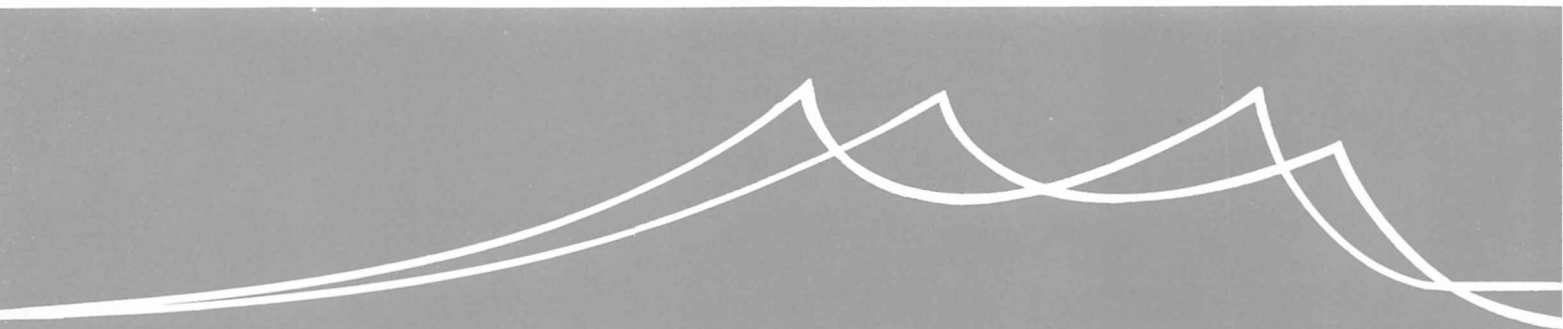
SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH



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INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH

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INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

PROCEEDINGS

OF THE

SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH

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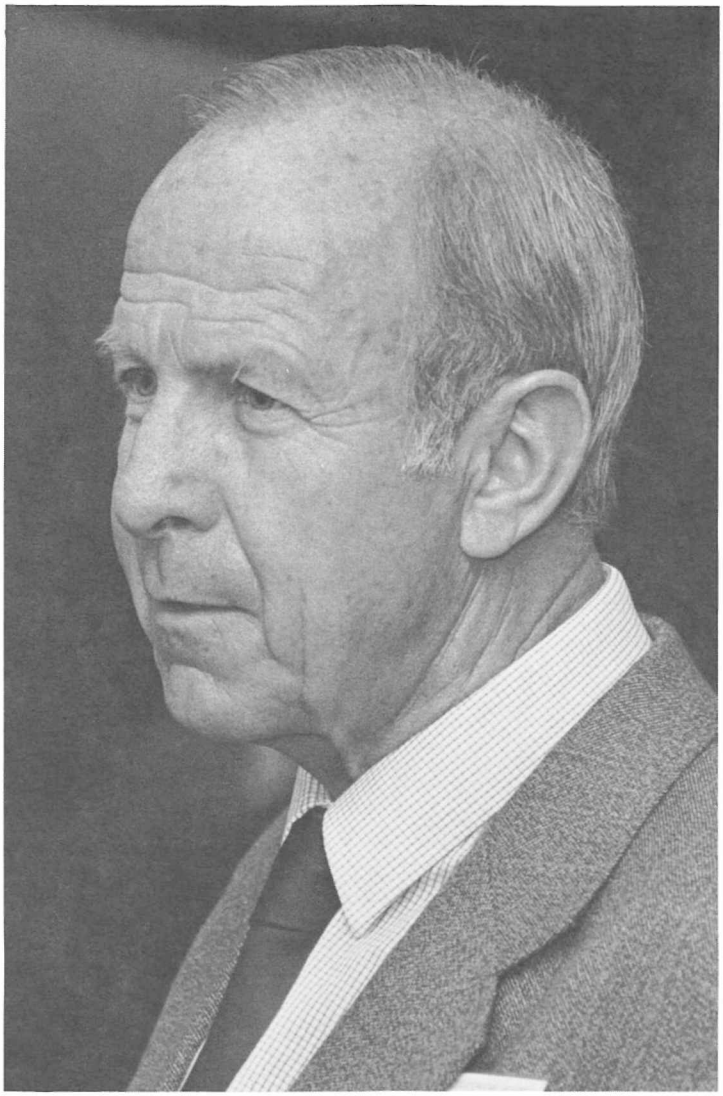
CONTENTS



This volume of *SCOR Proceedings* is dedicated with great respect and admiration to the late Professor E.S.W. Simpson, President of SCOR, who died on June 28, 1983. His many contributions to international ocean science will long be remembered by all who knew him as a colleague and a friend.

REPORT OF THE TWENTY-FIFTH MEETING OF THE SCOR EXECUTIVE COMMITTEE

Paris, France, 31 August to 2 September, 1983

The Twenty-fifth meeting of the Executive Committee of SCOR was held at the Headquarters of the International Council of Scientific Unions, Paris, from 31 August to 2 September, 1983. A list of participants is given in Annex I.

The meeting was chaired by the interim President of SCOR, Professor Gerold Siedler. Professor Siedler had assumed the responsibilities of President following the death in late June of Professor E.S.W. Simpson who had served as President of SCOR since 1980.

Professor Siedler welcomed the participants to the meeting which he noted was a sad occasion in view of the death of the late President of SCOR, Professor E.S.W. Simpson. Some of Professor Simpson's many achievements in marine science were reviewed by the interim President; in particular, his work in the field of ocean mapping (GEBCO, CGMW, GAPA, etc.) and in the international sphere through the Commission for Marine Geology and SCOR. In 1983 he had been elected President of the Royal Society of South Africa and in May had received from Prince Ranier of Monaco the third Albert I Grand Prize for Oceanography in recognition of his work as editor of the 5th edition of GEBCO. The representative of UNESCO drew attention to Professor Simpson's great personal concern for the direction of scientific and educational policies in his own country. The participants rose in silence in memory of Eric Simpson.

Professor Siedler welcomed two new ex-officio members of the SCOR Executive Committee. Professor Wolfgang Krauss, the newly-elected President of IAPSO, and Professor H.-J. Bolle, the new President of IAMAP. Professor Bolle was represented at this meeting by Professor R.G. Soulage, Vice-President of IAMAP. Congratulations were extended to Professor Wooster on his election as President of ICES and to Professor Lal on his election as President of the IUGG. The retirement of Dr. George Humphrey (Australia), the second President of SCOR and long-time participant in SCOR activities was noted as was the departure from active involvement in SCOR affairs of R.C. Vetter of the U.S. National Academy of Sciences. Appreciation was expressed to Professor Humphrey and Mr. Vetter for their many contributions to SCOR.

1.0 ORGANIZATION AND FINANCE

1.1 MEMBERSHIP

National Members:

The following changes in Nominated Members were noted:

The French National Committee has elected Dr. R. Chesselet, Dr. R. Schlich and Professor B. Saint-Guily as Nominated Members.

The Norwegian National Committee has reported that its Nominated Members until 1984 are Professor U. Lie, Professor O.H. Saelen and Professor J. Thiede.

Nominated members of the Canadian National Committee remain unchanged. The agenda for the meeting was in error.

The Philippines National Committee has informed SCOR that its Nominated Members are Mr. C.P. Arafiles, Mr. I. Ronquillo and Dr. E.O. Tan.

Representative Members:

The newly-elected Presidents of IAPSO and IAMAP, Professor W. Krauss and Professor H.-J. Bolle have become ex-officio members of the SCOR Executive Committee, replacing Professor D. Lal and Dr. W.L. Godson. The Secretaries of IAPSO and IAMAP are also Representative Members of SCOR.

It was reported that discussions had been held in late 1983 between representatives of SCOR and delegates of the People's Republic of China to the IOC Assembly regarding Chinese membership in SCOR. The President agreed to attempt to establish contacts with the Chinese oceanographic community and to pursue this topic at the earliest opportunity.

1.2 PUBLICATIONS

The Publications Officer, Professor Charnock reported on the status of publications arising from SCOR activities.

i) UNESCO Monographs on Oceanographic Methodology

Concern has been expressed by the Division of Marine Sciences of UNESCO regarding several monographs which are now out of print, in particular:

No.3 *A Guide to the Measurement of Marine Primary Productivity under some Special Conditions*, and

No.4, *Zooplankton Fixation and Preservation*

The UNESCO representative sought advice from SCOR on the advisability of reprinting these monographs and it was agreed to refer this matter to IABO for consideration.

No.7, *Mathematical Models in Biological Oceanography*

The Russian translation of this monograph has been approved and will appear in 1984.

No.8, *The Mangrove Ecosystem: Research Methods*

This monograph arises from the work of WG 60: a manuscript has been submitted to UNESCO and publication is expected in 1984.

ii) UNESCO Technical Papers in Marine Science

The following Technical Papers have appeared since the XVI General Meeting of SCOR.

No.43, *International Symposium on Coastal Lagoons*

This is a report of a symposium cosponsored by UNESCO, SCOR and IABO held in Bordeaux in 1981.

Future issues:

No.42, *Carbon Dioxide Sub-group of the Joint Panel on Oceanographic Tables and Standards* (in press)

It is expected that six other technical papers will be published in 1984-85. These may include Volume 4 of the International Tables and one or two other papers arising from JPOTS activities, reports from WG 51 (CTD manual) and WG 70 (Remote Measurement of the Oceans from Satellites), and papers arising from SCOR, UNESCO and IABO activities in the fields of coastal ecosystems and high diversity ecosystems. Finally, SCOR was pleased to note that Technical Paper No. 36 will be submitted for translation into several languages because of its special world-wide importance in discussing the Practical Salinity Scale 1978 and the International Equation of State 1980 which were developed by JPOTS.

iii) Other Publications Arising from SCOR Activities

Coastal Lagoons, the proceedings of the international symposium on coastal lagoons which was held in Bordeaux in 1981 was published in December 1982 as a special volume of *Oceanologica Acta*. The proceedings were edited by P. Lasserre and H. Postma.

Synoptic Eddies in the Ocean, A.S. Monin, V.M. Kamenkovich and M.N. Koshlyakov (eds.) was published in 1983 in Russian by Hydrometeoizdat, Leningrad. An expanded version is being prepared for publication in English by D. Reidel Co., Holland. Both versions include a preface written by Professor E.S.W. Simpson, which briefly describes SCOR's interest in promoting the study of eddy dynamics.

Proceedings of the Joint Oceanographic Assembly, 1982: General Symposia.

This volume which also includes abstracts of all special and association symposia and poster sessions, was published in 1983 by the Canadian National Committee for SCOR.

Eddies in Marine Science, A. Robinson (ed.). This volume is in press for publication in September 1983 by Springer Verlag . It is a result of the work of WG 34, and includes a preface by Professor E.S.W. Simpson.

Physical Aspects of Coastal Upwelling, J.J. O'Brien (ed.) has been published as Volume 12 of *Progress in Oceanography* and represents the final report of former WG 36.

Estimation of Micro-nekton Abundance, is in press as Volume 2, Nos. 2, 3 and 4 of *Biological Oceanography*. This publication is a report of a symposium organized by WG 52 and was expected to appear in August 1983.

Arctic Ocean Modelling Meeting, the report of a meeting organized by WG 58, Cambridge, June 1982 has been published as Report No. 57 of the Geophysical Institute of the University of Bergen.

Ocean Modelling Newsletter, continues to be published with the financial support of the Office of Naval Research. No. 51 appeared in July, 1983.

Report of the ICES/SCOR Working Group on the Study of the Pollution of the Baltic. Tallin, U.S.S.R. 24-25 March, 1983. This report of a meeting of WG 42 was published by ICES as Report C.M. 1983/E:4.

A large number of BIOMASS publications have appeared in several series since the XVI General Meeting of SCOR. Details of these are given in Annex V.

A complete list of the publications arising from the recent activities of CCCO is given in Annex IX.

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

1.3 FINANCE

The final financial statement for 1982 is given in Annex II. It was presented and briefly reviewed by the Executive Secretary as was an interim statement to July 31, 1983 and the 1983 budget which had been approved by the XVI General Meeting.

An *ad hoc* Finance Committee was appointed to consult with the Executive Secretary, to examine the financial records, draw up a draft budget for 1984 and to make recommendations on the levels of National Contributions for 1984 and 1985. The members of the Finance Committee were Dr. N.C. Flemming and Professor R.O. Fournier. Dr. Flemming presented the following report at the end of the meeting.

The Finance Committee had before them the audited statement of income and expenditure for the year ended December 31st 1982 and recommends this statement to the Executive Committee for acceptance. The accumulated balance at December 31, 1982 was $71,977.55, in comparison with a balance of $56,656.47 at year end 1981. This large balance compared with a predicted outcome of $23,000.00. This large positive balance is due mainly to the fact that many working groups held meetings at JOA and did not take up their allocated budget expenses.

For 1983, we had a projected budget for the year and an interim financial statement to July 31st. The projected budget surplus was $55,000.00 originally, but is now expected to be $85,000.00. This large positive balance is due to four working groups postponing meetings from 1983 to 1984. The committee felt that the carry-over of commitments to the four working groups whould not be allowed to reduce the finances available to other working groups in 1984 and should be financed by carry-over of the surplus.

The report on the 1981 accounts states that a minimum year end balance should be about $45,000.00 (see SCOR Proceedings, Volume 18). Since the Executive Secretary is required to conduct the business of SCOR at all times with a large margin of cash in hand, it is prudent that the value of this should be protected by the investment of a substantial proportion. During 1983, with total balances of $70,000.00 to $100,000.00, sums totalling $32,000.00 have been invested in short term certificates of deposit yielding a good rate of interest. This practice should be continued.

Arrears of subscriptions by members of SCOR have been greatly reduced over the last two years and arrears for 1982 are minimal, estimated at $4,000.00. There are still some payments due for 1983, but these are not regarded as potential arrears until October.

The Committee drew up a draft budget for 1984, taking into account anticipated income and the finances required for activities already agreed to by the meeting. Anticipated income in 1984 is $255,000.00 not making any favourable assumptions. There are only nine working groups being supported in 1984, including the four carried over from 1983. Total expenditure, including support for working groups, CCCO, JPOTS and administration amounts to an estimated $209,000.00. Of this, $133,000.00, or 52%, is dedicated to the support of scientific activities of SCOR subsidiary bodies. This compares with 56% and 50% in the previous two years.

The projected balance at December 31, 1984 would thus be $44,000.00 which compares favourably with the recommended balance suggested by the previous Finance Committee.

No subscription increase is therefore necessary for 1984, but it would be prudent to consider a subscription increase of 10% for January 1, 1985. If this is agreed by the meeting, a formal notice needs to be circulated to members before the end of the calendar year 1983.

In view of this suggestion that SCOR hold the level of national contributions constant for 1984, we recommend that member countries be invited to consider reviewing their category of membership. We suggest that the Executive Secretary circulate a letter to members stating that the membership categories are meant to reflect a country's economic level, commitment to oceanographic science and level of services received from SCOR. National SCOR committees should consider up-grading their category of membership where appropriate.

The meeting accepted the report of the *ad hoc* Finance Committee with gratitude and approved its recommendations regarding a 1984 budget and levels of National Contributions for 1984 and 1985.

1.4 NOMINATIONS

It was noted that the term of the President of SCOR (this office having been assumed by Professor Siedler following the death of Professor Simpson) would expire at the XVII General Meeting in 1984. One Vice-Presidency is vacant; the two remaining Vice-Presidents and the Secretary are all eligible for re-election in 1984.

A Nominations Committee consisting of three past Presidents of SCOR, Professor W. Wooster, Professor H. Postma and Dr. K.N. Fedorov, was appointed. The Executive Secretary will invite National Committees to forward nominations to the Committee which will report to the XVII General Meeting of SCOR. National Committees will be reminded that only Nominated Members of SCOR are eligible for election to the Executive Committee.

2.0 SUBSIDIARY BODIES

2.1 ARISING FROM FORMER WORKING GROUPS

WG 34, *Internal Dynamics of the Ocean*

Professor Charnock reported that advance copies of *Eddies in Marine Science* had been available at the IUGG Assembly just prior to the Executive Committee Meeting and the publication of this volume was expected in the very near future. WG 34 had made two recommendations to SCOR in its final report. The first of these suggested an observational study of eddy-mean field interaction in the region of the Gulf Stream and its extension. Professor Charnock noted that this topic is already being taken up by various existing groups and that no action is required by SCOR. WG 34 wished also to recommend that SCOR establish a working group on data assimilation in ocean models. The Executive Committee agreed that this was an important topic and requested Professor Charnock to obtain a proposal for such a group for submission to the next meeting of SCOR, taking into account the needs of CCCO and the activities of its Modelling Panel.

WG 36, *Coastal Upwelling Processes*

A volume entitled *Physical Aspects of Coastal Upwelling* which results from the work of former WG 36 had been recently published as Volume 12 of *Progress in Oceanography*, having been edited by Professor J.J. O'Brien.

WG 52, *Estimation of Micro-nekton Abundance*

A series of papers arising from a 1980 symposium organized by WG 52 is in press as an issue of *Biological Oceanography* for publication in August, 1983. The introductory chapter of this volume represents the final report of WG 52 and deals extensively with methods for the estimation of the abundance of micro-nekton, but does not make any recommendations for further SCOR action in this field.

WG 60, *Mangrove Ecosystems*

The final report of WG 60 was distributed to National Committees in late 1982 and appears as Annex III. Additional information had been sought on the publications arising from the work of WG 60 and the Chairman, Professor Snedaker had reported that the manuscript for a monograph of mangrove research methods had been submitted to UNESCO (c.f. item 1.2). In addition, the inventory of mangrove forest lands is presently being completed as a series of journal articles to be submitted for review. IUCN has used much of this information in its *Global Status Report on Mangroves*.

WG 63, *Marine Geochronological Methods*

WG 63 organized a symposium at the Joint Oceanographic Assembly and held its final meeting in Halifax in conjunction with the JOA. A final report, containing abstracts of the papers presented at the JOA symposium, has been submitted to SCOR and will be distributed to National Committees for their information. Since several other symposia on geochronology were held or published during 1982, the members of WG 63 did not think it appropriate to prepare a special volume for the JOA symposium, and the group did not have recommendations for future SCOR activity in the field of marine geochronology. Dr. J. McKenzie did suggest that in the future, CMG might wish to recommend that SCOR establish another working group in a similar area in an effort to combine paleomagnetic studies with biostratigraphy and stable iostope stratigraphy with emphasis on the identification of special events in the geochronological record.

WG 64, *Oceanic Atoll Drilling*

No final report was received from WG 64. The Executive Secretary will seek such a report, including a record of the publications arising from a GSA Symposium organized by WG 64, for presentation at the next meeting of SCOR.

2.2 EXISTING WORKING GROUPS

In introducing this item, the President noted that changes or additions to the membership of several working groups had been suggested. He referred the meeting to paragraph 3.5 of the "Objectives and Procedures" for SCOR Working Groups which limits working groups to eight to ten members. Financial constraints make adherence to this rule most desirable and the Executive Committee was asked to remember this point during its discussion of active working groups.

WG 42, *Pollution of the Baltic*

The Executive Committee Reporter for WG 42, Dr. Wolff, noted that the XVI General Meeting of SCOR had recommended that SCOR cosponsorship of WG 42 (with ICES) be continued until after the meeting of the group which was held in March, 1983. Following that meeting SCOR wished to consider whether its continuing sponsorship of WG 42 was appropriate in view of its regional nature and of the long-term aspects of the activities undertaken by WG 42. Dr. Wolff reminded the meeting that some members of WG 42 are from organizations outside ICES, and that financial support for their participation in WG 42, while modest, depends upon SCOR sponsorship of the group. SCOR involvement also facilitates the involvement of academics in WG 42, since the national links of ICES tend to involve government fisheries scientists. Following a lengthy discussion of these and other considerations, it was agreed that SCOR should continue to cosponsor WG 42. It was noted that many valuable publications have appeared in the open literature since 1972 as a result of WG 42 activities and that two major projects of WG 42, the patchiness experiment and the pilot sediment experiment, are expected to be completed within three years. For this reason, it was not felt to be necessary to change the status of WG 42 to a more permanent panel or committee.

Dr. Wolff introduced the report of the WG 42 meeting in Tallinn (March, 1983) which has been published as ICES Report C.M. 1983/E:4. The group considered national reports on studies of interest to WG 42. It discussed the result of the Workshop on Patchiness Experiments which had preceded the WG 42 meeting and identified three major aims for the patchiness experiments being planned in the region:

- The compilation of statistics on the patchiness of physical, chemical and biological parameters in the Baltic Sea;
- An understanding of the mechanisms of the generation and dissipation of patchiness; and
- A determination of the significance of patchiness in relation to the "ecosystem" of the Baltic and to the pollution, pollution monitoring and effects on fisheries.

A Study Group was established under Dr. B. Dybern, to coordinate patchiness studies in the Baltic region, and in particular to plan for a "joint patchiness experiment" in the Baltic to take place, possibly in 1985.

At the request of ICES, WG 42 had agreed to conduct a pilot study of sediments in the Baltic in order to determine the history of pollutants in dated sediment samples, to determine the role of the sediments as a final sink for substances and as a source of materials in the water column, and to monitor pollution in recent sediments in terms of the rate of sedimentation. The group began in July, 1983 to conduct an intercomparison exercise on the analytical methods to be used in the sediments study.

The groups reviewed other cooperative studies being carried on in the Baltic Sea, particularly Studies of the Biological Effects of Pollution, Biogeochemical Cycling and Budgets or Mass Balances, and the Baseline Survey of Contaminants in Fish and Shellfish. Details of these and other studies involving members of WG 42 may be found in the WG 42 report which is available from ICES.

Dr. E. Andrulewicz (Poland) has replaced Professor Mortimer (USA) as a member of WG 42.

The Executive Committee approved the request of WG 42 for a three day meeting in Copenhagen in April, 1984.

WG 46, *River Inputs to Ocean Systems*

A detailed report of a meeting of WG 46 held in December, 1982 appears as Annex IV. This was the first meeting of the reconstituted WG 46 and was held in conjunction with an IOC/UNESCO/UNDP workshop on "Estuarine Processes: An Application to the Tagus Estuary". The working group report includes a summary of the group's deliberaions on the current knowledge of RIOS and priority areas for research. WG 46 proposes to work through correspondence to produce an expanded document as its final report to SCOR. The report included several recommendations for future activities related to RIOS: some of these were directed to IOC and UNESCO, while others were for consideration by SCOR. Dr. Chesselet expressed some concern over the diversity of the questions which had been addressed by WG 46 and over those recommendations of the group which proposed that SCOR become involved in studies more related to rivers than to the estuarine and oceanic components of RIOS. He did, however, encourage the Executive Committee to support the recommendation of WG 46 that SCOR consider the establishment of a working group on the dynamics of the cycling of materials in estuaries. The Chairman of WG 46 will be invited to develop a proposal for such a group. There was also support for the suggestion that SCOR should evaluate critically the techniques for particle size analysis in reviewing estuarine and coastal systems. The UNESCO Division of Marine Sciences has taken up the suggestion that SCOR establish a new working group on methods for the determination of the concentration of chlorophylls and other plant pigments in estuarine waters (c.f. item 2.4). It was agreed that JPOTS be invited to consider whether it wished to consider the topic of a pH scale suitable for use in estuarine conditions. The remaining recommendations of WG 46 were felt to be more appropriate for referral to other international organizations such as IAHS or IAH rather than for concerted action by SCOR. It was expected that WG 46 would be discharged at the 1984 General Meeting of SCOR.

WG 51, *Evaluation of CTD Data*

The working group has continued to work towards the preparation of a "Guide to the Acquisition and Analysis of High Quality CTD Data". The Chairman of WG 51 reported that the editing process has not proceeded as quickly as hoped. The Executive Committee Reporter for WG 51, Professor Charnock, reiterated his concern, expressed at the XVI General Meeting, that delay in publication of the CTD guide would diminish its usefulness to CTD users. This concern will be conveyed to the Chairman of WG 51 with an offer of any appropriate assistance from SCOR.

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

An extensive review of the activities of WG 54 had been received from Professor El-Sayed; it appears as Annex V. In particular, the Executive Committee Reporter, Dr. Wolff, drew attention to the group's plans for the Second International BIOMASS Experiment which will involve seventeen ships from eleven countries operating in selected areas of the Southern Ocean from December 1983 to March 1984, and again from December 1984 to April 1985. SIBEX will concentrate on the study of mesoscale processes rather than on a circumpolar study (as was done in FIBEX). Specific objectives for SIBEX include a determination of krill abundance and distribution, an assessment of krill production, a description of krill reproductive cycles and studies of krill in relation to fish ecology and recruitment of fish stocks. Details of the plans for SIBEX are given in Annex V.

WG 54 has continued to consider the possibility of the establishment of a permanent BIOMASS data centre. In the meantime, the immediate data processing needs of BIOMASS are being met through a contract with the University of Hamburg.

Dr. Wolff noted various alterations to the structure of BIOMASS subgroups, and reported that seven BIOMASS-related meetings have been held since the XVI General Meeting, eight more being planned before mid 1984. Eight BIOMASS Reports, six BIOMASS Handbooks, two volumes in the BIOMASS Scientific Series and three BIOMASS Newsletters have been published since late 1982 (see Annex V for a list of the titles).

The Executive Committee approved a continuation of financial support of WG 54 in 1984 and noted that it was anticipated that the BIOMASS programme, as presently conceived, would be completed in 1986. For this reason it was not felt to be necessary, as had been suggested, to reconsider the status of WG 54 in spite of the size and scope of the group's activities.

WG 55, *Prediction of El Niño*

At the XVI General Meeting of SCOR it was agreed that the September, 1982 meeting of WG 55 should be its final meeting unless a clear need for the continuation of the group were established by WG 55 or by CCCO. A report of this meeting was submitted to SCOR and distributed to National Committees and is given in Annex VI.

The report of WG 55 generated considerable discussion amongst the participants in the Executive Committee Meeting. A number of them referred to other international cooperative activities related to El Niño, especially the plans of WG 56 for a symposium on "Vertical Motion in the Equatorial Ocean", the activities of CCCO and its plans for TOGA, the IAMAP/IAPSO 1985 symposium on the "Southern Oscillation and El Niño" and the activities of the IOC/WMO/CPPS Working Group on the Investigations of El Niño amongst others. While there was some concern that the IOC/WMO/CPPS Working Group might occasionally seek scientific advice from WG 55, it was felt that such advice could be sought from the CCCO TOGA Scientific Steering Group or the CCCO Pacific Tropical Panel. The SCOR Executive Committee considered that while the topic of the prediction of El Niño is of great relevance, it could not see the need to continue WG 55 in view of the programmes being planned within CCCO which are likely to include aspects of El Niño prediction. It was agreed therefore, that WG 55 should be disbanded at the General Meeting in 1984 and that no further meetings of the group were necessary.

WG 56, *Equatorial Upwelling Processes*

A meeting of WG 56 which had been planned for 1983 has been cancelled in favour of a four or five day symposium in 1984 entitled "Vertical Motion in the Equatorial Ocean and its Effect upon the Living Resources and the Atmosphere". It is proposed to exploit the 1982-83 warm event in the equatorial Atlantic and Pacific Ocean to organize this symposium with the aim of highlighting the rôle of the vertical motion in the upper layer of the equatorial zone and to organize past and present results so that a comprehensive understanding of the upwelling can be reached. The symposium would be held in Brest or Paris.

The Executive Committee approved the plans of WG 56 to hold this symposium, but did take note of the symposia being planned by IAMAP and IAPSO in conjunction with their 1985 General Assemblies in Hawaii. It was felt, however, that the WG 56 symposium would represent a multi-disciplinary approach since it proposes to address the question of the effects of vertical motion on the living resources of the equatorial region. The organizers of the WG 56 symposium will be urged to consult with the convenors of the IAMAP and IAPSO sessions in order to avoid unnecessary duplication between the two events. It was also agreed that the symposium should be the final meeting of WG 56.

WG 57, *Coastal and Estuarine Regimes*

No report of an *ad hoc* meeting of WG 57 which had been planned in conjunction with the recent IUGG Assembly was available. The XVI General Meeting had agreed that this should be the final meeting of WG 57. The Executive Secretary will seek a final report from the Chairman of WG 57 for presentation at the next meeting of SCOR, at which time the group will be disbanded.

WG 58, *Arctic Ocean Heat Budget*

Most of the members of WG 58 met in Sweden in mid-1983 in conjunction with the International Meeting on the Physical and Chemical Oceanography of the Arctic Ocean. The Chairman, in his report to SCOR, noted that WG 58 has fulfilled the tasks set out in its original terms of reference. The group's first report (1979) assessed the present state of knowledge of the Arctic Ocean Heat Budget and the physical processes controlling it. Many of the recommendations for further international research efforts made in that report have been implemented. WG 58 has since functioned as a forum for international discussion and coordination of investigations into Arctic Ocean and its relation to world climate. Members of the group have been instrumental in the organization of such efforts as Ymer - 80, EUBEX, the Greenland-Norwegian Sea Deep Water Project, the Fram Strait Project and others. WG 58 played an important role in the planning of the "Arctic Ocean Modelling Meeting" in June 1982. The report of this meeting has been published by the Geophysical Institute of the University of Bergen (Report No. 57, 1983).

The XVI General Meeting of SCOR had invited WG 58 to consider whether it might meet the needs of CCCO in the fields of ice dynamics and modelling. The Chairman's report included a proposal for a revision of the terms of reference of WG 58 and for additions to the membership of the group. The Chairman of CCCO, Dr. R.W. Stewart, advised the Executive Committee that CCCO still does not plan to establish a group to deal with problems of Arctic oceanography and climate, and has not yet clearly defined its needs in this field. CCCO will look to SCOR and SCAR for advice and assistance when its programmes in the polar regions have been further developed. Since many of the members of WG 58 appear to meet on a regular basis in connection with their research activities, it was agreed that WG 58 should be disbanded at the next General Meeting of SCOR, having discharged its terms of reference. The proposal for reconstitution of the group will be deferred until such time as CCCO seeks advice from SCOR in the area of Arctic studies.

WG 61, *Sedimentation Processes at Continental Margins*

The working group on Sedimentation Processes at Continental Margins presented a symposium at the JOA; it had been proposed that the papers presented on this occasion should be published as a volume of *Progress in Oceanography*. Information as to plans for this publication will be sought from the Chairman of WG 61.

A final report from WG 61 was presented to the Executive Committee and is given in Annex VII. While this report does not contain any specific recommendations for SCOR, it contains a number of points of interest to researchers in the field of sedimentation processes, and should be distributed to appropriate scientists by SCOR National Committees. WG 61 will be disbanded at the XVII General Meeting.

WG 65, *Coastal-Offshore Ecosystems Relationships*

Several suggestions were made to WG 65 following the XVI General Meeting as to the most appropriate way in which the question of coastal-offshore relationships might be addressed. In particular, WG 65 was requested to investigate these problems in a general sense rather than through specific case studies since many of these (mangroves, coral reefs, lagoons, etc.) had been the subject of former SCOR working groups. Dr. B. Kjerve (U.S.A.), a hydrodynamicist, was added to WG 65 following a request made in the first report of the working group for additional expertise in this field. A meeting of WG 65 will be held in Texel, the Netherlands in September, 1983. The meeting will concentrate on the following problems:

1. The nutrient balance between coastal and offshore ecosystems with questions as to the extent in which the coastal community acts as a sink or a source for various nutrients and the influence of physical, chemical and biological properties on that balance;
2. The exchange of organic matter between coastal and offshore ecosystems as affected by e.g. fresh-water outfalls, by the presence of salt-marshes etc., and by the physical and biological characteristics;
3. The way and extent in which invertebrate and fish populations in offshore communities depend on coastal ecosystems (or vice versa);
4. The carrying capacity and productivity of coastal and offshore ecosystems;
5. The effects of man-made disturbances on coastal communities in particular, and the significance of management;
6. Identification of common problems in coastal-offshore interactions, gaps in our knowledge and recommendation for future studies; and
7. Discussions on a proposal for a workshop or symposium on coastal-offshore interactions.

WG 65 expects to draft a final report before the summer of 1984.

WG 66, *Oceanographic Applications of Drifting Buoys*

A new Chairman of WG 66, Dr. G. Cresswell, was appointed in 1982 and the group was given new terms of reference following the completion of some aspects of the former terms of reference and the submission of a report to the IOC Twelfth Assembly. WG 66 will hold its first meeting in Boulder (U.S.A.) in November 1983.

WG 68, *North Atlantic Circulation*

The Executive Committee Reporter for SCOR/ICES WG 68, Professor Siedler, noted that the group had held its first meeting in early 1982 and that most members of WG 68 had also met in an *ad hoc* session during the JOA. The group has been extremely active and is now planning its second meeting to be held in Paris in October, 1983. One of the main subjects of discussion of this meeting will be the rôle of North Atlantic research in the WOCE programme of CCCO.

Various national research programmes in the North Atlantic region will be considered as will questions relating to modelling of North Atlantic circulation and monitoring needs. The agenda includes one special topic for the meeting: interannual variations in the North Atlantic.

Dr. M.N. Koshlyakov (U.S.S.R.) has replaced Dr. A. Sarkysian as a SCOR member of WG 68 while an ICES nominee, Dr. M. Saldanha has been replaced by Dr. A. Dias (Portugal).

The Chairman of WG 68, Dr. Schott, requested SCOR's approval for a third meeting of the group in 1984. The Executive Committee recognized that such an approval did not fall within the normal rules regarding the frequency of meetings of SCOR Working Groups. It was felt, however, that WG 68 is an unusually active group which is performing an important function by bringing together individuals working in many national programmes. In view of the relevance of WG 68 to the planning phase of the CCCO programme, approval was given for the group to meet in 1984.

WG 69, *Small-scale Oceanic Turbulence*

The Chairman of WG 69, Dr. K.N. Fedorov, reported that the group had continued to work through correspondence. This has proved difficult since the members provided such diverse responses to the questions raised by the Chairman. This exchange of views had not led to any clear direction for the group and it seemed advisable to postpone the meeting of WG 69 which had been planned for 1983. One of the terms of reference of WG 69 charges it with the organization, in 1984, of an international symposium on small-scale turbulence in the interior of the ocean. The group has agreed that it is not prepared to undertake this task so soon after the 1979 Liège Colloquium which addressed a very similar topic, especially as the report of a workshop on Turbulence in the Ocean held in conjunction with the Liège Colloquium had not yet been published.

WG 69 is now planning to hold its first meeting (which was originally scheduled for 1983) in Halifax in May, 1984. A few members had recently met in an *ad hoc* session during the IUGG Assembly in Hamburg, although no report of this meeting was available to the Executive Committee. A brief report will be sought from one of the participants in that meeting.

Dr. J.S. Turner has resigned from WG 69; an invitation will be extended to Dr. T.J. McDougall (Australia).

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

The Vice-Chairman of WG 70, Dr. J. Apel gave a verbal report on the activities of the working group. The group had held its first meeting in March 1983 and had succeeded in preparing a preliminary draft of a report which is intended to respond to all of the terms of reference assigned to WG 70. Dr. Apel presented a revised draft of this report which will be submitted to review in late 1983 and is expected to be published by UNESCO in 1984. The report is planned to be a statement of current capabilities in the field of satellite sensing of the oceans and of future needs in this field. WG 70 does not expect to meet again since the publication of its report will complete its terms of reference.

In response to an enquiry from the representative of UNESCO, Dr. Apel stated that the WG 70 report could be updated and expanded so as to take into account the applications and implications of satellite measurement of the oceans for developing countries, especially with respect to the question of access to satellite data for these countries.

The Executive Committee expressed its appreciation for the speed with which WG 70 has accomplished its task. While it had been expected that WG 70 might provide advice to CCCO in the field of satellite sensing, it appeared that it would not be necessary to keep WG 70 in existence for this purpose alone. CCCO has established its own Satellite Observing System Working Group and the Chairman of WG 70 is a member of this group. WG 70 will continue to work towards the completion of its report; the question of its continuation and its usefulness to CCCO will be considered at the next meeting of SCOR.

WG 71, *Particulate Biogeochemical Processes*

During the IUGG Assembly in Hamburg, a one day symposium on "Chemical Fluxes through the Water Column" was convened by Dr. S. Krishnaswami and Dr. M.P. Bacon (Chairman and member of WG 71, respectively). Eleven papers were presented, focussing on several aspects of marine particulates, collection methods, rôle of large particles and aggregates in the transport of organic and inorganic materials, the relevance of particles in the distribution of dissolved metals and radionuclides and the importance of advective transport to particle abundances. These papers touched upon various aspects of the terms of reference for WG 71 and the symposium provided an opportunity for several members of the group to discuss plans for a WG 71 meeting in 1984.

The following topics will be addressed during the first meeting of WG 71:

1. Sources of particles to the ocean, the factors controlling their lateral and vertical distributions;
2. Nature of "scavenging" processes, the relative significance of vertical versus boundary scavenging, large particles versus small particles, etc.;
3. Tracer distributions in the oceans and their relevance to particulate scavenging and dissolution within the oceans and at the water sediment interface; and
4. To evolve a common system of nomenclature and definition for particles and particle-associated processes in the ocean.

The Executive Committee Reporter for WG 71, Dr. R. Chesselet, supported the group's request for approval of a meeting in 1984 especially in view of the work which has already been achieved through correspondence. The meeting agreed, however, that the plans of WG 71 for its meeting did not make the addition of a microbiologist (as had been suggested by the Chairman) imperative at this time. The financial support available for WG 71 in 1984 would not permit enlargement of the membership, but the group may wish to consider a revision of its membership following its first meeting.

WG 72, *The Ocean as a Source and Sink for Atmospheric Constituents*

Several members of the newly reconstituted working group met in *ad hoc* sessions during two related meetings in July and August, 1983. These two occasions provided ample opportunity for planning the future activities of WG 72, and the formal meeting which had been approved for 1983 was postponed.

The group has submitted, instead, a request for support for an international workshop on air-sea exchange which will focus on the flux of trace substances at the air-sea interface. WG 72 will organize this workshop which will be held in Mainz, F.R.G. in October 1984, with support from the Max-Planck Society and the FRG government. The meeting approved this request; SCOR will cosponsor and support the WG 72 workshop.

Dr. S.C. Wofsy was unable to join WG 72 and an invitation will be extended to Dr. B. Norkrans (Sweden) who is also a microbiologist.

WG 73, *Ecological Theory in Relation to Biological Oceanography*

The Executive Committee Reporter for WG 73, Dr. P. Lasserre, reminded the meeting of the successful symposium on "Flows of Energy and Materials in Marine Ecosystems: Theory and Practice" which had been organized by this group (Formerly WG 59) in 1982. The proceedings of this symposium are expected to be published in the near future by Plenum Press.

The terms of reference and membership of the former WG 59 were revised at the XVI General Meeting of SCOR and the group was charged with the organization of an international workshop on community-level ecological theory and its applicability to biological oceanography. While this workshop was to have been held in 1983, financial support was not mobilized in time to make this feasible. The workshop, which is being organized by Dr. R. Ulanowicz has now received support from SCOR, NSF and ONR (USA) and from NSERC (Canada). It will be held at Laval University, Quebec City from 16 to 23 March, 1984 and Professor L. Legendre of Laval University is the local organizer.

The WG 73 workshop aims to bring together theoretical ecologists and practicing biological oceanographers in the consideration of five main topics.

1. Thermodynamics, especially the thermodynamics of irreversible processes, the theory of dissipative structures and the network ascendancy hypothesis;
2. Information theory as applied to taxonomic groupings, network flow structure, spatial patterns and sampling design;
3. Flow analysis to study indirect interaction, patterns of cycling, trophic relationships and niche descriptions;
4. Statistical mechanisms emphasizing possible macroscopic ecological analogs to thermodynamic variables, stochastic models of ecosystems; and
5. Ataxonomic aggregations of ecosystems, investigating alternatives to the prevailing practice of identifying ecosystem subunits in terms of taxonomy.

It is expected that the report of this workshop will contain the main recommendations of WG 73 to SCOR.

The Director of the Division of Marine Sciences of UNESCO reported that his organization wished to cosponsor WG 73 and might be able to provide some support for the workshop, possibly by providing some funds for the participation of a few scientists from developing countries.

The Executive Committee agreed that in addition to funds for WG 73 which would be carried forward from 1983 to 1984, an allocation should be made towards the cost of publication (by the Canadian government) of the conference proceedings. Finally, a request from the Canadian National Committee for SCOR that Professor Legendre be invited to join WG 73 was approved in view of his long association with the activities of the group and his efforts in organizing the conference in Quebec.

WG 74, *General Circulation of the Southern Ocean*

The first meeting of WG 74 was held in February, 1983 at the Lamont-Doherty Geological Observatory. The members of the group produced a preliminary report which was distributed to National Committee and appears as Annex VIII.

A draft version of this report was presented at the fourth meeting of the IOC Programme Group for the Southern Ocean where it was received with appreciation and where many of the scientific recommendations of WG 74 were incorporated into the programme being developed by IOC/SOC.

The intention of WG 74 is to produce a document, based on its preliminary report, which will describe more fully the status of physical and chemical oceanography of the Southern Ocean and will delineate major gaps in our knowledge of its general circulation. Members of the group have agreed to prepare drafts of sections of this document for review and discussion at a second meeting of WG 74 proposed by the Chairman. The completion of this document would satisfy the first term of reference of WG 74.

WG 74 also intends to begin a consideration of physical and chemical programmes which might fill the gaps identified in the document it produces, and to discuss priorities for research in these fields in the Southern Ocean. These matters will be pursued in correspondence between members of WG 74 and the group will formulate recommendations to SCOR when this process has been completed.

The request of WG 74 for a meeting in 1984 was approved; it is likely that it will be held at the Institut für Meereskunde in Kiel in mid-May. Dr. A.F. Treshnikov was unable to join, but Dr. E.I. Sarukhanyan (USSR) has been invited to replace him.

The representative of CMG expressed the interest of many marine geologists in the problems of circulation in the Southern Ocean and it was suggested that the Chairman of CMG might wish to contact the Chairman of WG 74 about liaison between the group and marine geologists. The Executive Committee Reporter for WG 74, Dr. Fedorov, wished to draw attention to the considerable influence of the bottom topography of the Southern Ocean on the Circumpolar Current and of the effects of this current on sedimentation, two topics of interest to marine geologists and physical oceanographers alike.

At the request of the U.S. National Committee for SCOR, Dr. W. Jenkins has become a corresponding member of WG 74.

WG 75, *Oceanic CO_2 Monitoring*

The Executive Committee Reporter for WG 75, Dr. Chesselet, had attended a one and one-half day meeting of the working group during the IUGG Assembly in Hamburg. He noted that the membership of WG 75 represents a wide diversity of approaches to problems related to CO_2 monitoring and that it did not appear to be well balanced. A formal report of this meeting was not yet available to the Executive Committee. Dr. Chesselet noted, however, that the group had begun to address its original terms of reference, but was now considering re-directing its activities more towards carbon cycles than CO_2 monitoring. The Executive Committee was concerned about this re-direction but agreed to await the formal report of the WG 75 meeting before considering the matter further. Dr. Chesselet agreed to consult with the Chairman of CNC/SCOR (which had originally proposed the establishment of WG 75) and with the Chairman of WG 75 as to possible revisions of the membership of the group and appropriate approaches to the approved terms of reference.

2.3 COMMITTEES

SCOR/IOC Committee on Climatic Changes and the Ocean

A status report from CCCO appears as Annex IX and verbal reports were presented by the Chairman, Dr. R.W. Stewart, and Secretary, Mr. B.J. Thompson.

The Secretary of CCCO reviewed the terms of reference, structure and membership of the joint Committee and its various Panels and Scientific Steering Groups. He noted that the scientific programme of CCCO has developed essentially along the three lines or "streams" identified for the overall World Climate Research Programme of which CCCO is planning the oceanographic component. These three streams represent the various time scales for climate research.

Stream 1 - The physical basis for long-term weather forecasting - (order of weeks).

Stream 2 - Interannual variability - (order of a few years).

Stream 3 - Longer-term climatic trends and climate sensitivity - (order of decades).

The CCCO programme includes large-scale experiments in support of the three WCRP streams; these may incorporate national and multinational research projects which will be encouraged, but not sponsored by CCCO. The programme will include a large number of limited duration exploratory time series intended to establish reliable first estimates of ocean variability, to develop new observational technologies, and to explore the benefits of long-term ocean monitoring programmes. A major long-term element of the CCCO programme will be the formulation of requirements and scientific bases for ocean monitoring involving many open-ended time series of observations to be maintained on a regular basis. The IOC will have responsibility for implementing this monitoring system.

Details of the objectives and components of the two large-scale experiments being planned by CCCO are given in Annex IX. These are TOGA (Interannual Variability of the Tropical Oceans and Global Atmosphere) and WOCE (World Ocean Circulation Experiment). A major International TOGA Programme Conference is being planned for September 1984 and will include discussion of scientific priorities for TOGA as well as provide a forum for informing scientists and national representatives of the programme in order that appropriate national commitments to the programme may be made. The TOGA programme will be launched in January, 1985 and is expected to last for ten years.

The overall goal of WOCE is a greatly improved understanding of the general circulation of the world oceans. This experiment, which requires more advanced technology than TOGA (although TOGA will make extensive use of it when it is in place), will begin formally during 1988-89 and will continue for about five years.

The first steps are currently being taken towards the development of an ocean observing system, both in support of the large-scale experiments and for the longer term needs for prediction of climatic variability. The Executive Committee was pleased to note that an extensive programme of sea-level measurement using tide gauges is being implemented by the IOC and that the first training course for sea level measurements was about to be offered at IOS (Wormley) in cooperation with the IOC.

The CCCO Secretary closed his presentation with a brief review of other aspects of the proposed ocean observing system, of the support which has been committed to CCCO by a number of countries, and of the predicted management needs of CCCO.

The Chairman and Secretary in responding to a number of questions on the CCCO programme confirmed that the existing data base had been surveyed but that the existing long time series of ocean measurements had been found most inadequate for the purposes of CCCO. The tasks of data storage and exchange of the large amount of data which will be collected during the CCCO programme will be assigned to IOC and its IGOSS and IODE groups. Some members of the Executive Committee questioned the apparent lack of interaction between CCCO and biological oceanographers, especially now that CCCO's Biological Panel has become inactive. Dr. Stewart reminded the meeting that Dr. Longhurst now acts as a correspondent to CCCO on the state of the science of biological oceanography with respect to climate studies, but it had not proved possible to develop a formal structure to incorporate biological studies into the CCCO programme. For example, the forthcoming OSLR workshop in Canada (c.f. item 3.0) is likely to consider the effects of climate on recruitment to fish stocks. For the time being, it was agreed that it is appropriate that the results of such discussions be communicated to CCCO through informal channels.

A request had been received from the Canadian National Committee for SCOR to formally endorse the U.S. TOPEX satellite programme. The CCCO Chairman advised the meeting that while TOPEX is a national programme, it, and others like it, will be crucial to the success of WOCE which is dependent on the measurement of sea surface topography and wind stress by satellite remote sensing. Satellites with appropriate altimeters and scatterometers are not now in place. Therefore, it was agreed that the President should communicate with the authorities of the French, Japanese and American space organizations and the European Space Agency to urge a high priority for the development and operation of such satellites as a vital contribution to the World Climate Research Programme.

The President then introduced the topic of negotiations between SCOR and IOC relating to the operation of CCCO and the implementation of its programme. These discussions have largely reflected the inevitable difficulties of large projects involving collaboration between intergovernmental and non-governmental organizations, each with their own constituencies with differing interests and demands. In this case, the development of the oceanographic component of the WCRP involves SCOR and IOC in a cooperative effort of unprecedented scale which should take advantage of the strengths of each organization. In an attempt to maximize the advantages of this cooperation, discussions between the officers of SCOR, IOC, ICSU and UNESCO have proceeded during the last few months towards the conclusion of an agreement between ICSU and UNESCO on the principles involved in developing the oceanographic aspects of the WCRP and a memorandum of understanding between SCOR and IOC as to the operational details of the programme.

The Executive Committee had before it a memorandum prepared by the Past Chairman of CCCO, Professor Roger Revelle, which had been presented to the Director General and Assistant Director General (Science) of UNESCO during a meeting between representatives of ICSU and UNESCO at Harvard University in July, 1983. This memorandum outlined the proposed principles for an agreement between ICSU and UNESCO for CCCO and the operations of its secretariat. They define a Planning Phase and an Implementation Phase of the scientific programme of CCCO, a mechanism for periodic reviews of CCCO operations and some aspects of the responsibilities of the CCCO secretariat.

These principles were endorsed by the SCOR Executive Committee in the expectation that they would form the basis for the continuing discussions, which, the Committee hoped, would soon lead to the signature of a formal agreement between ICSU and UNESCO regarding CCCO.

Several participants in the Executive Committee meeting who had been involved in these discussions were of the opinion that substantial progress had been made and that the negotiations could be concluded in the very near future. For example, the principles discussed above include the statement that not all of the CCCO programmes will require implementation by an intergovernmental body; some will be more suitable for implementation through more modest mechanisms such as inter-institutional cooperation. Other programmes, and in particular the global ocean monitoring system, will require extensive intergovernmental action for their success.

The Secretary and the First Vice-Chairman of the Commission reiterated their optimism for a satisfactory conclusion to the discussion between SCOR and IOC on this matter, as did Professor T. Malone, the Treasurer of ICSU, who had represented the Council in these discussions.

The consideration of matters related to CCCO closed with an expression of support for the scientific goals of the Committee and of hope that the administrative problems associated with its programme would be resolved in the very near future. The members of the Executive Committee entrusted further negotiations to the officers of SCOR and requested that they be kept appropriately informed on this matter.

Joint Panel on Oceanographic Tables and Standards

Professor Charnock, reporting on the activities of JPOTS, noted that this was a most successful group, having developed the Practical Salinity Scale 1978 and the International Equation of State 1980. Full details of the definitions are given in *UNESCO Technical Papers in Marine Science,* No. 36, 37 and 38. This allows the implementation of these equations in computers, but nevertheless the delay in publishing the oceanographic tables based on them is regrettable. These tables are now expected to be published within twelve to eighteen months and will permit the full and proper use of the new salinity scale and equation of state.

JPOTS had recommended that SCOR undertake the preparation of a basic manual to provide guidance to the users of the Practical Salinity Scale and the International Equation of State. The President of IAPSO noted that IAPSO had passed a resolution to this effect at its General Assembly in Hamburg. After some consideration as to the appropriate agencies for completion of this task it seemed that a "JPOTS Editorial Panel" consisting of one member representing each of the sponsors of the Panel might be the most efficient means of producing such a manual. The President of ICES and the Director of the UNESCO Division of Marine Sciences concurred with this proposal which will be developed further in consultation with the Chairman of JPOTS before the next meeting of SCOR.

JPOTS had recommended that SCOR accept the Fofonoff-Millard algorithms. These algorithms, which had been approved by WG 51, will be the basis for the Oceanographic Tables (properties derived from the equation of state of seawater) currently being prepared by JPOTS. The Executive Committee accepted the algorithms on the advice of Professors' Charnock and Siedler.

A report of a meeting of the CO_2 sub-group of JPOTS held in Kiel in August, 1983 was also considered. The sub-group felt that almost all the necessary work for the formulation of a consistent set of equations related to the thermodynamics of the CO_2 system in seawater has been accomplished, or will be in the near future. The sub-group intends to hold a final meeting in December, 1984 and will write its final report in such a way that it may serve as a manual in the use of the proposed formulae to yield information of the speciation of CO_2 in seawater; i.e. estimates of CO_2 partial pressure, concentrations of HCO_3 and CO_3 ions, and estimates of the degree of saturation with respect to calcium carbonate. The CO_2 sub-group reported that its membership had been changed, Dr. A. Dickson (U.S.A.) replacing Dr. Skirrow and Dr. A. Chen (U.S.A.) being added for his expertise on the CO_2 system.

The Executive Committee agreed that the recommendation of WG 46 regarding the development of a pH scale suitable for use in estuarine waters should be referred to JPOTS. The Panel will be invited to consider whether this problem falls within its area of interest or expertise.

Editorial Panel for the Ocean Modelling Newsletter

The meeting was pleased to note that issue No. 51 of the *Ocean Modelling Newsletter* was published in July, 1983. Support from ONR will continue until 1985.

Editorial Panel on Eddy Dynamics

The volume "*Synoptic Eddies in the Ocean*" edited by A.S. Monin, V.M. Kamenkovich and M.N. Koshlyakov was published in early 1983. Dr. Fedorov reported that the Russian volume is being expanded and translated into English for publication by the Reidel Publishing Company in 1984. It includes a preface written by the late President which reviews the history of the study of eddy dynamics and of SCOR's interest in this topic.

2.4 PROPOSALS FOR NEW WORKING GROUPS

Natural Variation in Carbon Dioxide and Carbon Cycles

The representative of CMG, Dr. J. McKenzie, introduced a proposal for a new working group on Natural Variation in Carbon Dioxide and Carbon Cycles which had been submitted by CMG. She noted that in recent years, high-resolution stratigraphic studies of marine pelagic sediments have revealed the existence in the geologic record of major excursions in the global carbon cycle. These excursions are recorded in the sediments as periods of major carbonate dissolution, major and minor carbon-isotope fluctuations in carbonate components and/or global increases in organic carbon content. Although these perturbations occur on geological time scales of 1,000's and 100,000's years, CMG proposed that an evaluation of the events or processes (e.g. palaeo-oceanographic and palaeoclimatic changes) producing these natural variations would give significant input into our understanding of the potential consequences of modern increases in atmospheric CO_2.

It was noted that the proposal received from CMG did not include terms of reference, nor did it indicate the time scales to be investigated by the proposed group. It was recognised that studies involving very short geological time scales (centuries) would be of most interest to CCCO, but that such studies are not likely to be feasible. Rather, the group would probably address variations in carbon cycles as seen through the geological records in the one thousand to ten thousand year scale. The Chairman of CCCO did note, however, that the proposal was well suited to CCCO's needs in the field of palaeoclimatology.

The Executive Committee agreed that the proposed working group would be complementary to WG 75. CMG was requested to develop its proposal further, altering the title to emphasize the group's interest in the geological record of variations in CO_2 and carbon cycles, and to submit the proposal with a suggestion as to chairmanship, to the Officers' Meeting in April, 1984 (c.f. item 5.2).

Ecology of the Deep Sea Floor

Dr. Wolff reminded the meeting that a proposal on this topic from the FRG National Committee was considered by the Executive Committee at its meeting in 1982. The Committee was concerned that potential uses of the sea floor could influence the work of such a group and requested a more detailed proposal. Dr. Wolff was asked to discuss the concept of such a group with his colleagues in the field and to assist the FRG National Committee in submitting a revised proposal to the Executive Committee.

The proposal was discussed in detail, with some members of the Executive Committee expressing reservations regarding the advisability of considering the environmental impact of industrial activities and risk evaluation, without adequate basic knowledge of the deep sea ecosystem. Some participants felt that current economic conditions will make extensive exploitation of deep sea resources unfeasible before the year 2000 and that it is therefore timely for the group to give its attention primarily to the current gaps in our understanding of deep sea communities.

On the basis of this discussion, the establishment of WG 76, "Ecology of the Deep Ocean Floor" was approved. The terms of reference proposed were modified and accepted as follows:

1. To recommend what further developments in methodology, theory and observation are needed to overcome the present shortcomings of our knowledge and concepts of the way deep-sea communities function and influence other chemical, physical and biological systems within the oceans;
2. To attempt to establish which deep-sea subsystems are fragile and which are most vulnerable to man's exploitation of the oceans and to develop a descriptive inventory of sub-systems; and
3. To assess whether the methodology, theory and observational data exist and are adequate to provide forecasts of the impact on deep-sea ecology by man's activities.

It was agreed that the proposed membership list should be submitted to the Chairman, Dr. A. Rice (U.K.) for his consideration with the stipulation that the group must not be larger than ten individuals including himself. Suggestions will be sought from National Committees as well and the final membership list for WG 76 should be submitted to the Officers' Meeting for approval.

WG 76 will be cosponsored by UNESCO, IABO and CMG. The representative of CMG expressed the interest of marine geologists in the study of benthic organisms as depth indicators for palaeo-oceanographic studies. CMG will be invited to suggest a micropalaeontologist for membership in WG 76.

Laboratory Tests Related to Basic Physical Measurements at Sea

A proposal received from the GDR National Committee under the title "Intercomparison of High-precision *in situ* Sensors" was discussed. The proposal arose from the conclusion reached at a meeting of WG 51 held in the GDR in 1981, that the technical data (relating to resolution, static and dynamic accuracy and short- and long-term stability of high precision oceanographic sensors for the *in situ* measurement of conductivity, temperature and pressure) which are published by the manufacturers of the sensors cannot be relied upon. The participants agreed that special experimental investigations under clearly defined and reproducible conditions would be of great use in clarifying the basic properties of CTD gauges.

It was generally agreed that there was a need for such a working group, but that the suggested terms of reference needed some revision in order to respond to questions related to metrology, precision requirements for hydrographic data and the influence of various sources of error on the precision and sensitivity of probes. The Past-President, Dr. Fedorov, Professor Charnock and Dr. K. Voigt of the GDR National Committee presented the following terms of reference:

1. To review the accuracy and precision of existing STD, CTD and related instruments used on research vessels;
2. To design and carry out related laboratory tests and inter comparisons;
3. To recommend standards of resolution, sensitivity, accuracy and short- and long-term stability under varying temperature and pressure to be met by acceptable equipment; and
4. To recommend appropriate calibration procedures to ensure that the requirements are satisfied.

It was agreed to establish WG 77 with the terms of reference given above and to invite Dr. K. Striggow (GDR) to be Chairman of the group. The membership of WG 77 will be developed in consultation with SCOR National Committees. Dr. K. Voigt, emphasizing the interest of his National Committee in the work of this group, offered the facilities of the Institut für Meereskunde at Warnemunde, GDR, for any laboratory activities undertaken by WG 77.

Hydrothermal Processes in the Ocean Crust

Professor S. Calvert (Canada) introduced this proposal which had been submitted by the Canadian National Committee. He noted that the recent discovery of deep-sea hot water vents has highlighted the importance of hydrothermal processes in several broad areas of marine science. The realization of the scale of the process is fundamentally affecting the way a number of oceanographers are viewing their own discipline, in much the same way that the theory of sea-floor spreading changed the way the earth scientists thought about evolution of the earth's crust.

It was proposed to create a new group to take stock of the probable extent of hydrothermal circulation in the ocean crust and its importance in the overall geochemical cycles and geochemical balance in the ocean and the crust. Emphasis would be on the ramifications of the new discoveries and the need for new methods for studying the overall problem.

The discussion of this proposal centred on the broader implications of the study of hydrothermal processes, as compared to a narrow study of hydrothermal vents. Professor Calvert emphasized that such a working group might work towards an increased understanding of the long-term geochemical history of seawater, for example. Some participants urged that the terms of reference for such a working group should also address the influence of hydrothermal processes on biological and physical processes in the ocean. For this reason, it was agreed that the proposal received from the Canadian National Committee should be sent to all National Committees for comments as to the scope of the work to be accomplished in this field, and suggestions as to appropriate membership for the group.

Determination of Chlorophyll in Seawater

A proposal on this topic was presented to the meeting by the Division of Marine Sciences of UNESCO. The representative of UNESCO referred to the large errors which result when spectrophotometric methods are used to predict algal biomass. This is especially true in estuarine environments where detrital matter may represent a significant portion of the pigments being analyzed and may make estimates of productivity extremely unreliable. The proposal reviewed some of the drawbacks of existing techniques and referred to a new method involving reverses phase high performance liquid chromatography which requires further development. In summary, the UNESCO proposal was submitted in the belief that the methods for chlorophyll determination should be reassessed and accurate recommendations made to the scientific community in the very near future since many of the estimates of the carrying capacities of oceans, seas and estuaries may be grossly in error.

Some concern was expressed that the new techniques referred to in the proposal may not yet be sufficiently developed to make the establishment of such a group timely. Since the proposal did not include suggested terms of reference it was agreed that it should be referred to IABO for further development before being considered in greater detail by SCOR.

At the conclusion of the Executive Committee Meeting, the following assignments as Executive Committee Reporters were made:

Professor H.-J. Bolle	70, 72
Professor H. Charnock	51, CCCO
Dr. R. Chesselet	46, 71, 75
Dr. K.N. Fedorov	56, 74, 77
Professor K. Hsu	61
Professor W. Krauss	66, JPOTS
Professor P. Lasserre	73, 76
Professor H. Postma	57
Professor G. Siedler	68, 69
Professor T. Wolff	42, 54, 65

2.5 SCOR SCIENTIFIC RAPPORTEURS

Coastal Research

The Rapporteur for Coastal Research, Dr. H. Postma noted that many items relevant to coastal science had already been discussed and that he did not wish to present a formal report.

Marine Pollution

There was no report from the Rapporteur for Marine Pollution; an extensive report was submitted to the XVI General Meeting of SCOR.

Law of the Sea

Professor Wooster presented his first report as Scientific Rapporteur on the Law of the Sea. It appears as Annex X. His report recommends that SCOR undertake an assessment of the impact of the U.N. Convention on the Law of the Sea on the conduct of oceanographic research in areas which now fall under the juridiction of coastal states. In collecting this information from its National Committees, SCOR might facilitate the exchange of data on the experience of researchers with the implementation of UNCLOS. It was agreed that Professor Wooster's report should be distributed to SCOR National Committees for their consideration prior to the XVII General Meeting.

3.0 RELATIONS WITH INTERGOVERNMENTAL ORGANIZATIONS

3.1 *IOC*

The President welcomed the First Vice-Chairman of the IOC, Mlle M.A. Martin Sané, and the Secretary, Dr. M. Ruivo. Dr. Ruivo expressed his pleasure at being able to participate in the meeting. He recalled the many contributions of the late Professor Simpson to the field of marine science and to the work of the IOC and expressed his best wishes to Professor Siedler in assuming the responsibilities of the presidency of SCOR. Dr. Ruivo also referred to the very active cooperative relations which have developed between SCOR and

the IOC, particularly in the development of the IOC programmes in OSLR and OSNLR (see below) and in the preparation of a report on "Ocean Science for the Year 2000". As one way to enhance the interactions between scientists and individuals working within intergovernmental agencies such as the IOC, Dr. Ruivo requested SCOR to consider whether meetings of working groups might be held in conjunction with those of intergovernmental bodies when appropriate. Such joint events, or meetings held in association with each other, would probably have a more intensive impact and this would be of mutual advantage to SCOR and IOC.

The Executive Secretary reported on matters arising from the Twelfth Assembly of the IOC (November, 1982) at which SCOR had been represented by Professor Simpson and herself. She noted that SCOR had been active in the preparation and submission of three major reports to the IOC Assembly: OSLR, OSNLR and "Ocean Science for the Year 2000". The OSLR report ("A Proposal for a Programme on Ocean Science in Relation to Living Resources") was prepared by SCOR WG 67 at the request of IOC and was presented by Professor Barber, Chairman of the Working Group. Briefly, the report recommended a major international experiment to study the effects of varying environmental conditions on recruitment to fish stocks (IREP). The WG 67 report and a discussion of its contents appeared in *SCOR Proceedings*, Vol. 18. The IOC Assembly adopted Resolution XII-1 which accepts OSLR as a scientific programme of the Commission and calls for the establishment of a Guiding Group of Experts to develop the concept of IREP in detail. In the meantime, two international workshops will be held which are relevant to the IREP proposal. The first, cosponsored by IABO and UNESCO, to be convened at Roscoff by Professor Lasserre (Sept. 6-10, 1983), will address the special problems of recruitment in high diversity, multi-species ecosystems. The second to be held at the Bedford Institute of Oceanography (Canada) in late September 1983, will be chaired by Dr. R. Beverton (U.K.) and will formulate a set of objectives for IREP and a strategy for practical research projects or the coordination of groups of projects within the IREP concept. Dr. Ruivo noted that the FAO has agreed to consider cosponsoring the OSLR programme when the results of the BIO workshop are known. He also noted that the IOC Guiding Group of Experts for OSLR will be established after this workshop and that SCOR will be invited to name a representative to the group.

At the request of the IOC, Professor Simpson had prepared a report which was a "Proposal on a Programme on Ocean Science in Relation to Non-Living Resources". This was done in consultation with several of his colleagues in the field of marine geology and taking note of the discussions at the Third International Marine Geosciences Workshop convened in 1982 by CMG. The late President presented his report to the IOC Assembly which adopted Resolution XII-2 calling for the acceptance of the OSNLR proposal as a scientific programme and for the establishment of a Guiding Group of Experts to develop and implement the OSNLR programme. The IOC Secretary reported that the United Nations OETB will cosponsor this programme. It will be discussed by various IOC Regional Subsidiary Bodies (such as WESTPAC which would be meeting in September 1983) with a view to the development of appropriate international experiments which might form part of the overall programme on OSNLR.

A report entitled "Ocean Science for the Year 2000" (commonly referred to as the "FORE" report - Future Ocean Research) was also presented to the IOC Assembly by Professor Simpson. This report was widely discussed during the JOA (see *SCOR Proceedings*, Vol. 18) and suggestions and comments arising from the discussion at the IOC Assembly were forwarded to the FORE Rapporteur, Professor W. Wooster, for incorporation into the final version of the report

which was sent to the IOC in early 1983. One objective of the FORE report was to assist the Commission in planning its long-term programmes in ocean science and it will be used as a basis for the updating of LEPOR - the Long Term and Expanded Programme of Oceanic Exploration and Research of IOC. Dr. Ruivo reported that the procedures to be used for the revision of LEPOR will be developed before the next meeting of the IOC Executive Council. He informed the meeting that the FORE report is being published by the IOC and should be available in the near future. Dr. Ruivo expressed the appreciation of the IOC to Professor Wooster for his extensive contributions, as Rapporteur, to the preparation of the FORE report.

Reports of SCOR representatives to recent meetings of relevant IOC Subsidiary Bodies (GESAMP, GEMSI, IGOSS) were discussed briefly. These reports have been directed to the appropriate SCOR working groups, especially WG 46 and WG 66, for their information, although no specific action by SCOR was required as a result of these meetings.

3.2 *UNESCO*

The Director of the Division of Marine Sciences of UNESCO introduced his report; several items relating to publications, working groups of mutual interest and to the proposal for a new working group on chlorophyll determination had already been discussed fully.

Following a recommendation of the UNESCO-SCOR Consultative Panel on Coastal Systems, IABO and UNESCO organized in July, 1983 a meeting of an *ad hoc* steering group on "Traditional Management of Coastal Systems". The report of this meeting will be available soon. IABO and UNESCO were also organizing a workshop on "The Mechanism of Recruitment in High Diversity Marine Systems" to be held in Roscoff in early September, 1983 (c.f. item 3.1).

Dr. Krause referred to a discussion at the XVI General Meeting of SCOR of a recommendation made by the Consultative Panel regarding the establishment of an international association for coastal research. In general, this recommendation had not received a favourable response from SCOR (see *SCOR Proceedings*, Vol. 18), and the question of improving interdisciplinary communication between coastal scientists remains unsolved. Dr. Krause requested SCOR to give this problem of interdisciplinary communication further consideration. He emphasized the importance of SCOR's participation in the Consultative Panel on Coastal Systems. Professor Postma, who is the SCOR representative on the Panel, proposed that it should meet somewhat more frequently, perhaps annually, and its scientific component should be strengthened by additional membership from the non-governmental scientific organizations such as SCOR and its affiliates. It was felt that such changes would increase SCOR's involvement in the coastal programmes of the Division of Marine Sciences, especially if the Panel were more interdisciplinary in its composition.

Dr. Krause drew the attention of the Executive Committee to a report of the 116th session of the UNESCO Executive Board on international non-governmental organizations and their relations with UNESCO. The report encourages organizations such as SCOR to maintain and strengthen their contributions to UNESCO activities. He noted that the Division of Marine Sciences of UNESCO looks to SCOR for scientific excellence in the areas of its expertise and hoped that relations between the two organizations would continue to flourish.

3.3 *ICES*

The President of ICES, Professor Wooster, was satisfied that issues of mutual concern (WG 42, JPOTS) had been fully discussed under previous agenda items. ICES is cooperating with CCCO in the publication of a regular brochure on ocean monitoring.

3.4 *ACMRR/FAO*

Current activities of FAO and its Advisory Committee on Marine Resources Research were briefly reviewed. The meeting was informed particularly of the forthcoming Technical Phase of the FAO World Conference on Fisheries Development and Management and of the main technical preparatory meetings, notably the Expert Consultation to Examine Changes in Abundance and Species Composition of Neritic Fish Stocks (San José, Costa Rica, April 1983). It was noted that a decision on FAO's cosponsorship of the IOC Programme on OSLR will be taken after the results of the Workshop on IREP (Halifax, September 1983) have been assessed by FAO and ACMRR.

3.5 *CCAMLR*

The Executive Secretary reported that she had established contact with her counterpart in the Commission for the Conservation of Antarctic Marine Living Resources, Dr. D.L. Powell. It was agreed that such informal contacts between the two organizations are appropriate for the time being. SCOR (and SCAR) were represented at a meeting of the Commission's Scientific Committee held from 30 August to 10 September by Professor G.A. Knox (New Zealand). While the Commission itself was primarily concerned with procedural matters at its second session since its establishment, the Scientific Committee was expected to begin addressing questions relating to priorities for scientific programmes.

4.0 RELATIONS WITH NON-GOVERNMENTAL ORGANIZATIONS

4.1 AFFILIATED ORGANIZATIONS

CMG

Dr. J. McKenzie, the representative of CMG reported that the Commission has edited and published three reports after the Third Marine Geosciences Workshop, which was held in July, 1982 in Heidelberg, Germany. They are:

1. IOC Workshop Report 31, *Third International Workshop on Marine Geosciences*, available in English, French, Spanish and Russian from the Intergovernmental Oceanographic Commission, UNESCO, Place de Fontenoy, 75700 Paris;
2. *Whither the Oceanic Geosciences*, CMG Report (Secretariat: J. Thiede, Kiel University, Kiel, Federal Republic of Germany); and
3. *Ocean Science and Non-living Resources*, a proposal presented to the IOC Assembly, November 1982, as Document IOC-XII/8, IOC, Paris.

The Commission has maintained close contacts with Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES), concerning future plans for ocean drilling. Additional participation in the Advanced Ocean Drilling Programme by western European countries (in addition to Great Britain, France and Federal Republic of Germany) is being negotiated between representatives of those countries with the U.S. National Science Foundation.

The Secretary of the Commission, assisted by N. Shackleton, has organized a symposium on Isotope Geology, held during the Second European Union of Geosciences, in April 1983. The Commission is also organizing a First International Conference on Palaeo-oceanography to be held July 1983 in Zurich, Switzerland and is planning several symposia on the History of the Oceans and on Oceanic Processes in Geologic History for the 27th International Geological Congress, to be held in Moscow in 1984.

A reorganization of the Commission has been planned, a sub-Commission on Non-living Ocean Resources is to be constituted in the near future.

IABO

The President of IABO, Professor P. Lasserre noted that IABO was to sponsor, with support from UNESCO and IOC, a meeting on "Mechanisms of Recruitment in High Diversity Ecosystems" to be held at the Marine Biological Station, Roscoff, France in early September 1983 (c.f. items 3.1, 3.2). The meeting would address the important question of biological interactions and environmental variability in determining the abundance of individual species in the community structure. Participants were, P. Lasserre (convenor), A. McIntyre (U.K.), K. Mann (Canada), R. Margalef (Spain), T. Parsons (Canada), and J.P. Troadec (France). It was hoped the report of this meeting would be available for the IREP Workshop in Halifax. This report will also include a proposal for the formation of a new SCOR/IABO Working Group which would evaluate in depth, the mechanisms of recruitment in high diversity marine ecosystems. The establishment of such a group was recommended in the final report of WG 67.

IAMAP

A report received from IAMAP included a list of symposia presented at the IUGG Assembly (Hamburg, August 1983) which were cosponsored by IAMAP and IAPSO. These were:

Remote Sensing for Climate Studies
Sea Ice Margins
Low-Latitude Coupled Ocean/Atmosphere Phenomena
The Ocean and the CO_2 Climate Response
Ocean and Atmosphere Boundary Layers
Coastal and Near Shore Zone Processes

In addition, IAMAP sponsored a symposium on the Application of Stable Isotopes to Problems of the Atmosphere, Cryosphere and Ocean.

IAMAP and IAPSO are planning a joint Scientific Assembly in August 1985 in Honolulu. The major theme of this assembly will be the World Climate Research Programme. SCOR has agreed to cosponsor this assembly and has been represented in early discussions of the programme.

The Secretary General of IAMAP, Mr. S. Ruttenberg, has worked in close collaboration with the CCCO Secretary on several CCCO activities: the preparation for publication of the report of the CCCO Tokyo Study Conference on Large-Scale Oceanographic Experiments for WCRP; and of the papers presented at the Study Conference. The Action Plan for Ocean Monitoring for Climate was revised by S. Ruttenberg and F. Bretherton for submission to CCCO in August 1983. These activities have provided a close working association between IAMAP and SCOR.

IAPSO

The report from IAPSO also centred on plans for the Scientific Assembly in 1985. The following IAPSO symposia are likely to be of interest to SCOR:

World Circulation Experiment
Formation of the Main Ocean Thermocline
Low Frequency Dynamics in Mid Latitudes
Dynamics of the Mixed Layer
Variation of Sea Level

In addition, the following symposia will be cosponsored by IAMAP and IAPSO:

The Southern Oscillation and El Niño;
CO_2 in the Ocean Atmosphere System;
Modelling the Global Ocean Atmosphere System;
Heat Transports, Heat and Water Budgets; and
Monsoon Circulation in Ocean and Atmosphere.

Resolution No. 2 of the IAPSO General Assembly held in Hamburg in August 1983 was addressed to SCOR and UNESCO and refers to the preparation of a basic users manual on the Practical Salinity Scale and International Equation of State. This had been discussed under an earlier agenda item (2.3).

4.2 CORRESPONDING ORGANIZATIONS

ECOR

The meeting reviewed discussions between ECOR and SCOR on the admission of ECOR as an Affiliated Organization of SCOR. It was felt that since the completion of joint activities on drifting buoys, there have not been enough topics of mutual interest to warrant such a change in the status of ECOR within SCOR. It was also noted that the existing Affiliated Organizations are all ICSU bodies and that a change in ECOR's status would result in an increase in the size of the Executive Committee. It was agreed, for the time being, that it would be more appropriate to retain ECOR in the category of Corresponding Organizations.

CMAS (SC)

The President of the Scientific Committee of CMAS, Dr. N. Flemming, presented his report reviewing recent activities of the committee. The proceedings of a symposium held in Edinburgh in 1980 have been published and the volume contains forty papers covering diving technology, electronic diving equipment and the use of diving in various fields of oceanography conservation and archaeology. The papers presented at a JOA Symposium organized by CMAS will be published in early 1984 by the Memorial University of Newfoundland. A General Assembly of the committee was held in Barcelona in January 1983, the emphasis being on education relating to underwater conservation.

Discussions have been held with the UNESCO Division of Marine Sciences concerning the help which CMAS could give to scientific marine research on the following subjects:

1. Compiling the text of an international Code of Practice for Scientific Diving taking fully into account the varying conditions world-wide;
2. An inventory for UNESCO Marine Science Division and UNESCO Archaeology Division of world-wide underwater archaeological site distribution and research priorities; and
3. A technical consultancy service to assist in the organization of diving training courses, or solving specific diving or instrumental problems which arise during research projects.

Contract proposals have been prepared for submission to UNESCO for projects 1 and 2 above and the endorsement of SCOR was requested since CMAS has no direct consultative status with the Division of Marine Sciences. The meeting agreed to inform UNESCO that it had noted the CMAS contract proposals with interest and that it wished to encourage the work of the Confederation.

4.3 ICSU

The ICSU Sub-Committee on Scientific Priorities is responsible for reviewing the activities of interdisciplinary committees and commissions of ICSU and for recommending the creation or cessation of such bodies or the launching of new scientific activities by ICSU. The President of SCOR has been informed that at a recent meeting, the Sub-Committee agreed that all Committees, Commissions and Permanent Services should be reviewed every three years with the participation of the ICSU Executive Board liaison officer (Professor L. Ernster for SCOR) and a representative of the body under review. This process will begin on January 3, 1984 when both SCOR and SCAR will be reviewed by the Sub-Committee on Scientific Priorities.

At its meeting in January, 1983 the ICSU Executive Board considered the following proposition for a central theme which it felt might provide purpose coherence, visibility and support for ICSU over the next decade:

> "The earth is a planet characterized by change and has entered a unique epoch when our species, the human race, has achieved the ability to alter its environment on a global scale. A scientific strategy is possible that will offer a basis for the difficult choices that lie ahead and for the complex decisions that must be made now to protect the integrity of the earth".

The General Committee of ICSU, noted the many programmes carried out by ICSU bodies ranging from studies of the earth's interior to the biosphere, oceans and the solar system and it felt that the success and effectiveness of these programmes may depend on the skill of ICSU in weaving these activities together. Following a Colloquium on Global Change held in Warsaw in August, 1983, the General Committee resolved to establish an *ad hoc* committee to develop the concept of an interdisciplinary, international research programme concerning global change and the impact of human activity on habitability of the earth before the next ICSU General Assembly (September, 1984).

Some members of the SCOR Executive Committee expressed concern about ICSU becoming involved in large-scale activities of this nature. It was felt, however, that there may be no other international organization capable of coordinating such an interdisciplinary study. A suggestion was made that ICSU might consider whether a study of possible international mechanisms for response to ecological emergencies would be practical.

An ICSU Press was established in early 1983 under the Chairmanship of Professor W.J. Whelan. The primary purpose of the Press is to serve the publication and communication needs of ICSU and its unions and committees. One project, which had been discussed in correspondence between Professor Whelan and Professor Simpson was for a popular volume on the history of oceanography and of SCOR. The Publications Officer will investigate this proposal further and will keep the Executive Committee informed of its progress.

4.4 ICSU UNIONS AND COMMITTEES

COSPAR

Following a discussion of COSPAR activities at the XVI General Meeting, SCOR received and has accepted, an invitation to cosponsor a Symposium on Space Observations for Climate Studies which will be held in Graz, Austria in conjunction with the 25th Meeting of COSPAR (25 June to 7 July, 1984). The symposium is also being sponsored by WMO, IAMAP, UNEP, URSI and SCAR.

The report received from the Secretary of COSPAR, Mr. Ruttenberg, drew attention to the proliferation of organizations interested in remote sensing of the oceans. He suggested that the functions and responsibilities of these groups and the relationships between them could usefully be discussed by SCOR. He referred to an URSI proposal regarding the establishment of an Inter-Union Commission on Remote Sensing which was to be discussed at the IUGG Assembly (see below).

SCAR

At the XVI General Meeting, SCOR agreed to cosponsor a SCAR group to study problems related to Antarctic pack ice zone. SCAR has now proceeded to establish a Group of Specialists on Antarctic Sea Ice which will have the following terms of reference:

1. To specify the main research objectives for a multi-discipline programme of studies in the Antarctic pack ice zone, taking into account requirements identified by other groups such as ACR, CCCO and BIOMASS;
2. To assess and recommend techniques and logistics methods for achieving such a programme; and
3. To cooperate with the SCAR Executive in seeking support from relevant organizations to implement an international coordinated programme of research.

The initial membership, which will be established by SCAR, is to be limited to no more than seven covering a large range of scientific interests and with contacts with specialists in satellites and logistics. The small group is to be charged not only with consulting with other interested international groups but should feel free to consult with individual specialists in all countries where expertise exists.

IUPAC

A brief report from IUPAC made note of CHEMRAWN IV, an international conference on "Chemical Resources of the Ocean" scheduled to be held in 1985. This conference will consider such topics as:

- exchange processes at the air/sea and water/sediment interface;
- nutrient chemicals and their availability to support marine life;
- chemical speciation of various elements in seawater;
- cycles of both organic and inorganic forms of carbon;
- precipitation of authigenic minerals and other solubility-controlled phenomena;
- consequences of seafloor marine mineral production - both harmful and beneficial; and
- commercially important chemical materials which can be derived from the sea and the seafloor and the prospects for their early recovery.

The conference will be interdisciplinary, bringing together oceanographers and marine technologists from around the world. The goals of the meeting will include recommendations for the directions future research should take, priorities that should be assigned to global ocean studies, actions to encourage international cooperation, and providing information required by those who make marine policy, particularly in regard to marine chemical resources of the sea.

It was agreed that SCOR should inform IUPAC of its interest in this conference and request IUPAC to inform SCOR of the detailed programme when it is available.

ICL

At a meeting of WG 6 (Nature and Evolution of the Oceanic Lithosphere) of the Inter-Union Commission on the Lithosphere attended by the late President of SCOR in early 1983, it was proposed to organize a workshop on the Dynamic Morphology of the Ocean Floor : Advanced Tools for Research, and the Deep Structure of Mid-Ocean Ridges. The Chairman of the ICL WG 6 had submitted a formal request to SCOR to cosponsor the proposed symposium along with details of the suggested programme. It was agreed that SCOR should submit this request to the Chairman of CMG for his advice, and that his recommendation would be accepted.

URSI

At its recent meeting in Hamburg, the IUGG Executive considered a modified proposal from URSI on the establishment, within ICSU, of an interdisciplinary Commission on Remote Sensing. The purpose of such a Commission would be to further the application of remote measurement to areas of geophysics (including physical oceanography and climate studies) and geology where these techniques may serve to advance the science. The proposal, which is still in very preliminary form, suggests that IUGG, URSI, COSPAR and SCOR might wish to consider cosponsoring such a Commission. The representative of URSI, Dr. J. Apel, suggested that SCOR delay detailed consideration of the proposal until it has been discussed further by the officers of IUGG. A formal proposal was expected to be prepared in time for consideration by SCOR at its next meeting.

5.0 MEETINGS

5.1 JOINT OCEANOGRAPHIC ASSEMBLY, 1982

Time constraints prevented a detailed consideration of the recent JOA and this was deferred to the Officers' Meeting (c.f. item 5.2). Reports on the JOA had been received from the Chairman of the Scientific Programme Committee, the Canadian National Organizing Committee and from interested individuals. It was agreed, however, that before these reports were disseminated, the opinions and comments of SCOR National Committees and other sponsoring organizations regarding JOA-82 should be solicited. These will be collected by the Executive Secretary before the Officers' Meeting in order that the Officers of SCOR may formulate recommendations to the XVII General Meeting in late 1984.

5.2 MEETINGS OF SCOR

The President, Professor Siedler suggested to the meeting that in view of his recent assumption of the presidency following the death of Professor Simpson, and of a number of issues of ongoing concern to SCOR, it would be desirable to hold an Officers' Meeting in April or May, 1984. It was agreed that such a meeting should be held in Copenhagen and that it should be attended by the President, two Vice-Presidents, Secretary and Executive Secretary. Other members of the Executive Committee will be invited to participate in this meeting, however it was agreed that such participation would be at their own expense. The Officers' Meeting will deal only with routine business and matters arising from this Executive Committee Meeting.

An invitation had been received from the FRG National Committee for SCOR to hold its XVII General Meeting at the Institut für Meereskunde in Kiel in October, 1984. There was some concern that this invitation did not include the traditional association between a SCOR General Meeting and an appropriate scientific event. Other possibilities were discussed briefly and it was agreed that they should be investigated further by the President and Executive Secretary and that a final decision on the location and timing of the XVII General Meeting should be made by the President in consultation with the Officers of SCOR.

5.3 OTHER MEETINGS

A report of a symposium on Sandy Beaches as Ecosystems organized by the South African National Committee and CSIR (South Africa) with the encouragement of SCOR is given in Annex XI. This symposium took place in Port Elizabeth in January, 1983.

First International Symposium in Integrated Global Ocean Monitoring - this symposium which is cosponsored by UNEP, IOC, the USSR Academy of Sciences and the government of the USSR, will be held in Tallinn from 2 to 10 October, 1983.

Symposium on Wave Breaking, Turbulent Mixing and Radio Probing of the Ocean Surface - this symposium will take place in Sendai, Japan in July, 1984 with the cosponsorship of SCOR and JSC. It will be followed by a JSC-CCCO Workshop on Modelling the Upper Ocean Boundary Layer.

International Symposium on the Most Important Upwelling Areas off Western Africa - this meeting will be held in Barcelona in late November, 1983. SCOR will be represented by Professor Lasserre.

Professor Siedler, in closing the twenty-fifth meeting of the Executive Committee of SCOR, expressed his sincere appreciation to the members of the Committee for their cooperation and assistance to him in the unusual circumstances of his assumption of the position of President so shortly before the meeting. He also thanked ICSU for the facilities and services which had been provided to the Executive Committee for its meeting.

ANNEX I

TWENTY-FIFTH EXECUTIVE COMMITTEE MEETING OF SCOR

Paris, France, 31 August to 2 September, 1983

Participants

Members of the Executive Committee

*	Professor G. Siedler	Fed. Rep. of Germany	President
*	Dr. K.N. Fedorov	U.S.S.R.	Past President
*	Dr. R. Chesselet	France	Vice-President
*	Professor T. Wolff	Denmark	Vice-President
*	Professor P. Lasserre	France	Ex-Officio / IABO
*	Professor W. Krauss	Fed. Rep. of Germany	Ex-Officio / IAPSO
*	Professor H. Charnock	United Kingdom	Co-opted Member
	E. Tidmarsh		Executive Secretary

Other Participants

Dr. J.R. Apel	URSI	Dr. J.A. McKenzie	CMG
Professor S. Calvert	Canada	Dr. S. Mizuno	WMO
Dr. N.C. Flemming	CMAS (SC)	Professor C.J. Nihoul	Belgium
Professor R. Fournier	Canada	Professor H. Postma	Netherlands
Dr. R. Griffiths	FAO/IOC	Dr. M. Ruivo	IOC
Dr. G. Gross	USA	Dr. R.G. Soulage	IAMAP
Dr. I. Hessland	Sweden	Dr. M. Steyaert	UNESCO
Dr. Tsu-Chang Hung	Taiwan	Dr. R. Stewart	CCCO
Dr. D. Krause	UNESCO	Mr. B. Thompson	CCCO
Dr. T. Malone	ICSU	Dr. D. Troost	UNESCO
Mlle M.A. Martin Sané	IOC	Dr. K. Voigt	GDR/IOC
		Professor W.S. Wooster	ICES
		Mr. G. Wright	UNESCO

* = SCOR members

ANNEX II

SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH

FINANCIAL STATEMENT 1982

BALANCE: January 1, 1982			
Paris	15,710.46		
Halifax	40,946.01		56,656.47
INCOME:			
National Contributions	83,230.29		
Arrears	5,185.00	88,415.29	
Contracts and Grants:			
UNESCO Subvention	13,000.00		
ICSU Grant	5,000.00		
IOC Contracts	47,000.00		
UNESCO Contracts	26,000.00		
SCAR	4,000.00		
COSPAR	2,000.00	97,000.00	
Miscellaneous Income		253.26	
Interest Income		1,026.74	
Total Income			186,695.29
TOTAL CASH PLUS INCOME			243,351.76
EXPENSES:			
Working Group 34	2,498.84		
42	718.59		
44	4,000.00		
46	2,303.23		
54	10,000.00		
55	3,557.10		
57	1,521.43		
59	8,472.29		
60	8,463.12		
61	1,469.42		
63	3,686.57		
67	6,661.63		
68	2,595.83		
70	1,772.91		
CCCO	28,000.00		
JPOTS	2,172.50	87,893.46	
SCOR/SCAR Workshop	11,095.66		
FORE	24,069.47		
Executive & General Meeting	13,303.14		
Publications	4,903.11		
Representation	3,905.21	57,276.59	
Administration		26,204.16	
TOTAL EXPENSES:			171,374.21
BALANCE: December 31, 1982			
Halifax	62,274.72		
Paris	9,702.83		71,977.55
TOTAL EXPENSES PLUS CASH			243,351.76

ANNEX III

FINAL REPORT - WORKING GROUP 60

MANGROVE ECOSYSTEMS

The final meeting of SCOR Working Group 60 on Mangrove Ecology was held concurrently with the Joint Oceanographic Assembly meeting in Halifax, Nova Scotia, August 2-13, 1982. Participating in the final meeting discussions were: Hartmut Barth (guest, Germany), Francois Blasco (member, France), John Bunt (guest, Australia), Gilberto Cintron (member, Puerto Rico), Ong Jin Eong (guest, Malaysia), Federico Pannier (member, Venezuela), Samuel Snedaker (Chairman, USA), and Bruce Thom (member, Australia). Each of the members and guests, listed above, also presented invited papers at the JOA Session A-7 (Mangrove Ecosystems, IABO/WG 60).

The primary topic of discussion was the arrangements being made for the completion of the Terms of Reference for the Working Group. The Chairman confirmed that the wishes of the Working Group were being pursued in that both terms of reference were being included within a single manuscript. The majority of the contributed papers, submitted earlier, had been externally reviewed and incorporated in a working manuscript. It was also reported that the majority of the remaining manuscripts had been received and were in the process of being typed, edited and assembled. Dr. Pannier reported that he was revising one of his contributions and that it would be sent to the Chairman. Two other contributors (members, Cintron and Thom) will also send manuscripts following the JOA. Dr. Thom was specifically asked to prepare an integration of the handbook volume at the time he prepared his specific contribution; Dr. Thom agreed.

It was proposed that all necessary efforts be undertaken to quickly complete the original terms of reference, and the resulting manuscript, by the end of 1982. It was also recommended that UNESCO's Division of Marine Sciences undertake to have the final manuscript externally reviewed for content, coverage and clarity of presentation prior to publication. The Chairman agreed to honoring the recommendations.

The secondary Terms of Reference proposed by the Working Group during its earlier deliberations were discussed. The Biosphere Mangrove Survey has been completed but not yet finalized for distribution as a review document. This delay has resulted from the sponsor's (U.S. MAB Consortium) inability to reach internal agreement on presentation format and publication requirements. The Handbook for Mangrove Area Managers was discussed in terms of recent accomplishments. Requests have been made to UNESCO and to IUCN to support a writer's workshop at the East-West Center in Honolulu in early 1983. The initiative is being undertaken by Chairman Snedaker representing the SCOR Working Group and by Dr. Lawrence Hamilton, representing the IUCN/COE Working Group and the East-West Center. Progress will be reported to Working Group members when decisions become final. As it pertained to the proposed Mangrove Atlas, it was generally accepted that this proposed Term of Reference could not be completed prior to the scheduled dissolution of the Working Group.

The remainder of the meeting was devoted to a discussion of alternative institutional mechanisms for continuing the initiatives of the Working Group. Among the various proposed alternatives were: (1) reconstitution as a Mangrove Association similar in structure and purpose to the Coral Reef Association; (2) reconstitution as an *ad hoc*

body supported by UNESCO or some other international organization; (3) assimilation into the IUCN/COE Working Group on Mangrove Ecosystems; and, (4) complete dissolution. Members and guests were unanimous in their agreement that a international body of mangrove researchers had a significant role in recommending policies on the scientific direction of research concerning the global mangrove ecosystem as opposed to conservation initiatives which are being adequately undertaken by the IUCN/COE Working Group on Mangrove Ecosystems. In addition, such an internationally-represented body could undertake projects of a global nature that were necessarily beyond the capabilities of individual researchers or individual institutions. After considerable discussion, the group concluded that reconstitution as a Mangrove Association represented the most viable alternative for productive collaboration in the future. Following this recommendation, a variety of terms of reference were offered for consideration as tasks that could be undertaken by the Mangrove Association. Among them were: (1) organizational sponsorship of the Writer's Workshop; (2) preparation of a Mangrove Resource Atlas; and (3) organization and coordination of a major international symposium on mangroves in the mid to late 1980's. It was further agreed that the membership of the Mangrove Association be redefined to include new individuals to achieve a better balance among scientific disciplines. The Chairman was instructed to pursue the formation of Mangrove Association and to solicit advice and support from UNESCO's Division of Marine Sciences.

In the final meeting session, the membership of the SCOR Working Group 60 on Mangrove Ecosystems expressed its gratitude to both SCOR and UNESCO for its support of WG 60 activities during the period of its existence.

ANNEX IV

WORKING GROUP 46

RIVER INPUTS TO OCEAN SYSTEMS (RIOS)

Report of Meeting: Lisbon, 17 - 18 December, 1982

The meeting was held in Palacio Foz, Lisbon, at the invitation of the Portugese National Commission of the Environment, following a Scientific Workshop on Estuarine Processes : an Application to the Tagus Estuary. Working Group members had been invited to participate in this workshop, which was organized by the Portugese national authorities, with technical support from IOC/UNESCO/UNDP. The following attended the meeting;

(i) Members of Working Group 46

J.D. Burton (Chairman), D. Eisma, R.F.C. Mantoura, J.-M. Martin, J.P. O'Kane, J. Richey (V.V. Gordeev, S. Stanley and K.K. Turekian could not be present).

(ii) Invited Experts

R. Dawson (IOC). Parts of the meeting were also attended by: H.L. Windom (representing IOC as Acting GEMSI Chairman), D. Krause (UNESCO), and T.R. do Espirito Santo (Comissao Nacional do Ambiente, National Director of the Tejo Project).

The Chairman reviewed the previous activities of Working Group 46, leading to the Review and Workshop on RIOS, held in Rome in March, 1979. Following this, a Sub-Group had met in Paris in November, 1981, and had made recommendations to SCOR concerning future activities. SCOR had reconstituted the Working Group with some changes in membership and new terms of reference, as follows:

(i) To review and evaluate knowledge of (a) factors which govern the input of materials by rivers to estuaries, and (b) the estuarine processes which modify the composition and flux of materials entering the ocean, including substances influenced by human activities.

(ii) To identify priorities for further work in this area, including the accurate estimation of river fluxes, and to promote international cooperation in the study of river-estuary-ocean systems.

It was intended that the Working Group should produce its final report after the present meeting.

Knowledge on RIOS and priority areas for research

Under the terms of reference the Working Group was concerned with two primary scientific questions:

(a) The input of water and dissolved and particulate material by rivers, with reference also to the processes governing these inputs.

(b) The modification of fluxes to the shelf seas and open ocean by processes occurring in estuaries.

The Working Group considered the current status of knowledge in these areas in some detail and the principal matters are summarized below.

The data base for evaluation of river inputs remains very poor. Water discharge records are incomplete in terms of coverage and some existing data are marginal in quality. Information on sediment concentration and discharge is inadequate for most of the major systems. The situation regarding series data on chemical composition, needed for estimation of fluxes of individual constitutents, is particularly poor.

Integrated studies on hydrology, sediment transport, water and sediment chemistry, with sufficient quality and resolution, are required to provide adequate estimates of fluxes. To date, Working Group 46 has given most attention to estuarine processes but for evaluation of RIOS the key problems in the study of rivers themselves must be addressed. Understanding of the origins of water (in surface run off and groundwater, as a function of elevation, rainfall regime and changes in land use) and sediment, and of river processes, is necessary to predict how river inputs will alter with changes in land-use, river management and climate. Important contemporary changes, such as intensive agriculture, deforestation, and damming, modify river processes through alterations in floodplain area and nutrient balances, with their effects on storage and on fertility. Detailed basic knowledge of river dynamics and chemical behaviour during tributary mixing is needed to evaluate the consequences of such processes for fluxes to estuaries and their seasonal variability. The sources of riverborne organic material require more detailed study, particularly with reference to the identification of key compounds which can act as markers for carbon sources and their fate in estuaries and seas.

While WG 46 is concerned with the implications of river processes for the fluxes of material entering estuaries, it was recognised that changes in river conditions influence transport pathways in the environment, for example by changes in fluxes of trace gases to the atmosphere as a result of changes in redox conditions in rivers and floodplains. The consequences for estuarine and marine systems of changes in river dynamics are of such potential importance, however, that in the Working Group's view SCOR is an appropriate organization to take the lead in establishing a group to evaluate the effects of major changes in management of river basins.

Estuaries have a central importance as regards RIOS for two principal reasons. First, because of the marked horizontal and vertical gradients in major physicochemical parameters (ionic strength, pH, pE), they are zones of exchange between dissolved and particulate phases and thus, with respect to dissolved constituents an estuary may act as a filter or an amplifier for the river supply. Secondly, some estuarine systems are highly efficient traps for sediment. The importance of marine inputs in estuarine sediment budgets has long been recognised. Little is known, however, of the sink functions of estuaries for dissolved material entering in sea water and the potential role of such a process in, for example, the transport of pollutants between estuaries.

Exchanges occur during estuarine mixing by formation of new solid phases and by scavenging on and releases from particle surfaces. Major redistributions occurring in bottom sediments can be coupled to overlying waters by diffusion and turbulent resuspension. Considerable advances have been made recently in knowledge of these processes. Much of the improved understanding relates, however, to the cycling of material within estuaries and less progress has been made towards the evaluation of export of material from estuaries. Moreover the large effort devoted to field and laboratory studies of interactions in estuaries has not resulted in a corresponding improvement in generalized predictive capacity. The key problem is that the extent to which a given reaction may proceed can vary between estuaries and temporally in a specific estuary depending upon residence time and the amounts and reactivities of particles. In the context of RIOS estuaries range from deep fjords with shallow sills to river plumes extending beyond land boundaries; with Monsoonal regions the early mixing zone may vary in position seasonally from up-river to the mouth.

In studying estuarine chemical processes the low salinity region warrants special attention since it is the location of important reactions relating to rapid changes in composition and, in many cases, to turbidity maxima with high, though variable, particle concentrations and release of reactive species from sediments. From the standpoint of estimating the export of dissolved material from estuaries there is a strong case for more intensive studies of mixing relationships in the higher salinity ranges, provided that data of high analytical precision can be obtained and the system is well understood hydrographically.

In addition to changes in the flux of dissolved elements through estuaries, substantial alterations in chemical speciation may occur, resulting in some cases from biologically mediated changes in oxidation states and molecular form, but also from differences in complexation reflecting the changes in the major complexing ligands along salinity gradients. The principles of equilibrium modelling of ion associations are well established; major discrepancies in models are largely attributable to deficiencies in the equilibrium data base. Since marked departures from equilibrium predicting are analytically observable the need for more information on non-labile complexes and on reaction kinetics is evident. For chemical modelling a particularly important requirement is a knowledge of pH. Considerable difficulties have arisen in marine chemistry through the use of several different pH scales. The problem is accentuated for estuaries with their wide range in ionic strength. Several workers are already addressing this problem. It would be of great value if standardized measurement procedures and a common pH scale could be adopted by estuarine scientists and this was considered by the Working Group to be an urgent task which could appropriately be undertaken under the auspices of SCOR. Any consideration of the pH problem in river and estuarine waters should take account of the role of the acid-base properties of the dissolved organic compounds.

The practical study of organic chemical processes in estuaries, as well as in rivers, is underdeveloped, principally because of methodological limitations and uncertainties of strategy in the approach to a system containing a hugh number of molecular entities. Even for total particulate and dissolved organic carbon, data are inadequate for budget calculations. The application of thermodynamic concepts to organic speciation and prediction of transformations of organic species is an area which warrants attention. The origins and characteristics of organic coatings on particles are little understood, despite their likely importance on surface properties and reactivity.

The Working Group recognised that measurements of certain biological processes are of central importance to our understanding of the river fluxes, estuarine trapping and cycling of material, and fluxes to coastal seas, for nutrients, organic substances and a number of inorganic constituents, with their important implications with regard to eutrophication of estuaries and coastal waters. Particular note was taken of the problems of accurate measurement of chlorophylls and other plant pigments in such waters. Investigations using high performance liquid chromatography have shown that in environments where plant material is being produced and decomposed at high rates the accuracy of standard spectrophotometric procedures for measurement of chlorophyll can become grossly inadequate. Re-evaluation of methods is urgently needed and this appears to be an appropriate undertaking for SCOR.

Several critical topics were recognised in relation to the processes regulating sedimentation and sediment transport in estuaries. Data on particle size distributions of suspended particulate material is of central relevance to the study of these processes; the sizes and surface characteristics of particles are also major determinants of their chemical reactivity. There are, however, methodological difficulties since sampling and analysis cause the disintegration of aggregates or flocs and information is thus lacking on *in situ* size distributions. Methods are also needed for the collection and characterization of particles extending into the colloidal range ($<1\mu m$), because of the importance of this fraction in terms of its surface reactivity. The Working Group considered these as priority areas for development

of improved approaches and methods and considered that there should be a detailed evaluation of this topic by SCOR.

Another key problem in this field is the role of organisms in particle aggregation and in alteration of surface sediment composition and micro-relief with consequent effects on sediment erosion and movement, and the seasonal variability of bottom boundary conditions. The lack of direct methods for realistically measuring bottom sediment transport is a major limitation on our understanding of the fate of sediment supplied to an estuary. Where large amounts of sediment enter and leave an estuary during a tidal cycle estimates of net flux from measurements across the estuarine boundaries are subject to large uncertainties. As with dissolved substances, there is thus inadequate information as to how much of the material entering estuaries is eventually exported.

Hydrodynamic factors in catchment areas are important in relation to the mass transport of material into estuaries. Insufficient attention has been given to statistical methods in the design of sampling to determine inputs. For the modelling of the behaviour of chemical constitutents in estuaries much more information is needed on the rates of exchange between dissolved and particulate material and on conversions between different chemical forms. There is often considerable lack of appreciation of the limits of the capabilities of a model, because of confusion as to objectives. Models constructed in response to management requirements for an estuary and which provide satisfactory simulations for the behaviour of specific constituents in this context may nevertheless be inappropriate when applied to a very different set of conditions or to another constituent which enters into reactions of a different type. Information on processes is essential, if responses to changes in input forcing functions are to be adequately predicted for a range of components and conditions.

Current programmes on RIOS

The Working Group noted a number of recent and current programmes and activities relevant to RIOS. These included the UNDP-supported research and training programme on the Asian mangrove ecosystem, with an emphasis on biological processes, and the Bordeaux international symposium on lagoons, organized by UNESCO, the proceedings of which will shortly be published. A number of organizations, including ICES and IOC, have been concerned in planning a symposium on Contaminant Fluxes through the Coastal Zone, to be held in May, 1984. Important data on the composition of river waters continue to be obtained through the work undertaken under the SCOPE/UNEP Carbon Unit's project on Transport of Carbon and Minerals in Major World Rivers. The value of national initiatives was recognized. Such initiatives have led, for example, to studies on the Amazon and Zaire systems which are among the most comprehensive undertaken for major systems.

The Working Group recognised a continuing need for closer coordination between the international organizations with interests in RIOS topics.

RIOS and contaminant fluxes

The Working Group had been asked by IOC to consider its possible role in respect of the evaluation of information regarding fluxes and mass balances of various classes of contaminants in the World Ocean and some regional sea areas. This followed recommendations on these topics made at the Fourth Session of the GIPME Group of Experts on Methods, Standards and Intercalibration (GEMSI).

Dr. Windom described the role of GEMSI in respect of pollution of coastal waters and referred to the related interests of the ICES Marine Chemistry Group. One concern of GEMSI is to evaluate our understanding of inputs of key inorganic and organic pollutants and the mass balance of pollutants in the ocean and in certain regional seas. Because of the practical difficulties of scale in oceanic monitoring and the

generally slow response of the oceanic reservoir to changes in the flux, the monitoring of inputs is important, allied in the case of river inputs with knowledge of changes in fluxes to the coastal seas and ocean brought about by estuarine processes. There is a requirement to establish the kinds of measurements and the location of sampling sites needed to estimate river inputs of pollutants to the ocean.

The Working Group's discussions emphasized the importance of man's modifications to rivers, by damming and redistribution of flows, and alterations due to deforestation and climatic change, in this context as well as in relation to baseline inputs as outlined in Section 1. Coverage of rivers for pollutant concentrations is very variable with most work done in developed countries, often on rivers of local rather than global significance. An extremely basic question exists as to the quality of data for trace substances in river and estuarine systems. Rigorous work in a few laboratories has led to the recognition that many oceanic data for trace metals, prior to the mid 1970s, were grossly erroneous and has emphasized the need for a high level of expertise if reliable, critical data are to be obtained. One of the criteria which can be used to assess oceanic data is consistency of distributions with known oceanographic processes; such criteria are more difficult to establish for rivers and estuaries where processes are more locally variable. For organics, data are extremely sparse and again uncertainties as to analytical quality are great.

A major step towards implementation of more systematic monitoring of pollutant inputs would be to set up intensive training workshops, with a relatively small number of participants (probably 12-20) carrying out intercomparisons of sampling and analysis. Among the locations discussed, the Working Group saw particular advantages in Thailand, where there is a reasonable logistic base including clean-room facilities, and an existing interest in the Regional Seas programme, and Mexico (Canpeche) where facilities include a hydrodynamic model. The scale of funding and the logistical requirements for workshops of this kind would be such as to make pursuance through UNESCO and IOC appropriate.

In addition to the basic need to ensure the quality of analytical data, there is a further important requirement to establish a strategy for the study of mass balances in estuaries. Detailed evaluation is needed of approaches to estimate inputs from rivers and other sources, and particularly to examine frameworks of measurements to determine net fluxes of material leaving estuaries. The Working Group considered that these aspects would best be studied through a field experiment in which the resources of expert groups were combined in an intensive investigation of a single system, concentrated on selected pollutants and other constituents of biological and geochemical importance. Such a workshop would also require the resources of organizations such as UNESCO and IOC.

The Tagus System

The Workshop on the Tagus System had shown that a considerable range of detailed chemical studies had been carried out providing a valuable first order assessment of the environmental quality of the estuary. They included seasonal, tidal and synoptic surveys of salinity, temperature, pH, dissolved oxygen, nutrients, particulate nitrogen and carbon, and chlorophyll. Studies of some toxic metals in sediments had also been undertaken; particular attention was given to mercury, arsenic and lead. At this stage quantitative estimates of inputs and fates of pollutants were not available.

The Working Group's discussions focussed particularly on the use of models. As indicated in Section 1, modelling of chemical processes in the RIOS context requires more attention to estuarine processes than may necessarily be needed for particular management objectives. From the former standpoint the involvement of estuarine chemists at an early stage of project planning is desirable. The Working Group particularly emphasized the value of making measurements of dissolved and particulate fractions of substances, in order that hypotheses to explain non-conservative behaviour can be critically tested.

Further actions by Working Group 46 and Recommendations

The Working Group considered that its final report should consist primarily of a more detailed and critically documented account, suitable for separate publication, of the current status of RIOS topics and priorities for research, as outlined in Section 1 of the present report. It envisaged that the preparation of this report could be handled by correspondence. The Working Group had identified a number of specific aspects on which early action is needed. Several requirements were considered appropriate for action primarily by SCOR. There had also been recognised a need for continuing evaluation and stimulus of action. Such activities include field experiments and practically orientated workshops. These are longer-term activities and they require substantial organizational resources; the Working Group considered the involvement of UNESCO and IOC to be essential here.

Specific recommendations are accordingly put forward by the Working Group in several categories, as listed below:

Recommendations (1) - (4) are for actions specific to SCOR,
(5) - (6) require interorganizational action,
(7) relates to the follow up to the work of Working Group 46.

RECOMMENDATIONS

(1) That SCOR re-evaluates the methods appropriate for the determination of the concentrations of chlorophylls and other plant pigments in estuarine and coastal waters with a view to the publication of revised recommended procedures. Similar problems exist for freshwater and SCOR may wish to affiliate with other appropriate bodies in this re-evaluation.

(2) That SCOR considers the question of a pH scale suitable for estuarine waters, and the problems of practical measurements of pH in such waters, and recommends suitable procedures. (JPOTS may be an appropriate group to address this task).

(3) That SCOR evaluates critically techniques for particle size analysis in river, estuary and coastal systems, with reference also to colloidal particles, and with a view to development of reliable *in situ* techniques.

(4) That SCOR should take the initiative in forming a group to deal explicitly with the analysis of the effects of land-use changes and dams on the downstream flux of water and materials within rivers and to the marine receiving waters. The specific terms of reference should include:

(i) retention by dams
(ii) input and routing of sediments and dissolved material
(iii) contact with "client" groups (e.g. those concerned with problems ranging from terrestrial erosion to management of mangrove and other near-shore ecosystems) and a synthesis of expertise in the diverse problem areas.

The group should include expertise on chemistry, hydrology, biology and sedimentology, focussed on a common model. The assessment of these problems should be brought to the attention of UNESCO with a view to implementation of a long term research programme.

(5) That intercomparison and training workshops are held in selected estuaries adjacent to regional seas, to evaluate the methods for the measurement of important pollutant substances in river and estuarine waters. This objective could appropriately be pursued through IOC and UNESCO.

(6) That a field experiment workshop be held to establish a strategy for the measurement of major sources of pollutants and other selected materials for a single estuarine system and the export of these materials from the estuary to the coastal zone. The planning and execution of this programme should be pursued through IOC and UNESCO agencies with the cooperation of SCOR.

(7) That SCOR continues to review the need for working groups to consider specific priority topics concerning RIOS. The working group suggests that one such topic is the dynamics of cycling of material in estuaries and that a group should address the following issues in relation to it; the surface chemistry and reactivity of particles in estuaries; the source and sink functions within estuarine waters and sediments; the characteristic time scales for biochemical and geochemical processes and their implications for the design of programmes of estuarine measurements.

The Working Group sees its primary task as being discharged when its fuller report on RIOS topics is presented. It suggests, however, that if its recommendations for longer term initiatives are taken up by UNESCO and IOC, SCOR might consider its retention for a further limited period, working mainly by correspondence and ad hoc opportunistic meetings, during the phasing in of these activities.

ANNEX V

WORKING GROUP 54

SOUTHERN OCEAN ECOSYSTEMS AND THEIR LIVING RESOURCES

I. SECOND INTERNATIONAL BIOMASS EXPERIMENT (SIBEX)

In the months since the Sixteenth General Meeting of SCOR (Halifax, Nova Scotia, August 1982), progress has been continuing on the planning for the Second International BIOMASS Experiment (SIBEX), an international coordinated study of the waters of the Southern Ocean and their living resources, which will begin at the end of 1983 for the austral summer of 1984 and continue in the austral summer 1985. At this point, eleven countries have committed seventeen ships to SIBEX. Their efforts will be concentrated on the study of mesoscale processes in the Southern Ocean rather than on a circumpolar study.

SIBEX Planning

From 27 September to 1 October 1982, the BIOMASS Technical Group on Programme Implementation and Coordination met in Bremerhaven, F.R.G., to further planning for SIBEX. The meeting included fifteen scientists from ten countries. Building on the decisions made by the *ad hoc* Group on SIBEX Planning (Cambridge, May 1982) and those of WG 54 (Nikko, Japan, June, 1982), the Technical Group listed the following as specific SIBEX objectives:

determine krill abundance and distribution (by age and size groups and maturity stages) in relation to: a) physical and chemical oceanography, b) the ice-edge, c) zooplankton communities, d) predators, e) phytoplankton composition and abundance;

assess krill production, seasonal and annual by areas including: a) growth, b) predation, and c) decomposition;

describe krill reproduction, seasonal and annual by areas;

examine fish recruitment in relation to krill fisheries;

study demersal fish ecology in SIBEX areas; and

assess predator stocks and trophodynamics including aerial and shore based studies.

The areas targeted for SIBEX include:

Atlantic sector:	western approaches of the Antarctic Peninsula, Bransfield Strait to the Scotia Ridge and South Orkney Islands
Indian sector:	in the area of the East Wind Drift between 60°E and 80°E with special reference to Prydz Bay
Pacific sector:	about 160°E.

I. contd.

The Technical Group decided that, in order to study krill population dynamics in Bransfield Strait, recruitment from the Weddell and Bellingshausen seas as well as the movement northward of krill from the area into the Drake Passage must also be investigated. Because this expands the area of study, SIBEX vessels will have to be used serially in a given area to provide maximum seasonal coverage.

For Prydz Bay, the major topics have been structured on the assumption that permanent or semi-permanent gyres exist in the sector 60° to 80°E. Results from the Australian oceanographic work during FIBEX and the Soviet/Polish expedition to Prydz Bay in 1969 indicate the existence of a well-developed gyre in Prydz Bay. SIBEX will seek to verify the existence of this gyre system. After examining the physical oceanography of the region, SIBEX will focus on biological questions. The T.G. decided to emphasize physical and biological oceanographic research in the 1983/84 seasons and biological investigations in 1984/85. The physical oceanographic data and the krill distribution pattern from 1983/84 will be used to refine the survey design for 1984/85.

The Pacific area around 160°E has been known for its heavy concentration of krill, whales and penguins. During FIBEX, Japanese vessels could not detect the high concentrations of krill in that area which had been reported earlier. Japan will send two ships to that area to investigate the apparently high degree of variability in krill abundance.

II. BIOMASS DATA CENTRE

The establishment of a permanent Data Centre continues to be an item of high priority on the BIOMASS agenda. The *ad hoc* Group on the BIOMASS Data Centre (Garth Newman, Chairman) is evaluating various sites for the Data Centre; at present, they see two viable alternatives; the Department of Computing Science (Fachbereich Informatik) at the University of Hamburg and the British Antarctic Survey in Cambridge. However, because a permanent centre will not be established for some time, a contract has been signed with the University of Hamburg in order to solve the immediate data processing problems of BIOMASS. In return for $25,000, the contract calls for the University of Hamburg to hire one full-time programmer and some student help to support data workshops and to work on the conversion of the existing BIOMASS PASCAL/R database for use on a wider range of computers. A contract has also been signed for 1984 which will extend the relationship for another year.

III. BIOMASS STRUCTURE

At its meeting in Nikko, Japan, SCOR WG 54 reviewed its internal structure, adding some new Working Parties and *ad hoc* Groups, disbanding others, and authorizing changes in the membership of still other subsidiary groups. For many of the new or restructured groups, the actual membership lists of the various groups were left to the chairman and the convenor to settle. That work has been done, letters of invitation have been sent, most responses have been received, and the new internal structure of BIOMASS is almost completely established.

IV. BIOMASS - Related Meetings - Meetings held since SCOR XVI

13-14 August 1982 - Working Party on Bird Ecology (Cambridge, U.K.)
20-25 September 1982 - Fish Ecology Working Party (Hamburg, F.R.G.)
27 Sept. - Oct. 1982 - Technical Group on Programme Implementation and Coordination (Bremerhaven, F.R.G.)
20-26 Sept. 1982 - First Post-FIBEX Hydrographic Data Interpretation Workshop (Hamburg, F.R.G.)
16-21 May 1983 - Seminar on Krill Biology (Bremerhaven, F.R.G.)
16-21 May 1983 - Second Post-FIBEX Hydrographic Data Interpretation Workshop (Hamburg, F.R.G.)
6-10 June 1982 - Symposium and Workshop on Recent Advances in Aquatic Biology (Bariloche, Arg.)

BIOMASS - Future Meetings - 1983 - 1984

12-16 September 1983 - Fourth Antarctic Biology Symposium (Wilderness, S.A.)
19-20 September 1983 - Meeting of SIBEX Chief Scientists (Atlantic and Indian sectors)(Cape Town, South Africa)
15-16 September 1983 - Meeting of the BIOMASS Executive (Wilderness, S.A.)
27-29 September 1983 - Meeting of the *ad hoc* Group on Squid Ecology (Tokyo, Japan)

April 1984 - Symposium on Fur Seal Biology (Cambridge, U.K.)
July 1984 - Acoustic Data Workshop (Hamburg, F.R.G.)
July 1984 - Krill Data Workshop (Hamburg, F.R.G.)
July 1984 - Bird Data Workshop (Hamburg, F.R.G.)

V. BIOMASS PUBLICATIONS since SCOR XVI

BIOMASS Reports:

BRS No. 23: *BIOMASS Scientific Advisory Group for SIBEX - I*
BRS No. 24: *Report of the Group of Specialists on Southern Ocean Ecosystems and their Living Resources*, Nikko, Japan, 31 May-4 June 1982
BRS No. 25: *Data, Statistics and Resource Evaluation*, Tokyo, Japan, May, 1982
BRS No. 25: *Working Party on Fish Biology, Report of Second Workshop on the Ageing of Antarctic Fishes*, Orono, Maine, U.S.A., 7-10 June 1982.
BRS No. 26: *Working Party on Fish Biology, Report of Second Workshop on the Ageing of Antarctic Fishes*, Orono, Maine, U.S.A., 7-10 June 1982
BRS No. 27: *Meeting of the BIOMASS Working Party on Bird Ecology*, Cambridge, U.K., August 1982
BRS No. 28: *Meeting of the BIOMASS Working Party on Fish Ecology*, Hamburg, F.R.G., 20-25 September 1982
BRS No. 29: *Technical Group on Programme Implementation and Coordination, Third Meeting*, Bremerhaven, F.R.G., 27 Sept. - 1 October 1982
BRS No. 30: *First Post-FIBEX Hydrographic Data Interpretation Workshop*, Hamburg, F.R.G., 20-26 September 1982

In Preparation:

BRS No. 31: *Second Post-FIBEX Hydrographic Data Interpretation Workshop*, Hamburg, F.R.G., 16-21 May 1983
BRS No. 32: *Symposium on Krill Biology*, Bremerhaven, F.R.G., 16-21 May 1983

BIOMASS Handbook Series:

No. 16: *Transmission of Data to the Post-FIBEX Workshop*
No. 17: *Methods for Studying Early Life History Stages of Antarctic Fishes*
No. 18: *Recording Observations of Birds at Sea*, BIOMASS Working Party on Bird Ecology
No. 19: *Monitoring Studies of Seabirds*, BIOMASS Working Party on Bird Ecology
No. 20: *Penguin Census Methods*, BIOMASS Working Party on Bird Ecology
No. 21: *Atlas of Fish Larvae of the Southern Ocean*, by V.N. Efremenko

BIOMASS Scientific Series:

Vol. III *Swimming Behaviour, Swimming Performance and Energy Balance of Antarctic Krill, Euphausia superba,* by Uwe Kils
Vol. IV: *Distribution and Abundance of Antarctic Penquins: A Synthesis of Current Knowledge*

BIOMASS Newsletter:

Vol. 4, Number 1 - September 1982
Vol. 4, Number 2 - December 1982
Vol. 5, Number 1 - July 1983
Vol. 5, Number 2 - will appear in December 1983

ANNEX VI

WORKING GROUP 55

PREDICTION OF "EL NINO"

The fifth meeting of WG 55 consisted of five sessions (totalling approximately 16 hours) held at the CIMAS conference room at the University of Miami's Rosenstiel School of Marine and Atmospheric Science from 30 September until 2 October 1982. WG 55 members, Lagos, Namias, O'Brien, Stuart and Wyrtki were present along with invited participants S. Zuta, David Enfield, Donald Hansen, A. Leetmaa and Rennie Selkirk.

The proposed agenda was adopted and a broad time schedule outlined. The chairman gave a brief history of this Working Group, recalled the various prior meetings and their main accomplishments, reviewed the terms of reference and read our definition of El Nino which was to be sharpened and clarified at this meeting.

UPDATING OF EL NINO RELATED ACTIVITIES

WG 55 members were brought up to date on activities related to El Nino via the following reports: Committee on Climatic Changes and the Oceans (CCCO) (Wyrtki), Joint IOC/WMO/CPPS Working Group on Investigations of El Nino (Zuta), Eastern Pacific Climate Studies (EPOCS) (Hansen, Leetmaa), Regional Study of the El Nino Phenomena (ERFEN) (Zuta, Lagos), Aerial Vigilance of Atmospheric and Oceanic Conditions (VACOM) (Stuart, Zuta), Eastern Boundary Undercurrent Studies (EBUC) (Enfield), workshop on El Nino Rapid Response (Wyrtki), plus announcements of upcoming meetings in Princeton, N.J. in October (study conference on Southern Oscillation and associated phenomena like El Nino) and in December (Long Range Prediction Meeting) by Wyrtki, O'Brien, Newell and Namias. These reports provided the WG members a good overview of the groups currently involved in El Nino studies. Many of the WG members are actively involved in these studies and/or are members of these various groups.

DATA

Stuart reminded the WG of their various prior recommendations concerning collection and prompt dissemination of data crucial to El Nino Prediction schemes. These data are mostly sea level, winds, sea surface temperature (SST), and XBT data. Considerable correspondence has been exchanged (involving WG 55 members and others) concerning SST analysis for the Tropical Pacific using a mix of in situ observations (ships, buoys, islands) and satellite derived SST. A group of leading oceanic and atmospheric scientists (10-20), as early as October 1981, addressed the Administrator of NOAA (Dr. Byrne) concerning this problem and no clearcut resolution seemed evident as of 15 July 1982. WG 55 feels as strongly as ever that the in situ data base and analyses must be kept separate from the remotely sensed data base and analyses. The recent volcanic eruptions in Mexico (El Chichon) give a very current example of our concern. The scientific community must maintain SST analyses based exclusively on in situ observations. Such in situ observations are necessary if we wish to be able to evaluate the impact (seasonally to climatically) of such an event on the world wide circulations of the ocean-atmosphere system.

The question of data surfaced again in our discussions of definition of El Nino, and prediction schemes. A specific recommendation concerning data is attached.

DEFINITION OF EL NINO

In our first meeting in April 1978 in Las Palmas, Gran Canaria, the Working Group clearly faced the question that before we try to predict El Nino we must be clear what we mean by El Nino. It was further agreed that our interest was in the 'rare' event which has associated climatic (oceanographic and meteorological) and economic effects. Our definition put forth in April 1978 is: "El Nino" is a massive influx of warm water into the coast of Ecuador and Peru as far south as Lima ($12^{o}S$). From our presently available data the coastal stations must have a positive temperature anomaly, ΔT, of $2^{o}C$ 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 Ninos are identified in 1973, 1972, 1969, 1958, and 1957 i.e. dates well known in the literature. Our emphasis was to focus on the 'rare' event and to predict the occurrence or non-occurrence of the event. The WG recognized, at that time, that sea level might be a better criterion to use in the definition, but SST data are available for more years and from more stations.

Almost from the beginning the WG has been considering the sharpening of this definition of El Nino. Points of contention have been:

1) How long should the SST anomaly ($\Delta T > 2^{o}C$) last,
2) How many stations must exhibit the SST anomaly of $\Delta T > 2^{o}C$,
3) How crucial is the choice of $\Delta T > 2^{o}C$, and
4) Perhaps some phrases in the definition should be changed.

At this latest meeting in Miami, we had available monthly mean SST data for a common 25 year period (1956-1981) for five (5) Peruvian Coastal Stations. These data allowed us to extend our analysis through 1981. Also we decided to deal with normalized SST anomalies. Our new definition is: "El Nino is the appearance of anomalously warm water along the coast of Ecuador and Peru as far south as Lima ($12^{o}S$). This means a normalized sea surface temperature (SST) anomaly exceeding one standard deviation for at least four (4) consecutive months. This normalized SST anomaly should occur at least at three (3) of the five (5) following stations." The data give the monthly mean SST and the standard deviation computed over the period 1956-1981 for each month for each coastal station. This revised definition identifies Los Ninos in 1957-58, 1965, 1972-73, and 1976 i.e. dates well known in the literature. This revised definition identifies most of the same 'rare' events as the earlier definition, but now we are not 'wed' to a somewhat arbitrary SST anomaly (i.e. $\Delta T > 2^{o}C$), but rather to a normalized SST anomaly equal to or exceeding one standard deviation for each respective station. Stations meeting this definition for the period 1956-1982 were identified.

EL NINO PREDICTION SCHEMES

During the Miami meeting presentations were made of several methods for simulating and forecasting El Nino events. From these presentations and others obtained since, Table I was created to summarize the results. The various schemes are identified by the associated researcher and the open literature contains numerous papers giving the specifics of each group's methods.

From Table I, and especially from the discussion, it is obvious that all methods make use of similar select data. The WG members were unanimous in their call for prompt flow of the data (generally monthly means of each variable) in order for the issuance of timely forecasts. This has lead WG 55 to formulate the attached recommendations concerning data and an El Nino International Center (ENIC).

The proposed ENIC would have the charge of acquisition and dissemination of the relevant data.

Finally, from Table I we note that most El Nino Prediction techniques give a forecast generally only 1-3 months in advance. For good Fisheries management, a forecast of an El Nino event is needed 1-2 years in advance. It is obvious that we need a deeper insight into the mechanisms of El Nino and/or a good extended length forecast of some of the critical variables (i.e. SST, winds, S.L., etc.).

WORKING GROUP 55 - ITS FUTURE

The WG had a healthy and broad-ranging discussion concerning its future. The Chairman pointed out that the SCOR Executive Committee reconsiders each working group each two years, and at this time WG 55 is likely to end within the next year. WG 55 members felt much work needs yet to be done on El Nino Prediction. Actually, we are entering the most important phase, especially with the emphasis on Climate, Southern Oscillation and related phenomena, and an El Nino Rapid Response field programme. The WG 55 members believe a WG with 8-10 members actively involved in El Nino Prediction is needed and has attached a specific recommendation on this. The WG felt, if its members were all actively working on El Nino problems, biannual meetings funded by SCOR would be sufficient since the WG members would also hold at least annual workshops related to their own research. Finally, the members requested the chairman to continue in his current role if the WG is continued.

SCOR WG 55 (EL NINO PREDICTION) RECOMMENDATIONS

Data: El Nino is a climate type fluctuation which requires long term data bases for its understanding and prediction. The currently employed prediction schemes depend on several variables (i.e. in situ SST, winds via ship and satellites, sea level, and XBT's) which are needed promptly on a continuing basis. Hence, we recommend the following:

1. Sea level observations at coastal and island stations throughout the North and South Pacific must be continued, expanded, and the data made available promptly.
2. The World Meteorological Organization (WMO) should expand and strengthen its reporting system for real time reporting of ship reports of the weather (S.L. pressure, SST, winds) throughout the North and South Pacific.
3. Analyses of SST over the North and South Pacific using exclusively in situ (ships, buoys, islands) reports must be continued. El Nino studies have become dependent on this good data base which already exists. Future studies and predictions of El Nino depend on such analyses of in situ SST data. Such studies are unable to use satellite SST data especially since such satellite data can be nearly useless if the atmosphere suffers a rapid pollution like during the latest El Chichon eruptions in Mexico.

EL NINO INTERNATIONAL CENTER (ENIC)

The eventual prediction of El Nino events requires the acquisition of several variables (in situ SST, winds, sea level, XBT's, sea level pressure) from over most of the North and South Pacific and perhaps into neighbouring ocean and continental regions. Such data are needed to provide an ongoing monitoring of the ocean-atmosphere system, for development of new prediction schemes, for input to current real time prediction schemes, for model development and verification, and for the general climatological data base. Even though only monthly means of the variables are needed, frequently they are received too late to be used for monitoring and prediction since the data must be received from such a vast region involving numerous countries. Furthermore, since El Nino Events are so widely spaced in time, interest in the crucial data often wanes and many years may pass before it is recognized that important data have not been taken and/or that proper quality control was not maintained.

Aware of the data and communication problems, we recommend the establishment, as soon as possible, of an El Nino International Center (ENIC) whose primary charges would be:

1. Acquisition - on a timely basis - of the relevant data needed for monitoring and prediction of El Nino.
2. Quality control, archival and dessimation of the relevant data to those groups (countries and individuals) involved in studies and predictions of El Nino and related phenomena.
3. Real time monitoring and analysis of key variables related to El Nino.
4. Evaluation and verification of El Nino predictions which would be issued by numerous groups - worldwide - not directly associated with the ENIC. ENIC would not be a forecast group.
5. A center for exchange of ideas concerning El Nino accomplished by providing a location for groups to meet and by arranging workshops.

We further recommend that such an ENIC be located near to the tropical Pacific, that it have good data communication facilities, that it be located where airline transportation is good to excellent, that it have access to computers, and that it have a small dedicated staff. Most importantly, it must be International in scope, philosophy, and practice. Finally, basic data must flow promptly into ENIC and ENIC must promptly provide reduced data.

SCOR WORKING GROUP 55 - EL NINO PREDICTION

Aware that El Nino is a climate type fluctuation with time scales nearing a decade,

Aware that there are several working groups involved in climatic type problems but with El Nino type phenomenon as a secondary or tangential interest and not specifically addressing the forecasting problem,

Aware that the general scientific community is becoming more interested in El Nino studies and such studies are being planned,

Aware that El Nino events can have important impact on the economics of countries of South America and perhaps many other countries of the world,

We recommend that SCOR continue a working group devoted to El Nino - escpecially its prediction. We recommend the terms of reference to include the following:

1. Evaluations of ongoing prediction schemes
2. Evaluation of proposed new prediction schemes
3. Recommendations of future research needed for the prediction of El Nino especially to yield El Nino forecasts 1-2 years in advance
4. Evaluation of why frequency of Los Ninos is different in various decade periods

Furthermore, we recommend a working group of 8-10 members who are actively working on El Nino problems. Membership should be selected from persons involved in observing, modelling, and predicting El Nino including persons in meteorology as well as oceanography. At least one interested biological oceanographer should be on the WG. Geographical distribution of members is not as important as being involved in El Nino problems. The chairman should be involved in El Nino but able to act somewhat neutrally. The working group should be prepared to meet annually (biannually at SCOR's expense) on a fixed schedule and such meetings should be held at the site of the proposed ENIC at a time critical for the forecast (or occurrence) of El Nino.

TABLE I - SUMMARY OF EL NINO PREDICTION TECHNIQUES

	INPUT		PREDICTION	
Group	Variables*	Where	What	When Issued
Wyrtki	Winds (ship or satellite); SST (ship or buoy) S.L. and AXBT	20°N - 20°S Whole Pacific 20°N - 20°S W. of 180° in Pacific	Yes or No to the occurrence of a strong or moderate El Nino Event	1 Oct of each year using data through August
Quinn	S.L. Pressure SST	Easter, Darwin Rapa Stations Peru Coastal Stations	Yes or No to the occurrence of an El Nino Event	1 Dec of each year using data through October
Barnett	Surface Winds SST, Sea Level	20°N - 20°S Whole Pacific and Indian Ocean	SST Anomaly at Talara, Christmas Island and other tropical locations	Not being currently prepared but could be issued with lead times of 10-12 months and 3-4 months (later needs S.L. and wind data)
Newell	Ship winds SST (ship or buoy) Sea Level Pressure	Whole N & S Pacific 40°N - 40°S Whole Pacific Peru Coastal Stations Easter, Darwin, Rapa	Temperature Anomaly for Jan. at Peruvian Coastal Stations	1 Nov. of each year using data through August
O'Brien	Ship winds	20°N - 20°S Whole Pacific	Yes or No for occurrence of a moderate or strong El Nino Event	1 Jan. using data through November (Uses a simulation model - not routinely deployed)
Miller	SST (ship, coastal station)	Eastern Tropical Pacific 30°N - 30°S, East of 180°W Coastal Stations of Ecuador and Peru	Prepares monthly means and anomaly charts of SST. Includes comments on likelihood of El Nino	Monthly charts available 15 days after end of each month

* All variables are monthly means and are required within 15 days of end of month.

ANNEX VII

FINAL REPORT - WORKING GROUP 61

SEDIMENTATION AT CONTINENTAL MARGINS

INTRODUCTION

This Working Group was set up by SCOR in 1978 and was asked to undertake the following tasks:

To review existing knowledge of sedimentation processes at continental slopes and margins, to recommend long term measurement devices for currents, turbidity, accumulation rates and other relevant parameters; to recommend coordinated quantitative determinations of suspended and accumulated materials; to define a few experiments in key areas on both eastern and western sides of oceans.

Members of the group have met from time to time at conferences, particularly the IUGG in Canberra (1979) and latterly at JOA in Halifax and the International Sedimentological Congress in Hamilton, Ontario during August 1982. Unfortunately, at no single meeting was it possible to get all the members of the WG together. We feel it is highly desirable for initial meetings of a WG to be organized so that a cohesive and more effective group is formed. This would require SCOR funds for at least two meetings of any given working group.

RECOMMENDATIONS FOR LONG-TERM MEASUREMENT DEVICES

1. Currents:

Engineers working with deep-sea current meter moorings have to be very conservative because experience has shown that even small changes to successful systems can result in the loss of whole moorings. At present the Vector Averaging or Measuring Current Meter (VACM or VMCM) using a savonius rotor and a vane is the preferred instrument for long-term deep ocean deployment. Microprocessors can now be added to these to allow them to sample at higher frequency when an event of interest (such as higher current speed) occurs. There is an increase in the use of acoustic current meters both for high-frequency turbulence measurements and for longer term measurements. An advantage of these devices is the absence of moving parts and low power consumption. While most instruments have been specially constructed at research institutions, one company (Neil Brown Inc.) now manufactures a deep ocean acoustic current meter. This type of device we suspect will be increasingly preferred as the older VACM's reach the end of their operating life. For boundary layer work the BASS (Benthic Acoustic Stress Sensor) of A.J. Williams at Woods Hole has proved highly successful in both shallow water (Coastal Ocean Dynamics Experiment CODE) and deep water (High Energy Benthic Boundary Layer Experiment HEBBLE). It has the advantage over electromagnetic meters of low power consumption permitting measurements of relatively long duration. At present the limiting condition is 8 hours of tape in the recorder. A move to *in situ* processing and compression of the data will allow much longer continuous records to be obtained. Event triggering allows high frequency data to be taken in relatively rare events of high energy, thereby conserving data storage capacity for times of interest.

2. Turbidity:

The continuous measurements of turbidity has hitherto been mainly by use of light-scattering measurments. Such measurements show quite good correlation with measured turbidity but are very sensitive to instrumental parameters. Different laboratories use different designs and their results are not easy to compare. Recently, a new generation of 0.25 and 1 m path length transmissometers have been designed for the deep-sea, the shorter one being in commercial production by Sea Tech Inc. The results from transmissometers are far less dependent on instrumental variation and a simple optical parameter, the attenuation coefficient, correlates very well with particle concentration. These instruments can operate in deep and shallow water and can be made to record in the pressure case of an associated current meter, thereby giving a record of the two parameters needed for estimates of sediment transport.

For the very high concentrations that may be encountered in some estuaries, (fluid mud with $C > 10$ kg m^{-3}) optical devices will not work. In these cases X-ray densitometry of the type undertaken by the Institute of Oceanographic Sciences (U.K.) in the Severn estuary may represent a viable technique. Long-term recording devices employing this principle have not been made.

Acoustic back-scattering particle measurement systems are currently being developed for deep and shallow water. They appear to detect suspended sand quite well and may also be satisfactory for muds. The advantage of these systems is that by range-gating measurements may be made up to 100 m away from the sound source. When combined with acoustic-doppler current meters also being developed, it may be possible to sense sediment transport rate remotely and obtain its vertical and horizontal profile. We can anticipate successful systems of this type before the end of the decade. Here again the possibility of event triggering with buffer storage gives us a means of studying episodic sediment transport. At present the frequency of events examined is of the order of one per month, but in principle much more rare events could be examined.

3. Equipment Loss:

An acute problem in shelf and upper slope depths (down to about 800 m) is loss of equipment to fishermens trawls. The two possible ways to combat this are to maintain close contact with fishermen and keep them informed of our activities or to develop cheap sensors that can telemeter data back to shore. Unfortunately, we see little chance that oceanographic sensors for sediment transport work are likely to be in sufficient demand to bring the price down through mass-production as with the XBT.

4. Accumulation and Particle Mixing Rates:

There have been many reviews of radioactive geochronologies for sediments. In determining the rate of accumulation in the uppermost part of the sediment column, the Holocene for the deep sea, results are made more difficult to interpret by biological mixing of the sediments. Material is moved into the bed both by advection - net sedimentation - and by mixing. For laminated sediments advection is dominant and isotopic data are more easy to interpret. Bioturbation effectively diffuses sediments downwards amd may be parameterised in the form of an eddy diffusivity. However, because there is more food near the surface there is a decrease in the biological activity with depth, and the biological diffusivity is higher in the top of the biologically mixed layer than it is lower down. The significance of this is that the portion of radionuclide profiles below the uniform mixed layer, where a decline of radioactivity with depth is found, may contain both an advective and a diffusive component. In the past it has (in the case of some ^{210}Pb data) been interpreted as entirely due to advection and decay. The inferred accumulation rate may be high

by a factor or two. Thus, a suite of radionuclides should be determined in conjunction with a multilayer model such as that of Olsen and others (J. Geophys. Res., 86, 11020-11028). The radionuclides most commonly used and their half-lives are ^{234}Th (24 d,), ^{210}Po (138d), ^{210}Pb (22y), ^{32}Si (280y) and ^{14}C (5600y). In addition the bomb-produced nuclides ^{137}Cs and $^{239,\ 240}Pu$ with a peak in 1962 are also used for dating.

For the upper Pleistocene, oxygen isotope stratigraphy gives the best resolution and is to be preferred to the older WXYZ biostratigraphic zonation, though that may still be useful for quick estimates. Also useful for some situations are pollen zones. Tephrochronology frequently gives excellent local correlation and dating if within K-Ar range or constrained by ^{14}C dates or O-isotope stratigraphy. A note of caution must be sounded for both ^{14}C dates and ^{18}O stratigraphy because they may be contaminated by reworked older material and give anomalous results.

Direct assessment of sedimentation by sediment traps gives satisfactory results in quiescent conditions such as some fjords, lakes and oceanic mid-depths. As current velocity past traps increases the behaviour of particles in relation to the trap becomes less and less well known. There appears to be a component concentration or horizontal flux rather than vertical flux to their behaviour, but in a non-linear manner. In the frequently active current regime of continental margins they produce results that cannot yet be properly interpreted and are not recommended for use in the nepheloid layer by the working group.

5. Problems of Episodic, Powerful Events:

An important aspect of sedimentation at continental margins is the episodic occurrence of powerful, gravity-driven sediment movement in slumps, debris flows and turbidity currents. Very few measurements have ever been taken of such movements in the sea, and those in lakes have been of comparatively slow low-density underflows. The major problem is being in the right place at the right time with suitable instruments. We have to be able to predict when a slide that may develop into a turbidity current is going to occur. The problem is not unlike that of earthquake prediction. In recent years much emphasis has been placed on measuring active processes of current transport and on measuring geotechnical properties of deposited sediments. The latter allow the conditions for slope failure to be evaluated. What is now needed is an effort to instrument areas where failure is expected soon so that measurements may be made of flow velocities and concentrations in turbidity currents.

Two strategies are suggested. One is repeated monitoring of a region of known instability using side-scan sonar and multi-beam echo sounding with accurate position fixing so as to be able to detect movements. Such an approach has been used by the group at Louisiana State University to reveal several slump scars and debris flows on the upper prodelta slope off the Mississippi, and by the French CNEXO on the Var delta slope failure near Nice. The second approach is to install *in situ* piezometers (to measure pore pressure) at depth. These would periodically be interrogated and with knowledge of the local slope an assessment of slope stability would be made. The systems used could be similar to those used in conjunction with oil platforms to keep track of their site stability. With approach of critical conditions a programme of instrument deployment would be initiated. Specially designed current meters and turbidity sensors would be emplaced along the probable path of a current. Downward-looking acoustic-doppler meters with event triggering could be moored above the probable path of such a flow. These would yield both flow speed and concentration profiles. The precise requirement of a site for such studies is that it should have very high rates of accumulation and secondly it should be close to an oceanographic institution to permit regular servicing and interrogation of monitoring devices. It would also be useful to find an area where there was the possibility of sandy turbidities being generated because this is the type most commonly studies in the geological record. Unstable areas of muddy bottom are most common however.

KEY EXPERIMENTS TO BE CONDUCTED

1. Laboratory Studies:

Several dynamics and sediment transport studies are currently being undertaken or have just concluded. Among these are the Coastal Ocean Dynamics Experiment (CODE) off California though this does not have a large sediment transport component, the studies of the shelf in the New York Bight by the NOAA labs in Miami, the joint U.S.-China programme in the east China Sea, studies of wave and tidal current sand transport on the shelves around U.K. by staff of the Institute of Oceanographic Sciences, and in deep water the High Energy Benthic Boundary Layer Experiment (HEBBLE) conducted by U.S. investigators from several institutions. It is becoming increasingly apparent from HEBBLE and other studies that biological mediation in sediment transport processes can not be neglected. Mucus coatings on both silt/clay and sand beds can and does significantly alter and control initial motion conditions, and aggregation with biological substrates is important in controlling suspended sediment settling velocity distributions. Thus, there is a need for a programme of controlled laboratory experiments to examine and define these effects. As a component of these efforts a renewed attack must be made on all aspects of cohesive sediment dynamics, particularly erosion, deposition and aggregation.

2. Sites for Mass Movement Studies:

Areas that might conform to the outline specification made above (rapid deposition rate, near oceanographic institute, relatively sandy) are the prodelta slopes of the Rhone and Ebro, the Danube, the Frazer in Canada, and because they are unstable though not sandy, the Mississippi and the Magdalena in Venezuela. Some submarine canyons such as La Jolla may also be suitable for examining the possibility of instability with instruments wired right into the laboratory. Other canyons with known instability and recorded mass movement are the area below Nice Airport on the Var Delta/Canyon system and the canyons of the Congo and Magdalena (Venezuela).

3. Sites for Studies of Modern Redistribution:

HEBBLE is conducting studies of sediment transport under deep western boundary currents with significant eddy contribution to the velocity field. Other studies of sediment redistribution in regions of current activity and sediment supply would be valuable. In the Pacific the Okinawa trough under the Kuroshio is a suitable target. In the S.W. Indian Ocean the Limpopo and Tugela Cones are fed with a substantial amount of sediment and have some reworking from AADW flows in the Transkei Basin/Natal Valley. In the North Atlantic, Rockall Trough has both a western boundary current constructing the Feni Drift on one side and deep sea fans (Barra and Donegal) and eastern boundary currents on the other side, with an abyssal turbidite plain in between. Here, however, there is little modern sediment input whereas the S.E. African cones and Okinawa Trough do have modern supply.

Upwelling areas have been targets principally for geochemical and biological studies of bottom sediments. However, the upwelling system off Walvis Bay in southwest Africa is associated with the Benguela Current and the reworking of the products of upwelling would be best carried out here.

These suggestions are by no means exhaustive. The working group has not sought to provide suggestions for everyone's own back yard. The cases we have mentioned are worth serious attention, at least a reconaissance study after gathering existing information together.

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ANNEX VIII

WORKING GROUP 74

GENERAL CIRCULATION OF THE SOUTHERN OCEAN

1. BACKGROUND

The initial meeting of the Scientific Committee on Oceanic Research (SCOR) Working Group 74, General Circulation of the Southern Ocean, was held on 17 and 18 February 1983 at the Lamont-Doherty Geological Observatory in Palisades, New York. The present group membership and attendees at that meeting are shown in Appendix I.

During the August 1982 meeting of the Joint Oceanographic Assembly in Halifax, the SCOR Antarctic Review Group was disbanded and SCOR Working Group 74 was established with the following terms of reference:

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

(ii) To specify physical and chemical programmes to investigate these problems.

The approval by SCOR of Working Group 74 with these terms of reference followed a proposal by the Scientific Committee on Antarctic Research (SCAR) that SCOR undertake the main responsibility for providing the focus within the International Council of Scientific Unions (ICSU) for physical and chemical oceanography of the Southern Ocean. Both SCOR and SCAR were aware that the Intergovernmental Oceanographic Commission (IOC) should have an important role in promoting international collaboration in physics and chemistry in the Southern Ocean, but that nevertheless there was a need for a scientific focus within ICSU which could best be provided by a SCOR Working Group.

The initial meeting of Working Group 74 was held as soon as practicable after its establishment in order that preliminary considerations would be available for possible presentation at the fourth session of the Programme Group for the Southern Oceans (SOC) of the IOC, scheduled for 7-12 March 1983 in Paris. The agenda for the initial meeting of Working Group 74 is given as Appendix II.

2. REPORT OF MEETING

Noting pertinent recommendations of many groups which in the last decade have considered the circulation of the Southern Oceans and bearing in mind the needs for physical and chemical information on the Southern Ocean by the BIOMASS Programme and the World Climate Research Programme, Working Group 74 has begun a review of the present level of understanding of the general circulation of the Southern Ocean. At our initial meeting we began to identify scientific questions and areas which are deserving of study. This process of identification will continue. It is our intention to produce by 1984 a draft document which sharply delineates major gaps in the knowledge of the general circulation of the Southern Ocean. At that time we will be in a better position to consider the specification of chemical and physical programmes to investigate these problems.

During the initial meeting of Working Group 74, the underlying considerations seemed to be for an understanding of fluxes within and from the Southern Ocean and for the overall heat budget of the Southern Ocean. For that reason we have arranged our discussions of scientific topics for an improved understanding of general circulation into the following groupings: Air-Sea-Ice Interactions; Interactions between Southern Ocean and Subtropical Gyres; Antarctic Circumpolar Current (ACC); Subpolar Gyres; Shelf-Slope Processes; and Sea Level Observations. We also discussed the needs for satellite observations of the Southern Ocean. The remainder of this report is arranged into the foregoing categories.

The reader should bear in mind that the considerations are quite preliminary. Even so, we have identified certain scientific problems which are deserving of prompt attention, which are amenable to attack with existing technology, and which may be appropriate for support by the SOC.

2. (a) Air-Ice-Sea Interactions

In order to improve our knowledge of the Southern Ocean heat budget and to better assess its role in global climate, we must improve our knowledge of heat and moisture fluxes between the atmosphere, ice and ocean.

(i) Ocean-atmosphere exchanges:

The distribution of sea ice and its thickness must be monitored throughout the yearly cycle. This clearly requires a programme of satellite observations. The areal extent of thin ice, through which fluxes are distinctly different than through the thicker pack ice, whould be determined.

Measurements of sea-air exchange are needed in open leads and polynyas to to determine operative processes and exchange rates. We must know the processes responsible for the generation and maintenance of polynyas, and to that end, we encourage continued attempts for measurements in polynyas and sea ice fields.

Estimates of ocean-atmosphere fluxes in open ocean are in need of improvement. It is not apparent how this can be done. (Perhaps exchange rates can be parameterized for distinct water mass zones to improve flux estimates. Perhaps satellite measurements can be utilized).

(ii) Ocean-ice exchanges:

Our knowledge of fluxes into the underside of sea ice must be improved. This should include how such exchanges affect, and are affected by conditions in the water column. (Perhaps ice buoys with subsurface thermistor chains could be frozen into sea ice).

Present knowledge of the energy and mass budgets associated with the freezing and melting cycle of sea ice are only rough estimates and must be improved.

(iii) Modelling and causal relationships:

There are basic unanswered questions regarding the detail to which sea ice characteristics must be specified for use in oceanographic, atmospheric and coupled numerical models. Can ice cover be treated as a slab? How should different types and thicknesses of ice be treated? How are water and ice (say iceberg) motions related?

Ice distributions and thicknesses should be related to larger scale ocean/atmosphere phenomena in other areas. Is there a relationship between ice cover and the Southern Oscillation? Could our understanding of the relationship between sea ice distribution and atmospheric storm tracks be improved?

2. (b) Interactions between Southern Ocean and Subtropical Gyres

Undoubtedly there are indirect atmospheric relationships between the subtropical gyres and the circulation in the Southern Ocean. We considered the direct exchanges of momentum and properties between the Southern Ocean and other ocean regions and arranged our considerations according to depth.

(i) Subtropical Front. The nature of this front seems to vary from region to region. In some areas, e.g., the southwest Atlantic, the Subtropical Front seems associated with the confluence of major currents and there is evidence for strong mixing across the boundary. In other areas the front is less distinct. Is the Subtropical Front really a circumpolar feature, or a series of independent horizontal gradients which persist downstream from confluence regions near the western margin of each ocean basin? Or, does it result from atmospheric effects? Or, is that nature of the front different in different areas? What is the relation between the surface and subsurface expressions of this front?

Additional temperature sections through the surface waters could improve our description of the Subtropical Front and assist in our planning for field experiments. It would be useful, if SOC would develop, and encourage the participation in a ship-of-opportunity programme (SOOP) designed to obtain better thermal descriptions* of the surface and near-surface waters across the Subtropical Front. This is but one of the several problems which are amenable to better understanding from a SOOP which SOC could develop, and we will mention this SOOP again in the discussion of those problems.

(ii) Subantarctic Mode Water and Antarctic Intermediate Water. There is active research into the types, characteristics and formation mechanisms for Subantarctic Mode Waters (SAMW). We encourage these studies as well as research into the relationship between SAMW and Antarctic Intermediate Water (AAIW) and of the formation rates and spreading of AAIW.

(iii) Circumpolar Deep Water. In terms of volume, the principal water mass in the Southern Ocean is the Circumpolar Deep Water (CDW), the upper portion of which is sometimes called Warm Deep Water where it underlies Antarctic Surface Waters. Those waters extend far northward into the world ocean modifying and being modified by waters and processes occurring outside the Southern Ocean. Better knowledge of the meridional exchanges and modifications of CDW likely must await the capability for measuring meridional velocities on basin scales. This is also the case for the Antarctic Intermediate Water.

(iv) Antarctic Bottom Water. One source of poleward heat flux to the Southern Ocean is the equatorward flow of the Antarctic Bottom Water (AABW) which underlies the CDW in the Southern Ocean. The outflow of AABW is limited to a few selected areas by bathymetric and dynamic control. It may be possible to monitor these outflows.

2. (c) Antarctic Circumpolar Current

During the past decade considerable progress has been made in understanding the kinematics of the ACC. For example, based on new observations, we now have: a different concept of the ACC as comprised of baroclinic current cores at fronts separating distinct water mass zones; a year-long record of the ACC transport and its variability; time series measurements of frontal motions; and studies of the formation from these fronts of rings and their subsequent behaviour.

* We note that data collected from ships-of-opportunity are biased. Generally, they are restricted to certain transit corridors, and in high latitudes are mostly collected in austral summer.

However, the fundamental dynamical problems regarding the ACC generally await solution (e.g., basic dynamic balance, maintenance of the zonation, processes responsible for meridional heat flux), although progress has been made in some areas (e.g., modal structure of currents, preliminary observed relationships between wind stress and ACC transport, estimates of energy conversion by baroclinic instability).

Most of these new results derive from the International Southern Ocean Studies (ISOS), based principally on measurements from Drake Passage. It is unknown, but important to determine how representative these results are for the entire ACC. We considered the scientific utility, as recommended in the 1974 U.S. National Academy of Sciences Report on Southern Ocean Dynamics, of similar major experiments in other "type" regions of the ACC, i.e., east-west ridge, flat topography, or north-south ridge without lateral constraint. As an alternative, we considered and at this time would recommend placing single moorings just to the north of the Subantarctic Front or limited horizontal arrays extending into the Polar Front Zone at locations along the length of the ACC. Results from these moorings would be compared with measurements in Drake Passage of quantities such as meridional eddy heat flux, kinetic energy versus frequency and modal structure of the currents. Such arrays would also give added information on the principal tidal currents from the Southern Ocean. If such moored arrays are deployed, consideration should be given to including long-term, in situ biological and geological measurements, including for example, sediment traps.

Measurments during the past decade have changed our descriptive ideas of the horizontal zonation of the ACC. The transition from antarctic to subantarctic surface waters seems definitely to consist of a Polar Frontal Zone bounded by two fronts -- the Polar Front to the south and the Subantarctic Front to the north. The evidence suggests that this structure is circumpolar in extent. Moreover, it appears that in nearly all cases where adequate thermal data are available, the fronts have a surface expression discernable to the trained observer.

We recommend measurements to better define the space and time distributions of these fronts and the subsurface thermal structure on a global basis. Here again a ship-of-opportuniy programme is to be encouraged. In fact, much of our recent information derives from a SOOP supported as part of the ISOS. In addition to properly spaced and calibrated XBT data, measurements from research and supply vessels across the Polar Frontal Zone and the Antarctic Surface Waters to the south should include surface biological and chemical sampling, acoustic biomass assessment and good bathymetry whenever possible.

A fundamental need is for an understanding of the causal relations responsible for the maintenance of this frontal structure. The feasibility of field experiments for this purpose should be evaluated.

2. (d) Subpolar Gyres

(i) General Descriptions. There are three rather large, clockwise circulation systems situated south of the ACC. One is located near the Weddell Sea, one near the Ross Sea, and one in the South Indian Basin. These circulation systems, which are probably wind driven, are referred to as subpolar gyres. The geographic extent, circulation strength, and variability of all three are of interest. While north-south sections are called for in most studies of the Subtropical Gyres, ACC and shelf-slope processes, east-west sections may be necessary to assess the intensity and extent of the subpolar gyres.

Knowledge of all three gyres could be improved at minimal cost through encouraging the measurement from ships-of-opportunity of surface temperature and salinity, temperature profiles using XBT's and bathymetry. This should improve our knowledge of the summer climatology. If in addition any country could be encouraged to provide off-season use of an ice breaker to obtain non-summer data, a programme could be organized to significantly improve our understanding in several areas.

Other effective tools in the general study of extent, strength and variability of the subpolar gyres would be satellite-tracked surface drifters and ice buoys.

(ii) Weddell Gyre Because of its importance to heat exchange and bottom water formation, the Weddell Gyre seems a good choice as the site for concentrated research programmes dealing with mass, heat and property transports; effects on sea ice; etc. Two recommended areas of study are:

(1) The determination of the westward extent of and variability within the Weddell Gyre. This should be of special interest to ecosystem biologists studying krill and to geochemists studying the transport into the Weddell Sea of tracers which may be incorporated into AABW.

(2) The mechanism responsible for the transfers of properties (particularly heat transfers) within the Weddell Gyre and between that Gyre and other ocean areas. One such process is Weddell Sea Bottom Water formation; another is modification of bottom waters to form Weddell Sea Deep Water; and there are others. Based on recent observational studies in the Weddell Sea, a programme to study mechanisms might include:

- Monitoring of westward flow in the vicinity of Maud Rise and along the continental slope (Polar Current);
- Assessing the intensity of the Weddell Gyre circulation using measurements across its western boundary current; and
- Study of the stability and meso-scale circulation of the front-current feature found east and north of Maud Rise.

2. (e) Shelf Slope Processes

Several major oceanographic problems related to the general circulation of the Southern Ocean must be studied on or adjacent to the continental shelf. This is the region where deep water is modified, where most of the preconditioning occurs prior to bottom water formation, and where most of the pack ice production and a major portion of glacial melting probably takes place -- all processes of climate significance. The slope front which occurs there may be of greater biological, if not physical, significance than the Polar Front. The area has been generally neglected by major chemical and physical programmes, and the operative oceanographic processes are not well understood.

Some examples of specific study areas are:

(i) Mixing processes within the shelf slope front and biological consequences;

(ii) Study of canyons and channels as sites for formation and outflow of dense waters; and

(iii) Interactions between open water and shelf ice and the water beneath ice shelves.

The study of exchanges between ice shelves may be approached with time series obtained from instruments moored along the shelf edge. Such measurements have begun along the Ross Ice Shelf and should be encouraged. Additional work at the shelf edge could be done from supply vessels during resupply periods.

2. (f) Sea-Level in the Southern Ocean

The global distribution of sea-level gauges shows a very high concentration in the northern hemisphere.* The dearth of suitable terrestrial locations at which to place tide gauges in the Southern Ocean hinders our understanding of the tidal regime in this ocean. Sea level measurements could also be of use in assessing the variability of circulation in the Southern Ocean, particularly poleward of the Antarctic Circumpolar current where the barotropic component is thought to be large.

The need for well-calibrated, high-quality sea-level measurements in the Southern Ocean has recently been stressed by a number of scientific bodies. The SCAR Working Group on Solid Earth Geophysics (1982) noted the need for an accurate geoid map of Antarctica so that heights above sea-level could in future be deduced from satellite doppler measurements; it therefore recommended that mean sea-level be determined at all antarctic bases. The Committee on Climatic Changes and the Ocean (SCOR/IOC) has in turn stressed the importance of long-term sea-level measurements of high quality to determine climatic trends in both sea level and in ocean currents.

We therefore recommend that all organizations which at present operate tide gauge installations in, or adjacent to, the Southern Ocean be urged to maintain and upgrade them. From a climatic point of view it is clear that the value of sea-level records is enhanced considerably by increased duration.

We would furthermore encourage all countries to urgently consider establishing high-quality sea-level measurement stations at their bases or ports in the Southern Ocean and adjacent areas. We also recognise the need for more long-term, scientific sea-level measurements at selected subantarctic islands and at suitable seamounts to monitor changes in the Antarctic Circumpolar and other currents.

We urge all bodies making sea-level measurements to supply copies of their records, both past and present, to the Permanent Service for Mean Sea Level (PSMSL) at the Institute for Ocean Sciences in the U.K. so that they may be accessible to the world scientific community. We commend the PSMSL and IOC for their efforts to establish a series of three-week training courses in sea-level measurement techniques. We recommend that invitations to attend such courses be extended soon to workers from countries adjacent to the Southern Ocean and that regular refresher courses be made part of this endeavour.

We believe it would be beneficial if the PSMSL were asked to become involved in the quality control and quality improvement of sea-level measurements made in the Southern Ocean. If they agree, funds should be made available to PSMSL for this purpose. Perhaps the SOC could take an active role in implementing these recommendations.

The use of tidal measurements for the study of long term trends in sea level and their relation to climatic variability is progressing. Further consideration should be given to the use of sea surface elevation measurements in improving our understanding of the general circulation of the Southern Ocean and its variability. Work in that direction is illustrated by the papers of McKee (1971)** and van Loon (1972)***

* Lutjeharms, J.R.E., and M.M. Alheit. 1982. *Long term sea level measurements: A Global Catalogue*, National Research Institute for Oceanology, CSIR Technical Report T/SEA 8210, 99 pp.

** McKee, W.D. 1971. "A note on the sea level oscillations in the neighborhood of the Drake Passage", *Deep-Sea Research, 18*: 547-9.

*** van Loon, M. 1972. "Half-yearly oscillations in the Drake Passage", *Deep-Sea Research, 19:* 525-7.

2. (g) Satellite Measurements

The immense area of the Southern Ocean means that even coarse-scale synoptic coverage would have to involve satellite monitoring of sea-surface elevation. The Subpolar gyres have weak baroclinic structure (typical top-to-bottom vertical shears being of the order of 1 cm/s), though the total transports are estimated to be appreciable. Thus, it should be possible to determine many features of the synoptic circulation directly from satellite altimetry without requiring an accurate (and therefore ground based) knowledge of the baroclinic structure as is required for other oceanic regions. Moreover, any synoptic description of ice cover can only be based on altimetry, combined with infrared or passive microwave imagery.

For these reasons, we recommend that altimetric satellite data coverage be planned to extend to latitudes of 78°S in order to include the entire Ross Sea.

APPENDIX I

SCOR Working Group 74 Membership

Dr. Roger Chesselet
Dr. Arnold Gordon
Dr. Ron Heath
Dr. Peter Killworth
Dr. K. Kusunoki
Dr. J.R.E. Lutjeharms
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Dr. E.I. Sarukhanyan
Dr. Walter Zenk
Dr. Konstantin N. Fedorov

APPENDIX II

Agenda for 17-18 February 1983 Meeting of SCOR Working Group 74
General Circulation of the Southern Ocean

I Opening Remarks and Adoption of Agenda

II Terms of Reference, Objectives and Membership of Working Group 74

- (a) Statement of Terms of Reference
- (b) Discussion of Working Group Objectives
- (c) Mode of Operation
- (d) Discussion of Membership

III Review of Previous Recommendations

- (a) Noting Background Documents
- (b) Summaries of Principal Documents/Recommendations

  SOC-I (1970), NAS (1974), CCCO/JSC Conference (1982), WCP-26 (1982)

IV Problems in Understanding the Southern Ocean Circulation

  Progress and Plans for Solutions
  Description of General Circulation Features, Dynamics of ACC,
  Consequences and Causes of Frontal Zones, Heat Budgets,...

APPENDIX II contd.

V General Recommendations for Future Research

VI Consideration of Programme Recommendations for SOC-IV

VII Assignments and Future Meetings

APPENDIX III

Partial List of Documents Reviewed by SCOR WG 74

SCAR-ACR (manuscript) "Requirements for further research relevant to an Antarctic contribution to the World Climate Research Programme", draft recommendations of SCAR Group of Specialists on Antarctic Climate Research based on meeting held during XVII SCAR in Leningrad.

BIOMASS Report Series No. 29 (1982) "Technical Group on Programme Implementation and Coordination", Report of Third Meeting, Bremerhaven, F.R.G., 27 Sept.-1 Oct. 1982

BIOMASS Report Series No. 30 (1982) "First Post-FIBEX Hydrographic Data Interpretation Workshop", Hamburg, F.R.G., 20-26 September 1982.

Gordon, A.L. (manuscript) "Polar Oceanography", prepared for 1983 IUGG quadrennial review.

SCAR/ACR (1981) "Basis for an Action Plan on Antarctic Climate Research", Report of the SCAR Group of Specialists on Antarctic Climate Research (Working Draft), Meeting at Cambridge, U.K., 18-22 May 1981.

U.S. National Academy of Sciences (1974) "Southern Ocean Dynamics; A Strategy for Scientific Exploration, 1973-1983", *ad hoc* working group on Antarctic Oceanography of Committee on Polar Research, Washington, D.C.

IOC Secretariat (1983) Announcement, Agenda and selected working documents for IOC/Southern Ocean Programme Group Meeting of 7-12 March 1983 (including "Ocean Science for the year 2000", report of an expert consultation organized by SCOR/ACMRR with the support of IOC and the Division of Marine Sciences of UNESCO).

SCAR (1982) Minutes of the meeting of the SCAR Working Group on Solid Earth Geophysics, 14-16 August 1982, Adelaide.

World Climate Programme-26 (1982) "The Role of Sea Ice in Climatic Variations", Report of the WMO/CAS - JSC - CCCO Meeting of Experts, Geneva, 24-29 June 1982.

CCCO (1982) *CCCO Updates*, June and December 1982.

Lutjeharms, J.R.E., and M.M. Alheit (1982) "Long-term Sea Level Measurements, A Global Catalogue", compiled for the CCCO, National Research Institute for Oceanology, CSIR Technical Report T/SEA 8210, Stellenbosch.

CCCO/JSC (1982) "Large-Scale Oceanographic Experiments in the World Climate Research Programme", Results of a Study Conference, Tokyo, 10-21 May 1982.

Zenk, Walter (1983) Background paper for SCOR WG 74 meeting on 17-18 February 1983, Institut fur Meereskunde, Kiel (F.R.G.).

ANNEX IX

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

INTRODUCTION

The CCCO was established jointly by SCOR and IOC in 1979 in order to develop the oceanographic component of the World Climate Research Programme. It is doing this in collaboration with the Joint Scientific Committee (JSC) for the WCRP of WMO and ICSU.

Between 1979 and early 1983, CCCO was actively developing its scientific programme. Various projects have been considered in detail and some have been submitted to feasibility studies or preliminary planning. A number of international meetings organized by CCCO have been instrumental in the development of this programme. These include conferences or workshops on such topics as satellite observations, time series of ocean measurements, ocean monitoring, mean sea level measurement and, especially noteworthy, a Study Conference on Large-Scale Oceanographic Experiments in the WCRP. As a result of these meetings and of the work of panels and sub-groups, the major aspects of the scientific programme for CCCO have now been defined and approved by both CCCO and JSC. The core programmes will include two large-scale oceanographic experiments and an extensive ocean observation system. CCCO is now entering a phase of detailed planning and experimental design prior to actual implementation of its scientific programme.

Both of the major experiments being proposed by CCCO involve oceanographic operations of a larger-scale and complexity than any ever before attempted. They will involve the newest technology and some of the more traditional means of making oceanographic measurements.

WORLD OCEAN CIRCULATION EXPERIMENT (WOCE)

The concept of WOCE grew out of the realization that the latest satellite instrumentation now permits the design of a truly global experiment to improve our understanding of the circulation of the world ocean and our ability to model it quantitatively. The lack of knowledge in this field has been identified by both CCCO and JSC as one of the most important limiting factors in meeting the objectives of the WCRP.

The purpose of WOCE is three-fold:

To obtain for the first time a first order picture or description of the general circulation of the world ocean, the relationships between horizontal and vertical motions throughout the interconnected waters of the earth's great water body, the transformation of water masses, and the order of magnitude of year-to-year variations in currents and water mass characteristics.

To gain a greater understanding of the transport of heat between low and high latitudes by the ocean waters and the related exchange of latent and sensible heat and radiation between the air and the sea.

To obtain data for the construction and verification of coupled ocean-atmosphere models of the general circulation of the ocean-atmosphere system.

A CCCO/JSC Scientific Steering Committee has been established under the chairmanship of Professor C. Wunsch (USA). This group has held a preliminary meeting at which nineteen technical issues related to WOCE were identified. Papers on these issues will be prepared before the first WOCE planning meeting which will be held in Woods Hole in August, 1983. The main purpose of the Woods Hole meeting will be to obtain agreement on a statement of the primary and secondary goals of WOCE, to agree on its major elements, and to consider the organization required for its implementations. Some of the major elements of WOCE are likely to be: world-wide observations of the windfield over the ocean using satellite scatterometers; sea surface height measurements by satellite altimeters; major shipborne programmes using traditional techniques for hydrographic and chemical tracer sampling; the use of very large numbers of deep drifting, "pop up" neutrally buoyant, satellite communicating floats for measuring physical parameters in situ; and the use of a very new technique, acoustic tomography, in the study of sub-surface temperature and velocity, and the development of a more mature and physically comprehensive general circulation model capable of representing the ocean's role in cliamte dynamics.

INTERANNUAL VARIABILITY OF THE TROPICAL OCEANS GLOBAL ATMOSPHERE (TOGA)

The objectives of TOGA are:

To determine the nature of the interannual variability of the tropical oceans and the global atmosphere.

To understand the mechanisms which determine the interannual variability and the predictability of the variations.

TOGA has been conceived in order to answer many questions arising from the recent realization that year-to-year variations in the tropical oceans and their overlying atmosphere are closely linked to world-wide climatic changes in the middle and high latitudes as well as to climatic events on land in low latitudes. Observations have shown that regular changes in atmospheric pressure between Australia and South America (the "Southern Oscillation") are related to changes in subsurface temperatures and sea level in the Equatorial Pacific. This and other such relationships are believed to be responsible for variations in the strength of the Indian Monsoon, droughts in Brazil and China, El Niño and other major climatic events.

The broad outlines of the TOGA experiment have been subjected to a feasibility study which has been reviewed by relevant panels within CCCO. A CCCO/JSC TOGA Scientific Steering Group has been established and is chaired by Dr. Adrian Gill, (U.K.). It will hold its first meeting in Hamburg in August, 1983 and will consider such topics as TOGA meteorological and oceanographic data requirements, monitoring schemes in support of TOGA-related experiments, on-going national programmes which might be usefully associated with TOGA, Monsoon Climate Programme and ocean circulation and coupled ocean-atmosphere models.

Early plans for TOGA involve fewer technological issues than WOCE since most of the techniques to be used are more traditional. While present plans for TOGA involve the use of satellite observations, the technology for these is better developed than those required for WOCE. TOGA could, in fact, be carried out without satellites, using land-based stations, should this be necessary. Preliminary requirements of TOGA call for the measurement of such parameters as sea surface and subsurface temperature and salinity, wind stress, sea level, and direct current measurements.

Both TOGA and WOCE will rely heavily on analytical and simulation modelling in order to plan for and guide observing programmes and to facilitate the analysis of the large amounts of data which will be collected. CCCO's own Modelling Panel and JSC's Working Group on Numerical Experimentation are encouraging these activities in cooperation with the Steering Groups for WOCE and TOGA. Two modelling meetings are planned in 1984 in support of these, and other, CCCO studies:

1) CCCO/JSC Symposium on Coupled Atmosphere-Ocean Models, 7-11 May 1984 (being held as the 16th International Liege Colloquium on Ocean Hydrodynamics)

2) CCCO/JSC Workshop on Modelling the Upper Ocean Boundary Layer for WCRP Objectives, 26-28 July 1984, Sendai, Japan.

Another sub-group of CCCO which has direct relevance to the two large-scale experiments is the newly established CCCO/JSC Satellite Working Group. It is anticipated that amongst other tasks this group will assist in the coordination of satellite requirements for the WCRP programmes and provide liaison between the groups planning experiments and the space agencies.

OCEAN MONITORING SYSTEM

The third part of the CCCO programme is intimately linked to the two large-scale experiments, but stands alone in that it will provide a wealth of information related to prediction of short-term climatic variability as well, and should continue to do so long after the experiments are completed. Monitoring according to CCCO, is "any open-ended time series of oceanic or atmospheric observations that is maintained on a routine and regular basis". CCCO has developed an "Action Plan for an Ocean Observing System" which has been endorsed by WMO and IOC but, at their request, is being revised for approval by CCCO later in 1983. The plan calls for routine observation, using land based stations, ships-of-opportunity, drifting buoys, tide gauges and expendable instruments of such parameters as sea surface temperature, heat content of the oceans, sea level, salinity, currents, wind stress, etc. A large number of on-going national and multi-national research programmes will be useful to CCCO in this light as well. The ocean observing satellites required for the ultimate success of WOCE and TOGA will not be available until the late 1980's. In the meantime, however, time series observations essential to both of the experiments could be routinely made.

While meteorologists have at their disposal long time series of data which provide a base for the prediction of atmospheric variability, very few adequate time series of observations exist which allow similar predictions for the oceans. Consequently, one aspect of the oceanographic component of the WCRP will be the promotion and development of ocean monitoring programmes which will provide sufficiently long time series for the recognition of significant trends in variability in the oceans. The techniques and instruments involved must be simple and relatively inexpensive if monitoring is to take place on a truly global scale. In many locations the individuals making the observations will not be trained oceanographers.

Some observing systems have already been identified as timely and feasible and CCCO is encouraging their implementation and/or expansion and continuation through the Member States. These include an expansion of the current programme of expendable bathythermograph observations, using tide gauges at coastal and island stations and measurement of surface and subsurface salinity and temperature near the tide gauges. A series of training courses for technicians involved in making sea level measurements is being organized by the Institute of Oceanographic Sciences in the U.K. CCCO has initiated the publication of a regular brochure on monitoring which is intended to encourage and foster enthusiasm for the rather routine tasks of monitoring and to provide those making measurements with information on data being collected elsewhere. The first volume of this "brochure", entitled "Time Series of Ocean Measurements (an annual review) - Vol. I, 1983" will be available later this year as IOC Technical Series Report No. 24.

PROGRAMME DOCUMENTATION

Following is a summary of CCCO programme planning and technical reports published since the XVI General Meeting of SCOR.

- CCCO Session Reports, III - 1982, IV - 1983.
- Long-Term Sea Level Measurements - A Global Catalogue by J.R.E. Lutjeharms and M.M. Alheit - July 1982.
- Report of the WMO/CAS-JSC-CCCO Meeting of Experts on the Role of Sea Ice in Climatic Variations - Geneva, 24-29 June 1982 - WCP-26.
- Large-Scale Experiments in the WCRP - Tokyo, May 1982.
    - WCRP Series No. 1, Vol. 1, June 1983 - Report of the Study Conference
    - WCRP Series No. 2, Vol. 2, Papers presented at the Study Conference- In Press.
- Report of the CCCO/JSC Study Group on Interannual Variability of Tropical Ocean and Global Atmosphere, WCP - 49, July 1983.
- Operational Sea Level Stations - D. Pugh, IOC Technical Series No. 23.
- Proposal for the Pacific Transport of Heat and Salt (PATHS) Programme - WCP - 51, July 1983.
- Time Series of Ocean Measurements: An Annual Review Volume I, 1983, IOC Technical Series No. 24 - In Press to be issued September/October 1983.
- Time Series Review by Baker/Tabata/Chelton. Being finalized by authors.
- CCCO Panel Reports
    - Tropical Atlantic Climate Studies - Yalta, June 1982
    - Tropical Pacific Climate Studies - Tokyo, May 1982
    - Tropical Atlantic Climate Studies No. 2 - Paris, February 1983
    - Indian Ocean Climate Studies - Paris, March 1983
- Report of the First Session (June 1983) of the JSC/CCCO Working Group on Satellite Observation Systems for Climate Research. In preparation.

ANNEX X

REPORT OF SCOR SCIENTIFIC RAPPORTEUR ON LAW OF THE SEA

Rapporteur: W. Wooster

Report on Matters Related to Law of the Sea

The United Nations Convention on the Law of the Sea was signed on December 1982 by 119 states; others have subsequently signed. Important holdouts at present include the United Kingdom, Federal Republic of Germany, and United States of America; with the exception of the United States which has rejected the treaty, they are expected to sign. The Convention will go into effect when it has been ratified by sixty states. Already the text is beginning to serve as a model for national policy, legislation, and regulations.

The essential provisions governing the conduct of marine scientific research are found in Part XIII, Section 3 of the Convention: a summary is attached. They apply primarily to the exclusive economic zone (out to 200 nautical miles) and on the continental shelf. Within these areas, the coastal state exercises essentially full jurisdiction over research conducted by investigators from other countries.

The regime is intended to ensure that coastal states share in the benefits of the research. It is hoped that the cooperation induced by interactions between the researching and coastal states will serve to strengthen the development of marine science in both.

It might be expected that for parties to the Convention, the marine science provisions will serve as a ceiling and that more convenient arrangements could emerge in the context of bilateral and multilateral agreements or in programmes of international organizations, as foreseen in the text (Articles 243, 247). How the conditions will be applied by coastal states to non-parties remains to be seen.

It is also too early to judge whether in practice the new regime will serve to promote or to restrict the development of marine scientific research. The experience of recent years with somewhat analagous conditions, perhaps exacerbated by the ongoing negotiations, has shown the potential for difficulties to arise. It is clear that access for research continues to be vulnerable to the state of political relations between the countries concerned.

It is important to evaluate the impact on research of the new conditions for its conduct as they come into force. While relevant information must initially be compiled at the national level, no country can fully appreciate the effect of its policies and practices on other countries, whether they be those whose ships wish to visit or those whose offshore areas are of research interest. Thus the pooling of information from many countries and its collective appraisal are indispensable. This sort of international cooperation can probably be carried out most effectively by a non-governmental scientific organization such as SCOR which could ask its national committees to obtain the necessary information and to participate in evaluation of the situation. I recommend that SCOR explore this possibility.

Summary of Marine Research Provisions

The essential provisions governing the conduct of marine scientific research in the exclusive economic zone and on the continental shelf are contained in Section 3 of Part XIII of the Convention. The major provisions are as follows:

Article 246: Research shall be conducted with the consent of the coastal State. That consent shall be granted "in normal circumstances" and coastal States are to establish rules and procedures to ensure that consent is not delayed or denied unreasonably. However, consent may be withheld under specified circumstances, particularly if the project "is of direct significance for the exploration and exploitation of natural resources, whether living or non-living", if it involves drilling, explosives, or introduction of harmful substances, or if the researching entity has provided inaccurate information concerning the project or has outstanding obligations from a prior project. Consent may not be withheld for research on the shelf beyond 200 miles except in areas that have been publicly designated as the location of exploitation or detailed exploration.

Article 247: A coastal State, through its membership in an international organization, is considered to have authorized access for participants in a research project of that organization if it had approved the project when it was adopted by the organization and if, within four months of notification by the organization, it had not expressed any objection.

Article 248: Researching entities* intending to undertake research shall, not less than six months prior to the expected starting date, provide the coastal State with a full description of the nature and objectives of the project, how it is to be done and with what ship and equipment, where and on what dates, and by whom. The extent of proposed coastal State participation is also to be stated.

Article 249: The researching entity shall comply with these conditions: ensure coastal State participation; provide preliminary reports and final results; on request, provide access to all data and samples; on request, provide an assessment of findings or assist in their assessment or interpretation; inform immediately of any major changes in the programme; remove installations and equipment when the research is completed. Results are to be made internationally available as soon as practicable, except that the coastal State may require prior agreement on this in the case of a project "of direct significance for the exploration and exploitation of natural resources".

Article 250: Communications concerning research projects shall be through official channels, unless otherwise agreed.

Article 252: The researching entity may proceed with a project six months after providing the information required under Article 248 unless within four months of receipt of that information, the coastal State informs that it has withheld consent, or that the information provided "does not conform to the manifestly evident facts" or that additional information is required, or that there are outstanding obligations from a previous project.

Article 253: The coastal State can require suspension of a project in progress if it is not being conducted in accordance with information provided under Article 248 or is not in compliance with Article 249, and may require cessation of the project if the non-compliance with Article 248 amounts to a major change in the project. Cessation may also be required if the noncompliance is not rectified within a reasonable time. The order of suspension is to be lifted when the research entity has complied.

* States or competent international organizations.

Article 254: Extends to neighbouring land-locked and geographically disadvantaged states the rights of being notified by a researching entity of an impending project and at their request, of being provided "when appropriate" with relevant information specified in Article 248, including any major change in the programme, of participating "whenever feasible" in the project with qualified experts "not objected to by the coastal State", and of being provided with information and assistance on the assessment ot interpretation of research findings, subject to that having been agreed by the coastal State.

While dispute settlement is provided, the coastal State need not accept (Art. 297,2) submission to dispute settlement of any question concerning its right to regulate research in the exclusive economic zone or on the continental shelf or to order suspension or cessation of such research. Such disputes can be submitted to conciliation, but the coastal State right to withhold consent for such reasons as that the research is of direct significance to resource exploitation cannot be questioned.

Note: Section 3 articles not summarized here are 251 on the establishment of general criteria and guidelines, 255 on measures to facilitate research and assist research vessels, 256 on research in the Area, and 257 on research in the water column beyond the exclusive economic zone.

ANNEX XI

SANDY BEACHES AS ECOSYSTEMS

by D. Ellis

An international symposium on Sandy Beaches as Ecosystems was held at Port Elizabeth, South Africa, January 17-21, 1983 and was hosted by the University of Port Elizabeth. Participants came from fifteen countries. The symposium was organised by the South African National Committee for Oceanographic Research (SANCOR) with the support and encouragement of SCOR in collaboration with the South African Council for Scienfific and Industrial Research, and the Department of Environment Affairs and Fisheries. The format consisted of three days of paper presentations, a continuing poster display, and two days of workshop sessions. These were grouped into five topics: physical aspects, chemical aspects, ecology, ecophysiology and autecology, and management. Each topic was introduced by an invited review in both paper and workshop sessions, and the workshop sessions terminated with comments by rapporteurs. There was a final panel discussion of needed research and management, ending with a recommendation that a second symposium be held in five years' time, preferably in the northern hemisphere.

A Proceedings will be published by the House of Junk (The Netherlands) and the deadline for return of manuscripts submitted and editorially reviewed prior to the symposium is March 31, 1983. Publication is expected this year. The broad coverage of the sessions, and the quality of many of the papers should ensure that these Proceedings will be a valuable reference work for scientists and managers involved with sandy beaches. However, the short time allowed for verbal presentation of papers (15 minutes plus 5 minutes questions) determined that little information was transmitted on sampling, technical and statistical details. Thus the onus is on editorial reviewers to ensure that needed information of this type is included in the Proceedings.

General conclusions reached by this Reporter are that the beach ecosystem can be recognised as having a core compartment, the wave-swept prism, but this is more or less open to adjacent compartments, especially the surf-zone, but also the dune zone, and laterally to sheltered estuarine and fine-grained beaches. Certain topics are currently the thrust of considerable research in institutions around the world, especially surf-zone phytoplankton blooms, and their role in sandy beach primary productivity and energy/materials dynamics. Other topics attracting interest were wave climates and physical impacts on particle dynamics and water percolation, beach categorisation by physical (energy dissipative or reflective) patterns, nutrient dynamics, organism (especially meiofaunal) particle relationships, and species strategies for feeding and sensing potential releasing and orienting stimulii. The management of the sand dune zone has proceeded substantially but pragmatically in view of social needs in many countries, whereas management principles are much less clear for the wave-swept prism and surf-zone. The well-known phenomenon of beach erosion following breakwater/groyne construction or other source interference still often causes externalising of impact costs, but fortunately waste dischargers appear in general to accept the concept of offshore rather than beach discharge, with a few exceptions, some of which were described. Accidents to offshore hardware can cause surf-zone and beach impact, and need adequate contingency responses.

One current area of marine research attracted few contributions and may reflect little present application to sandy beaches. This is the dynamics of trace chemicals, as nutrients and also as potential contaminants. Another topic which was conspicuously unrepresented in the submitted contributions was consideration of the voids between particles as habitat (following a surge of interest in the early 1970's) as opposed to considering particle shape and size as sediment parameters.

The final panel session stressed the need for inter-disciplinary teams to co-operate in identifying and answering important research questions, for studies of chemical processes rather than concentrations, for beach ecosystems to be investigated at any site through the interlinked compartments relevant at that site, for investigation of dune plant physiology and low energy beaches, and finally for integration of the concepts of energy and activity-time budgets. The management sessions indicated the need for coastal resource atlases, and effective information transfer channels between scientists, politicians and regulators. It was noted that wave energy extraction engineering can be expected to start soon, with presently unpredictable consequences for beach dynamics.

ANNEX XII

ABBREVIATIONS

AABW	Antarctic Bottom Water
AADW	Antarctic Deep Water
AAIW	Antarctic Intermediate Water
ACC	Antarctic Circumpolar Current
ACMRR	Advisory Committee on Marine Resources Research (of FAO)
ACR	Antarctic Climate Research (of SCAR)
BASS	Benthic Acoustic Stress Sensor
BIOMASS	Biological Investigations of Marine Antarctic Systems and Stocks
CAS	Commission for Atmospheric Sciences
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CCCO	Joint SCOR/IOC Committee on Climatic Changes and the Ocean
CDW	Circumpolar Deep Water
CMAS	Confederation Mondiale des Activités Sub-aquatiques
CMG	Commission for Marine Geology
CNC	Canadian National Committee (for SCOR)
CNEXO	Centre National pour l'Exploitation des Oceans (France)
CODE	Coastal Ocean Dynamics Experiment
COSPAR	Committee on Space Research
CPPS	(Chile/Equador/Peru): Permanent Commission for the South Pacific
CSIR	Council for Scientific and Industrial Research
CTD	Conductivity/Temperature/Depth
EBUC	Eastern Boundary Undercurrent Studies
ECOR	Engineering Committee on Oceanic Resources
ENIC	El Nino International Center
EPOCS	Eastern Pacific Ocean Climate Studies
ERFEN	Regional Study of the El Nino Phenomenon
EUBEX	Eurasian Basin Experiment
FAO	Food and Agriculture Organization (of the UN)
FIBEX	First International BIOMASS Experiment
FORE	Future Ocean Research
GAPA	Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
GEBCO	General Bathymetric Chart of the Oceans
GEMSI	Group of Experts on Methods, Standards, and Intercalibration
GESAMP	Group of Experts on the Scientific Aspects of Marine Pollution
GIPME	Global Investigation of Pollution in the Marine Environment (of IOC)
GSA	Geological Society of America
HEBBLE	High Energy Benthic Boundary Layer Experiment
IABO	International Association for Biological Oceanography
IAH	International Association of Hydrogeologists
IAHS	International Association of Hydrological Sciences
IAMAP	International Association of Meteorology and Atmospheric Physics
IAPSO	International Association for Physical Sciences of the Ocean
ICES	International Council for the Exploration of the Sea

ICL	Inter-Union Commission on the Lithosphere
ICSU	International Council of Scientific Unions
IGOSS	Integrated Global Ocean Station System (of IOC)
IOC	Intergovernmental Oceanographic Commission
IODE	International Oceanographic Data Exchange (of IOC)
IOS	Institute of Oceanographic Sciences (UK)
IREP	International Recruitment Programme
ISOS	International Southern Ocean Studies
IUCN	International Union for the Conservation of Nature and Natural Resources
IUGG	International Union of Geodesy and Geophysics
IUPAC	International Union of Pure and Applied Chemistry
JOA	Joint Oceanographic Assembly
JOIDES	Joint Oceanographic Institutions for Deep Earth Sampling
JPOTS	Joint Panel on Oceanographic Tables and Standards
JSC	Joint Scientific Committee (of WMO and ICSU)
LEPOR	Long-term and Expanded Programme of Oceanic Exploration and Research
MAB	Man and Biosphere Programme (of UNESCO)
NOAA	National Oceanic and Atmospheric Administration (of USA)
NSERC	Natural Sciences and Engineering Research Council (of Canada)
NSF	National Science Foundation (of USA)
OETB	Ocean Economics and Technology Branch (of UN)
ONR	Office of Naval Research (of USA)
OSLR	Ocean Science in Relation to Living Resources
OSNLR	Ocean Science in Relation to Non-Living Resources
PATHS	Pacific Transport of Heat and Salt (of CCCO)
PSMSL	Permanent Service for Mean Sea Level
RIOS	River Input to Ocean Systems
SAMW	Subantarctic Mode Water
SANCOR	South African National Committee for Oceanographic Research
SCAR	Scientific Committee on Antarctic Research
SCOPE	Scientific Committee on Problems of the Environment
SCOR	Scientific Committee on Oceanic Research
SIBEX	Second International BIOMASS Experiment
SL	Sea Level
SOC	Southern Oceans (Programme Group of IOC)
SOOP	Ship-of-opportunity Programme
SST	Sea Surface Temperature
STD	Salinity/Temperature/Depth
TOGA	Tropical Oceans and the Global Atmosphere (of CCCO)
TOPEX	Topographic Experiment
UN	United Nations
UNCLOS	United Nations Conference on the Law of the Sea
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
URSI	International Union of Radio Science
VACM	Vector Averaging Current Meter
VACOM	Aerial Vigilance of Atmospheric and Oceanic Conditions
VMCM	Vector Measuring Current Meter
WCP	World Climate Programme
WCRP	World Climate Research Programme
WESTPAC	Western Pacific
WMO	World Meteorological Organization (of the UN)
WOCE	World Ocean Circulation Experiment (of CCCO)
XBT	Expendable Bathythermograph