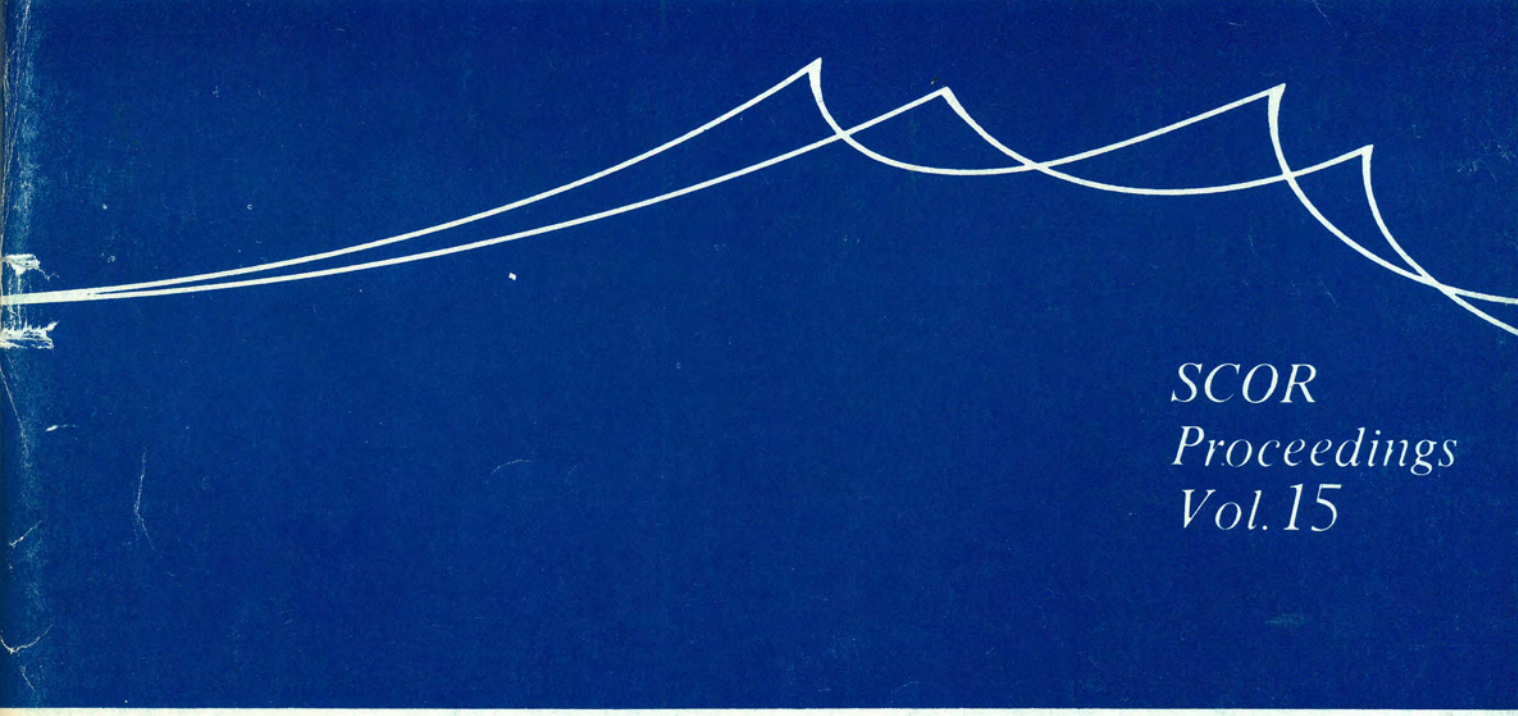


SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH



*SCOR
Proceedings
Vol. 15*

INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

Scientific Committee on Oceanic Research

THE EXECUTIVE COMMITTEE

President:	Dr K.N. Fedorov - President of SCOR Institute of Oceanology, Academy of Sciences of the USSR, 23 Krasikova Street, Moscow 117218, U.S.S.R.	Tel: Moscow (95) 125 6990 (Tuesday afternoons only) Telex: — Telegrams: OKEANOLOGIA MOSCOW
Past-President:	Professor H. Postma Netherlands Institute for Sea Research, Postbus 59, Texel, THE NETHERLANDS	Tel: Den Hoorn (2226) 541 Telex: — Telegrams: —
Vice-Presidents:	Professor G. Hempel Institute für Meereskunde, Universität Kiel Dusternbrooker Weg 20 23 Kiel, FRG	Tel: Kiel (431) 597 4521 Telex: 292619 Telegrams: MEERESKUNDE KIEL
	Professor E.D. Goldberg Scripps Institution of Oceanography University of California A-001, La Jolla California, 92093, USA	Tel: La Jolla (714) 452 2407 Telex: 9103371271 Telegrams: SIOCEAN LAJOLLA
	Professor P. Tchernia Laboratoire d'Océanographie Physique du Muséum 43/45 rue Cuvier 75231 Paris Cedex 05 FRANCE	Tel: Paris (331) 707 1900 707 8544 Ext. 202 Telex: — Telegrams: —
Secretary	Professor H. Charnock Department of Oceanography The University Southampton SO9 5NH UK	Tel: Southampton (703) 559122 Telex: 47661 Telegrams: —
Co-opted members	Mr R.I. Currie Dunstaffnage Marine Research Laboratory PO Box 3, Oban Argyll SCOTLAND, UK	Tel: Oban (631) 2244 Telex: — Telegrams: MARLABOBAN
	Professor W.S. Wooster Institute for Marine Studies HA35 University of Washington Seattle, Washington 98195 USA	Tel: Seattle (206) 543 7004 Telex: — Telegrams: UNWADO SEATTLE
Ex Officio: CMG	Professor E.S.W. Simpson Department of Oceanography University of Cape Town Rondebosch 7700 SOUTH AFRICA	Tel: Rondebosch 69 8531 Ext. 241 Telex: 57 0327 Telegrams: OCEANOGRAPHY DEPT. UNIVERSITY CAPETOWN
IABO	Professor T.R. Parsons Institute of Oceanography University of British Columbia 2075 Wesbrook Mall Vancouver, B.C. V6T 1W5 CANADA	Tel: Vancouver (604) 228 4273 Telex: — Telegrams: OCEANOGRAPHY UBC VANCOUVER
IAPSO	Dr R.W. Stewart Institute of Ocean Sciences PO Box 6000 9860 West Saanich Rd Sydney B.C. V8L 4B2 CANADA	Tel: Vancouver (604) 656 8215 Telex: 049 7281 Telegrams: —
IAMAP	Professor C. Junge Max Planck-Institut für Chemie (Otto-Hahn-Institut) Postfach 3060 D-6500 Mainz, FRG	Tel: Mainz (6131) 305218 Telex: 4 187 674 Telegrams: —
Executive Secretary:	Mr G.E. Hemmen 6 Carlton House Terrace London, SW1Y 5AG UK	Tel: London (1) 839 5561 Ext. 245 Telex: 917876 Telegrams: LONROYSOC LONDON

INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

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

**April 1979
London, England**

SCOR Proceedings Vol. 14 No. 2

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Report of The Fourteenth General Meeting of SCOR Brest, France – 13 to 18 November 1978

At the invitation of M. Y. La Prairie, Président Director Général of the Centre National pour l'Exploitation des Océans (CNEXO) and Professor H. Lacombe, Secretary of the Comité National Français de Recherches Océaniques, the Fourteenth General Meeting of SCOR was held at the Centre Océanologique de Bretagne (COB) of CNEXO in Brest, France, from 13 to 18 November 1978, with the President, Dr K.N. Fedorov, in the chair.

The participants, see Annex I, were welcomed by M. L. Laubier, Director of the COB.

The scientific component of the meeting was a 2-day symposium on Oceanic Fronts organized by Dr K.N. Fedorov; participants in this symposium heard a series of instructive papers and were impressed with the demonstration of the importance of Oceanic Fronts to the understanding of processes in marine physics, marine meteorology, marine biology and fisheries. SCOR was pleased to note that increased attention is being given to this subject by scientists of many countries. The papers presented are listed in Annex XXV and will be submitted for publication in *Advances in Oceanography*. A brief summary of the symposium is also given in Annex XXV.

At the opening of the meeting, on the invitation of the President, the participants stood in silence in memory of the late Dr E. Bruns, DDR, who had died on 30 October 1978.

1.0 Organization and finance

1.1 Membership

National Membership

In August 1978 the Secretariat had issued a circular letter inviting all National Committees to provide by 31 October up-to-date lists of their National Committee addresses and the names and addresses of their nominated members of SCOR. Many National Committees had not yet provided the required information and unless they did so promptly, the planned list of all addresses to be issued as a supplement to *SCOR Proceedings*, might contain incorrect details.

Professor T. Balkas, Chairman of the Marine Science Department of the Middle East Technical University, Ankara, Turkey, writing at the request of the President of the Turkish Science and Technical Research Council, had indicated his country's interest in becoming a member of SCOR so an earlier invitation has been re-issued. However, no firm acceptance had yet been received.

Affiliated organizations

CMG, IABO, IAMAP and IAPSO continue to be the four Affiliated Organizations of SCOR.

Represented organizations

The International Union of Theoretical and Applied Mechanics (IUTAM) had expressed interest in nominating a member of SCOR and had been provided with information about SCOR.

Corresponding organizations

ECOR

Ir. G.A. Heyning continues to serve as ECOR representative to SCOR.

CMAS (SC)

At its meeting in November 1975, the SCOR Executive Committee had considered an application from the Scientific Committee of the Confédération Mondiale des Activités Subaquatiques (CMAS) for some relationship with SCOR. At that time it had been considered with regret that there was no appropriate provision in the SCOR Constitution, but in 1976 the Constitution had been amended to include a category 'Corresponding Organizations', to which ECOR had been admitted. The Scientific Committee of CMAS had recently reiterated its interest in becoming associated with SCOR and the SCOR General Meeting agreed that the Committee be invited to become a Corresponding Member of SCOR.

1.2 Publications

a) *UNESCO Technical Papers in Marine Science*

No 28, containing the report of the 8th meeting of Working Group 10, May 1977, had been published early in 1978.

Dr Steyaert reported that future issues would include:

the report of the 9th meeting of WG 10, September 1978

Coastal Lagoon Survey; the results of a world-wide enquiry by the SCOR/ UNESCO *ad hoc* Advisory Panel on Coastal Lagoons (1976-78)

Seminar on Present and Future Research in Coastal Lagoons, 28 August – 2 September 1978 – (i) The Proceedings and (ii) Report, Guidelines and Recommendations.

The attention of UNESCO was drawn to recommendations of WG 10 that description of the methods used, measurements obtained, the analysis procedures and results of the investigations leading to the recommendations for a new practical salinity scale and the data sets and analysis used to construct the proposed equations of state for seawater be published in this series and that products likely to be forthcoming from WG 44 and WG 46 might also be suitable. It was suggested that the two proposed numbers arising from the Seminar on Present and Future Research in Coastal Lagoons might be considered more appropriate for the UNESCO Report Series.

In response to a request from UNESCO for advice on reprinting of issues 1 to 16, stocks of which with the exception of No 11 were exhausted, SCOR recommended reprinting a small quantity of Nos 15 and 16 only. It was noted that No 12 had contained only a report of a meeting and that the actual check list of fishes of the north-eastern Atlantic and Mediterranean had been published separately by UNESCO and adequate stocks of this remained.

SCOR stressed that a criterion for publication in this series should be substantial technical content.

b) *UNESCO Reports in Marine Science*

UNESCO-OCE had advised SCOR that the third issue in this series will be the report of a seminar on *Benthic Ecology and Sedimentation of the South-east Atlantic Continental Platform*, Montevideo, Uruguay, 9–12 March 1978. As noted above, SCOR suggested that both the report and proceedings of the Seminar on Present and Future Research in Coastal Lagoons, August/September 1978, might be considered for publication in this series.

c) *UNESCO monographs on oceanographic methodology*

No 5 *Coral Reef Methods* – published mid-1978

No 6 *Phytoplankton Methods* – publication expected before the end of 1978

In response to a request from UNESCO for guidance, SCOR recommended the Monograph series should retain 'oceanographic methodology' in its title but that the term methodology be interpreted broadly to enable a wider spectrum of methodological-related material, such as analysis and synthesis of appropriate high quality, to be included.

SCOR recommended the following for future publication in this series:

mangrove methods (WG 60)

a small new volume on photosynthetic pigment estimation (see item 3.2(c))

estimation of micro-nekton abundance (WG 52)

mathematical modelling in biological oceanography (WG 59) (now considered likely to be more appropriate for this series than the Technical papers)

salinity methods – to include final material from WG 51 together with a contribution from WG 10, on methods of determining salinity in the ocean. It was considered important that users of the CTD should have the benefit of the experience of skilled users.

SCOR confirmed that in its view this series was of value to be both developed and developing countries and should, if possible, be expanded because of the demand for technical details of methods available which were often not appropriate for publication in scientific journals.

d) ***Advances in Oceanography***

The papers from the General Symposia of the 1976 Joint Oceanographic Assembly had been published in October 1978 by the Plenum Publishing Company Limited under the title *Advances in Oceanography* at \$39.50.

e) ***General Circulation Models of the Ocean and their Relation to Climate***

The papers from the JOC/SCOR Joint Study Conference on General Circulation Models of the Ocean and their Relation to Climate, Helsinki, 23–27 May 1977, had been printed in unedited, limited edition by WMO. These papers will be published in edited and referred form in a forthcoming issue of *Dynamics of Atmospheres and Oceans*.

f) ***Tropospheric Transport of Pollutants and other substances to the ocean***

The report, with conclusions and recommendations, of the Workshop held in Miami in December 1975, organized by the Ocean Science Board of the US National Academy of Sciences at the request of SCOR, had been published by the Academy in early 1978.

g) ***The Proceedings of the Symposium on Warm Water Zooplankton***

held in Goa, India, in October 1976, with the support of UNESCO and SCOR, had been published in 1978 by The National Institute of Oceanography, Goa.

1.3 Finance

As foreseen by the Executive Committee at its meeting in January 1978 (SCOR Proceedings Vol. 14), the increasing number of important activities of SCOR (24 subsidiary groups in 1978, compared with 13 in 1971) and the virtual doubling of costs of travel and subsistence since national contributions were last raised in 1971, had eroded the reserve funds of SCOR to the extent that it was expected that, by the end of 1978, the balance in hand would be very small. No indication had been received from National Committees about activities which might be cut, and the only special contract which had been negotiated in 1978 had been an IOC contract to support the work of Working Group 46. It was clear that it would be impossible to support more than a small proportion of the desired activities in 1979 from the income expected from national contributions and regular contracts.

A Finance Committee, consisting of Dr R.W. Stewart (Chairman), Dr R. Dorrestein, Professor A.S. Monin and Professor W.S. Wooster, was asked to examine these matters carefully, seeking such information as they might require from the Secretariat.

The Finance Committee examined the audited Financial Statements for 1976 and 1977; summaries of Income and Expenditure since 1971; and estimates for 1978. The final Statement of Income and Expenditure for 1978 is given as Annex II. The Finance Committee brought the following salient points to the attention of the General Meeting:

- 1) The annual income of SCOR, from national contributions and regular contracts from IOC and UNESCO, has remained virtually constant at just under \$60,000 since 1971.
- 2) The expenses of SCOR before 1977 varied greatly from year to year, but never much exceeded income. In some years, particularly in 1976, there were substantial surpluses, so that at the beginning of 1978 SCOR had a balance of about \$74,000.
- 3) Expenses rose sharply in 1977, to about \$94,500; and still further in 1978 to an estimated \$144,000.
- 4) As a consequence, the expected balance at the end of 1978 is insignificant.
- 5) Requests for funds for 1979 bear no relation to anticipated income; indeed, some working groups have asked for sums exceeding the whole income of SCOR.

The situation calls for a sharp reduction in expenditure or a considerable increase in income. In view of the increase in costs which has occurred over the past few years, and the increasing range of demands requested of SCOR, an increase in funding is needed if SCOR is to continue to carry out its historical role and particularly if it is to continue to meet new challenges.

To increase revenues, the finance committee recommended that:

- i) The sum corresponding to each category of membership be doubled immediately. The notification of this change, to National Committees, should be supported by data comparing air fares and per diem rates in 1971 with those in 1978. Of course, each country remains free to choose its own category. This doubling of national contributions was understood to be equivalent to the level of increases in contributions to ICSU over the eight-year period.
- ii) SCOR seek special support from ICSU and from inter-governmental bodies for activities of special interest to these bodies and, in particular, for activities which it undertakes following requests from these bodies.

To decrease expenses, the Finance Committee recommended that:

- i) The expenses of meetings be kept to a minimum by choosing the venue carefully, bearing in mind the cost of both travel and per diem, as well as the suitability of the meeting place from other points of view.
- ii) Maximum use be made of excursion travel and other such savings.
- iii) All preparatory work be done by correspondence, so that meetings are called only to deal with matters requiring substantive discussion.
- iv) All working group chairmen be informed of the true financial position of SCOR, so that their requests for support may be realistic.
- v) Wherever possible, national funds should be called upon to support SCOR activities.

The Finance Committee was asked to propose suitable action relative to those members who are in arrears with their contributions. The meeting adopted a recommendation from the Finance Committee that ICSU procedures regarding non-payment of dues be implemented, viz:

- after two years of non-payment the National Committee concerned loses its voting rights
- after five years of non-payment they be notified that unless arrears are paid within two years their membership of SCOR will be terminated

Only one SCOR National Committee was in arrears by five years and this Committee will be notified that, unless the arrears are paid, their membership will be terminated at the Fifteenth Meeting of SCOR.

With respect to the 1979 budget, the Committee recommended that expenditure should be controlled in such a way that, if possible, there is a small (less than \$10,000) surplus, in order to restore a balance and thus restore flexibility. No attempt should be made to build the balance back to the pre-1977 level.

The Committee prepared a realistic budget and an extreme austerity budget to keep within expected income from national contributions and regular contracts at 1978 levels. Expenditure should be restricted in accordance with the extreme austerity figures unless, and until, additional income was forthcoming. If there is additional income, additional expenditure may be authorized by the Executive Committee.

The General Meeting accepted all the recommendations of the Finance Committee, and agreed to the following:

- National Committees be informed of the increases in levels for each category, taking effect from 1979, and be urged to continue, if possible, in their present categories at the higher rate. If this were not possible in 1979, they should contribute at the higher rate in 1980 or apply to adhere to SCOR in a lower category. Voluntary additional contributions should also be invited.
- ICSU be requested to consider providing as soon as possible \$10,000 towards the activities of CCCO and to consider special support for other SCOR activities likely to be of particular interest to ICSU (e.g. Working Groups 44 and 62) which might otherwise be delayed.
- IOC be requested to consider providing, in 1979, \$10,000 towards the activities of CCCO.
- Discussions be entered into with both IOC and UNESCO—OCE to seek support in 1979, in addition to the basic contracts, for SCOR activities of special interest to them which might otherwise have to be deferred.

It was noted, however, that to retain flexibility to undertake tasks considered to be important by SCOR and to avoid the possibility of SCOR's actions being determined largely by other organisations, it was necessary for SCOR's own resources, from national contributions, to be comparable with the total of contract income.

All chairmen of working groups planning to meet in 1979 should be informed of the sum in the austerity budget that could be allowed to them and be asked to submit to the Secretariat their recommendations regarding allocation of these funds. In all cases, members of groups were requested to make every effort to obtain support for their participation in meetings from their national funding bodies.

SCOR EXPENDITURE

1979

Area	Realistic	Extreme Austerity
WG 42	1,500	1,500
WG 43	750	750
WG 44	10,000 to 12,000	5,000
WG 46	6,000	6,000
WG 51	6,000	—
WG 52	17,750	5,000
WG 54	10,000	5,000
WG 56	13,000	5,000
WG 59	10,000 to 16,000	7,000
CCCO	10,000	5,000
Ocean Turbulence Workshop	4,000	—
Representation	10,000	5,000
Executive Meeting	10,000	4,000
Publications	7,000	4,300
Administration	20,000	14,000
	<hr/>	<hr/>
	\$136,000 to 144,000	\$67,550
	<hr/>	<hr/>

1.4 Election of Officers

The President explained that whilst the three Vice-Presidents were eligible for re-election, the Secretary, Mr R.I. Currie, had now completed six years in that office and was not eligible for re-election. At its meeting in January 1978 the Executive Committee had asked the President to discuss with the Royal Society the possibility of continuing to make available to SCOR after the 1978 elections the services of Mr G.E. Hemmen, and Dr Fedorov reported that he had received a favourable reaction from the Executive Secretary of the Royal Society, subject to certain constraints and conditions.

A nominations committee comprising Professor W.S. Wooster, Dr G.F. Humphrey and Dr R. Marumo concluded that it was desirable to continue the present administrative arrangements as far as possible, at least for the near future, but SCOR cannot depend for ever on the Royal Society to provide staff time. In 1980 the President and all the Vice-Presidents will retire and so SCOR will be faced with replacement of most of its Executive Committee. Considering that their task was to find a way to continue effectively for the near future and to plan for major changes in 1980, the Nominations Committee made the following proposals:

1. That Mr R.I. Currie, UK, be coopted to the Executive Committee with the special task of supervising publications and associated administrative matters.
2. That Professor H. Charnock, UK, be elected Secretary.
3. That Professor G. Hempel, FRG, Professor E. Goldberg, USA, and Professor P. Tchernia, France, be re-elected Vice-Presidents.
4. That Professor W.S. Wooster, USA, be retained as a coopted member of the Executive Committee but his special tasks be relations with other international bodies, exploring future long-term administrative arrangements for SCOR and enhancing the role of national members.
5. That Mr G.E. Hemmen, UK, be appointed Executive Secretary.

These proposals were adopted by acclamation and appreciation was expressed to Messrs. Currie and Hemmen for their work on behalf of SCOR over the past six years.

2.0 Subsidiary bodies

2.1 General

SCOR noted a substantial increase in the activities of its Working Groups in 1977 and 1978. However, it was suggested that in some cases meetings had been inadequately prepared in advance by correspondence and that first meetings of new groups were sometimes devoted entirely to planning and organizing the work instead of considering the scientific problems specified in their terms of reference.

It was agreed that it would be useful to prepare more detailed general instructions to Working Group Chairmen than were currently in use and to emphasise the importance of close liaison between Chairmen and the Executive Committee Reporters, particularly in the early stages of new groups. The Reporters should assume greater responsibility for ensuring that plans and agenda for proposed meetings warranted support of the meeting by SCOR and for conveying and interpreting to Chairmen the views and wishes of the Executive Committee, in addition to their traditional role of recommending action to SCOR based on requests from the WG's.

The General Meeting agreed that, in future, proposals for new Working Groups which were presented for the first time at the Meeting would not be considered. In future SCOR should insist that all such proposals were submitted to the Secretariat at least one month before the Executive Committee or General Meeting at which they were

to be discussed, and could then be conveyed to the members of the Executive Committee prior to the opening of the Meeting.

2.2 Arising from former Working Groups

WG 36, *Coastal Upwelling Processes*

Dr Fedorov, Chairman of the Editorial board for a review volume on physical aspects of coastal upwelling, reported that some members of the board had met in April 1978 to prepare a work plan but that preparation of the papers appeared to be going more slowly than had been hoped for. He believed that the major obstacle was the need to analyse further data from recent expeditions.

In view of the urgency of the need for this publication, Professor Wooster undertook to discuss with Professor J.J. O'Brien and/or Dr R.L. Smith ways in which the work might be expedited and to seek their ideas on possible publishers.

2.3 Existing Working Groups

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

The 9th meeting of the Joint Panel on Oceanographic Tables and Standards (JPOTS—SCOR WG 10) was held in Paris in September 1978. A revised draft report of the meeting, the final version of which will be published as a UNESCO Technical Paper in Marine Science, was available. A brief summary of the major recommendations concerning the practical salinity scale and the equation of state of seawater is given in Annex III.

The full report of the meeting invited the sponsoring organizations SCOR, IAPSO, ICES and UNESCO, to endorse the proposed definition of a practical salinity scale and a proposed new equation of state for seawater. The SCOR General Meeting recommended that such endorsements be deferred until views of a wider scientific community became known. SCOR did, however, encourage early action on the recommendations of the Group that details of the investigations leading to the proposed new practical salinity scale and the data sets and analyses for a new equation of state be published, possibly in the series UNESCO Technical Papers in Marine Science.

Also, SCOR encouraged the Group to pursue its plan to publish its proposals in a number of leading scientific journals in the form of a letter from the panel to the scientific community inviting their comments.

The election of Dr J.M. Gieskes, USA, as Chairman was approved and thanks were expressed to Dr Fofonoff, the retiring Chairman.

It was evident from the report of the September meeting of the Group and subsequent correspondence with the Chairman, Dr Gieskes, and the past Chairman, Dr Fofonoff, that its work on the salinity definitions was not yet finished. Especially, a clear and full statement of the theoretical and practical considerations that must be satisfied by conductivity meters and a study of the pressure dependence of conductivity had not yet been completed. No data had been published on the differences in weight which occur when KCl is treated in different ways before weighing.

The Group assumes that these matters can be settled by correspondence in the course of the next half year. In that case the report could again be discussed at the next SCOR Executive Committee meeting. The Group's far-reaching recommendations should not be adopted until the scientific basis for them has been made widely available by publication. Full endorsement of a practical salinity scale should wait until reactions of the scientific community to the proposals are better known.

It was agreed that the membership of the Group should remain unchanged until these matters were resolved and the Group be invited, in collaboration with WG 51, to prepare material for a UNESCO monograph on salinity methods.

The Group had recommended that on completion of the present work its attention should be turned to recommending approved formulae for other physical and chemical properties of seawater, which might include such subjects as sound speed, adiabatic lapse rate, specific heat, potential temperature etc., for which a revision of the membership would be necessary. Of immediate concern was an evaluation of present knowledge of the thermodynamics of the carbon dioxide system in seawater, regarding which the Chairman was in the process of determining, by correspondence, a list of names of workers in this field interested in forming a working party and he expected to submit a recommended list of names by March 1979.

SCOR requested the Chairman to consult closely with the Chairman of WG 62, on the Carbon Budget of the Ocean, and to seek his concurrence regarding the proposed terms of reference and membership of this working party before submitting them to SCOR. It might transpire that it would be more appropriate for the working party to be under WG 62 or formed jointly by WG's 10 and 62. SCOR looked forward also to receiving, in due course, specific proposals for future activities and suggestions about suitable changes in membership.

The Group had also discussed Dr Menaché's interim proposals regarding use of SI Units and standardised symbols, which he was preparing for presentation in December 1979 to the IAPSO working group on Symbols, Units and Nomenclature. They had been unable to endorse all of Dr Menaché's proposals but had encouraged him to continue his efforts to find compromises that could be accepted.

SCOR supported the views of WG 10 and confirmed the fears that had been expressed at the last two SCOR Executive Committee meetings that, while it was desirable to adopt SI Units where feasible, care had to be taken to ensure that units proposed would not cause confusion and that extreme caution was needed in respect of symbols. Some of the recent proposals could result in the same symbol being used for different parameters in one equation. Further consultation with a broad spectrum of marine scientists was clearly essential.

WG 34 *Internal Dynamics of the Ocean* (with IAPSO)

A report from the Chairman, Annex IV, was received in which a strong request was made to continue the Group for a further two years. Noting that there had been considerable informal activity among the members of the Group, it was agreed that the Group be retained and be encouraged to continue to hold informal meetings as proposed by the Chairman, to plan a symposium on Eddy Dynamics in mid 1980 and to

work towards preparing a review of the state of knowledge of eddy dynamics and identification of the most important next scientific problems.

SCOR was of the opinion that the activities initiated by this Group had contributed substantially to the understanding of mesoscale processes and completion of their work, as suggested, was of great importance.

WG 40 *Paleo-Oceanography* (with CMG)

Whilst recognising the importance of the subject area of paleo-oceanography, XIV SCOR felt that the field was currently adequately covered under the International Programme of Ocean Drilling and by personal contacts between the scientists involved. It was agreed, therefore, to support the recommendation of the Chairman and the SCOR Executive Committee and to disband this Group.

On the advice of CMG, it was agreed that international action on pre-Cambrian (more than 500 m years ago) ocean history was more appropriate for attention by IUGS than SCOR. With regard to the topics identified in Recommendation 8 of the 1976 Marine Geoscience Workshop, SCOR had already agreed to form a working group on marine geochronological methods (WG 61); the other two topics were still not sufficiently defined to justify SCOR action at this time.

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

A meeting of the Group had been held in Rostock, DDR, in April 1978, the report of which had been printed and distributed by ICES as paper C.M. 1978/E:4. A brief report by the Chairman (Annex V) was received. The proposal to meet in Tallin in January or February 1979 was approved but because of financial limitations SCOR would not be able to offer financial support for trans-Atlantic members.

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

The final GATE oceanography symposium entitled *GATE Symposium on Oceanography and Surface Layer Meteorology* had been held in Kiel in May 1978, organised by SCOR, IAPSO and IAMAP in consultation with WMO, IOC and the German Meteorological Society, in which 107 scientists from 13 countries had participated. A final meeting of WG 43 had been held during the Symposium.

Papers from the Symposium will be published in 1979 in two special supplements to *Deep Sea Research*. Guest editors are W. Düing, G. Siedler and J.D. Woods.

A substantial final report of WG 43 was presented to XIV SCOR, which included details of meetings held, publications and the final symposium programme. This report will be published as an ICSU/WMO report and will be distributed by WMO.

The final meeting of WG 43 reviewed the activities of and results that had been obtained from the GATE oceanography programme.

The oceanographic programme had been designed to investigate the response of the Tropical Atlantic to atmospheric forcing at various scales but had had to be planned within constraints imposed by the meteorological programme, which had taken precedence, with some additional facilities. The programme had proved remarkably successful.

Since the observational phase in 1974, WG 43 had devoted its attention to international cooperation in data validation, management and exchange and in analysis of results. The complete routine data set should be available in WDC's A and B in the near future and WG 43 felt there was no further need for continued coordination of analyses by this Group. All further international activities in evaluating the GATE oceanographic data could be handled by the GATE Atlas Editorial Board and by the established cooperation between groups involved.

SCOR therefore agreed to terminate WG 43 and expressed appreciation of their achievements.

GATE Atlas

Membership of the GATE Atlas Editorial Board had been established as follows: F. Ostapoff, USA, Chairman, V.A. Bubnov, USSR, W. Düng, USA, E.J. Katz, USA, J. Merle, France, G. Siedler, FRG, J. Woods, FRG, with V. Lee, USA, as Executive Coordinator, and the following as corresponding members: M. Garstang, USA, P. Hisard, France, J. Meincke, FRG, G. Philander, USA, and P. Weisberg, USA. IOC had responded favourably to a proposal from the SCOR Executive Committee that IOC might offer to contribute half the costs of the activities of the Board.

The first meeting of The Board had been held at the time of the GATE Oceanography Symposium at which an outline for the content of Volume 1 and a time table for its preparation had been agreed. Since then, the editors had prepared a more detailed outline of contents and list of figures (Annex VI) which are still regarded as 'working lists' on which comments would be welcomed.

SCOR supported the Board's proposal that Dr V.A. Bubnov be invited to work with the editors in Miami for a few weeks in early 1979 and for the Board to convene a second meeting in about September 1979.

SCOR confirmed that it was most desirable to proceed with the production of Volume 1 (A-scale) of the Atlas, along the lines proposed, and urged IOC and WMO to make available the necessary funds to ensure good quality reproduction of this work. The provisional cost estimates provided by the Editorial Board were \$21 750 (soft cover) or \$25 250 (hard cover) for 2500 copies. Considerable resources have already been devoted to the preparation of Volume 1 and this compilation of GATE results will represent a significant contribution to GARP and will be of great value in relation to further studies of the region on all scales. It was noted that not only had the final report of WG 43 confirmed the need for this publication, but so also had the JOC/SCOR specialist conference on the *Role of the Ocean in the Global Heat Budget* which had recommended to the JOC Climate Board that WMO and IOC/UNESCO be approached for financial support for this publication. However, in view of the proposed content of Volume 1, SCOR suggested that a more informative title than *Atlas* should be used for the actual publication.

It had earlier been proposed that a special bathymetric chart of the GATE area should be prepared for inclusion but it was believed that no progress had yet been made on this. It was agreed to ask the Editorial Board whether detailed bathymetry was important for GATE purposes or whether one of the available general bathymetric charts would suffice. Depending upon the detail required, the Board might attempt to identify a possible compiler and if special financial support was needed IOC and WMO should be invited to provide it.

No decisions were reached regarding the need for further atlases, covering the B and C scale studies, and SCOR should examine carefully, at a later date, any proposals which might be formulated by the Atlas Board.

WG 44 *Ocean Atmosphere Materials Exchanges* (OAMEX) (with IAMAP and IAPSO)

The Chairman, Dr R. Chesselet, presented a brief report outlining the plans for the first meeting of the Group to be held in May 1979 in Bermuda. SCOR noted that the Group intended to devote particular attention at this meeting to one or two well-focussed topics. The role of photochemical reactions in influencing the atmosphere/ocean fluxes and the fluxes of organic matter into and out of seawater had been suggested.

SCOR was most anxious for the important work of this Group to begin and expressed strong support for the meeting being planned. However, due to financial limitations (see item 1.3) SCOR could only guarantee to be able to make \$5,000 available. Should additional funds be forthcoming, WG 44 would be high on the list of priorities for additional allocations.

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

As reported in SCOR Proceedings Volume 14, an offer of support from UNEP for the activities of WG 46 had been received in February 1978. These funds were now available to IOC which had, in turn, contracted part of this money to SCOR to support the preparation for the workshop. The Steering Committee for the workshop met in August 1978. It was intended to hold the workshop in Rome from 26 to 30 March 1979. The provisional programme is given in Annex VII. The workshop will be followed by a meeting of WG 46 to consider the outcome and to discuss future developments. Meanwhile, work was proceeding on the preparation of research reviews in different areas, which will provide background documentation for the workshop. SCOR appealed to National Committees to assist in this work, if required.

Dr L. Brugmann has been nominated by the National Committee of the German Democratic Republic as a corresponding member to WG 46.

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

A report was received from the Chairman (Annex VIII). It was agreed to invite Dr J.C. Swallow (Chairman of the Indian Ocean Panel) and Dr B. Taft (Chairman of the Pacific Ocean Panel) to become full members of WG 47.

The Working Group was encouraged to continue in order to assist, if required, during the operational phase of FGGE and thereafter to review the scientific results. WG 47 had suggested that a preliminary review might be possible in late 1980. The General Meeting strongly supported the proposal for a FGGE oceanography symposium for which about three days might be required but suggested that WG 47 may find it more practical to defer such a meeting until 1981. The Group was invited to develop its proposal further and to report again to SCOR in due course.

It was understood that there were still some unresolved questions regarding FGGE oceanographic data management. Advice on these questions had been conveyed by SCOR to IOC and it was considered that this question was now primarily the respon-

sibility of IOC, with the assistance of Dr Simmons and other members of WG 47 as may be required.

SCOR expressed its appreciation to the Chairman, Secretary and panels of WG 47 for their considerable work over recent years which had culminated in the preparation of a substantial oceanographic programme for FGGE which was now in the stage of final typing. This programme, containing the combined proposals of the three panels and other material, would be published shortly as Volume 7 of the FGGE Implementation Operations Plan and copies could be obtained from Dr W. Simmons at WMO Headquarters.

WG 49 *Mathematical Modelling of Oceanic Processes* (with IAPSO)

A report from the Chairman was received in which he concurred with the suggestion of the SCOR Executive Committee that this Group might now be dissolved, at least for the present, provided certain conditions were met. Termination of the Group was therefore confirmed and SCOR made the following observations on the conditions proposed:

SCOR considered that *Ocean Modelling Newsletter* was of great value and commended its informal style which enabled it to be issued quickly after receipt of material. SCOR most strongly encouraged its continuation, under the auspices of SCOR, and requested the President to write to the US Office of Naval Research inviting their sympathetic consideration to a request they had received from the Editors (Dr A. Gill, Dr P. Killworth, Dr D. Anderson and Dr L. Relizani) for continuation of financial support for a further three years. In doing so the President should point out to ONR that the disbanding of WG 49 in no way reflected a lessening of interest in mathematical modelling, but was normal SCOR practice. The newsletter would continue to be a valuable vehicle for theoreticians to exchange views. SCOR urged modellers of all countries to utilise the newsletter and hoped that many articles and notes would be forthcoming from scientists in countries from which no, or few, contributions had been received.

SCOR was not able to accept the proposal that every working group, regardless of topic, should have a mathematical modeller among its membership. Some groups clearly had no need for such expertise. Nevertheless it was agreed that wherever it seemed desirable, the Executive Committee should try to ensure compliance with the suggestion. In this connexion it was noted that Dr D. Moore had been appointed to membership of WG 56 and Dr J.J. O'Brien to WG 59.

In order to advise and assist the SCOR Executive Committee and SCOR WG's in this matter, to bring to the attention of the Executive Committee matters in this field warranting their attention and in particular to notify the Executive Committee if at any future date modellers identified a requirement for a new working group, and to assist the editors of the *Ocean Modelling Newsletter*, if required, it was agreed to invite Dr J.J. O'Brien to serve as Scientific Rapporteur on Mathematical Modelling and to seek such assistance in this task from other specialists as he may consider necessary.

WG 51 *Evaluation of CTD Data* (with IAPSO)

A draft report of the first meeting of the Group, in Charlottenlund in September 1978, was received. (Annexe IX.)

There were comments to the effect that the report was almost exclusively concerned with planning the future work thus giving the impression that substantial matters had not been tackled during the first meeting.

Professor Stewart, Professor Tchernia and Dr Striggow all confirmed that, under the Chairmanship of Mr Crease, the Group was fully aware of the problems they had to tackle, and there had been substantial discussion of these problems at the first meeting. The preparation of a manual was not the only present activity of the Group, but it was considered by the members to be important to aim for a final publication which would review the various problems associated with CTD's and propose solutions which would contribute to achieving consistently high quality data. SCOR suggested that the Group might also consider summarizing what has already been published about the use of CTD recorders and, in conjunction with WG 10, prepare a monograph on salinity methods for the non-specialist user.

The Group's proposal to work by correspondence for about a year before calling another meeting was approved, although SCOR asked the Group to defer their meeting until early 1980. Dr Striggow said he had invited the Group to hold its next meeting in Warnemünde.

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

A report from the Chairman was received in which he explained that during 1978 the Group had been active by correspondence in preparing an informal symposium/workshop type meeting in 1979 to review methods of quantitatively assessing the abundance of micro nekton. A tentative programme of about 19 papers was proposed and speakers had been invited. As many of the contributors were resident in the USA, it was planned to hold the meeting there, and the Chairman of WG 52 sought financial support from SCOR of about \$14 500 – 15 000 for travel and per diem for 9 non-US participants.

WG 52 had been asked by WG 54 to recommend a net for sampling krill to provide 'ground truth' estimates for BIOMASS-FIBEX vessels engaged in acoustic surveys of Antarctic krill. The University of Tromsø had offered to make available to WG 52 in February 1979, seven days sea time of *Johan Ruud* for intercomparisons of catch efficiencies of various nets. The Chairman requested up to \$5 000 for travel and shipping expenses. It was suggested that some related study of stomach content of predators would also be worthwhile.

SCOR warmly supported Dr Percy's proposals but regretted that financial limitations prevented SCOR from undertaking to meet all the requests for support at this time. \$5 000 was assured, in the austerity budget, to enable planning of the February 1979 sea trials to proceed. Other sources of funds for the workshop/meeting would be sought and SCOR urged WG 52 to proceed with its planning. It was expected that the Group's review and recommendations would be published as a UNESCO Monograph on Oceanographic Methodology. ACMRR had not yet responded to the 1976 invitation to cosponsor this Group.

WG 53 *Evolution of the South Atlantic* (with CMG)

The Chairman, who was also Chairman of CMG, reminded SCOR that the terms of reference of this Group had included the identification of critical problems of the

structure of the ocean and evolution of water masses. He had conducted most of the work of the Group by correspondence and had met most of the members on different occasions although no meetings had been called.

The Group had specified a number of areas where relevant work was being done but needed a 1½ to 2 day symposium to complete their task. For some time it had been intended to hold such a symposium at the International Geological Congress, but the organizers of the Congress had recently declared that they would not accept symposia organized by other Groups. The International Programme of Ocean Drilling will concentrate on the South Atlantic in 1980 and so the Chairman proposed that the symposium be postponed until after that date and that WG 53 now be disbanded. SCOR accepted this proposal.

The evolution of ocean basins continued to be of great interest to geologists/geophysicists and physical oceanographers. In response to a suggestion that SCOR might provide some alternative framework for interchange of views between interested scientists, it was considered that this was adequately accommodated by the IPOD.

WG 54 *Living Resources of the Southern Oceans* (with SCAR, ACMRR and IABO)

A meeting was held in Kiel in May/June 1978 to discuss the implementation of the BIOMASS Experiment (FIBEX) in 1980/81. A full report of the meeting is available, a brief report by the Chairman is given as Annex X. This brief report includes details of the proposed revised membership of the Group and membership of 7 subsidiary groups considered necessary to plan the programme. These proposals were approved by SCOR.

Professor Hempel emphasised the importance of this proposed 8–9 year interdisciplinary programme, which he foresaw as being one of the major international collaborative scientific undertakings in the coming years, not only because of the potential economic importance of the resources of the region but more because of the multiplicity of basic scientific problems it was being designed to study which would demand close collaboration between biological and physical oceanographers.

SCOR endorsed the scientific importance of a major study of the southern oceans and supported strongly the concept of the BIOMASS programme, which included not only a series of planning meetings of the various subsidiary groups but also other related activities such as an examination of the *Discovery* data, the net trials of WG 52, a workshop on the identification of cephalopod beaks. The total cost of these preparatory activities, which were necessary for the effective planning of multi-ship operations which would represent the investment of many millions of dollars by national programmes, were entirely beyond the combined resources of SCOR and SCAR, and it was clear that substantial new sources of funding would be necessary if the programme was to proceed as planned.

SCAR had already committed as much as it was able and SCOR agreed, even within its extreme austerity budget for 1979, to provide as much support as possible. SCOR hoped that Antarctic Treaty Governments might provide substantial support for the planning and implementation of BIOMASS and agreed that ICSU might be asked to assist.

SCOR noted with pleasure that the development of BIOMASS to-date had represented a good example of collaboration between the non-governmental and inter-governmental bodies. Through its International Coordination Group for the Southern Oceans, IOC had an important role in the programme. IOC, with the assistance of ISOS, had been gathering information on research cruise plans and would shortly issue its first Southern Oceans Newsletter. IOC and ACMRR would have major roles with respect to data handling and statistics, whilst SCAR, in cooperation with SCOR and IABO, would be primarily concerned with elaboration of the scientific programme.

WG 55 *Prediction of El Niño* (with IAMAP and IAPSO)

The first meeting was held in Las Palmas in April 1978, the report of that meeting is given as Annex XI. The Chairman, Professor D. Stuart, had represented WG 55 at meetings of ERFEN and the first session of the joint IOC/WMO/CPPS Working Group on the investigation of El Niño in Lima, Peru, in October 1978, at which he had presented a progress report on WG 55 activities.

The next meeting of WG 55 will be held in San Francisco from 4–8 December 1978 during the meeting of the American Geophysical Union but SCOR did not feel able to provide support also for a meeting in 1979.

Dr M. Kanamitsu, Japan, had resigned from WG 55 and SCOR approved a suggestion from the Chairman that Dr P.R. Rowntree, UK, be appointed in his place.

Understanding that the IOC/WMO/CPPS Working Group was concerned primarily with a regional study of the phenomenon, SCOR again emphasised the importance of the work of WG 55 but stressed that before prediction could be attempted it was necessary first to understand the mechanisms of the processes which were of an ocean-wide nature and probably dependent on many physical factors.

WG 56 *Equatorial Upwelling Processes* (with IAPSO, IAMAP and IABO)

Membership of the Group was established as follows:

Dr H. Rotschi (Chairman)	Ivory Coast
Dr D. Halpern	USA
Dr O. Brown	USA
Dr B. Voituriez	France
Dr M. Vinogradov	USSR
Dr R. Boje	FRG
Dr R. Barber	USA
Dr J.J. Walsh	USA
Dr R. Jimenez	Ecuador
Professor H. Postma (Reporter)	Netherlands

Dr P. Hughes, UK, had been appointed to membership of the Group but had subsequently resigned. SCOR approved a suggestion by the Chairman that Dr D Moore, USA, be appointed in his place. Dr H. Lass, GDR, had been nominated by the GDR National Committee as a corresponding member of the physical panel, and at its next meeting WG 56 would consider appointing him to full membership.

The first meeting of WG 56 had been held during the CINECA Symposium in April 1978, and the physical panel had met in Kiel at the time of the GATE Symposium in May. Report of these meetings was included in the Chairman's report to SCOR (Annex XII). Proposals from the Group for amendments to its terms of reference were approved as follows:

1. First term of reference: no change.
2. Second term of reference: to read "To investigate the coupling of equatorial upwelling processes with the coastal upwelling in the adjacent areas along eastern boundaries of the ocean in association with relevant WG's such as 55 and 59".
3. Third term of reference: to read "To suggest lines of multidisciplinary enquiry into processes of equatorial upwelling for the planning of future expeditions".
4. Fourth term of reference: to read "To exchange information on the research programmes and plans of relevant expeditions, such as WG 47 (FGGE Oceanography)".

The Group had decided to assemble a directory of scientists and engineers interested in the physical and biological processes of upwelling in the region 15° North to 15° South, and a circular letter had been issued inviting interested scientists to send their names to either Dr R.T. Barber or Dr D. Halpern, Chairmen of the Biological and Physical Panels respectively.

A proposal from WG 56 to meet in Paris in early 1979 was approved and limited financial provision was made in the austerity budget of SCOR. A request for a contribution towards the travelling expenses of Drs Colin, Jarrige and Swallow, who had been invited by WG 56 to present reviews at the IUGG General Assembly on the equatorial upwelling physical variability respectively in the Atlantic, Pacific and Indian Oceans, was regretfully declined.

SCOR strongly recommended that another dynamical modeller be added to the membership of WG 56, particularly in view of the disbandment of WG 49 and the need for WG 56 to provide input to WG 55. Dr J.J. O'Brien should be asked for a recommendation. ACMRR had been invited to cosponsor this Group but had not yet accepted.

WG 57 *Coastal and Estuarine Regimes* (with IAPSO, UNESCO and ECOR)

The Group had met in Tallin, USSR, following the 16th International Coastal Engineering Conference in Hamburg. A report of that meeting is given in Annex XIII. The Group's proposals included the preparation of a state-of-the-art review of important aspects of coastal problems to be followed by a workshop and publication. The Chairman's estimate of the cost of these activities was almost \$90 000. Whilst SCOR approved these proposals in principle, it was clearly impossible for SCOR to contemplate providing financial support of the magnitude indicated. It was suggested that, in view of the importance and potential interest in this review, the Chairman should try to interest a commercial publisher in supporting this activity. It was also suggested that UNESCO might be interested in assisting with this review.

Proposals for a symposium on coastal and estuarine problems at the IUGG General Assembly in December 1979 and to cosponsor the 17th International Conference on

Coastal Engineering in Sydney, Australia, in March 1980, were approved — it being understood that no costs would fall to SCOR.

WG 58 *Arctic Ocean Heat Budget* (with IAPSO)

The Group met in Bergen in September 1978, the report from the Chairman is given as Annex XIV. SCOR agreed that the primary task of the Group was to complete its review of the state of knowledge of the Arctic ocean heat budget, and noted that it was intended that this review would be published early in 1979 in the University of Bergen Technical Report Series. It was agreed to continue this Working Group in order to provide a forum for future planning and coordination of field studies and modelling to improve the knowledge of the Arctic ocean heat budget and its relation to world climate.

WG 59 *Mathematical Models in Biological Oceanography* (with IABO)

The outcome of the first meeting of WG 59 was given in SCOR Proceedings Volume 14. Work has proceeded on the preparation of a review of the state of knowledge of mathematical modelling in biological oceanography, and the next meeting of the Group will be held in Barbados from 19–23 February 1979. SCOR suggested that the review might be suitable for publication as a UNESCO monograph on oceanographic methodology, rather than in the UNESCO Technical Series, and the publications officer of SCOR was asked to advise when the text of the review became available.

SCOR noted with pleasure that Dr J.J. O'Brien will participate in the next meeting of the Group.

WG 60 *Mangrove Ecosystems* (with IABO and UNESCO)

The first meeting of the Group had been held in San Jose, Costa Rica, in May 1978. A report to SCOR from the Chairman (Annex XV), contains a summary of the results of that meeting. It was noted that to meet both of its current terms of reference, the Group intended to produce a methodological handbook and had identified a series of topic headings which had been discussed and assigned to different members of the Group for writing up. Again SCOR suggested that this product might prove suitable as a UNESCO monograph on oceanographic methodology.

At its first meeting the Group had adopted a definition of mangroves and had proposed two further terms of reference one of which related to a questionnaire for the identification of current research, which could provide the basis for a world-wide directory on the subject, and the other concerned the identification of ways in which scientific research can be applied to problems of management and conservation of mangrove ecosystems. SCOR considered that it was not necessary specifically to add the first, because the Group was at liberty to adopt this procedure if it wished in order to comply with its existing terms of reference. Dr Steyaert said he hoped UNESCO would be able to support the proposed survey. Dr Steyaert agreed that the second proposed new term of reference was more appropriate for UNESCO attention. He advised that UNESCO was planning a symposium on mangroves of Asia, in 1980, and expressed the hope that WG 60 would assist in preparations for this.

SCOR approved a proposal by the Chairman that Dr A. Sasekumar, Malaysia, be added to the membership.

A further meeting of the Working Group in 1979 or 1980, with financial support from UNESCO, was approved.

WG 61 *Sedimentation Processes at Continental Margins* (with CMG)

Most of the prospective members of the Group had agreed to serve and some alternative names were proposed in case any of those already invited declined to serve.

The second term of reference of the Group, as given on page 23 of *SCOR Proceedings* Volume 13, has been changed to read:

“to recommend long term measurement devices for currents, turbidity, accumulation rates and other relevant parameters”.

The first meeting of the Group in late 1979 was approved and SCOR would try to provide some financial help, provided additional funds could be found.

WG 62 *Carbon Budget of the Ocean* (with IAPSO and IAMAP)

An initial membership for WG 62, taking into consideration suggestions by the Chairman and the President of SCOR, was approved. The President will now invite these members to serve, and SCOR expressed the hope that the Chairman would be able to initiate early action by correspondence and would maintain appropriate liaison with WG 10 and WG 44.

It was also suggested that the Chairman might consider adding a dynamical physical oceanographer to the membership of the Group.

2.4 Committees etc.

Committee on Climatic Changes and the Ocean

The urgency of initiating wide ranging long-term international programmes to further the understanding of climatic change and variability, and the importance of the role of the ocean in these processes had, in recent years, been recognised by a number of international bodies such as WMO, ICSU and IOC. This was reflected in the number of references to climatic problems in the agenda for the fourteenth General Meeting of SCOR. SCOR Working Groups had achieved remarkable success in planning oceanographic programmes related to GATE and FGGE, which had been concerned with the shorter time scales associated with the first objective of GARP, but to-date the oceanographic community had not been successful in determining programmes that were both desirable and feasible in relation to the longer time scales involved in climatic change. The report of the panel on monitoring ocean climate fluctuations of WG 48, published by WMO in early 1978, had offered some valuable suggestions which should be pursued. It was clear that a substantial oceanographic component was vital for the success of the proposed world climate research programme, to be organised jointly by WMO and ICSU. However it was technically impossible at this time to initiate a comprehensive study of the dynamics of the whole world ocean on climatic time scales.

These problems had been emphasised at a recent JOC/SCOR Specialists Meeting on the role of the ocean in the global heat budget (Annex XIX). It was essential therefore for experts in ocean modelling and ocean-atmosphere energy exchange to give vigorous

attention to what could be achieved with existing resources, which regions might be considered critical and what ocean data were likely to be significant to climate studies. This had been a major component to the philosophy of a proposal by Academician G.I. Marchuk, USSR, which had been submitted by the USSR to the Thirtieth session of the WMO Executive Committee in June 1978 and to the Tenth session of the IOC Executive Council in June 1978 and referred by them to JOC and SCOR respectively. The joint JOC/SCOR Specialist Meeting, referred to above, had considered this proposal carefully and had concluded that it was necessary to institute a pilot study over the next 5 to 10 years (see item 3.1 (a) and Annex XIX).

IOC had recently published in its technical series No 17 proposals for oceanographic programmes for the second objective of GARP. At the tenth session of its Executive Council, IOC had instructed the Secretary to conduct a census of on-going programmes of long time-series of oceanographic observations and had asked SCOR to advise on the types of scientific questions which should be asked in investigations of the impact of climatic changes on physical and human conditions.

ICSU and WMO expected to conclude an agreement regarding the joint planning of a world climate programme and over the coming few years the JOC for GARP would be transformed into a Joint Scientific Committee (JSC) for the climate programme which would include expertise from a number of related scientific disciplines, including oceanography. Meanwhile, the ICSU Executive Board had established a small core group to consider possible ICSU contributions to such a programme.

It was clear to the General Meeting that SCOR needed a vigorous and influential group to respond to IOC, ICSU, WMO and other requirements for advice on oceanographic programmes concerned with the study of global climate and approved the proposal of the January 1978 meeting of the Executive Committee to establish a Committee on Climatic Changes and the Ocean (CCCCO). It was, however, emphasised that whilst this committee should initially be concerned primarily with oceanographic contributions to the World Climate Programme, which would concentrate on time scales of a few weeks to some tens of years, it should also consider the actual climate of the oceans, the effects of changes on the biota and changes in oceanic circulation and the form of ocean basins on geological time scales. Also, it was agreed that because of the importance of the oceanographic component of a World Climate Programme and the desirability of close involvement of IOC, IOC should be invited to become a full cosponsor with SCOR of CCCCCO and the members be regarded as being jointly appointed for their scientific knowledge, capability and breadth of vision. The terms of reference for CCCCCO were determined as:

1. To assess the role of the ocean in climatic change and variability, the effects of such change on the physics, chemistry and biology of the ocean, and the ways in which oceanic research can contribute to the understanding and prediction of climatic change with priority to periods of several weeks to several tens of years.
2. To collaborate with the JOC for GARP and the proposed JSC for the World Climate Research Programme.
3. To identify research problems requiring increased attention and to initiate research activities.

4. To identify and seek solutions to impediments (scientific, technological and institutional) to achieving a more effective organization of oceanographic effort towards solution of the climate problem.
5. To keep under review relevant SCOR and IOC ocean science activities and to propose ways whereby they can be more effective.
6. To advise IOC on scientific aspects in developing the TEMA and service components of climate-related ocean science studies.

Professor R. Revelle, USA, was confirmed as Chairman of CCCO and Dr R.W. Stewart agreed to serve as Executive Committee Reporter. (At the time of going to press, the following had agreed to serve as members: K. Bryan, USA, J. Woods, FRG, L.M. Brekhovskikh, USSR, A. Gill, UK, T. Asai, Japan, J. Theide, Norway, R.W. Stewart, Canada).

It was also agreed that Chairmen of relevant SCOR Working Groups (WG's 34, 44, 46, 47, 55, 56 and 62) and the Chairman of the IAMAP Commission on Climate should be corresponding members, and if IOC accepted to cosponsor the Committee, it seemed likely they would wish the Chairmen of their relevant subsidiary bodies also to be corresponding members.

Because the effective development of FGGE plans had been greatly facilitated by the appointment of Dr W. Simmons as Secretary of WG 47 and the IOC staff appointment of Mr G. Withee, it was suggested that it might be advantageous if a Secretary were to be appointed to CCCO.

Other matters related to ocean climate research are reported under items 3.1(ii), 3.4 and 4.3.

Ad hoc Review Group on Antarctic Oceanography

A report from the convenor of the ad hoc Review Group was received (Annex XVI). SCOR strongly supported his proposal that a small specialised inter-disciplinary conference on Antarctic oceanography might be held in 1982, following the completion of major projects such as ISOS, IWSOE and FIBEX.

2.5 Proposals for New Working Groups

WG 63 *Marine Geochronological Methods* (with CMG)

A proposal from CMG was approved and a new Working Group on marine geochronological methods (WG 63, with CMG) was established with the following terms of reference:

"To review the existing knowledge of marine geochronology and to assess the state of integration of biostratigraphy, magneto stratigraphy, oxygen 16/18 and carbon 12/13 stratigraphy, absolute age determinations and global transgressions and regressions as revealed by seismic stratigraphic studies of continental margins:

To estimate the levels of precision and accuracy in these different methods:

To recommend studies of critical intervals and eventually to organize a symposium resulting in a publication presenting the state of the art."

It was further agreed that Professor W.W. Hay, USA, be invited to serve as Chairman of this Group and a list of 6 other members were approved.

Oceanic Atoll Drilling (with CMG and IABO)

A proposal by the US National Committee to establish a Working Group on ocean atoll drilling was considered. It was agreed to refer this proposal to CMG for advice and elaboration of specific terms of reference, after which the Executive Committee might agree by correspondence to establish a new Working Group. (This might be WG 64).

Coastal-Offshore Ecosystem Relationships (with IABO)

A proposal from UNESCO that SCOR and IABO might consider establishing a new Working Group on coastal-offshore ecosystem relationships was considered. SCOR agreed that this was a most important subject area and there were a number of questions relating to problems of organisms with life cycles in both nearshore and offshore areas which were in need of consideration. This highly complex subject had first been brought to the attention of SCOR at its 19th Executive Committee Meeting, but little progress had been made. SCOR agreed in principle that a Working Group might be established (this might be WG 65) but that it was first necessary to examine more carefully the terms of reference that had been suggested by UNESCO. IABO was invited to take the matter under further consideration. The views of National Committees and other relevant Working Groups of SCOR such as WG 49 and WG 57 might also be sought. The establishment of this Group need not await the outcome of the UNESCO Conference on Coastal Lagoons in 1980, which might identify further specific problems requiring attention.

Energy Fluxes through Food Chains

The National Committee of the Federal Republic of Germany had suggested that SCOR might invite IABO to examine carefully, and perhaps submit a detailed proposal, for the establishment of a new Working Group on energy transfer in marine food chains. This suggestion was approved by SCOR and accepted by IABO.

Benthic Sampling [Methods]

A suggestion for a Working Group on this subject was received from Professor D. Ellis. Again IABO undertook to evaluate the suggestion and to submit a detailed proposal to SCOR in due course.

2.6 Executive Committee Reporters for Working Groups

Duties as Executive Committee Reporters were allocated as follows and Chairmen of Working Groups were reminded that they should ensure that the appropriate Reporter was kept fully informed of their activities and plans.

Executive Committee member

Working Groups

Postma	46, 57, 62
Hempel	42, 54, 56
Goldberg	10
Tchernia	47, 51, 58, Antarctic Review Gp.
Simpson	61, 63, (64)
Parsons	52, 59, 60, (65)
Stewart	34, CCCO
Junge	44, 55

2.7 SCOR Scientific Rapporteurs

Scientific Rapporteur on Marine Pollution

A brief report was received from Dr B. Dybern. SCOR expressed its appreciation to Dr Dybern for maintaining, on behalf of SCOR, liaison with various international groups concerned with pollution of the marine environment. SCOR invited Dr Dybern to continue in this role and to bring to the attention of SCOR appropriate matters arising at environmental meetings. Dr Dybern had suggested that an area which might be appropriate for SCOR attention in the future was the influence of physical factors, such as salinity changes and siltation, on coral reefs.

Scientific Rapporteur on Coastal Research

Professor Postma considered that all relevant matters had already been discussed under foregoing items. He will continue to advise SCOR on matters he considered appropriate for SCOR attention in the field of coastal and estuarine research.

3.0 Relations with Intergovernmental Organizations

3.1 IOC

a) Matters arising from the tenth session of the IOC Executive Council, June 1978

i) *Atlantico-Ibero-African Area*

IOC requested SCOR to identify future topics for research in this area and, to evaluate the proposal for a co-operative study in the region outlined in document IOC/EC-X/18 rev.

It was recognised that this was an important area which had many interesting scientific problems in most marine disciplines. There was, however, a strong feeling that these were so diverse, that any proposal for a co-operative study in the IOC should be based on clearly identified research needs of the IOC members rather than from a general or regionally recognised desire to co-operate. For many years scientists from several countries had studied various scientific problems in the region either independently or on co-operative programmes and this was expected to continue. SCOR felt that the proposed co-operative study formulated in the document did not adequately identify

specific research tasks and they were thus unable to make a proper evaluation of the merit of the proposal.

SCOR would, however, be prepared to assist in the evaluation of any further proposals which identified more specific problems of IOC members and would then be better able to comment on the desirability of an IOC co-operative study.

Several of the members present drew attention to aspects of this region which were of recognised scientific interest and SCOR would also be prepared to review these provided the necessary support could be made available by IOC.

ii) ***Resolution EC/X 4 – Investigations of Processes in the Major Ocean Areas.***

SCOR had been invited to examine a proposal submitted by the USSR to the Tenth Session of the IOC Executive Council in paper IOC/EC-X/21. A similar proposal had been submitted to the meeting of the WMO Executive Committee in June 1978 under the title *research programme into the processes of ocean-atmosphere interaction*, and had been referred to JOC for comment. A revised and amplified version of the proposal had been discussed at the JOC/SCOR Specialist Meeting on the Role of the Ocean in the Global Heat Budget immediately prior to the General Meeting of SCOR at which comments on the original proposal by some members of the SCOR Executive Committee, the Indian Ocean Panel of WG 47 and the Chairman of WG 49 had been available.

The General Meeting concurred with the views of the JOC/SCOR Specialist Meeting (see Annex XIX) and agreed to convey their statement to IOC with the support of SCOR, emphasising to IOC the desirability of early initiation of the internationally coordinated pilot study related to long term time-series in selected regions of the ocean.

The SCOR General Meeting agreed that the general theme of the USSR proposal was both valuable and timely; the underlying idea being that it will be necessary to restrict the collection of ocean time-series extending over many years to selected sites that are particularly sensitive to the influence of the ocean on climate over periods of several weeks to several tens of years. It was recognized that the collection of such time-series was becoming important both for statistical studies aimed at understanding ocean-climate influence and equally for studies of related physical processes in the ocean. Some specialists considered that existing climate models are not yet sufficiently reliable to allow identification of the best sites for the collection of such time-series. Nevertheless, it would be appropriate for interested institutions to embark on a pilot study over the next 5 to 10 years using the best available indications. In view of the uncertainties at this stage, it will be advisable to minimize the cost of such a pilot study by using, wherever possible, ships of opportunity and charter ships equipped with expendable and/or towed instruments.

In this general spirit, the SCOR General Meeting wished to encourage any national initiatives towards implementing the proposed programme.

iii) *NW Indian Ocean*

The General Meeting considered the request from IOC (Resolution EC-X.10) to identify outstanding scientific problems relating to the marine environment and resources in the area of the North-Western Indian Ocean. Comments had been received from several relevant working groups and SCOR Executive members.

It was agreed to recommend to IOC that a multidisciplinary group of scientists interested in working in that area be formed and be invited to consider the matter more closely. SCOR was prepared to start organizing such a group of experts both from the region and from outside, and to prepare a meeting in the area during 1979 to develop a prospectus on the outstanding problems of the region, if IOC were able to provide the necessary financial support.

iv) *Intercalibration of the determination of selected pollutants*

SCOR had been asked to comment on the proposed IOC/WMO/UNEP Pilot Project on Monitoring Background Levels of Selected Pollutants in Open Ocean Waters and, in particular, on the proposed intercalibration exercise. It was agreed that SCOR should endorse this activity but, at the same time, it was felt that the attention of IOC should be drawn to the expense and technical difficulties.

Most of the analyses proposed were technically very difficult and required the attention of highly experienced analysts with sophisticated equipment; there were rather few laboratories properly equipped to undertake this work. It was felt that the validity of the results would best be appraised through the open scientific literature and IOC should encourage participants to bring the results to the attention of the scientific community in this way and at an early date.

- v) A request from the Tenth session of the IOC Executive Council for advice on the types of scientific questions which should be asked in investigations of the impact of climatic changes on physical and human conditions was taken into account in a general discussion of climate (see item 2.2 - CCCO). No specific response to this request was formulated at the meeting, and it was referred to CCCO for further consideration. It was felt, however, that IOC might urge the continuation of existing long time-series of measurements and stimulate member governments to initiate new time-series collection of climatically important oceanic data when these have been identified by CCCO.

b) *Future Role and Function of IOC*

Resulting from a proposal by ACMRR, and a suggestion by the IOC Working Group on the Future Role and Functions of IOC that the official advisory bodies of the Commission might wish to consult each other in order to provide appropriate input to the current work on reappraisal of the Commission's tasks and activities, an informal consultation of representatives of ACMRR, ECOR and SCOR was held in Paris from 16-20 October 1978.

The SCOR General Meeting endorsed the report of this informal consultation, which is given as Annex XVII, although SCOR did not consider that any benefit would be derived from meetings of the officers of the advisory bodies at this time. Transmission of this report to IOC was considered to be sufficient input from SCOR to the IOC Working Group meeting in December 1978.

SCOR considered that the careful and extensive discussions now being conducted within IOC were of great significance for the future of international marine science. It was important that IOC should increasingly be regarded as the UN specialised inter-governmental organization competent in the field of marine scientific research as it relates to the interests both of its member states and to marine science aspects of programmes and interests of other agencies of the UN system. SCOR should therefore continue to be ready to assist IOC in its endeavour, as and when appropriate.

Some members of the SCOR Executive Committee had already acted on an invitation from the President to assist in responding to Resolution EC-X.15 by offering directly to Mr L. Brown, Chairman of the IOC Task Team, their views on the future science programme of IOC. Mr Brown had recently produced a first draft of a paper entitled *Future Directions for the IOC's Marine Science Programme* which had been sent to members of the IOC Task Team for comment. SCOR had sent copies to the members of its Executive Committee and copies were distributed at the General Meeting. In general, the members of SCOR present commented favourably on this paper, but time did not permit a detailed consideration of it. The President invited all present to convey any detailed comments or views they may wish to offer directly to Mr Brown. It was understood that a revised draft would be presented to the IOC Working Group at its second meeting in December 1978 and that comments on that version would be invited by 1 February 1979 after receipt of which the Task Team would proceed to the preparation of its final paper. It seemed probable that copies of this final paper will be made available to SCOR in about May or June 1979 when a formal SCOR viewpoint on it may be formulated.

An extensive discussion ensued at which it was suggested that, in relation to the IOC review and the proposed discussion at the IOC Assembly in October 1979 on the future of the IOC Scientific Advisory Board, SCOR should be giving consideration to its own future role in relation to IOC. SCOR's traditional role had been the development of basic marine science by bringing together scientists from a number of countries who wanted to work together on a common problem.

In general, the questions demanding attention or action by SCOR had always been of a fundamental or universal nature of wide significance. In recent years SCOR somewhat shifted its attention towards specific topics of more immediate practical or scientific application. Whether or not SCOR should more fully respond to the needs of some developing countries for studies of the near-shore environment related to development, or whether these were better developed bi-laterally, warrants further discussion. It was believed that IOC would have a continuing need for advice and activity by SCOR and its Working Groups, but at the same time would need its own scientific mechanisms for such tasks as evaluating ongoing programmes and providing interface with SCOR. Experience had shown that the most effective Working Groups of SCOR had been those with narrowly defined terms of reference; also much of the advantage to IOC in

seeking scientific advice from SCOR lay in the fact that SCOR was a part of ICSU and could seek contributions to its work on basic scientific questions through its Affiliated Organizations, National Committees and other components of ICSU.

One recurring problem seemed to be that often requests from IOC (or UNESCO) were not formulated in a way in which SCOR could respond effectively or lay outside the area of SCOR competence. It was agreed that it would be beneficial for SCOR to formulate a statement of how SCOR saw its role in relation to IOC and UNESCO and how it could interact effectively with these bodies – it was not a general statement of SCOR aims and objects that was needed, but a statement confined to its advisory functions.

Such a statement in the name of SCOR would have to take into account the variety of views and interests of its 34 National Committees. In some countries it seemed likely that the SCOR National Committee would not be fully aware of the present relationships and interactions between SCOR and IOC/UNESCO and that before their comments were sought they should be given sufficient background information on the present situation, the problems posed by recent developments of both IOC and UNESCO and a variety of options as to how SCOR might develop in relation to these bodies.

The newly coopted SCOR Executive Committee member for matters concerning relations with other international bodies, Professor W.S. Wooster, accepted an invitation to prepare a draft of such a paper which would be discussed by the Executive Committee and amended as required before being sent to National Committees.

c) *Post IDOE Programmes*

With references to discussions at the twentieth and twenty-first Executive Committee meetings concerning important areas for international attention during the post IDOE period, Professor Wooster reported that the findings of the final summary workshop of a series of national workshops on this subject had recently been published by the US National Academy of Sciences under the title *The Continuing Quest* and copies were about to be sent to SCOR National Committees. Some non-USA members of SCOR had already read advance copies of this report and believed that, although it was essentially a national document written from the point of view of one country, in general the proposals it contained would be likely to find strong support from most oceanographers of whatever nationality. Sir George Deacon expressed a view of the British National Committee that good indicators of priority problems requiring international attention were to be found in the topics which are, and would be, identified by SCOR for attention by its Working Groups. The British National Committee had also suggested renewal of efforts to describe and understand the large-scale general circulation of the ocean and its effects on the biology and chemistry, incorporating recent advances in the knowledge of smaller-scale processes and studies of what happens to biological energy released when stocks of terminal predators are depleted through over-fishing.

SCOR considered that many views on the important subject areas for attention during the 1980's had already been mentioned in relation to the current review on the future role and structure of IOC, and recommended to national commit-

tees that when they consider their responses to enquiries regarding this latter topic they consider also the views expressed in *The Continuing Quest*. In view of this activity it was not considered necessary, at this time, for SCOR to pursue further the identification of projects for the post-IDOE phase of LEPOR.

d) ***General Bathymetric Chart of the Oceans (GEBCO)***

A set of those 5th edition GEBCO charts already published was displayed. A list of these and the proposed programme for publishing the remaining charts is given in Annex XVIII.

Sir George Deacon again emphasised the need for a polar projection GEBCO chart of the southern oceans to extend to the southern hemisphere continents. Professor Simpson, Chairman of the GEBCO Guiding Committee, said this would be possible once the data for the presently planned south polar chart and the adjacent Mercator charts were on a computer, but in view of the voluntary nature of the work on the series, he did not think an extended polar chart would be possible until after the completion of the present programme, in 1982. He would nevertheless bear the need in mind.

e) ***Bruun Memorial Lectures***

In response to an invitation from IOC to suggest names of possible speakers for the Bruun Memorial Lectures in 1979 on Renewable Resources, Non-renewable Resources, Energy and Ocean Climate, SCOR indicated its approval of the names selected by Dr N.J. Campbell and offered to the IOC representative a number of alternatives. SCOR suggested that it might be of benefit to concentrate the subject of the lecture on non-living resources to hydrocarbons of the deep sea, beyond the Continental Shelf.

f) ***Forthcoming meetings of IOC***

It was agreed to invite Mr J. Crease, UK, to represent SCOR at the meeting of the IOC Working Committee on International Oceanographic Data Exchange in New York in January 1979.

Professor W.S. Wooster agreed to represent SCOR at the eleventh session of the IOC Executive Council in Mexico City, 26 February to 3 March 1979.

3.2 UNESCO

a) ***Biogeochemistry of Estuarine Sediments***

Unesco expects the proceedings of the Workshop on biogeochemistry of estuarine sediments to be published shortly.

b) ***Coastal Lagoons***

The representative of UNESCO reported on the results of their enquiry on research in coastal lagoons and on their plans to publish this in the technical series. They had already held a seminar on present and future research on coastal

lagoons, at Beaufort, North Carolina, USA, and were planning an international conference on coastal lagoons in 1980 and 1981, probably at UNESCO, Paris.

At the suggestion of UNESCO, the SCOR Advisory Group on Coastal Lagoons was disbanded, but some of its members might be invited by UNESCO to serve on the conference planning committee.

Some concern was expressed about the degree of overlap with the interests of Working Group 57 and it was felt that they should be very much involved in the conference planning. UNESCO was advised to communicate with the Chairman, Professor B.J. Matthews.

c) ***Photosynthetic Pigments***

SCOR accepted the draft report on Intercalibration Tests of Chlorophyll Oceanographic Methodology and congratulated Drs Lorenzen and Jeffrey on the excellent nature of their study. SCOR requested the authors to submit a final copy of their report (including the Appendix) to UNESCO and recommended to UNESCO that it should be published as soon as possible as a technical report.

SCOR also welcomed the proposal to publish a fuller report of the study in a scientific journal.

SCOR recognised that it would be timely to prepare a comprehensive scientific review on the subject of photosynthetic pigments in sea water and decided to invite Dr Jeffrey and Dr Lorenzen to undertake this task, involving other appropriate experts in the field. It was considered that this would best be published in the open scientific literature where it would be widely available.

SCOR also recognised the need to update the UNESCO monograph on the *determination of photosynthetic pigments in sea water* and recommended that Dr Humphrey be asked to revise this on the basis of the Jeffrey/Lorenzen UNESCO Technical Report, including sections on extraction, equations, additions on the fluorescence technique and the recalculation of previous data using existing publications in these fields.

d) ***Coral Reefs***

SCOR noted the content of a proposed IABO/SCOR/UNESCO programme for Coral Reef studies but felt it was concerned largely with local problems. SCOR recommended that a more detailed study be made to identify specific problems of universal and generic interest for coral reef studies in different environments rather than of local interest. For this purpose SCOR recommends that an IABO/SCOR/UNESCO expert be appointed to visit various nations having coral reef ecosystems and determine which problems are common to researchers in these areas. The expert should submit his report to UNESCO through IABO/SCOR. Such an expert might also identify major local problems which might warrant support by UNESCO.

3.3 ACMRR/FAO

Matters concerning ACMRR liaison with SCOR Working Groups are reported under the

appropriate sections of item 2.2 and 3.1, above. The last meeting of ACMRR was held in June 1978 and the next meeting is likely to be in 1980.

3.4 WMO

SCOR had accepted an invitation from the WMO/ICSU Joint Organizing Committee for GARP (JOC) to cosponsor a joint JOC/SCOR specialists meeting on *the Role of the Oceans in the Global Heat Budget* which had been held in Kiel from 6 to 8 November 1978. The report of that meeting is given as Annex XIX. The GARP Activities Office of WMO will also distribute this report.

SCOR supported strongly a recommendation of the Specialists Meeting, arising from a proposal from the JOC Officers Meeting, September 1978, that a joint JOC/SCOR Study Conference on the Impact of Oceanic Processes on Global Climate be organised, possibly in 1980.

The SCOR Executive Committee Reporter for CCCO was asked to seek advice from that Committee regarding SCOR representatives for the organizing committee for the conference and to maintain liaison with JOC.

WMO, in collaboration with FAO, UNESCO, UNEP, WHO, ICSU and IIASA, is planning a World Climate Conference — a conference of experts on climate and mankind — in Geneva — from 12 to 29 February 1979. The first week will be devoted to presentation and discussion of overview papers on the present state of knowledge of climatic processes and the impact of climatic change and variability on various aspects of human affairs. This first week would be open to a wide audience and applications to attend should be sent to the Secretary General of WMO as soon as possible. The second week will be restricted to invited experts, formed into working groups, to prepare the findings and recommendations of the Conference.

It was noted that there were no papers on physical oceanography or the effect of the ocean on atmospheric climate in the programme of the conference. This omission was perhaps, understandable in view of the emphasis of the programme, as reflected in the sub-title, and the object of the conference which, it was understood, was to bring to the notice of a broad spectrum of interested people and officials an awareness of the impact of climatic variation on human endeavour. It was not considered necessary for SCOR to seek to be formally represented at this conference.

3.5 ICES

Professor G. Hempel reported that at the recent Statutory Meeting of ICES it had been decided to postpone a final decision regarding the proposed international eel expedition (see *SCOR Proceedings* Vol 14 p. 22 and Annex XII) until the results of a 1979 expedition by two vessels of the Federal Republic of Germany, in the area 20° — 32°N, 54° — 66°W, became available.

ICES had recently issued the first circular regarding the ICES/FAO/ICNAF/IABO/SCOR symposium on the *Early Life History of Fish* to be held in Woods Hole, USA, from 2–5 April 1979.

4.0 Relations with Non-Governmental Organizations

4.1 Affiliated Organizations

CMG

A report to SCOR from CMG, is given as Annex XX. A report of the 10th meeting of CMG, in April 1978, was distributed. At this meeting CMG had discussed, amongst other matters, future activities appropriate for CMG, particularly in the post-International Geodynamics Programme period. Suggestions had included cooperation with JOIDES in organizing follow-up workshops or review-type symposia.

IABO

A report from IABO to SCOR is given as Annex XXI. Other recent activities of IABO were reported in the *IABO Newsletter* issued in August 1978. It was noted that IABO had under consideration some form of affiliation with the International Seaweed Association.

IAMAP

A report of recent IAMAP activities of interest to SCOR is given as Annex XXII.

IAPSO

A report on IAPSO activities 1978 is given as Annex XXIII. This report includes details of IAPSO-sponsored or cosponsored symposia to be held during the General Assembly of IUGG in Canberra in December 1979. The SCOR/IAPSO symposium on Oceanic Turbulence will be held in Liege, Belgium, from 14-19 May 1979, in association with the 11th Liege Ocean Hydrodynamics Colloquium, at which invited and contributed papers will be on the subject Turbulence in the Ocean. Noting that IAPSO had already offered some financial assistance for this workshop, SCOR agreed to try to make some provision provided further funds were forthcoming in 1979 but regretted that SCOR could not offer the \$5,000 that had been requested by the organizers.

It was expected that IOC will assist a number of participants from developing countries, and the representative of UNESCO agreed to ascertain whether UNESCO could offer any support.

The SCOR General Meeting considered a proposal from Dr R. Chesselet, arising from a suggestion that had first been made at the 1976 JOA, that a SCOR/IAPSO workshop on the fluxes and chemistry of particulate matter in the ocean be held immediately following the IAPSO/IUGG General Assembly in December 1979.

SCOR supported the idea of a workshop to follow up, and elaborate upon, the four presentations of IAPSO Symposium PS11A and to publish the results in an established, referred journal and encouraged Dr Chesselet to try to make the necessary arrangements. However, SCOR did not feel able to support financially participants in any of the IUGG Assembly symposia and regretted that budgetary limitations prevented SCOR from providing subsistence allowances for participants in the workshop.

4.2 Corresponding Organizations

ECOR

The Third Annual Assembly of ECOR had been held in Washington, D.C., USA, from 3 to 5 May 1978, associated with which had been a workshop on ocean instrumentation. A brief report on the meeting had been received from the SCOR member of ECOR, Dr T.F. Gaskell. Ir G. Heyning advised that the report of the Assembly, which included one and a half day's discussion on technology transfer, and the report of the workshop, would be available shortly and he agreed that ECOR would provide sufficient copies of both for distribution to SCOR National Committees and members of the SCOR Executive Committee.

4.3 ICSU

Consideration was given to the Resolutions from the ICSU General Assembly, September 1978, and comments were made on some of these as follows:

Res. 6 *Anniversaries of the Polar Years and IGY*

Noting that ICSU was intending to organize, in 1982, a special event to commemorate the 100th anniversary of the first Polar Year, the 50th anniversary of the second Polar Year and the 25th anniversary of the IGY, SCOR expressed interest in the proposal and invited Sir George Deacon to discuss with ICSU, on behalf of SCOR, ways in which SCOR might contribute.

Res. 9 *Scientific aspects of nuclear waste disposal*

ICSU had decided to establish a study group, under the Chairmanship of Professor J. Harrison, Canada, to consider ICSU's role in this problem and, if considered desirable, to plan and review activities in the fields of terrestrial and marine disposal and pathways. A list of 13 scientists known to have knowledge and experience in matters related to marine disposal and pathways was prepared by SCOR and conveyed to the Executive Secretary of ICSU.

Res. 11 *Structure of ICSU*

ICSU had requested the Executive Board to initiate a study of ways in which the organizational structure of ICSU could be adapted to meet the changing patterns and needs of science, and had recommended that Unions, Committees and national adhering bodies be invited to formulate views for submission to the Executive Board's study.

SCOR invited all members of the Executive Committee, and other interested members of SCOR, to convey any views they might have to the Secretariat so that these could be considered by the SCOR Executive Committee at a later date.

Res. 15 *World Climate Research Programme*

ICSU had approved a draft agreement for the joint conduct of the World Climate Research Programme by both ICSU and WMO and had requested

the Executive Board to establish an appropriate coordinating mechanism on climate change and variability to stimulate work and facilitate cooperation within the ICSU family and with other international bodies.

It was agreed that ICSU be informed of the establishment by SCOR (and IOC) of a Committee on Climatic Changes and the Ocean and be invited to consider that committee as the group to provide the oceanographic input to the programme.

Res. 20 *Publications*

In order to bring the activities of ICSU to the attention of the scientific community at large, ICSU intended to publish, at frequent intervals, a Newsletter and urged all ICSU bodies to provide news of their current activities.

SCOR referred ICSU to the regular production of *SCOR Proceedings* as the main source of information about SCOR activities and agreed to provide special items from time to time, to be determined by the SCOR Executive Committee.

Res. 21 *Global Carbon Cycle*

Noting ICSU's request to SCOPE, in cooperation with other ICSU bodies, to convene a group of experts to discuss ways to utilize the expertise of the ICSU family, it was reported that in May 1978 SCOPE had been informed of the establishment of SCOR WG 62 on the *Carbon Budget of the Ocean* and that SCOPE was in communication with the Chairman, Professor E. Goldberg, and the SCOR Executive Committee reporter, Professor H. Postma.

4.4 ICSU Unions

It was regretted that Professor Goldberg had been prevented by illness from attending the SCOR General Meeting and was therefore unable to report on the latest developments regarding liaison between SCOR and IUPAC. However, it was understood that Dr E.I. Hamilton, UK, had been invited by IUPAC to serve as the focus of their liaison with SCOR and he was in communication with Professor Goldberg.

4.5 ICSU Committees

COSPAR/IUCRM

Dr J.E. Gower has accepted an invitation from SCOR to serve as liaison between SCOR and COSPAR in place of Dr D.E. Cartwright. In his report of the 21st Plenary Meeting of COSPAR, Dr Gower proposed that SCOR cosponsors, with COSPAR and IUCRM, a symposium on spacecraft oceanography in 1980. Dr S. Ruttenberg (COSPAR liaison member to SCOR) has suggested that such a meeting might be held at the time of a three-day symposium on *System Performance and Early Results of the Global Observing System* for FGGE, in Budapest, Hungary, in 1980.

There was a general feeling that several satellite remote sensing techniques have recently or will soon reach the important transition from the development stage to adoption as a routine tool in oceanographic research. This point was made in section 4.4 of the report of the Kiel meeting on the Role of the Ocean in the Global Heat Budget (see Annex XIX), and practical examples were seen in papers presented at the "Interdisciplinary Meeting on Oceanic Fronts" held during the SCOR General Meeting. SCOR therefore welcomed the suggestion to cosponsor a symposium and suggested that it might be entitled *oceanographic use of remote sensing techniques*. SCOR felt, however, that the value of such a symposium would be enhanced if it were to be held in association with a meeting at which oceanographers would be present, rather than in association with a COSPAR meeting. Such a symposium at a SCOR General Meeting would be ideal for demonstrating to oceanographers the capabilities of remote sensing, but it seemed unlikely that this would be possible at XV SCOR. The Executive Committee was asked to accept the invitations from COSPAR and IUCRM and to negotiate with them regarding a suitable venue and time.

Research requirements and recommendations, identified by the Infra-red Measurements Panel at the Inter-Union Commission of Radio Meteorology (IUCRM) Symposium on *Passive Radiometry of the Oceans*, conveyed to the President of SCOR by the President of IUCRM, will be published shortly as part of the Panel's formal report in *Boundary Layer Meteorology*. SCOR commended this publication to the attention of oceanographers and, noting that IUCRM was concerned largely with the development of methods and techniques, expressed the hope that some joint activity might prove feasible in the future, perhaps in cooperation with IOC and UNESCO.

ICSU Panel on World Data Centres

A report by Mr J. Crease, SCOR/IAPSO representative on the Panel, is given in Annex XXIV. Concerning a suggestion made by some members of the Panel that marine geology and geophysics belonged more naturally with the Solid Earth WDC's, SCOR agreed wholeheartedly with Mr Crease's view and recommended that there be no change made to the present arrangements.

5.0 Future Meetings

- a) Although experience had shown the benefit of SCOR Executive Committee meetings being held at approximately 8-monthly intervals, in view of the difficult financial situation it was agreed that unless additional funds were forthcoming, the Executive Committee meeting due about May 1979 might be replaced by a meeting of a few of the elected officers only. Other members of the Executive Committee who could attend such a meeting at no cost to SCOR would be welcomed. It was not expected that an issue of *SCOR Proceedings* would result from such a meeting, the report of which might be distributed in duplicated form and perhaps incorporated in the subsequent issue of *Proceedings*.

A full Executive Committee meeting should be held about January 1980, at which National Committee representatives would be welcomed.

Professor Hempel extended an invitation for the next SCOR Executive Committee meeting to be held in Kiel, FRG. This offer was accepted.

- b) It was agreed that the 15th General Meeting of SCOR should be held about September 1980. It was further agreed that at future General Meetings, it would be advantageous for the Executive Committee to meet for about 3 days before the General Meeting to discuss the more routine business matters and for the report of that meeting to be submitted to the General Meeting for comment and/or amendment and adoption, thus enabling the larger meeting to concentrate on fewer items and on the scientific component of the meeting.

Dr J.H. Steele, Director of the Woods Hole Oceanographic Institution, indicated his agreement to a suggestion that the 15th General Meeting of SCOR might be held in Woods Hole, USA, at the time of the Institution's 50th anniversary celebrations. In view of the proposed programme for these celebrations (see item 6 below), the assembly on current and future oceanography might be considered to constitute the scientific component of the SCOR meeting. The SCOR Executive Committee was asked to look into this suggestion further, in consultation with the US National Committee, bearing in mind the possibility that the SCOR Executive Committee might meet from 22–24 September 1980 and that the SCOR general business meeting be held on the Saturday and Sunday 27–28 September 1980, with perhaps a further session at the end of the week to clear up outstanding matters.

Should it not prove practical to hold the 15th General Meeting in association with the Woods Hole celebrations, Professor D. Ellis suggested that consideration might be given to adopting as the scientific topic an interdisciplinary discussion on rehabilitation of marine ecosystems, which would require contributions from physical, chemical, biological and geological oceanographers. The Executive Committee was asked to take this suggestion under further consideration.

The SCOR General Meeting agreed that between now and the 15th General Meeting, the Executive Committee should give careful consideration to ways in which encouragement could be given to greater contributions to SCOR activities from National Committees and more specifically how the next General Meeting might formulate requests for attention by National Committees.

- c) Discussion on whether periodic multi-discipline Joint Oceanographic Assemblies were profitable, and whether participants did not tend to restrict their attendance to those parts of an Assembly which were concerned directly with their own field of interest, revealed a general view that JOA do serve a useful purpose in encouraging marine scientists to discuss problems across traditional discipline boundaries. It was becoming increasingly difficult for scientists to keep abreast of all that was being published, even within their own scientific discipline outside the bounds of their particular interest, and the JOA kind of meeting did provide an opportunity for all to become acquainted with recent advances in marine science. It was agreed therefore that these larger meetings were of value and that the next JOA might be held in 1982. However, in planning the programme for such a meeting, the organizers should bear in mind the following important factors:

A JOA should concentrate on multi-discipline symposia.

There should be few, if any, concurrent sessions.

Associated meetings during the period of the Assembly should be actively discouraged. If such meetings were arranged to take advantage of the presence of

a number of scientists at the JOA, they should be scheduled during the week preceding the Assembly, and not be allowed to overlap into the Assembly time period.

Extensive poster sessions should be encouraged and these should be located immediately accessible to a general circulating area.

It was agreed to enquire whether any National Committee would like to host a Joint Oceanographic Assembly in 1982 and, bearing in mind a suggestion by UNESCO that it might be appropriate to hold such an Assembly in a developing country, to enquire of UNESCO whether they had any specific suggestions to offer.

6.0 Other Meetings

- a) Two announcements regarding the 3rd International Congress on the History of Oceanography, to be held from 22–26 September 1980, at Woods Hole, USA, had been issued. Offers of contributions should be sent directly to the Chairman of the Organizing Committee, Dr D. Merriman, 298 Sperry Road, Bethany, Connecticut 06525, USA.

During the week following the history congress (that is, from 29 September to 4 October 1980) an assembly will be held on current and future oceanography, further details of which are to be announced. This assembly will constitute part of the celebrations of the 50th anniversary of the Woods Hole Oceanographic Institution.

- b) A proposal was received from Dr M. Clarke, UK, for a workshop on the identification of cephalopod beaks. It was considered that such a workshop would be both scientifically interesting and timely, particularly in relation to the activities of WG 54 and WG 52, and IABO was invited to examine the proposal further. SCOR was unable to make the funds available in 1979 for such a workshop but hoped that if additional financial support was forthcoming for the BIOMASS programme, such a workshop might be considered under this programme.
- c) Professor Hempel reported that a request to his Institute from Unesco and Indonesia to assist with the preparation of a programme in east Indonesian waters had been referred to the SCOR National Committee of the F.R.G. They had agreed that the area was of great scientific interest and would be pleased to collaborate but the proposal had been too wide ranging in both subjects and geographical area for them to offer useful comment at this stage. The F.R.G. had felt that the advice and assistance of SCOR should be sought before the Unesco Regional Office for south-east Asia proceeded with their proposed programming workshop 4–8 December 1978.

Professor Postma stated that, as he reported in the previous SCOR executive meeting earlier this year, he had been engaged by Unesco as consultant to advise them how to proceed in response to a request from Indonesia for assistance in promoting the study of their marine areas. This had developed into an idea for an Expedition to the region which had been little studied since the important Dutch multidiscipline investigations from *Willebrord Snellius* of 1929–30 — a Snellius Anniversary Expedition. He had spent two weeks in Djakarta and had offered some specific suggestion, which had included concentration on the ventilation of the deep sea basins, and had advised

that the ideas be developed by a workshop in collaboration with a number of international organizations, including SCOR. Indonesia had sought Unesco support for the planning workshop, in December 1978, to which the Unesco Regional Office had invited a number of foreign scientists but the response had been somewhat disappointing, largely he thought because Unesco had not consulted the international marine science organizations, and also because, with the proposed study not formulated in detail, it would be impossible to obtain commitments for ship time for work in 1979 as had been proposed.

A number of participants in the General Meeting confirmed that there were important scientific problems that could be studied in the area, particularly what energises the mixing processes in the deep basins below the sill depths (2600–3000 m) in the absence of density and wind forces, the temperatures and salinities being uniform but the water at the greatest depths being well oxygenated, and the effects of this mixing on the biota. A study of these unique areas would be of significance to the understanding of other deep basins. Other problems include the deep structure and tectonics of the region, the interaction between Indian Ocean and Pacific Ocean waters and the local and seasonal upwelling.

Programmes to study these phenomena would require research ships with advanced equipment and experienced marine scientists and could not be planned in a short space of time.

As it was understood that the preparations for the Unesco planning workshop were well-advanced, it should proceed with the primary objective of enabling Indonesian scientists to identify what they see as the priority problems in their area warranting international attention. It should be recognised however that a workshop at this time would be unable to discuss in detail an international programme. Unesco should be advised to use the report of the workshop for stimulating interest in other countries and to plan, seeking advice from SCOR and other organizations, a further international workshop at a later date to identify interests of countries outside the area and to prepare a tentative programme. Any programme should be based on a limited number of priority scientific questions and provisional expressions of interest in sending ships and scientists. It should be noted also that the IOC workshop on co-operative investigations of the Kuroshio in 1979 would be concerned with defining priorities in the Western Pacific, which might have some relevance.

In concluding the meeting the President expressed sincere appreciation, to the French National Committee, to the Centre National pour l'Exploitation des Océans and to the Centre Océanologique de Bretagne (COB), for the invitation to hold the 14th General Meeting in Brest and for the excellent facilities that had been made available both for the business meetings and the scientific discussion on oceanic fronts.

Fourteenth General Meeting of SCOR

Participants

Members of the Executive Committee

*Dr K.N. Fedorov	USSR	President
*Professor H. Postma	Netherlands	Past President
*Professor G. Hempel	FRG	Vice President
*Professor P. Tchernia	France	Vice President
*Mr R.I. Currie	UK	Secretary
*Professor W.S. Wooster	USA	Reporter for Publications
*Professor E.S.W. Simpson	IUGS/CMG	Ex Officio
*Professor T.R. Parsons	IUBS/IABO	Ex Officio
*Professor C. Junge	IUGG/IAMAP	Ex Officio
*Dr R.W. Stewart	IUGG/IAPSO	Ex Officio

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

Mr F.W.G. Baker (ICSU)	*Dr U. Lie (Norway)
Dr R. Bastida (Argentina)	*Dr R. Marumo (Japan)
*Academician L. Brekhovskikh (USSR)	*Professor A.S. Monin (USSR/ICSU)
Dr J. Carreto (Argentina)	*Professor J.C.J. Nihoul (Belgium)
*Dr R. Chesselet (France)	*Professor P. Polk (Belgium)
*Sir George Deacon (UK)	*Professor J.E.G. Rayment (UK)
*Dr R. Dorrestein (Netherlands)	*Dr R.A. Scrutton (CMG/UK)
*Dr D.V. Ellis (Canada)	Dr G.D. Sharp (FAO/ACMRR)
*Dr C.J.R. Garrett (Canada)	Dr J. Steele (USA)
Dr T.F. Gaskell (CMG)	Dr M. Steyaert (UNESCO/OCE)
*Dr K.R. Gundersen (Sweden)	*Dr K. Striggow (GDR)
Ir G.A. Heyning (ECOR)	Professor M. Uda (Japan)
*Dr G.F. Humphrey (Australia)	*Ing F. Vila (Argentina)
Dr O.M. Johannessen (Norway)	Dr K. Voigt (IOC)
Dr P. Lassere (France)	Professor J.D. Woods (FRG)
Dr A.S. Laughton (UK)	*Professor S. Szymborski (Poland)

* = SCOR members

ANNEX II

STATEMENT OF SCOR INCOME AND EXPENDITURE

(1 January to 31 December 1978)

BALANCES 1 JANUARY 1978		\$	\$
London		71884.33	
Paris		<u>2312.16</u>	
			74196.49
<i>INCOME</i>			
National Contributions for 1977	1100.00		
1978	32600.00		
Contracts		33700.00	
IOC Regular Contract 1977 (final)	2000.00		
UNESCO Regular Contract 1977 (final)	1000.00		
IOC Regular Contract 1978 (first)	10000.00		
UNESCO Regular Contract 1978 (first)	9000.00		
IOC Special Contract RIOS (first)	6000.00		
Interest		28000.00	
		<u>648.57</u>	
			62348.57
<i>EXPENDITURE</i>			<u>\$ 136545.06</u>
Scientific Activities			
Working Groups			
10	1171.66		
42	634.71		
43 (inc. symp. & Atlas)	11124.74		
46	683.82		
47 Atlantic	4284.51		
Pacific	6541.81		
Indian	1211.45		
49	530.96		
51	2050.93		
54	2719.98		
55	10620.66		
56	8949.74		
57	4139.98		
58	2133.78		
60	11290.13		
Editorial Board Coastal Upwelling	835.80		
Photosynthetic Pigments	2115.00		
Oceanic Fronts	<u>7608.56</u>		
			78648.22
Representations at other meetings			
COSPAR	1512.82		
IUCRM	1389.63		
Diatom Symp.	934.72		
ICSU climate mtg.	1214.81		
ICSU Panel WDCs	344.04		
IOC EC.10	1147.53		
IOC W. Ctee. El Niño	1032.72		
GEBCO Guilding Ctee.	946.71		
ACMRR	735.37		
ACMRR/SCOR/ECOR Consultation	<u>1000.26</u>		
			10258.61
Publications			
Proceedings Vol 14	1702.41		
BIOMASS Vol 1	1741.20		
Proceedings Vol 13	<u>51.99</u>		
			3495.60
Meetings			
EX 21	19028.77		
XIV SCOR	<u>7858.30</u>		
			26887.07
Administration			<u>8207.74</u>
			127497.24
Balances 31 December 1978			
London	8546.78		
Paris	<u>501.04</u>		
			9047.82
			<u>\$ 136545.06</u>

SCOR WG 10, JOINT PANEL ON OCEANOGRAPHIC TABLES AND STANDARDS (JPOTS)

Report by N.P. Fofonoff

Salinity

The concept of salinity was introduced as a measure of the salt content of seawater. A simple basic measure is the mass ratio of dissolved salts to seawater. This ratio cannot be accurately or conveniently measured so a different measure (scale) is used. JPOTS recommends that the mass ratio be called *absolute salinity* to distinguish it from the *practical scale salinity*.

Sørensen (1902) introduced a salinity scale based on evaporating seawater to dryness. Knudsen used this procedure to establish a relationship between salinity and chlorinity using 9 samples of natural seawater:

$$S = .03 + 1.805 C1$$

Chlorinity could be determined by chemical titration and used to estimate salinity. Note that the composition changes with salinity and the equation is not conservative for addition and removal of pure water.

The introduction and subsequent widespread use of electrical conductivity in the 1950's to estimate salinity led to a reconsideration of the salinity scale. To achieve conservation for addition and removal of pure water salinity must be proportional to chlorinity. To be consistent with historical data, the new scale was chosen to coincide with the previous scale at 35‰ salinity. The result is

$$S = 1.80655 \cdot C1$$

To relate this salinity scale to conductivity, Cox determined a regression formula (least squares) between electrical conductivity ratio R_{15} at 15°C and chlorinity for a large number (135) of natural seawater samples including mid range samples made by mixing Baltic and Red Sea Waters. After replacing chlorinity by salinity using the proportionality factor 1.80655 the resulting formula is:

1969 salinity scale

$$\begin{aligned} S^{\circ}/_{\text{oo}} = & -0.08996 + 28.29720 R_{15} + 12.80832 R_{15}^2 \\ & -10.67869 R_{15}^3 + 5.98624 R_{15}^4 - 1.32311 R_{15}^5 \end{aligned}$$

The ratio R_{15} is determined relative to standard seawater for which absolute conductivity is known by precise measurements. (The absolute conductivity measurements were not made because of development problems with the laboratory apparatus.)

1978 salinity scale

Problems arose with the 1969 salinity scale. The R_{15} determinations are based on natural (or mixed) seawater samples of variable composition. The salinity-chlorinity conversion assumes fixed ratios. This is inconsistent. The scale is not reproducible. Since the salt ratios are time dependent, samples from the same geographical points would not yield the same relationship between conductivity and chlorinity. The single point necessary to fix the scale was tied to standard seawater through chlorinity and not absolute conductivity. In 1978 at the 10th meeting of JPOTS, the panel introduced a KCl conductivity standard to fix the salinity scale at $35^{\circ}/_{\text{oo}}$. The new practical salinity scale is fixed at $35^{\circ}/_{\text{oo}}$ salinity by reference to conductivity of a potassium chloride solution at 15°C containing a mass of 32.4357 gms KCl in a mass of 1 kilogram of solution. This point coincides with the 1969 scale and Knudsen scale by using chlorinity to find the $35^{\circ}/_{\text{oo}}$ point for the particular batch of standard seawater used. In future, the $35^{\circ}/_{\text{oo}}$ salinity may not be related precisely to chlorinity by the ratio 1.80655 because of long-term compositional changes in the oceans. Having fixed the $35^{\circ}/_{\text{oo}}$ point, other salinities can be produced precisely by addition (by dilution with distilled water) or removal (by evaporation) of water from the standard seawater. Such samples were used to develop a relationship between salinity and $R_{15} = C(S,15,0)/C(35,15,0)$ which is proposed as the new practical salinity scale. This relationship is:

$$\begin{aligned} S^{\circ}/_{\text{oo}} &= 0.0080 - 0.1692 R_{15}^{1/2} + 25.3851 R_{15} + 14.0941 R_{15}^{3/2} \\ &\quad - 7.0261 R_{15}^2 + 2.7081 R_{15}^{5/2} \\ &1^{\circ}/_{\text{oo}} \leq S \leq 42^{\circ}/_{\text{oo}} \end{aligned}$$

The new practical salinity scale is defined with fixed ionic ratios (by using standard seawater only) referenced to a readily reproduced fixed standard of conductivity (KCl). The formula for determining salinity has been extended to other temperatures in terms of the ratio $R_T = C(S,T,0)/C(35,T,0)$

$$\begin{aligned} S^{\circ}/_{\text{oo}} &= 0.0080 - 0.1692 R_T^{1/2} + 25.3851 R_T + 14.0941 R_T^{3/2} \\ &\quad - 7.0261 R_T^2 + 2.7081 R_T^{5/2} \\ &\quad + \frac{(T - 15)}{1 + 0.0162 (T - 15)} [0.0005 - 0.0056 R_T^{1/2} - 0.0066 R_T \\ &\quad - 0.0375 R_T^{3/2} + 0.0636 R_T^2 - 0.0144 R_T^{5/2}] \\ &- 2^{\circ}\text{C} \leq T \leq 35^{\circ}\text{C} \quad \text{S. D.} = 0.0007^{\circ}/_{\text{oo}} \end{aligned}$$

For CTD measurements, electrical conductivity of seawater $C(S,T,P)$ can be written in the ratio form

$$\begin{aligned} C(S,T,P) &= \frac{C(S,T,P)}{C(S,T,0)} \cdot \frac{C(S,T,0)}{C(35,T,0)} \cdot \frac{C(35,T,0)}{C(35,15,0)} \cdot C(35,15,0) \\ &= R_P \cdot R_T \cdot r_T \cdot C(35,15,0) \end{aligned}$$

or dividing by $C(35,15,0)$ to obtain the conductivity ratio $R(S,T,P) = C(S,T,P)/C(35,15,0)$

$$R(S,T,P) = R_p \cdot R_T \cdot r_T$$

WG 10 (JPOTS) accepted and proposes the relationship

$$\begin{aligned} r_T &= 0.676612 + 2.00557 \times 10^{-2} T + 1.10558 \times 10^{-4} T^2 \\ &\quad - 7.04373 \times 10^{-7} T^3 + 1.11940 \times 10^{-9} T^4 \\ &\quad - 2^\circ \leq T \leq 35^\circ \text{C} \end{aligned}$$

for the temperature dependence. The ratio R_p is still under investigation by Bradshaw and Schleicher at W.H.O.I. and should be determined by end of 1978. This will complete the definition of the practical salinity scale for the full range of oceanic variables of conductivity ratio, temperature and pressure.

EQUATION OF STATE FOR SEAWATER

An equation of state for seawater (EOS) using the new practical salinity and the IPTS-68 for temperature has been constructed from 5 data sets obtained by 3 laboratories. Only part of the EOS has been adopted by JPOTS. Questions remain about the EOS for seawater at atmospheric pressure because of discrepancies with a 6-th data set obtained recently by Poisson in France. The discrepancies are small $\sim 10 \times 10^{-6} \text{ cm}^3/\text{gm}$ but occur in the oceanic range of temperatures and salinities. It is expected that these will be resolved by March 1979.

The EOS is in the form

$$v(S,T,p) = v(S,T,0) [1 - p/K(S,T,p)]$$

where v is specific volume cm^3/gm , p pressure in bars and K is secant bulk modulus in bars. Note: the form is identical to that used by Ekman (1908). He used mean compression $\mu = 1/K$.

The EOS has been developed in 4 parts:

1. density of pure water at 1 atmosphere (adopted)
2. density difference of seawater at one atm (not adopted)
3. specific volume difference of pure water at elevated pressure (adopted)
4. specific volume difference from 1 atm difference for seawater and from pure water at elevated pressures (adopted)

The EOS has the form (in terms of bulk modulus K):

$$K^P = p v^0 / (v^0 - v^P) = K^0 + A p + B p^2$$

$$K^0 = K_w^0 + a S + b S^{3/2} \quad (\text{All coefficients are polynomials in } T.)$$

$$A = A_w + c S + d S^{3/2}$$

$$B = B_w + e S$$

and at 1 atm

$$\rho(S,T,0) = 1/v(S,T,0) = \rho_w + A_0 S + B_0 S^{3/2} + C_0 S^2$$

$$S.D. = 4.3 \times 10^{-6} \text{ cm}^3/\text{gm for pure water}$$

$$= 9.0 \times 10^{-6} \text{ cm}^3/\text{gm for seawater}$$

JPOTS has not accepted any formulas for other properties except for

- freezing point of seawater (8th report JPOTS)
- partial pressure of dissolved oxygen (Weiss eqn)

In particular, JPOTS has not recommended or proposed formulas for computing

- sound speed
- adiabatic lapse rate or potential temperature
- specific heat

These and other physical and chemical properties of seawater need to be evaluated by JPOTS.

References

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- Unesco, 1978. Eighth report of the joint panel on oceanographic tables and standards, Woods Hole, MA 23-25 May 1977. *Unesco Technical Papers in Marine Science No. 28*.
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Working Group 34

INTERNAL DYNAMICS OF THE OCEAN

Report to SCOR, October 28, 1978 by A.R. Robinson

This report on the status of and plans for activities of WG 34 covers the period May 1977 to the present. The members of WG 34 are: L. Fomin (USSR); A. Gill, J. Gould (UK); J. Gonella (France); K. Hasselmann, G. Siedler (FRG); G. Needler (Canada); A. Robinson (Chairman), H. Stommel, P. Welander (USA). The terms of reference are: to identify the critical scientific problems in the internal dynamics of the ocean, to suggest the most appropriate ways to study them and to advise on the design of mid-ocean dynamic experiments.

Substantial mid-ocean dynamical experimental scientific progress has been accomplished during this period by the acquisition of a very large amount of observational field data on synoptic scale (or mesoscale) low frequency phenomena. Aspects of the design, coordination and implementation of the programs and experiments which have gathered these data have involved considerable input from WG 34 and/or its members. These new data now provide the opportunity for ocean scientists to advance the understanding of eddy dynamics and to apply that understanding to problems such as general circulation, regional dynamics and to transport phenomena of importance to biology, geochemistry and climate. This period has also seen continued acceleration in the theory and numerical modelling of eddy phenomenon. In order responsibly and efficiently to exploit the unique, novel and massive new data set, a concerted and coordinated effort is required now for the analysis, interpretation, synthesis, assessment, communication and dissemination of results.

The main field program of *POLYMODE*, planned and coordinated by the US/USSR Joint *POLYMODE* Organizing Committee, is nearly completed. The final US mooring array is scheduled for recovery in October 1979. The major USSR multiple ships and mooring effort which began in July 1977 ended in September 1978. The document *POLYMODE – An overview* (PM News 39, Nov. 1977) was prepared to describe the main field program at its start. Most of the proposed field work was accomplished. A summary of theoretical progress "*Investigation of the Synoptic Variability of the Ocean: Materials of the Joint Soviet–American Theoretical Institute POLYMODE 1976*" has been published (Marine Hydrophysical Institute of the Ukrainian SSR, Sevastapol, 1977). Joint data inventories, reports, publications and an atlas are planned. A scientific meeting for preliminary discussion of results is scheduled to occur in the USSR in the summer of 1979 and a final scientific symposium on eddy dynamics is planned in the USA in the summer of 1980 to end the *POLYMODE* program.

The Bedford Institute, of Canada, has been maintaining since early 1976 a 3 mooring deep water current meter array in two sequential locations to the north and east of US *POLYMODE* arrays II and III; the present site will be occupied until late 1978. Early in 1979 two years of current meter data will be ready for analysis from the 6 mooring array of British, French and West German *Northeast Atlantic Dynamics Study – NEADS* (SCOR Proceedings Vol. 12, Annex III); XBT–lines with synoptic (meso) scale sampling are also obtained by NEADS.

A specific proposal prepared by G. Metcalf, WHOI, Massachusetts together with C. Ebbesmeyer and Evans Hamilton, Seattle for obtaining synoptic (meso) scale XBT data in the southern hemisphere using FGGE drifter deploying ships as ships of opportunity (SCOR Proceedings Vol. 13, p. 10) for this purpose was endorsed by WG 34 (August 1978 - Appendix I). The proposal was prepared after an analysis of existing data by J. Gould, C. Ebbesmeyer and others.

The Report of the *JOC/SCOR Joint Study Conference on General Circulation Models of the Ocean and their relation to Climate* (Helsinki, 23-27 May 1977), supported by UNEP and UNESCO/IOC was issued through the Geneva GARP office in two volumes in November 1977. Refereed versions of most papers from the Proceedings have been prepared for publication in a special edition of *Dynamics of Atmospheres and Oceans* under the guidance of an editorial committee consisting of D.J. Baker, K. Hasselmann and A.R. Robinson. Thus, this conference will have generated a generally available and reliable review of the subjects of ocean modelling and the dynamics of climate for the scientific community.

Early in 1978, in response to a query by the President of SCOR, the Chairman requested the members to consider the function and role of WG 34 presently and, if need be, in the future. Some individual members remarks have been copied to the President. The WG is of the opinion i) that ongoing field projects do require some continued support, ii) that the international coordination of at least the initial phase of analysis and synthesis of the large new eddy data set is essential, and iii) that a review in depth of the status of eddy dynamics, including a definition of the most important next scientific problems, and a consideration of arrangements necessary for their accomplishment, is necessary and important. We therefore request that SCOR continues WG 34 at least until the SCOR General Meeting in 1980 in order to accomplish these three tasks and that its future be reviewed at that time in terms of a report to be based on task iii) above.

In order to accomplish the above tasks we propose that a subgroup of WG 34 meet during the summer of 1979, that some members of WG 34 together with other scientists meet during the IUGG/IAPSO General Assembly in Australia in 1979, and that a Working Symposium on Eddy Dynamics be held in the summer of 1980, to be coordinated with the final POLYMODE Scientific Symposium. The objectives of these proposed meetings are: 1) to contribute to the coordination of the analysis of the results of POLYMODE, NEADS and other readily available results from recent mid-ocean dynamics experiments on the synoptic (meso) scale low frequency variability, 2) to facilitate internationally the dissemination of the results of these programs and experiments, 3) to identify additional existing sources of data and other scientific information on the variability and to assess the overall status of knowledge of the phenomena, and 4) to identify processes and/or regions in the world ocean where scientific research on eddy dynamics is important and feasible in the immediate future and to consider areas of scientific or technical applicability of the existing physical knowledge of the variability.

SCOR WG 34 ENDORSEMENT FOR THE FGGE XBT MESOSCALE SCIENCE PROJECT

SCOR WG 34 has been charged with overseeing the research activity on the internal dynamics of the ocean. An important phenomenon which is receiving much attention is that of the energetics and regional distribution of mesoscale eddy activity (mesoscale eddies may be considered to be the oceanic analogue of the depressions and anticyclones which dominate the atmospheric wind field).

Studies of the mesoscale phenomenon fall into two major categories: those designed to observe in detail the structure of mesoscale features (on scales of a few hundred km) and those designed to investigate the oceanwide distribution of such features. The vast majority of the scientific effort toward both of these goals has been expended in the oceans of the northern hemisphere; in the Atlantic Ocean in the POLYGON, MODE, POLYMODE and NEADS programs, in the North Pacific as a byproduct of the NORPAX investigations. This concentration in the northern hemisphere is as a result of logistic rather than scientific constraints since much of the ocean area of the southern hemisphere is remote and rarely visited by either research or commercial shipping. There is no reason to suppose that mesoscale eddy features do not exist in both northern and southern hemispheres.

The FGGE affords an opportunity to make observations over large areas of the southern hemisphere. A technique which has proved to be of great benefit in identifying areas of mesoscale activity is that of deploying XBT probes at regular closely spaced intervals in order to provide temperature "sections" across ocean basins. By deploying probes at typically hourly intervals the mesoscale features can be adequately resolved in the upper 800 m of the water column. Experience has shown that these operations can be performed satisfactorily by most types of ships and the installation of the necessary launching and recording equipment is in general neither difficult nor expensive.

The outline proposal to deploy XBT probes from FGGE ships in 1979 is therefore one which the Working Group wishes to endorse. The redeployment of XBT equipment currently being used in the POLYMODE experiment will help to reduce the overall cost of the exercise and the experience gained by the proposers during POLYMODE will be of value in tackling both logistic and scientific problems.

SCOR WG 34 feels that this proposed experiment could add significantly to knowledge of the distribution of mesoscale eddy features in the oceans of the southern hemisphere and will, together with other ongoing programs, aid the advance of knowledge of the nature of the mesoscale phenomenon.

August 19, 1978

SCOR Working Group 42

POLLUTION OF THE BALTIC

At the WG meeting 27–28 April 1978 in Rostock, GDR, (report C.M 1978/E:4) the three main items discussed were: 1 a draft manual on recommended sampling procedures and sample preparation methods for analysis of contaminant levels in Baltic biota, written by a group of scientists through coordination by ICES upon a request from the Helsinki Interim Commission; 2 status of BOSEX 77 data analysis, data exchange and plans; 3 future work.

At the Conference of Baltic Oceanographers, April 1978, 13 papers were presented based on BOSEX data, and during the ICES meeting in October another 5 BOSEX papers were given.

It is clear that a large amount of physical and chemical data were obtained but that the biological as well as certain pollutant observations were very limited, due to the weather conditions. It was agreed that the various groups should continue to work independently for the time being, that a Draft BOSEX Atlas should be circulated through ICES and include e.g. data inventories, preliminary results and data presentations that the ICES Data Bank should receive all standard data and that data without a common format could be circulated through the Atlas.

At the ICES meeting a separate BOSEX discussion was held where further information on data analysis and exchange was given. Results on data intercomparison showed good agreement between observations of nutrients at the central station except for some substances, like ammonia.

The WG discussed the future work considering the original terms of reference as well as the development during the work. It was agreed to consider especially

- i) modelling, where a bibliography on ongoing work will be generated
- ii) the dynamics of the coastal zone, where a presentation from each country is expected at the next WG meeting
- iii) the scientific principles for assessment and surveillance of the marine environment
- iv) studies related to new substances in the Baltic, like phthalate esters and polychlorinated terphenyls.

Finally it was recommended that the WG should meet again early in 1979.

GATE OCEANOGRAPHIC ATLAS: VOLUME 1, EQUATORIAL AND A-SCALE

OUTLINE OF CONTENTS: JANUARY 1979

Section 1: Introduction: Annual variability in the Equatorial Atlantic based on historical data

- 1.1 Surface currents in the Equatorial Atlantic: February and August
- 1.2 Winds
 - 1.2.1 Stress: March and August
 - 1.2.2 Monthly wind stress in 10° longitude bands
- 1.3 Sea surface temperature
 - 1.3.1 August and February
 - 1.3.2 Monthly SST along shiptracks in the eastern Equatorial Atlantic
 - 1.3.3 SST at coastal stations in the Gulf of Guinea
- 1.4 Net oceanic heat gain: February and August
- 1.5 Variation of density variables with depth along the equator
 - 1.5.1 Zonal section of temperature and salinity (0–300 m)
 - 1.5.2 Annual variability of salinity at 50 m and 75 m

Section 2: The Equatorial Atlantic during GATE

- 2.1 Introduction: Bottom topography and experiment design
- 2.2 Time averaged conditions
 - 2.2.1 Winds
 - 2.2.1.1 Stress: Phases I, II, III
 - 2.2.1.2 Curl: Phases I, II, III
 - 2.2.2 Sea surface temperature: Phases I, II, III
 - 2.2.3 Net oceanic heat gain: Phases I, II, III
 - 2.2.4 Average T, S profiles from fixed platforms, Phases I, II, III
 - 2.2.5 Average U, V profiles from current meters along 23.5°W and at 10°W, 0°: Phases I, II, III
 - 2.2.6 Mean current: meridional sections
 - 2.2.6.1 23.5°W, 7°S–12°N, from moorings: Phases I, II, III
 - 2.2.6.2 28°W, 1.5°S–1.5°N, from profilers: Phases II
 - 2.2.6.3 10°W, 1°S–1°N, from profilers: Phases II
 - 2.2.7 Dynamic height along the equator: Phases I, II, III
- 2.3 Repeated sections
 - 2.3.1 23.5°W, 7°S–12°N: *S. Dezhnev*: Phases I, II, III

- Temperature, salinity, sigma-T, geostrophic current
- 2.3.2 28°W, 5°S–29°N: *Trident*: Phase I
 - 2°S–8°N: *Trident*: Phase II
- Temperature, salinity, geostrophic current
 - 2°S–2°N: *Trident and Iselin*: Phase II
- U velocity component, salinity
- 2.3.3 10°W, 2°S–2°N: *Atlantis II* Phase 0
 - 2°S–2°N: *Capricorne* Phase II
- Temperature, salinity
- 2.4 Time variability
 - 2.4.1 28°W, 2°S–2°N: *Iselin* Phase II
 - U, V at 10, 80, 200 m
 - Temperature at surface and core equatorial undercurrent
 - Salinity in core of equatorial undercurrent
 - 2.4.2 28°W–26°W, 1.5°N–1.5°S: Moorings Phases II, III
 - Current vectors
 - 2.4.3 23.5°W, 6°S–12°N: Moorings Entire GATE period
 - Current vectors at 10, 75, 150 m
 - 1.5°S–1.5°N: Phase II
 - U, V at 15, 75, 200 m from moorings
 - Temperature, salinity at 5, 60 m (*v. Humboldt*)
 - 2.4.4 10°W, 1°S and 0°: Phases II, III
 - Current vectors
 - Equator, entire GATE period
 - U, V 0–700 m
- 2.5 Coherencies, spectra, etc.

Appendix: Table of statistics from selected moored current meters

Bibliography (and abstracts)

RIVER INPUTS TO OCEAN SYSTEMS (RIOS)**RIOS Workshop March 1979 : outline programme**

SESSION : *Controls on River Water Composition and the Mass Balance of River Systems.*
Rapporteur : A. Lerman

- F.T. MacKenzie : Mass Balance of Contemporary River Systems.
- M. Meybeck : Pathways of Major Elements from Land to Ocean through Rivers.
- J. van Bennekom : Pathways of Nutrients and Organic Matter from Land to Ocean
(with W. Salomons) through Rivers.
- J.M. Edmond : Pathways of Trace Elements from Land to Ocean through Rivers.
- J. Zobrist : Chemical Dynamics of the Rhine Catchment Area in Switzerland :
(with W. Stumm) Consideration of the "Pristine" Rhine River Input into the Ocean.
- F.J. Millero : Chemical Speciation in River Waters.

SESSION : *Erosion and Transport of Material (Dissolved and Particulate).*
Rapporteur : H. Postma

- J.D. Milliman : Flux of Riverborne Particulate Material to the Oceans.
- K.R. Dyer : Diffusion and Dispersion of Salt in Estuaries.
- R.B. Gordon : Estuarine Power and Trapping Efficiency
- J.R. Schubel : Transportation and Accumulation of Fine-Grained Sediments in
(with D.J. Hirschberg) Estuaries.
- J.K. Cochran : Biological Influences on Sedimentary Processes.
(with R. Aller)
- S. Krishnaswami : Geochronology of Estuarine Sediments.

SESSION : *Behaviour of Chemical Species During Estuarine Mixing.*
Rapporteur : D.R. Schink

- M. Whitfield : Speciation of Dissolved Constituents in Estuaries.
(with A.G. Dickson and D.R. Turner)
- V. Pravdic : Physicochemical Parameters describing the Role of Particulate
(with J. Jednacak- Material in Estuarine Waters.
Biscan and M. Juracic)
- J.M. Bowers : Behaviour of Trace Metals During Estuarine Mixing.
(with P.A. Yeats)

- J.D. Smith : Role of Iron in Control of Suspended Solids and Trace Metals in Estuaries.
- R. Wollast : Redox Processes in Estuaries.
- R.F.C. Mantoura : Dissolved organic Constituents in River and Estuarine Waters.
- J. Simpson : Fluxes and Behaviour of Reactive Material in Urban Estuaries.
(with R.F. Bopp, R.L. Deck and C.R. Olsen)
- J.E. Hammond : Diffusion in Interstitial Waters and Transport Across the Sediment-Water Interface.
- A. Lerman : Modelling of Estuarine Behaviour of Dissolved Constituents, including Processes at Sediment-Water Interfaces.
- E. Sholkovitz : Estuarine Chemistry as Deduced from Laboratory Experiments.
- SESSION : *Chemical Interactions involving the Biosphere and Fluxes of Organic Material in Estuaries.* Rapporteur : J.H. Reuter
- P.J. leB. Williams : Primary Productivity and Heterotrophic Activity in Estuaries.
- G. Rheinheimer : Estuarine Bacterial Populations and their Role in the Decomposition of Organic Material.
- R.A. Schroeder : Fluxes of Organics in Estuaries.
- J.J. McCarthy : Nutrient Cycling.
- W. Reeburgh : Anaerobic Methane Consumption and its Effect on Carbon and Sulfur Cycles in Marine Sediments.
- SESSION : *Man's Influence on RIOS and Comparison of Pathways to the Coastal Zone.* Rapporteur : P. Weyl.
- E.D. Goldberg : The Records of Man's Impact upon River Inputs to Ocean Systems.
- R.H. Meade : Man's Influence on the Discharge of Fresh Water, Dissolved Material and Sediment by Rivers to the Atlantic Coastal Zone of the United States.
- K.K. Bertine : Records of Changing Regimes in Sediments of Estuaries in Semi-arid Areas.
- H.L. Windom : Comparison of River Inputs and Atmospheric Transport of Inorganic Materials to the Coastal Zone.
- E.K. Duursma : Comparison of River Inputs and Other Pathways of Organic Materials in the Coastal Zone.
- P.S. Liss : Air/Sea Gas Fluxes in the Estuarine and Coastal Zones.

SCOR WG 47 OCEANOGRAPHIC PROGRAMMES FOR FGGE

Report by Chairman

The activities of SCOR Working Group 47 (Oceanographic Programme for the FGGE) were last summarized in the Chairman's Status Report to the IOC/WMO Second Planning Meeting on Ship Operations for the FGGE, which appeared in October 1977.

Since that time, the following planning meetings have taken place:

1. Jan 1978 Indian Ocean Panel Meeting Miami
2. April 1978 Pacific Ocean Panel Meeting Honolulu
3. May 1978 Atlantic Ocean Panel Meeting Paris
4. Sept 1978 Indian Ocean Panel Meeting Paris

Individual meeting reports have been circulated to the participants. Commitments of ship time and other resources for the experiment are now quite firm and I believe the latest plans resemble closely what will actually take place in the field during the FGGE. Dr Simmons, in consultation with Drs Hisard, Swallow, Taft and myself, is preparing a final summary programme plan which, together with other necessary materials, will comprise Volume 7 of the *FGGE Implementation/Operations Plan*. It is scheduled for wide distribution to participants in November 1978. Others may request copies through Dr Simmons at WMO Headquarters in Geneva.

With the appearance of the Implementations/Operations Plan and the onset of the Operational Year (1 Dec 1978–30 Nov 1979), Working Group 47 will have completed the first of its terms of reference

“to develop plans for comprehensive oceanographic programmes associated with FGGE,”

and nearly completed the second,

“to advise appropriate international and national bodies in the implementing of such programmes.”

SCOR may therefore wish to consider terminating Working Group 47. However, because circumstances may arise during the Operational Year (1 Dec 1978–30 Nov 1979) which may require further assistance by the Working Group in implementation, it may be desirable that the Working Group should continue to stand. Dr Simmons, who will be at the FGGE Operations Centre during the Operational phase could provide necessary liaison. Furthermore, each panel of Working Group 47 has called for an international workshop in early 1980. I propose a general meeting of the Working Group in late 1980 or early 1981 to review the overall scientific results.

Finally, it has been brought to my attention that Drs Swallow and Taft, who have served as such faithful chairmen of the Atlantic and Indian Ocean Panels of Working Group 47, are not formally members of the Working Group. I would like to nominate them for membership at this time.

SCOR WG 51, EVALUATION OF CTD DATA

Draft Report of 1st Meeting – Charlottenlund – September 1978

All but one member of the group were able to attend the meeting from September 25th to 27th. Those present were Crease (Chairman), Striggow, Dauphinee, Fofonoff, Grose, Plakhin, Lewis, Zenk. Dr Aitsam sent his apologies for not being able to attend.

The meeting was held in Charlottenlund Castle thanks to the kindness of the International Council for the Exploration of the Sea and of its staff who looked after our needs.

The Chairman apologised for the delay in the Working Group's start having hoped that much could be done by correspondence. It was apparent though that the free exchange of ideas during discussion was essential to the initiation of the work.

The first morning was spent in reviewing terms of reference and individual views of critical areas in the interpretation of CTD data.

Fofonoff reported on the work of WG 10 (JPOTS) whose recent meeting he, Lewis and Dauphinee had attended. In particular he reported on the proposed new definition of salinity. The group agreed that on matters of interpretation of salinity as a function of conductivity, temperature and pressure we need do no more than follow the lead of JPOTS. SCOR WG 51's job is to consider the problem of interpreting 'raw' outputs from temperature, pressure and conductivity sensors as good measurements of those parameters.

We reviewed in order

- (1) the characteristics and problems of each of the three sensors,
- (2) the in-situ procedures and methods of calibration,
- (3) the processing, consisting of acquisition, editing and archival.

It was agreed that the end result of the committee's work should be a publication designed to give full aid to use CTD systems effectively and consistently.

Temperature

This was felt to have the least problems and therefore appropriate for discussion first. In practice numerous problem areas arise. The sensors themselves are usually either thermistors or platinum/copper resistance. Physical characteristics for further discussion include pressure coefficient (for exposed elements), shock, vibration, electrical signal/noise, effect of leakage, contact and corrosion resistance.

Time response may be approximately modelled by a simple exponential but this may be seriously affected by too small a lowering speed or poor exposure. Problems of self-heating, heating of surrounding instrument and water can be significant. Discussion of power levels and component stability to temperature variation will be required. Calibration to common standards and use of the 1968 t_{68} scale together with description of triple point calibrations and transfer standards need discussion.

Dr Dauphinee agreed to contribute this section of a final report.

Conductivity

The sensors themselves fall into two groups, inductive and multi-electrode. For inductive cells the far field geometry was very important. Variation in cell dimensions although it occurred was believed to be one of the smaller problems. Shock and fouling, particularly the build up of calcium carbonate and the presence of oil films were all problems. Polarisation could be significant.

Modelling of the time constant appeared difficult. This arises very largely from the flushing time of the cell and is therefore dependent on whether the instrument is moving up, down or stationary. Additionally it is possible at low speeds for the cell to take a very long time to flush, the flow through it being effectively blocked. Problems of self-heat, modification of response due to tipping (in a wave field) of the whole instrument occurred. It was noted that a coating of detergent prior to launch improved the problem of getting the instrument through the contaminated surface layer.

Calibration techniques required particular care. Laboratory ones had to be concerned with wall effects and exposure of the instrument. In-situ we must be concerned with the problem of flushing during calibration with water samples. Present techniques presently rely often on the deep water historical T-S relation – a logically unsatisfactory procedure.

Dr Zenk with assistance from Dr Dauphinee agreed to contribute this section to the final report.

Pressure

A variety of types are in use – strain gauge, capacitive, quartz, solid state, bourdon and vibration.

Most members believed that this sensor's performance was the most limiting for precise CTD work.

This arose from the difficulty of correcting effectively for hysteresis, dependence on ambient temperature and time response. Shock, mechanical and temperature, is likely to be significant.

In-situ calibrations were possible in some circumstances using echo-sounding techniques – a suggestion that comparison salinity samples from rosettes be used for determination of pressure was thought interesting.

Mr Crease aided by Dr Dauphinee will develop this section.

Data Processing

Although as a group we could have no effect on existing basic instrumental acquisition of raw data it seemed worth while to comment in our final report on the criteria that should be followed, for example, in determining sampling frequency. These questions are intimately bound up with the response time of the instrument.

Dr Lewis will contribute this section.

The editing stage includes the elimination of unreasonable values for which first or second differences, flagging, use of 2 to 3 criteria may be appropriate. It is important to retain a uniform time base at this stage to permit investigation of time constants. The degree to which this stage is interactive or automatic needs determination.

Criteria for filtering the output of the sensors to a matched response time are required as well as for the detection of hardware errors in digital processing such as 'sticky bits'. The rejection of data when sensor velocities are less than a certain speed needs consideration.

In-situ calibration data will continue to be required so long as there are temperature and depth-dependent effects – particularly on the pressure sensor.

Dr Grose will develop this section of the report with contributions from Dr Lewis.

Archival & Exchange & Consistency

Solution of the problems discussed already will contribute to the production of consistent data sets. However it has become apparent that there is a need for consistent algorithms for computation of the physical parameters (including salinity) from the raw data. There are many and varied methods in use at present and a rationalisation of these algorithms is of some urgency. Archival is likely in many cases to involve data compression or creation of subsets of the full data sets. Criteria are not well established for this although there have been recommendations by bodies such as ICES. Further computational work on both high quality and noisy data sets is desirable to examine techniques such as criteria based on 'significant change' of the variables. Dr Grose volunteered to carry out some work on this aspect.

Dr Fofonoff reported that recent experience in his laboratory had shown up the need for much fuller documentation of the circumstances surrounding the data acquisition and of the steps in data processing. It was desirable also to develop even within the framework of flexible exchange formats now coming into use, specific data structures appropriate to use of CTDs in both vertical profiling and saw-tooth modes.

Dr Fofonoff agreed to develop this section.

It was agreed that though further intercomparison experiments both laboratory and in-situ may be desirable a decision on this should be deferred until our next meeting. In the meantime a number of the group had been associated with such comparisons and would summarise them. Dr Striggow would coordinate this section of the work prior to any new intercomparisons. Dr Striggow offered the facilities available at his institute for some future laboratory intercomparisons.

Summary

1. The group will develop a working document on how to achieve consistent high quality CTD data sets.
2. Specific sections of the report would be coordinated as follows:

Temperature

Dauphinee

Conductivity

Zenk & Dauphinee

Pressure	Crease & Dauphinee
Sampling & Time Constants	Lewis
Algorithms	Fofonoff
In-situ Calibrations	Crease & Plakhin
Data Processing	Grose & Lewis
Consistent Data Sets	Fofonoff & Crease
Intercomparisons	Striggow

3. We would plan to meet in a year's time having followed a 3 months schedule of
 - (i) production by individuals above of first drafts
 - (ii) review and additional contributions by all other members
 - (iii) second draft prepared by individuals above for consideration at next meeting.

We would attempt to carry on correspondence by each duplicating to all other members.

4. It was agreed that to minimise costs the next meeting was likely to be held near or at one of the members' institutions in Europe or America.

Report of the Group of Specialists on Living Resources of the Southern Oceans**SCOR WG 54****(In Co-Sponsorship with SCAR, IABO and ACMRR)***Kiel Meeting*

The group met in Kiel, FRG, 30 May – 2 June, 1978 at the invitation of Professor G. Hempel. Participants reported on national marine biological/oceanographic investigations in the southern oceans and plans for future work. The group heard a number of review presentations on recent research which had direct relevance to the BIOMASS Programs. In its discussion the group agreed that without ignoring other problems there was an urgent need to address its attention towards the problem of resource evaluation of krill and proposed that, apart from the study of the life history of krill, the following questions should be given priority in the first instance:

- (a) How much krill is there?
- (b) What are the trends and fluctuations in krill abundance?
- (c) What is the population identity of krill?
- (d) What is the swarming behaviour of krill?
- (e) To what extent are krill food limited?
- (f) How are the total populations of krill consumers sub-divided into unit populations?
- (g) How much krill is consumed by each predator species?
- (h) What are the present trends in stocks of consumers?
- (i) What will be the impact of krill harvesting at different levels on the dynamics of the populations of krill consumers?

These questions were discussed at some length by the Group and are included in the report of the Kiel meeting, copies of which are available on request.

The ACMRR Meeting

During the ACMRR meeting held 5–9 June, 1978 in Rome, ACMRR members were informed of the Group's activities and of future plans for BIOMASS as developed at the Kiel meeting. Also, at that meeting consultations regarding nominations for chairmen and members of the Technical Groups and Working Parties (within the organizational structure of BIOMASS) were initiated. These consultations were followed by solicitation of nominees from the four co-sponsors of the Group as well as such organizations as IOC, IWC, etc. A membership list for the Technical Groups and Working Parties is given in Appendix 1.

Soviet and Polish Participation/Contribution to BIOMASS

At the kind invitation of Dr A. Bogdanov, Director, All-Union Research Institute of Marine Fisheries and Oceanography, Moscow, USSR, and of Dr Adam Urbanek (Poland's delegate to SCAR) the Chairman made a two-week trip to Moscow and Warsaw in September 1978 to discuss further the BIOMASS programmes. Highlights of these discussions were given in a separate report. Professor Jan Kaczmarek, secretary of the Polish Academy of Sciences, offered to host a meeting of the Group in Warsaw in September 1979 and Dr Bogdanov offered to host a meeting of the Group in the USSR in late 1980, probably in Leningrad or some small town on the Black Sea.

Future Activities of the Group of Specialists and its specialized Technical Groups and Working Parties

A list of the projected meetings of the Group of Specialists, Technical and Working Parties for the remainder of 1978 and for 1979 is given in Appendix 2.

Financial Need

Based on the several meetings projected for 1979, SCOR is requested to make available the sum of \$10,000 towards the cost of travel and per diem expenses for members of the Technical Groups and Working Parties.

SCOR WG 54 (with SCAR, IABO and ACMRR)

Membership

S.Z. El-Sayed, Convenor

G. Deacon
G. Hempel
J-C. Hureau
R.M. Laws
T. Nemoto
T.G. Lubimova

G.G. Newman
S. Rakusa-Suszczewski
D.B. Siniff
A.P. Tomo
D.J. Tranter
J.A. Gulland (Technical Secretary of ACMRR)

Technical Groups

*Programme Implementation and
Coordination*

G. Hempel (FRG), Chairman

A. Tomo (Argentina)
K. Kerry (Australia)
J.P. Bloch (France)
T. Nemoto (Japan)
O.H. Saelen (Norway)
S. Rakusa-Suszczewski (Poland)
O.A. van der Westhuyzen (S. Africa)
R.M. Laws (U.K.)
T.G. Lubimova (U.S.S.R.)
..... (Chile)
..... (New Zealand)
..... (U.S.A.)
..... (IOC Adviser)
S.Z. El-Sayed (ACMRR Adviser)

Methods

D.J. Tranter, Chairman

S. Rakusa-Suszczewski
K. Sherman
[in consultation with
the Working Parties]

*Data, Statistics and Resource
Evaluation*

G.G. Newman, Chairman

D. Siniff
D. Sahrhage
R. Hennemuth
J. Gulland
A. Tomo
R.M. Laws
K. Nasu
H. Jones (IOC/WG/IODE)
R. Gambell (IWC.Sci.Comm.)

Working Parties

Acoustic Krill Estimation

O.A. Mathisen, Chairman
I. Everson
E. Marchal
H.U. Thiel
T. Doi
D. Cram
J. Kalinowski
V. Shevtsov
I. Hampton

Krill Biology

J. Mauchline, Chairman
M.A. McWhinnie
T. Pommeranz
T. Antezana
R. Lasker
S. Rakusa-Suszczewski
R. Makarov
Y. Le Gall
T. Nemoto

Fish Biology

D. Sahrhage, Chairman
I. Everson
H. DeWitt
J-C. Hureau
T.G. Lubimova
J. Gulland
T. Hoshiai
J. Popiel

*Physical & Chemical
Oceanographic
Observations*

A. de C. Baker, Chairman
G. Deacon
D.J. Tranter
J.M. Edmond
T. Foster
M. Stein
M. Bogdanov
J. Piechura
..... (ISOS)

**Projected Meetings of the Group of Specialists, Technical Groups and
Working Parties (1978/79)**

Name of Group	Dates	Place (Country)
(1) Group of Specialists on Living Resources of the Southern Oceans	September, 1979	Warsaw, Poland
(2) Technical Group: Programme Implementation and Coordination	June, 1979	Argentina
(3) Technical Group: Methods	June, 1979	Argentina
(4) Technical Group: Data Statistics & Resource Evaluation	May/June 1979	U.S.A.
(5) Working Party: Acoustic Krill Estimation	i) December, 1978 ii) late 1979	Lowestoft, UK.
(6) Working Party: Krill Biology	(To be arranged; possibly late 1979)	
(7) Working Party: Fish Biology	February, 1979	Hamburg, FRG.
(8) Working Party: Physical & Chemical Oceanographic Observation	(To work mainly by correspondence no meeting is planned at present)	

PREDICTION OF EL NIÑO

Summary of SCOR WG 55 Meeting 11–14 April 1978 in Las Palmas, Gran Canaria, Spain

We reviewed our Charge which is: "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 chairman mentioned that the SCOR Executive Committee had confirmed its view that WG 55 should *not* be concerned with the biological aspects, which should be considered separately. Hence our charge is narrowed somewhat.

A. What is to be Predicted?

The members present agreed that we needed a definition of El Niño before we could proceed very far. We agreed too, that our interest was in the 'rare' event which has associated climatic (oceanographic and meteorological) and economic effects. Our proposed definition is:

EL NIÑO is a massive influx of warm water into the coast of Ecuador and Peru as far south as Lima (12°S). From our presently available data, the coastal stations must have a positive temperature anomaly, ΔT , of 2°C or greater. Here, ΔT is defined as the difference of the monthly mean (arithmetic) Sea Surface Temperature (SST) at the coastal station from the long term monthly mean (arithmetic) SST for the coastal station. Using this definition El Niños are identified in 1973, 1972, 1969, 1965, 1958, and 1957 i.e. dates well known in the literature.

Our discussion included more sophisticated ways for defining the long term monthly means, but, at least for now, we settled on the straight arithmetic mean. Also, the present data bank dictates that SST data from coastal station be used with $\Delta T \geq 2^{\circ}\text{C}$ being chosen to limit the use of El Niño for those 'rare' events.

With regard to what is to be predicted, we decided the prediction should be of the occurrence or non-occurrence of El Niño only. Having predicted the occurrence of an El Niño this could then trigger predictions of other events which are typically associated with El Niño. Hence, we should focus on prediction of the event only and let others build their specialized sub-forecasts around this.

It was agreed that perhaps a better, or equally good, criterion for the definition of El Niño would be sea level rather than SST. However, the number of stations and years of data for sea level is much less than for SST. The group recommended that the number of coastal stations, measuring sea level in this region be doubled.

B. Prediction Schemes

As mentioned above the discussion was that the objective should be to forecast the occurrence or non-occurrence of El Niño. It was agreed that ultimately this has to be accomplished via some sort of index or indices. It was further stated that such indices should be based on reliably measured meteorological and/or oceanographic quantities and

particularly of readily available quantities — time wise. Even though we could not recommend, at this time, specific approaches to be followed, we wish to encourage the development of indices since currently available indices are not perfect. With the above proposed definition of El Niño we have at least defined which events any index must predict.

Some discussion was directed to the prediction lead time which any index should provide. This we acknowledged is a function of the use to be made of the forecast. As an example an index which gives a perfect prediction of an El Niño event three months in advance may be useful for sub-forecasts dealing with farming operations while for fishing operations an index which can give a perfect forecast of an El Niño event one year in advance is what is needed.

The role of modelling was also discussed. The group could not foresee that the forecast of El Niño would be accomplished by a continuing Ocean-Atmospheric operational model. Rather, modelling effort ought to be of a process type leading to a physical understanding of the whole El Niño phenomena. Hence we need models to give physical understanding of low frequency phenomena. Simulation runs via oceanographic and/or oceanographic and meteorological interactive models should help to identify indicators of an El Niño event. Hopefully, these simulation runs will say what oceanographic and/or meteorological quantities need to be measured, where, and how much in advance to yield a useful prediction. Then the appropriate monitoring program could be set up to verify the model results. If this proves correct then we can go into actual forecasting.

Perhaps the above comments give modellers some ideas of the direction we feel their efforts should go. Professor J.J. O'Brien plans to make simulation runs with an oceanographic model using maps of monthly mean surface stress prepared by Wyrski. It was requested that the chairman investigate what the atmospheric community is doing in their models being employed for FGGE and how these models effect our work. Especially of interest was what is being done in their models to obtain the surface winds. Finally, we invited Professor Newell to discuss his method of SST forecasting at our next meeting.

C. Data Base

As mentioned above, results of model simulation runs ought to be awaited before massive new monitoring programs are set up. However, we feel sure that a knowledge of SST and sea level is quite fundamental and we encourage the continuation and extension of such observations in the Central Equatorial Pacific and along the South American Coast. We recommend the doubling of the number of stations measuring sea level along the South American Coast.

We encourage the improvement of the accuracy and precision of satellite derived SST and of the dissemination of such data. We recommend archiving of calibrated but otherwise unaltered satellite SST data for an equatorial strip (5°N – 15°S) of the Pacific Ocean. The request is for a once daily SST value for each grid box $\frac{1}{4}^{\circ}$ Lat \times 1° Long across the whole Pacific between 5°N and 15°S . Note; similar data for slightly different latitude belts is being recommended by WG 56 for the Atlantic and Indian Oceans.

The group decided not to consider at this meeting the question of a Data Center.

D. Interaction With Other Groups

We briefly discussed various groups with which we should have contact and if possible identified the contacts.

First the various SCOR groups:

WG 36 Coastal and Equatorial Upwelling Processes. This working Group no longer exists but a review-summary volume on physical oceanography of coastal upwelling is in preparation; a similar biological volume is deferred at least until the physical volume is completed.

WG 56 Equatorial Upwelling Processes — Dr Rotschi, Chairman. This group is quite new also and will have biological and physical panels. WG 56 is concerned with equatorial upwelling in all three oceans (Pacific, Atlantic, and Indian). As mentioned earlier we had good interactions with WG 56 at Las Palmas and both groups recognize the need for close cooperation. A general discussion of the interaction of equatorial and coastal upwelling evolved. This included a recognition that the Atlantic might give clues to the Pacific El Niño problem. Stuart is trying to establish contact with groups studying coastal upwelling along the west coast of Africa south of the equator. It was agreed that any low frequency meteorological-oceanographic experiment in any of the oceans would be helpful to WG 55.

WG 49 Mathematical Modelling of Oceanic Processes — Dr O'Brien, Chairman. The contact is well identified but the future of the group was not so definite.

WG 47 Oceanographic Programmes during FGGE — Chairman, Stommel. This Working Group has three separate panels with Dr Taft heading up the Pacific Ocean panel. Various members of our groups have received the latest report (6 Oct 1977) outlining proposed FGGE experiments. A final report on oceanographic programs during FGGE will appear in Fall 1978.

Mention was made of a possible formation of a new group — like Climate and Oceans — later this year.

Other groups of interest with possible contacts are:

GARP —

NORPAX — Namias, Wyrski

ERFEN — Lagos, Parra Suarez, Stuart

IOC/WMO — Working Group in Coordination of Investigations of 'El Niño' — Stuart

CPPS — Lagos

Post FGGE — Tropical Pacific Programs

SCOR WG 56

EQUATORIAL UPWELLING PROCESSES

Report of Chairman, H. Rotschi

During the first half of 1978 the WG 56 held two meetings: a plenary one at Las Palmas in April, during the CINECA Symposium and a meeting of the physical panel at Kiel, in May, during the GATE Symposium.

Plenary meeting at Las Palmas

Two plenary sessions were held on Wednesday 12th of April and on Thursday 13th of April.

Participants were: O. Brown, P. Hughes and H. Rotschi of the physical panel, R.T. Barber, R. Jimenez, R. Boje, B. Voituriez of the biological panel. Other participants were D.W. Stuart, chairman of the WG 55, J.J. O'Brien chairman of the WG 49, R.L. Smith and M. Tomczak.

Replacement of M. Stevenson who was unable to accept the invitation to become a member of the physical panel

It was felt that the WG would benefit by the participation of a theoretician with a good insight into the problems of mathematical modelling and that close liaison with WG 49 "Equatorial Modelling" should be encouraged. Bearing in mind the need for a replacement for M. Stevenson it is proposed to the SCOR Executive Committee that Dr D. Moore, who is chairman of the equatorial panel of WG 49 be appointed a member of the physical panel of WG 56.

Appointment of a chairman to both the physical and the biological panels

D. Halpern was appointed chairman of the physical panel and R.T. Barber was appointed chairman of the biological panel.

Inventory of the spatial and temporal variability of equatorial upwelling in the three Oceans

All oceans manifest equatorial upwelling thermal signatures, when viewed in a mean taken over many years. However, temporal and spatial scales for equatorial upwelling are not well known. It seems to be a seasonal event (July–August) in the Atlantic east of 20°W, while only sporadically occurring west of this meridian. The large scale wind field pattern in the Pacific produces a longer lived, more classical Ekman divergence driven upwelling in the equatorial region. Past work in the Pacific (east of 180°) has shown the equatorial upwelling to be a permanent feature. Only recently has weak equatorial upwelling been identified as a semi-permanent (April–October) part of the circulation in the western Pacific. Indian ocean circulation is dominated by the annual monsoon winds. Upwelling is primarily a coastal event although there is evidence that strong upwelling is sometimes present in the eastern part of the basin; monsoon winds are favourable for Ekman driven upwelling for at least 75% of the year.

Much remains to be observed about equatorial upwelling at shorter time and space scales. Thus it is probably not possible at this time to generalize our limited knowledge to other situations. However, many theories of equatorial circulation presently exist which require verification. Subsequently, the most fruitful approach would appear to be the acquisition of physical, chemical, and biological data sets pertinent to equatorial upwelling situations.

Before planning this type of approach an inventory, as complete as possible, of the existing observational evidence on variability both in time and space is necessary, and priority must be given to reviews of our state of knowledge. The General Assembly of the IUGG in December 1979 at Canberra, during which Professor J. O'Brien will convene a session on equatorial circulation, would be a good opportunity for such reviews. Professor O'Brien proposed to have an invited paper on the physical variability of the equatorial upwelling in the Pacific by M.M.F. Jarrige of Orstom Noumea and in the Atlantic by C. Colin of Orstom Abidjan, and to invite a British Scientist to contribute a paper on variability in the Indian Ocean. (Subsequently Dr J.C. Swallow was invited to contribute this latter paper).

A similar review of the biological aspects of the equatorial upwelling should be undertaken but information in this field is scarce and more dispersed. The process of reviewing might take longer and it is proposed to appoint a group which would have the responsibility to plan the work and distribute tasks among concerned and willing scientists. Considering the important contribution of Soviet oceanography to the study of the productivity mechanisms in the equatorial upwelling zones, Dr Vinogradov will be asked to make the first proposals for the appointment of the group. It is further noted that in the oriental Pacific high productivity is not always bound to the presence of an equatorial thermal front, and special attention should be paid to this feature.

Finally, the hope has been expressed that Dr J. Walsh will ensure the connection between WG 56 and WG 59 on mathematical models in biological oceanography and will be successful in trying to accelerate the study of equatorial models.

Planning of investigations during FGGE

Attention was drawn to the American-French project of investigation of the seasonal and secular variability of the thermal structure in the upper waters of the equatorial Pacific from 20°S to 20°N (EQUAPAC) and it was felt that this programme would bring a noticeable contribution to the knowledge of the variability of the conditions in the equatorial region and that such research should be encouraged as well as the use of ships of opportunity routing along interesting paths, such as the 20 ships of opportunity which are used by J.R. Donguy at Orstom in Noumea to study the equatorial surface temperature and salinity.

It is also noticed that satellite data which are normally discarded contain extremely interesting information and the scientific community should try to persuade the authorities concerned to preserve these data for future exploitation because, for many reasons, the equatorial region needs to be more thoroughly studied and satellite temperatures are a fundamental tool.

Coupling of equatorial processes with coastal upwelling

Concerning the coupling between equatorial upwelling and coastal upwelling three points were evidenced:

- there is a wide spectrum of phenomena

- the Atlantic ocean is of special interest because of the annual existence of a phenomenon which is the Atlantic equivalent of El Niño
- the boundary phenomena are extremely important

This gives special interest to the requirement expressed by SCOR WG 55 of surface temperature maps of the Pacific equatorial region, between 5°N and 5°S, on a daily basis, with a definition of ¼° in latitude and 1° in longitude, based on satellite data.

WG 56 wishes to support this proposal which it feels should be extended in the Atlantic ocean to the latitudes 5°N – 10°S, in the Pacific to 10°N – 15°S and in the Indian ocean to 15°N – 5°S.

This requirement gives further support to the proposal contained in the preceeding item of systematic preservation of satellite temperature data pertaining to the equatorial zone.

Finally, it was agreed that the successful implementation of a regional programme such as ERFEN was of primary importance for the developing countries concerned.

Inventory of scientists engaged in active research on the various aspects of equatorial upwelling

Due to the intense investigations which were devoted in the past to the study of the equatorial region, by many countries and many groups, the known projects such as EQUAPAC and CIPREA, and the fact that the post-IDOE programme is likely to pay special attention during the next decade, to the equatorial dynamics, it seems that a large scientific community will be concerned with the work of WG 56 and that the latter could benefit considerably by closer association with interested scientists. It is thus proposed to make an inventory of all those scientists who are actually or will be in the near future actively engaged in the study of the various aspects, (mathematical modelling, hydrodynamics, hydrology, chemistry, biochemistry, production at various trophic levels) of the equatorial upwelling.

To achieve this aim, each member of the WG is invited to list the scientists of his country, whom he knows could and would be willing to contribute to the work of the WG.

Physical panel meeting 18 May 1978 Kiel

After a brief welcoming statement by the Chairman of WG 56 Physical Panel, Dr D. Halpern, the following agenda was agreed upon:

- (a) List of attendees
- (b) Terms of reference
- (c) Membership of Physical and Biological Panels
- (d) Las Palmas meeting report
- (e) Individual reports

Participants. Members of the Panel attending the meeting were Drs O. Brown, D. Halpern, P. Hughes and D. Moore. Dr H. Rotschi was unable to attend and sent his regrets. Dr R. Boje of WG 56 Biological Panel attended. Eleven observers attended.

Terms of Reference

- (a) With regard to the first term of reference, no changes were recommended.
- (b) With regard to the second term of reference, a modification was recommended:

To investigate the coupling of equatorial upwelling processes with the coastal upwelling in the adjacent areas along eastern boundaries of the ocean in association with relevant WG's such as 36, 49, 55 and 59.

- (c) With regard to the third term of reference, it was recommended to delete "in particular those of FGGE (through WG 47 of SCOR)". The modified third term of reference to become

"To suggest lines of multi-disciplinary enquiry into processes of equatorial upwelling for the planning of future expeditions".

- (b) With regard to the second term of reference, a modification was recommended:

To investigate the coupling of equatorial upwelling processes with the coastal upwelling in the adjacent areas along eastern boundaries of the ocean in association with relevant WG's, such as 36, 49, 55 and 59.

Physical Panel Membership

- (a) It was agreed that an expanded membership of the physical panel would provide greater representation of the equatorial upwelling activities pursued by the international community. It was agreed that D. Halpern would discuss this with H. Rotschi, Chairman of SCOR WG 56.

- (b) During D. Halpern's visit to Moscow on 26 May, the question of expanded membership was discussed with Dr K. Federov, President of SCOR. Because of the financial constraints imposed upon SCOR, it was decided to postpone appointing additional members and that interested individuals be made corresponding members.

Las Palmas Report

- (a) Review of equatorial upwelling. Drs C. Colin (Abidjan) and F. Jarrige (Noumea) were commended for their willingness to prepare summaries of equatorial upwelling processes in the Atlantic and Pacific Oceans, respectively. It was agreed that a review should also be made of equatorial upwelling processes in the Indian Ocean, and that a search for a candidate to prepare the Indian Ocean portion of the final report begin immediately.

- (b) Satellite sea surface temperature charts. Drs O. Brown and J.O'Brien have begun discussions with the U.S. National Oceanic and Atmospheric Administration to archive satellite-derived sea surface temperature measurements made within maximum resolution in time and space throughout the tropical oceans. These data will provide extremely useful information for the study of equatorial upwelling processes, and Drs Brown and O'Brien were encouraged by the attendees of the meeting to pursue this activity vigorously.

Individual Reports

(a) Dr A. Mesquita (Brazil)

Brazil plans to install meteorological instrumentation and a tide gauge at St Paul Rocks.

(b) Dr H. Lass (German Democratic Republic)

GDR plans to continue oceanographic research in the Atlantic after FGGE.

(c) Dr Ph. Hisard (France)

France plans to initiate an XBT Ship-of-Opportunity program in the Atlantic similar to the one conducted by the Noumea Orstom Laboratory.

(d) Dr P. Hughes (United Kingdom)

The UK has plans for equatorial oceanographic research in the Indian Ocean in 1981.

Membership

Since the Las Palmas meeting D. Moore has accepted to become a member of the physical panel and took part to the Kiel meeting. Dr P. Hughes, to the regret of the Chairman, has resigned. Dr K. Striggow of the SCOR Commission of the German Democratic Republic has requested the appointment of Dr H.U. Lass as a member of the physical panel. It is proposed to discuss this matter at the next meeting of the WG 56.

Satellite sea-surface temperature charts

Following the Las Palmas and Kiel meetings, an official request has been presented by the Chairman to Dr F. Webster for the archiving by NOAA of the daily SST data between 5°N and 10°S in the Atlantic, 10°N and 15°S in the Pacific and 15°N and 5°S in the Indian Ocean.

Review of equatorial upwelling

Drs C. Colin, F. Jarrige and J. Swallow have accepted to present SCOR WG 56 sponsored papers at the IUGG Canberra meeting reviewing the equatorial upwelling physical variability respectively in the Atlantic, the Pacific and the Indian oceans.

No funding by IUGG being available, it has been asked to invitees to get funding from national sources. Considering the travel costs to Australia, this might shown somewhat difficult so it is asked whether SCOR could contribute to the travel expenses of Drs Colin, Jarrige and Swallow to the extend of the order of at least US \$1000 per person which would cover about half the cost of the trip.

Biological aspects of the equatorial upwelling

Dr M. Vinogradov has been requested by the Chairman to make the first proposals for the appointment of the group which will have the responsibility to plan the work of reviewing and to distribute the redactional task.

Directory of individuals interested in equatorial upwelling processes

A notice has been published in the Bulletin of the American Meteorological Society, Transactions of the American Geophysical Union, and Limnology and Oceanography asking interested scientists to contact Dr D. Halpern or R.T. Barber.

Next meeting

There is a feeling that both panels should meet together in the early 1979. It is believed that a three days meeting could be organized, the first and third days being devoted to plenary sessions and the second to panel meetings. If this meeting were to be held at UNESCO in Paris, as has been suggested, the total travel cost would be of the order of US \$12000 plus per diem.

SCOR WG 57 COASTAL AND ESTUARINE REGIMES

Report of meetings in Hamburg and Tallinn 28 August – 6 September 1978

Members were invited to meet in Tallinn, Estonia 4 – 6 September 1978. Because several members could not go to Tallinn and since we had planned to be in Hamburg during the preceeding week, a preliminary meeting was held in Hamburg.

Present in Hamburg and Tallinn were the following:

J.B. Matthews (USA), Chairman, N.S. Heaps (U.K.), J. Imberger (Australia), A. Aitsam (USSR), H. Gade (Norway), C.N.K. Mooers (USA), H. Ferguson (Netherlands). Also in Hamburg were J.J. Voogt (Netherlands) and W. Hensen (FRG).

The group thanked Professors J. Sundermann, W. Hansen and J. Imberger for the arrangements and hospitality in Hamburg and Academician Upik and Professor Aitsam in Tallinn.

The group's first priority was to define some specific realizable goal or goals consistent with its terms of reference as directed by the SCOR Executive (SCOR Proceedings Vol. 14, p. 15, 1978). To accomplish this task the group reviewed its charge in the light of accomplishments to date. Terms of reference (SCOR Proceedings Vol. 12, p. 60, 1978) are as follows: To promote the coordination of the physical aspects of research on estuaries, coastal areas and shelf seas. In particular, special efforts should be made: 1. to encourage liason between physical oceanographers and those studying sediment transport phenomenon and 2. to relate numerical models with observational programs.

To date the group has

- (a) integrated the numerical modelling sub-group with the working group.
- (b) co-sponsored the meeting 'Numerical Modelling of Estuarine Physics' in Hamburg 24–6 August 1978.
- (c) co-sponsored the 16th International Conference on Coastal Engineering in Hamburg August 27 – September 3 1978.
- (d) suggested a Joint Oceanographic Assembly dealing with coastal and estuarine topics on an interdisciplinary basis.
- (e) planned a symposium on coastal and estuarine regimes, sea breeze and great lakes problems for the IUGG General Assembly 2 – 15 December 1979.

The working group felt that the sponsorship of the meetings in Hamburg had gone a long way toward filling our goals. The symposium on modelling addressed numerical models and their procedures and was directly in accord with objective number 2. We are indebted to Professor Sundermann for suggesting and organizing the conference. The ICCE meeting covered both objectives. However the group felt that without more assistance from sediment dynamicists it was not able to make further progress with special objective number 1. It was agreed to draw SCOR attention to this and ask advice.

Details of the symposium number 4 for the IUGG meeting in Canberra 2–15 December 1979 were discussed. There was difficulty in fitting speakers on all the topics into the time available. The first session will be devoted to sea breeze papers, the second to great lakes problems and the remaining sessions are to be divided between coastal and shelf seas and estuaries.

A major part of the group's discussion centered around the best way to approach a state-of-the-art review of our subject. After considerable discussion over several sessions, a list of topics and possible authors was generated. It was decided to write to the authors asking for an early expression of interest so that a report could be included for submission to the SCOR Executive.

Clearly this is a major work and will require support from our sponsors. It was felt that funding support should be requested through SCOR for the secretarial work and for holding a pre-publication workshop. Equipment and personnel capable of producing camera-ready copy appeared to be readily available only in the U.S.A. Drs Matthews and Mooers volunteered to supply such services if funding can be found. The chairman is exploring this possibility via SCOR.

Finally a draft letter for introducing the proposed volume to prospective authors was drawn up and approved. We are actively seeking comments and suggestions on our proposed work and schedule. Correspondence should be addressed to the Chairman, Dr J.B. Matthews, Geophysical Institute, University of Alaska, Fairbanks, Alaska 99701.

The group also has tentatively agreed, following the success of the 16th ICCE conference, to co-sponsor the 17th ICCE meeting to be held in Sydney, Australia 23 February – 9 March 1980. Although it was regretted that we could not bring the IUGG and ICCE meetings closer together, it was the opinion of the group that no conflict would ensue by sponsoring both meetings. There is only a small overlap and the sponsorship of one meeting would cause no noticeable effect on the other.

The group also wished attention to be drawn to two IAHR symposia which it is not sponsoring.

- 1) Symposium on stratified flow to be held in Trondheim, Norway 26 – 9 June 1980. Sub-topics are a) 'Vertical transport in lakes, reservoirs and estuaries' and b) 'Blocking and mean flow characteristics of stratified flow'. The convenor is Dr Torkild Carstens of the Technical University, Trondheim.
- 2) Symposium on Numerical Models to be held at Berkely, California, USA in December 1980. The meeting is to be an in-depth analysis of numerical model programs in which evaluation of methods of computation will take place. The convenor is Professor Hugo Fischer.

SCOR WG 58 THE ARCTIC OCEAN HEAT BUDGET

Report of Chairman, Dr A. Foldvik

SCOR WG 58 met from 5 to 7 September 1978 at the Geophysical Institute, University of Bergen, Norway. The terms of reference were

- I to assess the present state of knowledge of the Arctic Ocean Heat Budget and the physical processes which control it, and
- II to recommend a coordinated and international research effort to significantly improve understanding of the controlling processes, taking into account the plans for the Polar sub-programme of the Global Atmospheric Research Programme.

Substantial progress was made in the preparation of a full report responding to the group's terms of reference. The report will be completed by late 1978 and will be published in the University of Bergen report reviews. With reference to the first terms of reference, the full report identifies the major components and processes of the Arctic Ocean Heat Budget, including items that are sufficiently well known and important information gaps. With reference to item II, we recommend the following course of action:

- 1. That SCOR WG 58 be perpetuated as a forum for international discussion, planning and coordination of investigations into the role of the Arctic Ocean Heat Budget and its relation to world climate; that funding for the organization be sought outside SCOR; that activities be coordinated from a center in Norway; and that working group members in their own countries attempt to inform and stimulate interest in the programs proposed below with a view to obtaining participating and funding.
- 2. That the following field projects be carried out as soon as possible to improve understanding in the areas described. The group emphasises that such projects require a coordinated and international effort:
 - a. Advective exchange of latent (ice) and sensible (water mass) heat across the whole Fram Strait.
 - b. A synoptic hydrographic survey of the Eurasian Basin down to depths of 800m, and deployment of recording sensors to examine variability and the dynamics of the polar mixed layer.
 - c. An investigation of heat exchange over open water and associated effects on the underlying water column, with a view toward parameterizing the ocean-wide surface heat flux in terms of ice cover and thickness.

We note that field projects presently directed toward the above studies are currently underway at the University of Washington, the Frozen Sea Research Group in Sidney British Columbia, the University of Bergen and the Polar Institute of Oslo.

- 3. That modelling efforts be initiated early in the program to explore dynamical processes, identify important time-scales, and as aids in experimental design. A possible hierarchy of models would include

- a. One-dimensional models of the seasonal polar mixed layer, and longer time-scale "filling box" type models to investigate the effects of climatic changes on ocean structure.
- b. Circulation models including the seasonal advance and retreat of river plumes, and advection of deep ocean currents.
- c. Climate models including an evaluation of the effect of ice-cover on the Arctic-atmosphere, and in turn, the effect of changes in the Arctic atmosphere on world climate. Model studies on the role of abyssal circulation in global heat transport. Such models urgently need new information of polar mixing processes.

Summary Report on the Activities of the:
SCOR WG 60 ON MANGROVE ECOLOGY
to 31 October 1978

Dr Samuel C. Snedaker, Chairman

SCOR WG 60 Membership:

Dr S.C. Snedaker	USA
Dr F. Blasco	France
Dr H. Chansang	Thailand
Professor V.J. Chapman	New Zealand
Dr A. Lot-Helgueras	Mexico
Dr F. Pannier	Venezuela
Dr B.G. Thom	Australia
Professor T.R. Parsons (reporter)	

The SCOR Working Group 60 on Mangrove Ecology was formed during in late 1977 as a result of recommendations from UNESCO and the International Association of Biology Oceanography. The Executive Committee of SCOR provided the Working Group with the following terms of reference:

1. To provide a general scientific framework for mangrove ecosystem studies, including the need for research on structure, geographic range and ecosystem dynamics.
2. To identify the subject content of a methodological handbook such as would be required to carry out the programme identified in (1) above.

Following the establishment of the WG and the designation of its chairman, Dr Samuel C. Snedaker of the University of Miami, USA, the appropriate membership was solicited and plans made to hold the first meeting. All invitees accepted membership and the first meeting was held in May of 1978 in San José, Costa Rica. At the first meeting of the WG, the chairman charged the group with the terms of reference and outlined supporting goals to be achieved. The results of that meeting are summarized below.

Results of the San José Meeting

In order to deal with the terms of reference, the WG felt that it was first necessary to agree upon a working definition for the scientifically ambiguous term, 'mangroves' and to outline the major conservation and research problems. The following definition of mangroves was approved:

"Mangroves are a collection of woody plants, plus associated fauna and flora, that utilize a coastal, saline, depositional environment involving a variety of coastal land forms with typically anaerobic soils."

Two ancillary and explanatory sentences were also accepted:

"Mangroves are characteristically open systems in respect to nutrient flow, such nutrients being primarily derived from an upstream catchment or from tidal flooding, with organic material being exported."

"The net production from the mangroves is utilized by a variety of marine organisms in a complex, detrital-based food web."

This definition for an ecosystem which is neither wholly marine nor terrestrial is believed to be of value to all persons with responsibilities relating to the tropical and subtropical coastal zone.

The WG was unanimous in assigning causes of the worldwide and progressive disappearance of mangroves to: ill-advised freshwater management schemes, coastal mining activities, conversion to agricultural land use, timber exploitation, and regional development practices, in general.

From these bases it was then possible to address the terms of reference. It was agreed at this point that the "general scientific framework for mangrove ecosystem studies" stated in the first term of reference would also constitute the "subject content of a methodological handbook". Both terms of reference were kept in mind during the preparation of the material summarized by major topic headings:

Structure (with reference to both flora and fauna)

- Species composition of communities
- Morphological adaptations
- Population structure
- Physiognomy

Geographic Range

- Areal distribution of recognized communities mapped at a scale not to exceed 1:50,000.
- Species distributions in relation to temperature isotherms and precipitation

Ecosystem Dynamics

- Direct physical factors
- Hydrodynamics and geomorphology
- Biological interactions
- Community metabolism
- Detritus production, decomposition, export and utilization
- Evolution of the community

In a similar manner, the subject content of the methodological handbook was identified based on the above. The major topic headings to be included are:

- Biological survey of species and communities
- Environmental conditions: topography, hydrology, meteorology and pedology
- Productivity
- Nutrient cycling
- Process studies
- Community or ecosystem evolution
- Consumer systems
- Modelling: physical, chemical and biological

All of the topics were thoroughly discussed and each of the WG members was assigned one or more tasks to develop the information subsumed under the designated heading. Minutes were maintained throughout the meeting to serve as a basis for these individual work efforts.

During the course of the several day meeting it became apparent that in order to fully address the scientific problems associated with mangroves on a worldwide basis, it would be necessary to accept two additional terms of reference. These were

“To develop a survey sheet (questionnaire) for the identification of current research workers and research problems which could serve for interpretation and for publishing a general worldwide directory on the subject of mangrove research.”

“To consider the ways in which scientific research can be applied to problems of management and conservation of mangrove ecosystem.”

The chairman accepted the responsibility for assembling, distributing and processing the survey questionnaire. The fourth term of reference would become a major topic for discussion at any subsequent meeting of the Working Group. It was further decided that to continue the functions of the working group it would be necessary to include among the membership a zoologist. The name of Dr A. Sasekumar, Department of Zoology, University of Malaysia, was accepted as a logical candidate. Lastly, the group agreed that should any future meeting of the Working Group take place, it should be held in Africa (Senegal, Nigeria or Kenya) due to the fact that Africa is poorly represented in mangrove research activities.

Following the meeting in San José, the meeting minutes were typed and distributed to assist each member in discharging his task responsibilities. As of this date, all of the members have submitted their working drafts of promised materials and efforts are being made by the chairman to collate and edit the draft report. In addition, the chairman has solicited the cooperation of the Institute of Ecology (Dr Frank Golley) in the handling of the survey questionnaire, due to his recent experience with a survey of tropical ecologists. The survey questionnaire will be available for distribution in November at UNESCO's regional seminars in Cali, Colombia, and Dacca, Bangladesh, as well as meetings with similar objectives. A mass mailing of questionnaires will be made early in 1979.

SCOR AD HOC REVIEW GROUP FOR ANTARCTIC OCEANOGRAPHY

Report from Convenor, T.D. Foster

During the past year the convenor has met with the members of this group on an individual basis and kept in touch by correspondence; he has also visited a number of oceanographic institutions in Argentina, France, Germany, Norway, United Kingdom and the United States, which have Antarctic interests.

In general, research projects in Antarctic oceanography seem to be proceeding quite well along disciplinary lines; however, with some exceptions there do not seem to be many research projects which have considered the interdisciplinary aspects of Antarctic research. There is a real need for interdisciplinary research in Antarctic oceanography, particularly with regard to investigating the interaction of physical and chemical parameters with biological systems. It is hoped that when oceanographic research programs are planned, interdisciplinary aspects are considered and researchers from various disciplines are brought into the initial planning processes, especially in the case of large international programs.

The very successful Polar Oceans Conference held at Montreal in May 1974 brought together biologists, chemists, geologists, glaciologists, meteorologists and physical oceanographers. Because there has been much new research in polar oceanography since 1974, especially in the Antarctic, it is time to start thinking about having another specialized conference, perhaps restricted to Antarctic oceanography. If this conference were kept small like those held at Santiago in 1966 and at Montreal in 1974, meaningful interdisciplinary discussions might take place. Thus the proposed conference might best succeed at emphasizing interdisciplinary aspects if it were held apart from major international meetings. Perhaps 1982 would be a good year to hold such a meeting as it would follow completion of projects such as ISOS, IWSOE and FIBEX.

REPORT ON CONSULTATION BETWEEN REPRESENTATIVES OF ADVISORY BODIES OF IOC, ON THE COMMISSION'S FUTURE ROLE AND FUNCTIONS

Introduction

The consultation took place at Chateau du Bois du Rocher, Paris, from 16-18 October 1978. It was attended by two representatives (listed in Appendix) of each of the Commission's Advisory Bodies, SCOR, ACMRR and ECOR, serving in their personal capacities, together with the Secretary of IOC. Dr H. Postma was appointed chairman and Mr B.B. Parrish rapporteur for the meeting.

The group first considered its terms of reference as agreed between ACMRR and the SCOR Executive Committee, which were as follows:

1. To appraise the likely nature of international marine science activities and services that can best be promoted and supported through intergovernmental action within the UN system and other intergovernmental bodies engaged in marine affairs
2. To recommend ways and means to make IOC more effective as an instrument of member states and a joint co-ordinating mechanism of ICSPRO agencies . ."

The Group agreed that in the time available it would not be possible to examine in depth all aspects of these items, especially item 1, a detailed examination of which would require more time, and a considerably wider range of expertise than was available at this meeting. Consideration of this item was therefore restricted to a general assessment of the likely future impact of the new ocean regime on international marine science activities, relevant to IOC, and attention was focussed mainly on item 2, with special reference to the future role and effectiveness of the Commission's Advisory Bodies.

Impact of new ocean regime

It seems clear that whatever the final outcome of the UN Conference on the Law of the Sea may be, the recent changes in national jurisdiction over the seas and their resources, which have already taken place in many parts of the world, will become accepted and will constitute an element of a future ocean regime. As already experienced in some areas this will generate changes in the attitudes of countries towards international marine science activities and to the latter's detailed nature and content. In particular, the interests of countries will tend to become focussed more on specific problems of an applied significance, occurring within or related to the environment and resources in their economic zones, individually or regionally. This trend is already visible in IOC. Further there will be a requirement, especially by developing countries, for the close involvement of coastal states in the scientific programmes, and for a tangible pay-back in the form of research results and scientific education and awareness. This involvement will facilitate agreement on, and the implementation of, programmes of common interest.

The group was of the opinion that while these changes will inevitably affect the content of international marine science programmes and the detailed working arrangements for dealing with them, they in no way negate the need for a global, marine scientific body such as IOC. Indeed, due to the nature of many ocean processes and the common interests in certain

resources, the need for such a body under the new ocean regime is enhanced, especially with regard to:

- (a) providing liaison between developing and developed countries with respect to the planning and implementation of research programmes in the waters of individual, or groups of, coastal states;
- (b) providing common services for information, documentation and data exchange and products, in support of research activities and their application;
- (c) promoting standards for oceanographic data and intercalibration, as well as standardization of instruments and methods;
- (d) promoting the transfer of technology in marine science particularly to developing countries;
- (e) mobilising financial resources for the conduct of global or regional research programmes.

The Group believed that most of these functions are allowed by a broad interpretation of the IOC statutes.

Another feature of marine science which is also of major importance in this regard is the growing erosion of the distinction, which has been generally accepted previously, between basic and applied aspects. This applied especially in fisheries where the need to understand basic ecological processes and the influence of environmental factors (including man-made ones) as well as the fisheries themselves on the availability and productivity of exploited-resources is becoming increasingly recognised. The impact of this development on the Commission's activities is already reflected in some of its current programmes (e.g. those under IOCARIBE which include fisheries orientated projects; those under SEATAR which include mineral resource surveys; and the oceanographic components of GARP which relate to weather and climate). There is also an increasing need for oceanographic data for ocean engineering.

In the Group's view these and other similar developments provide a basis for advocating a future broadening of the Commission's responsibilities and total range of activities. These would cover all aspects of marine science and related ocean services and lead to the strengthening of the Commission as the global intergovernmental body responsible for the promotion, development and co-ordination of international marine research on behalf of its member countries. They would also meet the needs for scientific information and advice, of the UN agencies members of ICSPRO, as well as other global or regional organizations.

Improvement in effectiveness of IOC

Any consideration of developments and changes in the Commission's structure and working arrangements which may be necessary to improve its effectiveness is inevitably influenced by the definition of its future overall scope and functions. Thus, an extension of its scope to include all aspects of basic and applied science, as mentioned in the previous paragraph, would call for greater changes in structure, organisation and working arrangements than would be the case if its role is effectively confined, as hitherto, to essentially the promotion of basic scientific programmes. However, the Group concluded that some adjustments are

likely to be needed to meet the demands resulting from the new ocean regime, whatever the future scope may be. The following were considered to be of particular importance:

- a) there is a need for a greater involvement of member country scientists than hitherto, in the regular activities and meetings of the Commission with regard to scientific policy making, formulation of programmes, co-ordination of their implementation and appraisal of results. In the Group's view such involvement is essential for ensuring the most efficient conduct of the Commission's work. In this regard the Group was pleased to note the intention of the Commission to hold scientific session committee meetings in advance of the main plenary sessions at the next Assembly.
- b) With the growing emphasis on regional or sub-regional activities, the structure and working arrangements within the Commission should be geared accordingly. Consideration may have to be given to the establishment of semi-autonomous regional bodies operating under the Commission's umbrella, to perform these tasks – along broadly the same lines as in the North Atlantic where ICES provides both a scientific forum and an input to management bodies concerned with marine pollution and fisheries. Such a development would remove a good deal of the detailed consideration of programmes by the IOC governing bodies and would facilitate the involvement of scientists from countries within the regions in the programme of work. In the Group's view such a regionalisation of the Commission's activities would become essential if its scope was extended as mentioned in previous paragraphs.

Future role of the advisory bodies

The Secretary of the Commission informed the Group that, in his opinion, the Advisory Bodies' role in serving the Commission works well and they had responded satisfactorily to the requests by the Commission for advice and action – although it was acknowledged that the response time was sometimes rather long. Further the Advisory Bodies had served as a valuable, independent source of objective advice on the scientific merit and appropriateness of scientific proposals emanating from the Commission and had provided the stimulus for new activities of the Commission.

The Group considered that notwithstanding possible developments leading to the creation of new institutional machinery and working arrangements (e.g. to meet regionalisation needs), involving the possible establishment of "in house" standing scientific committees etc., the independent Advisory Bodies would continue to have a valuable role to play. They would provide a vital link with the scientific community as a whole and would appraise the scientific merit, content and appropriateness of proposals for new programmes being developed by the Commission. They would also advise on new methodologies in marine science and technology especially on a global basis. They would in addition constitute independent fora for appraising and advising the Commission on the progress in, and the results of, its programmes of work.

The Group considered whether the amalgamation of the existing, separate Advisory Bodies into a single body would be a more effective way of meeting the needs of IOC and other agencies which they also serve. It felt that there is no justification for such an amalgamation at the present time, although it recognised the increasing convergence of the multi-disciplinary scientific fields covered by SCOR and ACMRR. It expressed the view that because of this, there is a need for the advisory bodies to reexamine their interrelationships and

methods of co-operation and to maximise their collective effectiveness in serving the needs of IOC and their sponsoring agencies. In this connection the Group proposes a combined meeting of the officers of the Advisory Bodies in the not too distant future. It also felt that the future structure and arrangements for independent scientific advice might need to be examined further when the future overall role and functions of IOC have been settled.

Participants

SCOR Professor Dr H. Postma
 Mr R.I. Currie

ACMRR Mr. B.B. Parrish
 Dr M. Ruivo

ECOR Ir. G.A. Heyning
 Mr J.G. Th. Linssen

IOC Secretariat

Mr D.P.D. Scott
Dr L.R.A. Capurro

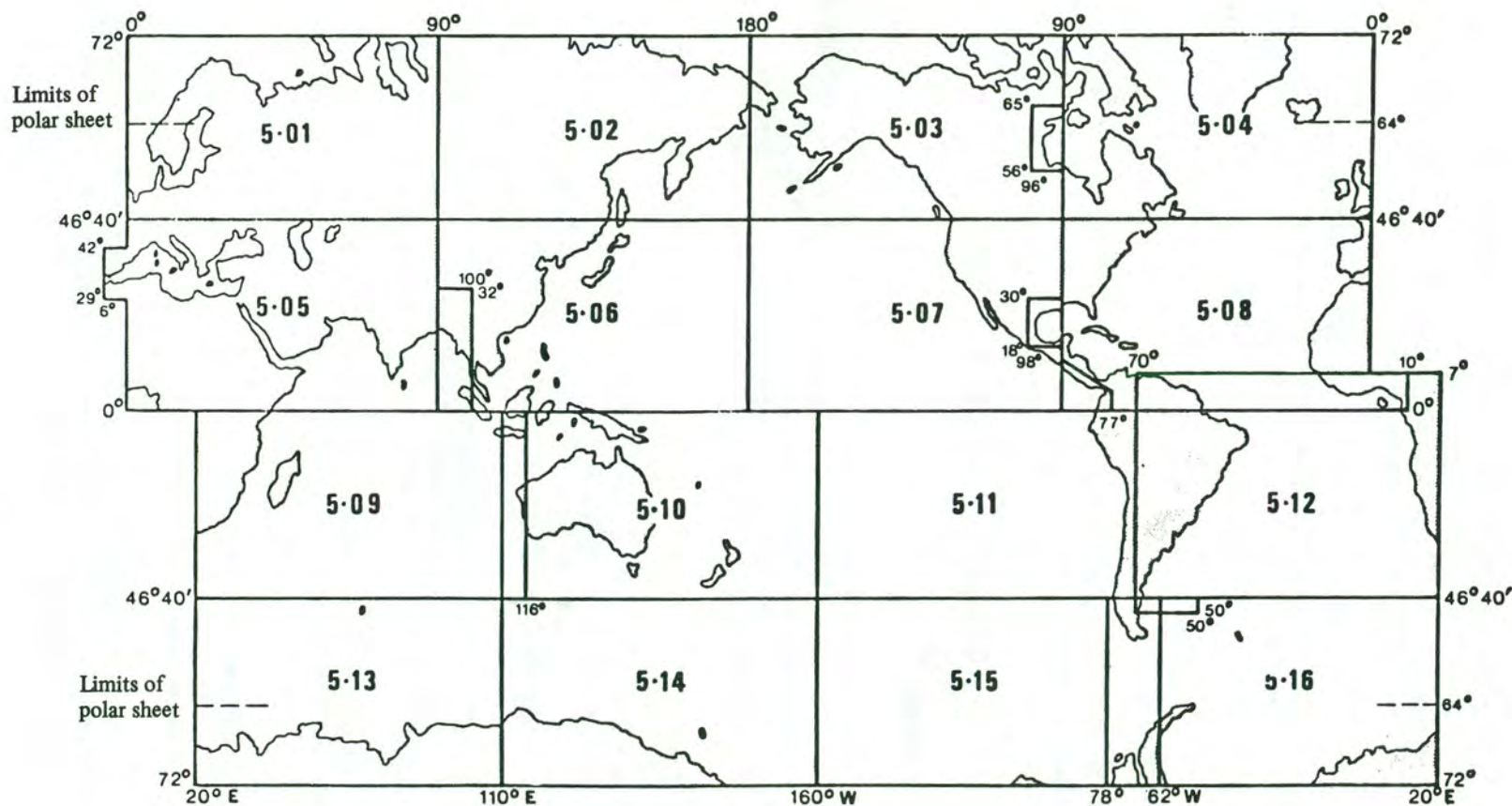
**PROGRAMME FOR THE COMPILATION OF THE
GENERAL BATHYMETRIC CHART OF THE OCEANS (GEBCO)**

(5th Edition)

Sheet 5.05	Published 1975
Sheet 5.01	Published March 1978
Sheet 5.04	Published May 1978
Sheet 5.12	Published May 1978
Sheet 5.17	Submitted to CHS March 1978 Publication end-1978
Sheet 5.03	Submitted to CHS March 1978 Publication end-1978
Sheet 5.06	Submission date July 1978 Publication end-1978
Sheet 5.18	Submission date July 1978
Sheet 5.09	Submission date end-1978
Sheet 5.10	Submission date end-1978
Sheet 5.02	Submission date end-1978
Sheet 5.11	Area east of 130°W almost complete Submission date end-1978
Sheet 5.14	Submission date September 1979
Sheet 5.16	Submission date September 1979
Sheet 5.13	Submission date end-1979
Sheet 5.07	Submission date mid-1980
Sheet 5.08	Submission date March 1981
Sheet 5.15	Submission date March 1981

Note: The submission date is the deadline date for receipt of all materials by the Canadian Hydrographic Service, which is printing and publishing the series.

ASSEMBLY DIAGRAM FOR GEBCO SHEETS (5th Edition)



THE ROLE OF THE OCEAN IN THE GLOBAL HEAT BUDGET

Report of JOC/SCOR Specialists Meeting Kiel, FRG. 6 to 8 November 1978

Participants: W. Böhme, GDR, K. Bryan, USA, B.R. Döös, JPS for GARP, K. Hasselmann, FRG, J.T. Houghton, UK, G.R. Kontarev, USSR, E.B. Kraus, USA, C.E. Leith, USA, A. Musaelan, USSR, A.H. Oort, USA, G.W. Paltridge, Australia, M.J. Rubin JPS for GARP, A. Rybnikov, USSR, R.W. Stewart, Canada, Yu. Tarbeev, WMO, K. Voigt, IOC/UNESCO, J.D. Woods, FRG.

1. Opening of the Meeting

The Specialists Meeting was opened by the Chairman, Dr R.W. Stewart, at 0900 h. He introduced Professor G. Siedler, who welcomed the participants. Professor Siedler described briefly the role that the Institut für Meereskunde has played in the furtherance of the GARP aims and expressed the hope that this meeting would lay the basis for continued work on the role of the oceanic processes in climate.

2. Approval of the Agenda

The meeting agreed that it was advisable to expand the scope and change the title of the Meeting to consider the role of the ocean in the global heat budget not only on the annual cycle as proposed by JOC, but on the broader spectrum adopted for the GARP Climate Dynamics Sub-programme, namely from several weeks to several decades. Therefore, the title "The Role of the Ocean in the Global Heat Budget" was adopted.

3. Aims of the Meeting

The main aim of the Meeting was to carry out a general discussion that will lay the basis for international cooperation in the study of the role of the ocean in the global heat budget, primarily within the content of the second objective of GARP and the World Climate Programme. Secondary aims of the Meeting were to consider:

- (i) scientific problems related to the impact of oceanic processes on regional and global scales, such as those that might be of importance in extended range forecasting and the global climate, and
- (ii) the USSR proposal on a research programme into the processes of air-sea interaction for the purpose of developing long-term weather and climate theory.

4. The Ocean Circulation and Heat Transport

4.1 *The Problem of Measurement*

The mean and seasonal heat balance of the northern hemisphere has been analysed by Oort and Vonder Haar (1976) using radiation budget measurements from satellites, upper ocean heat storage measurements, and radiosonde data on meridional energy transport and storage in the atmosphere. As a residual of this calculation they determine the

meridional heat transport in the oceans necessary for net balance. They find the mean total heat transport across mid-latitudes to be above 3×10^{15} watts. Atmospheric transport is dominant in northern latitudes, but the oceanic component is responsible for most of the transport out of the tropics. There is a marked annual variation (0 to 5×10^{15} watts) in the ocean transport across 20°N latitude.

A number of questions about the general circulation of the ocean are posed by these results. Is it possible to account for the deduced oceanic transports by: mesoscale eddies, differential heat transport in gyres, vertical meridional circulations, or some combination of these processes? Since the transports are observed to change considerably through a seasonal cycle, what can be deduced about the general characteristic response times for ocean circulation changes? Are direct measurements of these ocean heat transports feasible? Are ocean circulation models yet competent to resolve spatially the transport processes on various time scales? Such questions have initiated much of the discussion of this meeting.

4.2 *Time Series Measurements*

It is evident that the role of the ocean in the climate system cannot be determined without time series of measurements taken over many years. However, at the present time there is no practicable method available that will enable frequent measurements to be taken to describe the three dimensional state of the ocean as a whole.

Satellite measurements give promise of becoming able to yield sea surface temperature to useful accuracy on a global basis. Temperature difference patterns are already proving of great value. However, the absolute accuracy remains inadequate, in that it does not much (if at all) exceed the standard deviation of interannual variations, and regions of persistent cloudiness continue to cause difficulty.

At present the limitations of the satellite temperature measurements cause oceanographers and meteorologists still to rely largely on sea surface temperature data obtained from merchant ships. In some areas of the northern hemisphere oceans these data are quite dense in space and time. Despite the fact that they are significantly less accurate than they might be, these data have proved to be of great value and they are the main source of present information on sea surface temperature anomalies.

Climate studies require much more than only sea surface temperature. Ultimately it will be necessary to understand the global and regional ocean circulation in terms of the mean behaviour, annual cycle, and interannual variations. For this purpose measurements at depths will be needed.

Temperature observations throughout the upper few hundred metres can be obtained with limited, but still useful, accuracy using XBT's. These can be launched from non-specialized ships and are sufficiently inexpensive that programmes using many thousands are not out of the question. The U.S. NORPAX results have demonstrated the feasibility of this sort of operation. There is some promise that salinity may also soon be accurately measureable with expendable instruments.

However, measurements of the type required for ocean climate research, below the upper few hundred metres, require specialised research vessels, manned by skilled personnel.

Even if the world's entire fleet of research vessels were deployed for the purpose of obtaining time series measurements of variables relevant to climate studies, only a small fraction of the world's oceans would be covered. As it is, these vessels are in great demand for a variety of other programmes, and only a fraction of their time is likely to be devoted to climate monitoring.

Thus, it is essential that an operational strategy be devised which recognises the limitations imposed by finite resources and seeks to optimize the results which are obtained. As a first step, several pilot investigations should be carried out toward the design of an optimal long-term measurement strategy.

Efforts are now being made to use existing data to identify geographical areas of the ocean which are of particular importance for their influence on the atmosphere. However much more needs to be done in this direction; the results generated to date are not yet entirely convincing. Thus only some of those groups commanding ship resources are prepared to commit their research vessels to oceanic time series in areas indicated by the work now completed.

4.3 *Relations between Models and Measurement Strategy*

Another difficulty in defining an international, large-scale, long-term ocean monitoring programme at this time is that the sensitivity of ocean model calibrations to the form of the available verification data has not yet been systematically investigated. The traditional approach in ocean modelling is to construct a numerical model and compare its results with existing observations. Deviations between the measurements and the model may suggest some revision of the model, but a systematic fit of the model to the data using general inverse modelling methods is not usually attempted. Recently, however, modern inverse model fitting techniques, in which ocean models containing a large set of free parameters or fields are constructed by optimally fitting the model to observations, have been actively explored by Stommel and Schott, Wunsch, Davis, Bryan and Sarkisyan. These techniques, when combined with an appropriate statistical analysis of the error residuals, provide a quantitative measure of the relative value of different observational data sets for model construction. They therefore represent an essential tool for the rational planning of observational networks. While the application of these techniques to ocean modelling is still too new to identify the most effective measurement strategy for a long-term ocean monitoring programme, the systematic application of inverse techniques to this programme in the near future is certainly feasible and promising. They clearly should precede an attempt to define an extensive measurement programme. Investigations in this direction should therefore be strongly encouraged.

4.4 *Impact of New Technologies*

4.4.1 *Introduction*

Oceanographic observation systems are at present in a state of rapid development. Several new technologies are reaching the stage of advanced testing. At least some of these technologies can be expected to be operational within the next few years. When that happens it will give the oceanographic community unprecedented opportunities to obtain a variety of data in real time along a continuous line or over a continuous area. While these developments proceed, it is probably unwise to make rigid large-scale and long-term commitments for any specific type of observation.

In principle, the variables observed with the new instruments are the same as those observed by older methods. It is their rapid sampling rate, internal data processing and prospects for combined usage which has the potential of revolutionizing our view. Among the new systems one might list specifically the following:

4.4.2 *Shipborne Instrumentation*

- (i) A global positioning system will allow a ship to determine its position anywhere on the ocean with an accuracy of ten metres or better by simultaneous contact with several satellites. The exact position can be updated continuously. The system will be in use almost immediately for a limited number of hours each day over a limited part of the world's oceans. It is expected to be fully operational everywhere, at all times within a few years.
- (ii) A current-velocity measuring system will use acoustical back scattering from suspended matter in the ocean to determine relative velocities from a moving ship. The system can provide velocity vectors at different levels, from the surface down to a depth of a few hundred metres.
- (iii) Undulating instruments (such as batfish) towed at up to 14 knots offer great potential for the collection of high resolution hydrographic sections through the upper ocean (typically 0-400 metres) far more rapidly than conventional hydrographic stations. At present these systems are still in an experimental phase suitable for use only by experienced teams supported by the facilities normally available only on an oceanographic research vessel. However, a number of laboratories are striving to develop more reliable systems suitable for routine use on ships of opportunity or charter ships. If achieved, this development promises to revolutionize the collection of high quality upper-ocean hydrographic data from freighters, just as the development of the Longhurst-Hardy towed plankton recorder achieved for biologists in the last decade.
- (iv) Shipborne computer terminals which communicate via satellite with a base computer allow processing of observed data in real time.

Used in conjunction, the techniques described in (i), (ii) and (iii) can obtain complete sections of the temperature, salinity and horizontal velocity fields from a moving ship. With (iv) scientists can obtain immediate displays of processes data with the resulting possibility of immediate tactical adjustments in their observational programmes.

4.4.3 *Unmanned Floating Platforms*

- (i) A large number of freely-floating surface floats can now be monitored simultaneously from a satellite to provide Lagrangian current measurements and other sea surface or atmospheric quantities.
- (ii) Subsurface neutrally buoyant floats tracked acoustically from shore or moored deep-sea listening stations can provide Lagrangian current measurements at various depths for periods of years.

4.4.4 *Remote Sensing*

- (i) Sea surface temperatures are now derived routinely from satellite radiances. The reliability of such data, however, is not yet adequate. Refinement of the operational procedures for deriving sea surface temperature from radiance observations is urgently required with particular emphasis on the elimination of faulty measurements due to the influence of clouds or the presence of high humidities. Attention must be paid to changes in operational algorithms or changes of satellite instruments in the study of long time series.

There is good expectation that the value and reliability of satellite sea surface temperature measurements will eventually be comparable to or better than those obtained routinely by merchant ships.

- (ii) Mean sea surface height can also be measured by satellites. At present these measurements are barely accurate enough for geostrophic measurements of intense currents. It is hoped, however, that refinements of the instrumentation and of the sampling procedure will allow determination not only of the major currents but perhaps also large eddies and possibly gyres in the not too distant future.
- (iii) Information on wave spectra and surface winds (surface stresses) can be inferred from microwave backscatter measurements from satellites. The capability of wave spectra determinations and surface wind measurements from satellites has already been developed and initial tests performed with the aid of the first Seasat satellite.
- (iv) Essentially the same doppler measurement techniques using decimeter radio-waves backscattered from the sea surface has been applied from shore stations and could probably be deployed from a ship. The measurements can provide near surface currents with a resolution of a few kilometers over a radius of several tens of kilometers.

The remote sensing instruments have the advantage of being able to provide a very wide areal coverage of sea surface conditions. Potentially they have the capacity to determine the work of the windstress and perhaps at some later stage also other energy fluxes, stress curl and stress divergence.

5. **USSR Proposal for Research on Air-Sea Interaction**

5.1 *Introduction*

The Meeting reviewed the document on the Research Programme into the Ocean-atmosphere Interaction for the Purpose of Developing Long-term Weather Forecasting and Climate Theory, as requested by the WMO Executive Committee. It also followed with interest an oral presentation of the USSR effort in this regard by Dr G. Kontarev. It was understood that the JOC/SCOR Specialists Meeting was charged with reviewing the scientific basis for the USSR proposal and reporting through JOC and SCOR to the WMO and IOC. It was further understood that the Secretary-General of WMO was charged by the Executive Committee with presenting a proposal to the World Meteorological Congress (8th Session) on the subject.

5.2 *Discussion*

The Specialists Meeting had insufficient time to examine the scientific basis of the proposal in full detail, but it did examine its basic scientific philosophy. The Specialists Meeting considered that its comments on the scientific merits of the proposal are valid and will be of use to the WMO and IOC, especially in the context of its other discussions, the report of which should be provided to WMO and IOC for additional guidance.

5.3 *Conclusions*

The Meeting was in agreement with the reasoning upon which the Soviet proposal is based, namely:

- (i) Climate research requires time series observations in the ocean, extended over many years.
- (ii) Resources available now, or likely to be available in the near future, do not permit time series to be undertaken everywhere. Nevertheless, the urgency of tackling the climate dynamics problem is such that there should be no long delay in instituting time series observations.
- (iii) Therefore it is necessary to try to identify regions of the oceans to which the climate system is particularly sensitive, and to concentrate such resources as can be applied to oceanic time series on these regions.

Where differences in judgement appeared was in the estimation of how well regions of particular sensitivity could now be identified.

The Soviet proposal is based upon the belief that these regions can now be identified with sufficient confidence that the employment of major research ships is warranted to obtain time series information on the oceanic behaviour in these regions.

Other participants believe that substantially more work must be done, using existing data both in statistical and modelling studies, to determine such regions and critical processes with more confidence. The Meeting therefore did not consider it appropriate to recommend generally that oceanographic research vessels be allocated to an international programme of routine ocean monitoring of the kind proposed in the USSR proposal, except by such groups as are themselves convinced that this is warranted.

While taking into account the scientific basis for the USSR proposal, the Meeting preferred to recommend that a pilot time series programme be developed (presented in Chapter 6) using such research vessels as can be made available, but relying heavily on more economical vessels such as ships of opportunity (as used in NORPAX) and charter vessels (as used in JASIN).

The Meeting further recommends that the theoretical studies necessary to refine the location of sensitive areas be pursued as a matter of high priority.

6. A Recommended Pilot Ocean Monitoring Study

6.1 General Recommendation

The Meeting recommended to JOC and SCOR that there should be a *pilot study* using a variety of methods for the collection of oceanic data during the 1980's as a preliminary to a *future ocean monitoring programme for climate research and potential prediction*. This pilot study should have important elements in all oceans. There are arguments in favour of paying increasing attention to the Atlantic Ocean, largely because it has a rather different spectrum of variability from the Pacific Ocean which the NORPAX programme has studied in recent years. The data collected in this pilot study will serve to stimulate progress in the understanding of the fundamental dynamics responsible for oceanic redistribution of heat and other scalars on periods in the range of a few weeks to a few years. They will also enrich the existing data base for the purpose of statistical studies and model fitting experiments designed to investigate the effect of the ocean on climate on these time scales. While it is too early to specify the measurements needed for ocean monitoring, the experience gained in the pilot study will be directly relevant to the anticipated future monitoring programme.

6.2 Specific Recommendations

- (i) Every effort should be made to continue and expand the successful programme in the Pacific, notably NORPAX and the Ocean Weather Station sections.
- (ii) The greatest possible effort should be made to expand the use of *ships of opportunity* and *charter ships* equipped with expendable or towed instruments, following the successful operations during NORPAX (line freighters), during GATE and JASIN (charter ships), and routinely by operators of ocean weather ships.
- (iii) Proposed national and international programmes involving the use of oceanographic research vessels for the collection of relevant time series over periods of 5–10 years should be coordinated within the framework of the proposed pilot study. Examples discussed at the Meeting include the following proposals for the 1980's:
 - (a) the Soviet programme for selected hydrographic sections and polygons in the North Atlantic and Pacific Oceans,
 - (b) the programmes advocated by French and American oceanographers for studying the dynamics of the tropical anticyclonic gyre in the North Atlantic, paying special attention to the meridional heat flux,
 - (c) the Institute für Meereskunde (Kiel) programme for standard sections through the warm water sphere in the North Atlantic using towed undulating instruments.
- (iv) A planning meeting should be organized by JOC and SCOR, possibly in Miami during spring 1979, to develop a specific measurement programme for the pilot study outlined in (ii) and (iii) above, taking account of the available results and future needs of relevant climate models.

- (v) Experimental work should be encouraged to develop new techniques offering promise for a future ocean monitoring programme.

7. JOC/SCOR Study Conference on the impact of Oceanic Processes on Global Climate

The Meeting considered the proposal made by JOC (JOC Officers' Meeting, September 1978) that a joint JOC/SCOR Study Conference on the "Impact of Oceanic Processes on Extended Range Forecasting and Global Climate" be organized. The specific purpose of the conference would be to produce an assessment of the present state of understanding of:

- (i) Air-sea interaction on a time and space scale appropriate to climate dynamics and extended range forecasting, and the parameterization of contributing processes taking into account both air and sub-surface factors.
- (ii) Modelling of the large scale circulation of the global ocean, including the statistical dynamics of meso-scale oceanic processes.

The Meeting recognized the need for such a Study Conference and made the following *recommendations* to JOC and SCOR with regard to the organization of the conference:

- (i) The proposed title for the Study Conference should be simplified to read: The JOC/SCOR Study Conference on the Impact of Oceanic Processes on Global Climate.
- (ii) The programme for the conference should include, in addition to the problem areas identified above, the "Role of the Oceans in the Global Heat Budget".
- (iii) The background material to be prepared for the conference should include a clear identification of the requirements for oceanographic observations, taking into account the limitations of the resources available.
- (iv) An organizing committee with representatives of SCOR and JOC should be established for the preparation of the detailed plan for the conference.
- (v) Considering the time schedule for other meetings and study conferences related to the GARP Climate Dynamics Sub-programme and the time required for the planning of the conference it was agreed that it could not be held earlier than 1980. The possibility of holding this conference in conjunction with the JOC Study Conference on "Parameterization of Land Surface Processes" (June 1980) was mentioned.

The Meeting also stressed the need for a review of existing and planned programmes within the scope of this conference, to be available prior to the conference. The Meeting *recommended* that a consultant be appointed to prepare a detailed survey of work on the role of the ocean in climate being carried out at present in institutes around the world. The survey should be circulated as a background document to the JOC Board on the Climate Dynamics Sub-programme and the SCOR Committee on Climatic Changes and the Ocean. The consultant should also assist in the preparations for the Study Conference.

8. GATE Oceanographic Atlas

Dr K. Voigt, Assistant Secretary IOC and Professor J.D. Woods, Member of SCOR GATE Oceanographic Atlas Board, gave a brief progress report on this project. The Meeting considered that the nearly completed draft of the GATE A-scale oceanographic atlas is of particularly great value for the planning and evaluation of ongoing and future regular climate related field observations in marine tropical areas and *recommended* that it be published.

The Specialists Meeting also *endorsed* the concept that the SCOR Editorial Board should be free to choose the printing format and quality needed to best meet the specific requirements of future users, e.g. tropical ocean survey or research vessels and coastal stations.

The Meeting *recommended* to the JOC Climate Board that WMO and Unesco/IOC be approached to consider favourably appropriate financial support for the production of this atlas to be started in 1979 if possible. The Meeting *further recommended* to the JOC that it review the progress of and provide support for, if necessary, the planned volumes of GATE B- and C-Scale Oceanography products keeping in mind the great scientific and practical importance of these unique data sets for further research projects.

COMMISSION FOR MARINE GEOLOGY (CMG)

Report to SCOR, 1978

1. MEMBERSHIP

There have been no membership changes. The possibility of recruiting national correspondents in other countries has been discussed within CMG.

2. MEETINGS

The 10th meeting of the Commission was held on 28th April, 1978 in London. Minutes of the meeting have been circulated to all interested parties.

The 11th meeting is planned for 15th November, 1978 in Brest to take advantage of the presence of many marine scientists at the SCOR meetings.

4. RELATIONSHIPS WITH OTHER ICSU AND INTERGOVERNMENTAL BODIES

4.1 SCOR

CMG has further considered what action to take on Recommendation 8 of the 1976 Mauritius Marine Geoscience Workshop. The field of Marine Geochronological Methods has been identified as having scope for SCOR involvement. At the SCOR meetings in November a proposal for a new working group will be put forward. CMG has also considered the need for SCOR action relating to pre-Cambrian ocean history. At the moment there is no strong desire amongst pre-Cambrian geologists and oceanographers for any such action.

Working Group 53 (Evolution of the South Atlantic: Chairman, E.S.W. Simpson) is still awaiting allocation of time for a symposium at the 26th International Geological Congress, Paris, 7th-17th July, 1980. The apparent inflexibility of the programme devised by the French organising committee is causing the delay. (see item of report of SCOR meeting).

"Carbon Budget of the Ocean" is the title of a new SCOR Working Group 62 (Chairman, E.D. Goldberg). CMG notes that there is a geological element to this topic and would thus be pleased to advise SCOR on geological matters in this regard.

4.2 IOC/IHO Guiding Committee for GEBCO

The fifth session of the Joint IHO/IOC Guiding Committee for the General Bathymetric Chart of the Ocean (GEBCO) was held under the Chairmanship of Professor E.S.W. Simpson in the Canadian Hydrographic Service Headquarters, Ottawa, 24th-26th April, 1978.

The Committee approved a comprehensive Summary Report from which the following salient points have been extracted:

1. A revised production programme was drawn up. The following sheets have been published or are in press, and can be ordered from the Canadian Hydrographic Service (Price 5 Canadian dollars each): Sheet 5.01 (Norwegian and Barents Seas), Sheet 5.04 (North Atlantic, 46° 40' - 72°N); Sheet 5.05 (NW Indian Ocean and Mediterranean); Sheet 5.12 (South Atlantic, 7°N - 46° 40'S).
2. Publication of the following sheets is expected before December 1978: Sheet 5.17 (Arctic, north of 64°), Sheet 5.03 (NE Pacific), Sheet 5.06 (Western Pacific, 0° - 46° 40'N).
3. Submission, for review, of the following sheets is scheduled for December 1978: Sheets 5.18, 5.09, 5.10, 5.02, 5.11.

Every effort is being made to ensure that the full set of 18 sheets of the GEBCO 5th Edition will be published in time for exhibition at the XII International Hydrographic Conference, and the Joint Oceanographic Assembly, to be held in 1982.

The sixth meeting of the Guiding Committee will be held in Ottawa, 14th-18th May, 1979.

4.3 ICG

CMG has agreed to co-sponsor (financially, if possible) with ICG two symposia to be held at the IUGG 17th General Assembly, Canberra, 2nd-15th December, 1979:

- (i) *Tectonics of the Southwest Pacific Margins*
(Conveners: R. Richmond and G. Packham).
- (ii) *Continental margins of the Indian Ocean*
(Convener: C.C. von der Borch).

4.4 IUGG/IAPSO

CMG has agreed to co-sponsor (financially, if possible) with IUGG/IAPSO four symposia to be held at the IUGG 17th General Assembly, Canberra, 2nd-15th December, 1979:

- (i) *Acoustic Stratigraphy of the Deep Ocean*
(Convener: W.B.F. Ryan).
- (ii) *Fluxes and chemistry of Particulate Matter in the Oceans*
(Convener: J.M. Gieskes).

N.B. This symposium includes a section on oceanic crust and seawater interaction, a topic that was identified by CMG/SCOR as worthy of special attention.

- (iii) *The Nature and Origin of Cherts*
(Convener: J.M. Gieskes).
- (iv) *The Origin and Nature of the Southern Ocean*
(Convener: Sir George Deacon).

CMG is also considering co-sponsorship of other IUGG symposia: *Chemical evolution of the atmosphere, oceans and crust, New techniques in geophysical instrumentation; sea level, ice sheets and climatic changes, Problems of coastal and estuarine zones, Ocean crust and sea-water interaction.*

4.5 CCOP

Dr E.M. Davin has continued to keep CMG informed of progress in the SEATAR programme.

4.6 CGMW

A further meeting to discuss the production of geoscience maps of the sea floor was held on 12th and 13th March, 1978 during the Planary Session of CGMW in Paris. R.A. Scrutton attended on behalf of CMG. A report on the meeting, is available from CMG.

An informal working group of marine geologists is now preparing trial legends for depicting sea floor geology on the Geological Map of Africa and will meet in the first half of 1979 to extract a final draft from the trials.

5. 26th International Geological Congress

CMG proposed the following symposium titles for inclusion in the Congress (Paris, 7th-17th July, 1980):

- (i) *Status of knowledge of seismically inactive continental margins*
(Conveners: L. Montadert and O. Eldholm).
- (ii) *Evolution of subduction complexes in the light of Pacific deep drilling*
(Convener: ? S. Uyeda).
- (iii) *Cenozoic history of the ocean basins*
(Convener: ? J. Thiede).
- (iv) *Hydrothermal circulation in the oceanic crust - processes and products*
(Convener: ? D. Cronan).
- (v) *Evolution of the South Atlantic*
(Convener: E.S.W. Simpson and H.D. Needham)

(i) to (iv) roughly correspond to various sessions pre-determined by the Congress organising committee, and CMG is satisfied that their proposals are met in these cases.

(v) appears to be most appropriately placed in section S.06, although this has not yet been done. (see item 4.1 of this report).

6. Symposium Publication Status

The papers given at a number of symposia organised, sponsored or co-sponsored by CMG in the last few years have been edited for publication. Their status is as follows:

- (a) *Active Plate Boundaries of the Western Pacific*
25th IGC, edited by S. Uyeda, 'Tectonophysics', 45, 4 (1978)
- (b) *Economic Geology of the Sea Floor* (excluding fuels)
25th IGC, edited by E. Seibold to appear in "Contributions to Sedimentology"
(1978)
- (c) *Synthesis of Deep-Sea Drilling in the Indian Ocean*
25th IGC, edited by C.C. von der Borch, "Marine Geology". 26, 1-2 (1978).
- (d) *Crustal Properties Across Passive Continental Margins*
Halifax, June 1978 to be edited by C.E. Keen and appear in "Tectonophysics",
1979.

7. *Heezen Memorial Volume*

CMG and Lamont-Doherty Geological Observatory decided to organize a volume of papers to dedicate to the late Professor B.C. Heezen. A list of invitees was drawn up and, in August 1978 34 scientists were invited to contribute.

Over 20 papers are now assured and a contract has been signed with John Wiley Incorporated to publish the volume, in 1980.

INTERNATIONAL ASSOCIATION OF BIOLOGICAL OCEANOGRAPHY (IABO)

Report to SCOR, 1978

1. *Symposium on "Present and Future Research in Coastal Lagoons", (sponsored by UNESCO, IABO and Duke University Marine Laboratory), Beaufort, N.C., USA, 28 August to 2 September 1978. (Reported by Dr R.R. Parker).*

The symposium was attended by 20 invited delegates from 11 countries. The proceedings were divided into two parts; the first two days were given to papers by participants, outlining the present state of their research on lagoon problems or reviews; the remaining days were utilized by work groups which outlined research needed to answer three questions:

- 1) What information is necessary for better understanding and utilization of coastal lagoons?
- 2) What research program is needed to find this information?
- 3) What training program is needed to provide for the research program?

The ensuing recommendations identified where interdisciplinary and team work ecological problems was necessary. It was recommended that Institutes for Lagoon Research be established on existing university campuses for graduate students enrolled in advanced degrees, and to employ research scientists for both conducting research programs and providing specialized training. Symposium proceedings will be published by UNESCO.

2. *Other symposia and working groups*

Dr E. Boltovsky (Argentina) will attend the *ICSEM Symposium on Plankton Indicators* (November 78 Antalya, Turkey) on behalf of IABO and sponsored by UNESCO. A draft proposal for research on coral reefs has been prepared by Dr Stoddart (U.K.). The proposed program was circulated to Drs Bunt and Talbot (Australia), Smith and Johannes (U.S.A.), Qasim (India) and Raj (Fiji). Announcements for the *ICES/FAO/IABO/SCOR Symposium on the Early Life History of Fish* (Woods Hole, April 79) have been distributed.

3. *New members*

National correspondents have been established in Fiji and Turkey. A tentative affiliation of the International Seaweed Association with IABO has been approved by the IABO Executive and the IUBS. Final approval will be sought from participants at the next General Meeting of IABO.

4. *Communications*

Professor Hempel (F.R.G.) was appointed IABO representative to attend meetings of ACMRR as an observer. Correspondence has been exchanged with IAPSO on the

definition of physical units and with FAO on the use of oceanography in fisheries. *Ad hoc* meetings were held on the desirability of publishing an Atlas of Zooplankton of the southwest Atlantic and on the standardization of methods for estimating photosynthetic pigments in sea water. An IABO newsletter was sent to national correspondents in August 1978.

INTERNATIONAL ASSOCIATION OF METEOROLOGY AND ATMOSPHERIC PHYSICS (IAMAP)

Report to SCOR, 1978

IAMAP is organizing its new Commission on Climate. Professor Monin has been invited to be a member, to bring to the discussions and planning of symposia his knowledge of ocean-atmosphere couplings, and oceanographic processes that must be taken into account in studies of climate.

The major activity of IAMAP since the 1977 Seattle General Assembly has been the participation in organizing the IUGG Symposia for IUGG XVII, Canberra, Australia, December 1979, and in organizing additional IAMAP sessions. IAMAP is taking a lead role or participating in the organization of several Union symposia of interest to SCOR, including:

- Symposium 1. *The Chemical Evolution of the Atmosphere, Oceans and Crust;*
- Symposium 2. *Sea Level, Ice Sheets and Climate;*
- Symposium 4. *Problems of Coastal and Estuarine Zones;*
- Symposium 5. *the Origin and Nature of the Southern Ocean;*
- Symposium 6. *Relationships between Variations in the Earth's Rotation and Geophysical Phenomena;*
- Symposium 12. *Volcanism and Climate;*
- Symposium 13. *Ocean and Atmosphere Boundary Layers.*

We are also preparing for our next Special Scientific Assembly, Hamburg, 1981. There has been an inquiry from IAPSO as possibly holding another Joint Assembly, as was conducted very successfully in Melbourne, 1974. IAMAP has decided, however, that the 1981 Assembly should be devoted primarily to meteorological topics, but since this will perforce include many discussions on climate matters, the possibility is quite open to invite IAPSO to join with IAMAP in joint sponsorship and organization of some of the sessions. These matters will be discussed with our colleagues at IUGG Canberra.

IAMAP, through its secretary, has also been active in the organization of the Joint WMO/ICSU World Climate Conference, (WCC), February 1979, Geneva. The major purpose of the WCC is to give to research workers and planners in climate sensitive areas an overview of current state of knowledge, a view of potential improvements, an assessment of possibilities of useful outlooks on various time scales, and a discussion of various kinds of climate data and services now available. In return, it is expected that our understanding will be improved of what those working in climate sensitive areas require for their work and planning. For example, many kinds of observations are taken for other purposes, such as operational short-time meteorological forecasts. An important question to be discussed is: are those observations after having been processed to obtain traditional climatological means the best basis for research and planning in climate sensitive areas. If not, what observations

are required, what are time and space scales of greatest use, that processing must be accomplished and on what time scale to provide the needed information? The first week of the WCC will be devoted to presentations and discussions. Participation will be by invitation, owing to limited space available in Geneva, but all interested people can apply to the WMO to request an invitation. During the second week, a series of Working Group discussions will take place, mainly on impacts and on climate data and services. Participation here will be by invitation only and will be limited to the space available at the WMO building. It is expected that by the time of the SCOR Assembly in Brest, a program for the WCC may be available from the WMO.

IAMAP has also participated, through its President and its Secretary (ex-officio IUGG Liaison Officers to WMO) in discussions of the joint ICSU/WMO agreement that was initiated for GARP and that is being reviewed for extension on a much broader basis for the World Climate Program. The question of cooperation has in the meantime been settled at meetings in Geneva (WMO) and Athens (ICSU).

INTERNATIONAL ASSOCIATION FOR THE PHYSICAL SCIENCES OF THE OCEAN

Report to SCOR, 1978

PSO/IUGG General Assembly

Plans for the next General Assembly to be held in Canberra, Australia, 2-15 December '79 are progressing well. The Australian Organizing Committee has issued its First Circular and a Second Circular is in preparation. IAPSO will soon issue its own circular. IAPSO conveners and representatives have been appointed and anyone interested in participating in any the symposia should contact the appropriate convener.

IAPSO Symposia

- PS1 *Small Scale Motion and Structures in the Ocean* – J.S. Turner
- PS2 *Intermediate Scale Motion and Structures in the Ocean* – J.D. Woods
- PS3 *Large Scale Motion and Experiments in the Ocean* – A.S. Sarkisian
- PS4 *Acoustic Stratigraphy of the Deep Oceans* – W.B.F. Ryan
- PS5 *Shelf Break Circulation and Exchange Processes* – C.N.K. Mooers
- PS7 *Symbols, Units and Nomenclature in Physical Oceanography* – M. Menache
- PS8 *Radiant Energy in the Sea* – A. Morel
- PS9 *Marine Pollution Transfer Processes* – G.B. Kullenberg
- PS10 *Remote Sensing of Oceanographic Variables* – J. Apel
- PS11 *Ocean Geochemistry*
- PS11A *Fluxes and Chemistry of Particulate Matter in the Ocean* – J.M. Gieskes
- PS11B *Geosecs Results in the Indian Ocean* – M. Ostlund
- PS11C *Nature and Origin of Cherts* – J.M. Gieskes
- PS11D *Ocean Crust and Sea Water Interaction* – D. Cronan
- PS12 *Physical, Chemical and Geophysical Oceanography* – E.C. LaFond

Inter-disciplinary symposia in which IAPSO has prime responsibility

- 4 *Problems of Coastal and Estuarine Zones* – J.B. Matthews
- 5 *Origin and Nature of the Southern Ocean* – G.E.R. Deacon
- 13 *Ocean and Atmospheric Boundary Layers* – P.P. Niiler
- 20 *Tidal Interactions* – D.E. Cartwright

Inter-disciplinary symposia in which IAPSO is a co-sponsor (with IAPSO representatives)

- 1. *Geochemical Evolution of the Atmosphere, Oceans and Crust* – J.M. Gieskes
- 2. *Sea Level, Ice Sheets, and Climatic Change* – E.F. Roots
- 3. *New Techniques in Geophysics* – A.S. Laughton
- 6. *Relationship between Variations in the Earth's Rotation and Geophysical Phenomena* – A.S. Monin
- 8. *Evolution of the Upper Mantle* – S. Uyeda
- 9. *Recent Crustal Movement* – J. Chappelle
- 12. *Volcanism and Climate* – Y.R. Nayudu
- 19. *Geodetic Applications to Oceanography* – J. Apel

Other Meetings

IAPSO co-sponsored an International Symposium on *Interaction of Marine Geodesy and Ocean Dynamics*, held in Miami, Florida, 10-12 October 1978. Dr George Mourad was the convener.

IAPSO is co-sponsoring a symposium on *Turbulence in the Ocean*, to be held in Liege, Belgium, 14-19 May 1979. Professor J.D. Woods is the convener.

ICSU Panel on World Data Centres

Athens September, 1978

Report to SCOR/IAPSO by J. Crease (also alternate for T. Winterfield, IOC representative)

Sir Granville Beynon one of the originators of the WDC concept has resumed the chair after Professor Perek's resignation.

There was a rather full attendance of bureau and members the distinction between functions of bureau and members not being wholly apparent to any of those present who were:

Beynon	(Chair)
Dyer	(Secretary)
Hart	(WDCA)
Belousov	(WDCB)
Maede	(WDCC)
Shapley	(SCOSTEP)
Garland	(FAGS)
Liebscher	(COWAR/IASH)
Crease	(IAPSO/SCOR)

Notable absentees were representatives of meteorology. There was a suggestion that the panel seeks nominations from JOC and from GARP. This will be taken up by Chairman with Smagorinski and Doos (both being in Athens at this time). It was suggested that there should be a representative of C1 (European) WDC's and Dr Rishbeth's name was suggested (Appleton Laboratory).

The functions of the panel were reviewed. These included approval and publishing of guides to exchange through WDC's. Approval of new WDC's, safeguarding of archives of defunct WDC's and publicising work of the data centres.

It was agreed that a sufficient number of discipline guides had been revised since the present consolidated guide was published to warrant a new edition in 1979. It would be particularly advantageous to have it available for the IUGG General Assembly, December 1979 in Canberra. It was hoped that there would be an open informal session of the panel during the assembly similar to that at Grenoble. The possibility of a poster display was considered. All amendments to the guides should be with the panel secretary by the end of November 1978.

The new Oceanography guide was approved but Shapley and some others were concerned that the present sections of marine geology and geophysics belonged more naturally with the solid earth WDC's. The Chairman would seek the views of Commission on Geodynamics. My personal view is that there is some logic in the present arrangement and that in any case there is not much point in disturbing the existing arrangements in WDC's (Oceanography) who could easily transfer required data to solid earth centres if they so desired it. However, I agreed to convey the panel's comments to SCOR/IAPSO and to IOC.

Belousov proposed and the panel supported a resolution which would require ICSU to ensure that data archival and exchange aspects of major new programmes were receiving proper consideration before ICSU agreed to support such programmes.

To aid the Secretary in his work, informal offers of secretarial assistance were given by WDC's A and B. One of the jobs requiring such help included seeing the new edition of the consolidated guide through to publication and another was to carry out a survey of the status of WDC's, in particular of the various C centres.

The panel now has representatives on CODATA in an attempt to improve the communication between the two groups. The panel feels rather strongly that, in general, time dependent data archival in the geophysical and solar field was its responsibility and not in CODATA's province though it recognised that CODATA's present work in the field relating to techniques of compression, analysis and so on could be helpful.

SCOR

Interdisciplinary Discussion on Oceanic Fronts

Programme

Introduction — by *Professor Michitaka Uda* (Tokyo University of Fisheries, Japan)

A review of physical aspects of oceanic fronts — by *Professor J.D. Woods* (Institut für Meereskunde, Kiel, FRG)

A review of biological aspects of oceanic fronts as related to broader issues of variability — by *Dr J.H. Steele* (Woods Hole Oceanographic Institution, USA)

- | | |
|---|--|
| <i>Pingree R.D.</i> (UK): | Mixing and stabilization influence on phytoplankton distribution on the North West European continental shelf. |
| <i>Simpson J.H.</i> (UK): | A study of the European Shelf sea front |
| <i>Laurs R.M.</i> (USA): | Albacore tuna and oceanic fronts. |
| <i>Johannessen O.M.</i> (Norway): | 1) Topographically controlled polar front in the Barents Sea.
2) Ice edge upwelling as a mechanism of frontal generation. |
| <i>Fedorov K.N.</i>
<i>Karabasheva E.I.</i>
<i>Paka V.T.</i> (USSR) | How frequent are Thermal Fronts in the Ocean |

The Interdisciplinary Discussion on Oceanic Fronts was organized by the President of SCOR, Dr K.N. Fedorov who opened the meeting on Tuesday, 14 November 1978 with short welcoming remarks in which he also drew attention to the recent upsurge of interest among oceanographers to the multi-faceted phenomenon of oceanic fronts. The Introduction to the subject was given by Professor M. Uda (Japan) who outlined the forty-year long history of research on oceanic fronts and called for international cooperation in this field. A great number of black-and-white and colored slides shown by Professor Uda demonstrated the enormous variety of visual appearances of oceanic fronts and also proved beyond any doubt the existing close relation between positions of traditional fishing grounds of Japanese fishermen and locations of major frontal zones in the seas around Japan.

Professor J. Woods (Institut für Meereskunde, Kiel, FRG) gave a review lecture on physical aspects of oceanic fronts. In this lecture he reviewed more than five hundred published papers on the subject, which appeared over the past few years. It became evident from his presentation that fronts in the ocean which until recently were treated mostly as boundaries between large scale climatically determined water masses may in fact be encountered much more frequently on all possible scales of oceanic motion. It was also evident that being boundaries in one sense the oceanic fronts are in fact mechanisms of intense mixing

between water masses they separate. While the importance of all ageostrophic motions at fronts was emphasized in this respect, it was recognized that the true physical nature of the mixing processes involved was still poorly understood. A number of analogies with the atmospheric frontogenesis were pointed out, and the recently discovered role of oceanic synoptic scale eddies in the formation of fronts in the upper ocean was brought to the attention of scientists.

Biological aspects of oceanic fronts were reviewed by Dr J.M. Steele (WHOI, USA) in the general context of describing physical and biological causes of plankton patchiness. It was stressed that fronts can provide relatively simple and well-defined physical features for the study of physical-biological interrelations although they must be regarded as one extreme in a range of variable environments. At a strong physical feature, such as a front, there are normally marked changes in some biological components such as plankton concentration or species composition. But these changes may take various forms which can differ from area to area (or from one front to another) or with time.

In the shorter contributions which followed a number of specific topics were treated. A statistical generalization entitled "How frequent are thermal fronts in the ocean?" (Karabasheva E.I., Paka V.T., Fedorov K.N., USSR) was presented as a discussion subject by Dr K.N. Fedorov. His data demonstrated that the average distance between thermal fronts in coastal areas was of the order of a few kilometers, while in the open ocean it would come close to 1000 km. An interesting point of the discussion which followed was the question should the sharp thermal inhomogeneities of the surface ocean layer which appear on a still sunny day be regarded as fronts? As usual in such discussions, a need for an unambiguous criterium or a definition for an oceanic front was very strongly felt. Fronts appearing on the European continental shelf as a result of tidal mixing were described in detail from the point of view of biological variability by R. Pingree (UK) and from the physical point of view by J. Simpson (UK). Dr R.M. Laurs (USA) described patterns of albacore tuna movements in the Pacific ocean as related to the appearance and evolution of oceanic fronts. Dr J. Simpson (UK) demonstrated a very instructive film on the advancement and retreat of an estuarine salinity front. Dr O. Johannessen (Norway) spoke briefly of a front generated by an ice-edge upwelling in very much the same manner as fronts generated in coastal upwelling areas. He also presented illustrations of a topographically controlled oceanic front in the Barents Sea which has a number of similarities with the tidal fronts on the European continental shelf.

A distinct feature of this meeting on oceanic fronts was an ample amount of time allowed for free discussion of presented papers as well as for questions and answers. The topics raised at the discussion ranged from the effect of salinity to the necessity of introducing some classification into the phenomenon, which should possibly be based on the consideration of horizontal scales. The discussion was truly interdisciplinary and touched upon a variety of biological, chemical, acoustic, dynamical and general physical questions.

Most of the papers presented during the meeting extensively used remote sensing data obtained from satellites (mostly IR images). This demonstrated the extreme usefulness of this new tool of ocean research in the study of oceanic fronts.

The meeting was attended by more than 50 participants. This ensured a very thorough discussion combined with a good degree of informality.

FUTURE MEETINGS OF SCOR

and affiliated organizations

Date	Place	Meeting
1979		
22–27 January	Paris	WG 56 – Equatorial Upwelling Processes
23–25 January	Tallin	WG 42 – Pollution of the Baltic
February	at sea	WG 52 Net Trials, <i>Johan Rund</i>
19–23 February	Barbados	WG 59 – Mathematical Modelling in Biological Oceanography
26–30 March	Rome	WG 46 – River Inputs to Ocean Systems – Workshop
2–5 April	Woods Hole	ICES/SCOR Symposium on The Early Life History of Fish
14–19 May	Liege	SCOR/IAPSO Symposium on Oceanic Turbulence
–	–	SCOR Officers meeting
24–28 September	Warsaw	WG 54 – Living Resources of the Southern Oceans
2–15 December	Canberra	IUGG General Assembly: IAMAP, IAPSO Symposia (some with CMG), WG 57 Symposium
? 17– December	Canberra	SCOR/IAPSO Workshop on Fluxes, Chemistry and Composition of Particulates in the Ocean
? December	Canberra	WG 44 – Ocean-Atmosphere Materials Exchange
to be arranged	USA	WG 52 – Estimation of Micro-Nekton Abundance
mid 1979	USSR	Preliminary discussion of POLYMODE results
1980		
January/February	Kiel	SCOR Executive Committee
? January/February	Warnemude	WG 51 – Evaluation of CTD Data
23 February – 9 March	Sydney	WG 57 – cosponsoring International Conference on Coastal Engineering

7-17 July	Paris	International Geological Congress: CMG symposia
? 22-24 September	Woods Hole	SCOR Executive Committee
? 26-29 September	Woods Hole	Fifteenth General Meeting of SCOR
to be arranged		JOC/SCOR Study Conference on the Impact of Oceanic Processes on Global Climate
		WG 60 - Mangrove Ecosystems
		GATE Atlas Board
mid 1980	USA	WG 34 - Final symposium on Eddy Dynamics (with final POLYMODE symposium)
? late 1980/ early 1981		WG 47 - Workshop to review FGGE oceanography results
Other possible meetings in 1980		WG 61 - Sedimentation Processes at Continental Margins
		WG 62 - Carbon Budget of the Ocean
		WG 63 - Marine Geochronological Methods
		(WG 64)
		(WG 65)

ABBREVIATIONS

ACMRR	Advisory Committee on Marine Resources Research (of FAO)
BIOMASS	Biological Investigations of Marine Antarctic Systems and Stocks
BOSEX	Baltic Open Sea Experiment (1977)
CAS	Co.mmission on Atmospheric Sciences (of WMO)
CCCC	Committee on Climatic Changes and the Ocean
CPPS	Comisión Permanente del Pacifico Sur
CER	Coastal and Estuarine Regimes (WG 57)
CGMW	Commission for the Geological Map of the World
CINCWIO	Cooperative Investigation on the North and Central Western Indian Ocean (IOC)
CINECA	Cooperative Investigation of the Northern Part of the Eastern Central Atlantic
CMAS (SC)	Confédération Mondiale des Activités Subaquatiques, Scientific Committee
CMG	Commission on Marine Geology (of IUGS)
COB	Centre Océanologique de Bretagne
CODATA	Committee on Data for Science and Technology (ICSU)
CNEXO	Centre National pour l'Exploitation des Océans
COSPAR	Committee on Space Research (of ICSU)
CTD	Conductivity Temperature Depth
ECOR	Engineering Committee on Oceanic Resources
EOS	Equation of State, for Seawater
EQUAPAC	Equatorial Pacific Cooperative Survey
ERFEN	Estudio Regional del Fenómena 'El Niño'
FAO	Food and Agriculture Organization of the UN
FGGE	First GARP Global Experiment
FIBEX	First BIOMASS Experiment (WG 54)
GARP	Global Atmospheric Research Programme (of WMO/ICSU)
GATE	GARP Atlantic Tropical Experiment
GEBCO	General Bathymetric Chart of the Ocean
GIPME	Global Investigation of Pollution in the Marine Environment
IABO	International Association for Biological Oceanography (of IUBS)
IAGA	International Association of Geomagnetism and Aeronomy (of IUGG)
IAHR	International Association for Hydraulic Research
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)
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
ICNAF	International Commission for the Northwest Atlantic Fisheries
ICSEM	International Commission for the Scientific Explanation of the Mediterranean
ICSPRO	Inter-Secretarial Committee on Scientific Programmes related to Oceanography
ICSU	International Council of Scientific Unions
IDOE	International Decade of Ocean Exploration
IHO	International Hydrographic Organization
IIASA	International Institute for Applied Systems Analysis
IOC	Intergovernmental Oceanographic Commission
IOCARIBE	IOC Association for the Carribean
IOC/EC	IOC Executive Council
IODE	International Oceanographic Data Exchange (Working Group of IOC)
ISOS	International Southern Ocean Studies
IUBS	International Union of Biological Sciences (of ICSU)

IUCRM	Inter-Union Commission on Radio Meteorology (ICSU)
IUGG	International Union of Geodesy and Geophysics (of ICSU)
IUGS	International Union of Geological Sciences (of ICSU)
IUPAC	International Union of Pure and Applied Chemistry (of ICSU)
IUTAM	International Union of Theoretical and Applied Mechanics
IWSOE	Internal Weddell Sea Oceanographic Expedition
IWC	International Whaling Commission
JASIN	Joint Air-Sea Interaction Project
JOA	Joint Oceanographic Assembly (1976)
JOC	Joint Organizing Committee for GARP
JOIDES	Joint Oceanographic Institutions Deep Earth Sampling
JPOTS	Joint Panel on Oceanographic Tables and Standards (WG 10)
JPS	Joint Planning Staff for GARP
LEPOR	Long-term and Expanded Programme of Oceanic Research
MODE	Mid-Ocean Dynamics Experiment
NEADS	North East Atlantic Dynamics Studies (subgroup of WG 34)
NOAA	National Oceanographic and Atmospheric Administration (USA)
NORPAX	North Pacific Experiment
OAMEX	Ocean-Atmosphere Materials Exchanges (WG 44 of SCOR)
RIOS	River Inputs to Ocean Systems
SAB	Scientific Advisory Board (of IOC)
SCAR	Scientific Committee on Antarctic Research (of ICSU)
SCOPE	Scientific Committee on Problems of the Environment (of ICSU)
SEATAR	IDOE Studies on East Asia Tectonics and Resources (CCOP–IOC WG)
SIBEX	Second BIOMASS Experiment (WG 54)
SST	Sea Surface Temperature
STD	Salinity Temperature Depth recorder
TEMA	Training Education and Mutual Assistance
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNESCO-OCE	Unesco Division of Marine Sciences
WCC	World Climate Conference
WDC	World Data Centre
WHOI	Woods Hole Oceanographic Institution (USA)
WMO	World Meteorological Organization
XBT	Expendable Bathy Thermograph