and the Tropical Atlantic Panel has defined its needs for an expanded Sea Level network. In regard to Sea Level, Dr. J. Lutjeharms has undertaken a study of the worldwide existing and planned Sea Level Stations. His report will be submitted to the CCCO sea level workshop (31 July, chaired by Dr. D. Cartwright) which will assess network requirements, the need for MSL data more frequently than monthly and the requirments for rapid availability of data.

Time Series of Ocean Measurments (TSOM'S) have been given considerable attention by CCCO and JSC. Two reports (Presented Papers, Report of the Meeting) from the Tokyo, May 1981 meeting are available and a third report (could be a series of reports) by Baker, Chelton and Tabata, will address the significance of TSOM'S, methods of analysis, difficulties with interpretations and existing records and instruments - a handy guide to TSOM's, so to speak. The Tokyo meeting recommended that an annual brochure on TSOM'S be issued to inform scientists of recent results and to generally publicize TSOM'S. CCCO has invited ICES to assist on this project and hopefully it will begin in 1983.

SEA ICE

The processes of ocean-sea ice interaction are undoubtedly significant for the world climate problem, but the resources of scientific manpower capable of studying these problems are stretched very thin, with heavy demand on their time from various international and national bodies.

The CCCO is hesitant to add to these demands. Consequently, it was decided to seek the advice of the Joint WMO/CAS-JSC-CCCO Meeting of Experts on the Role of Sea Ice in Climate, held in Geneva from 24-29 June 1982, and to reconsider the need for a Sea Ice Panel at the August 1982 meeting of the CCCO Steering Committee.

In addition to the technical advice, it was requested that the meeting advise CCCO on how the scientific study of sea-ice ocean interactions related to climate could best be coordinated internationally, and how CCCO can help in doing this. The meeting considered this question and has recommended that CCCO establish a Panel on Ice Covered Southern Oceans and that the terms of reference of SCOR/Working Group 58 (Arctic Ocean Heat Budget) be expanded to include Sea Ice and modelling. The CCCO Officers will consider the proposal at its meeting on 4 and 5 August.

BIOLOGICAL ASPECTS

Attempts have been made to establish a CCCO panel to study the questions:

1) Biological Relevance to Exisiting Physical Time Series Data; and 2) The Role of Biota in the Oceanic CO_2 Sink. So far, CCCO has not succeeded in persuading marine biologists that such a panel would have sufficient importance and interesting work to do at this time. Hence, it is likely that CCCO will delay further efforts in this area until a more appropriate time.

ANNEX XI

JOINT PANEL ON OCEANOGRAPHIC TABLES AND STANDARDS

Report of the Meeting of the Carbon Dioxide Sub-Group of the JPOTS

(This is an extract from the above report; the full report can be made available from the Executive Secretary of SCOR).

Recommendations for Future Work:

In the following we shall briefly review "state of the art" with respect to the various parameters governing the CO_2 system in seawater and attempt to identify priority areas for further research which will lead to a uniformly acceptable description of the thermodynamics of the CO_2 system.

Solubility of Carbon Dioxide Gas:

The formula presented in section 4 is recommended for future use, and no further work appears necessary at this stage.

pH Measurements:

A primary note of caution concerns the use of glass electrodes in seawater solutions. Glass electrodes should be tested against hydrogen electrodes to test their slopes versus the theoretical slopes. Next the combination of the glass electrode and the reference electrode(s) should be tested against pairs of buffers to ascertain whether the liquid-junction potentials are working well, i.e., whether the assembly has roughly ($\gtrsim$99%) the theoretical slope. In actual runs only one buffer is used to avoid the effect of different liquid-junction potentials in various buffers.

The NBS (pH_{NBS}) scale serves well for kinetic and equilibrium studies, where variations in k_H (c.f., section 5.1.1) are small when compared to the uncertainties in solubilities.

When an electrode assembly is standardized with the NBS phosphate buffer a delay in attaining equilibrium of about 10 minutes is observed upon the transferring of the electrodes to seawater. For these reasons, it is advisable to have available some established seawater buffers (e.g., Trisbuffers, Bates and Culberson, 1977) as secondary standards. The latter buffers will also allow a ready connection to the pm_H scale.

Recommendation

The sub-panel on CO_2 does recommend that further work be carried out on establishing seawater buffer standards over the range of pH of seawater (8-9), and that values be established as a function of temperature (0-40°C) and salinity (S=30-40).

Furthermore careful work should be carried out on the determination of the apparent activity coefficient of the proton to relate the pH_t, pm_H and pH_{NBS} (c.f., section 5.1.1) scales. These measurements should be made using a standard electrode/liquid junction combination. This would provide an independent check for the expected differences of dissociation constants based on various pH-scales (pH_{NBS} and pH_t).

Dissociation Constants

Carbonic Acid

Though the comparison on the two data sets on pk_1 and pk_2 (Section 5.1.2) showed that the data sets are internally consistent within the experimental error of the measurements the subpanel agreed that further independent determinations of these constants (on either pH scale) would be appropriate.

In particular, the sub-panel does recommend the redetermination of the product or the ratio of the equilibrium constants by various techniques (potentiometrically; gasometry, i.e., pCO_2-ΣCO_2 methods). Such data over a range of temperature and salinity would serve to resolve the small differences in pK_i's obtained in the studies of Hansson and Mehrbach *et al.*

Boric Acid

The sub-panel on CO_2 recommends strongly that the ionization constant of boric acid in seawater be redetermined as a function of temperature and salinity. This would clear up the differences (Millero, 1979) that exist between the work of Lyman (1957) and Hansson (1973). Such work is presently in progress.

Carbonate Solubility

The panel wishes to take this problem under further consideration, but more careful work appears necessary in this area to unravel the causes of the differences reported in Table 1 of section 6 of this report.

Meeting of JPOTS Members (Morcos, Millero, Poisson, Gieskes) on Future Oceanographic Tables.

Dr. Selim Morcos discussed the plans to publish information on "the Practical Salinity Scale, 1978" in the International Marine Science Newsletter published by UNESCO (IMS Special Issue 1981-1982, Number 30).

It was noted that some questions remained concerning Part 2 of the new International Oceanographic Tables, Volume 4: "Properties derived from the equation of state of seawater". It was agreed to approach panel members N. Fofonoff and O. Mamayev on this matter.

ANNEX XII

ANTARCTIC REVIEW GROUP

REPORT ON THE SCOR/SCAR WORKSHOP ON ENHANCEMENT OF INTERACTION BETWEEN PHYSICAL, CHEMICAL AND BIOLOGICAL OCEANOGRAPHERS WORKING IN THE SOUTHERN OCEAN

24-26 May 1982 Tokyo, Japan

The workshop was attended by 29 scientists from 11 different countries including 15 biological, 3 chemical and 9 physical oceanographers, 1 glaciologist and 1 meteorologist. During the two and one-half days of the workshop discussion was aimed at identifying interdisciplinary problems in the Southern Ocean and at means of promoting the cooperation of physical, chemical and biological oceanographers in their solution.

The primary focus of the workshop was the Antarctic marine ecosystem viewed as an interacting physical-chemical-biological system. It can be concluded from the discussions during the workshop that there are important physical, chemical and biological interactions that must be studied in order to understand the Antarctic marine ecosystem. It can therefore also be concluded that the study of the ecosystem should involve physical and chemical oceanographers as well as biologists. The problems involved in Antarctic ecosystem research require their investigation by first-rate physical and chemical oceanographers and not just technicians or biologists not trained in modern physical and chemical oceanographic techniques and analysis. Therefore ecosystem research should involve the cooperation of biological, chemical and physical oceanographers, and they should be brought together at the beginning of the planning stage.

During the workshop several important interdisciplinary problems were identified and discussed. These problems were not viewed as exhaustive, but only as representative problems of the Antarctic marine ecosystem.

1. The relation between primary production and the physical-chemical environment:

   How does production depend upon density structure, vertical motion, light and temperature? More specifically, how long do phytoplankton spend below the euphotic zone in the mixed layer? Are there chemical factors that limit primary production?

2. The influence of sea ice on the ecosystem:

   What is the effect of ice formation and melting on stability and wind mixing?
   What is the role of algae that are incorporated into sea ice on freezing and released on melting in the ecosystem?
   Is the attenuation of light by sea ice an important factor?
   What are the chemical fractionization effects of ice formation and melting?
   How does the advance and retreat of sea ice, which provides a habitat for birds and seals, affect the ecosystem?

3. The relation between the distribution of krill and the physical-chemical environment:

   What are the physical and chemical characteristics of krill spawning areas?
   How important is north-south and east-west transport of krill?
   What mechanisms effect these transfers?
   How are the rates of sinking of eggs and ascent of larvae affected by water, circulation and environmental conditions?
   How do krill survive in winter?
   What is the relation of krill to eddies and fronts?

4. The influence of krill on the carbon and other chemical cycles:

   What is the quantitative effect of the krill life cycle on the carbon cycle?
   What is the effect of krill on other chemical cycles?
   For example, how is the silicate cycle affected by krill assimilation of diatoms?

The study of krill swarms was also considered as a possible interdisciplinary problem, but it was concluded that at the present time much more about the purely biological aspects of swarming must be known in order to formulate problems requiring the assistance of physical and chemcial oceanographers.

It was recommended that SCOR continue the present Review Committee on Antarctic Oceanography, but to expand the membership to include another biological oceanographer, a chemical oceanographer and a sea ice glaciologist with at least two of these to be from southern hemisphere countries.

ANNEX XIII

REPORT OF SCOR SCIENTIFIC RAPPORTEUR ON MARINE POLLUTION

Rapporteur: Bernt I. Dybern

In 1972 the Stockholm Conference on the environment was held. A series of resolutions regarding the protection of the global environment was agreed upon. The United Nations Environment Programme (UNEP) was later created and was intended to be an umbrella organization which should catalyze and coordinate activities carried out both by UN specialized agencies and other international organizations.

Now, ten years afterwards, it is evident that both positive and negative things have occurred on the global level. Among the positive ones are:

1. There is a greater general awareness of the environmental problems as such, especially in the developing world.
2. There is a greater awareness of the fact that environmental problems to a great extent are natural resources problems.
3. A better scientific knowledge on pollutants and their distribution has been achieved.
4. A better international contact between people who are engaged in the protection of the environment has been established.
5. A number of international agreements, conventions and control programmes for the protection of the environment have been set up.

Negative features are:

1. More pollutants than ever are spread over the globe. More of the land, forests and sea has been destroyed than ever before.
2. The number of conventions, resolutions, agreements etc. have not led to a corresponding number of practical results.
3. There is a tendency to observe more the effects of big and rapid catastrophes than the long-term and at the first sight not so evident effects.
4. There is a tendency in industrialized countries to locate matters and activities, known to damage the environment, to developing countries, thus carrying over some of the pollution load to them.
5. Many influential people do not yet seem to understand that environmental problems to a great extent are survival problems in the long run, and that the solution of these problems must be given a correspondingly high priority.

What has been said above is very much applicable to the marine environment. Man is still continuously increasing the quantity and diversity of pollutants discharged into it in spite of its recognized vulnerability. This does not only spoil many sea areas - especially coastal areas - from being used as a resource for traditional fishery and recreation but also destroys the possibility of using them as one of the most important protein sources of the future: cultivated marine and brackish-water fish, shellfish and algae.

Many people have in different ways pointed out what ought to be done, and this does not refer only to the protection of the seas:

1. Better environmental education and information to politicians and others responsible for the environment, the natural resources and the social welfare.
2. Better legislation for protection of the environment.
3. Better environmental planning on both national and international levels.
4. Creation of more funds allocated to pollution abatement and the improvement of the environment - and not only to the setting up of Working Groups, Committees etc.
5. Transfer of knowledge and funds from richer to poorer parts of the world.

All this is possible to achieve. There are able and willing people devoted to their work, and there is plenty of money "available" - just take part of the funds for military expenditures! With good plans and sufficient funds available one could clean the world in a couple of decades.

The pollution of the sea was thoroughly discussed during several years at the Law of the Sea Conference(s), but there is a fear that the practical outcome as to pollution abatement may be small.

What can SCOR do? SCOR is a group of marine scientists who mainly carry out basic science. But many, perhaps most, results achieved by its different groups are essential for those who work with applied science in the marine environmental field. It can safely be said that there is not much overlapping between the SCOR groups and other similar international groups. The scientific importance and impact of SCOR is therefore great and of very high value for promoting scientific work in connection with marine pollution problems.

Protection of the natural environment and natural resources, not the least the sea, is one of the most important tasks for science today. SCOR should therefore continue to keep an eye open on what happens in this field and actively offer assistance if necessary. A few of the UN specialized organizations such as UNESCO/IOC, WMO, WHO and FAO (and the common GESAMP) and a few regional organizations such as ICES, ASEAN and the South Pacific Commission could especially be worth observing. With some of these organizations SCOR is already cooperating.

Among items of special importance and in which SCOR already makes or could make an important in-put are:

1. Interaction between the sea and the atmosphere.
2. Interaction between the water and the seabottom.
3. Interaction between the coastal areas and the open sea.
4. Protection of coral reefs.
5. Protection of mangrove areas.
6. Protection of coastal areas suitable for aquaculture.
7. Research to make research methods comparable (intercalibration).
8. Promotion of the understanding of the synergistic effects on the life of the sea of different natural and man-made factors.
9. Better development of information systems.
10. Transfer of scientific knowledge from rich to poor countries.

ANNEX XIV

REPORT OF SCOR SCIENTIFIC RAPPORTEUR ON COASTAL RESEARCH

Rapporteur: H. Postma

Report on Coastal Research Activities

Several Working Groups of SCOR are, directly or indirectly, concerned with coastal oceanography. In physical oceanography WG 57 is preparing a monograph series (to be published by the American Geophysical Union) and a first volume on coastal upwelling has recently been published. Continued attention is given to numerical modelling and recently attention is focussed on problems of open lateral boundaries. Detailed proposals for future actions in this field are given in the report of the group. The basic issue is that of fluxes through lateral boundaries, which are often neglected. Activity of the group in this direction should be supported. This seems of considerable importance also for the study of sediment transport phenomena, which is mentioned under the terms of reference of the group, and for chemical and biological transport and exchange processes such as those studied by WG 46 and 65. The next meeting proposed for WG 57 is in Hamburg in 1983 during the IUGG.

In chemical oceanography new terms of reference have been worked out for WG 46 which indicate, more clearly than the old ones, that the group will follow the fate of chemical species from rivers through estuaries into the ocean. A new membership of the group has been established (see report of the group). A number of SCOPE activities appear to be related to those of the group. One is a working group on chemical changes in the coastal zone; the other is the programme on carbon in rivers of the "carbon unit" in Hamburg. A good working relationship with these two groups should be established.

In connection with the carbon group it should be mentioned that extra storage of organic carbon in the coastal zone is considered as one of the sinks of carbon dioxide produced by fossil fuel. Here a connection should be made with the activities of WG 62 on the carbon budget of the ocean (or its successor). In general, WG 46 might assist in the identification of gaps in information on mass balance and fluxes of various contaminants. The group proposes to meet in Lisbon in December 1982.

For marine geology, the proposed activities of WG 61 on sedimentation processes at coastal margins are very relevant. The group will meet for the first time during the JOA. A greater insight into sediment accumulation rates and development of long-term devices will be of great value for several other working groups. It is recommended that during its deliberations the group is aware of the activities of WG 46 and 57. It should moreover take into account the future activities of the new WG 70 on remote sensing which will also meet during the JOA.

In biological oceanography two groups are at present active in coastal waters. One is WG 60 on mangrove ecosystems, the other WG 65 on coastal-offshore ecosystem relationships. The activities of the biological groups concentrate on increases in general understanding of ecosystems. A recent conference (May 1982) in Bombannes (near Bordeaux) organized by WG 59 revealed considerable gaps in our knowledge, especially on fluxes, in ecosystem research. The growing importance of this field seems to require reconsideration of the overall structure of biological working groups.

SCOR has provided assistance to the coastal programmes of UNESCO and IOC through its working groups, by participating in UNESCO panels, by contributing (via ICSU) to the UNESCO medium term plan 1984-1989 and by input into a programme about the "Future of Oceanography to the Year 2000".

SCOR participated, together with UNESCO and France, in the organization of a major symposium on coastal lagoons, held in Bordeaux in September 1981.

The UNESCO/SCOR Consultative Panel on Coastal Systems met for the second time in Paris in January 1982. The two meetings, in addition to pointing out promising fields of scientific research, stressed the need of more knowledge for the management of coastal waters and the protection of the environment. Because of this trend the Division of Marine Sciences of UNESCO has developed a major project for research and training leading to the integrated management of coastal systems.

It should also be mentioned here that IOC together with the Division is developing a programme to "increase the marine science capabilities of developing countries", mainly as a consequence of the results of the Law of the Sea Conference. Such programmes will require continuous advice of SCOR in the near future.

ANNEX XV

SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH

REPORT TO IOC 12th ASSEMBLY

This report will present information on the activities of SCOR, particularly in its role as an IOC advisory body, since the 11th Session of the IOC Assembly in 1979.

SCOR was represented at the 11th Session of the IOC by its President and Executive Secretary. Several SCOR members were present as members of national delegations. Some of the Assembly Resolutions referred to SCOR and these were considered at the next opportunity, the 22nd meeting of the SCOR Executive Committee, in January, 1980.

Resolution XI.2 requested SCOR to propose action on the evaluation and presentation of data from the FGGE Oceanographic Programme. This was referred to WG 47.

Resolution XI.3 stated the agreement of the IOC to cosponsor CCCO.

Resolution XI.8 invited CCCO to include El Niño in its scope. The SCOR Executive Committee endorsed this proposal and it has been carried out by CCCO.

Resolution XI.9 requested SCOR and ACMRR to advise on the composition of a technical advisory group to CINCWIO. This was done, as noted in a subsequent Resolution (EC-XIII-5).

Resolution XI.14 asked SCOR for information on the support required for FIBEX.

Resolution XI.17 requested SCOR to assist in the development of a comprehensive plan and project proposals aimed at understanding the marine ecosystem complementary to, and in support of, fisheries research. The Executive Committee recognized this to be an extremely important project and nominated Professor W. Wooster to liaise with the IOC on the matter. At its General Meeting in September, 1980, SCOR established WG 67 on "Oceanography, Marine Ecology and Living Resources". WG 67 has been active since late 1980 and will present a report on "Ocean Sciences in Relation to Living Resources" to the IOC at its 12th Assembly. WG 67 was cosponsored by ACMRR who named three members to the group.

Resolution XI.28 invited SCOR's comments on an IOC document (IOC/EC-XII/7) on the major directions of its future programme. These were transmitted to the IOC.

Resolution XI.29 established the Scientific Review Board and invited SCOR to designate a member. Dr. H. Postma has represented SCOR on the SRB since 1980.

Resolutions of the 13th Session of the IOC Executive Council were also considered by SCOR. Some of these related to matters discussed above. In particular, SCOR responded to Resolution EX-XIII.10 by establishing a working group on "Oceanographic Applications of Drifting Buoys". The Chairman of WG 66 participates in joint IOC/SCOR/ECOR consultative meetings on drifting buoys.

The 14th Session of the Executive Council was attended by the SCOR President, Professor Simpson, and by Dr. H. Postma. The input of SCOR to the UNESCO Medium Term Plan was noted in Resolution EC-XIV.1.

On the recommendation of the SRB, Resolution EC-XIV.4 called on the Advisory Bodies to assist with a study of expected major trends in ocean sciences up to the year 2000. This developed into a significant effort for SCOR in 1981 and 1982 and will result in the presentation of the FORE report at the 12th Assembly. SCOR was especially active in the selection of subject leaders and associates in each area of oceanography, the selection of participants and some arrangements for the Villefranche workshop, and a major discussion of the scientific chapters of the FORE report at the JOA.

Resolution EC-XIV.II approved the adoption of the new Practical Salinity Scale, 1978 and of the new International Equation of State of Seawater, 1980 and recommended their use from January 1, 1982. These new standards were developed by the SCOR/ICES/UNESCO Joint Panel on Oceanographic Tables and Standards and will lead to greater precision in research related to the physical properties of seawater. The IOC WC on IODE is investigating the necessity for relevant changes in data formats and in data centre procedures.

The President and Executive Secretary of SCOR attended the 15th Session of the Executive Council in March, 1982.

Resolution EC-XV.1 asked SCOR and CMG to develop a scientific programme plan and project proposals to provide a scientific basis for the management of marine non-living resources. The SCOR President has undertaken this responsibility and will present a programme on "Ocean Science and Non-Living Resources" at the 12th Assembly of IOC.

In addition to the representation at IOC meetings discussed above, SCOR has participated in IODE and GESAMP meetings during the last two years. The SCOR activities outlined above have been undertaken specifically as a result of IOC Resolutions since November, 1979. Other activities have continued in the meantime. Nineteen SCOR working groups have been active in the period since 1979 as well as CCCO, JPOTS, the Antarctic Review Group and two editorial panels. Detailed records of their achievements may be found in SCOR Proceedings, volumes 16, 17 (1) and 17 (2). Five of these groups will have discharged their terms of reference by September, 1982 and four new ones are beginning their work. Many publications arising directly from working group activities have appeared. *"River Inputs to Ocean Systems"* (WG 46), *"Progress in Equatorial Oceanography"* (WG 47), *"Mathematical Models in Biological Oceanography"* (WG 59), and *"Coastal Upwelling"* (WG 57), amongst others, are major contributions to the oceanographic literature. Many other reports have been published in the various UNESCO, and IOC series. Partial support for the activities of working groups of special interest to the IOC (ten in 1982) has been provided through contracts between the IOC and SCOR.

Finally, SCOR has, of course, been extremely active in the planning for the Joint Oceanographic Assembly to be held in Halifax in August, 1982. The Scientific Programme Committee for the JOA has been chaired by Dr. W. Hay, a member of the SCOR Executive Committee. The Executive Secretary is a member of the National Steering Committee. The IOC/UNESCO Logistics Committee has provided funds to assist with the travel expenses of some convenors and speakers and of scientists from developing countries.

In summary, relations between SCOR and the IOC have been extremely productive during the three years since the 11th Assembly. Plans for the near future include an Executive Committee Meeting (July 1982, Halifax) and a General Meeting (August 1982, Halifax). The 25th Executive Committee Meeting will be held in late 1983 (location undetermined) and the 17th General Meeting will take place in the autumn of 1984. Details of the plans for meetings of SCOR subsidiary bodies will be available after the 16th General Meeting.

Financial problems continue to be a major concern of the SCOR Executive Committee. SCOR income derives from two sources: national contributions and grants and contracts from ICSU, UNESCO and IOC. An attempt has been made to offset the effects of inflation by instituting regular increases in the levels of national contributions. Contracts, however, have not been similarly increased and continue at much the same level in spite of the fact that SCOR has assumed certain tasks specifically at the request of the IOC or UNESCO. For example, the basic contract between IOC and SCOR in 1981 was for $20,000.00, while the activities it was supposed to cover cost about $54,000.00. The rapidly escalating costs of meetings will result in a reduction in the pace of SCOR's scientific programmes unless income can be increased somewhat.

In particular, the financial support for CCCO is a serious problem. CCCO has been clearly identified by both the IOC and SCOR as a major scientific effort. In the years since 1979, SCOR has made commitments of funds to CCCO as large as resources will permit; no other subsidiary body has received such levels of support from SCOR. Each year SCOR seeks a grant from ICSU and the funds obtained have been entirely allocated to CCCO in addition to $10,000.00 annually from other SCOR income. In spite of these efforts, and those undertaken by the IOC and the Chairman of CCCO, it appears likely that CCCO will experience a budgetary shortfall in 1982 and that some of its scheduled scientific activities will have to be curtailed. SCOR urges the IOC to continue its efforts to ensure adequate funding for CCCO activities in 1983 and subsequent years.

It has not been possible for this report to address specific agenda items of the 12th Session of the IOC Assembly since the Provisional Agenda was not available at the time of writing. If commentary from SCOR on certain agenda items seems appropriate it will be submitted at a later date.

ANNEX XVI

REPORT OF IAPSO TO SCOR

Since its last report to SCOR (see Annex XII, SCOR Proceedings 17 (2)), IAPSO has cosponsored a number of symposia:

"The Role of the Oceans and Volcanoes in Atmospheric Chemistry" Hamburg, Germany, August 1981.

"Radiation Transfer in the Oceans and Remote Sensing of Ocean Properties" Hamburg, Germany, 1981.

"Climate Fluctuations and Relations to the Tropical Atlantic" Hamburg, Germany, 1981.

"North Sea Dynamics" Hamburg, Germany, August-September 1981.

"Hydrodynamics of Semi-enclosed Seas" Liege, Belgium, May 1981.

"Oceanography of Straits", Copenhagen, Denmark, December 1982 (tentative).

The IAPSO General Assembly will be held concurrently with those of other IUGG Associations in Hamburg, Germany, from 15-27 August 1983. Since IAPSO has its own symposia as well as joint symposia with other Associations, this report is designed to supplement the Second Circular issued by the German Organizing Committee and emphasize the IAPSO Programmes. It presents all the IAPSO sponsored and co-sponsored symposia:

IAPSO No. PS1 - Effects of interfacial processes on the body of the ocean.

Convenor: Professor G. Kullenberg.

IAPSO No. PS2 - Large scale dynamcis and circulation in the ocean.

Convenor: Dr. W.R. Holland.

IAPSO No. PS3 - Intermediate scale motion and structures in the ocean.

Convenor: Professor C.N.K. Mooers.

IAPSO No. PS4 - Small scale motion and structures in the ocean.

Convenor: Professor M. Gregg.

IAPSO No. PS5 - Oceanographic problems of the North Sea and Baltic Sea.

Convenor: Professor G. Krause.

IAPSO No. PS6 - Oceanographic advances from new technologies.

Convenor: Dr. R.E. Stevenson.

IAPSO No. PS7 - Marine optics and optical modelling of the upper ocean.
Convenor: Dr. R.C. Smith.

IAPSO No. PS8 - Chemical fluxes in the water column.
Convenor: Dr. S. Krishnaswami.

IAPSO No. PS9 - Deep and bottom water formation and circulation and topographic effects.
Convenor: Professor Knut Aagaard.

IAPSO No. PS10 - Seasonal and interannual variations in the oceans and atmosphere.
Convenor: Professor Henry Charnock.

IAPSO No. PS11 - Physical, chemical and geophysical oceanography. (Precis and poster sessions).
Convenor: Dr. E.C. LaFond.

IAPSO No. PS12 - Tsunami wave propagation (cosponsored by IASPEI).
Convenor: Professor T.Y. Wu.

IUGG SYMPOSIA IN WHICH IAPSO IS INVOLVED

IUGG No. 4 Geodetic Features of the Ocean Surface and Their Implications.
Sponsors: IAG, IAPSO; IAPSO Co-convenor: Dr. J. Apel

IUGG No. 5 Geophysics of Polar Regions.
Sponsor: All associations, SCAR; IAPSO Co-convenor: Dr. A. Gordon.

IUGG No. 6 Data Management.
Sponsors: IAGA, ICL, All associations; IAPSO Co-convenor: Mr. J. Crease.

IUGG No. 8 Assessment of Natural Hazards.
Sponsors: IASPEI, IAVCEI, Tsunami Committee, IAHS, IAPSO.
Co-convenor: Dr. Misashi Miyoshi.

IUGG No. 11 Structures and Composition of the Oceanic Crust.
Sponsors: IAVCEI, IASPEI, IAPSO, ICL. IAPSO Co-convenor: Prof. T.D. Hilde.

IUGG No. 13 Scientific Discoveries from MAGSAT Investigations.
Sponsors: IAGA, IAVCEI, IAPSO; IAPSO Co-convenor: Dr. D.F. Heinrichs.

IUGG No. 15 Remote Sensing for Climate Studies.
Sponsors: IAMAP, IAPSO, IUCRM; IAPSO Co-convenor: Dr. C. Gautier.

IUGG No. 16 Sea Ice Margins.
Sponsors: IAHS, IAPSO, IAMAP; IAPSO Co-convenor: Dr. Ola M. Johannessen.

IUGG No. 17 Low Latitude Coupled - Ocean/Atmosphere Circulation.
Sponsors: IAPSO, IAMAP; Convenor: Dr. D. Halpern.

IUGG No. 18 Ridge Crest Hydrothermal Activity and Chemistry of Sea Water.
Sponsors: IAPSO, IAVCEI, ICL; Convenor: Prof. J.M. Edmond.

IUGG No. 19 The Ocean and CO_2 Climate Response.
Sponsors: IAMAP, IAPSO. Co-convenors: Prof. K. Hasselman, & K. Bryan

IUGG No. 20 Ocean and Atmospheric Boundary Layers.
Sponsors: IAPSO, IAMAP; Convenor: Dr. R.T. Pollard.

IUGG No. 21 Coastal and Near Shore Zone Processes. A. Physical Processes.
Sponsors: IAPSO, IAMAP, IAHS; Convenor: Dr. P. H. LeBlond.

Coastal and Near Shore Zone Processes. B. Chemical Processes.
Sponsors: IAPSO, IAMAP, IAHS; Convenor: Prof. T.M. Church.

ANNEX XVII

CONFEDERATION MONDIALE DES ACTIVITES SUBAQUATIQUES
WORLD FEDERATION OF UNDERWATER ACTIVITIES

REPORT OF THE CMAS SCIENTIFIC COMMITTEE

By: N.C. Flemming

Introduction

The CMAS Scientific Committee provides communications between marine scientists who use scuba and other forms of diving in the conduct of their research. The committee organises symposia, publications, and assists in the planning of cooperative projects. The committe monitors safety standards and accident reports, and provides assistance and guidance when required on matters such as training standards, safety legislation, and recognition of training standards between countries.

Symposia and Meetings

The 6th Symposium of the Scientific Committee of CMAS was held at Heriot Watt University, Edinburgh, Scotland, in September 1980.

The 7th Symposium will be held at the Universities of Padova and Venice on September 15-18th 1983. The symposium is planned to attract diving scientists from 20-30 countries, and will include programme sessions on marine biology, marine geology, conservation, marine archaeology, and diving instrumentation. There will be specialist workshops on diving legislation, safety, and training.

CMAS was represented at the European Community Conference on Diving Safety, organized in Luxembourg, October 1980, by the Mines and Safety Division. A paper was presented by CMAS analysing the different types of training in different European and American scientific institutions, and comparing the accident and fatality records with various classes of commercial and military diving. The presentation was part of a continuing effort to persuade legislators to recognise scientific diving as a distinct class of activity, requiring safety and training standards distinct from those of commercial diving.

CMAS representatives assisted in the planning of the International DiveTech Conference in London, November, 1981, which brought together experts in offshore diving technology. A session on scientific diving was included in the programme.

In January 1982 a group of French universities held a scientific diving symposium at the University of Nice, inviting also delegates from Italy and Britain. This meeting will probably become a regular item on the annual calendar, and will provide a useful forum, especially for marine scientists conducting diving research in the Mediterranean.

A General Assembly of the Scientific Committee, together with a small symposium, was held at Can Cun, Mexico, in December 1980.

The American Academy of Underwater Sciences held its National Symposium on Diving Science at Scripps Institution of Oceanography in September 1981. Address list and Abstracts available through CMAS.

The CMAS Scientific Committee was a sponsor, together with the Shorelines Commission of INQUA, of a conference at Scripps Institution of Oceanography, entitled "Quaternary Land-Sea Bridges and Human Occupation of the Continental Shelf". This

was held in September 1981. The meeting brought together marine geologists, physical oceanographers, archaeologists, and anthropologists, to study the survival and excavation of palaeolithic and neolithic archaeological sites on the continental shelf. The proceedings will be published in late 1982.

The next General Meeting of the Scientific Committee of CMAS will be held in Barcelona, Spain, in January 1983.

Legislation, Safety, and Training

During the last few years the following countries have passed legislation having direct effect on the status and training and insurance of divers in research establishments: France, Germany, Sweden, U.S.A., South Africa, U.K., Italy, Ireland, and Israel. In most cases there has been a tendency to over-legislate and to constrain scientific divers using scuba diving methods with the same controls applied to commercial divers using bell diving and saturation techniques. The CMAS Scientific Committee has collected the documents resulting from these negotiations in each country, and has been able to help in some cases. The files show the best solutions which have been obtained in each case. The same problems are likely to recur in other countries as legislation is introduced, and marine science institutions concerned about the forthcoming legislation applicable to divers are encouraged to contact the CMAS Scientific Committee.

The British legislation on diving safety "Health and Safety at Work, Diving Operations, Regulations, 1981" became law in July 1981. This legislation recognises 4 classes of divers, each requiring different types of training, safety precautions, and supervision. Scientific diving using Scuba only, is in a special class, with additional exemption from some of the regulations. The example of this legislation, (S.I. 399, 1981, available from HMSO), may be of assistance to other countries where scientific diving may be over-restricted. The British legislation and Guidance Notes recognise that sports diving training standards, which have been attained by many university students, are relevant to scientific diving with Scuba, and that Institutes and University Departments can organise short conversion courses which will up-grade divers to a standard recognised by legislation as suitable for employed divers.

The CMAS Scientific Diver training identity card is available from the CMAS HQ, 34 Rue du Colisée, Paris 75008, France. This card was introduced in late 1980, and certifies that the holder is entitled to dive in the course of employed work at a laboratory or marine research institute in his/her country of origin. It is now widely used by scientific divers working abroad.

ANNEX XVIII

PROPOSALS FROM SCAR TO SCOR REGARDING THE ANTARCTIC PACK ICE ZONE AND SOUTHERN OCEAN PHYSICAL AND CHEMICAL OCEANOGRAPHY

Antarctic Sea Ice Zone

In late 1981 the SCAR Group of Specialists on Antarctic Climate Research produced a report Basis for an Action Plan for an Antarctic Climate Research Programme, copies of which were distributed to the organizations likely to be interested, including CCCO and JSC.

From the outset, CCCO, JSC and other groups have recognised the importance of the seasonal sea ice in climate research. At its third meeting in March 1982 CCCO confirmed significance of ice-covered seas and identified some major problems requiring attention. No positive decisions regarding CCCO actions were taken at this meeting, but the question of how best ice-ocean-atmosphere interaction could be considered internationally was referred to the June 1982 CAS/JSC/CCCO meeting of experts on the role of sea ice in climate variations. Meanwhile, at the May 1982 JSC/CCCO Study Conference on Large Scale Oceanographic Experiments the Chairman of CCCO held discussions with a group of participants and concluded that CCCO should concentrate on the Antarctic and probably form a Southern Ocean panel.

The WMO/CAS - JSC - CCCO meeting of experts on the role of sea ice in climatic variations (24-29 June 1982) defined a research strategy for the investigation of the climatic role of sea ice, and in particular the Antarctic sea ice with emphasis on the Weddell Sea. These conclusions were taken into account by the SCAR group of specialists on Antarctic Climate Research, and other discussions on the Antarctic Climate question, at XVII SCAR in July 1982.

The sea ice zone is recognised by SCAR as being of major significance in any Antarctic Climate Research Programme but it is also an important area for biologists. The SCAR Group of Specialists on Southern Ocean Ecosystems and Their Living Resources (SCOR WG 54) has recently agreed on the need to form a small working party to concentrate on the biological problems of the pack ice zone.

There are thus many groups and many disciplines interested in the pack ice zone (meteorology, climatology, oceanography, glaciology, biology). It is an extremely difficult area to work in, there are limited facilities available and special techniques such as satellites and data buoys will be required.

Because of the importance of the Antarctic ice zone to many disciplines and because of the practical problem of working there, SCAR believes there is an urgent need for an expert group to draw up realistic proposals for multi-discipline programmes that would make the most effective use of facilities. Such a group could serve as a focus and meeting point for the Antarctic Sea Ice Zone interests of many international groups, without necessarily replacing them. For example, the BIOMASS working party would still be required and it may well be that a panel under CCCO would also be required to identify needs but the proposed new group would be central in practical planning and should involve satellite and buoy experts.

SCAR therefore suggests to SCOR that perhaps the best way to proceed would be for SCAR and SCOR jointly to set up such a group but involving also representatives of other organisations that have specialised interests in the pack ice area.

SCAR did not have details of the proposal to establish a new SCOR Working Group on Marginal Ice Zone Studies but wishes to emphasise that the need is to consider the whole of the Antarctic sea ice zone, not just the marginal area although for some purposes this will be of particular significance.

SCAR would be willing to take the lead in setting up such a group but awaits the reaction of SCOR regarding this proposal for a joint initiative.

Antarctic Physical and Chemical Oceanography

The report of the SCAR Working Group on Oceanography to XVII SCAR reviewed briefly the interests of many international organisations in the Southern Ocean. (copies of that report are available).

SCAR has decided to disband its Working Group on Oceanography because there was no real function for a group consisting of one nominee from each SCAR country which gave a somewhat unselective mix of scientific disciplines with few members in a position to make commitments. In any case, as long ago as 1970 the group had itself concluded that the promotion of physical and chemical oceanogrpahy in the Antarctic was likely to be more successful under SCOR auspices. That 1970 decision led to the establishment of SCOR WG 38 on Ocean Processes in the Antarctic and its successor, SCOR's Antarctic Review Group.

Since that time the BIOMASS programme has been launched which brings together internationally the scientific interests in the Antarctic marine ecosystem and SCAR has now proposed the formation of a joint SCAR/SCOR group to be concerned with the interdisciplinary problems of the Antarctic sea ice zone. There is still needed an international focus for discussion of problems and programme planning in physical and chemical oceanography of the Southern Ocean. It had been thought that the IOC Programme Group for the Southern Oceans might undertake specific functions in these fields but even so there would be a need for a scientific group within ICSU which SCAR believes could be provided most effectively by a specially constituted group within SCOR. Many physical oceanographers working in the Antarctic are concerned with the Southern Ocean and its particular problems as part of their study of the World Ocean and are, generally, more closely related to SCOR than to SCAR. Also, a SCOR group would provide an appropriate interface with IOC. SCAR therefore invites SCOR to undertake the main responsibility for providing the focus within ICSU for physical and chemical oceanography in the Southern Ocean. If SCOR accepts this responsibility, SCAR would be pleased to be associated with any group set up by SCOR be it a new SCOR Working Group, successor to WG 38, or an expanded SCOR Antarctic Review Group. It would, of course be important, when considering programmes, to bear in mind the needs of BIOMASS for physical and chemical input and to consider, with SCOR WG 54, logistics aspects such as optimum use of facilities and for that purpose a liaison member from WG 54 might be included in the membership.

Now that IOC has postponed until 1983 the proposed meeting of its Programme Group, it might be opportune for the sixteenth meeting of SCOR to discuss the scientific needs and possibilities for international physical/chemical programmes in the Southern Ocean and identify priorities and at the same time identify specific tasks which might most profitably be undertaken by IOC. The U.S.A. and U.S.S.R. have already identified major studies they believe should be undertaken internationally, in prepartion for the IOC meeting. Perhaps SCOR should consider the scientific needs for these activities and establish mechanisms for elaborating plans for their implementation. Many believe there is a need for an intergovernmental group concerned with Antarctic ocean science and the IOC Programme Group should be continued to meet that requirement. It may be that given suitable mechanisms, SCOR could provide the scientific leadership and look to the IOC group for practical support and for providing the links with the Ocean Services of IODE and IGOSS.

ANNEX XIX

ABBREVIATIONS

ACMRR	Advisory Committee on Marine Resources Research (of FAO)
AGU	American Geophysical Union
ARG	Antarctic Review Group
ASEAN	Association of South East Asian Nations
ASFIS	Aquatic Science and Fisheries Information System
BIOMASS	Biological Investigations of Marine Antarctic Systems and Stocks
CAGE	CCCO Proposed Experiment in the North Atlantic
CAS	Commission for Atmospheric Sciences
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CCCO	Committee on Climatic Changes and the Ocean
CCOP/SOPAC	Committee for Coordination of Joint Prospecting for Mineral Resources in South Pacific Offshore Areas
CINCWIO	Cooperative Investigation in the North and Central West Indian Ocean
CMAS	Confederation Mondiale des Activités Sub-aquatiques
CMG	Commission for Marine Geology
CNC	Canadian National Committee (for SCOR)
CNES	Centre National d'Etudes Spatiales
COSPAR	Committee on Space Research
CTD	Conductivity, Temperature, Depth
CZCS	Coastal Zone Colour Scanner
EC	Executive Committee (SCOR) or Executive Council (IOC)
ECOR	Engineering Committee on Oceanic Resources
ECGM	Eddy Resolving General Circulation Model
EKE	Eddy Kinetic Energy
FAO	Food and Agriculture Organization (of the UN)
FGGE	First GARP Global Experiment
FIBEX	First BIOMASS Experiment
FOCAL	French Equatorial Atlantic Ocean Climate Programme
FORE	Future Ocean Research
GARP	Global Atmospheric Research Programme (of WMO/ICSU)
GESAMP	Group of Experts on the Scientific Aspects of Marine Pollution
HMSO	Her Majesty's Stationery Office
IABO	International Association for Biological Oceanography
IAG	International Association of Geodesy
IAGA	International Association of Geomagnetism and Aeronomy
IAHS	International Association of Hydrological Sciences
IAMAP	International Association of Meteorology and Atmospheric Physics
IAPSO	International Association for Physical Sciences of the Ocean
IASPEI	International Association of Seismology and Physics of the Earth's Interior
IAVCEI	International Association of Vulcanology and Chemistry of the Earth's Interior
ICES	International Council for the Exploration of the Sea
ICL	Inter-Union Commission on the Lithosphere
ICSU	International Council of Scientific Unions
IFM	Institüt für Meereskunde (Universitat Kiel)
IGOSS	Integrated Global Ocean Station System
INQUA	Union Internationale pour l'Etude du Quaternaire

IOC	Intergovernmental Oceanographic Commission
IODE	International Oceanographic Data Exchange
IOS	Institute of Oceanographic Sciences (UK)
IREX	International Recruitment Experiment
ISA	International Seaweed Association
IUB	International Union of Biochemistry
IUBS	International Union of Biological Sciences
IUCN	International Union for the Conservation of Nature and Natural Resources
IUCRM	Inter-Union Commission on Radio Meteorology
IUGG	International Union of Geodesy and Geophysics
IUPAC	International Union of Pure and Applied Chemistry
JOA	Joint Oceanographic Assembly
JOC	Joint Organizing Committee for GARP
JPOTS	Joint Panel on Oceanographic Tables and Standards
JSC	Joint Scientific Committee (WMO/ICSU)
MAR	Mid Atlantic Ridge
MAFF	Ministry of Agriculture, Fisheries and Food (UK)
MPNA	Marine Pollution in the North Atlantic (an ICES Working Group)
MSL	Mean Sea Level
NASA	National Aeronautics and Space Administration (USA)
NBS	National Bureau of Standards (USA)
NEADS	Northeast Atlantic Dynamics Studies
NOAA	National Oceanic and Atmospheric Administration (USA)
OAMEX	Ocean-Atmosphere Materials Exchange
OGCM	Ocean General Circulation Model
ONR	Office of Naval Research (USA)
OSLR	Ocean Science in Relation to Living Resources
OSNLR	Ocean Science in Relation to Non-Living Resources
PATHS	CCCO Proposed Experiment in the Pacific Ocean
PG/SOC	Programme Group for the Southern Ocean (of IOC)
POLYGON	USSR Oceanographic Experiment in the Northeast Atlantic
POLYMODE	POLYGON Mid-Ocean Dynamics Experiment
POMS	Pilot Ocean Monitoring Study
RIOS	River Input to Ocean Systems
SCAR	Scientific Committee on Antarctic Research
SCOPE	Scientific Committee on Problems of the Environment
SCOR	Scientific Committee on Oceanic Research
SEQUAL	Seasonal Equatorial Atlantic Experiment
SIBEX	Second BIOMASS Experiment
SRB	Scientific Review Board (of IOC)
SST	Sea Surface Temperature
TEMA	Training, Education and Mutual Assistance
TOGA	CCCO Proposed Tropical Oceans Experiment
TSOM	Time Series of Ocean Measurements
TTO	Transient Tracers in the Ocean
UN	United Nations
UNCLOS	UN Conference on the Law of the Sea
UNDP	UN Development Programme
UNEP	UN Environment Programme
UNESCO	UN Educational, Scientific and Cultural Organization
URI	University of Rhode Island
URSI	International Union of Radio Science
WCP	World Climate Programme
WCRP	World Climate Research Programme
WESTPAC	Western Pacific

WG	Working Group
WHO	World Health Organization (of the UN)
WHOI	Woods Hole Oceanographic Institution
WMO	World Meteorological Organization (of the UN)
WOCE	World Ocean Circulation Experiment (of CCCO)
XBT	Expendable Bathythermograph