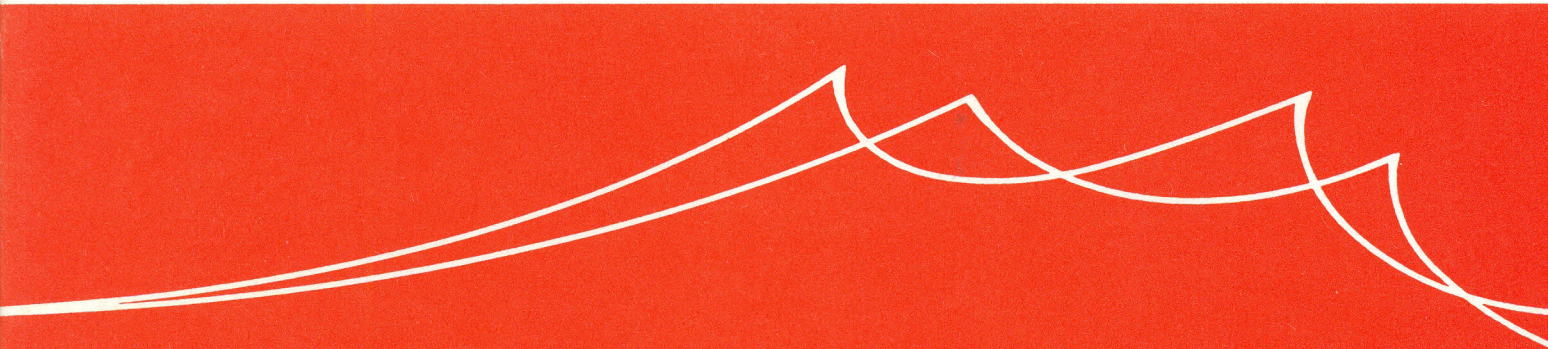


SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH



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INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH

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INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

**PROCEEDINGS  
OF THE  
SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH**

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## REPORT ON THE NINETEENTH MEETING OF THE SCOR EXECUTIVE COMMITTEE

Stellenbosch, South Africa, 12 to 15 November 1975

The nineteenth meeting of the SCOR Executive Committee was held at the University of Stellenbosch, South Africa, from 12 to 15 November 1975, with the President, Professor H. Postma in the Chair.

Dr E. S. W. Simpson, Director of the National Research Institute for Oceanology of the South African Council for Scientific and Industrial Research (CSIR) welcomed the participants. The Vice Rector of the University of Stellenbosch, Professor W. L. Mouton, entertained the participants to a lunch and the President of CSIR, Dr C. v. d. M. Brink, entertained the participants to an evening reception and supper party.

A list of those attending the meeting is given in Annex 1.

### 1.0 ORGANIZATION AND FINANCE

#### 1.1 MEMBERSHIP

##### National membership -

The President had invited Colombia, Ecuador, Peru, Venezuela and Ireland to become members of SCOR. The first two countries had expressed considerable interest, but had sought additional information on the necessary financial commitment. No answer has yet been received from Peru. Venezuela plans to form a national committee for oceanographic research in the near future; meanwhile Dr Gregorio Reyes Vásquez, Director of the Instituto Oceanografico at Cumana, had agreed to serve as an invited member of SCOR.

The National Science Council of Ireland is considering their relations with SCOR in connexion with recommendations of an OECD review of marine science and technology. Professor Hempel informed the meeting that this review was now completed and that the National Science Council might soon approach SCOR.

Regarding countries which have been approached earlier by SCOR, Professor Hempel will inquire further about possible interest of Egypt; Professor Wooster about Cuba and Turkey and Professor Postma about Belgium.

Dr Tandberg reported the apparent interest of the People's Republic of China in SCOR activities. SCOR was particularly anxious to enlist the collaboration of Chinese scientists in the activities of WG 46, as was noted in the report of that group (Annex VIII). The Executive Committee invited Dr Tandberg to convey a copy of that report to the appropriate authorities and to emphasize the desire of SCOR for suitable Chinese experts to attend the workshop on River Inputs to Ocean Systems in September 1976 and participate in future activities of WG 46.

##### Organizational membership -

Following a recommendation by IUPAC in 1974 concerning the re-determination of the absolute density of water, part of which referred to ocean water, the President had expressed to IUPAC SCOR's willingness to assist and SCOR's wish to effect closer collaboration with IUPAC on matters of marine chemistry. WG 10 had devoted considerable attention to the problem of the absolute density of sea water, at its meeting in September 1975, and it was noted that two members of this Working Group were connected with IUPAC which should ensure effective liaison. As WG 10 was the only subsidiary body of SCOR that was, at the present time, closely concerned with questions of marine chemistry, the decision of the Executive Committee of IUPAC not to take any action regarding formal representation on SCOR was accepted without question.

A letter had been received from the Confédération Mondiale des Activités Subaquatiques Scientific Committee (CMAS) seeking to establish some relationship with SCOR. The CMAS is the world body responsible for standardizing diving training and equipment for non-commercial and non-navy divers.

The request was discussed and it was agreed that some relationship would be desirable. Affiliated organizations were, however, confined to the ICSU family and the membership of SCOR to National Committee nominees and representative members of ICSU bodies.

ECOR at present had no formal relations with SCOR and thus it seemed desirable to resolve the situation by amending the constitution to create a suitable category into which CMAS



and ECOR could fit. A proposed amendment will be distributed to National Committees for their consideration prior to XIII SCOR.

## 1.2 PUBLICATIONS

A Supplement to SCOR Proceedings containing details, as at June 1975, of SCOR members, SCOR Working Groups and publications resulting from their activities, together with other information, was in press and would be distributed at the end of 1975.

The material for the IIOE Atlas on Phytoplankton Production and some Related Factors was completed just before the death of Professor Krey of Kiel University in May 1975. Professor Hempel informed the meeting that the publication would be financed from the FRG contribution to the IOC Trust Fund but that not all the proposed environmental background charts could be included because of financial restrictions. This would, however, not essentially diminish the scientific value of the Atlas, since these charts were available in other IIOE atlases.

It was expected that the IIOE Geological and Geophysical Atlas would be available shortly, through Soviet sales agents.

Further discussions had been held with IOC and FAO concerning a new edition of an International Directory of Marine Scientists. FAO had now agreed that such a directory should include, under each country, the full addresses of each institution with a list of staff members and one or two words describing their main activity; such descriptions to be chosen from the list of ten previously provided by SCOR. The publication should also contain an alphabetical index of names. FAO will, after further consultation with IOC and SCOR secretariats, produce a draft computer print-out of national entries for such a directory by the end of January 1976. Draft national entries will then be sent by SCOR to its National Committees and by IOC to its TEMA contacts for correction and updating within one month so that FAO can proceed to printing and distribution by August 1976. The SCOR Executive Committee reiterated its view that such a directory was most desirable and hoped that FAO and UNESCO would be able to make the necessary financial arrangements to ensure early distribution of copies to all individuals wishing to receive one.

UNESCO monographs in oceanographic methodology

- No. 1 Determination of Photosynthetic Pigments -  
After consultation with a number of interested scientists the Secretary had advised UNESCO not to reprint this volume but to consider producing a revised, updated version (see item 3.2 of this report).
- No. 2 Zooplankton Sampling -  
The Secretary had advised UNESCO that reprinting would be justified if an annex could be included to describe new techniques.
- No. 4 Fixation and Preservation of Marine Zooplankton. This was in galley proof stage and UNESCO expected to print in January 1976.
- No. 5 Coral Reef Methods -  
About three-quarters of the text had been submitted to UNESCO by Dr D.R. Stoddart and UNESCO hoped to print the monograph by the end of 1976.
- No. 6 Phytoplankton Methods Manual -  
A contents list has now been agreed, with the approval of IABO. Dr Sournia, the editor, had invited contributions from the authors selected and requested the submission of a first draft by May 1976 with a view to publication in 1977.

Noting that the monographs on oceanographic methodology all resulted from activities of SCOR Working Groups and were products of collaboration between SCOR and UNESCO, but that no mechanisms existed for ensuring the adequacy of the texts and introductions to illustrate this collaboration, it was agreed that it would be appropriate for SCOR to suggest to UNESCO that SCOR establish a small editorial board of perhaps two scientists to assist UNESCO and approve both the manuscripts and introductions for all future monographs.

UNESCO Technical Papers in Marine Science

In response to a request from UNESCO for advice, the Executive Committee recommended reprinting of a number of the Technical Papers. UNESCO hoped to have copies of these reprinted issues available for distribution at JOA.



It was agreed that, to aid effective distribution, the Chairmen of SCOR Working Groups whose reports are submitted for this series should be invited to provide UNESCO with lists of scientists who might be interested in receiving a copy.

SCOR/SCAR Polar Oceans Conference, May 1974

It was reported that the Editor, Professor M. Dunbar, had experienced some difficulty in negotiating with the publishers who had originally expressed interest. He had since sought other means of publishing the proceedings of this important conference. The Arctic Institute of North America had now agreed to undertake the publication and the National Science Foundation had offered some support but nevertheless there remained a need for additional financial help. The Executive Committee was anxious to see early publication of this volume and agreed to provide the required financial support and hoped that SCAR would also offer some assistance.

### 1.3 FINANCE

An estimate of SCOR income and expenditure for 1975 was noted. The final statement for 1975 appears as Annex II.

It was agreed that some of the Officers should meet in about May 1976 and that during that meeting they would review the financial situation of SCOR for 1976 and, if necessary, prepare proposals for increasing SCOR income for submission to National Committees for consideration prior to XIII SCOR.

### 1.4 OFFICERS

a. Professor R.W. Stewart (Canada) has replaced Professor H. Lacombe as President of IAPSO and as 'ex officio' member of the SCOR Executive Committee. Professor C. Junge (FRG) has replaced Dr S. Fritz as President of IAMAP and as 'ex officio' member of the SCOR Executive Committee.

b. The meeting recognized that the following officers will have completed their terms of office at the next General Meeting of SCOR in September 1976; the President, Past President, the two Vice-Presidents and the Secretary. Only the latter is eligible for re-election. Moreover, the meeting was informed that the President of IABO will retire in September 1976, and that the President of CMG might change in 1976. To avoid future massive changes in the membership of the Executive Committee, which threaten the continuity of the work of SCOR, some changes in the Constitution were proposed whereby terms of office of the Vice-Presidents and Secretary would be reduced to two years but they would be eligible for re-election twice and the Executive Committee could co-opt additional members for limited periods for specific responsibilities. These proposals will be submitted to National Committees for consideration prior to further discussion at the next General Meeting.

## 2.0 WORKING GROUPS

### 2.1 FORMER GROUPS

WG 21: Continuous Current Velocity Measurements (with IAPSO and UNESCO). The final report of the Group, being the report of an experiment carried out from RV Atlantis II in August/September 1972 had been published in 1975 as UNESCO Technical Paper in Marine Science No. 23.

SCOR/ICES - Nutrient Intercalibration Experiment (arising from WG 25)

The statistical analysis of the data from the 1970 Nutrient Intercalibration Experiment is now being co-ordinated by Dr K.M. Palmork and Dr Ø. Ulltang from the Institute of Marine Research in Bergen, who hope to complete the research report before the end of this year. The meeting noted with appreciation the progress which is now being made. It was agreed that the report should be published as a Co-operative Research Report of ICES, but the title and introduction should clearly recognize the role of SCOR in promoting the experiment. Also the great contribution of Professor Sugawara in providing the samples for the nutrient intercalibration should be stressed. Of the \$1650 granted by SCOR to ICES in the beginning of the experiment only \$100 had been spent so that there are no great economical difficulties in completing the analysis.

WG 27: Tides of the Open Sea: This Group held its final meeting in Grenoble on 29 August 1975. The report of this meeting was approved and is given in Annex III. Regarding future



"satellite altimetry of the sea surface", IAPSO, at its meeting in Grenoble, adopted a resolution (no. 4) which recommended that when it has been demonstrated that these data are sufficiently accurate for tidal studies, IAPSO would request SCOR to form a Working Group to encourage and co-ordinate such studies. The report and analysis of results of the 1973 intercomparison of deep sea tidal meters had been published in 1975 as UNESCO Technical Paper in Marine Science No. 21.

WG 33: Phytoplankton Sampling Methods: An announcement of a course which is being organized by Professor Paasche at the University of Oslo, had been circulated to National Committees. The course which is for experienced workers will take place from 26 July to 20 August 1976, and UNESCO had agreed to assist in providing help for participants from developing countries. It had proved impossible to organize an ad hoc advisory panel on the Inverted Microscope Technique and further advice had been sought from IABO. IABO had convened a small meeting of experts who, amongst themselves, had agreed to conduct some laboratory work on specific aspects of the problem. It appeared that there was no further action SCOR could take, but it was hoped that there would be some evaluation of the technique in the Phytoplankton Methods Manual (see item 1.2).

## 2.2 EXISTING GROUPS

### WG 10: Oceanographic Tables and Standards (with IAPSO, ICES and UNESCO)

A preliminary report was received from the meeting of the Group in September 1975 in Grenoble. Some of the items discussed were the following:

The Group reinforced a previous recommendation (1/1973) and asked SCOR and IAPSO to identify, through their national bodies, institutes prepared to undertake accurate determinations of the temperature coefficient of the conductivity of sea water below 12°C particularly for the salinity range from 36‰ down to 32‰, and possibly lower, within the next three years. The Executive Committee observed that the Working Group itself should identify known competent scientists and institutes to facilitate the requested action.

It decided to associate with IUPAC to further an international programme of new determinations of the absolute density of water between 0 and 40°C with an accuracy of at least  $1 \times 10^{-3} \text{ Kg/m}^3$ . The Working Group and IAPSO had both agreed to recommend the intermediate use by oceanographers, until values for the absolute density of water are available, of the density tables for pure water recommended by IUPAC.

The Group called attention to new studies which showed unacceptable variations in the electrical conductivity of standard seawater. They also discussed in detail a new equation of state for seawater which would make a revision of the Knudsen-Ekman tables necessary and decided to issue a note in major oceanographic journals to draw the attention of the oceanographic community to this far-reaching question.

The Executive Committee decided to await the final report of the Group before taking further action. The final report will be published in the series UNESCO Technical Papers in Marine Science.

### WG 34: Internal Dynamics of the Ocean (with IAPSO)

The Group met in Grenoble in September 1975. The report of the meeting appears as Annex IV. This report was not available for discussion by the Executive Committee but the Chairman, Professor A. Robinson, had drawn some important items to the attention of SCOR.

A proposal that three or four scientists meet during early 1976 to develop plans for an eastern North Atlantic eddy experiment, to be co-ordinated with POLYMODE, was approved.

The Executive Committee approved, in principle, a proposal to organize an international symposium on Eddy Dynamics and Parameterization, as proposed by the JOC ad hoc Working Group on Coupled Ocean-Atmosphere Models, subject to confirmation of JOC support. It was recommended that the symposium be held in early 1977 and that plans for the symposium be developed by WG 34, in co-operation with WG 49 and JOC for presentation to XIII SCOR.

### WG 36: Coastal and Equatorial Upwelling Processes (with IABO, IAPSO, ACMRR and ACOMR)

It was noted that a successful Third International Symposium on Upwelling Ecosystems had been held in Kiel 25-28 August 1975, under the sponsorship of the Deutsche Forschungsgemeinschaft/SCOR/IOC/UNESCO/Kiel University.



A meeting of WG 36 was held at Banyuls-sur-Mer from 8 to 11 September 1975. The report of the meeting is in Annex V.

The Executive Committee expressed interest in the proposal to hold the Fourth Upwelling Ecosystems Analysis Symposium in 1978 in Peru and hoped that it would be possible for UNESCO to support such a symposium.

The proposal was endorsed that SCOR should advise IOC and, through it, the Government of Ecuador on the desirability of conducting regular marine meteorological, physical, chemical and biological observations in the area of the Galapagos Islands to monitor the interconnections between the upwelling along the west coast of South America, the equatorial upwelling in the Pacific Ocean and the development of El Niño conditions.

The Executive Committee agreed with a suggestion of the Executive Committee Reporter for the Group, Professor Lacombe, that biological and physical modellers should be invited to take part in the discussions at the next meeting but not, at this stage, be added to the permanent membership.

#### WG 38: Ocean Processes in the Antarctic (with IAPSO and SCAR)

The Group met in August/September 1975 and decided that their report to SCOR should include a survey of ongoing and planned scientific programmes and proposals for future activities that might be considered feasible and within a reasonable and acceptable economic frame. The Chairman and Rapporteur are compiling such a report in consultation, by correspondence, with other members of the Group, and a meeting in 1976 may prove necessary to discuss the report before it is submitted to SCOR.

It is intended to invite a physical oceanographer from WG 38 to join the new Working Group 54 on living resources of the Southern Ocean to provide advice on the physical environment which supports the living resources.

It was agreed again to urge the Chairman to add Argentine and South African scientists to the membership of the Group and to keep the Chairman of WG 47 informed of all programmes in the southern oceans that were being planned to take place during FGGE. Also, it was suggested that at the next SCOR General Meeting, which would be after the CMG symposium on Circum-Antarctic Marine Geology (August 1976), the meeting of experts on Living Resources of the Southern Oceans (August 1976) and the compilation of the WG 38 report, it might be advantageous to consider the desirability of organizing a workshop to integrate the future plans in the three main marine science disciplines.

#### WG 40: Paleo-Oceanography (with CMG)

This group is organizing a symposium on Paleo-oceanography at the Joint Oceanographic Assembly 1976.

#### WG 42: Pollution of the Baltic (with ICES, IAPSO and IABO)

The Joint Working Group on the Study of Pollution of the Baltic held a meeting in Charlottenlund, Denmark, 18-19 June 1975. The full report had been sent to the members of the Executive Committee and an abridged version was discussed at the meeting. Extracts from the report are published in Annex VI. The Group had reviewed the present state of knowledge and also the need to avoid any duplication of activities by a group set up by the Scientific-Technological Working Group of the Interim Commission for the Protection of the Marine Environment of the Baltic Sea Area.

Professor Hempel and Dr Tandberg both stressed the importance of continuing SCOR participation which facilitated the involvement of academic scientists. The assistance given by SCOR to Professor Grasshoff to attend a meeting of biologists and chemists in Gdynia in October 1975 to plan the Open Sea Experiment (task 5 of the WG 42 action plan) was appreciated.

The next meeting of the group will take place in Tallin in April/May 1976 at the invitation of the Estonian Academy of Science.

#### WG 43: Oceanography related to GATE (with IAMAP and IAPSO)

During 1975 the Group had organized two workshops, a C-Scale workshop in Southampton in June and an Equatorial and A-scale workshop in Geneva in August, and two meetings of the Group, one in Southampton in June and one in Grenoble in September.



Professor Siedler, Chairman of the Working Group, explained that the two workshops had been held soon after the field phase of GATE to enable participants to discuss at an early date questions related to data processing and to organize further collaboration in small groups. The report of the C-Scale workshop had been produced by its convenor Professor J. Woods (UK) and a manuscript of The Equatorial and A-Scale workshop had been prepared by its convenor, Dr W. Düing (USA). The recommendations arising from the workshops had been considered at the meetings of the Working Group and are referred to in the summary report of these meetings which appears as Annex VII. It was hoped that the reports would be published in an appropriate GARP report series.

The Executive Committee supported the Group's proposal to hold three small meetings and another major workshop in September 1976 and a final symposium on GATE oceanographic results in late 1977, after which it was expected that the Working Group could be disbanded. Both IAMAP and IAPSO have expressed general approval of the proposal for a major final symposium in 1977 and it was expected that these meetings would be jointly sponsored by SCOR, IOC and WMO. SCOR will continue to support representation at appropriate meetings of TEB.

To facilitate the analysis of data, the Group's intention to form a number of small groups to work together by correspondence and to arrange small informal workshops on specific questions was noted.

Of particular concern to WG 43 and the workshop participants were matters concerning the quality of international data validation and processing. It was understood that the Oceanographic Sub-programme Data Centre (OSDC) at Brest had computer programmers but no fulltime oceanographer solely committed to GATE data. Some validation of data could be achieved by the small ad hoc groups but there was an urgent need to ensure international validation and to provide advice to OSDC.

In order for this problem to be assessed, it was agreed that SCOR should meet the expenses of an early visit to Brest by Dr Meincke (Kiel) and that he should be invited to submit his report to the Chairman of WG 43. SCOR will ask IOC to negotiate with WMO and with the French Government with a view to attempting to meet the requirements specified by WG 43 of a French oceanographer being appointed to the staff of OSDC and funds being made available for shorter visits by internationally appointed experts on various types of data during 1976 and 1977. It might become necessary, at a later stage, to recommend the appointment of a further international expert for up to two years, as suggested by the WG 43 Southampton meeting.

Discussions regarding the proposed GATE oceanographic Atlas were proceeding and final recommendations from the Atlas Study Group of WG 43 should become available by the end of 1976.

#### WG 44: Tropospheric Transport of Pollutants

Following a request from the SCOR General Meeting, the US National Committee had invited Professor J.M. Prospero and Professor R.A. Duce to organize a workshop on the subject, from which should result recommendations on future actions by SCOR. This workshop will be held in Miami from 8 to 12 December 1975.

#### WG 46: River Inputs to Ocean Systems (with ECOR, IAHS, ACMRR, UNESCO, CMG, IAPSO and IABO)

The Group met in New Haven, USA, in March 1975. The report, Annex VIII, contains the Group's proposals for future activities, which include (Phase I) a review of ongoing research activities, (Phase II) a workshop on the subject to be held in the UK in September 1976 and (Phase III) the establishment of three field stations on the mouths of major rivers. The SCOR Officers had encouraged WG 46 to proceed with Phases I and II and an application for financial support for these activities had been submitted to UNEP by IOC. Development of plans for Phase III should not be undertaken before the workshop.

The meeting discussed the report and endorsed the action taken. On the advice of IABO, Dr S.O. Stanley (UK) a sediment biologist, had been appointed to membership of the Working Group.

The Argentine National Committee had expressed particular interest in the work of this Group because of their direct concern with the problems of the large fluvial system of Rio de la Plata. The Chairman of WG 46 was asked to take the Argentine interest into account and to ensure that Argentine scientists were invited to the 1976 workshop.



As reported in section 1.1, it is hoped that it will prove possible for scientists from the People's Republic of China to participate in the activities of this Group.

#### WG 47: Oceanographic Programmes during FGGE (with IAPSO and IAMAP)

The Chairman, Professor H. Stommel, has conducted extensive correspondence with the members of his Working Group and he, and other representatives from the Group, have participated in various meetings organized by JOC, particularly the June 1975 meeting of the JOC ad hoc Working Group on coupled Ocean-Atmosphere Models. Resulting from these consultations the Chairman had prepared an extensive report for the September 1975 meeting of the WMO Executive Committee Inter-governmental Panel on the FGGE in which the WG 47 views were given on areas in which oceanographic programmes could most benefit from the FGGE atmospheric data. The main areas for FGGE oceanographic activities should be the equatorial regions of the three major oceans, the Arabian Sea and the southern oceans. It was understood that the meteorologists required no oceanographic measurements, other than sea surface temperature, for the basic objectives of FGGE, but they were particularly anxious for many additional platforms for upper wind measurements in the tropical oceanic regions and were of the opinion that joint ocean/atmosphere studies in the tropical regions would be particularly advantageous in relation to the longer term objectives of GARP.

It appeared that, at this stage, the proposals of WG 47 were compatible with the needs of meteorologists and that close collaboration would be mutually beneficial. To further the planning of the oceanographic programmes, which would take into account such projects as NORPAX, MONEX, INDEX, El Niño etc., it had been decided by WG 47 to establish separate panels for the Pacific, Atlantic and Indian Oceans. A meeting on the Pacific equatorial plan would be held in Hawaii in December 1975 and the Executive Committee agreed to support meetings on the Indian Ocean and Atlantic Ocean plans in 1976. It was expected that the activities of WG 38 would contribute to the Antarctic plan.

Apart from the proposals for oceanographic programmes related to FGGE in 1979, the discussions in WG 47 and recent WMO sponsored meetings on GARP had shown clearly that there was a need to develop closer collaboration between SCOR and its Affiliated Organizations, JOC and IOC on various related numerical ocean models that needed to be developed in connection with the second objective of GARP and studies that need to be initiated to resolve the broad problems of climatic change. As had been recognized by the JOC ad hoc Working Group on Coupled Ocean-atmosphere Models, such activities would necessitate contributions by a number of the current Working Groups of SCOR. This could not be co-ordinated adequately by any existing mechanism and therefore it was agreed, subject to the concurrence of JOC and IOC, to establish a Committee on Oceanography and GARP (COG) to assist ICSU, IOC and WMO and to work in close co-operation with JOC with the following terms of reference and membership:

Terms of Reference: To identify, stimulate and co-ordinate oceanographic programmes linked to the objectives and activities of the Global Atmospheric Research Programme.

#### Membership:

- |   |   |
|---|---|
| a) Chairmen, relevant SCOR WG's (e.g. 34, 38, 47, 48, 49)       | 5 |
| b) Nominees (2) of JOC  | 2 |
| c) Nominees (1 each) of IAMAP, IAPSO                            | 2 |
| d) Nominees (2) of IOC (e.g. representatives of IGOSS and IODE) | 2 |
| e) Nominees (up to 3) of SCOR, including Chairman               | 3 |
| plus observers from GAO and IOC.                                |   |

Such a Committee should be formed as soon as possible and be asked to assist IOC in the formulation of the IOC plan for oceanographic programmes in support of GARP as envisaged in IOC resolution IX-6.

#### WG 48: The Influence of the Ocean on Climate (with IAPSO and IAMAP)

The membership of WG 48 has not yet been established. In January 1975, ICSU had arranged an ad hoc meeting on an integrated approach to climate studies with representatives from ICSU organizations (including the Chairman of SCOR WG 48), WMO, and UNESCO/IOC at which the breadth of the scientific problems and interests was noted. The Chairman of WG 48 had suggested that it was difficult to see how a SCOR Working Group could make any substantial impact on the problem except as a component of some broader based body; also, the problem of climate research went beyond the objectives of GARP and that perhaps what was required was a



new and major project co-ordinated by ICSU. The SCOR Executive Committee sympathized with this view but did not wish to make any firm proposals to ICSU at this time because, it was felt, the new mechanism indicated above for COG would provide much of what was necessary for the immediate future and could eventually lead to a more detailed proposal for ICSU initiative. Meanwhile, it was agreed that the terms of reference for WG 48 should be limited to:

"to keep under review research on processes determining climate, particularly the oceanic input of such research, and to report periodically to SCOR and other interested bodies on possible actions that might further such research",

and that the membership of the group be reconsidered.

The Chairman had conveyed to the Executive Committee, with his support, a proposal from the Chairman of the Ocean Climate Panel for a meeting of some of his members, and others, in early 1976 to complete their recommendations concerning the Pacific Ocean. The Executive Committee approved this proposed further meeting from which it expected a final report would result, after which the panel might be disbanded.

#### WG 49: Mathematical Modelling of Oceanic Processes (with IAPSO)

An ad hoc meeting of this Group was held in September 1975, the report of which is printed in Annex IX. The report includes a proposal to publish an informal newsletter to improve information flow, exchange of programmes etc. between mathematical modellers in physical oceanography.

It appears the U.S. Office of Naval Research may be able to fund this project which could be undertaken by Dr Gill (UK).

#### WG 50: Biological Effects of Ocean Variability (with IAPSO and IABO)

In accordance with its terms of reference, this group is engaged in preparations for a symposium at the Joint Oceanographic Assembly.

### 2.3 NEW WORKING GROUPS

The National Committee for FRG made proposals for the establishment of five new Working Groups on:

1. The Evaluation of CTD data
2. The Statistical Treatment of Plankton Samples
3. Modelling of Marine Ecosystems
4. Biochemical and Other Methods for Determining Production at Higher Trophic Levels
5. Estimation of Micro-nekton Abundance

WG 51: Evaluation of CTD data (with IAPSO). Instruments for the continuous measurement of conductivity, temperature and depth (pressure) meet with the difficulty that the sensors used do not always respond immediately and simultaneously to changes. This effect is of particular concern in profiles with sudden changes in temperature. The meeting decided that the problem merits international evaluation and decided to establish a Working Group with the following terms of reference:

To identify problems arising in correcting temperature, conductivity and pressure measurements made with profiling instruments and in calculating salinity and density;

To consider instrumental tests, calibrations and intercalibrations required before the above problems can be resolved;

To review correction and conversion methods presently used at the major laboratories;

To advise on procedures for obtaining consistent CTD data sets.

#### The Statistical Treatment of Plankton Samples

IABO had held a scientific meeting in 1966, one section of which had dealt with this topic. Subsequently SCOR had endeavoured to commission a handbook of statistical methods for use in plankton studies, both for sampling design and analysis, but without success.

The Executive recognized that whilst adequate statistical techniques did exist, many biologists still had a problem of not knowing where to find descriptions of these techniques or which to apply. Although it was felt premature to establish a Working Group, the Committee agreed to seek further advice and to reconsider the matter at the next meeting.



Modelling of Marine Ecosystems and Biochemical and Other Methods for Determining  
Production at Higher Trophic Levels

In both these proposals the Executive Committee felt they did not have sufficient information before them to reach a decision. IABO was therefore invited to consider these two proposals and advise SCOR at its next meeting.

WG 52: Estimation of Micro-nekton Abundance (with IABO, ICES, SCAR and ACMRR)

There have been considerable developments in this field in the last ten years and this together with the need for better quantitative estimates of young fish and organisms such as krill and squid encouraged the meeting to accept this proposal and create a new Working Group with the following terms of reference:

To compile and review information on methods for assessing presence, vertical distribution and species composition of micronekton, particularly krill and juvenile stages of fish and squid;

To review possibilities for quantitative estimates of micronekton abundance by acoustic methods and net sampling;

To prepare a manual on recommended methods for estimating and sampling micronekton.

The membership of the Group will be discussed together with ACMRR, ICES, SCAR and IABO.

WG 53: Evolution of the South Atlantic (with CMG, ICG, IAPSO and IABO)

The Commission for Marine Geology presented a proposal for this Working Group which was warmly received by the Committee and approved with the following terms of reference:

To stimulate scientific preparation for and to organize a symposium to review and critically evaluate the status of knowledge and interpretation of data relating to the origin and evolution of the floor and margins of the South Atlantic between South America and Africa;

To consider also the concomitant effects upon changes in ocean circulation and life.

Dr E.S.W. Simpson agreed to serve as Chairman of this Group and to recommend other members for consideration by the officers.

The symposium should take place not later than 1980 (to coincide with the termination of the International Geodynamics Project and the IPOD programme in the South Atlantic).

WG 54: Living Resources of the Southern Ocean (with IABO, SCAR and ACMRR)

SCOR had been invited by SCAR to collaborate in and co-sponsor the SCAR group of specialists on Living Resources of the Southern Oceans. The meeting agreed to do this and accepted the present terms of reference of the Group:

To assess the present state of knowledge of the Antarctic marine ecosystem from the point of view of structure, dynamic functions and biomass of the organisms at different trophic levels;

To encourage and stimulate investigations of the ecology and population dynamics of the organisms at different trophic levels with particular reference to krill, squid, fishes, and whales;

To maintain liaison with FAO;

To advise SCAR and SCOR and, through them, other international organizations and in particular to respond to relevant recommendations, conveyed to the group by SCAR or SCOR, of IOC and the Antarctic Treaty Consultative Meetings.

The current membership of the Group is as follows:

Dr S. Z. El-Sayed (USA) - Chairman  
Dr J. C. Hureau (France)  
Professor G. A. Knox (New Zealand)  
Dr R. M. Laws (UK)  
Dr T. Nemoto (Japan)

Dr G. G. Newman (South Africa)  
Dr D. B. Siniff (USA)  
Dr A. P. Tomo (Argentina)  
Professor G. Hempel (FRG) - IABO nominee  
Dr J. A. Gulland - ACMRR nominee



It was agreed to invite WG 38 to nominate a physical oceanographer to join the group and IABO would be asked to identify a second nominee (see also item 4.3 - SCAR).

WG 55: Prediction of "El Niño" (with IAMAP, IAPSO and ACOMR)

In its Resolution EC-V.8 IOC invited SCOR to establish, with the assistance of IOC, WMO and other appropriate bodies, a Working Group on the phenomenon known as "El Niño" with the following terms of reference:

To examine possible prediction schemes and indices for "El Niño" and to recommend the research needed to define the processes that should be taken into account in such forecasting procedures.

The meeting decided to establish this Working Group.

The Advisory Committee on Oceanic Meteorological Research (ACOMR) of WMO was invited to appoint a member on the Group. Further membership will be decided upon in collaboration with IAMAP and IAPSO.

## 2.4 EXECUTIVE COMMITTEE REPORTERS FOR WORKING GROUPS

The allocation of these duties was reviewed and reporters were appointed for the existing and new Working Groups as follows:

Executive Member	Working Groups
Monin	38
Voigt	34, 42, 43
Wooster	47, 51, 55
Stewart	10, 36, 48*, 49
Gaskell	40, 46, 53
Hempel	50, 52
Junge	48*
Currie	54

\* = Joint reporters

## 3.0 RELATIONS WITH INTERGOVERNMENTAL ORGANIZATIONS

### 3.1 IOC

The President participated in the fifth session of the IOC Executive Council in Venice, 3-8 March 1975, and for a few days in the ninth session of the IOC Assembly in Paris, 22 October to 4 November 1975, together with Mr Hemmen.

Relevant resolutions from the Executive Council session had been formally brought to the attention of SCOR.

IOC resolution EC-V.4 on Proposal for engagement of oceanographers in a study of "Air flow over and around mountains", connected to cyclogenesis over the Ligurian Sea had already been referred to IAMAP and IAPSO, who had discussed it in their September meetings in Grenoble. The final comments of these organizations and of JOC have not yet been received.

IOC resolution EC-V.7 on the Southern Oceans was taken into account in the discussions on the establishment of the new WG 54.

IOC resolution EC-V.8 on the Regional Study of the Phenomenon known as "El Niño" (ERFEN) was taken into account in the discussion on the establishment of the new WG 55.

IOC resolution EC-V.18 on the Committee for Co-ordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas (CCOP) invited SCOR, and other organizations including CMG, to send observers to meetings of the newly formed CCOP-IOC Joint Working Group for East Asian Transects. SCOR had asked CMG to represent its interests at the first meeting of the Group in August 1975 and at other relevant CCOP meetings. The President of CMG, Dr Gaskell, reported that resulting from these meetings extensive proposals for marine geoscience research in the South-west Pacific were emerging.



The final report and recommendations of the ninth session of the IOC Assembly were not yet available but the SCOR Executive Committee was able to consider a number of relevant draft resolutions, as amended at the final plenary meeting, and had the benefit of the presence at its meeting of the Chairman of IOC, Dr Humphrey.

IOC resolution IX-3 on the Programme of work in the South Pacific requests SCOR to review this programme and to give its comments before the next session of the IOC Executive Council in June 1976. CMG agreed to provide these comments before May for the SCOR Executive Committee to consider. A request for advice on the possible utilization of nutrients and thermal energy of deep ocean waters for such purposes as fish farming had been, on advice from SCOR, directed to ECOR.

IOC resolution IX-6 on the WMO/ICSU Global Atmospheric Research Programme (GARP) approves the establishment of an ad hoc Task Team to identify an IOC Comprehensive Programme in support of GARP and requests SCOR to appoint four members on this team representing relevant SCOR Working Groups (34, 47, 48 and 49).

As a first step to assist IOC in this matter the Executive Committee decided that SCOR should co-ordinate the activities of its own groups related to GARP by establishing a Committee on Oceanography and GARP. (For the relevant discussion and decisions, see this report under WG 47.)

IOC resolution IX-10 invited several international bodies, among them SCOR, to comment on The Comprehensive Plan for GIPME. Dr Humphrey explained that this resolution was one of several adopted by IOC in the field of marine pollution. He stressed that SCOR, although it disbanded WG 45 at its 12th General Meeting (see Proc. Vol. 10, No 2, p. 93) should continue to be prepared to provide scientific advice on marine pollution affairs, not only for IOC, but also for other international bodies such as SCOPE.

The Executive Committee, after a lengthy discussion, decided that a Scientific Rapporteur on Marine Pollution matters should be appointed with the specific task of following the development of the main related international programmes, especially GIPME and SCOPE programmes, and to advise SCOR where it could give scientific guidance on these programmes.

The Chairman of IOC also brought to the attention of SCOR a request from the twelfth session of ICSPRO, Rome, 12-15 October 1975, asking SCOR's assistance in preparing a list of international, including intergovernmental and non-governmental, bodies active in the field of Marine Pollution Research and Monitoring together with their composition, terms of reference, areas of activity, etc.

Professor Wooster informed the Executive Committee that Dr E. Miles, a social scientist who is a member of the US SCOR Committee, was in the process of completing a report on this matter. It was suggested that Dr Miles should convey a copy of his report to IOC and to SCOR. It was agreed to invite the scientific rapporteur on marine pollution to comment on this report and to assist in the compilation of a revised listing, if this appeared necessary for ICSPRO and SCOR purposes.

Professor Siedler informed the Executive Committee that IAPSO has set up an Advisory Committee on Physical and Chemical Aspects of the Dispersal of Natural and Artificial Substances and Heat in Oceans and Seas. The scientific rapporteur on marine pollution matters should also keep the activities of this Group under review.

IOC resolution IX-19 on the IOC Scientific Advisory Board decided to establish such a Board for a period of two years. This Board will review all scientific activities of IOC, recommend on priorities in scientific programmes, on needs for publications and on other matters needed to strengthen the scientific aspects of the work of IOC. The members of the Board, no more than twelve, are to be selected by the IOC Executive Council from a list of candidates nominated by member states. The SCOR Executive Committee noted this new development with interest. Some concern was expressed that the functions of this Board might overlap with those of the scientific advisory bodies of IOC.

Several draft resolutions of IOC-IX were concerned with TEMA, which has organized a number of ad hoc meetings to stimulate closer regional co-operation. SCOR repeated its willingness to give scientific support to TEMA activities, as already expressed during its twelfth General Meeting (Proc. Vol. 10, No. 2, p. 99). Professor Hempel and Dr Tandberg will participate in TEMA regional meetings in Cairo and Nairobi. Though both are going in another capacity, they offered also to act for SCOR. The Executive Committee gratefully accepted this proposal.



### 3.2 UNESCO

IABO had been asked for suggestions for replacements for retiring members of the UNESCO Advisory Panel on Marine Biological Centres and these suggestions had been conveyed to UNESCO.

It was noted that the proposed UNESCO symposium on Tropical Zooplankton had been postponed to late 1976.

#### SCOR Ad Hoc Advisory Panels

##### Biogeochemistry of Estuarine Sediments

The Panel met in Southampton, United Kingdom, on 8 and 9 September 1975. The participants were E.D. Goldberg (Convenor, USA), J.D. Burton (UK), M.J. Orren (S. Africa), J. Carpenter (USA), E. Suess (FRG) and R. Wollast (Belgium). The Executive Committee received the report of that meeting which had been sent to National Committee, which included the panel's definition of its aim as follows:

"To seek out a critical evaluation of the procedures for characterizing the nature of reactions in estuary sediments, with special reference to biological processes."

It had proposed to hold a workshop on the subject in Europe in June 1976, with 20 - 30 invited participants. The Executive Committee approved this workshop, inviting the panel to include the Chairman of WG 46, Professor D. Lal, in the list. Noting the intention of the Group to publish its results, the Chairman will be asked how he plans to arrange such publication.

##### Coastal Lagoons

The Panel met in La Jolla from 29-30 April 1975. The following had participated: Dr A. Ayala-Castañares (Convenor, Mexico), Dr B. d'Anglejan (Canada), Dr P. Lasserre (France), Dr C. Olaniyan (Nigeria), Dr F.B. Phleger (USA), Dr R. Lankford (UNESCO/UNDP, Mexico), Dr M. Steyaert (UNESCO Headquarters).

A report, which had been sent to National Committees, was received. This Panel had been requested to assist UNESCO in identifying the scientific problems in this subject and to advise SCOR if there was any useful action they could take. The report included several recommendations which included one for the formation of a Working Group on the subject but the Executive Committee considered that activities proposed were so wide ranging and would need such extensive support that it would be premature to establish such a Group. They did, however, accept the proposal that the panel should undertake the compilation of a list of bibliographic references on coastal lagoons, a review of area distribution of coastal lagoons and a register of relevant research activities in different countries. If so requested by the Panel, SCOR would seek the help of National Committees in compiling the register of research activities.

The second part of the report which gave specific advice on a UNESCO programme on coastal lagoon research and training had been transmitted to UNESCO. The Executive Committee agreed to examine any requests which UNESCO may wish to make for further action on specific topics and, in accordance with a request from UNESCO, to nominate four scientists to assist UNESCO in drafting initial research programmes.

##### Mangrove Ecology

Dr M. Vannucci has agreed to convene this panel and six scientists have been invited to serve on the panel. The first meeting will be arranged to follow the Thai national symposium on Mangroves which is being held at Phuket, Thailand, 10 - 15 January 1976.

#### UNESCO Manual on the Determination of Photosynthetic Pigments in Sea Water

UNESCO had asked for advice on the desirability of reprinting the above monograph and, after consultations, had been advised that it should not be reprinted in its present form. There was, however, a need to prepare a new manual which would take into account such matters as the new equations for the calculations of pigment concentrations from spectrophotometric extinction measurements, information on the use of chromatographic techniques in field programmes and an evaluation of the fluorescence technique for pigment measurement. It was recognized that some further laboratory work would be desirable to make such an evaluation.

It was agreed to recommend to UNESCO three alternative courses of action (in order of preference): (1) To set up a workshop of about six people for about one month in the CSIRO



Unit of Marine Biochemistry, Sydney and thereafter to prepare a new manual; (2) To support the travel of one scientist to Sydney, to conduct some laboratory work with Dr S.W. Jeffrey and then to prepare a new manual; (3) To ask specialists to write critical essays on specific topics such as chromatographic and fluorescence methods and to publish these as a monograph.

### 3.3 FAO/ACMRR

Professor W.S. Wooster represented SCOR at the meeting of ACMRR in Sesimbra, Portugal, 8-13 September 1975.

Dr D.L. Alverson (USA) had been elected Chairman of ACMRR; the SCOR Executive Committee expressed the hope that he would attend XIII SCOR.

### 3.4 WMO/ACOMR

A number of items of common interest with SCOR would be discussed at the meeting of ACOMR from 24 to 28 November 1975 in Geneva at which Dr J. Namias (USA) would represent SCOR.

## 4.0 RELATIONS WITH NON GOVERNMENTAL ORGANIZATIONS

### 4.1 AFFILIATED ORGANIZATIONS

CMG: The report of CMG is printed in Annex X. The Secretary of CMG reported on plans to hold a second Marine Geoscience Workshop, which should have input from physical and biological oceanographers, in Mauritius from 9-13 August 1976\*. SCOR agreed to cosponsor this workshop. It was hoped that some support might be provided by IOC, but if the need arose SCOR would be prepared to contribute up to \$5,000.

CMG had represented SCOR at the first meeting of the Joint CCOP-IOC Working Group for East Asian Transects, \*\* held in Tokyo, 13-14 August 1975.

IABO: The report of IABO will be published in the next volume of the IABO Proceedings. IABO will hold their next General Assembly at the JOA in Edinburgh.

Other activities relating to IABO are reported in various sections of this volume.

IAMAP: During the General Assembly of the International Union of Geodesy and Geophysics (IUGG) in Grenoble from 24 August to 6 September 1975, IAMAP held two plenary meetings at which new officers were elected as follows: Professor C. E. Junge (FRG) (President); Dr P.R. Pisharoty (India) and Dr W.L. Godson (Canada) (Vice Presidents); Dr S. Ruttenberg (USA) (Secretary).

The IAGA/IAMAP Joint Committee will organize joint meetings and symposia: one symposium will be held during the next IAMAP Assembly at Seattle 1977. IAMAP will also sponsor the COSPAR Meeting on meteorological observations from space, their contributions to FGGE determination of wind, temperature and humidity (Philadelphia, 9-18 June 1976).

IAPSO: The IAPSO General Assembly was held concurrently with the IUGG General Assembly in Grenoble in August/September 1975. A brief report is given in Annex XI.

The representative of IAPSO drew special attention to Resolution No. 7, which resolves to create a Working Group on Coastal and Estuarine Regimes and which proposes to investigate with SCOR the possibility of joint sponsorship. The Secretary will communicate with the proposed Chairman, Dr B. Mathews (USA), to find out the terms of reference and other information available about the Group and circulate this information to National Committees, so that a decision on the proposal can be taken at the next General Meeting.

It was suggested that ECOR might also be associated with the Group, since part of the work would be on numerical models of coastal and estuarine regions.

Other IAPSO resolutions were discussed under WG's 10 and 27.

\* These dates have not yet been confirmed.

\*\* Since renamed the CCOP-IOC Joint Working Group on IDOE Studies on East Asia Tectonics and Resources.



## 4.2 ICSU BODIES

ICSU: The report of the ICSU General Committee meeting, September 1975, was noted.

Law of the Sea: A statement entitled the Characteristics of Marine Scientific Research, (Annex XIII) which had been prepared by Professor Wooster, in consultation with a number of other SCOR members, was submitted by ICSU to the 1975 session of the United Nations Law of the Sea Conference. This, together with a copy of the President's introductory remarks (Annex XIV) had since been sent to the President of ICES and to the Secretary of IOC, with a request that they distribute copies to their national members. It was understood that the statement together with the President's remarks had been distributed to the delegations at the ICES meeting in Montreal; unfortunately IOC had not distributed it to their member states. At its meeting on 1 October 1975, the ICES Council adopted a resolution on this subject urging that a goal of UNLOSC should be, inter alia, to promote the effective conduct of marine scientific research.

It was noted that in their consideration of scientific priorities, ICSU had identified climate and renewable marine resources as subjects worthy of high priority. The meeting expressed the hope that the Unions supporting the affiliated organizations of SCOR would recognize the need to strengthen the support of their activities in these fields, if these objectives were to be accomplished. Both feature strongly in the activities of SCOR.

The General Committee of ICSU had agreed to the publication of a brochure on ICSU and its activities. SCOR was asked to provide an entry. It was decided that the pamphlet on SCOR, prepared for the Joint Oceanographic Assembly in Tokyo in 1970 and updated by the Secretary for the JOA in Edinburgh, should be used for this purpose.

COSPAR: Dr D.E. Cartwright has been appointed to represent SCOR interests in COSPAR and to effect liaison between SCOR and COSPAR.

SCOPE: SCOPE is preparing a major report on the state of knowledge of simulation modelling of the environment. This report is intended to provide information particularly in relation to the problems concerned with the application of environmental science to decision making.

SCOPE is also conducting, on behalf of ICSU, a review of activities of ICSU bodies in environmental science. For information concerning SCOR they had been referred to the SCOR Proceedings. SCOPE had indicated that this was adequate for their purposes.

SCAR: Several activities relating to SCAR are reported in various sections of this volume. It was noted that the SCAR Group of Specialists on Living Resources of the Southern Ocean, which within the SCOR structure is known as SCOR WG 54, is organizing a meeting of experts in August 1976 in response to an invitation from the Eighth Antarctic Treaty Consultative Meeting as well as the IOC resolution EC-V.7.

4.3 ECOR: The Treasurer of ECOR, Ir G.A. Heyning, stated that ECOR valued SCOR representation at its meetings and welcomed the opportunity to participate in SCOR meetings. He also emphasized ECOR's willingness to respond to any requests from SCOR for engineering advice and assistance.

He noted that a number of SCOR activities were of particular interest to ECOR viz WG 27, WG 42, WG 46, WG 48, WG 51 and two of the ad hoc panels. He suggested that ECOR might be of particular assistance in relation to WG 51; that the panel on Biogeochemistry of Estuarine Sediments might wish to draw upon ECOR expertise in matters such as sampling the water/sediment interface with minimum disturbance and that ECOR might be able to provide the panel on Coastal Lagoons with useful information from the engineering point of view.

## 5.0 FUTURE MEETINGS

### 5.1 THIRTEENTH GENERAL MEETING

The thirteenth General Meeting of SCOR will open in Edinburgh on Monday, 13 September 1976, the day before the opening ceremony of the 1976 Joint Oceanographic Assembly. Meetings will be held during the period of the Assembly and a final Executive Committee meeting will be held the day after the Assembly closes; that is, on Friday, 24 September.



## 5.2 JOINT OCEANOGRAPHIC ASSEMBLY 1976

A report of a meeting of the Steering Committee for JOA held on Friday, 14 November 1975, appears as Annex XII. Particular concern was expressed that the Logistics Committee had so far been unsuccessful in obtaining assurance from the sponsoring agencies of the funds required to ensure that convenors and invited speakers would be able to participate if national funds were not forthcoming. Plans were approved for an extensive programme of poster sessions and for publication of abstracts and of the invited papers of the general symposia.

## 5.3 SURFACE GRAVITY WAVES IN WATER OF VARYING DEPTHS

A request had been received from the Australian National Committee for financial support from SCOR for an International Symposium on Surface Gravity Waves in Water of Varying Depths, being sponsored by IUTAM in Canberra in July 1976. On the basis of the information available it was not possible to judge the content of the symposium and while a symposium on Waves might be timely there were already heavy financial pressures on SCOR at that time and SCOR did not regard itself as a funding organization for symposia arranged by other ICSU bodies without any SCOR involvement.

## 5.4 WESTERN BOUNDARY CURRENTS OF THE INDIAN OCEAN

The South African National Committee drew the attention of the meeting to the large amount of work which had been done in recent years in the Western Indian Ocean especially in the Somali and Agulhas currents. It was recognized that it would be important to try to bring this together well in advance of the proposed GARP activities in this area. It was decided, therefore, to organize a SCOR symposium on the Western Boundary Currents of the Indian Ocean to be held in mid-1977. It was suggested that Durban might be a suitable location for the meeting, that it should be organized as an interdisciplinary event, and that plans for CINCWIO and FGGE should be borne in mind by the Steering Committee. Mr F.P. Anderson accepted an invitation to serve as convenor of the Steering Committee.

## 5.5 OTHER SCOR MEETINGS

Other future meetings being organized by, or on behalf of, SCOR, are referred to in appropriate sections of this report and are summarized in Annex XV.

\* \* \* \* \*

The President closed the meeting by expressing his sincere thanks to the Council for Scientific and Industrial Research, who organized the meeting and provided secretarial assistance, transport facilities and other support. He also thanked the University of Stellenbosch which had made available an excellent conference room and secretarial headquarters. Dr E.S.W. Simpson, Director of the National Institute for Oceanology, who gave enthusiastic support throughout the meeting as did Mr F.P. Anderson, Dr A.E.F. Heydorn and Mr O.A. van der Westhuisen.



## Nineteenth Meeting of the SCOR Executive Committee

## List of participants

## Members of the Executive Committee

*Professor H. Postma	Netherlands	President
*Professor W.S. Wooster	USA	Past President
*Mr R.I. Currie	UK	Secretary
*Dr T.F. Gaskell	IUGS/CMG	Ex Officio
*Professor Dr G. Hempel	IUBS/IABO	Ex Officio
Professor Dr H. Hinzpeter (Representing Professor C. Junge*)	IAMAP	Ex Officio
*Professor Dr G. Siedler (Representing Professor R.W. Stewart*)	IAPSO	Ex Officio

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*Mr G.E. Hemmen	UK/SCAR	Assistant Secretary
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## Other participants

*Dr F.P. Anderson	(South Africa)
*Sir George Deacon	(UK)
*Dr A.E.F. Heydorn	(South Africa)
Ir G.A. Heyning	(ECOR/Netherlands)
*Dr G.F. Humphrey	(IOC/Australia)
Dr R. Pollard	(UK)
(Thursday, 13 November only)	
*Dr E.S.W. Simpson	(South Africa)
*Dr O. Tandberg	(Sweden)
Mr O.A. van der Westhuysen	(South Africa)

\* = SCOR Members



STATEMENT OF SCOR INCOME AND EXPENDITURE(1 January to 31 December 1975)

<u>BALANCES 1 JANUARY 1975</u>	\$	\$
London	19 377.47	
Paris	<u>4 026.35</u>	23 403.82
Reserve Fund		25 292.94
<u>INCOME</u>		
National Contributions		32 900.00
Contracts		
UNESCO Special Contract WGs 27/36 (1974)	8 900.00	
IOC 1974 Regular Contract (full payment)	10 000.00	
UNESCO 1974 Regular Contract (final payment)	2 000.00	
IOC 1975 Regular Contract (first payment)	10 000.00	
UNESCO 1975 Regular Contract (first payment)	<u>10 000.00</u>	40 900.00
Interest on deposit account		2 843.22
Exchange difference		<u>463.83</u>
		<u>\$ 125 803.81</u>
<u>EXPENDITURE</u>		
Scientific activities		
Working Groups		
10	1 680.41	
23	12.71	
27	4 109.01	
34	164.00	
36	4 432.85	
38	1 312.37	
42	496.85	
43 (including GATE meetings)	4 583.33	
46	1 059.57	
47/FGGE	7 833.47	
Estuarine sediment biogeochemistry panel	847.75	
Mangrove panel	<u>1 350.49</u>	27 882.81
Symposia		
Upwelling ecosystems	5 328.31	
IAPSO	<u>3 000.00</u>	8 328.31
Representation at other meetings		
IOC EC-V	438.34	
IOC IX Assembly	710.56	
GEBCO Guiding Committee	366.85	
UNLOSC	371.74	
IUGG GA	<u>723.18</u>	2 610.67
Publications - SCOR Proceedings		4 152.16
SCOR Meetings		
Officers meeting	1 499.61	
EX 19	<u>12 366.68</u>	13 866.29
Administration		<u>8 701.73</u>
		65 541.97
Balances 31 December 1975		
Funds held by ICSU, Paris	85.40	
Funds held by SCOR, London	<u>8 796.94</u>	8 882.34
Reserve Fund		51 379.50
		<u>\$ 125 803.81</u>



## SCOR WORKING GROUP 27 (WITH IAPSO &amp; UNESCO)

## TIDES OF THE OPEN SEA

Report of Final Meeting, Grenoble, 29 August 1975

Members present: D. E. Cartwright (UK) Chairman; C. G. Dohler (Canada); W. H. Munk (USA); F. Schott (FRG); T. Teramoto (Japan); S. Voyt (USSR); B. D. Zetler (USA). (J. Hyacinthe and R. Radok were unable to attend).

National Reports

The following summaries of work done in the last year or projected for the future were given.

Hyacinthe (France, written report) had tested the CNEXO instrument alongside the standard tide-gauge in Brest harbour for 6 months, with excellent comparative results. He had then laid the instrument in the 2200m site B of the 1973 Intercalibration Exercise, and recovered it successfully after 5 months. Unfortunately, this record was spoiled by a fault in the a/c supply to the vibrating wire, probably incurred at the time of launching, and never encountered before. He intended to re-lay the capsule at site B, and the results of both tests will be circulated to those concerned when complete, for comparison with the 1973 results. Hyacinthe hoped for an eventual campaign to occupy some 20 tidal stations in the North Atlantic, using a yacht-sized vessel for maximum economy, but no definite plans had yet been made.

Cartwright (UK) reported on shallow water and oceanic programmes at IOS-Bidston, combining pelagic measurements with numerical tidal models of various scales. Results from the last few years' measurements round the shelf edge surrounding Britain had been used to model the entire shelf seas, with estimates of dissipation in distinct zones such as the Irish and North Seas. A more southern set of boundary data for the North Sea was planned as part of the JONSDAP exercise in early 1976. An oceanic programme was underway, to define the tides along boundaries defined by latitudes  $37\frac{1}{2}^{\circ}\text{N}$  and  $53\frac{1}{2}^{\circ}\text{N}$ , longitude  $30^{\circ}\text{W}$  (Mid-Atlantic Ridge) and the West European shelf. About three-quarters of the circuit were due to be completed in October 1975, and the whole will be used in conjunction with an ocean-cum-shelf model to study shelf-edge conditions and the effects of dissipation. The zone under study will also be useful for marine tide loading in Europe and as "sea-truth" for geodetic studies by satellite altimeter. Some 30 sets of pelagic tidal constants, obtained by IOS over the past seven years, had been sent to I.H.O.

Dohler (Canada) presented a written report. Aanderaa pressure meters had been deployed in Arctic waters and on seven seamounts in the northeast Pacific, but only a few meters had so far been recovered. Work is in hand to improve the reliability of acoustic releases. Records had been obtained from several sites in Hudson Bay, James Bay, St Lawrence River, Cabot Strait and on the Scotian Shelf. The Central and Atlantic records are to be used in conjunction with the GEOS-3 Altimeter studies. Future projects include a string of tidal stations off the Bay of Fundy/Gulf of Maine complex. The keypunching of the IHO library of tidal constants is well underway, and should be completed by the next IHO Conference in April 1977.

Zetler (USA) reported on work at IGPP (La Jolla) and by Wimbush at Nova University (Florida). The MODE tides study had been published, (J. Phys. Oceanog. 5, 430-441, 1975), and the results will be used with calculations of meteorological effects on sea level to provide sea-truth for the GEOS-3 Altimeter in its primary test area of good orbital tracking. Hendershott and Parke had made progress with the difficult problem of solving the ocean tidal equations with crustal yielding and shelf-attraction, and their model will also be used in the GEOS-3 work. Wimbush and Mofjeld are continuing the Caribbean tide study originated by Zetler. Wimbush is adding pressure capsules of his own design to current meter strings in the Gulf of Mexico and in the Florida Straits, and plans a shelf-edge study on the Blake escarpment. Munk and Zetler are investigating a tidal modulation in acoustic signals from Eleuthera Island to Bermuda. The ray path passes through the MODE area, but encounters only the minor axis of the  $M_2$  ellipse, which is insufficient to account for the amplitude of modulation. Zetler also reported that NOAA (National Ocean Survey) are installing gauges in the Gulf of Alaska.

Schott (FRG) has continued his work on baroclinic tides, using experiments off the NW African shelf, in the Iberian Basin, and in the MODE area, and has examined their role as a



possible sink for barotropic tidal energy, using Baines-type calculations of shelf edge interactions. Baroclinic and barotropic energy levels have been found to be roughly equal in places. Calculations of world-wide energy conversion rates from shelves and bottom-scattering suggest that baroclinic tides are unlikely to balance the known energy budgets. Zahel has nearly completed his 1 degree world tidal model including shallow seas down to 20m depth. He finds  $3.6 \times 10^{19}$  ergs/sec total  $M_2$  dissipation, of which only  $0.7 \times 10^{19}$  is due to bottom friction, the rest being due to lateral eddy viscosity, according to his model.

Teramoto (Japan) reported little progress in oceanic tides, but plans were being prepared for an experiment involving bottom pressure measurements across the area of the Kuroshio Current.

Voyt (USSR) reported a new tide modelling venture by Marchuk, involving stratification, bottom friction and homogeneous boundary conditions. Voyt himself has completed a paper on the influence of stratification and bottom topography on long wave propagation. He was unable to supply information on Arctic tidal constants which had been requested by Canadian researchers.

#### Review of past achievements and future possibilities

As agreed at the 1974 meeting, the Chairman had written a 10-page survey of the Working Group's activities, entitled "The future of oceanic tidal research", with a 22-page appendix by R. Radok, summarising the detailed accounts from the first ten volumes of the SCOR Proceedings. Copies had been circulated to all members and others interested. In brief, WG 27 had stimulated a great deal of research into instrument development and analysis techniques during its ten years of existence, culminating in the Intercalibration Exercise report, which had been published by Unesco a few weeks before the Grenoble Assembly. However, the early realisation of reliable oceanic tidal maps, hoped for when the Group was formed, had proved over-optimistic. The numerical modellers who were most likely to produce such maps had made little use of the new pelagic measurements, and field-workers were unable to get ships to oceanic test-points specified by the modellers. Other techniques for tackling the problem, such as inversion of the Earth Tide marine loading equations, or analysis of satellite orbit perturbations, are becoming relevant. Further progress will need a wider inter-disciplinary approach than was possible within the original framework of Working Group 27.

Field deployments of bottom pressure recorders will continue to be necessary for a long time, but it is now obvious that only very few countries are willing to support such programmes. Active participants are too few, and their tasks too diffuse to justify an international working group. The Chairman's survey did however conclude with advocations for new Working Groups in related areas of research, and these were discussed at the meeting.

One possible research area was "Baroclinic Tides". The subject had frequently been suggested as an extension to the work of WG 27, but had been considered too distracting from its main purpose. After discussion, the Group decided not to recommend a new Working Group in this field because : (a) too few people are really interested, (b) it would be difficult to frame a succinct objective, (c) the subject is inseparable from the wider issues of internal wave dynamics, of which the tidal motions form only a minor component, (d) the "energy sink" question now seems less important than was once thought.

The other research area considered was "satellite altimetry of the sea surface", since this appears in principle to be the most promising means of obtaining world-wide tidal definition, provided the required accuracy (a few decimeters) is reached. The suggestion of a new Working Group was also rejected because : (a) the SCOR Officers felt that technological advance of measurement systems was the first requirement and this was not a function for SCOR, (b) it was not yet known whether the accuracy was sufficient for independent tidal analysis, as distinct from providing tidal estimates as "sea truth" corrections for geoid determination, (c) there is at present a restriction on the release of altimeter data to oceanographers. Nevertheless, WG 27 agreed that the matter of a Working Group on satellite altimetry of the sea surface should be re-considered at a later date. To that end, they authorised the Chairman to pass a Resolution to IAPSO, urging early release of altimeter data for oceanographic research, and that IAPSO should ask SCOR to form a Working Group on this subject as soon as the first investigators had shown the data to be accurate enough to serve for tidal determination.

Finally, Working Group 27 endorsed a Resolution framed by the IAPSO Committee on Tides and Mean Sea Level, welcoming the recent move by the International Hydrographic Organisation to computerize their lists of tidal constants, and to include constants from the open sea,



and urging all oceanographers who obtain tidal data to send their harmonic constants to I H B as a central data bank.

Dr Dale Krause, a visitor representing Unesco, offered to disseminate a statement similar to the above through the publication IMS Newsletter.

After a brief exchange of polite commendations, the Chairman declared the Working Group on tides of the open sea to be disbanded.



SCOR WORKING GROUP 34 (WITH IAPSO)  
INTERNAL DYNAMICS OF THE OCEAN

Report of Meeting, Grenoble, 5 September 1975

I. Participants:

WG 34 Members Present: A. E. Gill (UK), A. R. Robinson (USA) Chairman,  
P. Welander (Sweden - USA)

Absent: L. Fomin (USSR), K. Hasselmann (FRG),  
N. Phillips (USA), H. Stommel (USA)

Invited Participants: R. Bernstein (USA), K. Fedorov (USSR), J. Gonella (France),  
J. Gould (UK), J. Lazier (Canada - alternate for G. Needler),  
G. Siedler (FRG), W. Simmons (USA), J. Swallow (UK)  
K. Bryan (USA), T. Sanford (USA), W. Zenk (FRG)

II. Discussion Topics:

This was the first meeting of the group held under the expanded charge  
"to identify the critical scientific problems of the internal dynamics of the ocean  
and to suggest the most appropriate ways to study them",

as well as the continuing charge

"to advise on the design of mid-ocean dynamics experiments."

The discussion was organized around three major agenda topics with sub-items as follows:

A. International Planning for POLYMODE\*\*.

1. Communication of existing plans for POLYMODE and other related national experiments on eddies.
2. Planning and coordinating the international aspects of POLYMODE and related MODE experiments.

B. Consideration of Longer Term and Global Investigations of the low (and lower) frequency mesoscale variability.

1. Assessment of our present state of knowledge of the dynamics of low frequency mesoscale and of the geographical distribution of eddy characteristics over the world's oceans.
2. Identification of existing and potential data sources related to (1).
3. Long-term observational and experimental considerations.

C. Relationship of the Mid-Ocean Eddy Problem to more general questions in the Internal Dynamics of the Ocean.

1. The interaction of the low frequency mesoscale with other scales; the desirability of future MODE experiments in conjunction with other programmes.
2. Assessment and coordination of theoretical and numerical modelling activities of the eddies among eddy-modellers and with modellers primarily concerned with other phenomena.
3. The role of the eddies in the general circulation; the parameterization problem.

A summary of the discussion is attached as an Appendix.

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\*\* See SCOR Proceedings Vol. 10, No. 1, p. 54 and No. 2, p. 119.



### III. Conclusions and Recommendations:

#### A. Mesoscale Mid-Ocean Experimentation in the Eastern North Atlantic in Coordination with POLYMODE.

Being aware of indications that mesoscale phenomena are present in many parts of all oceans, SCOR WG 34 wishes to encourage more active exploration of the geographic distribution of these phenomena. It recognizes also the need to observe at even larger scales in the ocean. A specific opportunity of furthering both these needs is seen in developing a plan for mesoscale observations to be made in the Eastern North Atlantic, simultaneously with POLYMODE. To do this, it is recommended that a sub-group of WG 34 should be formed to consider the possibility of designing a suitable Eastern North Atlantic experiment. They should be invited to work by correspondence, and if necessary to meet, at SCOR's expense, to formulate a plan of work and a first report to WG 34 by the spring of 1976.

#### B. Near Surface Layer Experiment in POLYMODE.

When exploring the mechanisms of production, transformation and dissipation of mesoscale eddies in the deep ocean, the interaction with processes in the near surface layer and forcing by the atmosphere will have to be considered. As a basis, descriptive and kinematical studies are needed for examining the structure of the near surface part of such eddies. For mesoscale studies of interaction between the surface layer and the deep sea, a parameterization of smaller scale processes is required which is properly based on an understanding of transfer mechanisms at the ocean surface and in the mixed layer and thermocline. While studies of these small scale near surface processes are being undertaken in GARP-related experiments like GATE and JASIN, the exploration of the structure and the kinematics of the near surface layer on the mesoscale should preferably be carried out simultaneously with deep ocean experiments in POLYMODE.

SCOR WG 34 therefore resolves to encourage the development of plans for suitable near surface experiments in connexion with POLYMODE. Some questions which seem appropriate to be considered at this time are: (1) Spatial and temporal scales of the surface wind stress and possible resonant excitation of baroclinic motions on the mesoscale or modification of the existing eddy field; (2) Mixed layer depth variations on the mesoscale in relation to the transfer of momentum, energy and heat from the atmosphere and from below the mixed layer; (3) Upper layer manifestation of mesoscale eddies, indicating the modal structure and possible phase shifts associated with eddy transport of mean density.

The types of measurements which seem appropriate for the scales considered are:

- (A) Density and current profiling from ships, combined for the near surface and the deep part of the ocean;
- (B) Observations from satellite tracked buoys carrying wind and/or atmospheric pressure sensors and temperature sensors for surface temperature and mixed layer depth, operating quasi-continuously;
- (C) Repeated observations with drifting surface buoys carrying current, temperature and electrical conductivity sensors at several depth levels;
- (D) Sea surface temperature mapping from satellites;
- (E) Observations from surface moorings using wind and/or atmospheric pressure sensors at the surface and current, temperature and conductivity sensors near the surface.

#### C. Satellite Measurements of the Mesoscale Low-Frequency Variability.

Oceanographic information from orbiting satellites has improved by orders of magnitude over the last decade; work already underway assures that this improvement will continue unabated through the next decade. The major advances during the past decade have been in infrared and visible band scanning radiometers. While this area will continue to show great progress, active and passive microwave band measurements, including radar altimetry of high accuracy, will most likely be the area of greatest advance during the coming decade. The efforts by oceanographers to utilize these data should be encouraged. Organized efforts within existing programmes, such as POLYMODE, to design and carry out particular experimental observations and to combine these emerging tools with more conventional ones, should continue to be developed and pursued.

The considerations that follow deal with the scanning radiometer data now being collected. The systems that produce and handle most of these data are intended for operational meteorological purposes. Nevertheless, significant oceanographic information on sea surface temperature and its horizontal gradient is frequently available. To retrieve this oceanographic information it is generally necessary to obtain the data in a form as close



as possible to the original signal. These original data are frequently not saved or archived in sufficiently original form to perform oceanographic reconstruction.

To improve this situation efforts must be made in three simultaneous ways:

- (i) Original scanner data should be made more accessible to oceanographers. Also the retention time for such data should be increased to allow oceanographers to review these data up to one year after the fact. Special attention should be focused on polar and geostationary orbiting radiometers with the highest spatial and thermal resolutions; it is these radiometers that are proving to contain the highest quality oceanographic information.
- (ii) Data manipulation and display resources should be improved in ways that would allow greater numbers of oceanographers to review the above-mentioned data in an efficient way to extract quickly the most valuable portions for detailed study.
- (iii) Consideration should be given to SCOR sponsorship of a colloquium designed to bring together oceanographic users of satellite infrared scanner systems, and those responsible for operation of these systems, to explore avenues toward improving the oceanographic accessibility and utilization of these data.

D. Investigation, Dissemination, Coordination of Information about Mesoscale Eddies on a Long-Term Global Basis.

Information from ocean experiments: It is important that the notice of as many marine scientists (of all disciplines) as possible be drawn to the characteristics of mesoscale ocean circulation features. Possible methods of doing so are (i) by a notice or "advertisement" in appropriate scientific journals, to be prepared under the direction of WG 34, (ii) by the introduction of appropriate papers and sessions at international meetings. The objects would be (a) to help scientists in the design of experiments, as the mesoscale features may affect the interpretation of their results (b) to alert scientists to the possibility of helping understand the distribution of such features by providing information found in their experiments to scientists particularly interested in the phenomenon. This information could be communicated via journals, via informal newsletters (e.g., Hot Line News) or be sent directly to the chairman of WG 34. The notice or advertisement would give the appropriate addresses.

Ocean monitoring: It is recommended that a small sub-group or group of experts be asked to (i) prepare for WG 34 a statement about the present level of routine collection of (a) ocean surface data (temperature, sea-level, etc.) and (b) sub-surface data, (ii) investigate what feasible expansion of this collection rate could usefully be employed to (a) give a time history of changes in the baroclinic structure of parts of the ocean (b) give a picture of the geographical distribution of mesoscale activity and of changes in this activity with time, (iii) investigate ways of implementing such an expansion. Item (iii) could lead to suggestions about retention of suitable satellite data or about new instruments (e.g., fitting of new ships with e.m. logs, developing a pressure-temperature sensor for towing behind ships of opportunity), etc. The group could consist of (a) IGOSS representative, (b) NORPAX representative with expertise in objective mapping of large scale features, (c) representative of climate panel of WG 48, (d) expert on instrumentation.

E. International Symposium on Eddy Dynamics and Parameterization.

In consideration of the progress occurring in the construction and development of theoretical/numerical models of ocean mesoscale eddies, it is recommended that an international symposium be organized to assess and intercompare models and to address the status of, and prospects for, parameterization of eddy processes in large scale ocean models. Participants should include ocean eddy dynamicists, atmospheric dynamicists, and parameterization specialists, including turbulence theorists. The meeting should be organized for sometime during 1977 by a steering committee consisting of the Chairman of SCOR WG 34, together with SCOR WG 49 (Mathematical Modelling of Oceanic Processes) and a representative of JOC-GARP. This constitutes an endorsement of a recommendation initiated by JOC-GARP Ad Hoc Working Group on Coupled Ocean-Atmosphere Models in June 1975 at its Hamburg meeting (but with a suggested possible delay of six months).



## APPENDIX TO WG 34 REPORT

### Resume of Discussion

1. USA POLYMODE planning to date was summarized: (i) recent evidence (XBT and POLYMODE Array I) for order-of-magnitude geographical variation of the variability over the North Atlantic gyre was reviewed; (ii) evolution from a POLYGON-MODE like experiment over larger-longer scales was noted; (iii) present ideas for statistical, geographical, dynamical experiment with clusters of instrumentation distributed to explore energy levels and scales over the western North Atlantic gyre (with East/West rather than North/South preferred orientation) were presented; (iv) the intention of designing the clusters for local dynamics experiments and of adding special process components was noted; and (v) the support for such an approach from the general results of numerical models was described.
2. The USSR POLYMODE plans for the intensive North/South array of sixteen moorings instrumented at six levels, and mapping and statistical long density lines from several ships were reviewed briefly. Possibility of some change was mentioned. Increased interest in (i) studying the feasibility of satellite measurements, (ii) pursuing insights from historical data, and (iii) obtaining temporal statistics near moorings were noted.
3. The UK Institute of Oceanographic Sciences' topographic influence experiments in the eastern basin of the North Atlantic were described and plans for establishing three site moorings, probably along  $30^{\circ}\text{N}$  for a total of one to two years in six month cycles to determine eddy variability in the eastern basin ( $24^{\circ}$  to  $40^{\circ}$ ) were noted.
4. The Institut für Meereskunde at Kiel, Federal Republic of Germany, has been working in the Eastern North Atlantic at internal wave scales and three to four week durations, off Portugal and off Africa, including upwelling experiments. Possible interest in cooperation with the Institute of Oceanographic Sciences in mooring experiments in the eastern North Atlantic basin was noted.
5. Bedford Institute, Canada, plans a three mooring array under, and along, the Gulf Stream near the northern terminus of USA POLYMODE Array II, 50 km spacing, 18 month duration, and instrumentation up to 1000 m above the bottom.
6. The interest of several French scientists in (i) the effect of eddies on properties of the near surface layer, the (ii) relative importance of direct surface forcing effects on eddies, and (iii) the design of a possible satellite-tracked drifting buoy experiment in POLYMODE was described.
7. The use of meteorological satellite data on one to two day occasions (separated by four months) when wide-spread ( $\sim 1000$  km) clearing occurs to produce large scale synoptic surface temperature maps was described. IR data is good to  $\sim 0.1$  cm, as shown by simultaneous hydrographic measurements. Problems are retaining data (storage, and round off), and getting fast response simultaneous ground-truth measurements.
8. A method for dealing with the problem of variabilities in the large-scale ocean circulation in which eddy signals are noise, and therefore averaged over, was described. Credible sea surface temperature maps have been produced and the method is being tried at depth.
9. The use and instrumentation of commercial ships of opportunity for mesoscale XBT tracks was discussed.
10. Recent work on the variability of the Equatorial Current System in the Indian Ocean (by surface currents from navigation plus moved current meters) revealed a variability wave length of 500 km, period of 50 days, and 10-25 cm/sec speeds. Equatorial currents may be a relatively simple and important area for the study of low frequency variability.
11. The importance of informing oceanographers and others making measurements at sea (e.g., fisheries) about the low frequency variability was discussed. In many instances, the eddies would act as noise on the measurements of interest, and should be considered in determining sampling frequencies. Not only would properly adjusted measurements be more useful for their primary purpose, but they could also contain information on eddies of interest to scientists studying that phenomenon. How could this be pursued - by a special Science or Nature article, a WG 34 publication, a special WG sponsored meeting, a symposium at JOA, Edinburgh?
12. Other questions discussed included the desirability of communicating the fact that eddy experiments are not necessarily large scale and sophisticated, and of encouraging experimenters



to make simple observations such as limited surveys that could be performed in all the world's oceans by many nations. Could WG 34 serve to channel eddy inquiries from experimenters at large to the appropriate channels? Could it coordinate global eddy information?

13. The status and progress of numerical modelling of eddy phenomena was briefly reviewed.



SCOR WORKING GROUP 36 (WITH ACMRR & ACOMR)  
COASTAL AND EQUATORIAL UPWELLING PROCESSES

Report of 3rd Meeting, Banyuls-sur-Mer, France, 8-11 September 1975

SCOR WG 36 met at Laboratoire Arago, University of Paris, Banyuls-sur-Mer, France, 8-11 September 1975.

The following members of WG 36 attended the meeting:

Dr K.N. Fedorov (USSR) Chairman; Dr R.C. Dugdale (USA) Chairman of the biological panel; Dr D.H. Cushing (UK); Dr G. Hempel (FRG); Dr R. Margalef (Spain); Dr H. Minas (France); Dr E. Mittelstaedt (FRG); Dr B. Saint-Guily (France); Dr R.L. Smith (USA); Professor S. Zuta (Peru).

Professor H. Charnock (UK) had been invited to attend as a representative for ACOMR/WMO, but was unable to do so.

Dr D. Nehring (GDR), Dr Y.I. Sorokin (USSR) and Dr K. Yoshida (Japan) were unable to attend.

Dr A. Huyer (USA) participated in the discussions of the Working Group as an observer.

1. Progress of pertinent research over the past year

The following is a summary of the exchange of views between the Group members on the major results of upwelling research by various laboratories over the past year.

Upwelling areas may be considered to be a natural laboratory in which physical and biological processes are intensified (in comparison with the open ocean), and therefore can be more readily observed.

Phytoplankton growth rates are closely linked to wind events because the growth rates are reduced by vertical mixing.

General distribution of phytoplankton can be described in the North West Africa region, although there is great variability. There is biological evidence in the form of indicator species of a deep poleward flow. Patches themselves may have an internal structure as they appear to contain sheets or laminations.

It is now possible to separate both dissolved oxygen and nutrients into fractions of biological origin and mechanical (mixing) origin. Off N.W. Africa total nitrogen uptake correlates very well with the biologically produced oxygen in the classical ratios. The presence of an ammonia layer may be associated with one-celled upwelling circulation - it does not appear when the circulation consists of two cells. Atmospheric oxygen fraction is high when ammonia is low and vice versa.

It is important to determine whether adult anchovies can survive and grow on a mainly phytoplankton diet, or whether they eat mainly zooplankton. The controversy remains.

The Coastal upwelling regime is limited to a narrow region, not broader than 50 Km off-shore. Upwelling further offshore is very likely due to larger-scale divergence of the wind field. There is now much information as to how various layers (Ekman layers, compensation layer, under-current) in the narrow coastal zone respond to local winds. Larger scale circulation is less known but very important for all coastal upwelling systems, e.g. as a source of water for the under-current.

Processing and first analyses of JOINT-1\*) current meter and hydrographic data are now complete. Results are contained in "A compendium of physical observations from JOINT-1" by Barton et al, in papers by Mittelstaedt et al, and Barton et al. There are now observations on the transition from the non-upwelling season (winter) to the upwelling seasons (spring and summer) off Oregon. The transition seems to be very rapid and dramatic. In the 1975 upwelling season off Oregon, current meters were moored on mid continental slope. This will allow comparison with conditions off Africa during JOINT-1 and in particular comparison of the undercurrents in the two

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\*) CINECA and CUEA expedition to Northwest Africa in February-May 1971.



regions. Theoretical studies in CUEA include the propagation of forced and free barotropic shelf waves, the interaction between barotropic and baroclinic waves, and effects of non-uniform shelf topography.

Observations off Oregon and Washington indicate significant alongshore coherence in currents and sea level at the event time scale over distances exceeding 200 km.

In the Oregon upwelling regime, anomalies in the T-S characteristics may be indicative of either horizontal or vertical advection and mixing. T-S anomalies therefore may possibly be used to distinguish between the one- or two-celled circulation. The layering forming between upwelling events may be the result of inertial motion.

An El Niño watch cruise was conducted in an attempt to verify the existence of predicted El Niño conditions. Results showed abnormal conditions (suggestive of El Niño) in February 1975, but there was a return to more normal conditions in March and April.

Studies of transient upwelling (several hours to several days) are being conducted in the Gulf of Lion. Studies of equatorial upwelling in the Gulf of Guinea in the vicinity of Abidjan have also begun. There, oscillations of 14 and 40-50 days in sea level and temperature have been detected. In the Gulf of Guinea it is common to observe coastal upwelling during weak local wind.

Peruvian scientists have been studying alongshore variations of upwelling and are presently planning to study four sites: at 5°, 8°, 12° and 15° S. New projects include environmental studies, El Niño study and study of fish for human consumption.

First published results are now available from the 1974 AKADEMIK KURCHATOV (USSR) equatorial and Peru upwelling cruise. Although this cruise was not specifically designed to study the connection between the two upwellings, their comparison proved extremely useful and interesting.

METEOR and DISCOVERY completed a N.W. Africa upwelling survey (AUFTRIEB-75) in January-March 1975. Three lines of current meters were placed at 25°N, 23°N and 21°40' with three moorings each in depths of 60, 500 and 2,000 m. Observations included hydrography and productivity sections, studies of patches, benthic sections, and aircraft observations of sea surface, temperature and chlorophyll. JOINT-1 and AUFTRIEB-75 results indicate that there are more sardine eggs than expected from the local sardine catch, and that most spawning occurs inshore. Species separate so that horse mackerel is at the shelf break and sardines and anchovies are nearer shore.

## 2. Reports of symposia and plans for future discussions

The report of the 1974 El Niño Workshop has been prepared and is available from FAO or IOC. It will be distributed to all members of Working Group 36. The Working Group welcomes the IOC initiative in stimulating El Niño studies through organizing the workshop meetings and ERFEN field programme and expresses the hope that international assistance will be provided to IMARPE and other institutions involved, in acquiring the necessary instruments and equipment and in processing oceanographic data.

Abstracts are available for the Third International Symposium on Upwelling Ecosystems in Kiel. Text of the invited papers and a few contributed papers will be published. Abstracts of papers presented at the Upwelling Symposium at the IUGG meeting in Grenoble have been published by IAPSO. Papers presented at the Liège Shelf Dynamics workshop will be published in due course. Future events include the 1976 Joint Oceanographic Assembly, 1977 CINECA Symposium, and the 1978 Fourth International Symposium on Upwelling Ecosystems.

Working Group 36 felt that SCOR should recommend holding the proposed Fourth Upwelling Ecosystems Symposium in 1978 in Peru with possible assistance from Unesco.

For the symposium on Regional Studies of Dynamics and Productivity, at the Joint Oceanographic Assembly in 1976, the Working Group tentatively recommended to the convenor, Dr K.N. Fedorov, the following topics and speakers:

1. Review of physical aspects of coastal upwellings - R.L. Smith or M. Tomczak.
2. Review of biology of coastal upwellings - R.T. Barber.
3. Physics and biology of equatorial upwelling - M. Vinogradov or M. Flint.
4. Mediterranean special features of dynamics and productivity - Gascard or Nival, or Equatorial front - speaker to be selected.



5. Biology of Peruvian upwelling (with emphasis on higher trophic levels) - H. Santander.
6. Upwelling domes - Voituriez.

### 3. New terms of reference

SCOR WG 36 noted the new terms of reference as stated by SCOR (Proceedings, V. 10, No. 2, 1975).

### 4. Comparison of equatorial and coastal upwellings

The Group had at its disposal copies of Vol. 102 "Transactions of the Institute of Oceanology, Acad. Sci. USSR" containing papers on the results of 1974 studies of Equatorial and Peruvian Upwellings. A summary of pertinent information on the Equatorial Upwelling was presented by Dr Fedorov. An extended discussion followed on various aspects of the phenomenon. However, the Group was not yet ready to make a detailed comparison between equatorial and coastal upwelling. Instead, a list of questions for future research was formulated as follows:

1. Does equatorial upwelling have seasonal cycles in every ocean?
2. How different are its various manifestations in different oceans?
3. Does equatorial upwelling occasionally cease or weaken during seasons when it is normally strong?
4. How wide is the upwelling zone? Is it wider than the equatorial undercurrent?
5. What is the maximum depth from which water is upwelled?
6. Where is the equatorial upwelling strongest?
7. What is the residence time of water in the equatorial undercurrent?
8. What is the connexion between equatorial and low latitude coastal upwellings?
9. How is El Niño related to the Pacific equatorial upwelling?
10. Why is biological productivity lower at the equator than in coastal upwellings?
11. Is there effective recycling of nutrients and re-seeding of water in the equatorial upwelling system?
12. Does occasional weakening of upwelling around the Galapagos signify corresponding weakening of the Cromwell current?
13. Why are higher trophic levels not abundant along the equator?
14. Do the warmer minimum temperatures of equatorial as opposed to coastal upwelling affect the biological productivity?
15. Is equatorial upwelling closely tied to the equatorial undercurrent, and oscillating about the equator with it?
16. What is the effect of weakening or strengthening of the trade winds on the equatorial upwelling velocity?

### 5. Specific features of some less studied upwelling areas

- (i) Cabo Frio, Brazil. Dr Minas reported on studies of the coastal upwelling off Cabo Frio conducted by Valentin and Kempf. There is an attempt to utilize this upwelling for aquaculture by pumping water from 45 m depth. The success of this experiment will depend on the presence of upwelled water at this depth. As upwelling is seasonal there, the aquaculture will have to be seasonal.
- (ii) Somali-Arabian and Antarctic. Information presented at the 1974 and 1975 symposia was insufficient for detailed consideration by the Group. The Group hopes that increased investigations will be conducted in those areas under MONEX and ISOS, with special attention being paid to upwelling phenomena.

### 6. Formulation of problems for future research

#### (a) Physical aspects

A considerable amount of pertinent data has been collected during upwelling studies of 1974 and 1975 near the N.W. African, Peruvian and Oregon coasts. The response to upwelling events (several days of strong favourable winds) is fairly well understood. The hydrography and long-shore flow responds rapidly to wind fluctuations. Detailed descriptions are now available in the literature for the Oregon and N.W. African upwelling regimes. However, in spite of the very intensive programmes of current measurements, with both moored current meters and cyclosondes, the general low-frequency picture obtained does not provide an unambiguous distinction between one-cell, two-cell and possibly other schemes of upwelling and their dependence on the stratification, shelf-width and configuration, wind force, and other factors. The time scales for which the



various schemata are relevant is not clear. It is not unlikely that a two-cell scheme of upwelling and maybe a two-cell transverse circulation over the upwelling area, including both the shelf and partly the slope zone are transient (tidal and inertial time scale) features of the upwelling process. These features may perhaps not show up in a quasi-stationary view of upwelling. Further cyclosonde measurements and numerical model simulations are necessary to elucidate this problem.

Related to this problem is the question of upwelling fronts, the existence of which may be indicative of multi-cell circulation in the upwelling zone. It is not yet understood whether sharp fronts with high horizontal and/or vertical shears and density gradients are characteristic of every upwelling region. It is worth studying whether high salinity gradients associated with river discharge (as in the Oregon case) or any other local conditions are also associated with more frequent appearances of sharp upwelling fronts, while rather uniform salinity conditions (e.g. in the Peruvian upwelling) are accompanied by less frequent front formation. One may perhaps hypothesize that fronts would be more persistent in, say, the Oregon area and short living and diffuse in the Peruvian upwelling zone. In studying scales of coastal upwelling one may also try to find out at what maximum distance from the shore thermal or thermohaline fronts are usually observed.

It has been found that both velocity and temperature fluctuation spectra have strong inertial and tidal signals in the upwelling zones. It is worth finding out whether such signals in temperature fluctuations are associated with vertical oscillations or with horizontal oscillatory motions across isotherms. It is not unlikely that the vertical structure interleaving is caused by such horizontal oscillatory motions at fronts during the periods between intensive upwelling events. Such interleaving on the horizontal scale of 3-5 km (and possibly more) may create sharp vertical density gradients with consequent redistribution of planktonic organisms.

The basic three-dimensionality of coastal upwelling needs to be addressed in future observation studies. The three-dimensionality means that, in general, one cannot describe the upwelling process only in terms of the flow in a single section normal to the coast and using only local winds. This is manifested in the effect of the longshore variation of bottom topography, the propagation of low frequency baroclinic shelf waves, etc. It is now apparent both in theory and observations that the curvature of the midshelf bathymetry and of the shelf break is more important than the curvature of the coastline in determining the alongshore flow, its variability, and the magnitude of upwelling. The existence and effect of free and forced shelf waves in the coastal upwelling region has been studied extensively in theory. Observations off Oregon and Washington support the propagation of coherent fluctuations in the current over substantial distances (200 km) but the distinction between barotropic and baroclinic modes, and forced and free waves is not clear in the present observations. Strong suspicions of the contribution of baroclinic free shelf waves to upwelling exist in the data from the Gulf of Guinea where upwelling is apparently not tied to local winds.

Tied to the three-dimensionality questions are questions on the poleward undercurrent. Some present models link the undercurrent with the coastal upwelling process and indicate its existence may be tied to local curvature of the bathymetry. Observations (both biological and physical) suggest that it is a larger-scale feature exhibiting a persistence and meridional extent that indicates the undercurrent is part of the general eastern boundary current system. It is possible that the upwelling process may locally enhance the undercurrent and also feed upon it (draw from it part of the upwelling water). Since the existence, persistence and extent of the undercurrent is of considerable importance to the ecology of upwelling regions, as well as of considerable interest with regard to the physical dynamics, future measurements in upwelling regions should consider its extent, both offshore and onto the shelf and its variability, and consider ways to estimate residence times of water in the undercurrent.

The question as to the significant time-scales involved in coastal upwelling processes is of continuing importance. The diurnal, event, and seasonal time-scales clearly are important in biological and physical dynamics. Many of the questions remaining and the problems posed above result from our ignorance of the relation between the processes occurring on three different scales. Much of the work of the past several years has concentrated on the event scale (several days to a few weeks). This is partly due to the relatively recent 'discovery' of the existence and importance of the event-long time-scale, and to the fact that it is a 'convenient' time-scale for contemporary research techniques. There is particularly need for investigations on the seasonal scale both for understanding the effect of coastal upwelling on the higher trophic levels and the relation (interaction) of coastal upwelling with the larger scale, dynamics (e.g. the eastern boundary currents). The need for information on and understanding of processes on the seasonal time-scale will necessitate different research strategies.



There is a need for quantitative statistical indices for coastal upwelling regions, especially with regard to wind since it is the major driving force for coastal upwelling. The importance of the event time-scale in the upwelling process has shown the need for indices and statistics that reveal the intermittency of the upwelling producing wind, as well as the strength. For example, monthly mean wind stress (or equivalently the Ekman transport directed offshore) is not sufficient to characterize the differences between upwelling regions since the intermittency of favourable winds and the variability of strength appears to be as important to the biological processes as the monthly mean wind stress.

(b) Biological aspects

The coupling between the primary production and the higher trophic levels remains one of the most difficult functions to understand in coastal upwelling ecosystems. Analysis of recent data obtained from N.W. Africa has confirmed the view that the shelf region is characterized by small zooplankton and the shelf break by euphausiid populations. However, there are still no indications of the mean residence time of these zooplankton populations in the water masses in which they reside. Although the maximum distances travelled are compatible with the generation times as suggested in the previous report of this Working Group, it may be assumed that the mean longshore velocity is reduced by vertical migrations. Coupling of the sites of production of phytoplankton and grazing, however, remains a largely unknown process. A mid-shelf series of observations made off N.W. Africa recently showed an association between the quantity of phytoplankton during calm periods and the quantity of zooplankton population with no evident time lag.

Biological oceanographers studying upwelling have been adapting observational and analytical techniques from physical oceanographers. Even more attention should now be given to carrying out field programmes in which the biological and physical observations can be overlaid in time and space and thus can be analyzed with the same statistical techniques on the same scales. An advantage obtained from conducting such experiments is that the various time and distance scales can be recognized and separated into the various components. For example, the correlation between surface winds and shelf currents in upwelling areas is now known to be close and, even more remarkably, the longshore coherence in shelf currents of the Washington and Oregon coast has been found to be very high. These results suggest that appropriately designed biological time series observations on a slope or shelf in an upwelling area may yield new insights into the coupling of trophic levels and the primary production mechanism. The successive appearance of identifiable cohorts of copepod species at downstream stations would provide rates of downstream drift that could be compared with water velocities and at the same time provide some information on growth rates, and thus on secondary production. The absence of such cohorts in the downstream system would yield important information on the space scales of secondary production. N.W. African observations of contemporaneous peaks in copepods and diatom bloom need to be studied further in other areas with finer resolution in time.

The demonstrated presence of the undercurrent as a consistent longshore feature of coastal upwelling associated with the general circulation and thus with the seasonal time-scale suggests that biological time series in the undercurrent would be highly desirable, giving the same general kinds of information for euphausiids, for example, as the shelf time-series should yield for the smaller zooplankton.

The deployment of such one, two or three-dimensional experiments would require considerable expansion in manpower or an improvement in observational techniques and equipment.

A certain variability of biological productivity related to the high and low winds was observed off N.W. Africa. Under high winds, upwelling occurs at the break with the peak of nutrients and a production up to  $4\text{gC/m}^2/\text{day}$ . During the low wind system, upwelling occurs inshore and nutrients decay seaward and the mean production is about  $2\text{gC/m}^2/\text{day}$ , the lowest rate ( $0.7\text{gC/m}^2/\text{day}$ ) being in the freshly upwelled water near the coastline. When a low wind system is succeeded by a high wind one, the new upwelling at the shelf break is added to the system. When the reverse occurs, the shelf break water retreats inshore and mixes with that upwelling there. The wind regime is intermittent and so each system inherits some properties of its predecessor. Hence there might be a case for sampling across the high and low wind systems to estimate an average condition and perhaps its variability.

The life history and development rates of the zooplankton in upwelling areas are not well known and they should be studied in the traditional ways.

The biological models used may be put in simplified form:  $P_1 = P_0 \exp (R-G)t$ , where  $P_0$  is the initial quantity of algae and  $P_1$  that after time  $t$ ,  $R$  is the algal productivity rate and  $G$  the



mortality due to grazing. Present models have used inserted values of  $R$ ,  $G$  and  $P_0$  to predict  $P_1$  and they have been quite successful. Another way is to observe  $P_0$ ,  $P_1$  and  $R$  and obtain  $G$ . Provided that the time intervals are fairly short, 2 or 3 days, it should be possible to obtain a number of measures of  $G$  within patches of upwelled water, which might be correlated at first with zooplankton dry weight. Subsequently, the grazing mortality should be partitioned by dominant species, sizes of developmental stages of the grazers as our knowledge of their life histories improves.

Any attempt to relate plankton distribution ('patches') with an increasing detailed knowledge of environmental variables (circulation cells, eddies, and so on) cannot be solely based on the conventional and possibly very limited sets of plankton samples, but requires an increase in the number of these samples or an increase in the information to be extracted from a limited number of samples distributed in space and time. This can be done through the intensified use and eventual further development of methods of continuous automatic recording on moorings and use of such devices as fluorometers, Coulter's and Boyd's counters, and so on. Studies on small scale distribution of oxygen and some elements (phosphorus, metals) can help to ascertain recycling going on in small structures and help to define shape and age of such structures. Experimental work on the biology of complex plankton systems is much needed, including in-situ studies of artificial upwellings, studies of the effects of light in deep water, for instance, to ascertain the significance and importance of 'needs' of populations, and eventual natural chelators or relevant chemical compounds. Further intensification of taxonomic studies and development of more reliable methods for phytoplankton census (dilution cultures, scanning electron microscopy of filters with plankton retained on them) should be encouraged.

#### 7. Long term plans for upwelling research

The following summary was given informally by the Group members to the best of their knowledge. Naturally, it is incomplete both in terms of the expeditions planned and in terms of countries (particularly coastal ones) participating in these and other expeditions.

1. Marine environmental project of IMARPE (Instituto del Mar del Peru)  
This project, to be carried out from 1975 onwards, comprises two basic parts:
  - a) The coastal upwelling, with intense observations at four coastal areas about 5°S, 8°S, 12°S and 15°S, with emphasis at 8°S and 15°S, especially the latter into the JOINT II of CUEA. It is expected to get co-operation for the area about 5°S in connection with the equatorial upwelling.
  - b) El Niño phenomenon, with the participation of Colombia, Ecuador and Chile, and the support of the IOC and the SPC (South Pacific Commission of Ecuador, Peru and Chile). During this study, a seasonal monitoring will be carried out of the area giving special attention to the fluctuations of the equatorial front, the variability and the extension of the Cromwell Current east of the Galapagos Islands. A good understanding of the circulation in the eastern South Pacific Ocean should be obtained. The programme of observations includes physical, chemical and biological measurements and sampling and is meant to provide a good basis for further prediction of the oceanographic conditions.
2. CUEA (off Peru)  
 March - May 1976 : THOMPSON and ALPHA HELIX  
 July - September 1976 : EASTWARD  
 March - May 1977 : 3 major US ships
3. North-West Africa  
 1977 : METEOR (FRG)  
 September 1976 : CHARCOT (France) - to Guinea Dome
4. Equatorial Atlantic  
 1977 : ORSTOM studies of Gulf of Guinea  
 1988 : METEOR (FRG)
5. South-West Africa  
 Late 1975 : ATLANTIS II (USA)



6. Arabian Sea

Early 1976 : AKADEMIC KURCHATOV (USSR)

7. Antarctic Divergence

February 1977 : MARION DUFRESNE (France)

8. Galapagos Islands

The Group thought that SCOR might advise the IOC and through it the Government of Ecuador on the desirability of conducting regular marine meteorological, physical, chemical and biological observations in the area of the Galapagos Islands to monitor the interconnections between the upwelling along the west coast of South America and the Equatorial upwelling in the Pacific Ocean and the development of El Niño conditions.

8. Other matters and future activities of the Group

The Group discussed various aspects of eventual use of satellites and orbiting laboratories for observation and monitoring of upwelling associated phenomena. It was recognized that the remote sensing technique in the upwelling studies may be useful if it can provide information which it is otherwise impossible or more expensive to obtain by conventional oceanographic means. It was felt that any recommendations to this effect should be very specific in terms of the descriptions of the phenomena to be observed and of the accuracies and resolution with which the desirable parameters have to be measured. The Group agreed to proceed with working out such recommendations through correspondence.

The Group was strongly convinced that some changes in its composition should be made during the interim period. Especially, biological and physical modellers should be added to the Group or invited to attend the next full meeting which should be shaped to address the new directions and problems that will become clear during the extensive set of meetings and symposia already scheduled.

The Group was of the opinion that in view of the great number of upwelling studies conducted over the past few years, the Working Group should not meet formally until the results of these studies are assessed in the laboratories and institutions. Consequently, only informal consultations between the Chairman and the other Group members present at the Joint Oceanographic Assembly in Edinburgh were foreseen for 1976. The Group will continue working through correspondence and eventually establish the date of its next formal meeting.



SCOR WORKING GROUP 42 (WITH ICES)  
STUDY OF POLLUTION OF THE BALTIC

Extracts from report of Meeting, Charlottenlund, 18-19 June 1975

(The full report will be published in ICES Cooperative Research Reports)

Participants

Dr G. Kullenberg (Denmark) (Chairman)

Dr H. J. Brosin, Germany (GDR)	Mr O. Vagn Olsen, Denmark
Prof. Dr K. Grasshoff, Germany (FRG)	Dr W. Słaczka, Poland
Mr A. Haverinen, Finland	Mr E. Somer, Denmark
Prof. G. Hempel, Germany (FRG)	Mr A. Svansson, Sweden
Mr A. Nielsen, Denmark	Mr H. Tambs-Lyche, Denmark
Mr G. Okolotowicz, Poland	Dr A. Voipio, Finland

Information on International Activities related to pollution research in the Baltic

- (a) It was noted that SCOR had agreed to continue its participation in the Group's work, and that the last year's report had been favourably received both by SCOR and ICES.
- (b) A. Voipio informed the Group about recent developments concerning the Convention on the Protection of the Baltic Environment. There was a discussion about possible co-operation, but in the absence of formal contacts, no concrete recommendations were made.
- (c) G. Hempel reported on the Meeting of the Committee of Baltic Marine Biologists. The Group noted that although no formal co-operation agreement with that organization exists, there are effective contacts on specified tasks and satisfactory mutual information.
- (d) ICES has received the report on the ad hoc meeting of Experts on the Methodological Pilot Study of the Water Balance of the Baltic Sea, February 1975. The Group recognized its importance.
- (e) It was agreed to explore the possibilities for organizing meetings of the Task Team 2 (Physical Investigations) and Task Team 3 (The Baltic Circulation Study) in conjunction with the planned USSR/Swedish Meeting on Modelling, Tallin, 10-20 November 1975, with opportunities for participation of scientists from other countries.
- (f) The Group noted with satisfaction the development of the different activities now in progress in the Baltic, and felt that efficient working contacts exist between the Group and most of these activities. The hope was expressed that contacts with the Interim Commission for the Helsinki Convention may soon be formalised, in order to avoid double work. The Group also felt some concern that bilateral activities might in some cases create difficulties as other countries invited to join in such activities would not have had sufficient opportunity to participate in the planning. It was, therefore, hoped that bilateral undertakings could gradually develop into really multinational activities, or that when not practical, this concern would be taken into consideration.

Report on the Input Study by H. J. Brosin

The draft report on the replies to the questionnaire to determine sources of input to the Baltic Sea was received with appreciation.

In a general discussion it was agreed that even if the report showed that there is still a long way to go before one has a satisfactory picture of the total input of contaminating substances to the Baltic Sea, there could also in several cases (e.g. BOD) be noted significant progress since the former report was published in 1970. It was agreed that the report needs to be followed up by a listing of those tasks which should now have priority, in order that the picture can be more complete.

It was suggested that one way of following up this study and to combine its results with those from the baseline study as well as with the scientific tasks outlined earlier (Coop. Res. Rep. No. 42) could be to bring together those persons who have attempted to set up partial budgets for certain substances in the Baltic Sea, such as, for instance, phosphorus, with the aim of obtaining a progress report on such studies. The possibility is to be explored before next Meeting.



Studies of the air-borne input need to be considerably intensified. In this connection one should also study the transport of such pollutants which accumulate at the sea surface from sea to air through sea spray. The Group took note of the activities in different Committees of ICES and Working Groups of SCOR in order to intensify the studies of those processes in estuaries, river mouths and fjords which determine the proportion of river-borne, land-based pollution which reaches the sea itself.

The Commission for the Protection of the Baltic Sea Environment has as one of its main aims to bring the inputs of pollutants to the Baltic under control, irrespective of sources. The Working Group felt that, with this responsibility, and with the broad support the Convention on the Protection of the Baltic Sea Environment had achieved in all Baltic countries, the Commission may be in a good position both to stimulate the necessary investigations and to stimulate the reporting by national agencies.

The Working Group recommends that it - or ICES as such - should, for the time being, not take further steps to institute a yearly reporting system, or a monitoring of inputs. However, it does recommend that it shall continue and, if possible, intensify the co-ordination of analytical and methodological studies, the studies of the role of estuaries and of the "sieving" effects of island chains, exchange of pollutants between sea water and sediments, studies of water exchange between the North Sea and Baltic, and of the scientific tasks defined in earlier reports.

#### Report on the Progress of the Base-Line Study

The operational phase of the Baltic Base-Line Study was started in October 1974. The following countries had agreed to participate: Denmark (with a limited analytical programme), GDR, Sweden, Finland, USSR, Poland, and the Federal Republic of Germany.

All countries, except USSR, have reported the performance of the sampling programme according to a questionnaire distributed in May 1975 by the Convenor.

With respect to the Danish sampling programme, the Working Group was informed that samples of cod, herring and plaice have been taken in the areas off Aarhus, Copenhagen and Bornholm monthly during the period 1973/74 and analysed for heavy metals and organochlorine pesticides. This programme has been discontinued, but the Danish input to the Base-Line Study will be made from it.

Standard samples of fish oil and fish meal have been received from Dr Topping and were distributed to all participating laboratories which have been nominated for the analysis of the base-line samples. The standards for intercalibration are identical with those used in the North Sea study.

Results of the analysis of the biological material and the standards have been received from the Federal Republic of Germany and Finland.

The Working Group congratulated the Coordinator, Professor Grasshoff, on the considerable progress made since the previous meeting. It was agreed that it would be necessary to call a meeting of the analysts involved as soon as all analyses had been made. (Recommendation No. 1).

It was noted that preparations had been made by a sub-group under the Working Group for Monitoring and Base-Line Studies of Pollution in the Oslo Commission area and part of the ICNAF area, for an international base-line study of the level of "dissolved" heavy metals in sea water. It was agreed to review the progress of this work at the Group's next meeting.

Professor Grasshoff also informed the Group about methodological studies made in Kiel on the level of heavy metals in phytoplankton of the Baltic. The Group agreed to revert also to this subject at its next meeting.

#### The Basic Oceanographic Research Programme

##### (a) Physical Investigations (Task 2)

A report on the meeting of the Task Team Group on 28 September 1974 was available. The Task Team at its forthcoming meeting in Tallin, in November 1975, should aim at starting the experiment in the latter half of 1976.

##### (b) The Baltic Circulation Study (Task 3)

In the frame of the USSR-Swedish bilateral co-operation on environmental protection problems, a Workshop on physical, chemical and biological modelling will be held in Tallin on 10-20



November 1975. Its convenor Professor Aitsam, has welcomed a suggestion to organize also a Task 3 meeting in the same time period, with P. Svansson as Chairman.

The Working Group expressed the hope that it would be possible also to have a Task 2 meeting at that time, and further that the two Groups (2 and 3) could meet together for discussion of common topics, e. g. theoretical considerations to be taken into account in the Open Sea Programme, 1976-77.

The Working Group was given a brief report on the Federal Republic of Germany's "Baltic-75" expedition which might be considered a pilot project also for Task 3.

(c) The Open Sea, Multidisciplinary, Continuous Stations (Task 5)

Professor Hempel reported on the progress of Task 5.

A circular letter to national contacts was sent out by the international co-ordinator. Replies were as follows:

Finland : Positive, regarding ships' time. Reporting on detailed studies on bottom topography and sediments at a possible site off the Finnish coast. Major interest in measurements of primary production, sedimentation rate of organic matter and degradation processes in the sediment.

Sweden : Positive reactions by the Askö Laboratory and the Fishery Board, but no fixed schedule for RV ARGOS. Doubts concerning present ability to measure sedimentation rate by traps. Hope for increased activities in the field of microbiology through the University of Göteborg.

GDR : Hope for one ship for 2-3 periods of two weeks each: STD, optical measurements, current measurements (possibly with dye tracers for vertical transport in combination with Task 2).

O<sub>2</sub> (H<sub>2</sub>S), PO<sub>4</sub>, Nitrate, Nitrite, Ammonia, dissolved organic N and C, Silicate, heavy metals. Primary production (total and for groups of phytoplankton), photosynthetic pigments (Chlorophyll a and b, phaeophytin), particulate organic C in the water column. Qualitative measurements on phytoplankton and seston. Reference is made to the methodological recommendations of the Baltic Marine Biologists.

Denmark : So far, only plans for physical oceanography are at hand. Possibly a Danish vessel available for 1-2 weeks, but in addition interest in invitations to work on foreign vessels.

Optics, also in relation to studies in dye tracing, in and below the thermocline and halocline layers for measurement of horizontal and vertical mixing, in connection with biological work. Possibly observations of currents and particulate matter in the benthic boundary layer (by a Laser Doppler Anemometer).

FRG : Availability of ships' time depends largely upon whether and when in 1976 the new 160 ft research vessel of the Institute of Marine Science in Kiel will become operative, otherwise only relatively small vessels will be available in 1976. Discussions on scientific contents and execution was delayed in order to incorporate the experience of the "Baltic 1975" which contained elements similar to Task 5.

Poland : No commitments could be made at this time, but good hope for participation, particularly in seston studies and sediment analysis.

The Working Group welcomed the report and noted that it was likely that 3-4 vessels would be available for this task for two 2-week periods. It was agreed that the Task Team should meet in Kiel in September 1975. The Baltic Marine Biologists, meeting in Gdynia in October 1975, should be informed. It was agreed to locate the station of investigation close to the area of Task 2. The aim should be to start the fieldwork in August 1976 and then follow the time scale outlined earlier.

## RECOMMENDATIONS

### Recommendation No. 1

It was recommended that a meeting of the analysts who had taken part in the Base-Line Study of the level of pollutants in marine organisms in the Baltic should be held, at national expense, at



Charlottenlund in January or February 1976, as soon as the analytical work has been completed. The meeting should report to the ICES/SCOR Working Group on the Study of Pollution of the Baltic on the results of the Base-Line Study.

#### Recommendation No. 2

Since intercomparability of chemical data is a pre-requisite for all future international work with respect to the pollution and eutrophication of the Baltic and since intercomparability of results of analysis of dissolved substances containing nitrogen is unsatisfactory, it was recommended that ICES should organize an intercalibration exercise between laboratories of all Baltic countries concerning four parameters; viz.

- (a) Nitrate      (b) Ammonia      (c) Total nitrogen      and      (d) Urea.

#### Recommendation No. 3

It was recommended that the ICES/SCOR Working Group on the Study of Pollution of the Baltic should meet again in Tallin at the invitation of the Estonian Academy of Science in April/May 1976.



SCOR WORKING GROUP 43  
OCEANOGRAPHY RELATED TO GATE  
Summary Report of 1975 Meetings

The Group met in June 1975 in Southampton, UK, following a GATE Oceanography C-Scale Workshop in Southampton, and again in August 1975 in Grenoble, France, during the IUGG General Assembly, following a GATE Oceanography Equatorial and A-Scale Workshop in Geneva, Switzerland. A combined and shortened version of the reports and recommendations of these meetings is given here.

Participants of the meeting in Southampton, 20-21 June 1975

WG 43: W. Düing, G. Needler, F. Ostapoff, G. Siedler (Chairman), J. Woods.

By invitation: R. Landis (IOC), G. Peluchon (OSDC/BNDO Brest, France), R. Pollard (University of Southampton, UK), A. Rybnikov (Government Oceanography Institute, Moscow, USSR).

Participants of the meeting in Grenoble, 29 August 1975

WG 43: W. Düing, I. Galindo, J. Gonella, G. Siedler (Chairman), J. Woods. By invitation: J. Elliott (Bedford Institute, Dartmouth, Canada), D. Halpern (NOAA, Seattle, USA).

1. Status of International GATE Activities

The Group discussed the implications of the termination of the ISMG and the necessary interaction between SCOR, IOC and the new bodies, the JOC Panel on GATE and the GARP Activities Office (GAO). It was understood that direct cooperation between SCOR WG 43 and the GAO will be essential for the analysis phase of GATE. When discussing the international cooperation in GATE, the members of SCOR WG 43 noted with concern that its two USSR members had been unable to attend any of the meetings to date and expressed strong hopes that they would be able to participate in the remaining meetings and Workshops devoted to the coordination of scientific analysis and the review of results, where their contributions would be particularly important.

2. GATE Oceanography Workshops in 1975

Two GATE Oceanography Workshops were organized by SCOR in close consultation between GAO at WMO, IOC and SCOR in 1975.

The Convenor of the C-Scale Workshop, held in Southampton from 16 to 20 June 1975, was Professor J. Woods; the convenor of the Equatorial and A-Scale Workshop in Geneva from 15 to 23 August 1975 was Professor W. Düing. The quantity, quality and the stage of processing of the oceanographic data was examined in detail, and it was found that in general the data set is sufficient to meet the objectives of the GATE Equatorial, A-Scale and C-Scale Oceanography programmes. During the Workshop the principal investigators discussed the physical interpretation of the data and formulated plans for future continued cooperation. While C-Scale oceanographer thought it sufficient to encourage direct international contacts between groups involved in this programme, the Equatorial oceanographers set up several small ad hoc Working Groups for specific topics. Recommendations concerning data exchange, data analysis and further meetings originated from these Workshops which were taken up by SCOR WG 43. The participants of the Workshops considered the progress made at these Workshops a very essential step in achieving a fast scientific analysis of the data set. Reports on the results of the two Workshops were prepared by the participants and were later duplicated and distributed by the GARP Activities Office.

3. Plans for further Workshops and Symposia

One Workshop similar (in number of participants) to the two Workshops of 1975 was proposed for late 1976, close to the time of the Joint Oceanographic Assembly in Edinburgh, covering C-Scale and B-Scale processes and simultaneously problems of the general oceanic circulation of the Tropical Atlantic. In addition three meetings of small ad hoc Groups were proposed. The analysis meetings proposed for 1976 thus are:

- a) Workshop of "C/B-Scale processes and general oceanic circulation of the tropical Atlantic".  
September 1976, Europe



- b) Small Workshop on "Currents and Water Masses of the Western Atlantic".  
April 1976, Mexico City
- c) Small Workshop on "Time Series Observations Related to the Equatorial Region".  
November 1976, Leningrad
- d) Small Workshop on "Quasi-Synoptic Spatial Observations in the Equatorial Region".  
December 1976, Miami

The distinct nature of the surface wave programme may require a special Workshop in order to facilitate the final data analysis, but specific recommendations could not be made at this time.

SCOR WG 43 proposed that a major symposium for the presentation and discussion of scientific results on GATE Oceanography be organized in 1977, with the participation of meteorologists. It was suggested to explore the possibility of holding such a symposium under the joint auspices of SCOR, IAPSO and IAMAP. \*

#### 4. GATE Oceanographic Atlas

Members of the Group reaffirmed their belief that a GATE Oceanographic Atlas could provide a useful service, especially to oceanographers who did not have direct access to the original data. It was felt that the time was now ripe for a detailed study of the form that such an atlas might take. Dr Landis (IOC) asked whether it would be appropriate to submit the plan to produce an atlas at the forthcoming IOC Assembly, with a view to obtaining funds within the next two years. After reviewing the scheduled dates for completion of the oceanographic data set, it was agreed that presentation at the 9th Assembly would be premature.

#### 5. Future Role of SCOR WG 43

The Group felt that there is a need for it to continue the task of advising the GAO and the OSDC on data management and to organize the scientific analysis phase and oceanographic meetings in close consultation with IOC and GAO. Looking to the future, the Group could only see a requirement for its services until late 1977 or early 1978 by which date all the oceanographic data should have been processed and a large portion of the scientific analysis should be completed. The members felt that it would be appropriate to make their final activities as a SCOR Working Group in sponsoring the major symposium proposed for that date above.

#### 6. Recommendations

Arising from Southampton meeting:

- i. That scientists working on oceanographic C-scale problems meet again in late 1976, possibly close to the time of the Joint Oceanographic Assembly at Edinburgh, and, taking advantage of increased understanding of the finer scale processes, the group of C-scale oceanographers be extended to consider the B-scale oceanographic objectives of GATE.
- ii. That every effort be made to encourage the rapid analysis of the data set by means of collaboration between scientists working in small international groups or as visitors to institutes in other participating countries, in addition to the major Workshops and symposia proposed by SCOR WG 43.
- iii. That a major symposium for the presentation and discussion of scientific results from the GATE Oceanographic Subprogramme be organized in 1977, with the participation of meteorologists.
- iv. That SCOR re-consider the earlier proposal for providing expert oceanographic advice for data validation at the Oceanographic Subprogramme Data Centre (OSDC) in Brest, France. The Group felt that this advice should be supplied by an available part-time consultant for the remainder of 1975 and early 1976, but that it is necessary that an oceanographer join the OSDC for one to two years, starting in 1976. This oceanographer should have experience in handling and interpreting large oceanographic data sets and in modern oceanographic instrumentation.
- v. That, in order to overcome special problems connected with the surface wave data and their international validation, wave spectra from all GATE contributors be first examined

IAPSO and IAMAP subsequently welcomed these suggestions. A joint symposium will possibly be deferred until early 1978.



at one central institute (such as the Max Planck Institute of Meteorology in Hamburg, F. R. G.) for validation purposes. When completed, the validated data set should be submitted to the OSDC.

- vi. That all scientists involved in the GATE oceanographic programme send preprints of publications to interested oceanographers including all SCOR WG 43 members.
- vii. That all publications resulting from GATE should be identified by the phrase "Gate Contribution" and that lists of existing publications and reports including titles and possibly abstracts be published in the GARP Newsletters. The members were unenthusiastic about the use of a numbering system for GATE contributions.
- viii. That a small study group, comprising Drs W. Duing, G. Philander and J. Woods, should be set up to consider the form that a GATE Oceanographic Atlas might take, with a view to presenting a draft scheme to SCOR WG 43.

Arising from Geneva meetings:

- i. It is recommended that the National Processing Centres as well as individual scientists make every effort to ensure the delivery of their data sets to the OSDC, Brest, by the previously agreed upon deadline of 1 April 1976.
- ii. In order to proceed efficiently with the synthesis of data from the Equatorial and A-Scale programme, it is recommended that ten working teams be established for this part of the programme.
- iii. It is recommended that the Director of OSDC contact the Synoptic Scale Data Centre, Bracknell, to determine if the information requested below is available and how it should be obtained. Results of the determination by the Director of OSDC should be distributed to N. Tyabin (USSR) and C. Rooth (USA) to permit formulation of final specific recommendations.

Synoptic maps and tabulations, prepared from observations of sea-surface temperature and surface winds by all GATE ships, are required to support investigation of large-scale features and to provide ground truth for satellite sea-surface temperature observations. These maps should cover all three phases of GATE at 6-hour intervals (at 0, 6, 12 and 18 hours) daily for: (a) sea-surface temperature, (b) surface wind velocity, (c) curl of wind stress, and (d) divergence of wind stress. It is desirable to know if maps of the above quantities are routinely available and at what scales they are produced. If these quantities are not routinely available, can they be produced as special products and, if so, by whom and over what time frame?

- iv. Recognizing the necessity and importance of international validation before introducing oceanographic data into the final GATE ARCHIVE, it is recommended that:
  - (a) OSDC retain the basic responsibility for the final validation of these data;
  - (b) a preliminary validation be done by each of the ten working teams in the time period between April and September 1976; this work will be coordinated by the chairmen of the working teams in close contact with OSDC;
  - (c) the results of this work will be submitted to OSDC by December 1976, and must include complete documentation of validation procedures to assist in the international validation of the data.
- v. To ensure high-quality data validation at OSDC, we recommend that:
  - (a) funds be made available through international channels for visits (including residence) to OSDC of one or more international experts on various types of data over the course of two years. These experts should act as advisors to OSDC and be given the opportunity to do oceanographic research.
  - (b) as soon as possible, an oceanographer, experienced in data validation, should be added by OSDC to their staff for a period of two years.
- vi. GATE Equatorial Oceanographers need to obtain maps at an early date. It is recommended that:



- (a) by the end of 1976, a report be compiled from all graphs produced by the Working Groups;
  - (b) in order to facilitate this compilation, it is essential that the previously established common scales be adhered to; an ad hoc committee on common scales has been established under the chairmanship of Mr P. Hisard, with Dr Rybnikov, Mr Peluchon, Dr Weisberg and Professor Woods as additional members;
  - (c) by 1 January 1976, this committee is to propose a more comprehensive set of scales than those attached to this report;
  - (d) by the end of 1976, a final recommendation on the production of a more comprehensive atlas will be made by the Atlas Study Group of SCOR WG 43.
- vii. Bathymetric measurements during GATE. Investigators who made bathymetric measurements during GATE are urged to submit their data to IOC before 31 December 1975 (see report on the bathymetric programme).
- viii. Distribution of scientific results pertaining to GATE Oceanography. It is recommended that one copy of any report or publication describing GATE oceanographic results, including internal Institute reports, be sent to the Director, GARP Activities Office, WMO, Geneva. The Director is requested to circulate a list of reports and publications received in Geneva to as many members of the oceanographic community as possible every three months. Scientists are urged to obtain copies of reports directly from the authors, rather than from the GARP Activities Office.



## SCOR WORKING GROUP 46 (WITH ECOR/IAHS/ACMRR/UNESCO)

## RIVER INPUTS TO OCEAN SYSTEMS (RIOS)

Report of the second meeting, New Haven, USA, 24-26 March 1975

The second meeting of SCOR Working Group 46 was held at the Yale University, Geology Department, at the invitation of Professor K. K. Turekian. The following attended the meeting:

(i) Members of RIOS Working Group

D. Lal, India (SCOR) (Chairman); J.D. Burton, UK (SCOR); R. Chesselet, France (SCOR); D. Eisma, Netherlands (SCOR); F. Fournier, France (IAHS); K.K. Turekian, USA (SCOR); A. Walton, Canada (SCOR). (J.S. Alabaster, E. Eriksson, J.A. da Costa and P. Storrs could not be present.)

E.L. Hendricks, UNESCO consultant for the UNESCO/UNEP World Registry of Rivers participated on behalf of J.A. da Costa.

(ii) Invited Experts

Y. Kitano (Water Research Institute, Nagoya);  
J. M. Martin (Laboratoire Geologic Dynamique, Paris)

T.F. Gaskell (SCOR Executive Committee Reporter), R.C. Griffiths (Assistant Secretary IOC) and E.D. Goldberg (Convener, SCOR ad hoc advisory panel on Biogeochemistry of Estuarine Sediments) were invited, but had been unable to attend the meeting.

On the second day of the meeting, Mr N. J. Brown of United Nations Environment Program (UNEP) joined the meeting at the invitation of the Working Group.

I. BRIEF SUMMARY OF DELIBERATIONS

The minutes of the first meeting of the Working Group, Paris, 24-27 June 1974, were approved.

The Chairman, D. Lal, presented a summary of the points made to him by members since the first meeting. The increase in global activities in the study of river-ocean processes indicated that there existed a growing awareness in the scientific community of the importance of such studies.

The Working Group received several interesting documents relevant to the purposes of RIOS: R.C. Griffiths sent reports relating to UNEP, GESAMP and POOL; K.K. Turekian presented a copy of the report of a workshop entitled Continental and Coastal Waters sponsored by the Energy Related General Research Office, Research Directorate, N.S.F.; J.D. Burton discussed a report entitled Basic properties and processes influencing the behaviours of chemical constituents in river inputs during estuarine mixing based on a paper by him to be published in a forthcoming volume Estuarine Chemistry resulting from a meeting held in London in May, 1974. E. L. Hendricks presented a summary of the deliberations of the Group of Experts on the World Register of Rivers Discharging into the Oceans. F. Fournier presented a summary of the study made on Gross Sediment Transport into the Oceans by the International Commission on Erosion and Sedimentation of the IAHS.

Ideas were exchanged on the important scientific problems with which RIOS should be concerned. The Group emphasized the need to answer the important questions posed at its first meeting:

1. How does river water and its sediment load acquire their chemical qualities in response to climatic, geological and cultural factors?
2. What transformations occur when a river meets the sea?
3. What is the ultimate flux of constituents to the open oceans via river systems?

The scientific community is currently engaged in the study of these processes for a variety of reasons. Useful data on the above questions, based on observations of natural and artificial substances in the hydrosphere, are continually becoming available. Such data would



eventually be useful for developing suitable generalized models capable of describing the physical, chemical and biological processes in the river-ocean systems and interfaces, thus advancing predictive capabilities.

However, it was felt that the present rate of developments in this field was far below that desirable and it was considered that the RIOS Working Group, being scientifically oriented, should aim at making a significant contribution to the advancement of the understanding of the influence of continents on the oceans. This, as was stated at its first meeting, was not only of great academic importance but also relevant to man with regard to problems of resources, pollution and coastal engineering.

How can RIOS promote global studies of the river-oceans system? The activities of RIOS which would make an impact would include bringing scientists together, developing scientist training programmes, encouraging studies of particular river-ocean systems, and publication and dissemination of scientific information; they would obviously require an appreciable level of funding which could at best only be met partly by SCOR. In view of this, the Group presented a detailed discussion of its aims and objectives to Mr N. J. Brown, representative of UNEP, and asked him for his views. Mr Brown responded very positively to the need to implement the ideas and work planned by RIOS. He stated that the interests of RIOS were clearly compatible with UNEP's programme of action.

Encouraged by the possibility of being supported by UNEP and realizing that support may also become available from other agencies such as UNDP for certain aspects of RIOS study related to development (e.g. harbour management, resource utilisation), the Group set out to prepare a specific plan of action for RIOS, which is recommended for execution with a high priority and urgency.

## II. RECOMMENDATIONS FOR RIOS ACTIVITIES

### 1. RIOS action plan

It was considered that one of the most important contributions which could be made by the RIOS Group would be the active encouragement of the study of a number of major river-ocean interfaces in the world. Such studies would, over a period of time, yield substantial data on these regions thus leading eventually to comprehensive mathematical modelling of the systems in question.

Reviews of the world's river systems suggest that there is a considerable lack of data and study of several major rivers/estuaries in remote and developing areas of the world. For example, the need for data from the Congo and the Amazon, to name only two such rivers, is obvious. It is clear, however, that such information will only be forthcoming as a result of specific actions.

Firstly the data-gathering process should be encouraged in the countries in question. This can only be accomplished through trained personnel working in the various river/ocean systems and who are provided with the technical facilities needed for such studies.

Recognizing these requirements the Group believes that four specific actions should be undertaken immediately to further these objectives:

- a) Surveys of research activities in RIOS.
- b) The development of RIOS training programmes.
- c) The establishment of field stations for RIOS projects.
- d) The organization of workshops on RIOS subjects.

#### a) Surveys of Research Activities

A major problem for RIOS is that, because of the multi-disciplinary nature of its subject matter and the frequent use of "grey" literature as an outlet for significant data, it is difficult for workers to maintain a thorough awareness of relevant work. This is a problem for the Working Group generally in its consideration of the field, and more specifically in the identification of material and individuals for workshop contributions. It is particularly important that there should be an adequate awareness of new programmes. To ensure its effectiveness in these directions the Group considers it essential that a primary input of information on present and proposed research programmes should be obtained by correspondence and limited travel by members with responsibilities for particular regions as specified below:



Burton	UK, Australia and New Zealand
Eisma )	
Martin )	Europe, Russia and China
Fournier	Africa, S. America
Kitano	Japan
Lal	India
Turekian	USA
Walton	Canada

These members will present a summary of their findings at the workshop proposed for September 1976, in addition to presenting printed reports.

#### b) Training programme

The Group believes that the establishment of training programmes for scientific personnel is not one which can be specified completely at this stage since it will depend on many factors including the needs of the country involved and the background and qualifications of individuals seeking training. Nevertheless, in considering the basic objectives of the RIOS programme stated earlier, certain basic areas of needed competence can be identified within the broad fields of oceanography, environment chemistry and methodology:

- a) physical oceanography
- b) marine microbiology
- c) sedimentary geochemistry
- d) atmospheric chemistry
- e) marine chemistry
- f) organic/physical/solution chemistry
- g) isotope-chemistry/geochemistry-geochronology
- h) estuarine mathematical modelling
- i) statistics
- j) laboratory practice; viz., clean laboratories, intercalibration
- k) computer science
- l) oceanographic sensor technology

#### c) Field Stations

In establishing field stations it was felt by the Group that the following guidelines should be considered:

1. The location of the station should be close to the estuarine zone. Such a location is particularly advisable in view of the short-term variability of estuarine processes.
2. Facilities should be of modular construction so as to give flexibility in operations and adaptability to different areas of study.
3. Basic facilities should include: i) clean laboratories - chemical/biological  
ii) living accommodations for 6-12 persons iii) general services including communication equipment.
4. Local docking facilities should be established by the host country.

The use of such facilities is not intended to exclude the more conventional use of oceanography vessels in these studies. Field stations supplement the vessels for extended study over longer periods of time. Furthermore the field stations will provide the focal points where local scientists can avail themselves of needed facilities for RIOS studies as required. Moreover, their existence will allow visiting scientists from other countries to participate in these local projects and lend their expertise to host personnel.

The group identified the following possible locations for the demonstration projects:

1. Amazon
2. A major Chinese river, e. g. Huang-Ho
3. Congo
4. Ganges

#### d) Workshop

Research within the RIOS concept is at a particularly critical stage of development. Substantial research programmes are few and relatively new, but there is a considerable development of work in this field within institutions that span a wide range of interests, and among workers



with very diverse backgrounds and approaches. There is need for a high-level forum in which scientists of various disciplines and from many countries, working in areas relevant to RIOS, can be brought together to exchange ideas and data, and provide an informed basis for the development of new research programmes. The Working Group proposes that workshops should be held at approximately two-yearly intervals to meet this need and to ensure a continuing exchange and review, with the first workshop ideally to be held in the United Kingdom in September 1976. This RIOS workshop should be restricted to four days of meeting, with participation by invitation only and with a ceiling of 50 participants. Working papers would be circulated before the workshop to ensure maximum opportunity for productive discussion, and invited contributions would be published. The Working Group appointed a Steering Committee consisting of Burton, Eisma and Martin to undertake the detailed organization of the workshop.

Recommendations from members of WG 46 for contributions to the workshop should reach Burton by mid 1975. The following programme was agreed:

Late June	Steering Committee to meet in Europe and formulate a proposed programme and list of participants which will be circulated to the WG 46 for their concurrence.
Early September	Steering Committee to meet with members of WG 46 who will be at the IUGG Assembly in Grenoble, to finalize a preliminary programme, with first choice and reserve list of persons for identified roles. The participation of T.F. Gaskell at this time would be most desirable.
Mid September	Invitations to go out, with deadline of 31 October 1975 for acceptance.
Early November	Reserve invitations to go out as necessary, with deadline for acceptance in early December.
Mid December	Meeting of Steering Committee in Europe to finalize programme, which will be circulated to the WG 46.

The provisional timetable for the workshop is 6 September 1976: meeting of WG; 7-10 September: workshop; 11 September: meeting of WG.

(Submission of brief summaries of papers to be presented or to be considered at the workshop would be required by 30 April 1976.)

## 2. Outline of Proposal to be submitted to SCOR for implementing the RIOS Action Plan

It was recommended that the above RIOS Action Plan be implemented in three phases along the lines discussed below. A draft proposal will be submitted to SCOR for appropriate action.

### Phase I: Preliminary and Exploratory Phase

This phase, which should be completed between July 1975 and September 1976, will consist of two actions:

- A. Identification of ongoing research in RIOS matters
- B. Planning of workshop to be held in September 1976.

"A" will include preparation of descriptive documents on what work is currently being carried out in river-estuary-ocean processes. This would be the key to RIOS programme development as it would define the state of knowledge in this field. During the development of phase I, consideration will be given to the identification of important aspects of estuarine studies in which training programmes for scientists from developing countries will be necessary during phase III. However, should an urgent need develop for a modest pilot training programme before phase III, a separate submission will be prepared for presentation to SCOR. Under item "B" will be included meetings of the workshop Steering Committee review of documents prior to the September 1976 workshop, arrangements regarding the workshop and publication of the deliberations of the workshop.

It is estimated that the financial assistance needed for phase I will be \$10 000, including printing, for A; and \$5 000 for B.

### Phase II: Workshop: United Kingdom September 1976

The phase II will be the workshop itself and subsequent publication of the proceedings.



Attendance at this meeting will be exclusively by invitation. The number of participants in the workshop will be forty-five to fifty, including the RIOS Working Group members and accredited observers. The duration of the workshop will be 4 days; SCOR WG 46 will meet on two days, one day before and one day after the workshop.

It is planned to publish the proceedings of the workshop.

Expenses towards transportation and per diem for 45 to 50 scientists will amount to about \$50 000. A sum of \$30 000 may be required for the publication of the workshop proceedings.

#### Phase III: Demonstration Projects

Phase III, which will immediately follow the September 1976 workshop, would be planned for a duration of 5 years and will consist of the following:

- A. Establishment of field stations
  - 1. Survey of potential sites
  - 2. Building of three facilities
- B. Training programme
- C. Visiting scientists programme
- D. Workshops

The establishment and maintenance of three field stations is estimated to cost about \$300 000 per year. The training programme is designed for training six scientists annually and will cost about \$75 000 per year. The visits of scientists from developed countries to the field stations will cost about \$25 000 per year. The total expenditure amounts to \$2 000 000 for five years.

Two workshops will be convened during phase III; this will need a total sum of about \$200 000.

The three phases involve financial support of about 2.3 million dollars over six years in addition to the costs of meetings of WG 46.

Phase I	\$15 000	July 1975 to September 1976
Phase II	\$80 000	September 1976 to mid 1977
Phase III	\$2 200 000	October 1976 to October 1981
Total	<u>\$2 295 000</u>	

It was strongly recommended that the above RIOS Action Plan be implemented and that support to the extent of 2.3 million dollars be requested from UNEP/UNDP and other organizations, through SCOR. The first such request to be in respect of phases I and II only.

### III. OTHER RECOMMENDATIONS AND SUGGESTIONS ON ITEMS PERTAINING TO RIOS MATTERS

The WG noted the report of the Group of Experts on the World Register of Rivers Discharging into the Ocean, presented by E.L. Hendricks, and that of IAHS on sedimentation, presented by F. Fournier. The global data presented and envisaged in these reports constitutes an important source of information for RIOS, and it is important that the existence of any other data of this kind be known to the Group. The Group urges the establishment of the proposed world wide river sampling network and commends such an action. The importance of knowledge of individual chemical components transported by suspended matter in addition to that in dissolved form was stressed. Proposals made by WG 46 for training and the establishment of field stations could help to extend measurement capabilities on a global scale. The Group was informed of the creation by SCOR of two ad hoc advisory panels:

- 1) Biogeochemistry of Estuarine Sediments
- 2) Coastal Lagoons

In noting these recent developments the members were particularly interested in the terms of reference for these ad hoc panels. For matters relating to the biogeochemistry of estuarine sediments the Group recognized an overlap in the nature of the needed scientific information with that already recognized as essential to the broader concepts embraced by the RIOS programme. RIOS cannot disregard biogeochemical processes governing or affecting transfer across the river-ocean interface. On the other hand, the Group does not consider it within its purview to examine



closely the detrimental effects to life in the coastal zone due to man's intervention. The Group hopes that the major effort of the ad hoc panel on Biogeochemistry of Estuarine Sediments would supplement the more process-oriented approach of RIOS with one aimed primarily at detrimental man-induced, perturbation of the coastal eco-system.

The WG had been asked to comment on a proposal for an IBP Handbook on Estuarine Chemical Methods. While generally sympathetic to the idea of such a handbook, the Group felt that considerable caution was necessary in specifying recommended procedures for such variable environments, and that at this stage critical reviews of various areas would be more valuable than the specification of detailed methods. The need for more evaluation and intercomparison was recognized. The workshop proposed by the Group should provide an improved basis for assessing this question.

SCOR was requested to seek active participation of scientists from the USSR and the People's Republic of China in future deliberations of WG 46, bearing in mind the importance of river-ocean systems in these countries.

The meeting adjourned on the evening of 26 March with a warm vote of thanks to K. K. Turekian for the excellent arrangements made for the meeting and to Mr R. C. Griffiths and Mr G.E. Hemmen for their valuable help and guidance.



SCOR WORKING GROUP 49  
MATHEMATICAL MODELLING OF OCEANIC PROCESSES

Report of Meeting, Grenoble, France, 30 September 1975

Present: Professor K. Hasselmann, Dr A. Gill, Dr K. Bryan.  
Apologies for absence: Professor K. Yoshida, Professor C. Garrett,  
Professor A. Sarkisyan, Dr S. Godfrey

An open meeting was held attended by members of WG 49 and more than 20 other members of IAPSO interested in modelling. Matters under discussion were:

1. An initiative by WG 49 to publish an informal newsletter to exchange information on ocean models. The newsletter would contain extended abstracts of work in progress. It would provide information on modelling algorithms which investigators are willing to share with others. There would be a special bias toward modelling the dynamics of the equatorial region. The goal of this newsletter is to speed up the flow of ideas between mathematical modellers in physical oceanography in different countries, and avoid redundant development work on numerical models.

Adrian Gill has agreed to lead this undertaking if funding can be found to cover the necessary office expenses.

2. SCOR WG 47, responsible for planning an oceanographic experiment for FGGE (First GARP Global Experiment) has requested WG 49 to send some members familiar with equatorial dynamics to a planning meeting in Honolulu to be held in November or December of 1975. It is agreed that at least one member of WG 49 (Gill, Godfrey, Yoshida) should attend.

3. Brian Mathews outlined the plans to form an IAPSO group on the problems of coastal and estuarine modelling. This was followed by a general discussion of the possible overlap with WG 49, and to what degree it was possible to coordinate or combine the two groups. Although there were advantages in a combined group, it was felt that the large amount of activity in coastal modelling was sufficiently great to more than justify a separate group, permitting WG 49 to concentrate on large-scale modelling of the open ocean. (At its plenary session, IAPSO, set up a new group with Brian Mathews as chairman.)

4. It was agreed that WG 49 can play a useful role in encouraging the intercomparison of different ocean models. One dimensional models of the ocean's mixed layer require only a small amount of computation, but are essential elements for larger scale air-sea interaction models.



COMMISSION FOR MARINE GEOLOGY (CMG) OF IUGS  
Report of Activities for 1975 by Dr E.S.W. Simpson, Secretary

1. Membership

Current members of the IUGS Commission for Marine Geology are as follows:  
Dr T.F. Gaskell (Chairman) (UK); Dr E.S.W. Simpson (Secretary) (South Africa); Professor P.L. Bezrukov (USSR); Dr J.M. Harrison (France); Professor B.C. Heezen (USA); Dr A.S. Laughton (UK); Dr A.E. Maxwell (USA); Dr N. Nasu (Japan); Professor E. Seibold (FRG); Dr G.B. Udintsev (USSR); Dr S. Uyeda (Japan).

In order to fill the vacancy caused by the resignation in 1972 of Dr X. le Pichon, it was agreed to nominate Dr L. Montadert (France) as a member of the Commission for Marine Geology.

2. Meetings

The Seventh meeting of the Commission was held on 27 August 1975, during the XVI General Assembly of IUGG in Grenoble, France.

3. CMG Representation (other than on SCOR)

ECOR: T. F. Gaskell

IAPSO Executive: E.S.W. Simpson, S. Uyeda

IAPSO Commission on Marine Geophysics: B.C. Heezen, S. Uyeda, L. Montadert

IOC Indian Ocean Geological/Geophysical Atlas Editorial Board: G.B. Udintsev, A.S. Laughton, E. Seibold, E.S.W. Simpson

CGMW: B.C. Heezen

ICG: S. Uyeda

IHO: T.F. Gaskell, E.S.W. Simpson

GEBCO Guiding Committee (IOC/IHO): E.S.W. Simpson (Chairman)

IGCP: E. Seibold

ICA Working Group on Oceanic Cartography: E.S.W. Simpson

4. Relationship with other Bodies

(a) SCOR

(i) Meetings

Both the Chairman and the Secretary of CMG attended the 19th SCOR Executive meeting held in Stellenbosch, South Africa, 12-15 November 1975.

(ii) Working Groups

WG 40 on Palaeo-Oceanography (Tj. H. van Andel) continued in active operation.

Having organized a workshop on mathematical and statistical models in Palaeo-Oceanography in Madison, USA, April 1974, under the Chairmanship of Dr G. Imbrie, the Working Group is now preparing for a Special Symposium (S1) during the Joint Oceanographic Assembly, Edinburgh 1976.

WG 46 on River Inputs to Ocean Systems (D. Lal) has had two successful meetings and is planning a scientific workshop to assess the present state of knowledge.

(b) Joint Oceanography Assembly (Edinburgh, 13-24 September 1976)

CMG is represented on both the National Organizing Committee and the International Steering Committee by its President, Dr T.F. Gaskell.

Two General Symposia, four Special Symposia and four 'C' sessions will be of direct interest to marine geoscientists, one of the 'C' sessions will be open for contributions in marine geology through the medium of Poster Sessions.

(c) XXV International Geological Congress (Sydney, 16-25 August 1976)

The scientific involvement of CMG remains as follows in terms of symposia for which arrangements are well advanced (Convenors in brackets):



- (i) Economic Geology of the Sea Floor, except fuels (E. Seibold).
  - (ii) Active Plate Boundaries of the Western Pacific (S. Uyeda and L. Hawkins).
  - (iii) Circum-Antarctic Marine Geology (D.E. Hayes and L. Frakes).
  - (iv) Synthesis of Deep Sea Drilling results in the Indian Ocean (C.C. von der Borsch).
- (d) XVI General Assembly of IUGG (Grenoble, 25 August - 6 September 1975)  
 CMG actively co-sponsored the following inter-disciplinary symposia:
- (i) Subduction Zones, Mid-Ocean Ridges, Oceanic Trenches and Geodynamics (S. Uyeda and T. Atwater). (CMG, IASPEI, IAVCEI, IAGA and ICG).
  - (ii) Deep-Sea Drilling: The History of the Oceans (D.E. Hayes for N. Terence Edgar). (CMG, IAPSO, IAVCEI and ICG).
  - (iii) Present Status of Plate Tectonics (J. Bonnin and R.S. Dietz).
  - (iv) The Influence of Abyssal Circulation on Sedimentary Accumulations in Time and Place (B.C. Heezen). (CMG and IAPSO).
- The Seventh meeting of the Commission for Marine Geology was held in Grenoble on 27 August 1975.
- (e) IOC
- (i) Proposed Second International Marine Geoscience Workshop  
 Following upon the successful outcome of the first International Marine Geoscience Workshop (Honolulu, September 1971), provisional arrangements are in hand for a second such workshop in Mauritius, 9-12 August 1976 i.e. during the week immediately before the XXVth International Geological Congress in Sydney, Australia. These arrangements are subject to confirmation.
  - (ii) International Indian Ocean Geological/Geophysical Atlas  
 It was announced in September 1975 by the Inter-Governmental Oceanographic Commission (UNESCO, 7 Place de Fontenoy, 75700 Paris) that the Geological/Geophysical Atlas of the Indian Ocean had been published in Moscow and is available through Soviet Sales Agents throughout the world at a price of 25 Roubles, approximately US \$30. The Atlas comprises 168 pages of charts and is divided into chapters treating the following subject areas:
    - a. Status of knowledge
    - b. Bottom topography
    - c. Photographs of the bottom
    - d. Magnetic anomalies
    - e. Gravity
    - f. Heat flow
    - g. Seismicity and active volcanoes - deep structure of the ocean floor
    - h. Sedimentary cover and exposures of igneous rocks
    - i. Bottom sediments and suspended matter
  - (iii) IOC/IHO Guiding Committee for GEBCO  
 Good progress has been made with the 5th Edition of the General Bathymetric Chart of the Oceans. The first sheet (5.05) of the 17-sheet series was compiled, scribed, printed and published during the first year of existence of the new GEBCO Guiding Committee, by the members of which it was subjected to close critical scrutiny at a meeting held in Monaco 28-30 April 1975.
- (f) UNESCO/CMG Marine Geological/Geophysical Inventories  
 The format devised by CMG for reporting post-1970 cruises has been internationally adopted by IOC/IODE and by some countries and institutions.
- (g) ICG  
 Under the auspices of the Brazilian Academy of Sciences and the Brazilian National Committee for the Geodynamics Project, a highly successful symposium was held in Sao Paulo, 13-17 October 1975, under the Chairmanship of Professor F.F.M. de Almeida. The convenors were M. Bott, H. Martin and E.S.W. Simpson. The theme of the Symposium was 'Continental Margins of Atlantic Type'.
- (h) CMG/ICG/CIESM Symposium on the Structural History of the Mediterranean Basins  
 (Convenor L. Montadert) Split, Yugoslavia, October 1976.



INTERNATIONAL ASSOCIATION OF PHYSICAL SCIENCES  
OF THE OCEAN OF IUGG

## 16th GENERAL IAPSO ASSEMBLY

Report by E. C. LaFond (Secretary, IAPSO)

The IAPSO General Assembly was held concurrently with other Associations of IUGG in Grenoble, France, from 25 August to 6 September 1975. Both scientific and business meetings were arranged. Approximately 500 marine scientists attended.

National reports from Argentina, Canada, Cuba, France, DGR, India, Italy, USSR, and Yugoslavia, presenting their oceanographic activities over the past four years, were distributed to the delegates.

## IAPSO SCIENTIFIC PROGRAMME

IAPSO sponsored eight scientific symposia (21 sessions); 11 joint symposia in which IAPSO was the principal sponsor (19 sessions); and seven joint symposia in which another Association was the principal sponsor (26 sessions). (See SCOR Proceedings, Vol. 10, No. 2).

Of special interest was a Poster Session on Ocean Microstructure, arranged by Professor J.S. Turner. In this session, 35 authors each displayed graphs, equations, photographs and explanatory material on a meter square board, and stood by for an hour or so to explain and discuss his/her paper. The advantages of the Poster Session were: (1) the participants were not a captive audience, (2) the participants spent as much or as little time on each paper as he/she wished, (3) participants felt freer than in a large audience to ask questions, (4) communication in languages other than French and English, was possible, (5) more papers were accommodated in a given time than is possible in a formal presentation, and (6) absence of one or two of the authors did not cause a disruption in the schedule. The Poster Session, a first for IAPSO/IUGG, proved a success; and this method of presenting papers is expected to be used more extensively in the future.

## IAPSO BUSINESS MEETING

IAPSO held Plenary Sessions as well as meetings of Committees and Working Groups.

The elected members of the IAPSO Executive Committee, to serve for the next four years are: Professor R.W. Stewart (President); Professor J.S. Turner and Professor G. Siedler (Vice-Presidents); Dr E.C. LaFond (Secretary); Dr J.M. Gieskes (Deputy Secretary); Adm. M. da Silva, Dr E.S.W. Simpson, Professor B.L.K. Somayajulu and Dr S. Uyeda (Members).

In addition to the existing Commissions, Committees, Working Groups and Services (see Procès-Verbaux No. 13), IAPSO created one Committee and two Working Groups:

- (1) Advisory Committee on Physical and Chemical Aspects of the Dispersion of Natural and Artificial Substances, and Heat in the Oceans and Seas.
- (2) Working Group on Coastal and Estuarine Regimes.
- (3) Sub Working Group on Coastal and Estuarine Modelling.

Ten resolutions were adopted; those most pertinent to SCOR are:

Resolution No. 4

IAPSO recommends that all satellite altimeter data be made available to all interested researchers in oceanography. Furthermore, when it has been demonstrated that these data are sufficiently accurate for tidal studies, SCOR should be asked to form a Working Group to encourage and coordinate such studies.

Resolution No. 7

IAPSO, KNOWING that the interest in coastal and estuarine topics within its membership is growing, and

NOTING the active response to the Coastal and Estuarine Symposia at the XVI IUGG General Assembly in Grenoble 1975, and



COGNIZANT of the request by workers on numerical models of coastal and estuarine regions for a Working Group to coordinate their intercomparison tests and to hold special symposia, and

NOTING the need for a body to coordinate special interdisciplinary symposia and help in the cooperation in international experiments on coastal and estuarine topics,

RESOLVES to create a Working Group on Coastal and Estuarine Regimes and to investigate with SCOR the possibility of the Working Group on Coastal and Estuarine Regimes being afforded Joint Sponsorship in order to facilitate its cooperation with bodies outside the IUGG structure.

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The Minutes of the IAPSO Plenary Sessions and the Proceedings, including abstracts, will be distributed to all IAPSO correspondents, committee members and associated organizations.

The next IAPSO General Assembly is scheduled to be held in Canberra, Australia, in 1979.



JOINT OCEANOGRAPHIC ASSEMBLY  
STEERING COMMITTEE

Report of meeting on 14 November 1975

The Steering Committee met in Stellenbosch under the chairmanship of Professor W.S. Wooster (SCOR/ACMRR); other members of the Steering Committee or their representatives present were: Professor H. Postma (SCOR), Professor G. Siedler (IAPSO), Professor G. Hempel (IABO), Professor H. Hinzpeter (IAMAP), Drs T. Gaskell and E. Simpson (CMG), Ir G.A. Heyning, Jr (ECOR), and Messrs. R.I. Currie and G.E. Hemmen (Royal Society). Other participants included Sir George Deacon, Chairman of the British Organizing Committee, Dr G. Humphrey, Chairman of IOC, and representatives of the National Committees of South Africa and Sweden.

Logistics:

It had been agreed at an earlier meeting (15 May 1973) that at least \$60 000 would be required to ensure participation of convenors and invited speakers who could not obtain national funding; the sponsoring agencies had agreed to foresee adequate amounts in their 1976 budgets. In the ensuing period, travel and subsistence costs have risen significantly. At a recent meeting of the Logistics Committee, however, only UNESCO confirmed the availability of its prorated share, the other sponsoring agencies being able to provide only a few thousand dollars at most. It is also apparent that little provision has been made for support of participants from developing countries.

Thus with less than a year remaining before the Assembly, less than a third of the amount required for bringing convenors and invited speakers has been committed. Discussion of this situation led to the following proposed actions: (1) sponsoring agencies should again be reminded of their earlier agreement to support the Assembly and again requested to review their possibilities for providing support; (2) participating Associations (IAPSO, IABO and CMG) should seek support from their parent Unions; (3) the IOC Secretary should be requested to seek UNEP support; (4) the Steering Committee Chairman should explore other sources of funds. Even if these actions are successful, it is clear that the majority of participants will require national funds for their support.

Programme:

Details of the programme were reviewed and suggestions were made for its strengthening. It was agreed to use Poster Sessions as a means to broaden participation in the Assembly. These sessions would be organized by the participating Associations; the Steering Committee Chairman would draft guidelines for review and distribution by Messrs Currie and Hemmen.

Publication:

The British Organizing Committee has arranged for publication of invited papers of the General Symposia by Plenum; Sir George Deacon and Professor H. Charnock will serve as editors. Instructions to authors will be issued by the British Organizing Committee. Plenum is also corresponding with convenors of Special Symposia concerning the possibilities of publication. ICES has agreed to publish invited papers of symposia S5 (Biological effects of ocean variability), S7 (Oceanography and fisheries), and S11 (Controlled ecosystem experiments). The Steering Committee Chairman was requested to complete arrangements with FAO for the publication of abstracts for General and Special Symposia and to distribute instructions to invited speakers in the near future. Preprinting of abstracts of contributed papers (including Poster Sessions) was also desirable and should be arranged if possible.



# ICSU STATEMENT ON THE CHARACTERISTICS OF MARINE SCIENTIFIC RESEARCH

Presented at the Third Session of the United Nations Conference  
on the Law of the Sea, Geneva, 1975

Decisions of the United Nations Conference on the Law of the Sea may either strengthen marine scientific research or may seriously cripple it. Thus it is important that those engaged in the negotiations understand the nature of such research and how it could be affected by excessive regulation.

Earth is a water planet, the land masses of which occupy less than a third of its surface. Life arose in the sea, and marine life has the potential of feeding millions of hungry people. Abuse of the ocean's capacity for wastes can blight these opportunities and, together with inept coastal development, can destroy the amenities of the seashore. The ocean is a communications and shipping link that binds nations together. The storage and transport of heat in the ocean dominates weather and climate, with important consequences for agriculture, forestry and most other land activities of man. Petroleum resources of the continental margins, and mineral resources there and farther offshore, can augment the dwindling supplies ashore.

Living effectively on this water planet and making the most of its benefits requires information and understanding that can only be obtained through marine scientific research. Such oceanic research, often called oceanography or oceanology, has been defined as the scientific investigation of the ocean, its contents and the contents of its subsoil, and its interfaces with the land, atmosphere and the ocean floor.

During the past century, a few scientists with limited financial support have achieved a preliminary description of the nature of the physical, chemical, biological and geological processes in the ocean. Some of their results have been of direct and immediate application to the rational use of the ocean and its resources. In other cases there have as yet been no obvious applications, although any scientific knowledge is likely to contribute eventually to rational ocean use. Scientists are now attempting to go beyond this first description, to seek a more fundamental understanding of oceanic phenomena.

Whether motivated by the solution of practical problems or by scientific curiosity, most oceanic research is conducted by scientists of university or government laboratories, and research plans and results are public knowledge. Such "open" research can be distinguished from the much smaller amount of research whose results are held privately by commercial and government laboratories.

The results of open oceanic research are freely exchanged internationally through the World Data Centre System of the International Council of Scientific Unions and the Intergovernmental Oceanographic Commission. In addition, data exchange arrangements are common among scientists and institutions throughout the world. When delays in data exchange occur, they can usually be attributed to the time required for scientists to process and to evaluate results to ensure their usability by other scientists.

Most oceanic research is conducted in coastal waters within a few hundred miles of the marine laboratory concerned. Some of this work leads to fundamental understanding of oceanic phenomena and processes that can be applied elsewhere in the ocean, while other results only have relevance to the local region. But essentially all oceanic research, wherever carried out, depends on the body of general knowledge, and the methods and techniques contained therein, that has been, and is being, developed in a handful of major marine laboratories. These are in most cases the laboratories that have the facilities and resources to deploy their research vessels globally and to work habitually in distant waters.

The reasons for some laboratories to conduct investigations on a global, rather than on a local, basis include the need to look at oceanic systems in their entirety (for example, geological interactions between the deep ocean basin, the continental margin, and the adjacent land), the need to establish global knowledge and phenomena (for example, the background of natural variations and the effects of man's interventions), and the need to study certain processes where they are most highly developed (for example, coastal upwelling and oceanic fronts), and the value of comparative studies (to determine the relative importance of controlling factors). In each



case, the results of such research provide the basis for designing more local and applied investigations and for interpreting their results.

In carrying out their activities in coastal waters or farther offshore, research vessels present no special threat to other uses of the sea or to the marine environment. In fact, their impact is likely to be far less than that of other sea-going vessels, and particularly those engaged in fishing, ocean dumping or the exploitation and transport of petroleum and minerals.

A number of international organizations have been established for the purpose of promoting oceanic research. Those of non-governmental character are used for the discussion of scientific problems and for the exchange of information and ideas, while the inter-governmental organizations are designed to facilitate joint action by governments. Co-operative investigations of oceanic problems have been organized by both types of organizations as well as through informal arrangements among the scientists and laboratories concerned. Such investigations have proved particularly effective when designed and co-ordinated by the scientists directly involved in the research.

Many scientific problems, however, are best investigated outside the formal framework of international co-operative investigations. Scientists often work most effectively when, within the framework of sufficiently broad objectives, they are free to define particular areas of inquiry, to determine their own methods of approach and to establish their own ways to gather and analyse relevant information. Even these more individual investigations are basically international in that data are made available, results are published in widely available journals, and information and ideas are freely exchanged throughout the international scientific community.

The goal of the Law of the Sea Conference should be to promote the effective conduct of marine scientific research both nationally and internationally, while protecting both the valid coastal state interests in gaining marine scientific information about ocean regions under their jurisdiction and the equally valid interests of the international community in gaining such information about the world ocean. If the scientific understanding required for rational management of the ocean and its resources is to be achieved in reasonable time, there is required a vastly expanded competence among nations in the scientific study of the marine environment. This expansion can be assisted by advanced oceanographic laboratories which must also be encouraged to apply their innovative ideas and advanced techniques wherever important oceanic problems are identified. A convention that actively encourages such expansion is necessary to facilitate the solution of a number of problems of great scientific and practical importance and to prevent a general decline in the scientific content and value of oceanic investigations and disruption of free exchange of information such as would result from rigorous regulation of scientific research.



Introduction of the ICSU statement by the President of SCOR\*

Thank you very much, Mr Chairman, for giving me an opportunity to speak to this Assembly. The International Council of Scientific Unions is the leading international scientific organization in the world. The connection with national scientific bodies in the various countries generally passes through national academies of science or comparable institutions which advise their countries on scientific affairs. This structure guarantees that scientific opinions and ideas on a national level come to the attention of the international scientific community, and vice versa. Some 75 countries are involved which are from all parts of the world, including land-locked parts, and in all stages of scientific development.

ICSU has several special commissions and of these the Scientific Committee on Oceanic Research of which I have the honour to be the President is charged with marine affairs. At the same time SCOR is an advisory body to the Intergovernmental Oceanographic Commission of UNESCO.

The statement which has been put before you is the result of extensive discussion within ICSU and SCOR and its national commissions and I was empowered by ICSU to introduce this statement here.

I would like to draw your attention here to a few of the more important points.

All scientific research is international and can only thrive in an atmosphere of free exchange of thoughts and ideas. Marine scientific research is more dependent on such a free exchange than any other field of science since its object of study, the ocean, covers more than two thirds of our planet and acts as one indivisible system. What happens in one single part of this system can influence all other parts and usually does so. Ocean currents follow their paths guided by physical forces and do not stop at artificial barriers invented by men. In a geological time-scale this even holds for the movements of the ocean floor. Variations in the rainfall in India or North Africa, of the winters in northern Europe and in the yield of the fisheries along the coast of Peru depend on oceanic processes which cover vast ocean areas. Such variations can only be predicted if much more information is collected over these areas.

A very large effort is made in our time to improve our knowledge of the oceans, not only in temperate regions but also in tropical areas. It is quite obvious that marine research of this kind can only be carried out efficiently by a free movement of marine scientists and ships over the globe. Such research would lose most of its efficiency and become much more expensive if countries would be allowed to carry out research only in the geographical region which they have claimed and if they would keep others outside this region. In fact, many of the most fertile scientific results and ideas which we inherited from our predecessors would never have been attained if such a system of mutual isolation would have existed in the past.

There is a wide-spread feeling among oceanographers that the consequences of impairing marine scientific research would be disastrous. Many of the best scientists might become frustrated and switch over to other fields of research in no sense related to the ocean. As one distinguished oceanographer stated, oceanography would be left without foresight and theory and would be thrown back to the stage of an empirical witchcraft. Without the adequate input from fundamental science, industrial and applied research would within relatively short time become a blind tool for collecting endless and senseless data.

However, the principal victims of legal and geographical restriction would be the developing nations. Many of them are on the threshold of bringing their own independent contributions to the field of marine science. Isolation in any way would most seriously hamper their scientific development. This is especially deplorable in view of the fact that many intergovernmental organizations such as UNESCO and FAO and also the Scientific Committee on Oceanic Research (SCOR) are making a very large and rapidly increasing effort in the field of training and mutual assistance to help developing countries in increasing their own scientific potential. These achievements may easily be annihilated.

The fear that marine science as such would be used only for the benefit of a few privileged countries is, in our opinion, unfounded. All science can be used in a positive and a negative manner and this use is outside the competence of the scientists themselves. However, this fear

\* Delivered before the third committee of the Law of the Sea Conference, 25 April 1975.



is a reality and the basis of this fear is ultimately the fact that many developing countries do not yet have enough scientists to be fully involved in marine scientific affairs. Obviously there is the danger that we get into a vicious circle. If this conference would let itself be guided by such a fear and place unnecessary restrictions on marine research this would not only severely hamper this research but also strongly retard the development of independent scientific potential in many countries. In this way the fear would endlessly remain.

It is for this reason that on behalf of the whole marine scientific community I urgently ask this conference to erect no barriers against international marine research. I am glad to see that the conference also gives its attention and energy to the formulation of articles which promote creative marine science. There are ample opportunities to do so.



## FUTURE MEETINGS OF SCOR

1976		
<u>Date</u>	<u>Place</u>	<u>Meeting</u>
January	Phuket, Thailand	ad hoc Advisory Panel on Mangroves
First half 1976		WG 34 Eastern North Atlantic panel meeting
First half 1976		Committee on Oceanography and GARP
April		WG 48 Ocean Climate Panel
April/May	Tallin	WG 42 meeting
Mid 1976		WG 38 possible meeting - not yet confirmed
June	Europe	Workshop on Biogeochemistry of Estuarine Sediments
?		WG 43 Workshop
?		WG 47 Indian Ocean Panel
?		Atlantic Ocean Panel
9 - 13 August *	Mauritius	Marine Geoscience Workshop
17 - 21 August	Woods Hole, USA	WG 54 Experts meeting
23 - 24 August	Woods Hole, USA	WG 54 meeting
7 - 10 September	UK	WG 46 Workshop on River Inputs to Ocean Systems
September		WG 36 Informal discussions at JOA
September		WG 40 Symposium at JOA
September		WG 50 Symposium at JOA
13 - 24 September	Edinburgh	{ Joint Oceanographic Assembly XIII meeting of SCOR
		WG 51 ) New Groups - meetings will be 52 ) arranged as required after 53 ) formation of the Groups 55 )
1977		
Early 1977		Symposium on Eddy Dynamics and parameterization (WG 34/49)
May		WG 10 meeting
Mid 1977	Durban	Symposium on Western Boundary Currents of the Indian Ocean
		Final GATE Oceanography Symposium
1978		
		Upwelling Ecosystem Symposium

\* dates not yet confirmed by the government of Mauritius



## ABBREVIATIONS

ACMRR	Advisory Committee on Marine Resources Research (of FAO)
ACOMR	Advisory Committee on Oceanic Meteorological Research (of WMO)
AMTEX	Air Mass Transformation Experiment (GARP)
ASFIS	Aquatic Science and Fisheries Information System (FAO/IOC)
CCOP/EA	Committee for Coordination of Joint Prospecting for Mineral Resources in offshore areas/East Asia
CCOP/SOPAC	Committee for Coordination of Joint Prospecting for Mineral Resources in offshore areas/South Pacific
CGMW	Commission for the Geological Map of the World (of IUGG)
CICAR	Cooperative Investigation of the Caribbean and Adjacent Regions
CIESM [ICSEM]	Commission International Exploration Scientifique Mediterranee
CIM	Cooperative Investigation of the Mediterranean
CINECA	Cooperative Investigation of the Northern Part of the Eastern Central Atlantic
CLIMAP	Climatic Mapping Programme (IDOE)
CMG	Commission on Marine Geology (of IUGS)
CTD	Conductivity Temperature Depth
CUEA	Coastal Upwelling Ecosystems Analysis
ECAFE	Economic Commission for Asia and the Far East (of UN Economic and Social Council)
ECOR	Engineering Committee on Oceanic Resources
ERFEN	Estudio Regional del Fenómena 'El Niño'
FAO	Food and Agriculture Organization of the UN
FGGE	First GARP Global Experiment
GAO	GARP Activities Office (at WMO)
GARP	Global Atmospheric Research Programme (of WMO/ICSU)
GATE	GARP Atlantic Tropical Experiment
GEBCO	General Bathymetric Chart of the Ocean
GESAMP	Group of Experts on Scientific Aspects of Marine Pollution
GFCM	General Fisheries Council for the Mediterranean
GIPME	Global Investigation of Pollution in the Marine Environment
IABO	International Association for Biological Oceanography (of IUBS)
IAEA	International Atomic Energy Agency
IAG	International Association of Geodesy (of IUGG)
IAGA	International Association of Geomagnetism and Aeronomy (of IUGG)
IAHS	International Association of Hydrological Sciences (of IUGG)
IAMAP	International Association of Meteorology and Atmospheric Physics (of IUGG)
IAPSO	International Association for the Physical Sciences of the Ocean (of IUGG)
IASPEI	International Association of Seismology and Physics of the Earth's Interior (of IUGG)
IAVCEI	International Association of Volcanology and Chemistry of the Earth's Interior (of IUGG)
IAWPR	International Association on Water Pollution Research
ICA	International Cartographic Association (of IGU)
ICES	International Council for the Exploration of the Sea
ICG	Inter-Union Commission on Geodynamics (of IUGG/IUGS) and also used with reference to International Coordination Groups of IOC
ICITA	International Cooperative Investigation of the Tropical Atlantic
ICSPRO	Inter-Secretarial Committee on Scientific Programmes related to Oceanography
ICSU	International Council of Scientific Unions
IDOE	International Decade of Ocean Exploration
IGCP	International Geological Correlation Programme (UNESCO/IUGS)
IGOSS	Integrated Global Ocean Station System (of IOC)
IHD	International Hydrological Decade
IHO	International Hydrographic Organization
IIOE	International Indian Ocean Expedition
IMCO	Intergovernmental Maritime Consultative Organization
INDEX	Indian Ocean Experiment



IOC	Intergovernmental Oceanographic Commission
IODE	International Oceanographic Data Exchange (Working Group of IOC)
ISMG	International Scientific and Management Group for GATE
ISOS	International Southern Ocean Studies
ISSC	International Ship Structures Congress
ITSU	International Tsunami Warning Service
IUBS	International Union of Biological Sciences (of ICSU)
IUGG	International Union of Geodesy and Geophysics (of ICSU)
IUGS	International Union of Geological Sciences (of ICSU)
IUTAM	International Union of Theoretical and Applied Mechanics
JASIN	Joint Air-Sea Interaction Project
JOA	Joint Oceanographic Assembly (1976)
JOC	Joint Organizing Committee for GARP
JONSDAP	Joint North Sea Data Acquisition Programme
JPS	Joint Planning Staff for GARP
LEPOR	Long-Term and Expanded Programme of Oceanic Research
MODE	Mid-Ocean Dynamics Experiment
MONEX	Monsoon Experiment (subprogramme of GARP)
NASA	National Aeronautics and Space Administration (USA)
NOAA	National Oceanographic and Atmospheric Administration (of USA)
NORPAX	North Pacific Experiment
OECD	Organization for Economic Cooperation and Development
OSDC	Oceanographic Subprogramme Data Centre
POLEX	Polar Experiment (related to GARP)
POOL	Pollution of Oceans Originating on Land
RIOS	River Inputs to Ocean Systems
ROMBI	Results of Marine Biological Investigations (report form)
ROSCOP	Report of Observations or Samples Collected by Oceanographic Programmes
SCAR	Scientific Committee on Antarctic Research (of ICSU)
SCOPE	Scientific Committee on Problems of the Environment (of ICSU)
SCOSTEP	Special Committee on Solar Terrestrial Physics (of ICSU)
TEB	GARP Tropical Experiment Board
TEMA	Training, Education and Mutual Assistance (IOC-WG)
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
WDC	World Data Centre
WMO	World Meteorological Organization