

SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH



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INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH

THE EXECUTIVE COMMITTEE

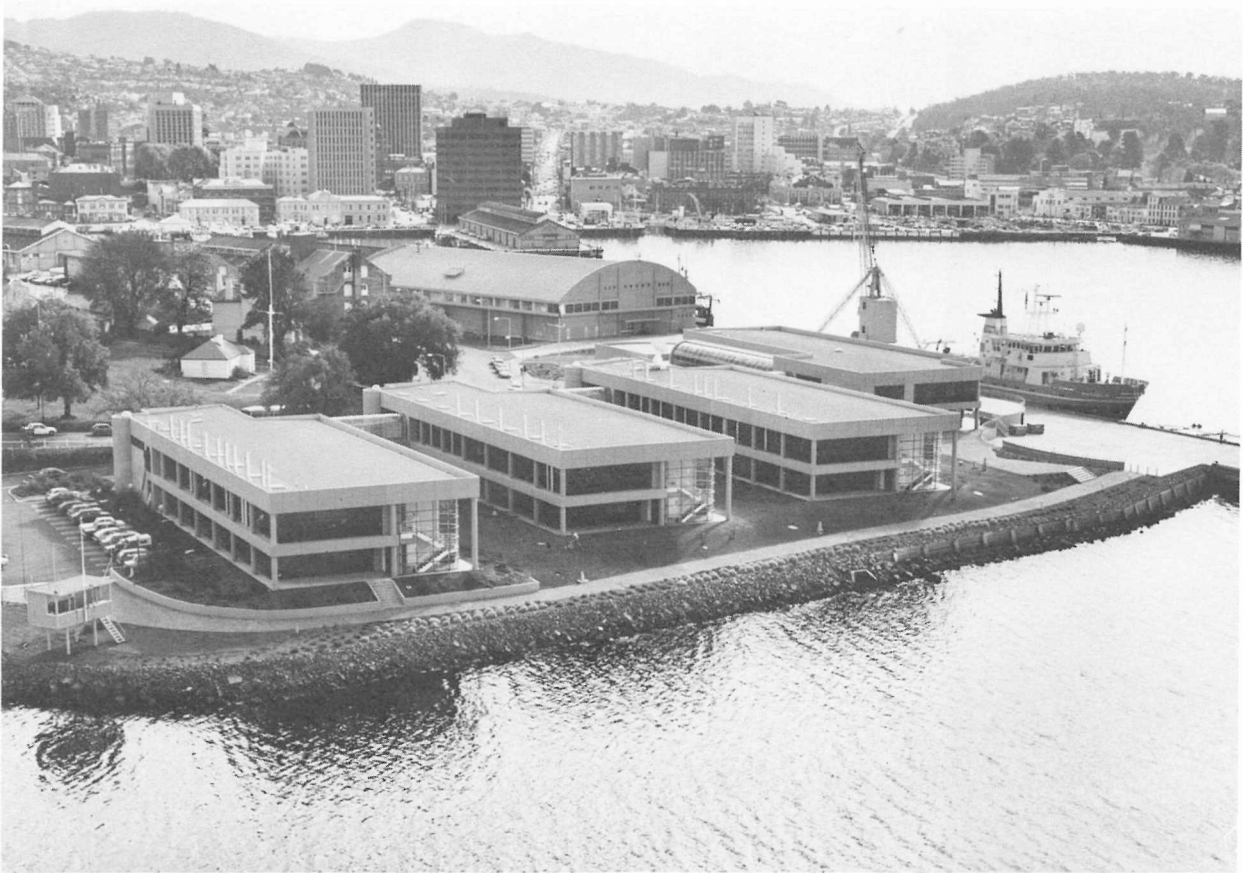
| | | |
|----------------------|--|--|
| President: | Professor G. Siedler Institut für Meereskunde Universität Kiel Düsternbrooker Weg 20 2300 Kiel FEDERAL REPUBLIC OF GERMANY | Tel: 49-431-597-3890 Telex: 0292619 ifmk d Telemail: G.Siedler Telegrams: MEERESKUNDE KIEL |
| Secretary: | Professor R.O. Fournier Department of Oceanography Dalhousie University Halifax, Nova Scotia B3H 4J1 CANADA | Tel: 902-424-8865 Telex: 258861 (USA,RCA) Telemail: R.Fournier Telegrams: OCEANOGRAPHY DALHOUSIE HALIFAX |
| Past President: | Dr. K.N. Fedorov Institute of Oceanology Academy of Sciences of the USSR 23 Krasikova Street Moscow 117218 U.S.S.R. | Tel: 95-124-5996 Telex: 411968 OKEAN SU Telegrams: OKEANOLOGIA MOSCOW |
| Vice-Presidents: | Dr. R. Chesselet CNRS-INSU/Oceanography 15 Quai Anatole France Paris 75700 FRANCE | Tel: 33-1-4555-9225 ext. 2302 Telex: 260034 CNRS Telemail: R.Chesselet |
| | Professor G.R. Heath College of Ocean and Fisheries Sciences University of Washington Seattle, WA., 98195 U.S.A. | Tel: 206-543-6605 Telemail: R.Heath |
| | Professor J.-O. Stromberg Kristineberg Marine Biological Station S-450 34 Fiskebackskil SWEDEN | Tel: 46-523-22007 |
| Co-opted Member: | Dr. A. Ayala Castanares Instituto de Ciencias del Mar y Limnologia Universidad Nacional, Autonoma de Mexico Apartado Postal 70-157 MEXICO, D.F. 04510 | Tel: 905-548-8206 Telex: 1760155 CICME Telemail: A.Ayala |
| Ex-Officio: CMG | Professor K. Hsu Swiss Federal Institute of Technology Geological Institute Sonnegstrasse 5 CH-8092 Zurich SWITZERLAND | Tel: 41-1-256-3669 Telex: 53178 ETH bi |
| IABO | Professor P. Lasserre Directeur, Station Biologique 29211 Roscoff FRANCE | Tel: 33-98-69-72-30 |
| IAMAP | Professor H.-J. Bolle Institut für Meteorologie WE 07 im FB Geowiss Freie Universität Berlin Dietrich-Schafer-Weg 6-8 1000 Berlin 41 FEDERAL REPUBLIC OF GERMANY | Tel: 49-30-838-3961 Telex: 183188 |
| IAPSO | Professor W. Krauss Institut für Meereskunde Universität Kiel Düsternbrooker Weg 20 2300 Kiel FEDERAL REPUBLIC OF GERMANY | Tel: 49-431-597-4491 Telex: 0292619 ifmk d Telemail: IFM.Kiel Telegrams: MEERESKUNDE KIEL |
| Executive Secretary: | E. Tidmarsh Department of Oceanography Dalhousie University Halifax, Nova Scotia B3H 4J1 CANADA | Tel: 902-424-8865 Telex: 258861 (USA,RCA) Telemail: E.Tidmarsh Telegrams: OCEANOGRAPHY DALHOUSIE HALIFAX |

INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

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

May, 1987

Halifax, Nova Scotia, Canada



The CSIRO Marine Laboratories, Battery Point, Hobart, Australia with the Research Vessel "Sir John Franklin" at dockside. Site of the XVIII General Meeting of SCOR, November 26 to 28, 1986.

SCOR Proceedings, Volume 22

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REPORT OF THE EIGHTEENTH GENERAL MEETING OF SCOR

Hobart, Australia

November 26 to 28, 1986

The Eighteenth General Meeting of SCOR was held at the CSIRO Marine Laboratories in Hobart, Tasmania, Australia, from November 26 to 28, 1986. It was preceded by an informal preparatory meeting of the SCOR Officers. The President of SCOR, Professor Gerold Siedler, presided over both meetings. A list of participants is given in Annex I.

The scientific component of the General Meeting was a symposium entitled, "Interfaces in the Ocean - A Preliminary View" which was organized and convened by Dr. Angus McEwan, Chairman of the Australian Committee for Oceanic Science and Director of the CSIRO Division of Oceanography. The scientific programme of the symposium, which took place on November 24 to 26, is given in Annex II.

The President opened the General Meeting by welcoming all the participants, especially the four representatives of the new Chinese Committee for Oceanic Research who were attending the first meeting of SCOR since their Committee was formed in 1985. He also expressed his congratulations to Dr. McEwan for the very successful symposium which he organized to complement the General Meeting.

Professor Siedler noted the deaths of two long time participants in SCOR activities, Professor Paul Tchernia and Dr. Adrian Gill. Professor Tchernia had been involved in SCOR affairs for many years, attending nearly every meeting between 1959 and 1980. He played an important role in the development of the International Indian Ocean Expedition, one of the major activities in SCOR's early years, and served as Vice-President from 1976 to 1980. Dr. Gill's many contributions to international marine science are well known by his colleagues. At the time of his death he was serving the SCOR community as Chief Editor of the well-known Ocean Modelling Newsletter and as Chairman of the JSC/CCCO Scientific Steering Group for TOGA. He had contributed to the development of the CCCO programme from its very early stages, both as a member of CCCO itself, and as Chairman of TOGA.

The meeting was also informed of the recent untimely death of Dr. Elvira Tan who had been one of the Nominated Members from the Philippines SCOR Committee for a number of years.

The participants rose to observe a moment of silence in memory of Drs. Tchernia, Gill, and Tan.

On a happier note, the President informed the meeting that one of the founding members of SCOR, Professor Roger Revelle, had recently been awarded the prestigious Balzan Prize for his achievements in science. The meeting agreed that its congratulations to Professor Revelle should be formally noted and conveyed to him as soon as possible.

Before proceeding to the business of the meeting, several minor changes were made in the order of items on the agenda. These are reflected in the format of this report.

1.0 ORGANIZATION AND FINANCE

1.1 MEMBERSHIP

The Executive Secretary informed the meeting of a number of changes in SCOR membership since the twenty-seventh meeting of the Executive Committee in September 1985:

Argentina:

Drs. N. Lanfredi, A. Yung and S. Olivier have been appointed by the recently reconstituted Comité Argentino de Oceanografía.

Australia:

Dr. J. Veron has replaced Dr. J. Bunt as a Nominated Member from the Australian Committee for SCOR.

Canada:

On January 1, 1987, Drs. A. Hay and B. d'Anglejan will replace Drs. A. Longhurst and K. Mann as Nominated Members of SCOR. Dr. d'Anglejan will assume the Chairmanship of CNC/SCOR.

Chile:

Captain F. Espinosa has replaced Captain H. Garcia as the Chairman of CONA, the Chilean Committee for SCOR.

India:

Professor K. Krishnamurthy has replaced Dr. A.A. Ramasastry as one of the Indian Nominated Members of SCOR.

Japan:

The three Nominated Members from Japan are now Professors T. Asai, R. Marumo and S. Okabe.

Mexico:

The three Nominated Members from Mexico are now Drs. Ayala Castanares, S. Alvarez Borrego and J. Adem.

Netherlands:

Dr. E.K. Duursma has been made a Nominated Member of SCOR following the retirement of Professor H. Postma. Dr. Ir. L. Otto is the third Nominated Member from the Netherlands Council on Oceanic Research.

Norway:

There are now three Nominated Members from the Norwegian SCOR Committee: Professor M. Mork, G.R. Hasle and T. Vorren.

Philippines:

Professor E.D. Gomez becomes a Nominated Member of SCOR following the death of Dr. Elvira Tan.

Switzerland:

Professor K. Hsu is now the second Nominated Member from the Swiss Commission of Limnology and Oceanography.

The President informed the General Meeting that he has had correspondence with the Vice-President of the Consejo Superior de Investigaciones Científicas of Spain regarding a renewal of Spanish membership in SCOR. The former Spanish Committee for SCOR was suspended

several years ago for non-payment of membership contributions. The former Spanish SCOR Committee was narrowly based, consisting of members from one institution only. There is now interest in forming a new Committee for Oceanic Research within the Consejo; however, the question of the outstanding debt for membership contributions remained unresolved. The General Meeting agreed that if an application for membership is received from a Committee which adequately represents Spanish marine scientists in all disciplines and in all types of institutions, this debt should be waived. The membership of the Spanish Committee will be considered to be a new one rather than a renewal of the membership of the former Spanish SCOR Committee.

The President reported that at the recent ICSU General Assembly, the membership of Colombia in ICSU had been re-established. At one time, there was a Colombian Committee for SCOR, although its membership was suspended several years ago for non-payment of membership contributions. Professor Siedler noted that he had discussed the renewal of Colombia's membership in SCOR in a very preliminary manner with the representatives of that country at the ICSU Assembly.

The category of Invited Member in the SCOR membership structure was discussed by the General Meeting. Several participants agreed that the original intent of this type of SCOR membership was to enable individuals in countries which did not have SCOR Committees to be involved in SCOR affairs. It was assumed that these individuals would, in turn, encourage the formation of Committees for SCOR in their countries. There are two Invited Members of SCOR at present; although each has been a member for more than ten years, there has been no apparent progress towards a broader involvement of their countries in SCOR. It was agreed that they should be contacted and invited to consider whether there is any possibility of membership in SCOR for the communities of marine scientists in the two countries involved. It was felt that the category of Invited Member is a useful one which should be maintained and used in the future as a means of increasing the breadth of the SCOR membership.

1.2 Publications

The Executive Secretary presented the following list of publications from SCOR activities which have appeared since the Executive Committee meeting in September 1985:

UNESCO Technical Papers in Marine Science

- No. 46 "Opportunities and Problems in Satellite Measurements of the Sea" The final report of SCOR WG 70.
- No. 47 "Research on Coastal Marine Systems." Report of the third meeting of the UNESCO/SCOR/IABO Consultative Panel on Coastal Systems.

The final report of SCOR/IABO/UNESCO WG 65, "Coastal-Offshore Ecosystem Relationships," has been submitted to UNESCO for publication as No. 48 in this series.

BIOMASS Publications

BIOMASS Report Series

- No. 40 "Post-FIBEX Acoustic Workshop." Frankfurt, F.R.G., 3 - 14 September 1984.
- No. 45 "Meeting of the BIOMASS Data Centre Advisory Group." Cambridge, U.K., 5 - 7 February 1986.

- No. 46 "Meeting of the BIOMASS Executive." Hamburg/Bremerhaven, F.R.G, 24 - 25 February 1986.
- No. 47 "Report of the Meeting of the SCAR Groups of Specialists on Seals." Seattle, Washington, U.S.A., 2 - 3 May 1985.
- No. 48 "Meeting of the BIOMASS Executive." San Diego, California, U.S.A., 19 June 1986.

BIOMASS Scientific Series

"Krill Review" - to be published late 1986

BIOMASS Handbook Series

- No. 21 "Identification Key and Species Description for Antarctic Squids" Takahashi Okutani and Malcolm R. Clarke (1985).
- No. 24 "A Guide to Foraging Methods Used by Marine Birds in the Antarctic and Sub-Antarctic Seas" P.C. Harper, J.P. Croxall and J. Cooper.
- No. 25 "Application of the Coastal Zone Color Scanner in Antarctic Waters" S.Z. El-Sayed, W.A. Hovis and C.C. Trees.
- No. 27 "Scheme for Classifying Aggregations of Antarctic Krill." Janusz Kalinowski and Zbigniew Witek.

CCCC Publications

Summary Report of the Seventh Session of CCCO, Paris, France, 14 - 21 January 1986. (includes report of the Fifth Session of the JSC/CCCC Scientific Steering Group for WOCE, 15-18 October 1985 - Cambridge, U.S.A.)

Time Series of Ocean Measurements, Volume 3 - 1986. IOC Technical Series, No. 31.

Report of the TOGA Drifters Planning Meeting, La Jolla, USA, 27 - 29 March 1985. WCP - 103.

Report of the Third Session of the JSC/CCCC Working Group on Satellite Observing Systems for Climate Research, Madison, USA, 29 April - 2 May 1985. WCP - 105.

Report of the Third Session of the JSC/CCCC TOGA Scientific Steering Group, La Jolla, USA, 22 - 26 April 1985. WCP - 107.

Report of the Fourth Session of the JSC/CCCC TOGA Scientific Steering Group, New Delhi, India, 10 - 14 February 1986. WCP - 120.

Report of the Workshop on Assimilation of Satellite Wind and Wave Data in Numerical Weather and Wave Prediction Models, Shinfield Park, UK, 25 - 26 March 1986. WCP-122.

International Conference on the TOGA Scientific Programme. WCRP Publication Series No. 4.

Scientific Plan for the World Ocean Circulation Experiment. WCRP Publication Series No. 6.

Report of the Fourth Session of the CCCO Panel on Tropical Pacific Ocean Climate Studies, Honolulu, USA, 12 - 14 November 1985.

Report of the Fourth Session of the CCOO Panel on Tropical Atlantic Ocean Climate Studies, Rio de Janeiro, 9 - 13 September 1985.

Report of the Sixth Session of the JSC/CCCO Scientific Steering Group for WOCE, Wormley, UK, 21 - 23 April 1986. In preparation.

Second Version of the International Implementation Plan for TOGA. In preparation for publication in late 1986.

Miscellaneous Publications

General Circulation of the Southern Ocean Status and Recommendations for Research. A [final] Report by SCOR Working Group 74. WCP - 108.

Report of the ICES/SCOR Working Group on the Study of the Pollution of the Baltic. Kalmar, Sweden, 1 - 3 April 1986. ICES Report C.M. 1986/E:38.

Biogeochemical Processes at the Land-Sea Boundary. P. Lasserre and J-M. Martin (eds.) 1986. Elsevier Oceanography Series No. 43. Lectures presented at the Scientific Seminar held in conjunction with the XVII General Meeting of SCOR, Roscoff, France, October 1984.

The proceedings of a symposium entitled "Vertical Motion in the Equatorial Upper Ocean and its Effects Upon the Living Resources and the Atmosphere," which was organized by WG 56 and took place in Paris in May 1985 are in press as a special volume of Oceanologica Acta.

The proceedings of a workshop on "Coastal-Offshore Ecosystems Relationships," which was organized by WG 65 and took place in San Francisco in April 1986 will be published by Springer-Verlag in early 1987.

The representative of the UNESCO Division of Marine Sciences, Dr. S. Morcos, drew the attention of the General Meeting to the new UNESCO policy concerning deadlines for manuscripts. Beginning 1 January 1987, due to stricter accounting procedures and tighter control being implemented by UNESCO in light of reductions in the organization's budget, shorter deadlines must be established (evenly distributed throughout the year) for submission of manuscripts to the organization's printing service. Therefore, when a given date is agreed upon for the delivery of a manuscript or camera-ready-copy to the Division of Marine Sciences the authors or editors should make every effort to adhere to that target date, since delays in submission may cause loss of funds and perhaps even cancellation of the document in question. Dr. Morcos requested that the pertinent SCOR Working Groups be advised of this new situation and that they be urged to fix and meet realistic deadlines for submission of manuscripts for publication by UNESCO.

Dr. Morcos was pleased to report that there has been a great deal of interest in the final report of WG 70 (UNESCO Technical Papers on Marine Science, No. 46) and that plans are now being made to have this report translated into all the official languages of UNESCO. This document, which is entitled "Opportunities and Problems in Satellite Measurements of the Sea" has been highly sought after, for both educational and scientific purposes.

The meeting then discussed several concerns regarding SCOR publications which were raised by the President and the Publications Officer, Professor Charnock. In particular, they felt that many publications arising from symposia, conferences, or workshops organized by working groups did not give sufficient recognition of SCOR as the sponsor of the activity. In many cases, contracts have been negotiated with publishers without reference to the Executive Committee and without assuring that complimentary copies will be made available for use by SCOR. While it was not the intention of the General Meeting

to develop a rigid policy for publications arising from SCOR activities, the Secretary and Executive Secretary were instructed to develop a set of guidelines on publications which would provide assistance to Working Group Chairmen in this matter. It was expected that these guidelines will be submitted for approval by the Executive Committee at its next meeting. It was also agreed that the Secretary should assume the responsibilities of Publications Officer (see item 1.4).

1.3 Finance

The Executive Secretary, speaking on behalf of the President and Secretary of SCOR who are responsible for the financial administration of SCOR under the terms of the Constitution, presented two financial documents which she had prepared. These included a comparison of the 1985 budget with the final financial statement for the year, (see Annex III) and a larger document which dealt with several aspects of the 1986 finances.

She noted that in 1985 substantial progress was made in the collection of arrears in membership contributions and that none were outstanding for years prior to 1985. In general, expenses were less than anticipated due to the postponement of several working group meetings; while the budget had allowed for total expenses on scientific and related activities of about \$270,000, the amount which was actually spent was \$170,000. Administrative expenses continued to be low, about 13% of the total budget. The balance at the end of 1985 was high again, as it had been in 1984 - \$139,500. The expectation of this large year-end surplus had led the Executive Committee to recommend, at its meeting in late 1985, that there should be no increase in Membership contributions in 1986.

The Executive Secretary then discussed 1986 finances. The 27th Executive Committee Meeting had approved a budget for 1986; however, it had also authorized the Executive Secretary to modify this budget in consultation with the President and Secretary, as seemed appropriate during the course of the year. She informed the General Meeting of the budgetary changes which had been made. The larger than expected beginning balance had made it possible to increase some commitments to working groups, in particular, WG 65 and 73 which had organized international workshops in conjunction with their final meetings. She presented an interim financial statement for the year 1986 to the end of October, and a projection of income and expenses to December 31, 1986. These documents showed SCOR's financial position to be favourable.

In accordance with the SCOR Constitution, the General Meeting appointed an ad hoc Finance Committee which was given the task of examining the financial records of SCOR, establishing a budget for 1987, taking into account the requests for financial support received from the Chairmen of SCOR Subsidiary Bodies, and recommending appropriate levels of membership contributions for 1988. Dr. J. Bradford (New Zealand) and Dr. J. van der Land (Netherlands) formed the Finance Committee and their report was presented by Dr. Bradford towards the end of the General Meeting. She reported that the Finance Committee found the financial records of SCOR to be in order and that it was satisfied that SCOR is in a very healthy financial situation, to the extent that membership contributions had not been increased for the 1986 financial year. Examination of the budget for 1986 and the interim financial statement for the year showed that the 1987 fiscal year will open with a balance of about \$113,000. Expenditure in 1986 will be about \$30,000 less than expected and half of this could be attributed to the lack of expenditure on JOA planning to date. Income of about \$300,000 is expected in 1987 which produces a total budget of about \$405,000. The budget proposed for 1987, takes into account requests received from subsidiary bodies for support, and other commitments made by SCOR. A total of \$187,650 was allocated to direct scientific activities in 1987 (meeting of subsidiary bodies), \$111,000 for related activities (representation at meetings of other organizations, publications, etc.), and \$53,000 for administrative costs. This would leave an estimated balance of \$53,000 on hand at the end of 1987, a figure which was considered appropriate (see report of XVI General Meeting) with which to begin activities in 1988.

It was noted by the Finance Committee, however, that in the budget for 1987, expenses will be \$60,000 higher than income. Clearly, the 1987 level of support for working group activities cannot be sustained.

The Finance Committee confirmed the recommendation of the 27th meeting of the Executive Committee that there should be a 10% increase in the level of membership contributions for 1987 and it suggested that a 5% increase be made in 1988. The Finance Committee also recommended that the 1987 budget be revised by the Executive Secretary, with the approval of the President and Secretary, in the light of future financial developments.

The President noted that at its General Assembly, ICSU had approved increases in membership fees of 5% for 1988 and 7% for 1989. The suggested increase for SCOR was, therefore, an appropriate one. He felt that regular, small increases are preferable to no increases followed by larger ones, such as would occur in 1986 and 1987.

The report of the ad hoc Finance Committee was approved by the General Meeting.

1.4 Elections

The twenty-seventh Executive Committee Meeting had appointed a Nominations Committee to receive and consider nominations for positions on the Executive Committee and report to the General Meeting. At the General Meeting, the terms of the three Vice-Presidents and the Secretary were due to expire. The Vice-Presidents were all eligible to serve another two year term, as specified in the SCOR Constitution. The Secretary, however, was not eligible for re-election, having served three terms. The nominations Committee was chaired by the President, Professor Siedler, and included Dr. T. Wolff (Denmark) and Dr. D.J. Baker (USA).

Professor Siedler reported that his committee had agreed that the Secretary of SCOR should be a respected scientist, familiar with SCOR affairs, and, if possible, located relatively close to the SCOR Secretariat. The Nominations Committee wished to support the nomination of Professor R.O. Fournier by the Canadian Committee for SCOR. The General Meeting agreed unanimously with the proposal of the Nominations Committee that the three Vice-Presidents be re-elected by acclamation and that Professor Fournier be elected Secretary, also by acclamation, there being no further nominations for the position.

The President also noted that Professor Charnock had served for four years as a co-opted member of the Executive Committee with special responsibilities as Publications Officer. This is the maximum term allowed under the SCOR Constitution. He informed the General Meeting that the Executive Committee would appoint new co-opted member(s) to the Executive Committee taking into account special tasks which may need to be fulfilled. This responsibility is granted to the Executive Committee by the Constitution.

1.5 Constitutional Review

Professor Siedler invited the General Meeting to consider whether a review of the SCOR Constitution is needed. He explained a number of concerns about the current Constitution. For example, it gave no guidance to the Officers as to procedures for replacing the former President when he died suddenly, while in office. The Officers of SCOR are not defined in the Constitution; for a number of years, meetings of the Executive Committee have been held less frequently than specified in the Constitution. These and a number of other possible weaknesses in the SCOR Constitution concerned the Executive Committee which recommended to the General Meeting that a review be carried out. If revisions are felt to be appropriate, proposals should be prepared in time for detailed consideration by SCOR Committees before the XIX General Meeting in 1988. The meeting

agreed that the Secretary and Executive Secretary should develop preliminary proposals on this matter for presentation to the Executive Committee at its meeting in 1987.

2.0 JOINT OCEANOGRAPHIC ASSEMBLY

2.1 Report from the President of SCOR

Professor Siedler reported to the General Meeting that, following the instructions of the twenty-seventh Executive Committee meeting in late 1985, discussions had continued with the Chairman of the Mexican Committee for SCOR about the Mexican invitation to host the Joint Oceanographic Assembly in 1988. These discussions had culminated, in mid-1986, in the receipt and acceptance by SCOR of a formal invitation from the Consejo Nacional de Ciencia y Tecnologia (CONACYT) which is the parent organization of the Mexican Committee for SCOR. Professor Siedler also reported that SCOR had moved to establish an international Scientific Programme Committee under the Chairmanship of Professor W. Wooster (USA), as had been agreed by the XVII General Meeting in 1984. The Affiliated Organizations of SCOR, the Mexican Organizing Committee, and ICSPRO were invited to nominate members to this committee (c.f. item 2.3 below).

2.2 Report from the Chairman of the Mexican Organizing Committee

Dr. Ayala Castanares, Chairman of the Mexican Committee for SCOR, informed the General Meeting about the preliminary arrangements which have been made for JOA-88. The Acapulco Convention Center has been selected as the site of JOA, an earlier choice in Mexico City having been destroyed in the 1985 earthquake. A Mexican Organizing Committee has been established with Dr. Ayala as Chairman. This committee will be advised by the Mexican Committee for SCOR as needed. He announced that the first circular was ready for distribution and that a second, more detailed circular would be prepared in early 1987.

The representative of IOC and UNESCO, Dr. Morcos, informed the meeting that these bodies intend to provide significant financial support for the JOA, for both travel and publications. A meeting of ICSPRO was to take place in February 1987, at which support for the JOA by other UN agencies would be discussed.

2.3 Report from the Chairman of the Scientific Programme Committee

Professor Wooster also described the procedures followed in the establishment of the Scientific Programme Committee. The General Meeting agreed with his concern about the nominations received from the organizations involved. It was felt that any committee which would be established on the basis of these nominations would have insufficient international representation, and the Scientific Programme Committee had, therefore, not been formally constituted. It was agreed that the nominees of the Affiliated Organizations and their Officers should now serve as advisors to a formal Scientific Programme Committee which would consist of one representative of each Affiliated Organization, one from the Mexican Organizing Committee (Dr. Ayala), one from the ICSPRO Logistics Committee (Dr. Ruivo), and one to be coopted by SCOR as needed, in order to ensure broad geographical representation. The draft programme which Professor Wooster presented to the General Meeting had been developed in consultation with these initial nominees. He had also consulted with this group in determining the timetable for the JOA and the General Meeting approved of his proposed schedule as follows:

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| Tuesday, August 23 | - | SCOR Officers meeting, meetings of other organizations Opening Ceremonies |
| Wednesday, August 24 to Friday, August 26 | - | Scientific Programme |
| Saturday, August 27 | - | SCOR XIX General Meeting |
| Sunday, August 28 | - | Free |
| Monday, August 29 to Wednesday, August 31 | - | Scientific Programme |
| Thursday, September 1 | - | SCOR Executive Committee Meeting, other meetings |

The General Meeting discussed, in detail, how Professor Wooster's proposed programme could best be implemented so as to avoid some of the problems of former JOA's. It was agreed that the Scientific Programme Committee should be responsible for the development and organization of the whole programme which will consist of General and Special Symposia and Association Sessions. For the General Symposia, which are intended to be broad interdisciplinary reviews of current topics in marine science, papers will be invited by the convenors in consultation with the Scientific Programme Committee. For Special Symposia, which will have cross-disciplinary topics, a general call for proposals to present papers will be issued in early 1987. From these proposals, the convenor, in consultation with the SPC, will select those that will give the best balanced and most interesting coverage of the topic. The Association Sessions will be the most specialized; papers and posters for these sessions will be selected from those submitted in response to the call for papers referred to above. Titles and abstracts submitted will be sent to the appropriate Association representative for selection for oral presentation. It was expected that a very large number of contributed papers would be assigned for presentation in poster format, the facilities in Acapulco being especially well designed for this purpose.

5.3 International Council of Scientific Unions

[This item was brought forward in order that participants could be informed of the latest developments in the ICSU International Geosphere Biosphere Programme before they moved to the discussion of the activities of SCOR Subsidiary Bodies.]

Professor Siedler reminded the General Meeting that the activities of ICSU in developing plans for a major international study of Global Change (also known as the International Geosphere-Biosphere Programme, IGBP) have been the subject of discussions at the last two meetings of SCOR. (See SCOR Proceedings Vol. 21.) ICSU had established an ad hoc planning committee for IGBP which was to report to the ICSU General Assembly in Bern in September 1986, at which time a decision would be taken as to whether to proceed with IGBP. SCOR had responded to the requests from this committee for information on SCOR activities relevant to preliminary plans for IGBP and had informed ICSU that, in general, SCOR was strongly in favour of the proposal for IGBP. The ICSU ad hoc committee prepared a detailed report for the ICSU General Assembly. Professor Siedler reported that he had attended the Assembly and that this report was favourably received. ICSU agreed to establish a Special Committee for the Geosphere-Biosphere Programme (SCGB) in order to develop formal plans for IGBP. SCOR had been invited to submit nominations of scientists as candidates for membership in SCGB and the participants in the General Meeting agreed that this should be done by the Officers immediately following the meeting. It was also agreed that SCOR should keep in close touch with developments in IGBP and should consider on a continuing basis how SCOR

can best contribute to this programme and how it can most appropriately provide scientific input to the planning process.

7.0 Other Business

[The Executive Committee introduced a new agenda item relating to global ocean flux studies. This item was brought forward in order that it could be brought to the attention of the General Meeting before the discussion of the activities of certain working groups and CCCO.]

A Proposal that SCOR Sponsor a Meeting to Discuss a Coordinated International Study of Ocean Fluxes

The Executive Secretary introduced a proposal which had been submitted to SCOR just before the General Meeting. It arose from discussions at meetings of both CCCO and the IOC Working Committee for GIPME which had been followed by consultations between the Chairman of the U.S. Committee for the Global Ocean Flux Study (GOFs), the Chairman of GIPME, the Secretary of CCCO, and herself. These had resulted in the following formal proposal:

PURPOSE

The global geoscience programmes now emerging contain elements focussing on both the physical circulation of the ocean (WOCE), and its interaction with the atmosphere (TOGA), as well as on the major biogeochemical cycles. In this latter area, programmes such as the U.S. Global Ocean Flux Study (GOFs) and others being developed in countries such as France, U.K., F.R.G., and Japan have quite similar goals and scientific needs. Yet no suitable international mechanism exists which will permit the coordination and unification (where appropriate) of such scientific activities. Nor is there any means of establishing lines of communication between these programmes or between them and the relevant intergovernmental programmes. The purpose of the proposed meeting is to seek the advice of experts currently active in this field on the matter of formulating such an international programme and framework for cooperation and collaboration.

The subject has been discussed previously at WC/GIPME VI for the purpose of establishing lines of communication between the emerging global geoscience programmes and the IOC/GIPME Programme, and more recently between N. Andersen (Chairman, WC/GIPME), P. Brewer (Chairman, U.S. GOFs Executive Committee), B. Thompson (Secretary, CCCO), and E. Tidmarsh (Executive Secretary, SCOR) with regard to establishing an international mechanism for GOFs collaboration/cooperation using a structure already in place (i.e. SCOR), and looking, in the future, to using the offices of ICSU/IGBP for this purpose. This proposal is a result of this latter discussion, but it is also meant to provide input for GIPME and CCCO considerations.

OBJECTIVES

It should be the goal of this meeting to:

- review and state the important scientific goals and content of an international ocean flux programme and to identify the goals and activities which are common to the various national programmes.
- examine appropriate mechanisms for bringing such an international programme into being and for monitoring its activities. [It should be noted that these activities would be consistent with the aims and interests of several proposed and existing international bodies such as the newly formed ICSU Special Committee for the Geosphere Biosphere Programme.]
- devise both short and long term plans to assist with the execution of such a scientific programme.

VENUE

The international nature of the meeting as well as the probable locations of the participants suggest that London or Paris would be an appropriate site. This would make it possible to request the good offices of The Royal Society or ICSU to assist in convening the meeting by making available suitable facilities. With regard to timing, it is hoped that the meeting could be convened in January or February, so as to provide an opportunity for N. Andersen to inform IOC XIV in March 1987 of developments, and for B. Thompson to report to the CCCO Officers in March 1987 and to CCCO-8 in May 1987.

PARTICIPANTS

The potential participants will be identified by the SCOR Executive Committee in consultation with the Chairmen of GIPME and CCCO. Representatives of planned and ongoing national GOFs programmes should be included as well as representatives of relevant international organizations. [end of proposal]

Participants in the General Meeting were pleased to note that this proposal reflected comments which had been made by Dr. Chesselet and others at the last SCOR Executive Committee meeting, urging SCOR to play a lead role in the coordination of planning for global ocean flux studies as more countries become involved in individual national programmes in this field. (Readers are referred to SCOR Proceedings Vol. 21, page 11.) The General Meeting of SCOR, therefore, approved the proposal which calls for the advice of experts currently active in the study of major biogeochemical cycles on the matter of formulating an international programme and an appropriate framework for scientific cooperation. It was of the opinion that the meeting of these experts should also consider the relationships between GOFs-type programmes and other major oceanographic experiments such as WOCE and TOGA, as well as the newly-established International Geosphere-Biosphere Programme of ICSU. The General Meeting felt strongly that the proposed meeting should be held at ICSU Headquarters, Paris, if space is available, so as to emphasize the potential links between an international study of ocean fluxes and IGBP. It advised the Executive Committee that the participants in the meeting should be selected because of their involvement in an ongoing or planned national programme of ocean flux studies, because they are familiar with related international activities (CCCO, SCOR Working Groups, etc.), or in the expectation that their attendance at this meeting would enable them to inform the oceanographic communities in their countries about the plans for such an international programme, and to encourage the development of additional national studies. The President proposed that SCOR invite Dr. D. James Baker (USA) to chair this meeting because of his experience in the early stages of development of several other international programmes. He also suggested that Dr. Chesselet be SCOR's representative in the meeting, that he be consulted when its agenda and scientific content are determined, and that E. Tidmarsh assume responsibility for organizing the meeting and for mobilizing the financial support which had been promised by the Chemical and Biological Oceanography Programs of the U.S. National Science Foundation. The General Meeting agreed with these suggestions.

3.0 SUBSIDIARY BODIES

3.1 Former Working Groups

WG 46 River Inputs to Ocean Systems

Dr. Chesselet reported that the draft final report of WG 46, which had been tabled at the last meeting of SCOR, had now been further developed so that it is nearly ready for

publication by UNESCO. Dr. Burton, the Chairman of WG 46, has agreed to proceed with the final editing. A publication deadline for this volume will be established between Dr. Burton and Dr. Morcos of UNESCO.

WG 51 The Evaluation of CTD Data

The General Meeting shared the concern of Professor Charnock, the Publications Officer, at the continuing delay in the publication of a volume to have been prepared by WG 51. It was agreed that Dr. Crease should be urged to complete the editing of this volume as soon as possible or to return the manuscript to the Publications Officer. The representative of UNESCO noted that his organization would provide funds to support a meeting of two or three people in order to complete the preparation of this volume which is now urgently needed by the JPOTS Editorial Panel for an Oceanographic Manual.

3.2 Existing Working Groups

WG 42 Pollution of the Baltic (with ICES)

A meeting of the SCOR/ICES Working Group on Pollution of the Baltic took place in Kalmar, Sweden in April 1986. At this meeting, the group reviewed the progress which had been made in several ongoing projects. These included the Baltic Sediment Study, the Patchiness Experiment, and the Baseline Study on Contaminants in Fish and Shellfish. At the request of SCOR, WG 42 also reviewed a proposal by Dr. O. Avaste to establish an interdisciplinary programme of sea-atmosphere optical monitoring above the Baltic as a representative basin (SEAMAB). The full report of the WG 42 meeting has been distributed to SCOR Committees and is available from ICES as ICES report C.M. 1986/E:38.

The Chairman of the ICES Consultative Committee, Professor Wooster, reported that the ICES Statutory meeting in October 1986 had passed a resolution which called for the merging of the SCOR/ICES Working Group on the study of Pollution in the Baltic with the ICES Working Group on Hydrography of the Baltic so as to form a new group which will be entitled "The Baltic Marine Environment". The Resolution called upon the General Secretary of ICES to invite SCOR to cosponsor this group. Professor Wooster noted that the terms of reference of the new group are very broad, unlike those of other SCOR Working Groups. The meeting was also reminded by various members of the Executive Committee that WG 42 is the oldest SCOR Working Group in existence and that it had been agreed at earlier SCOR meetings that once the Patchiness Experiment and two other activities of WG 42 were well underway or completed, SCOR should reconsider its cosponsorship of the group. It was agreed, therefore, that SCOR should discontinue its cosponsorship of WG 42 at this time and that it would not cosponsor the new ICES group. In informing ICES of this decision, however, the continued interest of SCOR in these and related ICES activities will be expressed.

WG 54 Southern Ocean Ecosystems and their Living Resources (with SCAR, IABO, ACMRR and IOC)

The report of the Chairman of WG 54 was introduced by Dr. Longhurst. It appears as Annex IV to this report. He reviewed the activities of the group since the last meeting of SCOR. The field phases of the BIOMASS Experiment having been completed, these related largely to a series of BIOMASS data analysis workshops which are being organized in the period between 1986 and 1989. This series of workshops will culminate in a final BIOMASS Evaluation Meeting in 1989. Dr. Longhurst reminded the General Meeting that the Executive Committee had agreed in 1985 that WG 54 should be disbanded and that this phase of analysis and synthesis of BIOMASS data could be organized by the BIOMASS Executive Committee. He noted that this recommendation accorded with the decision of SCAR to dissolve the main group. Accordingly, it was agreed to disband WG 54. As one of the sponsors of the BIOMASS programme, however, SCOR will continue to provide a modest

amount of financial support to SCAR in order to assist with this final phase of the BIOMASS programme. SCOR will designate representatives to the data workshops as appropriate in order to ensure that physical and chemical oceanographers participate in the analysis of the BIOMASS data.

The representative of SCAR, Dr. Budd, reiterated the importance of the data analysis portion of the successful BIOMASS programme. He noted that a permanent BIOMASS Data Centre is now operational at the British Antarctic Survey.

WG 56 Equatorial Upwelling Processes (with IOC and UNESCO)

The meeting was reminded, by Dr. Fedorov as Executive Committee Reporter, that in 1985, WG 56 had organized a symposium entitled "Vertical Motion in the Equatorial Upper Ocean and its Effects upon the Living Resources and the Atmosphere." The Executive Committee had agreed, at its meeting in 1986, that WG 56 should be disbanded. The papers presented at this symposium are being published, after scientific review, as a special volume of Oceanologica Acta. In addition, a brief summary of the symposium, together with the abstracts of papers presented, will be published and distributed to a wider audience as an IOC Workshop Report. Since the Chairman of WG 56, Dr. H. Rotschi, had retired from his position and was unable to provide a final report of the working group, it was agreed that the Oceanologica Acta volume should stand as the final report of the WG 56. The General Meeting agreed to disband the group.

WG65 Coastal-Offshore Ecosystem Relationships (with UNESCO)

A summary of the activities of WG 65 since its establishment in 1980 was submitted to the General Meeting by the Chairman, Dr. Zijlstra. It is given in Annex V. It includes a large number of recommendations for future research in various fields of coastal biology. There were no firm proposals for immediate action by SCOR and the Executive Committee suggested that they be reviewed first by the UNESCO Division of Marine Sciences in light of its COMAR programme. These recommendations may then lead to formal proposals for new SCOR activities.

The Executive Committee Reporter for WG 65, Dr. Stromberg, noted that the group had organized a workshop on Coastal-Offshore Ecosystems Relationships in San Francisco in early 1986. There were twenty-four participants from ten countries. Professor Postma expressed his view that the WG 65 workshop had been successful in that it had provided a unique opportunity to bring together scientists working on both the east and west coasts of North America with those from Europe. A major topic of discussion at the workshop was the implications for ecological research of the varied ways in which scientists have been defining the boundaries of the ecosystems they study. It is expected that the workshop proceedings will be published by Springer Verlag in mid-1987. Dr. Stromberg also reported that the final report of the working group had been submitted to UNESCO for publication as No. 48 in the Technical Papers in Marine Science. The General Meeting agreed that WG 65 should be disbanded, its terms of reference having been discharged.

WG 66 Oceanographic Applications of Drifting Buoys (with IOC)

The Chairman of WG 66, Dr. G. Cresswell, presented his report which is given as Annex VI. Most members of the group had last met informally in 1985. He reported that the group had identified the "problems of merging data from drifters of different design," but that the group would require some new members and a new Chairman if it was to address these problems and others associated with the varied responses of drifting buoys to wind and current conditions. He suggested that the working group design an experiment which would compare and intercalibrate drifting buoys using a vessel equipped with acoustic Doppler equipment. The Chairman of IAPSO, Professor Krauss, reiterated the urgent need for such an experiment, especially in view of the fact that the number of drifting buoys

in use is now about 1,500 and is apparently increasing by about fifteen per cent per year, according to information presented at a recent ARGOS meeting. The implementation of WOCE in the near future will make such intercalibration even more necessary. The representative of WMO, Dr. J. Zillman, expressed his hope that SCOR would agree to Dr. Cresswell's proposal as did the Chairman of the SCAR Antarctic Climate Research Group, Dr. Budd. The General Meeting concurred with these opinions as to the need for an intercalibration exercise. It felt, however, that the changes proposed for WG 66 were substantial enough that the group should be reconstituted as WG 88, with the title "Intercalibration of Drifting Buoys", and the following terms of reference:

To design procedures for determining the current-following effectiveness of various drifting buoy systems.

To analyse and report on the results of applying such procedures by investigators world-wide.

To identify recent scientific and technological advances with drifting buoys.

Following a discussion about the difficulties of archiving buoy data and of ensuring its quality, it was agreed that WG 88 should focus first on questions related to the current measuring capacities of drifting buoys before addressing data related problems.

WG 68 North Atlantic Circulation (with ICES)

The President of SCOR presented the final report of WG 68 (see Annex VII) and noted that a large part of the activities of the group had been conducted in collaboration with the WOCE Numerical Experimentation Group with which it had some members in common. In particular, the model intercomparisons initiated by WG 68 will be continued and expanded by WOCE NEG and the observational programmes recommended by WG 68 will be considered in the planning of WOCE. The General Meeting concurred with Professor Siedler that WG 68 had completed its terms of reference and should be disbanded.

WG 69 Small-scale Turbulence and Mixing in the Ocean (with IOC)

The Chairman of WG 69, Dr. K.N. Fedorov, reported that during 1986 his working group had been involved in preparations for the 1987 Liege Colloquium for which some members of WG 69 had formed the programme committee. The Colloquium will take place at the University of Liege in May 1987. The programme committee had met in London just before the General Meeting and had finalized the programme for the colloquium, which will be followed by a meeting of WG 69.

In the meantime, other members of WG 69 have continued their work on a glossary of terms and definitions used in turbulence studies. While in Hobart, Dr. Fedorov had an opportunity to discuss the second draft of this document with Dr. T. McDougall. Some clarifications were agreed upon which should permit the third draft to be distributed to WG 69 members prior to the Liege Colloquium. It was recognized, however, that it was unlikely that it would be possible to reconcile the various points of view at this stage. Therefore, Dr. Fedorov thought it would be advisable to wait for the results of the WG 69 meeting in May before finalizing the glossary.

WG 70 Remote Measurement of the Oceans from Satellites (with UNESCO)

Professor Charnock informed the General Meeting that the final report of WG 70 ("Opportunities and Problems in Satellite Measurements of the Sea") had been published by UNESCO in early 1986. The report has been extremely well received as a useful overview of the field of satellite sensing of the oceans and UNESCO is now considering publishing it

in the other official UN languages. The General Meeting confirmed the decision of the twenty-seventh meeting of the Executive Committee that WG 70 be disbanded.

WG 71 Particulate Biogeochemical Processes (with UNESCO)

Dr. Chesselet, The Executive Committee Reporter for WG 71, noted that the second meeting of WG 71 had taken place at Cambridge University in April 1986 and that a good report had been submitted to SCOR by the Chairman, Dr. Krishnaswami. This report was distributed to SCOR Committees. As requested by the Executive Committee, WG 71 had established liaison with the planners of the Global Ocean Flux Study and recommendations for international cooperation in the field of flux studies were included in the Chairman's report. Dr. Krishnaswami will be one of the participants in the meeting on International Scientific Planning and Coordination of Global Ocean Flux Studies which will be convened by SCOR in February 1987.

The Chairman of WG 71 had requested in correspondence that the group be given approval to organize an international symposium on particulate biogeochemical processes and fluxes of materials through the water column in 1987 or a JOA session on particle production and export from the euphotic zone and particle transformation in the euphotic zone. It was agreed, however, that before proceeding further with these activities, the group should receive the results of the international planning meeting referred to above. The subject of ocean fluxes had already been incorporated into the programme for the JOA by Professor Wooster.

WG 72 The Ocean as a Source and Sink for Atmospheric Constituents (with IOC)

In introducing the report of WG 72 (see Annex VIII), Dr. Chesselet stated that the symposium on air-sea exchanges which the group had organized in Mainz, FRG, in March 1986 had been highly successful. He expressed the hope that the results of this symposium would be published. WG 72 had held a formal meeting at the time of this symposium and Dr. Seiler's report identified four topics upon which the group had agreed to focus its attention in the near future. These are:

The improvement and development of techniques for measuring transfer velocities at the air-sea interface.

Studies on the role of atmospheric input of nutrients on marine productivity and ocean fluxes.

Studies on the role of photochemical processes in the air-sea exchange of chemical species.

Studies on the role of biological activities in the exchange of trace constituents between the ocean and the atmosphere.

Detailed reports of the work proposed on each of these topics were annexed to Dr. Seiler's report. A change in Chairmanship was suggested by Dr. Seiler as were membership additions, two members of the group having resigned. The General Meeting agreed with these suggestions and agreed that Dr. M.Q. Andreae should be invited to assume the Chairmanship of WG 72. The group will be encouraged to proceed in the directions proposed in Dr. Seiler's report and approval was given for a meeting of WG 72 in 1987.

WG 73 Ecological Theory in Relation to Biological Oceanography (with UNESCO)

Dr. J. Field, a member of WG 73 and leader of its sub-group on Flow Analysis (see below), elaborated upon the report which had been submitted by the Chairman, Dr. K. Mann.

Dr. Field reminded the meeting that the XVII General Meeting had approved two main activities for WG 73. One of these was a workshop on Flow Analysis which had been organized by a sub-group of WG 73 headed by Dr. Field. This workshop was to take place in Santa Cruz, California, immediately after the General Meeting and just before the final meeting of WG 73. Various ecosystem models were to be tested against existing data sets. WG 73 had found that techniques such as loop analysis, input-output analysis, information networks, and dynamic network analysis have emerged as a family of techniques ranging from qualitative to quantitative and possibly predictive methods which were grouped under the generic term "flow analysis." The sub-group was established to explore these techniques and their utility in developing ecosystem theory. Sets of data on whole marine ecosystems were solicited from a large number of contributors. These were used by a small group which met in the UK in November 1985 to test and improve the programs for flow analysis which had been developed by its members. In particular they evaluated the four techniques of flow analysis referred to above by comparing similar data from several ecosystems, using the same measures and indices, and searching for patterns. The workshop on Flow Analysis was then planned to compare different ecosystems using a range of techniques to elucidate patterns and relationships between the various measures and techniques available, and their usefulness in improving our understanding of ecosystems. The proceedings of the workshop will be published by Springer Verlag in 1987 following editing by a small group (Mann, Field, Wulff).

Another sub-group of WG 73 was established under the Chairmanship of Dr. L. Legendre in order to promote integrated biological and physical studies of well-defined energetic oceanic interfaces such as fronts, ice-water, and sediment-water interfaces which appear to be associated with enhanced biological productivity. This group's proposal for a series of integrated studies was to be considered in detail by the full working group at its final meeting in December. This would take place in conjunction with AGU/ASLO meetings in San Francisco at which a special session on "Mechanisms responsible for the biological productivity of marine interfaces" will be chaired by Dr. Legendre.

The General Meeting agreed that WG 73 could be disbanded, but that a small editorial group (Mann, Field, Wulff) should be maintained in order to complete the editing of the Workshop proceedings for Springer Verlag. SCOR agreed to support a meeting of this group in 1987, should it be necessary.

WG 74 General Circulation of the Southern Ocean (with IOC)

The General Meeting was pleased to note that the final report of WG 74, "General Circulation of the Southern Ocean: Status and Recommendations for Research", had been published in the WCP report series of WMO in mid-1986. It will be of particular interest to the planners of the World Ocean Circulation Experiment, which is a principal activity of the WCRP related to climate variability and prediction over decadal time scales. It was noted that the Southern Ocean plays a prominent role in the zonal exchanges between the other oceans as a region of major heat loss to the atmosphere and as the site of formation of much of the subsurface water of the global ocean. An improved knowledge of its circulation is critical for many advances in physical oceanography and climate studies. This is an important goal of WOCE Core Project 2 which focusses on the Southern Ocean. The General Meeting agreed that WG 74 should be disbanded.

WG 75 Methodology for Oceanic CO₂ Measurements (with UNESCO)

The Executive Committee Reporter for WG 75, Dr. Chesselet, reviewed the history of this working group and informed the General Meeting that, in his opinion, the group is now dealing well with its primary task of addressing methodological questions related to CO₂ studies.

The General Meeting considered a report from the Chairman of WG 75 in which he summarized the discussions which took place at a meeting of the group in September 1985. These focussed on two major issues:

Interface with the CCCO-CO₂ Advisory Panel and interface with JPOTS on CO₂ standards. For the first topic, the need was for a clear division of labour between the CCCO-CO₂ Panel and SCOR WG 75. It was agreed between SCOR and CCCO that WG 75 would concentrate on the technical aspects of oceanic CO₂ measurements while CCCO CO₂ Panel on the scientific questions. To prepare for input of the group in the first CO₂ Panel meeting in October, 1985, WG 75 revised the 1984 network design with updates by its members, particularly on the new programmes of France in Indian Ocean and Atlantic Ocean and the Japanese Programme in the Pacific Ocean. Three types of sampling schemes were designed: (a) network stations: in key regions to obtain reliable understanding of seasonal variabilities and regional secular increase in oceanic CO₂, (b) special cruises: reaching all the key regions of the world to establish large-scale oceanwide spatial variations and global secular changes in oceanic CO₂, and (c) ships-of-opportunity: providing more complete coverage of the above and also in remote but oceanographically important areas. These key regions, where an integrated international programme needs to be established to study the oceanic carbon variations, are (i) the equatorial belt 10°S - 10°N, (ii) the subtropical gyres, (iii) the high latitude circulation systems, and (iv) coastal zones of high variability.

Interface with JPOTS was the second major topic. WG 75 expressed the need to fit the plans for CO₂ standards and intercalibration into a time table of the SCOR oceanic CO₂ monitoring network and the CCCO WOCE/TOGA programmes. A review of existing expertise and preparative work on CO₂ was made. The precision requirements for the standard reference materials were established. SCOR WG 75 would cooperate with a proposed JPOTS sub-group on CO₂ standards to create the standards and to carry out international an calibration exercise.

Dr. Chesselet noted that a sub-panel of JPOTS has been established to deal specifically with the work involved with the preparation of the various reference standards required for CO₂ analyses and intercalibration of instruments and techniques. He expressed his thanks, on behalf of the SCOR Executive Committee, to Dr. S. Morcos of the UNESCO Division of Marine Science for the part he had played in arranging for the establishment of this important group. The sub-panel includes members from WG 75 and it is expected that there will be close collaboration between JPOTS and WG 75 in this work on standards for CO₂ measurements.

Dr. Wong's report also sought approval for a meeting of WG 75 to be held in 1987, possibly in association with the IUGG Assembly. He proposed that this be the final meeting of WG 75 and that the group would consider the following items:

- Contents and time table of the final WG 75 report.
- Organization of a CO₂ intercalibration exercise.
- Progress on creation of oceanic CO₂ standards jointly with JPOTS.
- CO₂ sampling and analytical manuals for SCOR oceanic CO₂ monitoring network.
- Organization of a pilot regional monitoring network as a feasibility study.
- Interface with WG 71 on combined network design under GOFs, WOCE and SCOR.
- Publication format, policy, and financing of final report.
- Options after WG 75: Disbanding, continuing, merging with other group, or formation of a new group.

The General Meeting approved this request for a final meeting of WG 75.

WG 76 Ecology of the Deep Sea Floor (with IOC)

A report from the Chairman of WG 76 is given in Annex IX. Following its first meeting in 1985, the group had been asked by SCOR to refine its terms of reference so that they identify more specific problems in the field of benthic ecology which the working group would be able to address in a reasonable time period. It was agreed that the original terms of reference assigned by SCOR were too broadly stated to give sufficient guidance to WG 76 as to what was expected of it. The new terms of reference as proposed in Annex IX are intended to provide a much more focussed set of objectives than did the earlier ones. The General Meeting approved the following statement which was presented by the Executive Committee:

Recognizing the great technical and statistical difficulties of obtaining adequate information on the deep sea benthic ecosystem, the WG will draft a critical review of the present state-of-the-art clearly identifying what would be desirable but presently impracticable to do. The review should pay particular attention to the following proposed terms of reference:

To make recommendations on the extent and type of information necessary to describe deep-sea benthic and benthopelagic communities to enable significant future changes, from whatever cause, to be detectable.

To identify those areas of research in which current knowledge or technology are not adequate to enable these recommendations to be fulfilled.

To identify those areas of research relevant to the above, which would be best tackled by international collaboration.

From this review, SCOR will be able to identify the extent to which deliverables from ecological research in the deep ocean benthic ecosystem will fall short of what is apparently demanded by current concerns for the continued health of this system. It was agreed that WG 76 would begin this work in correspondence during 1987.

WG 77 Laboratory Tests Related to Basic Physical Measurements at Sea (with UNESCO)

The first meeting of WG 77 had taken place in Rostock-Warnemunde, GDR, just prior to the General Meeting. The report of this meeting was made available in time for the General Meeting and appears as Annex X. The group established a set of priorities for the types of sensors it wishes to test and compare and it agreed to organize two laboratory workshops in order to carry out these intercomparisons. At one of these, to be held at the Institut fur Meereskunde of the Academy of Sciences of GDR in Rostock-Warnemunde, CTD sensors which can be removed from their host instruments ("separable CTD systems") will be tested and intercalibrated. The intercomparison of whole CTD's will be carried out at the Institute of Applied Physics of the University of Kiel where a larger pressure tank facility will allow whole instruments to be immersed. The working group expected that these workshops would take place in 1987 at no cost to SCOR since the instruments and technicians for the tests will be supplied by interested institutions. The General Meeting approved this plan of work and also agreed to the request of WG 77 that it hold a formal meeting to assess the results of the workshops in late 1987 or early 1988. The Chairman of WG 77, Dr. Striggow, asked for assistance in identifying a Soviet member for his group and the Executive Secretary was instructed to contact the USSR Committee for SCOR on this point.

WG 78 Determination of Photosynthetic Pigments in Seawater (with UNESCO)

A report of the first meeting of WG 78, which took place early in 1986, was submitted to SCOR and appears as Annex XI. Dr. Longhurst reviewed the content of this report and of a briefer one submitted to the General Meeting by the Chairman of WG 78, Dr. Mantoura. The objectives of the WG 78 meeting were to refine the group's terms of reference, to identify gaps in its expertise, and to establish a plan of action in order to achieve the methodological aims of the working group within the time and resource constraints placed on the group. Members of WG 78 also prepared and presented "mini-reviews" of their fields of expertise in relation to the objectives of WG 78. The main recommendations of WG 78 were accepted by the General Meeting. These included minor revisions to the terms of reference as follows:

To critically evaluate the accuracy of historical data and of existing methods for the determination of photosynthetic pigments in seawater including an appraisal of the SCOR/UNESCO spectrophotometric procedures published in 1966 and their intercalibration in the 1978 evaluation (UNESCO, 1980) for the determination of chlorophylls and their breakdown products in relation to novel chromatographic techniques.

To evaluate extraction conditions and storage requirements prior to analysis of individual component chlorophylls, their breakdown products, and accessory pigments.

To evaluate and recommend the simplest high performance liquid chromatographic (HPLC) system for ship-board or field-based determination of chlorophylls a, b, c, and their principal degradation products.

To provide advice on the establishment and provision of reference chloropigments, carotenoid, and phycobiliprotein standards for calibration of HPLC-fluorescence or absorbance methods.

To evaluate procedures for the extraction and determination of phycobiliproteins, recently identified as important constituents of phytoplankton in marine water.

To relate and intercompare measurements of individual chlorophylls and their breakdown products to in situ fluorescence recordings and remotely sensed colour imagery.

The working group adopted a plan of intersessional work to be completed before an intercalibration workshop which it plans to hold in late 1987. This workshop will carry out a critical comparison between HPLC and the existing methods of pigment analysis.

After lengthy considerations by the WG, the CSIRO Marine Laboratory was chosen as the site of the workshop because of the availability of the necessary equipment, reference algal cultures, reference chlorophyll standards, and expertise in the preparatory isolation of pigments. The availability of Dr. Jeffrey and her team at Hobart will ensure that all aspects of previous SCOR/UNESCO intercalibrations are replicated precisely and thus methodological continuity is maintained. The Hobart workshop is provisionally scheduled for December 1987. The General Meeting endorsed these plans.

The representative of the Division of Marine Sciences of UNESCO reiterated the interest of his organization in these activities as a cosponsor of WG 78. He committed some financial support to the activities of WG 78 in the 1987-88 period.

WG 79 Geological Variations in CO₂ and the Carbon Cycle (with IOC)

WG 79 held its first meeting at Woods Hole in September 1986 during the Second International Palaeoceanography Congress (see Annex XII). The group recognized that it would benefit from the addition of a member with expertise in the geologic record of terrestrial variations in the CO₂ cycle, the consensus being that land plants and soils should not be ignored in an assessment of global carbon cycle variations. The General Meeting agreed with the proposal of the Chairman of WG 79 that such an individual be invited to join WG 79. It also agreed to a request from WG 79 that SCOR cosponsor a symposium in 1987 on "The Global Carbon Cycle : Palaeoclimatic Perspectives" which is being organized for the INQUA Congress in Ottawa in August 1987. The Chairman of WG 79, Dr. Sundquist, is co-convenor of the symposium which will include several members of WG 79. The next meeting of WG 79 will be held in conjunction with this symposium. Both the symposium and the working group meeting will emphasize Quaternary time scales (10³ to 10⁶ years); it is expected that the focus of WG 79 will then shift primarily to longer time scales (10⁶ to 10⁹ years) on the basis of isotope signals. The conclusion of WG 79 after its first meeting was that simple mechanisms cannot account for the glacial-interglacial variations in CO₂.

During the discussions of WG 79's report, it was pointed out that the terms of reference assigned to the group are too vague. The representative of the French Committee for SCOR, Dr. Labeyrie, was of the opinion that problems of different time scales need different approaches involving different methodologies. In addressing questions relating to variations in time scales of the order of thousands of years, one is dealing with oceanic time scales for which models can be generated. It is not clear whether the evidence of CO₂ variations found in ice cores can also be seen in sediment cores which provide records of much longer time periods. It was agreed that the working group should be asked to consider revisions to its terms of reference which would more clearly define the important questions to be addressed and the way in which this can best be achieved (whether through the production of a final report or other significant publication, organization of an international meeting, or some other appropriate activity).

WG 80 The Role of Phase Transfer Processes in the Cycling of Trace Metals in Estuaries (with UNESCO)

Dr. Chesselet reminded the General Meeting that WG 80 was established by the Executive Committee at its last meeting, based on a recommendation in the final report of WG 46, River Inputs to Ocean Systems. Dr. M. Whitfield (UK) subsequently accepted SCOR's invitation to chair WG 80 and the following individuals have agreed to serve as members:

| | | | |
|--------------|-------------|-------------------|---------|
| J. D. Burton | UK | B.L.K. Somayajulu | India |
| T.M. Church | USA | R. Wollast | Belgium |
| J.C. Duinker | FRG | J.M. Wood | USA |
| K.A. Hunter | New Zealand | Yu Guohui | China |
| J.M. Martin | France | | |

A preliminary report from the Chairman was considered by the General Meeting. He plans to have WG 80 begin work on its first two terms of reference in correspondence in preparation for the first meeting of the group in early 1988. Members will provide discussion papers on the following topics:

The influence of particle-water interactions on the cycling of redox-sensitive elements, on the cycling of radionuclides, and of non-redox sensitive trace elements in estuaries.

The characterization of estuarine particles.

The concept of residence time and reaction time in estuaries and their importance for interpreting particle-water interactions.

The significance of particle-water interactions in tropical and sub-tropical estuaries - the influence of seasonal effects.

Microbially mediated particle-water interactions in estuaries - water column processes and processes in the settled sediments.

The importance of particle-water interaction in the cycling of trace metals in the major estuaries of South East Asia.

The report of the Chairman of WG 80 was approved.

WG 81 Deep Water Palaeoceanography (with IOC)

WG 81 met for the second time during the Second International Palaeoceanography Conference in Woods Hole in September 1986. The group also fulfilled one of its terms of reference by presenting a session at the conference which addressed aspects of change in deep-water circulation in the geologically recent past - the last 100,000 years or so - during which there have been no significant changes in the physical boundaries of the ocean. The overall conclusion of the session was that, contrary to many previous opinions, the deep ocean has been affected at least as much as the surface ocean by glacial-interglacial climatic change. The papers presented at the conference will be published in the AGU journal, Palaeoceanography.

At the meeting of WG 81 itself, future plans were discussed. An urgent need for better interaction between palaeoceanographers and the community of physical oceanographers was identified and WG 81 proposed to SCOR that a workshop be organized for the purpose of bringing these groups together.

The Executive Committee Reporter for WG 81, Professor Heath, summarized the opinions expressed during the discussion at the General Meeting. There was general support for the desire of WG 81 to develop interactions with physical oceanographers, however, it was considered that this task needs to be better defined. In particular, Professor Heath felt that the oceanic general circulation models offer the best long term prospects for rigorous progress in deep water palaeoceanography, and that there are modellers who would be interested in this type of collaboration. While more descriptive interactions may help to enhance geologic intuition, they may lead to speculative interpretations which are not very useful unless they generate testable hypotheses. As a result, it was agreed to invite the Chairman of WG 81, Dr. Shackleton, to develop a more specific proposal for this workshop and to present it to the next meeting of SCOR in 1987 for consideration. It could then be held in 1988, possibly in conjunction with the JOA.

WG 82 Polar Deep Sea Environments (with IOC)

The first meeting of WG 82 took place in Woods Hole during the palaeoceanography conference referred to above. The group came to the general conclusion that it may not be feasible to address its first term of reference ("to assess Mesozoic and Cenozoic polar deep sea palaeoenvironments with emphasis on processes in the northern and in the southern hemisphere") because of a lack of information from sufficiently old sediment cores in the polar regions. A brief report from the Chairman also noted that WG 82 has played a role in the planning for drilling during the Southern Ocean legs of the Ocean Drilling Programme and that some members are involved in a feasibility study for high Arctic Ocean drilling. A preliminary suggestion was made that the group organize a "Polar Oceans Conference" in 1988. The General Meeting agreed that the Chairman of WG 82 would be asked to provide more information on this proposal and on his plans for future activities of the group leading

up to the conclusion of its work within a reasonable time period.

3.3 Committees and Panels

Joint SCOR/IOC Committee on Climatic Changes and the Ocean

The Chairman of CCCO, Dr. R. Stewart, presented a report which was submitted to the SCOR Secretariat by the Secretary of CCCO and is reproduced in Annex XIII. He supplemented this with information on recent developments in the CCCO programme. He reaffirmed the close connections between CCCO and SCOR, the Committee's founding organization. The level of activity within CCCO has become very complex as can be seen from the Secretary's report, and in the last year or two, this activity has "moved from words to deeds" as scientific plans are actually implemented in the form of major experiments, monitoring programmes, and so on.

As an example of this, Dr. Stewart noted that TOGA has been underway since early 1985, that many measurements are being taken, analysis and theoretical interpretation is being accomplished in "quasi-real time," and the programme has attracted a lot of international participation. The sea level network in the Pacific Ocean has been considerably expanded (the IOC-WMO IGOSS Sea-Level Pilot Project in the Pacific - ISLPP) and drifting and moored buoy programmes are now in place. He reported that although further improvements have yet to be made to the observational programmes in the Atlantic and Indian Oceans, changes in the USSR Sections Programme are providing better coverage in the tropical Atlantic and progress is being made in increasing the number of XBT lines in the Indian Ocean. Dr. Stewart expressed the hope that the move of the TOGA International Project Office from Boulder to Geneva, certain staff changes, and the death of Dr. Gill, the Chairman of the TOGA SSG, would cause only brief setbacks to this vigorous programme.

With regard to WOCE, Dr. Stewart was pleased to report that the Scientific Plan for WOCE had recently been published by WMO. He reviewed the development of the three WOCE Core Projects. The first will provide a global "snapshot" or description of the world ocean on a nearly synoptic time scale. The second focusses on the Southern Ocean, and on the Antarctic Circumpolar Current in particular. The process of deep water formation in this region is a major concern and will be at least partially dealt with in WOCE. The third Core Project is a study of gyre dynamics using the North Atlantic basin as a testing ground since it shows most of the features of a whole ocean such as a source of deep water formation, a western boundary current, and eddies. Dr. Stewart reported that WOCE planning is proceeding quickly and that the satellite instruments so vital to the success of the programme will apparently be available on schedule.

A third aspect of the CCCO programme is the Ocean Observation System Development Programme. Dr. Stewart emphasized that this is a "system development" activity rather than an operational one. He noted some technical advances especially with regard to measurement of currents using backscatter from acoustic ship logs. He also noted new developments in the design of pop-up drifting buoys. Some problems have been encountered with regard to the archiving and management of data, however, Dr. Stewart felt that these would prove to be relatively minor obstacles. Access to EEZ's for the purposes of measurements of boundary currents, may prove to be a more serious problem which will require considerable effort to resolve.

The interactions between CCCO and the ICSU Geosphere-Biosphere Programme are discussed elsewhere in this report. The problem of the build-up of CO₂ in the atmosphere was an early motivation behind the WCRP and CCCO is beginning to consider oceanic aspects of this topic. While a CO₂ programme had been developed for incorporation into WOCE, the Committee wished to take into account forthcoming decisions with regard to IGBP and GOFs before proceeding further along these lines.

Dr. Stewart reported that he and the President of SCOR have collaborated in the selection of new members for CCCO and that they would shortly be working with the Vice-Chairman of CCCO, Dr. McEwan, and the CCCO Secretary in selecting a replacement for Mr. Thompson who has resigned his position as Secretary of CCCO, effective in early to mid-1987. He expected that they would make a nomination, for approval by the Director General of UNESCO early in the New Year. The representative of the IOC expressed the hope of the IOC Secretary that this position could be refilled as soon as possible and that no vacancy would occur.

Finally, Dr. Stewart referred to a letter he had written to the President of SCOR following the Seventh Session of CCCO, in which he requested the assistance of SCOR in promoting the prompt submission by scientists to national and international data centres of data which may contribute to TOGA and WOCE. He recognized that several factors deter scientists from making their data more readily available to the general oceanographic community, but that incorporation of these data into the data sets held by the WDC's is crucial to the success of TOGA and WOCE. This topic generated lengthy discussions in the General Meeting with a wide spectrum of views being expressed. The overall consensus was that SCOR should make a statement of principle regarding the exchange of data since international cooperation depends on the full and timely exchange of data of known quality. In joint programmes such as TOGA and WOCE, data exchange was felt to be an explicit responsibility of the individuals who are formally involved in these programmes. However, it was recognized that it is equally important to obtain data from related projects, even when they are not a formal part of these major joint experiments. The General Meeting concurred with the view of Professor Wooster that in the absence of data and information exchange we will never be able to understand how the ocean works.

The General Meeting gave its provisional approval to a statement, drafted by Professor Charnock and pending revision by the SCOR Officers for transmission to CCCO before its Officers Meeting in March 1987, on the subject of data exchange in relation to the WCRP. The revised statement reads:

"In response to a request from the Chairman of CCCO, the General Meeting discussed questions related to the availability of data for the large-scale experiments such as TOGA and WOCE which are part of the WCRP. In particular, SCOR has been invited to consider how best to promote the prompt submission to data centres of the various types of data required for the success of these experiments. The meeting shared the concern of Dr. Stewart and his Committee that large amounts of data which are relevant to oceanic studies are being collected, yet are not reaching the interested users. It was agreed that the international exchange of oceanographic data is a basic requirement in marine science and should be furthered by appropriate mechanisms.

It was recognized that non-submission of data is a recurring problem; in spite of the efforts of NODC's, IGOSS and IODE, many individual oceanographers continue to reserve their data for their own use for long or indefinite periods of time. While realizing that certain types of raw data do require considerable time and effort to be processed and reduced to a generally usable form the Meeting agreed that most data ought to be submitted to data centre more quickly than at present. It was also agreed that further efforts are needed if the scientific community is to reduce the waste involved in the collection of data which are used for restricted goals or by small groups of individuals. After considerable discussion, the General Meeting proposed that:

- Data sets collected by scientists in projects formally linked to CCCO programmes should be submitted to data centres according to guidelines which should be developed on the basis of the experience gained during the GARP experiments, and that

- SCOR Committees should be requested to identify scientists who would be willing to augment the work of their national data centres (or similar organizations) using their familiarity with the data sets available, or likely to become available, in their countries. They should be respected senior scientists who have a general appreciation of what is needed for the success of the large-scale international oceanographic experiments. They should be charged to encourage observers to make their data available to the international scientific community. It is hoped that they would be able to assure the observers that by submitting their data they will be making an important contribution to the progress of global oceanography.

The cost of such an effort would be negligible compared to the cost of the collection of even small amounts of oceanographic data. SCOR wished to assist in the realization of the full value of data collected at great expense by ensuring that it is used to the benefit of the international scientific community. It was emphasized that this effort should be carried out in cooperation with the NODC's and taking into account the functions of intergovernmental groups which have been established to deal with data management".

Joint SCOR/UNESCO/ICES/IAPSO Panel on Oceanographic Tables and Standards

Professor Krauss presented a brief report which had been submitted by the Chairman of JPOTS, Dr. Gieskes. The activities of JPOTS since the previous meeting of SCOR have centred on three main activities. The first of these was a meeting of the JPOTS Carbon Dioxide Sub-Panel which has continued its evaluation of the thermodynamic information available on the CO₂ system. Dr. Gieskes expected that the final report of this sub-panel would be submitted to UNESCO for publication late in 1986. Another activity of JPOTS has been the establishment of a new Sub-Panel on Standards for CO₂ Measurements (see also the discussion of WG 75). All of the JPOTS cosponsors were involved in determining the terms of reference and membership of the sub-panel. The terms of reference for this sub-panel are:

Coordination and assessment of work done towards preparing CO₂ standards for oceanic measurements.

Development of recommendations for the production and use of such standards.

The membership of the sub-panel, which includes two members of WG 75, is:

| | |
|------------|---------------------|
| A. Dickson | USA (SCOR) Chairman |
| F. Culkin | UK (IAPSO) |
| A. Poisson | France (ICES) |
| C. S. Wong | Canada (SCOR) |
| F. Millero | USA (UNESCO) |

The sub-panel is expected to hold its first meeting during the IUGG Assembly in Vancouver in August 1987. It will be encouraged to meet in a joint session with WG 75 at this time.

Dr. Morcos, the representative of UNESCO, reported on the first meeting of the JPOTS Editorial Panel on an Oceanographic Manual that took place in Moscow in June 1986. See Annex XIV for a report of this meeting which was submitted by the Chairman of the Editorial Panel, Dr. O. Mamayev. A more extensive report, which describes the intended format and content of the manual in detail, will be published by UNESCO as part of a technical report on 1983-86 JPOTS activities. The Editorial Panel will meet again in 1987 and hopes to conclude its work on the oceanographic manual in 1988. It will be entitled "Manual on Processing Oceanographic Station Data" and UNESCO plans to publish it in its series UNESCO Monographs in Oceanographic Methodology.

Editorial Group for the Ocean Modelling Newsletter

The Ocean Modelling Newsletter was originated by SCOR WG 49 over a decade ago. With continued funding from the Office of Naval Research (USA), the Newsletter has produced about eight issues per year, with issue number 72 having been published at about the time of the General Meeting. Its popularity continues to increase with a circulation of about 735 copies. The production of the Ocean Modelling Newsletter was moved to Oxford during 1986, when Drs. Gill, Killworth, and Davey joined the Hooke Institute there; printing and distribution are still carried out from Cambridge for cost reasons. Following the death of the Chief Editor, Dr. A. Gill, in April 1986, the editorship and the ONR grant were transferred to Dr. P. Killworth.

3.4 Proposals for New Working Groups

The General Meeting had six proposals for the establishment of new working groups to consider. Since these had all been received by the SCOR Secretariat well in advance of the meeting, they had been circulated to SCOR Committees for comments and membership suggestions. A member of the Executive Committee presented each proposal to the General Meeting, along with the comments received from the SCOR Committees.

Coastal Ocean Processes

This proposal was received from the Argentinian Committee for SCOR and it included the following suggested terms of reference:

To review the present knowledge of coastal ocean processes, especially sediment transport, including the effects of bottom, current, and wave conditions on longshore, offshore, and onshore sediment transports.

To identify the measurements required to provide a fundamental scientific understanding of this subject needed to ensure efficient exploration, exploitation, and conservation of non-living marine resources and judicious management of the coastal zone.

To consider the most effective means of making the necessary satellite data available to working scientists in this field.

To organize, in 1990, an international symposium on the problems of sediment transport and to publish the proceedings of this symposium.

The General Meeting agreed with Dr. Heath, and with the comments which had been made on this proposal, that these terms of reference were too broad. One suggestion was that the question of the effect of sea level rise on the adjustment of beach profiles would benefit from the attention of the group such as the one proposed. Dr. Lanfredi, Chairman of the Argentinian SCOR Committee, agreed that this would be a useful focus for the group he had proposed. Several participants noted that SCOPE has a new project on Estuaries and

Coastal Embayments which will begin by concentrating on the interactions of river modifications with sea level rise in coastal estuarine delta areas. If this new SCOR working group is established, it should interact with this SCOPE study. The General Meeting invited Dr. Lanfredi to work with Dr. Heath and one of the proposed members, Dr. P. Komar (USA), to refine the terms of reference and to reduce the lengthy list of suggested members to a workable number. A revised proposal for a working group on Coastal Ocean Processes should be submitted to SCOR before the 1987 meeting of the Executive Committee.

Wave Modelling

The Netherlands SCOR Committee had submitted the proposal for a new working group on this topic. It arose from an informal wave modelling group (WAM) in which wave researchers from different European institutes have been working together for some time to develop and implement a "third generation wave model." It was hoped that the establishment of a SCOR group on this topic would considerably broaden the activities and membership of the existing informal group (WAM) which is supported by the Council of Europe. The comments made at the General Meeting, and those received beforehand, were all supportive of the proposal, particularly in the context of the use of the wave and wind/windstress observations that are expected to come from satellite instruments. It was agreed that the group be established as WG 83 with the following terms of reference:

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

To develop regional versions of the third-generation model to be nested with the global model.

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

To perform physical studies of wave dynamical processes in order to extend our understanding of wave evolution, where needed.

To develop data assimilation techniques which will make it possible to make full use of satellite observations of the sea-state.

The meeting also agreed that Dr. G.J. Komen (Netherlands), who is the Chairman of the existing WAM group, be invited to chair WG 83. The group will be requested to clarify the meaning of "data assimilation techniques" in terms of using the third generation wave model in the interpretation of real-time satellite data on sea surface state. The group should also ensure that the third generation wave model will be applied to the full use of satellite data in cooperation with national agencies.

Hydrothermal Emanations at Plate Boundaries

Dr. Heath reminded the General Meeting that a proposal for a working group on the subject of hydrothermal processes had originally been submitted to SCOR by the Canadian SCOR Committee at the XVII General Meeting. It had proved difficult to establish the group as originally proposed, possibly because the small scientific community working in this field was not yet prepared to approach this relatively new topic on the global scale demanded by the terms of reference. More recently, however, CMG had reviewed the proposal and refined it to take into account new activities in studies of subduction zones in the sea floor. After some discussion, the Chairman of CMG, Dr. Hsu, suggested that the emphasis of the group should be on emanations from these zones. It was agreed that Professor E. Suess (USA) be invited to chair this group which will be WG 84 and will have the following terms of reference:

To review existing knowledge on mid-ocean ridge processes and subduction zone venting.

To establish an estimate of the global water and dissolved mass fluxes during tectonic accretion.

To develop criteria for recognizing and differentiating subduction-induced hydrothermal processes and spreading-induced processes in the ancient geologic record.

To assess the importance of both types of hydrothermal fluxes on the global geochemical budget.

To recommend novel techniques and approaches for studying these processes at plate boundaries.

Dr. Suess will be invited to select the membership of WG 84 from the lengthy list available at the General Meeting. This membership should reflect the focus of the group on emanations and should have an appropriate international distribution.

Experimental Ecosystems

The twenty-seventh Executive Committee meeting had considered this proposal and had asked IABO to review it taking into account the results of an ICES symposium on this topic which was to take place in late 1985. The General Meeting agreed that the new proposal from IABO incorporated the concerns expressed by the Executive Committee and approved the establishment of WG 85 on Experimental Ecosystems. The following terms of reference will be assigned to WG 85:

To examine previous studies involving experimental ecosystems; critically evaluate the results and the application of such techniques to estuarine, coastal and open sea problems.

To make recommendations for complete systems (mesocosms, field, laboratory, and simulation modelling) approaches to current problems in biological oceanography.

To specify design criteria pertinent to studies in the range of estuarine, coastal, and open sea conditions.

It was agreed that Dr. Li Guanguo (China) should be invited to be Chairman of WG 85 and that Professor T. Parsons (Canada) assist him as Vice-Chairman. They will be asked to select the membership of WG 85 from the list submitted with the proposal which was supplemented by additional suggestions from SCOR Committees. Professor Fournier and Dr. Longhurst expressed their view that this group will be a very timely one since, even after nearly twenty years, several important questions remain to be answered about the validity of the use of experimental ecosystems in ecological research. The Division of Marine Sciences of UNESCO will cosponsor WG 85.

Ecology of Sea Ice

Professor Siedler introduced this proposal which had been received from the Arctic Ocean Sciences Board. The proposal noted that:

Sea ice is populated by a variety of organisms, and several kinds of crustacea live in the brine channels and on the underside of ice floes and fast ice, being temporarily

the feeding ground for certain fish and crustacea. During melting the ice organisms may play an important role in initiating plankton blooms in spring ("seeding effect"). Sea ice biota have been studied in both one-year ice of the Antarctic and multi-year ice of the Arctic. However, the colonization of the young sea ice by various kinds of organisms, their interactions and fate during the course of ice growth and melting are poorly known. Field and laboratory studies concentrate on the relation of the organisms to physical properties of the ice and its contents in nutrients and gases. Communication to date between scientists who study sea ice biota has been somewhat limited, particularly between teams working in the Arctic and Antarctic. The SCAR Group of Specialists on Sea Ice Studies and the European Science Foundation's European Polarstern Study 1988/89 will put emphasis on work on Antarctic sea ice biota. Similar activities in the North are needed, which should take into account results and methods which have been developed for the Antarctic.

While the General Meeting wished to approve the establishment of this working group, it was noted that the proposal made no specific recommendation for a Chairman. A number of comments were made about the suggested membership and gaps in expertise, for example, in the fields of sea ice diatoms and ice physics. Several alternative nominations were made. It was agreed that the Chairman of AOSB should be asked to nominate a Chairman for WG 86 and to revise the original membership proposal in the light of comments at the SCOR General Meeting. If this is done fairly promptly, the General Meeting felt that it would not be necessary to wait for the next SCOR meeting, but that the group could be established as WG 86 if the Executive Committee Reporter, Professor Fournier, gives his approval.

The terms of reference for WG 86 will be:

To review the present knowledge on sea ice biology in arctic and antarctic regions and relate it to the physical and chemical properties of the various types of sea ice.

To review methods of sampling, in situ observations, as well as experiments in the field and in the laboratory with the aim to compare various ways and means of estimating abundance, respiration, production, and trophic relationships in ice communities.

To explore the desirability and feasibility of cooperative multidisciplinary studies.

To plan a workshop on biological sea ice studies.

The representative of SCAR, Dr. Budd, informed the General Meeting that SCAR wishes to cosponsor WG 86 and looks forward to being consulted in the selection of the membership. The General Meeting approved this suggestion.

Fine-scale Distribution of Gelatinous Planktonic Animals

This proposal was submitted by the Scientific Committee of CMAS and was presented to the General Meeting by Dr. Longhurst. He noted that SCUBA diving and other in situ techniques, such as remotely operated vehicles, have proved to be of considerable utility in the study of planktonic animals, particularly for the taxonomically diverse group of gelatinous organisms. The provision of intact, relatively unstressed animals has enabled laboratory studies to be made on their physiology and biochemistry; and invaluable information has been gathered on, for instance, their feeding rates. Dr. Longhurst reiterated the view expressed in the proposal that by using these direct, in situ methods, it has proved relatively easy to obtain information on the behaviour and fine-scale distribution of planktonic animals and it is clear that this is an area where rapid

advances in our scientific knowledge can be made. In order to achieve such a goal, however, it will be necessary to standardize and calibrate the various available techniques and to identify the areas of research that would most benefit from the application of these methods. It was felt that the proposed working group could assess these two factors; the methodology itself, and the scientific objectives that can be achieved with it. The usefulness of in situ techniques in studying the distribution of planktonic animals is known to decrease as the space scale increases. Therefore, it is necessary to assess the scale limits of in situ methodology, both from the qualitative and quantitative standpoint, to consider how to investigate ways which such techniques can be improved; and to discuss how fine-scale phenomena can affect sampling at larger scales. It was expected that considerable attention would be given to ways in which in situ techniques can be improved and made available to a broader spectrum of the oceanographic community than presently use them. In situ observations are relatively inexpensive, particularly when compared with many other oceanographic methods, and therefore could be profitably employed by investigators operating within relatively modest budgets. The publication of the results of such a SCOR working group would provide a means of disseminating information on this primarily American technique to other parts of the world.

In response to a comment that the group proposed should concern itself more with the results on the distribution of zooplankton than with the techniques, Dr. Lomghurst wished to emphasize that the main focus of the proposal was on the quantification of the distribution of gelatinous zooplankton which cannot be collected by traditional means. Dr. Labeyrie of the French SCOR Committee hoped that the group would concern itself to some extent with the role of gelatinous plankters in geochemical cycles since they are known to be major producers of faecal pellets. The General Meeting agreed that the group should not limit itself to SCUBA diving techniques, but that it should consider other methods, especially in light of the need to quantify distributions in relation to chemical processes. The establishment of WG 87 was approved, although it was agreed that the Chairman of the CMAS Scientific Committee and the proposed Chairman of WG 87, Dr. G.R. Harbison (USA), would be asked to make some revisions to the proposed terms of reference in view of the discussion at the General Meeting. This was done immediately following the General Meeting and the Executive Committee Reporter for WG 87, Dr. Stromberg, gave his approval to the following terms of reference for WG 87:

To assess the scales over which directed sampling methods can yield useful results.

To suggest practical improvements in the methodology of directed sampling techniques, particularly with regard to standardization.

To assess how fine-scale biological layering affects the results of sampling biota at larger scales using conventional sampling techniques.

"Directed sampling" is used to mean those techniques in which the in situ identification of gelatinous plankton species is possible. This may include SCUBA, ROV's, or other techniques with which these delicate organisms can be observed and/or collected intact.

Dr. Morcos informed the General Meeting that the Division of Marine Sciences of UNESCO has been associated with the initiative to form this Working Group in cooperation with Dr. N.C. Flemming, President of the Scientific Committee of the World Confederation of Underwater Activities (CMAS), and declared that UNESCO wishes to cosponsor WG 87.

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

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|---------------------------|------------|
| Dr. R. Chesselet | 71, 72, 75 |
| Dr. K.N. Fedorov | 77, 83 |
| Professor R. Fournier | 78, 86 |
| Professor G.R. Heath | 80, 81, 84 |
| Professor K. Hsu | 79, 82 |
| Professor W. Krauss | 88, JPOTS |
| Professor P. Lasserre | 85 |
| Professor G. Siedler | 69, CCCO |
| Professor J.-O. Stromberg | 76, 87 |

3.5 SCOR Scientific Rapporteurs

Marine Pollution

The President reminded the meeting of the decision of the twenty-seventh meeting of the Executive Committee to establish an ad hoc group to carry out a review of the current and potential role of SCOR in the field of marine pollution studies. This group was chaired by Professor H. Postma (Netherlands) and included the Rapporteur for Marine Pollution, Dr. B. Dybern (Sweden), Dr. R. Chesselet (France), and Dr. A.D. McIntyre (UK). Professor Postma presented his report which is reproduced in Annex XV. He reviewed the existing international organizations, both governmental and non-governmental, which are involved in marine pollution affairs, and he summarized the major activities of each. His group had interpreted "pollution" broadly and had included activities in the fields of CO₂ and trace element research in its review. It found that many of these activities include very fundamental aspects of oceanography and predicted that marine pollution research will become even more integrated into basic marine science in the future. For this reason alone, Professor Postma felt that SCOR should look closely at its relations with other organizations active in this field. He noted that although SCOR has for some years had a Scientific Rapporteur who submits regular reports on the status of marine pollution affairs, SCOR's role has been a passive one. His report offered some suggestions as to ways in which SCOR could assume a more active role in this area. Dr. Chesselet supported the view that pollution studies have become an important component of marine science and that global scale pollution oriented programmes are being incorporated into some of the ongoing and planned global experiments (tracer studies in WOCE, for example). The representative of SCOPE, Dr. J. Freney, referred to the SCOPE programme on biogeochemical cycles. A number of suggestions received from the ad hoc group were considered by the General Meeting. It was agreed that SCOR should ensure that it is represented by an observer at all GIPME and GESAMP meetings and that one of the Officers should be given the responsibility of providing liaison between SCOR and the relevant organizations and for keeping SCOR informed of developments in the field of marine pollution. Professor Stromberg agreed to accept this responsibility. Professor Postma will continue to maintain liaison between SCOR and SCOPE as he has done for some time. The General Meeting agreed that these decisions obviated the need for a Scientific Rapporteur for Marine Pollution and that SCOR's thanks should be sent to Dr. Dybern for having assumed this role in recent years.

Coastal Research

Professor Postma did not submit a formal report in his capacity as Scientific Rapporteur for Coastal Research since he felt that most relevant issues had been dealt with during the discussion of the working groups. He did, however, wish to inform the meeting that the SCOR/IABO/UNESCO Consultative Panel on Coastal Systems was about to meet in Dakar, Senegal, in December 1986, and that he would attend this meeting in his capacity

as a SCOR member and Chairman of the Panel. This panel is responsible for reviewing, developing and recommending ways of implementing the COMAR programme of the Division of Marine Sciences and to promote the involvement of developing countries in coastal marine science. The General Meeting agreed with the suggestion that these formal links to the Coastal Panel and the close working relationship between SCOR and the Division of Marine Science meant that there was no longer a need for a Scientific Rapporteur for Coastal Research. Thanks were expressed to Professor Postma for his contributions as Rapporteur.

Law of the Sea

Professor Wooster reported that the number of countries which have ratified the Law of the Sea Treaty has continued to increase. In the meantime, coastal states have been developing regulations which, in many cases, limit or rigidly control the access of oceanographic vessels to their EEZ's. While this new regime appears to be largely workable, it requires a great deal of cooperation between the coastal states and other nations, scientists, vessels, or institutions wishing to conduct research within their EEZ's. Professor Wooster referred to his attempts during the last two or three years to obtain information from SCOR Committees on the experience of their oceanographers in dealing with these new regulations. He had proposed that SCOR conduct a survey along these lines; however, the lack of response to his initiative seemed to indicate either that there was no information available yet or that there was no interest in contributing it to a central source for use by an international organization such as SCOR. He recommended, therefore, that the position of Scientific Rapporteur on the Law of the Sea be dropped until such time as there is sufficient interest in this topic to warrant further activity within SCOR. This recommendation was approved by the General Meeting which thanked Professor Wooster for his efforts in this matter in the last four years.

Joint Oceanographic Assembly

The President of SCOR noted that during the preceding discussion all three SCOR Scientific Rapporteurs had been discharged. He suggested that Professor Wooster, in his capacity as Chairman of the Scientific Programme Committee for JOA-88, be made a Scientific Rapporteur on JOA until 1988 in order that he may maintain his formal membership in SCOR. This recommendation was enthusiastically endorsed by the General Meeting.

4.0 RELATIONSHIPS WITH INTERGOVERNMENTAL ORGANIZATIONS

4.1 Intergovernmental Oceanographic Commission

The representative of IOC, Dr. S. Morcos, stated that the IOC has a strong commitment to providing continued support to SCOR in spite of the financial constraints under which UNESCO is operating. He mentioned several working groups which are of special interest to the IOC. He regretted the delays in the further development of LEPOR (Long-term and Expanded Programme of Ocean Exploration and Research) in which SCOR was to have played an important role. These delays have been caused by staff and budgetary shortages at IOC and not by any lack of commitment to proceed with LEPOR. Dr. Morcos announced that IOC has decided to provide substantial financial support to the JOA in 1988 and he made special mention of the forthcoming meeting of ICSPRO which would be an important opportunity for the mobilization of support for JOA within the other UN agencies. He urged SCOR to send a very clear statement of needs along with a report on the status of planning for the JOA to the ICSPRO meeting. Other matters relating to SCOR-IOC relations have been discussed under previous items in this report.

Professor Hsu regretted that the former close links between CMG and IOC have been lost since the death of Professor Simpson in 1983. In particular, he looked for closer cooperation with IOC in the planning of the next International Marine Geosciences Workshop. It is being planned on the topic of non-living resources which is also the basis for one of the core programmes of IOC. He also hoped that CMG would, in future, be kept better informed of the activities of the IOC Group of Experts on OSNLR. Professor Siedler offered his assistance, as President of SCOR, in strengthening the links between CMG and IOC. At the same time he expressed his confidence in the relationship between SCOR and IOC and looked forward to continued collaboration in the many areas of mutual interest to the two organizations.

4.2 UNESCO Division of Marine Science

Dr. Morcos stated that he was satisfied that all items referring to joint SCOR/UNESCO Division of Marine Science activities had been fully discussed earlier in the meeting. He referred to the previous discussion on Coastal Research and expressed his strong conviction that this topic merits the continued interest and attention of SCOR. He reaffirmed that the Division attached great importance to its work with SCOR and will continue to provide financial support to SCOR in spite of the current constraints at UNESCO.

Professor Siedler extended the gratitude of the Executive Committee to Dr. Morcos for his many contributions to the joint work of SCOR and UNESCO, especially with regard to JPOTS, WG's 75, 78, 56, and others. Professor Charnock also wished to draw special attention to the work of Mr. Gary Wright, Publications Officer of the Division of Marine Sciences, whose efforts have ensured that SCOR has received exposure in the IMS Newsletter and that several SCOR publications have appeared in a timely manner. These sentiments will be forwarded to the Director of the Division.

4.3 International Council for the Exploration of the Sea

Professor Wooster, Chairman of the Scientific Committee of ICES, had no new matters to raise, the two joint SCOR/ICES working groups (WG's 42 and 68) having been discussed earlier in the meeting. He did inform the General Meeting of ICES' intention to cooperate with SCOR in regard to the JOA in whatever ways seem most appropriate as plans develop.

4.4 World Meteorological Organization

The representative of WMO, Dr. J. Zillman, presented the following report:

The current activities of WMO of most interest to SCOR, concern ocean drifting buoys. The WMO Executive Council, at its thirty-seventh session (Geneva, June 1985) decided to establish a Drifting Buoy Cooperation Panel, essentially to promote, coordinate, and expand the deployment of drifting buoys in support of programmes such as the World Weather Watch and the World Climate Research Programme. The Executive Council provided terms of reference for the panel, suggested that the panel should establish for itself a full-time technical coordinator, and invited the IOC to cosponsor the panel. Such cosponsorship was subsequently approved by the IOC Executive Council.

The panel held its first session in Toulouse in October 1985, and the second in Geneva in October 1986. It is expected that a Technical Coordinator will be appointed early in 1987, financed by voluntary contributions by panel Member Countries and located in CLS/Service Argos in Toulouse, France. The essential objectives of the panel are:

To coordinate and expand drifting buoy deployments to meet the requirements of WMO and IOC operational and research programmes for ocean data.

To promote the distribution of quality-controlled buoy data over the GTS.

To act as an information exchange on all aspects of drifting buoys.

To encourage and coordinate contributions to drifting buoy programmes from as many countries as possible.

The World Weather Watch, Marine Meteorology Programme, and the joint IOC/WMO Integrated Global Ocean Service System have a close and developing interest in the processing and use of satellite-derived ocean data for both services and research. In particular, WMO sponsored in 1984 a workshop on the intercalibration of satellite and conventional SST data (details in Report No. 16 in the series Marine Meteorology and Related Oceanographic Activities). In addition, the WMO Commission for Marine Meteorology has commissioned a rapporteur's study on "The use of satellite data in marine meteorological services," while IGOSS has commissioned a similar rapporteur's study on "Techniques to be used to derive ocean mixed layer depth from satellite altimeter data." Finally, a CMM Group of Rapporteurs on Numerical Wave Modelling is examining, *inter alia*, the use of satellite-derived wave parameters in numerical wave models. Reports on all topics are expected in 1988.

The following results of the fifth session of the CMM Working Group on Marine Climatology, Geneva, 10-14 November 1986, may also be of interest to SCOR:

- agreement on a modified draft proposal for the establishment of a TOGA Marine Climatology Data Centre in the United Kingdom. This modified proposal will be submitted by WCRP to WMO EC-XXXIX.

- agreement on a uniform set of minimum quality control procedures to be applied to all VOS data for climatological purposes.

- adoption of a plan for a pilot project concerning a high-quality subset of VOS. Pilot project initially confined to North Atlantic (in conjunction with OWSE-NA) and has the objective, *inter alia*, of showing the feasibility of developing a permanent subset of VOS for high quality, quick return (non-GTS) data to be used for calibration purposes for other VOS and satellite-derived ocean parameters in support of the Ocean Observing System Development Programme of CCCO/WCRP.

Otherwise, WMO has an interest in and strongly supports the formation of the proposed new SCOR WG on wave modelling which is seen as complementing the recently established CMM *ad hoc* Group of Rapporteurs on wave modelling. WMO has agreed provisionally to cosponsor the COST-43 Seminar on Operational Ocean Station Networks.

4.5 Commission for the Conservation of Marine Antarctic Living Resources

Dr. D. Powell, the Executive Secretary of CCAMLR, welcomed the participants to Hobart which is the home of the CCAMLR Secretariat. He presented a report on CCAMLR activities in the fields of management of, and research on, Antarctic marine living resources. This report appears as Annex XVI to this issue of SCOR Proceedings. He invited members of the SCOR community to contact CCAMLR Secretariat for more detailed publications on these activities. The representative of CCAMLR, Dr. Kerry, encouraged SCOR to continue its practice of sending observers to CCAMLR meetings, especially those of its Scientific Committee. He noted that both SCOR and CCAMLR are sponsors (with IOC and SCAR) of a Seminar on Antarctic Variability and its Effects Upon Living Resources, Particularly Krill, which will take place in Paris in June 1987.

On behalf of the Executive Committee, the President expressed his appreciation to the representatives of CCAMLR who were attending a SCOR meeting for the first time.

5.0 RELATIONS WITH NON-GOVERNMENTAL ORGANIZATIONS

5.1 Affiliated Organizations

Commission for Marine Geology

The Chairman of CMG, Professor Hsu, presented his report which is given in Annex XVII to this document. In particular, he referred to the activities of CMG in the field of the history of the oceans, cooperation between CMG and ICSU in the development of IGBP, and the plans of CMG for its Fourth Workshop on Marine Geosciences on the subject of shelf seas, and, continental margins. In his last report to SCOR, Professor Hsu had noted the difficulty of involving developing countries in the Ocean Drilling Programme. He was pleased to report some progress in this area with JOIDES journals being made more readily available to CMG national correspondents in non-JOIDES nations, and invitations being extended to scientists from coastal nations to work on the D/V Joides Resolution when she is drilling in their waters. Readers are referred to Annex XVII for more information on current activities of CMG.

International Association for Meteorology and Atmospheric Physics

A brief report from the Secretary General of IAMAP included the information that IAMAP is, as usual, collaborating with IAPSO in planning for the IUGG General Assembly in Vancouver in August 1987. IAMAP is participating in IAPSO symposia on marginal ice zone processes, low latitude ocean-atmosphere interaction, and long-term variations of ocean climate. IAMAP is itself convening a symposium on the prediction of transitions of the climate system in interannual time scales and another on the dynamics of flow over topography which includes papers on topographic effects over oceans.

IAMAP's Commission on Atmospheric Chemistry and Global Pollution (CACGP) has agreed to initiate the planning for specific international collaborative research efforts in global atmospheric chemistry as part of the International Global Tropospheric Chemistry Programme. The report from IAMAP provided information to SCOR on the steps which will be taken by CACGP during the coming years to develop the proposed programme.

International Association for the Physical Sciences of the Ocean

The report from IAPSO to the General Meeting emphasized the planning for the XIX IUGG General Assembly in Vancouver from 9 - 22 August 1987. The following Union Symposia were cited by Drs. Krauss and LaFond as being of interest to the SCOR community:

- Chaos and self-organization in the lithosphere and earthquake prediction.
- Milankovitch theory and climate.
- The new solar system.
- Magma genesis and plate tectonics.
- Irregularities in the earth's rotation and geophysics.

IAPSO will be the lead organization or cosponsor of the following Interdisciplinary Symposia:

- Quo vadimus: Where are we going?
- Impacts of global positioning systems on geophysics.
- Variations in earth rotation.
- Hydrogeological regimes and their subsurface thermal effects.

Dynamics and monitoring of pollution.
Contributions of geophysical sciences to climate change studies.
Marginal ice zone processes.
Low latitude ocean-atmosphere interactions.
Long-term variations in ocean climate.

The IAPSO Symposia will be:

Satellite oceanography and the role of satellite observations in large-scale oceanographic programmes.
Large-scale oceanographic studies: A - Pacific, B - Atlantic, C - high latitude oceans.
Intermediate and small-scale processes and structures in the ocean.
Marginal seas and straits.
Optical variability and its relationship to biology, physics, and dynamics of the upper ocean.
Ocean data assimilation and prediction studies.
Coastal, nearshore, and shelf oceanography.
Physical oceanography based on acoustics.
Recent studies in marine chemistry.

There will also be Precis and Poster Sessions in physical, chemical, and geophysical oceanography and a workshop on oceanographic advice to developing countries. Eight IAPSO Committees and Commissions will meet during the IUGG Assembly.

The report from IAPSO also noted the accomplishments of JPOTS which were discussed under item 3.3. The General Meeting welcomed this report, especially in regard to plans for the IUGG programme, since these will need to be taken into account by Professor Wooster's committee as it develops the programme for the JOA.

5.2 Corresponding Organizations

Arctic Ocean Sciences Board

Dr. Longhurst informed the General Meeting that at its last session, AOSB had decided to request SCOR to undertake a review of the science plan for the Greenland Sea Project. This review had been carried out by an ad hoc group which consisted of himself as Chairman, Dr. G. Needler (WOCE IPO, Wormley), and Dr. S. Jacobs (USA). The review was sent to the Executive Secretary just prior to the General Meeting and was to be forwarded to the AOSB immediately. The next meeting of the AOSB was scheduled to take place at the Bedford Institute of Oceanography in early March 1987, and the GSP and SCOR's review were expected to be topics for discussion at that time.

Confederation Mondiale des Activites Subaquatiques, Scientific Committee

A written report from the CMAS Scientific Committee was available to the General Meeting. It drew attention to the major recent activities of CMAS which would be of interest to SCOR. A proposal from CMAS that SCOR establish a new working group (WG 87) on in situ techniques for the quantification of the distribution of gelatinous plankton had been dealt with and accepted earlier in the General Meeting.

UNESCO has agreed to publish the report entitled "Code of Practice for Scientific Diving - Principles for the safe practice of scientific diving in different environments", which was prepared by the CMAS Scientific Committee, in the series UNESCO Technical Papers in Marine Sciences.

Engineering Committee on Oceanic Resources

The Executive Secretary of ECOR had sent some information on recent ECOR activities to the SCOR Secretariat and had noted in her accompanying letter that there has been a recent resurgence of enthusiasm since ECOR's reactivation. SCOR was pleased to note that the implementation of an effective work plan by the ECOR Officers had been successful. ECOR has undertaken a study for IOC on those aspects of new sources of ocean energy that would benefit from international cooperation in the IOC framework, with special reference to TEMA.

5.3 International Council of Scientific Unions

Readers are referred to page 9 of this report. This item was brought forward in the agenda for the General Meeting in order that the discussion on the ICSU IGBP could take place before the relevant working group activities and the CCOO report were considered.

5.4 ICSU Unions and Committees

Reports had been sought from those members of the ICSU family which are represented in SCOR. The following organizations responded with information for the General Meeting:

Scientific Committee on Antarctic Research

The representatives of SCAR, Drs. Budd and Kerry, drew attention to several items of interest contained in the report from SCAR. They noted that following the completion of the field phase of the BIOMASS Programme and the disbanding of the SCAR Group of Specialists (SCOR WG 54), it had become clear that some new international scientific group was required to continue to facilitate international cooperation in Southern Ocean ecology and related fields. The XIX General Meeting of SCAR decided to establish a new Groups of Specialists on Southern Ocean Ecology with the following terms of reference:

To identify important fields for research on Antarctic marine ecology and to propose cooperative studies, including multi-ship experiments.

To encourage and facilitate interdisciplinary studies in Antarctic marine ecosystems.

To further Southern Ocean ecosystems studies through workshops and other activities.

To respond through SCAR to requests for scientific advice and information by the Antarctic Treaty Organization, CCAMLR, and other international organizations with interests in science, resources, and conservation in the Southern Ocean.

To liaise with other relevant international research programmes.

The SCOR General Meeting accepted the invitation contained in the SCAR report that SCOR cosponsor this new group and agreed that it would nominate a physical and a chemical oceanographer as members.

As is noted elsewhere in this report, SCAR indicated that it would wish to cosponsor the new SCOR Working Group on the Ecology of Sea Ice when it is established and wishes to be consulted in the determination of the membership for this group.

SCOR agreed to a request contained in correspondence from Dr. Kerry that it cosponsor the Fifth SCAR Symposium on Antarctic Biology which will be held in Hobart from 29 August to 3 September 1988. The overlap between the dates for this symposium and those of JOA-88 was deeply regretted, but neither organization seemed to be in a position to change the arrangements which had already been made.

Committee on Space Research

The report from COSPAR Commission A was distributed to all participants in the General Meeting and their attention was drawn to several recent and planned satellite launches of interest to scientists. It also reviewed progress in the International Satellite Cloud Climatology Project and the International Satellite Land Surface Climatology Project. It noted that interest has been increasing in the results from the U.S. CZCS on Nimbus-7. These data are now being processed and were the subject of one of the scientific sessions during the COSPAR Plenary Meeting in Toulouse in the summer of 1986. The COSPAR report listed some of the scientific sessions which are planned for the next COSPAR Plenary in Helsinki in 1988. The General Meeting agreed that SCOR should indicate its interest in cosponsoring three of these:

Symposium on the Contribution of Space Observations to the World Climate Research Programme and the Global Change Programme.

Topical Meeting on Satellite Observations of Mesoscale Processes in the Atmosphere and Ocean.

Topical Meeting on the Latest Results in Space Observations for Meteorology and Oceanography.

Scientific Committee on Problems of the Environment

A report from SCOPE was distributed to all participants in the General Meeting. The representative of SCOPE, Dr. J. Freney, wished to emphasize that SCOPE intends to establish a new project on Estuaries and Coastal Embayments, if possible in collaboration with SCOR. While plans for this project had not been finalized at the time of the SCOR General Meeting, SCOPE had agreed that the first phase of the project should concentrate only on the part of the overall plan which deals with the interactions of river modifications with sea level rise in coastal estuarine delta areas. SCOPE expected that plans for this project would be further developed at its Executive Committee Meeting in February 1987. Dr. Postma will keep SCOR informed on this matter.

Union Radio Scientifique Internationale

A report from Dr. G.R. Valenzuela, the URSI Representative, reviewed the recent activities of URSI Commission F (Remote Sensing and Wave Propagation). In particular, the General Meeting noted plans for a symposium on Climate Modelling and Radio Probing of the Ocean Surface which will take place in Southampton in September 1988 or 1989. This will be drawn to the attention of CCCC.

6.0 FUTURE MEETINGS

6.1 Meetings of SCOR

Professor Hsu presented an invitation on behalf of the Swiss Committee for SCOR that invited SCOR to hold its twenty-eighth Executive Committee Meeting in Zurich in late

September or early October 1987. The General Meeting accepted this invitation with gratitude and instructed the Officers to finalize the dates in consultation with Professor Hsu so as to avoid conflicts with other international meetings (ICES, History of Oceanography Congress, etc.).

The XIX General Meeting of SCOR will take place in Acapulco, Mexico, during the Joint Oceanographic Assembly in August 1988.

6.2 Other Meetings

The Executive Secretary presented the following list of meetings which may be of interest to members of the SCOR community:

- WMO Conference on Mechanisms of Interannual and Longer Term Climatic Variations. Melbourne, Australia. 8-12 December 1986.
- AOSB Arctic Ocean Sciences Board - 6th Session. Halifax, Canada. 2 - 3 March, 1987.
- SCAR Group of Specialists on Antarctic Climate Research (SCAR-ACR) Bern, Switzerland. Workshop on the Antarctic ice core climate record. 6 - 8 April, 1987.
- ICES Symposium on Marine Sciences of the Arctic and sub-Arctic Regions, Santander, 28-30 September 1987.
- International Glaciological Society Symposium on Ice Core Analysis. Bern, Switzerland. 30 March - 4 April, 1987.
- Symposium on Marine Ecosystem Experiments. Beijing, People's Republic of China, 19 - 23 May, 1987.
- COST - 43 Operational Ocean Station Networks. Institut Francais pour la Recherche et l'Exploitation de la Mer, Brest, France. 16 - 18, June 1987.
- International Symposium on Fisheries Acoustics. Seattle, Washington, U.S.A. 22 - 26 June, 1987.
- IOC/CCAMLR/SCOR/SCAR: Antarctic Ocean Variability and its Influence on Marine Living Resources, Particularly Krill. Paris, France. 2 - 6 June, 1987.
- IUGG General Assembly. Vancouver, Canada. 9 - 21 August, 1987.
- 4th International Congress on the History of Oceanography. Hamburg, F.R.G. 23 - 29 September, 1987.
- International Symposium on Red Tide. at Takamatsu International Hotel, Takamatsu City, Japan. 9 - 14 November, 1987.
- IOC/WMO/SCOR: International Conference on WOCE. Early 1988.
- SCAR Symposium on Antarctic Biology. Hobart, Australia. 29 August - 3 September, 1988.
- Second International Liege Colloquium on Coupled Ocean Atmosphere Models. Liege, Belgium, May, 1989.

The Executive Secretary reported that several requests for SCOR cosponsorship of international meetings had been received. The first of these involved the COST-43 Seminar on Operational Ocean Station Networks to be held in Paris in June 1987. The General

Meeting felt that in spite of the regional nature of this meeting (it will be largely European), SCOR cosponsorship would be appropriate since the meeting will deal with a number of international programmes such as the WCRP, the IOC/WMO Drifting Buoy Cooperation Panel, and so on.

The General Meeting also agreed that SCOR should respond positively to a request from Dr. Nemoto of the Japanese SCOR Committee for SCOR cosponsorship of an International Symposium on Red Tide which will take place in Kagawa, Japan, in November 1987. The programme of this symposium is interdisciplinary in nature and received strong support from Dr. Chesselet who had discussed it with Japanese colleagues during a recent visit to Japan.

Finally, the meeting considered a request that SCOR cosponsor a meeting entitled "Climate and Geosciences, a Challenge for Sciences and Society in the 21st Century." This meeting is to take place in Belgium in mid-1988 and is being organized by the Geo-sciences Panel of NATO. The General Meeting did not consider it appropriate for SCOR to cosponsor this meeting.

7.0 OTHER BUSINESS

Readers are referred to page 10 of this report for an item relating to global ocean flux studies which the General Meeting agreed should be discussed before the review of the activities of SCOR subsidiary bodies.

In closing the XVIII General Meeting of SCOR, the President expressed special thanks to Professor Henry Charnock who was attending for the last time in his capacity as a member of the Executive Committee. Professor Charnock had served as SCOR Secretary from 1978 to 1980, as Vice-President from 1980 to 1982, and as a co-opted member with special responsibility for publications from 1982 until this General Meeting. All present joined Professor Siedler in voicing the hope that Professor Charnock would continue to be involved in SCOR activities. Thanks were also extended to Dr. Alan Longhurst who had served as Secretary of SCOR since 1980, and especially for his provision of guidance and scientific advice to the Executive Secretary during these years. Finally, the gratitude of SCOR was expressed to Dr. Angus McEwan, Chairman of the Australian SCOR Committee and Director of the CSIRO Division of Oceanography, who had hosted the General Meeting and arranged the symposium which preceded it. The participants joined Professor Siedler in thanking Dr. McEwan for the facilities which had been made available and for the generous hospitality shown them by Dr. McEwan and his colleagues.

ANNEX I

EIGHTEENTH GENERAL MEETING OF SCOR

Hobart, Australia, November 26 - 28 1986

LIST OF PARTICIPANTS

Members of the Executive Committee

| | | |
|-----------------------------|----------------------|---------------------|
| * Professor G. Siedler | Fed. Rep. of Germany | President |
| * Dr. A.R. Longhurst | Canada | Secretary |
| * Dr. K.N. Fedorov | U. S. S. R. | Past President |
| * Dr. R. Chesselet | France | Vice-President |
| * Dr. G.R. Heath | U. S. A. | Vice-President |
| * Professor J.-O. Stromberg | Sweden | Vice-President |
| * Professor W. Krauss | Fed. Rep. of Germany | Ex-Officio / IAPSO |
| * Professor K. Hsu | Switzerland | Ex-Officio / CMG |
| * Professor H. Charnock | United Kingdom | Co-opted Member |
| E. Tidmarsh | | Executive Secretary |

Other Participants

| | | | |
|---------------------------|---------------|-----------------------|-------------|
| * Mr. F. Anderson | (S. Africa) | * Dr. J. Middleton | (Australia) |
| * Prof. T. Asai | (Japan) | Dr. S. Morcos | (UNESCO) |
| * Dr. A. Ayala-Castanares | (Mexico) | * Prof. M. Mork | (Norway) |
| * Dr. J. Bradford | (New Zealand) | Mr. B. Nicholls | (Canada) |
| Mr. Lou Brown | (USA) | Dr. J. O'Brien | (IAPSO) |
| Dr. W. Budd | (Australia) | Dr. J. Paimillil | (Kuwait) |
| Dr. J.C. Chen | (China) | Dr. J.S. Perry | (USA) |
| * Dr. G. Cresswell | (Australia) | Dr. M. Pitman | (AMSTAC) |
| * Prof. B. d'Anglejan | (Canada) | * Dr. H. Postma | (Neth) |
| * Dr. J. Field | (S. Africa) | Dr. D. Powell | (CCAMLR) |
| * Dr. R. Fournier | (Canada) | Dr. P. Scott | (ICSU) |
| Dr. J.R. Freney | (SCOPE) | Dr. J. Soyer | (France) |
| * Dr. R. Gammon | (USA) | * Dr. R. Stewart | (CCCO) |
| * Dr. I. Hessland | (Sweden) | * Dr. C.K. Tseng | (China) |
| Dr. D.X. Hu | (China) | * Dr. J. Van der Land | (Neth) |
| Dr. K. Kerry | (SCAR/CCAMLR) | Dr. S. Wen | (China) |
| Dr. L. Labeyrie | (France) | Dr. B. Winterhalter | (Finland) |
| Dr. E.C. LaFond | (IAPSO) | * Prof. W. Wooster | (USA/JOA) |
| * Dr. N.W. Lanfredi | (Argentina) | Dr. A. You | (Australia) |
| Dr. F. Liang | (China) | Dr. J. Zhang | (China) |
| * Dr. A. McEwan | (Australia) | Dr. J. Zillman | (WMO) |

* = SCOR members

ANNEX II

SCOR General Meeting, Hobart, Australia, November 26-28 1986

SCIENTIFIC PROGRAMME

Seminar on "Interfaces in the Ocean - A Preliminary View"

PROGRAMME

MONDAY 24 OCTOBER

Official Opening by the Governor of Tasmania, His Excellency Sir James Plimsoll, AC CBE.

Introductory remarks by Dr. Angus McEwan.

Physical/Chemical/Biological

Graham Harris (CSIRO Marine Laboratories, Hobart)
The Subtropical Convergence in South Australian Waters and the Tasman Sea

Chen-Tung Chen (Sun Yat-Sen University, Taiwan, China)
Comparison of Summer-Winter Water chemistry across the Subtropical and Polar Fronts in the Southwestern Indian Ocean

Graeme Pearman (CSIRO Division of Atmospheric Research, Victoria)
Possible Southern Ocean biota effects on atmospheric CO₂ in the Southern Hemisphere

Physical/Biological

John Field (University of Cape Town, South Africa)
The Interface between upwelled Benguela Water and Oceanic Water

Joseph Paipillil (Kuwait Institute for Scientific Research)
Physio-Chemical Characteristics of Arabian Gulf Waters

Shengchang Wen (Shandong College of Oceanography, China)
Brief review of the work on the Front and Thermocline in the East China Sea done by Shandong College of Oceanography

Paul Sammarco (Australian Institute of Marine Science, Townsville)
Larval dispersal and recruitment in corals: implications of the Helix Experiment

Small-Scale

Trevor McDougall (CSIRO Division of Oceanography, Hobart)
Interfaces: real and imaginary

Judith Holyer (University of Bristol, United Kingdom)
Recent advances in double-diffusive interleaving

Roger Grimshaw (University of New South Wales)
Finite-amplitude interfacial gravity waves

Ian Jones (RAN Research Laboratory, New South Wales)
Turbulence in the Diurnal Thermocline

TUESDAY, 25 NOVEMBER

Large-Scale Dynamics

Gerold Siedler (Institut für Meereskunde, Federal Republic of Germany)
Central water ventilation at the Azores Front

John Klinck (Texas A & M University, U.S.A.)
Fronts in the Antarctic Circumpolar Current with emphasis on Drake Passage and the South Atlantic

Large-Scale Water Masses

Jean Donguy (ORSTOM, France)
Surface observations connected to Intertropical Climate Features

Matthias Tomczak (The University of Sydney, New South Wales)
Review of methods for the analysis of mixing processes in the Oceanic Thermocline

Large-Scale (Tropical)

James O'Brien (Florida State University, U.S.A.)
Interannual upper ocean circulation: Now and the Future

Roger Lukas (University of Hawaii, U.S.A.)
The Confluence of Southern and Northern Waters in the Western Equatorial Pacific

Stuart Godfrey (CSIRO Division of Oceanography, Hobart)
The Leeuwin Current: Do small-scale interfacial processes control its large-scale structure

Chemical

Richard Gammon (NOAA/PMEL, Washington, U.S.A.)
Freon transient tracers of water mass formation and thermocline ventilation

Jerzy Trau (University of Sydney, New South Wales)
The distribution of different chemical species of silicon in the ocean: A vertical profile

David Smith (University of Melbourne) & Peter Carpenter (University of Tasmania)
Estuaries - Mediators at the ocean-river interface

Air-Sea

Eric Webb (CSIRO Division of Atmospheric Research, Victoria)
Prospects for measurement of air-sea CO₂ transfer

John Bye (Flinders University, South Australia)
The coupling of wave drift and wind velocity profiles at the air-sea interface

William Budd (University of Melbourne, Victoria)
The construction of an observed surface current digital data set for the Southern Ocean

Continental Shelf

Dunxin Hu (Institute of Oceanology, Academia Sinica, China)
Front-caused upwelling in the Yellow Sea

Rick Nunes (Flinders University, South Australia)
Recent observations of a saline outflow from the South Australian Gulfs into the deep ocean

Jason Middleton (University of New South Wales)
Mixing processes on the Antarctic Continental Shelf

ANNEX III

SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH
Final Financial Statement, 1985
(U.S. dollars)

| | | |
|-----------------------------------|-------------------|-------------------|
| BALANCE, Jan. 1, 1985 | 113,524.92 | |
| INCOME | | |
| Membership | 116,874.88 | |
| ICSU Grant | 38,000.00 | |
| IOC Contracts | 35,428.84 | |
| UNESCO Contracts | 23,500.00 | |
| NSF Grant | 16,376.79 | |
| Can. Contract | 8,490.55 | |
| Interest, Misc. and Loss on Exch. | <u>3,174.05</u> | |
| TOTAL INCOME | 241,845.11 | |
| TOTAL CASH PLUS INCOME | | <u>355,370.03</u> |
| EXPENSES | | |
| Scientific Activities: | | |
| WG 42 | 1,863.53 | |
| 54 | 10,000.00 | |
| 56 | 23,770.71 | |
| 68 | 6,508.06 | |
| 70 | 196.81 | |
| 73 | 4,004.44 | |
| 74 | (5.72) | |
| 75 | 7,350.38 | |
| 76 | 2,005.40 | |
| 81 | 1,648.05 | |
| CCCO | 52,000.00 | |
| CCCO Chmn's Travel | 8,492.38 | |
| JPOTS | <u>1,834.50</u> | |
| Total Subsidiary Bodies | 119,668.54 | |
| Related Scientific Activities | | |
| Publications | 9,521.91 | |
| Representation | 8,669.72 | |
| NSF Travel | 16,376.79 | |
| Exec. Meeting | 11,858.24 | |
| Conferences | <u>3,400.00</u> | |
| Total Related Expenses | 49,826.66 | |
| Total Scientific Expenses | 169,495.20 | |
| Administration | | |
| Salaries & Benefits | 36,316.85 | |
| Communications | 5,799.97 | |
| Audit | 930.66 | |
| Misc. and bank charges | 1,335.22 | |
| Office Equipment | <u>2,062.73</u> | |
| Total Admin. Exp. | 46,445.43 | |
| TOTAL EXPENSES | <u>215,940.63</u> | |
| BALANCE, Dec. 31, 1985 | 139,429.40 | |
| TOTAL CASH PLUS EXPENSES | | <u>355,370.03</u> |

ANNEX IV

WORKING GROUP 54

SOUTHERN OCEAN ECOSYSTEMS AND THEIR LIVING RESOURCES

SCOR WG 54 activities for the period between September 1985 and August 1986 include full operation of the BIOMASS Data Centre, the first meeting of the BIOMASS Data Centre Advisory Group, a shift in the responsibility for guiding the BIOMASS Programme from SCOR WG 54 to the BIOMASS Executive Committee which will oversee the phase of the BIOMASS data analysis and data interpretation, and planning for future meetings and data analysis workshops. Highlights are detailed here.

1. Operation of BIOMASS Data Centre

a. Data collection

The BIOMASS Data Centre, located at the British Antarctic Survey (BAS), Cambridge, U.K., is now fully operational. The Data Centre has transferred the complete set of data for the FIBEX cruises from the database in Frankfurt, F.R.G., and is in the process of loading and validating SIBEX data. Once all SIBEX 1 and 2 data are loaded, the database will be available for use by BIOMASS scientists. The BIOMASS Executive is currently investigating how the International Southern Ocean Studies (ISOS) data could be transmitted to the Data Centre.

b. Data Centre Advisory Group

Dr. W. Hiller of the Alfred-Wegener Institut für Polar-und-Meerforschung, F.R.G., chaired the first meeting of the group which was held in Cambridge, 5-7 February 1986. At this meeting, the group discussed the current status of the Data Centre, access to data, future data analysis workshops, and communication between advisory group members and the Data Centre, with the BIOMASS community, and with other data centres. The group made several recommendations to the BIOMASS Executive Committee. A second meeting is scheduled for October 1986 in Bremerhaven.

2. Meetings of the BIOMASS Committee

The Executive met 19 June 1986 in San Diego, U.S.A., and 24-25 February 1986 in Hamburg/Bremerhaven, F.R.G.

a. Report of the Meeting of BIOMASS Data Centre Advisory Group

At the February meeting, Dr. Hiller discussed the report of the Advisory Group with the Executive. The Executive considered the recommendations that resulted from the meeting and has since acted upon these recommendations (see BIOMASS Report Series No. 45).

b. Future workshops

At the Hamburg/Bremerhaven meeting, the Executive approved proposals for data analysis for the following workshops:

Krill Physiology and Biochemistry. Objectives are to focus on future areas for research through an exchange of information about current research projects. Proposed topics include: reproduction, feeding, moulting, oxygen consumption, seasonal biochemistry, energetics of larval development, and lipofuscins and their value in age determination. A planning meeting and one workshop, to discuss current research and decide upon topics most in need of attention, are planned for 1986. A second workshop, to review results, will be held in 1989. Venue of the first workshop is the Institut National de la Recherche Scientifique-Océanologie, Rimouski, Quebec, Canada.

Fish Ecology Objectives are to validate SIBEX data oriented to ichthyoplankton, including mesopelagic fish, and to formulate objectives for a final evaluation workshop. The first workshop, dedicated to the validation of the fish data transferred to the BIOMASS Data Centre, will be held in October 1986. A second workshop, devoted to the validation of SIBEX fish results, will follow in October 1987 at the BIOMASS Data Centre. The steering committee met in Cambridge (British Antarctic Survey) 26-28 November 1985. All scientists who intend to participate have been asked for detailed information on the SIBEX cruises, cruise track, the vessel used, period of the survey area, gear used, and so forth.

Krill Larval Ecology. The purpose of this workshop will be to determine the factors controlling the distribution of krill larvae and the characteristics of areas of krill abundance. The planning workshop will be held in Europe in the spring of 1987. The second workshop is planned for autumn 1988.

Catch per Unit of Effort (CPUE) as an Estimator of Krill Abundance. The goals of this workshop are to determine the extent to which CPUE (catch per unit of effort) of individual vessels and fleets can be used as an estimator of abundance over large-scale areas of the Southern Ocean. A planning meeting, venue undetermined, will be held in late 1986. The workshop will be held in mid-1987 at the BIOMASS Data Centre.

Phytoplankton/Zooplankton Relationship. This workshop will focus on: species as indicators of water masses, patchy and vertical distribution in relation to bottom topography, interaction between species, seasonal succession and annual variation of species composition and biomass, relation between phytoplankton and zooplankton. Two workshops will be held back-to-back: the first, on South Atlantic data, will be held in Rio de Janeiro, Brazil, in October 1987; the second would follow immediately in College Station, Texas, U.S.A, with a participant from the Rio meeting attending to report on it. In May, 1988, a combined workshop meeting will be held at the BIOMASS Data Centre to allow interaction between physical and chemical oceanographers.

Physical and Chemical Oceanography. Objectives of this workshop are to analyze SIBEX data and prepare the results in a form which may be used during the interpretation of SIBEX biological data. A data preparation session will be followed by a data evaluation session, both held in 1987 at the BIOMASS Data Centre.

Krill Acoustic Workshop. The purpose of this workshop will be to analyze SIBEX krill abundance data once they are added to the data base and validated. Venue and dates not yet determined.

The Chairman of the BIOMASS Executive has sent letters to the workshop convenors inviting them to proceed with plans for the data analysis workshops.

c. BIOMASS Publications

The final draft of the Krill Review, written by Mr. Denzil G.M. Miller, is nearly finished and will be published as part of the BIOMASS Scientific Series. The Executive noted the near completion of the printing of the BIOMASS Handbook Series.

The Executive agreed that an inquiry by Cambridge University Press (CUP) concerning publishing work arising from the BIOMASS programme was premature and that the main publication vehicle should be refereed scientific journals. At the San Diego meeting, the Executive agreed that an option should be kept open with CUP regarding the possibility of publishing the proceedings of the final BIOMASS Evaluation Meeting and publishing the reports of the data analysis workshops in a single volume.

Presently, almost all of the papers to be published in the Proceedings of the Regional Symposium on Recent Advances on Antarctic Aquatic Biology, with Special Reference

to the Antarctic Peninsula Region have been sent to the printer, and publication is anticipated by Fall 1986.

The National Science Foundation has expressed interest in arranging the English translation of Morphological Bases of the Systematics and Phylogeny of the Nototheniid Fishes by A.V. Balushkin of the Zoological Institute, Leningrad, USSR, which was recently published in Russian. Several Antarctic ichthyologists had expressed great interest in obtaining an English translation.

d. BIOMASS Finances

The BIOMASS executive presented its budget to SCAR XIX. The Chairman and Treasurer met on 18 and 25 June in San Diego with contributors and potential contributors to the BIOMASS Special Fund to discuss budget estimates for 1987 et seq., expenditure, and management of the fund. A document listing the different workshops, publications, projected budgets, and the statements of income and expenditure was distributed to the participants. The contributors expressed concurrence and approval of the way the Special Fund is being handled.

e. Future Biological Studies of the Southern Ocean

A comprehensive paper on this subject was prepared by the Chairman and reviewed by the Executive at the San Diego meeting. The Executive agreed that the paper, with minor modifications, should be published as a "one-off" in the BIOMASS Scientific Series.

3. Future Workshops/Meetings

See the listing of future workshops in Section 2b above.

The BIOMASS Executive will meet 1 June 1987 in Paris at the Museum National d'Histoire Naturelle, prior to the Scientific Seminar on Antarctic Ocean Variability which will be held in UNESCO Headquarters.

4. Recommendations

Although SCOR WG 54 will be disbanded at the Eighteenth General Meeting of SCOR, analysis of the enormous amount of BIOMASS data will continue to occupy the BIOMASS community for several years to come. Because of the continuing need for data analysis, it is requested that financial support to defray the cost of the 1987 workshops be approved by SCOR.

ANNEX V

WORKING GROUP 65

COASTAL-OFFSHORE ECOSYSTEMS RELATIONSHIPS

Summary of WG activities:

In 1980, SCOR in close collaboration with UNESCO and IABO, initiated the formation of its Working Group 65 (Coastal-Offshore Ecosystems Relationships) with the following terms of reference;

- (i) to review and compare the energetics of coastal (littoral and estuarine) and offshore pelagic and benthic populations.
- (ii) to suggest methods for improving knowledge of energy conversion between coastal and offshore pelagic migratory and benthic populations and to determine what further research is needed.

In consultation with IABO, the Working Group decided to concern itself primarily with differences in the energetics of coastal and offshore ecosystems and with significant energy and material fluxes between such systems. These fluxes could include the exchange of organic material and plant nutrients between the two systems. In addition, it was recognized that fluxes might exist which are probably insignificant in terms of energy exchange, but are important in terms of quality, and should therefore be considered. Such fluxes could include, for example, migrations of (juvenile) crustacea and fish from the coastal zone to offshore populations as well as fluxes of pollutants.

The Working Group, established in the course of 1980, had two meetings, the first in Bordeaux (France), from 5-7 September 1981, in conjunction with the International Symposium on Coastal Lagoons, 8-13 September 1981; the second in Texel (the Netherlands), from 12-15 September 1983. The membership of the WG was as follows:

| | | | |
|----------------|----------------|----------------|---------------|
| B. O. Jansson | (Sweden) | S. W. Nixon | (USA) |
| B. Kjerve | (USA) | M. M. Pamatmat | (USA) |
| P. Lasserre | (France) | B. Zeitzschel | (FRG) |
| A. D. McIntyre | (UK) Secretary | J. J. Zijlstra | (Netherlands) |
| R. C. Newell | (UK) | | Chairman |

The group recognized the great diversity of the coastal zone, which might lead to local differences in the relationship between coastal and offshore ecosystems. It was therefore decided to exchange documented accounts of the situation with which each of the members was most familiar. These accounts covered areas as different as San Francisco Bay, North Inlet (South Carolina, USA), the Bermuda platform, a southern Benguela kelp community (South Africa), sandy beaches in western Scotland, a Baltic coastal-offshore system, and the Wadden Sea (the Netherlands).

These accounts, together with exchange of views during meetings and by correspondence, assisted in focussing attention on six aspects, which appear to be of general interest for all coastal-offshore situations, (with the possible exception of tropical areas, for which no information was presented) and provide a background for the relationship between the two ecosystems. These aspects are:

- (1) Coastal-offshore classification;
- (2) Nutrient exchange between coastal and offshore systems;

- (3) Transport of organic matter across the coastal-offshore boundary;
- (4) Coastal-offshore relations in animal populations;
- (5) Productivity in coastal and offshore systems; and
- (6) Effects of man-made disturbance.

CONCLUSIONS ON ASPECTS CONSIDERED

The main conclusions in relation to the aspects considered were:

- (1) In the past many discussions about coastal-offshore interactions addressed the exchange over the estuarine-nearshore boundary. Little is known about the interactions between the nearshore and offshore areas.
- (2) It seems doubtful that coastal areas, in particular estuaries, contribute significantly to the nutrient supply of offshore areas.
- (3) "Outwelling" of organic matter from coastal, in particular estuarine, areas to nearby offshore regions is probably much smaller than formerly postulated. In fact, in some cases there are indications of an import of organic matter into coastal regions.
- (4) Migration of nekton, in particular larger crustacea and fish, over the coastal-offshore boundary is well-established for various, often commercially important, species. However, the importance and background of the exchange is insufficiently recorded and understood.
- (5) Notwithstanding higher nutrient levels, a higher nutrient recycling, a higher potential energy and higher habitat diversity, coastal ecosystems may not be always as productive on all trophic levels as is generally postulated, in comparison to offshore systems.
- (6) Most man-made disturbances are from point-sources and will have extremely local effects. Impacts on coastal-offshore interactions can be expected, in particular at the mouths of large river systems or in areas bordering highly urbanised regions.

During the second meeting of WG 65 a proposal was made to arrange a one week workshop with about 30-40 participants in late 1985. The aim of the proposed workshop was:

1. To review the state-of-the-art.
2. To discuss the progress of research in a multidisciplinary group of experts.
3. To propose and stimulate interdisciplinary research for the next decade.

The workshop was held from 7-11 April 1986 in San Francisco (U.S.), with Dr. M.M. Pamatmat acting as local organiser and Dr. B.O. Jansson as chairman. The following topics were considered:

- (1) Physical exchange processes.
- (2) Fluxes of chemical and biological matter.
- (3) The inshore area as a pool for chemical and biological matter.
- (4) Migrations.
- (5) Models.

Some 25 scientists participated in the workshop, of which twenty presented papers which were amply discussed. Arrangements have been made to publish the papers together with a full discussion of the results of the workshop in the light of the terms of reference of WG 65.

Proposal to Terminate WG 65:

At its last meeting in April 1986, the members of WG 65 discussed the future of the working group. The members decided that during the two meetings and at the workshop, of which the results will be further evaluated for publication, the Working Group had covered the requirements formulated in its terms of reference. The report of WG 65 together with the publication of workshop papers covers the review and comparison of the energetics of coastal and offshore pelagic and benthic populations, whereas the research recommendations in the report indicate the needs for the future research (see Appendix 1).

Therefore the Working Group suggests that it has finished its task and proposes to be disbanded.

APPENDIX 1

RESEARCH RECOMMENDATIONS

a. Nutrients

The ideal framework within which to evaluate the exchange between estuarine, nearshore, and offshore systems is the annual mass balance. In spite of the difficulties involved in efforts to obtain annual budgets of nutrients and organic carbon, the working group recommends that multidisciplinary, integrated research programmes be developed in different types of estuarine and nearshore ecosystems to provide estimates (with associated error terms) of the annual inputs and outputs of nitrogen, phosphorus and silica. It is extremely important for these efforts that the research team include chemical, biological, and physical oceanographers, as well as sedimentologists, who work together to obtain simultaneous estimates of nutrient inputs, primary production, nutrient regeneration, denitrification, long-term sediment accretion, and composition and exchange with near-shore waters.

The major ways in which estuarine and nearshore areas may serve as nutrient sinks include denitrification and burial in sediments. Both processes are, however, difficult to measure. The working group therefore recommends that efforts be made to intercalibrate the various methods used to measure each process (for example, $^{15}\text{NO}_3$ uptake, acetylene blockage, N_2O enrichment, NO_3 enrichment, N_2 pore water profiles, N_2 flux, etc. and bathymetric changes, ^{14}C dates, ^{210}Pb , etc.) and, if necessary to develop new techniques for the measurement of these processes.

As part of the mass-balance studies direct flux measurements across carefully chosen transects to system boundaries should be carried out. It is critical that such work involve a multidisciplinary team with attention to the problem of water transport and spatial and temporal variability in constituent concentrations in order to optimize the information gained within the constraint of a practical level of effort and instrumentation.

b. Organic matter

The various recommendations made on nutrients apply to the study of organic matter transport. Both direct flux measurements and mass balance calculations are important and should be undertaken together in different nearshore-offshore systems. Each approach is subject to many sources of errors leading to uncertainties that are difficult to quantify. The best way to evaluate the reliability of the final estimate of annual transport is to compare values obtained by both means.

One evident mechanism of transport of photosynthetically active matter is the drift seawards by upwelling-induced plankton blooms at the coast. In addition to the well-known,

large-scale upwelling events at the west coasts of the large continents there are minor, intermittent events at higher latitudes which are little known. We recommend an inventory of known cases, possibly as a topic of the recommended workshop, followed by multidisciplinary research programmes in selected geographical areas. Emphasis should be put not only on the horizontal transport but also on the sedimentation processes, the "unloading" of the patch during the horizontal displacement. The successful performance of such an investigation would need not only a high diversity of scientists but also a whole array of instruments from remote sensing platforms to drifting sediment traps.

In order to explore the possibility that primary and/or secondary production of the near-shore zone is enhanced by inputs from the estuarine zone, the group recommends that studies be made comparing the standing stock and productivity of plankton and benthos in areas influenced by river-estuarine plumes with that of near-shore areas without such plumes.

The biological processes leading to production and metabolic losses of organic matter in estuaries need further attention. For example, estimates of marsh grass production from biomass changes are understood to be minimal values but the extent of the underestimate is not known. In the case of benthic mineralization, and regeneration of nutrients, the relative importance of aerobic and anaerobic metabolism and their dynamic relationship is still largely unknown.

c. Fish-invertebrates

Although there is little doubt that coastal-offshore relations exist in many nekton-species, in particular in fish and crustacea, the importance and background of that relationship is insufficiently recorded and understood.

The Working Group recommends that future work be concentrated on:

Distributional patterns of juvenile stages in species for which a coastal nursery has been claimed.

The habitat selected by such juveniles in the coastal area.

Modes and mechanisms by which the juveniles enter the coastal area at the end of their larval stage.

Food selection, food availability and growth of the juveniles in the coastal zone.

Predation on and mortality of juveniles in various parts of their area of distribution and in various stages of their development.

Density-dependent factors affecting growth and mortality of juveniles with the ultimate aim of assessing whether the size and quality of the coastal area determines the size of the offshore nekton populations.

In view of the multitude of species involved it is recommended that the effort be concentrated on some carefully selected species, to detect general principles rather than disperse the attention on many species, for which incomplete data would be collected.

d. Productivity

Future work should be concentrated on:

Comparison of primary and secondary productivity in estuarine, nearshore, and offshore regions along various coasts to assess the causes and conditions inducing variability in productivity.

Mechanisms and causes of localized upwelling in estuarine and nearshore areas and the relationship to biomass concentration, changes in productivity, and impact on the structure of the ecosystem.

ANNEX VI

WORKING GROUP 66

OCEANOGRAPHIC APPLICATIONS OF DRIFTING BUOYS

INTRODUCTION

The SCOR Working Group 66 on Oceanographic Applications of Drifting Buoys last met in November 1983. The TOGA Drifters Planning Meeting held in La Jolla in March 1985, in effect, took the place of a meeting of WG 66 in 1985. Five of the nine WG 66 members were at this meeting which had many aims in common with those of the working group. The convenor, Dr. T. Kanashige of the Joint Planning Staff prepared a report on the meeting for the World Climate Research Programme.

In this report to SCOR we (1) outline the role and immediate future for WG 66, and (2) highlight some of the contents and recommendations of the report of the TOGA Drifters Planning Meeting.

1. WG 66 - role and immediate future

The value of WG 66 to the marine science community is its freedom to take a broad view of the applications of drifting buoys, without being confined to individual programmes or disciplines. For the WG to be effective in the near future it needs a new Chairman and several new members. These are under consideration now. It is desirable for the revised WG to meet in 1987, perhaps as part of the General Assembly of the IUGG in Vancouver in August.

2. TOGA Drifters Planning Meeting

The TOGA Drifters Planning Meeting examined the state of development and scientific utilization of drifters. The TOGA Programme is studying the interaction of the tropical oceans and the global atmosphere over a ten-year period from 1985 through 1994. An essential component of TOGA is a network of drifters to provide measurements of currents and temperature structure in the upper ocean as well as surface meteorological parameters.

3. The Scientific Use of Drifters

An example of the unique scientific importance of drifters was given by Dr. Hansen of AOML, Miami. He discussed the Equatorial Pacific Ocean Climate Studies Programme (EPOCS), which has used drifter releases from 1979 to the present time. The drifters revealed dramatic changes to the surface currents during the 1982-83 El Nino event: zonal currents experienced unusual major reversals and oscillations, and mesoscale eddies, normally characteristic of the equatorial North Pacific, were absent. Drifters moved towards and even across the equator, in contrast to their normal "aversion" to the equatorial region.

Dr. Hansen used the drifters to identify regions of convergence and divergence, and used wind information to recreate realistic tracks for drifters that had lost their drogues.

The Drifter Types

The meeting identified four basic satellite drifter types: Meteorological, current following, thermal and flux.

Meteorological drifters must, at the least, transmit barometric pressure and sea-surface temperature in near-real time in a format that permits automatic translation into the WMO DRIBU code for distribution over the Global Telecommunication System.

Current drifters are to measure advection in the mean surface mixed-layer and sea-surface temperature. The status of their subsurface drag elements should be included in the information telemetered from the drifter.

Thermal drifters are to measure temperature at several points along a subsurface line, as well as to measure hydrostatic pressure at one or more points. This will enable calculations to be made of heat content and potential energy integrated to a fixed depth, the mixed-layer temperature and depth, and the thermocline temperature gradient and depth.

Flux drifters should make it possible to determine the fluxes of momentum and heat for research purposes, and to calibrate such measurements from future satellites.

The meeting proposed standards for each drifter type (Table 1). The standards represent performance criteria that the various drifter systems should reach to obtain TOGA certification. Details of the performance and calibration for a particular system must be included in the TOGA data set for that system. This will reduce or remove problems that presently arise when attempts are made to merge data from drifters of different design.

Table 1 - The preliminary TOGA drifter standards.

| Meteorological drifters | Current drifters | Thermal drifters | Flux drifters |
|--|---|---|--|
| - <u>pressure</u> , ± 1 mb (in extratropics) | - <u>drogue slippage</u> , ± 5 cm/sec, at a depth of 10-20 m, under winds of Beaufort 4, and not in under- current (daily average) | - <u>minimum length thermistor line</u> : 150 m (200 m for W. Pacific) | - <u>wind stress</u> , accurate enough for use as ground truth for satellite measurements |
| - <u>sea surface temperature</u> ± 0.1°C | - <u>location error</u> : no greater than those due to drogue slippage | - <u>temperature sensors along the line</u> : minimum of 10, with at least one sensor in upper 5 m of the ocean | - <u>wind speed</u> : ± 1 m/sec, averaged over several hours |
| - <u>drogue</u> : no | - <u>sea surface temperature</u> : ± 0.2°C in upper 5 m of the ocean | - <u>temperature</u> : ± 0.1°C | - <u>latent heat flux</u> , ± 30-40 W/m ² for hourly means, and ± 20 W/m ² for monthly means |
| | | - <u>depth of tempera- ture measurements</u> : 5% | - <u>long and short wave flux</u> : to be determined by other means) |

The problems of merging data from drifters of different design are apparent in Table 2, which was prepared from details of drifters which were discussed at the meeting; in other words a subset of the world's drifters. There are numerous hull shapes and sizes, drogue types and sensors. The difficulties of comparing the movements of, and measurements made by, one drifter with another are obvious.

Table 2: The drifters discussed at the TOGA Drifters Meeting.

An asterisk (*) indicates an affirmative, while a blank either indicates a negative or, in some cases, that the information was not given in the report. A dash (-) indicates no relevance, e.g. 'axis length' for a sphere. SST: sea-surface temperature. P: atmospheric pressure. Chain: thermistor chain (number of thermistors). W: wind speed and direction. CHUTE: parachute drogue. SOCK: holey sock drogue. WSHADE: window-shade drogue. CORNER: a drogue that can be erected to resemble a corner reflector for radar. LCD: low-cost drifter. MLD: mixed-layer drifter. Further details are available in the report of the meeting.

| Name | Hull type | Mass (kg) | Flot'n Diam (m) | Spar Diam (m) | Axis Length (m) | SST | P | Chain | W | Drogue |
|------------------|-------------|-----------|-----------------|---------------|-----------------|-----|---|-------|---|--------|
| Australia | | | | | | | | | | |
| CSIRO | Torpedo | 40 | 0.4 | - | 1.6 | * | | | | CHUTE |
| Canada | | | | | | | | | | |
| Hermes Fgge | Spar | | | | | * | * | | | |
| " Airdrop | Spheroid | | 0.5 | - | 0.3 | | | | | SOCK |
| France | | | | | | | | | | |
| Ecomar | Spar | 26 | | 0.2 | 2.0 | | | | | WSHADE |
| Ecocap | Spar | 26 | | 0.2 | 2.0 | * | | | | WSHADE |
| Marisonde B | Spar | 100 | 0.54 | 0.2 | 2.7 | * | * | | | WSHADE |
| Marisonde BT | Spar | | 0.8 | 0.2 | 2.8 | * | * | *(10) | | WSHADE |
| Marisonde G | Spar | 130 | 0.8 | 0.2 | 4.1 | * | * | | * | |
| Marisonde GT | Spar | 130 | 0.8 | 0.2 | 4.1 | * | * | *(10) | * | |
| Marisonde C | Spar | | | 0.2 | 5.3 | * | * | | * | WSHADE |
| Focal | Spar | 136 | 0.8 | 0.2 | 2.7 | * | * | *(10) | * | WSHADE |
| BP77 | Spar | 350 | 0.4 | 0.25 | 10.0 | * | * | *(10) | * | |
| BDS82 | Sphere+Tube | | 0.72 | 0.2 | 0.95 | * | * | | | WSHADE |
| Japan | | | | | | | | | | |
| Toyo | | | | | | | | | | WSHADE |
| USA | | | | | | | | | | |
| LCD | Cannister | 4.5 | 0.14 | - | 0.08 | | | | | SOCK |
| MLD | Sphere | | 0.46 | - | - | | | | | CORNER |

New Sensors

K. Peal of the Woods Hole Oceanographic Institution described plans to measure scalar wind-stress through an inversion of the ambient noise measure beneath a drifter and the wind direction from the orientation adopted by the drifter because of an airfoil vane.

The possibility of replacing the electrical cable down to subsurface thermistors with a non-conducting cable that relies on acoustic signalling is being examined.

International collaboration for drifter activities

Effective international collaboration will lead to reduced costs for drifter systems and will simplify the logistics for large-scale experiments. It will also expedite the establishment of performance standards and data transmission formats, the sharing and distribution of data, and the resolution of legal issues, such as drifters from one country operating in the territorial waters of another.

Closing Comment on the IOGA Drifters Meeting

The TOGA Drifters Meeting provided a valuable survey of the state of the art in drifters as well as emphasizing the benefits of international collaboration for large-scale experiments.

ANNEX VII

WORKING GROUP 68

NORTH ATLANTIC CIRCULATION

Report on the Joint Meeting of SCOR-WG 68 and WOCE-NEG held at the Royal Society, London during 29-31 October 1985, by D. Anderson (Chairman, NEG) and F. Schott (Chairman, WG 68).

I. Introduction: Objectives and course of the meeting

SCOR WG 68 held three meetings prior to this final session: The first meeting took place at RSMAS/(U. Miami) on 9-10 March 1982 (SCOR Proceedings, 18, 68-73); the second one at UNESCO (Paris) on 17-19 October 1983; and the third one at GFDL (Princeton) on 24-26 September 1984 (SCOR Proceedings, 20, 56-67). Earlier on it had been decided to join forces with WOCE Numerical Experimentation Group (NEG) because it was felt that the basic objective of WG 68, to work on an improved understanding of North Atlantic circulation, could initially best be helped with a concerted modelling effort. At the Paris meeting, the first held jointly with NEG, a set of model intercomparison experiments with various types of ocean models was formulated. The test basin was to be the Atlantic from 85°N to 30°S. It was hoped that the evaluation of the output fields of the different models would also provide guidance for experimental and monitoring activities later on. More details on the intercomparison experiments were firmed up in a separate NEG meeting at Oxford in December 1983; and first results were presented at the second joint meeting of both groups at Princeton in October 1984.

The first objective of the London meeting reported here was presentation and discussion of more complete results of the models presented in the previous year as well as new results from recent start ups. Besides the intercomparison presentations, several process-oriented model studies on various aspects of North Atlantic circulation were reported on.

The second objective of the meeting was exchange of results of recent ongoing field experiments on North Atlantic circulation and discussion of plans for the near future (1986-88). These are summarized in activity charts for the individual years.

The third objective was discussion of field work considered necessary for WOCE. Sector meetings had been held in spring 1985 for all ocean basins but the North Atlantic; a discussion of WOCE relevant North Atlantic problems and shaping national or individual interests was therefore considered useful.

Reports and discussions on these objectives are briefly discussed here. A complete report with the individual contributions can be obtained from F. Schott, RSMAS/MPO, University of Miami, 4600 Rickenbacker Causeway, Miami, Florida 33149, USA.

II. Overview of model intercomparison and other NEG activities

1. Model intercomparison

At the time of the Paris 1983 meeting, there was essentially one model (the Bryan, Cox, Semtner model, hereafter denoted GFDL) capable of handling most of the thermodynamic processes thought to be of relevance to WOCE (although there were other models which could deal with some of the processes of interest to WOCE). There was, therefore, a need to stimulate the development of other differently formulated models and to intercompare their outputs so that some experience could be gained on their relevant strengths and

weaknesses. Rather than intercompare different models on an abstract experiment, it was decided to concentrate on a real ocean basin, the most suitable being the Atlantic since it is limited in size, has a strong thermohaline circulation, and has the best observations with which to test the models. A set of response experiments was needed with various types of ocean models to establish the significant signatures of the ocean in response to different types of forcing on different lengths and time scales and to establish the sensitivity of the model output to different parameterisations. It was anticipated that intercomparing different models for a given experiment would shed light not just on what were the most interesting regions of ocean for long-term measurements but would also bring out the critical aspects of different models. It was decided to split the intercomparison into two parts. For the first, denoted a tight intercomparison, the models would be thermodynamic, forced in as nearly as possible the same way. Ideally, any intercomparison should be done with as similar external parameters (geometry, topography, forcing) as possible. But this would exclude adiabatic models, which, while not able to represent all processes of interest, could be used to study aspects of the wind driven circulation, such as western boundary transport, eddy statistics etc. For this reason another group of models was used but which can only be loosely compared with the former thermodynamic model.

The tight intercomparison consisted of a run with mean plus seasonal wind forcing to study the model climatologies as well as their seasonal variations. Since the net heat flux needed to force the ocean thermodynamically is not known adequately, the alternative approach of fixing the surface temperature and salinity was adopted. In this approach the surface fluxes of heat and fresh water can be calculated by the model and compared with observation. The resolution was chosen to be 2° with 12 levels in the vertical, the basin geometry extending from 85°N to 29°S . The Caribbean, with its complicated geometry and topography, cannot be adequately simulated at 2° resolution so only one large island to represent the Antilles was retained. Where possible, the same output should be extracted from each model.

Following the mean plus seasonal runs, extending calculations for a few decades to examine, amongst other things, the sensitivity to changes in fluxes and wind stress were planned. The twenty-six years of Bunker monthly mean wind stresses can be used to examine interannual variability.

Originally three models were proposed for the tight intercomparison: the existing GFDL model, the nascent Hamburg geostrophic model, and the Miami isopycnal models. The GFDL model was quickly run to simulate the mean and seasonal circulation, but both the other two models took time to overcome unexpected difficulties. At present, the Hamburg geostrophic model has been run in a mode close to the initial specification (see Maier-Reimer) and to study interannual variability using the Bunker 26-year wind stress (Olbers and Willebrand). The Miami isopycnic model has been run in adiabatic mode only and a new isopycnic model, only recently developed in Hamburg, has also been run in adiabatic mode (Oberhuber).

The GFDL version now used has different specifications from that chosen initially (25 levels as opposed to 12, northern boundary at 68°N rather than 85°N , and different handling of the southern boundary conditions). These changes were introduced after deficiencies were found in the model climatology when compared to data. The revised model gives a better simulation when compared with observations (see Sarmiento and Bryan), but makes the model intercomparison less easy, prompting Gerdes to repeat some calculations. At present the intercomparison is incomplete as the model integrations have only recently been performed. Further intercomparison of the wind-driven isopycnic model is also required before they are made diabatic. These two models are quite different. The Miami model explicitly resolves barotropic gravity waves and for this component of the integration requires very small time steps. The Hamburg model uses a version of time splitting and can be integrated with much larger time steps (2 weeks). The method of

handling topography is also different. Brief details of the models are included in the Appendix (see Boudra and Oberhuber).

Another feature of interest is that both the GFDL model and Hamburg geostrophic model have some peculiar features in the equatorial region. The cause of this is not known but is probably associated with the level of friction used in the integrations (later studies by Gerdes confirm this for the GFDL model). The spurious salinity subsurface maximum is also an artifact of too low diffusion.

The adiabatic models of Anderson and Corry and Krauss appear to give different pictures of the seasonal variability in the Florida Straits/Gulf Stream system. The former model, which has 1° resolution and resolves much of the Caribbean geometry, gives transports which agree well with the early observations of Niler and Richardson (1973) and more recent STACS. But the model does produce a seasonally variable Antilles current, apparently at odds with observations.

An intercomparison between a quasigeostrophic model (Holland) and two isopycnic eddy-resolving models (Bleck/Boudra and Holland/Linn) is also in progress, though not yet complete. When the models are forced so that outcropping occurs, the quasigeostrophic model behaves differently from the isopycnic models (as expected). The two isopycnic models also differ from each other (see Holland).

It is clear from this summary and the abstracts that much remains to be done to complete the work so far undertaken. But a lot of experience has been gained on ocean modelling relevant to WOCE and, perhaps most encouraging, we now have a variety of models under development which can handle diabatic processes. New eddy resolving models are also in preparation.

Finally, one should not forget that using models to interpret data is only one way of using models for WOCE. An alternative is to try to combine data with models (see for example Wunsch). But this topic was the subject of a three-day meeting (Miami, April 1985) sponsored by CCCO and U.S. WOCE. A copy of the abstracts of talks at that meeting may be obtained from D. Haidvogel.

2. Global modelling

The concentration in the first phase of NEG modelling was on the Atlantic basin. But WOCE is a global experiment and some attention should be given to global models. Chemical tracers can provide useful data with which to verify models; the more tracers, the more useful they are in restraining model parameters. Tritium, Helium, Carbon 14, Fluorocarbons and Silica were thought to be useful tracers. To facilitate the attempted simulation of these tracers by modellers, WOCE-NEG requests that the best possible specification of the source functions for the above tracers be obtained. Tritium has been prepared by Sarmiento, but it was recommended that Broecker should be invited to prepare a C^{14} source function; Weiss, Fluorocarbons; and Edmond, Silica.

3. Inverse modelling

The NEG felt that the inverse/assimilation meeting held at Miami in 1985 had been very successful. This type of modelling activity is appreciated as being important to WOCE but it was felt that no organized modelling activity should be arranged at present. Rather, another meeting of about the same size as the first (30 participants) should be arranged. Sometime in early 1987 was considered a suitable time.

4. Coupled models

WOCE will have a need for coupled models. CCCO is sponsoring a meeting on coupled models sometime in late 1986/early 1987. The NEG endorsed the plans for this meeting; no further decisions on coupled models were taken.

5. Community climate model

At present primitive equation models can be run at a resolution of $1/3^\circ$ for a limited basin size. This resolution is, however, still inadequate. A high resolution experiment at $1/6^\circ$ is a major undertaking beyond the resources of any single group.

The idea was raised, however, of a major modelling initiative being taken collectively. The best available model would be run for an experiment, formulated by several international scientists, but carried out at one institute. Instead of the model being transportable, involved scientists would visit the institute at which the experiment was being carried out to check on progress and analyze results. One or two post doctoral scientists would be needed at the institute to supervise the day to day running of the model.

The above idea was proposed at NEG and generally supported by the group. However, the success of such a venture needs the support of the wider modelling/theoretical community than that present at the WOCE-NEG meeting. The proposal was that NEG should pursue the idea, and if considered feasible, bring forward a specific proposal to the WOCE-SSG for their consideration. W. Holland was assigned the task of assessing the feasibility of such a community model and formulating this proposal.

III. Discussion of ongoing and planned North Atlantic field work

Input on the programmes discussed in the following section was provided partially by meeting participants, and partially through input obtained from various investigators involved.

1. Florida Current and Gulf Stream

a) STACS

The Florida Current study at 27°N has been jointly carried out by NOAA/AOML and RSMAS since 1982, using PEGASUS profiling, moored current meter stations, cable measurements (NOAA/PMEL), tide gauges, and other methods. An EOF analysis has shown that Florida Current variability consists of cross-channel, out-of-phase, meandering modes which have small transport efficiency and small coherence with winds, and in-phase modes which have high transport efficiency and high coherence with winds. Concerning the seasonal cycle, it is still puzzling that model simulation of the Florida Current, which fairly well explains the observations (Anderson and Corry, 1985) also yields a large seasonally reversing current east of the Bahamas in apparent contradiction to recent moored measurements there.

At this time continuous transport time series are available for 1982-1985 and are analyzed jointly with winds from the ATOLL system (twice daily) regarding possible forcing mechanisms in various parts of the subtropical Atlantic/Caribbean. Analysis on how to combine a subset of the applied measurement techniques for a continuous monitoring scheme of the Florida Current is still in progress.

During 1986/87 the STACS field programmes are being expanded to include the flow east of the Bahamas/Antilles island arc, using PEGASUS/CTD along the lines in Figs. 1,2 as well as a moored array off Abaco, and also a line across the eastern Caribbean at 76°W with three to four cruises per year. The moored array is also instrumented to obtain transport estimates of the southward undercurrent of NADW. In 1987 moorings will be added in the eastern Caribbean inflow regime (Fig. 2).

b) FACTS and related studies

Several boundary current studies were carried out in the past few years between 27°N and Cape Hatteras. At present it is attempted to undertake a unified analysis of this most complete data set of the Florida Current ever compiled. There is also a possibility for more moored measurements in the southern Florida Straits/loop current region in the 1987 time frame.

c) SYNOP

The objective of this combined experimental and modelling programme is to understand the dynamics of the free Gulf Stream jet east of Cape Hatteras. Experimental work will include moorings with upward looking acoustic Doppler Current profilers (ADCP's) on top, inverted echosounders/transport meters, RAFOS floats, and an acoustic tomography array. A two-month long pilot study with two test moorings is scheduled for fall 1986, the full-blown experiment to begin in fall 1987 (Figs. 1,2).

d) BIO/WHOI Gulf Stream array

A two-year programme, with eight moorings and hydrography across the Gulf Stream upstream from the New England seamount chain, was concluded in April 1985. Results should be relevant for Gulf Stream models or high-resolution GCM's.

2. North Atlantic Current system

a) BIO Programme

Analysis of time series from a 4-mooring array across the subpolar front in the southern Labrador Sea found low horizontal coherence at mooring separations of about 50 km, but high vertical coherence due to deep-reaching small eddies, which have transports of the same order as the NAC. Hence, the array could not be used to construct NAC transport time series.

Plans for 1986/87 are for six moorings across the NAC and western boundary undercurrent and two upstream (Figs. 2,3) with horizontal spacings of about 30 km. Batfish and ADCP profiling will be carried out across the frontal zones in April 1986, February and November 1987.

b) Warm Water Sphere Programme of IfM Kiel/TOPOGULF

From satellite-tracked buoys, moorings, and hydrographic sections the following picture of the North Atlantic Current and recirculation was derived:

- (i) The NAC is a superposition of the current along the polar front and a broad drift which transports more than 20 Sv to the North. The main return flow occurs in the deeper layers, which implies that a considerable amount of water leaves the Warm Water Sphere south of Iceland. The subtropical gyre extends to about 43°N; its main transport towards east occurs along the Azores Front.
- (ii) East of the MAR the number of NAC branches was found to vary from two to five at a width of 200 to 400 km. The average WE transport was 27 ± 6 Sv against 2000 dbar, which was the reference level determined by moored measurements.
- (iii) The eastern recirculation amounts to about 10 Sv and is mainly fed by the Azores Current along the Azores Front. The front is baroclinically unstable and is a source for eddy activity south of the Azores.
- (iv) The currents in the entire recirculation area are eddy-dominated. While r.m.s. velocities of the eddies are isotropic, time and length scales are anisotropic.

Future IfM work during 1986-1988 (Figs. 1-3) will concentrate on:

- Continuation of Batfish sections Lands End-Azores-weather ship C;
- Frontal surveys at the polar front;
- Origin of the North Atlantic Current southeast of Newfoundland;
- Origin and location of the Azores Current and Azores Front;
- Continuation of the observations in the Canary basin;
- Observations in the "shadow area" north of the Cap Verde Islands.

c) Faroe-Shetland Channel branch

From four moorings, deployed by IOS for one year off Shetland, a northeastern flow of 7.7 Sv was determined with a seasonal cycle of 2.6 Sv (maximum in January/February, minimum in July/August).

Plans are for a more extensive study of the inflow into the Norwegian Sea across the Iceland-Faroe ridge (Figs. 2,3) in 1987/88 to investigate the questions of how much and what type of water crosses the ridge, what the role of the I/F front in this transfer is; and what fraction of this water actually enters the Norwegian Sea versus just recirculation back out around the Faroes.

3. USSR Sections programme

Unfortunately, the USSR member of WG 68 (Kosklyakov) was unable to attend the meeting and no input regarding status of that programme was provided.

4. Hydrographic long lines

An overview of the status was provided by M. McCartney; lines done during 1981-1985 are shown in Fig. 4; the 20°W line is proposed by McCartney for 1987 (to run through to South Georgia - along 25°W in the South Atlantic). At 11°N, only the western half has been done so far.

5. Western basin float programmes

(a) Floats, which were launched in 1983 near 34°N, 70°W to study spatial scales and eddy diffusivities in a particularly energetic Gulf Stream region, are still being tracked (WHOI/UW).

(b) Twenty floats will be released in 1986 at 700 m and 2000 m in the North Atlantic Current in the Newfoundland basin, to be tracked until 1988 (WHOI).

(c) Plans are underway for 1987/88 to launch forty-five floats in the Western North Atlantic boundary regime near 8°N (Fig. 2) at 700 m, 2000 m, and 4500 m, corresponding respectively to the layers of Antarctic Intermediate, upper and lower North Atlantic Deep Water to be tracked for four years (WHOI).

6. Deep Eastern basin studies

These studies, carried out for some years, by IOS, MAFF, COB and DHI Hamburg, focus on deep advection and diffusion. Long current meter time series of up to 7 years duration (MAFF) are now available from various sites. Principal results from Rockall channel sites are that the winter-spring peaks in eddy kinetic energy lag the winter peaks in wind stress by one to three months, probably caused by the cumulative effect of wind forcing and eddy dissipation; there also appears to be a correlation between interannual variability of wind stress and EKE.

Joint SOFAR float experiments by IOS/MAFF/COB continue with tracking of floats released at 2000 m near 24°N, 14°W, and at 3000 m near 32°N, 24°W. Sampling of various tracers in the bottom layers is also continued near the dumping site (46°N, 17°W) by MAFF; an experiment with active tracer release (perfluorocarbon) is being considered for 1987.

7. Norwegian/Greenland Sea

a) Greenland Sea Project

A 5-year study of the circulation, water mass conversion, and ventilation of the Greenland Sea, designed by the Arctic Ocean Sciences Board (AOSB), will begin in 1987. It has the following major components:

(i) Circulation studies using floats, hydrography and tomography (core period 1988/89)

(ii) Study of inflows and outflows by monitoring fluxes of ice and water masses

through Fram Straits, through the line Greenland - Jan Mayen and across the Mohn Ridge between Jan Mayer and Swalbord, using drifting buoys, moored instrument and hydrography.

(iii) Water mass census by seasonally repeated hydrographic surveys of the Greenland Sea.

(iv) Biology of the Greenland Sea, in particular, relating water masses of Polar, Arctic and Atlantic origin and to the distribution and the life cycle of plankton and fish.

Presently Canada, Denmark, Finland, France, F.R.Germany, Iceland, Norway, U.K., and U.S.A. have definite plans to participate.

b) New Federal Republic of Germany Programme.

The programme, entitled "Processes Relevant to Climate in the Ocean-Atmosphere-Cryosphere System," will begin in 1986 as a joint effort of meteorological and oceanographic instrumentation in Hamburg, Geesthacht, and Bremerhaven, and will focus on the development of parameterisation of processes that are essential to improve the models needed to understand the ocean's, the atmosphere's, and the cryosphere's role in climate. It is designed to combine modelling work, direct observations, and the development of methods for remotely sensed information as well as acoustic and electromagnetic methods for boundary layer work in the atmosphere and the ocean. Priority will be given to processes in high latitudes, since the effects of ice and deep oceanic convection are among those least understood in global climate modelling.

Although this programme is essentially global in its orientation, much of the observational work will be carried out in the high-latitude basins adjacent to the North Atlantic.

8. Mediterranean outflow

A combined shipboard/moored programme on the Mediterranean inflow/outflow in the straits of Gibraltar is underway during October 1985 - October 1986. Moorings include current meters, upward looking ADCP's, pressure and sea level gauges; shipboard work includes hydrography/tracers and microstructure measurements; surface drifters and radar measurements of surface currents are also used.

9. Subduction, ventilation

Two air-sea interaction studies are planned for early 1986. FASINEX, located in the subtropical front in the MODE area (Fig. 1), is designed to measure frontal currents, interactions, and subduction using small scale shipboard surveys with a variety of instrumentation, moored current meters and profilers, and drifters.

The second experiment is a fine-scale CTD survey of the frontal zone between Madeira and the Azores, in which bobbers will also be used (WHOI).

10. XBT Lines

The following XBT lines are operated in the North Atlantic (Fig. 5) with frequency and horizontal resolution as given below:

- (1) English Channel - Rio de Janeiro (FRG/DHI Hamburg)
Operated since 1980, until 1983 with 2 ships, since then 1 ship (round trip 6 weeks) at a sampling rate of 2 XBT's/degree.
- (2) English Channel - San Juan (FRG/IfM Kiel)
Operated since August/1984, 6 XBT's/day 14 sections until October/85.
- (3) LeHavre-South America only 20°N-10°S (France/ORSTOM)
Operated since 1981, 20 sections per year, 1 XBT/degree latitude.

- (4) Baltimore-Dakar (FRG/IfM Kiel)
Operated since November/1984, 1 ship, 6 XBT's/day, 3 sections until October/85.
- (5) Scotland-Cape Farewell (UK/Hydrography Dept.)
Operated since 1983, approximately 11 sections/year, 2 XBT's/day
- (6) Belle Isle Straits-Iceland (Canada/BIO)
To begin in 1986.

IV. North Atlantic Wind Fields

J. Willebrand reported on intercomparisons carried out at IfM Kiel between the Bunker winds and the Hellermann and Rosenstein (1983) winds. Differences were in general small, except for the NW corner, probably due to the different sampling time periods.

Another intercomparison, between ECMWF and the Miami ATOLL winds, was carried out by D. Anderson, who drove his two layer model with both wind stress data sets at daily intervals, for the month of February 1983. The phases of Florida Current transports came out similar, for both calculations but the amplitudes of the ATOLL driven transports were too high. Several years of ATOLL data did not reproduce a seasonal transport cycle of the Florida Current similar to the Bunker wind results.

In general, the meeting concluded that the best procedure for analysis of present-day observations would be to obtain wind stresses from ECMWF.

V. Discussion of issues related to WOCE

1. Status of WOCE planning

The U.S. WOCE committee has organized meetings for four ocean basins: South Atlantic, North Pacific, South Pacific, Indian Ocean. The proceedings of these meetings are published in U.S. WOCE Planning Report No. 2. No such meeting had been held for the North Atlantic. In addition to those "sector meetings," other meetings have been held or are planned on various phenomena and technical issues important for WOCE. One such meeting of relevance here, on ventilation and subduction, was held in July 1985 (convenor J. Luyten), with the result that a steering group was set up to plan a subduction experiment for the North Atlantic.

At the international level, WOCE is subdivided into three core projects (Core 1: general description of the oceans; Core 2: interbasin exchange; Core 3: gyre dynamics experiment). International meetings to work on experimental plans for these three topics will be held in 1986. Since the North Atlantic is a probable site for the gyre dynamics experiment and will be considered in Core 1, participants felt no need to work out specific recommendations but agreed to hold a more general discussion on the North Atlantic questions relevant for WOCE related field work and possible interests their groups might have.

2. Discussion of North Atlantic field work for WOCE

a) General

In the previous joint meeting of WG 68 and WOCE-NEG (Princeton, September 1984) it had been recommended to investigate the feasibility of a line of direct current measurements and hydrographic/tracer stations running from Labrador over to Greenland and from there to Ireland. Two members of the WG, A. Clarke and R. Dickson, looked into the problem and determined that the small horizontal correlation scales of a few tens of kilometers would make the cost of direct measurements all the way across prohibitive. Mooring separations would have to be 20 to 40 km. Hence, a section from Cape Farewell to Ireland would require the order of 75 moorings; from Grand Bank to the Azores 60 moorings. Even at these numbers uncertainties in the order of 1cm/s would remain in the interior of

the gyre. The recommendation therefore was (not quite unexpectedly) to use current meters only in the boundary flows, and hydrography, altimetry, drifters etc. to determine the interior flows.

In view of the significant differences of meridional heat flux in the northern North Atlantic in different computations it was concluded that one such line of measurements across the northern part of the basin would not suffice. Instead, one line should run from Cape Farewell (60°N) to Ireland (55°N) as discussed before; a second one, from the Grand Banks (48°N) to the Azores (38°N), then over to West Africa, where it has to be considered that in the eastern part of that second line, clearance problems might be an obstacle. These two lines should be repeated seasonally for one year, then continued annually. Interests at the national and institutional level (see next section) are emerging to occupy the western part of those sections along the western boundary and MAR topography.

Another zonal section considered crucial to WOCE was one north of the equator, near 10°N, to measure the seasonal exchange of mass and heat between the Atlantic basins. This line would need an instrumented section in the west, running normal to the Brazilian coast across the Guyana Current. It would also need special consideration of the upwelling regime at the eastern end. As at the two northern lines, seasonal measurements are considered necessary here.

Not much support was voiced at this meeting for long-term hydrographic stations which were previously recommended in addition to the Palunirus station.

b) Expressions of interest

(i) Western Subtropical Atlantic

An initiative, called "Western Boundary Indices" (WESBIN), has been started in NOAA/AQML to develop a programme for the subtropical North Atlantic into the WOCE period. One initial component of it, an extension of the Subtropical Atlantic Climate Studies (STACS), would be the establishment of indices in the western boundary currents; i.e. calibration of low cost monitoring techniques, similar to the STACS Florida Current application, which could then be used to obtain long time series of transports. Relation between sea levels and transports would be of particular interest in that context with regard to usefulness of TOPEX altimetry; submarine cables will also be further explored in that region (NOAA/PMEL). The second component would be repeated CTD/tracer lines across the subtropical North Atlantic; candidates would be a near-tropical line (8°-11°N range) and repeat of the 24°N section. Deep instrument arrays and sections at the western boundary would measure transport variations of the southward undercurrent. The plan is for the programme to begin in 1988 (Fig. 3).

(ii) Subpolar gyre/overflow

Initiatives are beginning both at MAFF and BIO to establish long-term array measurements of the overflow from the Norwegian Sea into the Atlantic. MAFF's interest is in either the East Greenland Current branch or the branch along the mid-Atlantic Ridge (Fig. 2). Work is proposed to begin in 1987. BIO is also interested in the East Greenland Current area.

(iii) Gulf Stream/North Atlantic Current

A second area of interest of BIO is a long-term moored hydrography section across the Gulf Stream/NAC running out SE from the Grand Banks. At WHOI, an experiment to run a seasonally repeated section triangle from Cape Hatteras-Bermuda-Cape Cod in the WOCE context is in the proposal stage.

3. Historical data analysis

As in the previous meeting, high priority was put on speedy analysis of the large inventory of historical data from the North Atlantic in preparation for the pre-WOCE and

WOCE circulation studies. As an example, old sections and XBT data in the vicinity of the proposed northern WOCE sections could be analyzed to better determine the resolution needed in the observations.

At the scale of the subtropical gyre, the XBT inventory should be analyzed to determine decorrelation scales at the upper thermocline level. Further, a decomposition of dynamic height variance into steric effects and upper thermocline tilt effects should be carried out. Based on these results, a sampling strategy for XBT data in the North Atlantic during WOCE should be established. Existing XBT track lines (e.g. Channel-S. America) plus the general XBT inventory should allow analysis of seasonal and interannual variability of the upper baroclinic structure and should proceed as a priority. Historical data should also be used to compare such parameters as heat storage and sea levels with equivalent results from numerical models as expected out of the intercomparison exercise.

VI. Summary and Recommendations

1. Model Intercomparison

A model intercomparison undertaken by WOCE/NEG has had several major successes. At the start of the intercomparison exercise, there was essentially only one GCM model capable of modelling thermodynamic processes to relevance to WOCE (GFDL, Hamburg), with two more (isopycnic) models well on the way to development, although the isopycnic models have so far only been tested without thermal forcing.

Although the intercomparison is fairly well advanced, it has not yet been brought to a satisfactory conclusion. In particular, the two thermodynamic models require further comparison as do the two isopycnic models. A priority issue therefore is to complete the intercomparison. This can best be done by direct collaboration between interested parties; the conclusions to be written as a report for the next NEG meeting. At a later stage, when the isopycnic models include thermodynamic processes, they should be compared with the level models.

No specific action is needed with respect to the layer models associated with the intercomparison of the wind driven response (Anderson, Krauss).

The intercomparison of the quasigeostrophic and isopycnic eddy resolving models (Holland, Boudra) should be completed.

2. Observational programmes for WOCE

Various committees of WOCE will take over the planning of observational studies in the North Atlantic; most obviously, Core-1 (general description of circulation/hydrography); there is also a possibility that the gyre dynamics experiment (Core-3) might take place in the North Atlantic. Further, process-oriented studies in the WOCE context will be carried out in the North Atlantic; one of them a subduction/ventilation experiment.

In summary, specific recommendations as to future field work by WG 68 are not needed at this time.

However, proposals and planning of several groups as presented at the meeting are already aiming at programme components relevant for WOCE in the North Atlantic, among them:

- Norwegian Sea overflow arrays (MAFF, BIO)
- North Atlantic Current transport array (BIO)
- Subtropical gyre transports in WESTBIN (NOAA)

3. Wind fields

The best interim product prior to availability of NSCAT was considered to be the ECMWF wind stresses. Increased efforts should be undertaken to make them more easily available for the community.

Concerning historical wind stress, data sensitivity studies with numerical models as to the effects of their differences are recommended.

4. Historical data

Acceleration of historical data analysis on seasonal and interannual variability, for decomposition into steric and dynamic effects, and for products to be used in the intercomparison with numerical models, is recommended.

VII. Acknowledgements

This was the final meeting of the WG 68 and the contribution of its members to its activities, as well as logistical support by Mrs. E. Tidmarsh, SCOR Executive Secretary, is gratefully acknowledged.

We thank the Royal Society for hosting the meeting.

APPENDIX

Summaries of presentations given at joint meeting of SCORWG68/WOCE-NEG
29 - 31 October 1985

I. NORTH ATLANTIC MODEL STUDIES

A. Basin Wide Models and Intercomparison

1. Modeling seasonal changes in the heat balance of the North Atlantic - J. L. Sarmiento and K. Bryan
2. Mean NA circulation with two versions of the GFDL model - R. Gerdes
3. Preliminary studies with a large scale geostrophic model of the North Atlantic - E. Maier-Reimer
4. An isopycnic coordinate model of the North Atlantic circulation with seasonally fluctuating wind forcing - R. Bleck, D. Boudra, L. Smith
5. An isopycnal model used for North Atlantic circulation calculations - J. M. Oberhuber
6. Response of North Atlantic Circulation to interannual wind and heat flux variations - D. J. Olbers and J. Willebrand

B. Regional and Process Studies

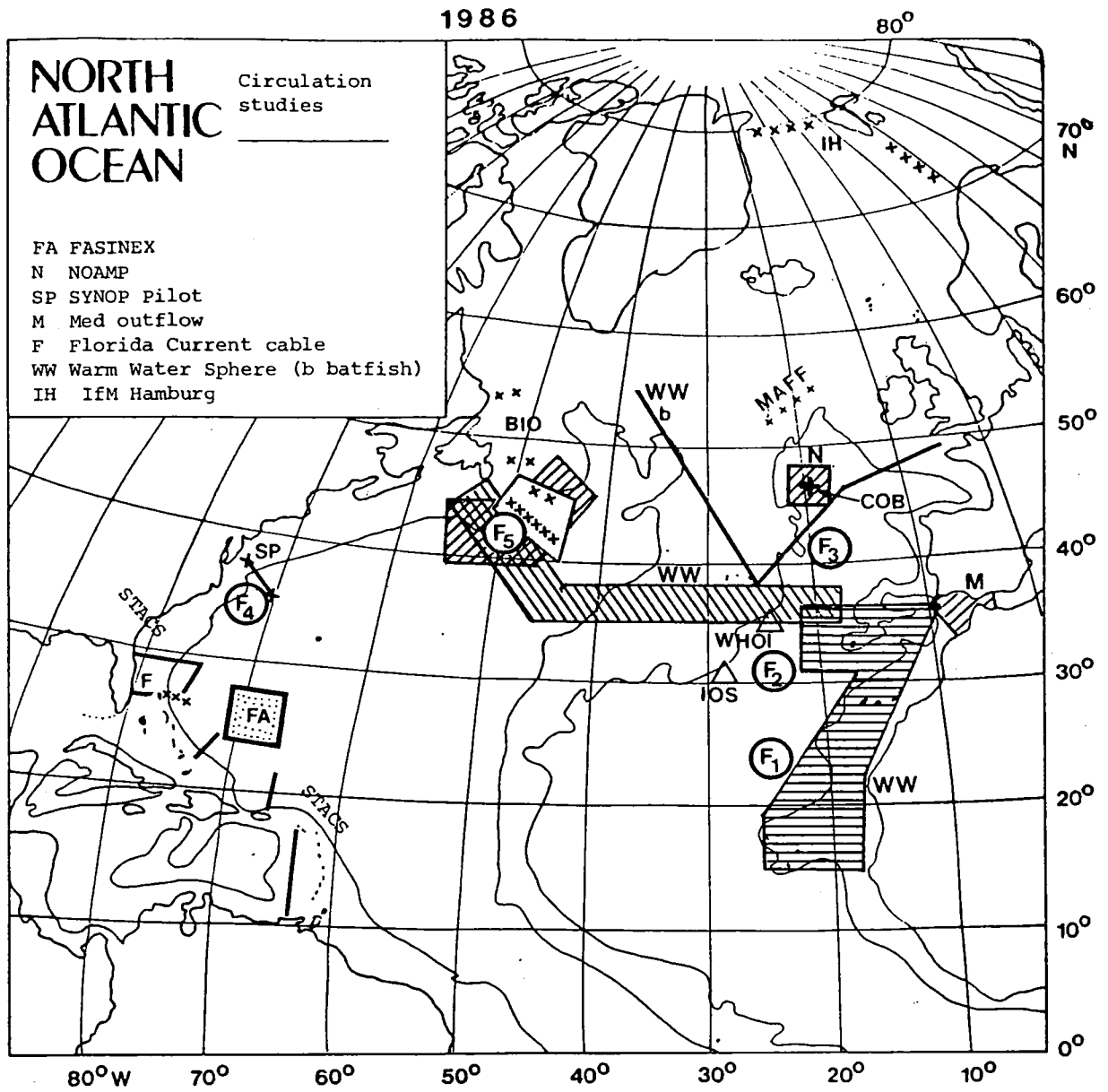
1. High-resolution modeling of western-boundary circulation - W. R. Holland
2. Quasigeostrophic mode model - W. Krauss
3. Some of the effects of a mid-ocean ridge in an EGCM simulation - C. Le Provost and J. Verron
4. Numerical modeling of low-frequency fluctuations in the Florida Current - D. Boudra, F. Schott and R. Bleck
5. Inverting Acoustic Doppler Data Simultaneously with hydrography - C. Wunsch

II. NORTH ATLANTIC OBSERVATIONAL STUDIES

1. Observational programs in the western subtropical Atlantic and Florida Current - F. Schott
2. BIO programs, current and planned - A. Clarke
3. North Atlantic Current/Warmwatersphere program - W. Krauss
4. North Atlantic Current transport across the Mid-Atlantic Ridge - J. Meincke
5. Faroe-Shetland Channel flow - P. M. Saunders and J. Gould
6. Eastern basin programs of MAFF - R. R. Dickson
7. Greenland Sea/Norwegian Sea Studies - J. Meincke
8. French North Atlantic programs - Y. Desaubies and J. Merle

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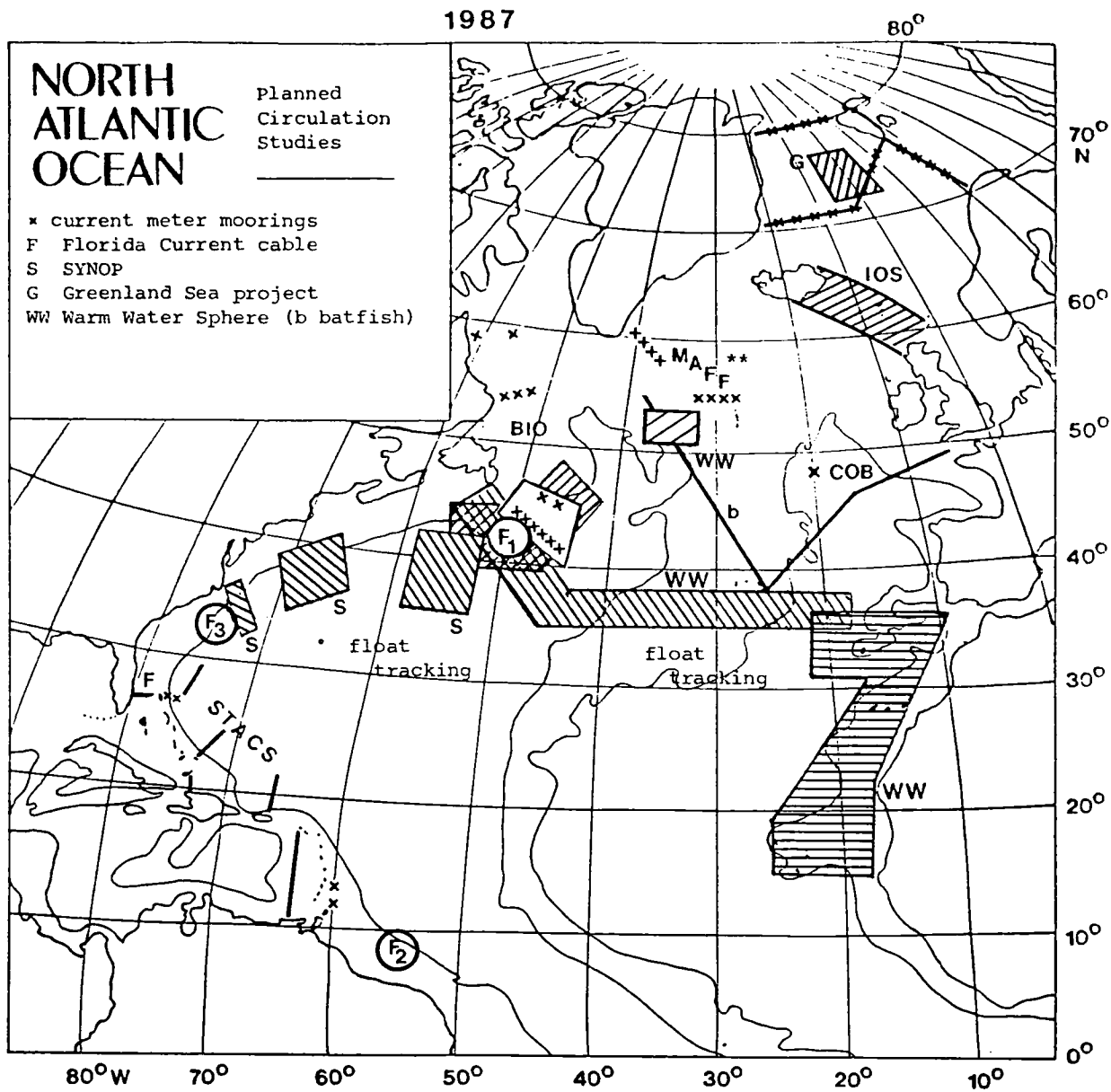
 A collection of these abstracts can be obtained from F. Schott, RSMAS/MPO, University of Miami, 4600 Rickenbacker Causeway, Miami, Florida 33149-1098, U.S.A.



Deep drifters:
 F1 8 SOFAR/3000 m (IOS/MAFF)
 F2 8 SOFAR/2000 m (IOS)
 F3 (MAFF)
 F4 RAFOS (URI)
 F5 20 SOFAR/700,2000 m (WHOI)

Moorings:
 x single
 Δ triangle

Figure 1.

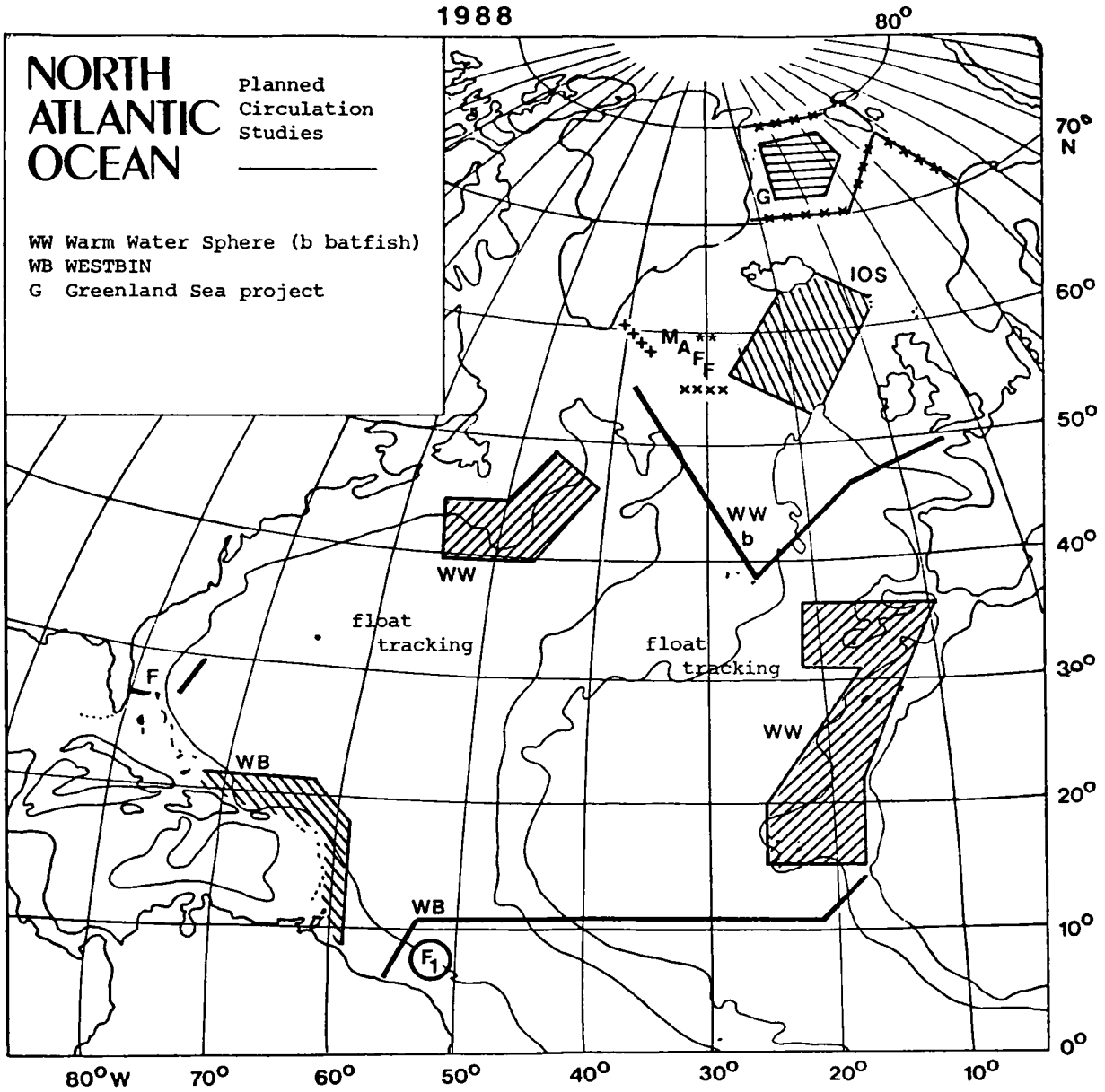


Deep drifters:

- F1 SOFAR/700,2000 m (WHOI)
- F2 SOFAR/700,2000,4000 m (WHOI)
- F3 RAPOS (URI)

** MAFF does northern or southern array

Figure 2.



Deep drifters:
 F1 SOFAR/700,2000 m (WHOI)

** MAFF does northern or southern array

Figure 3.

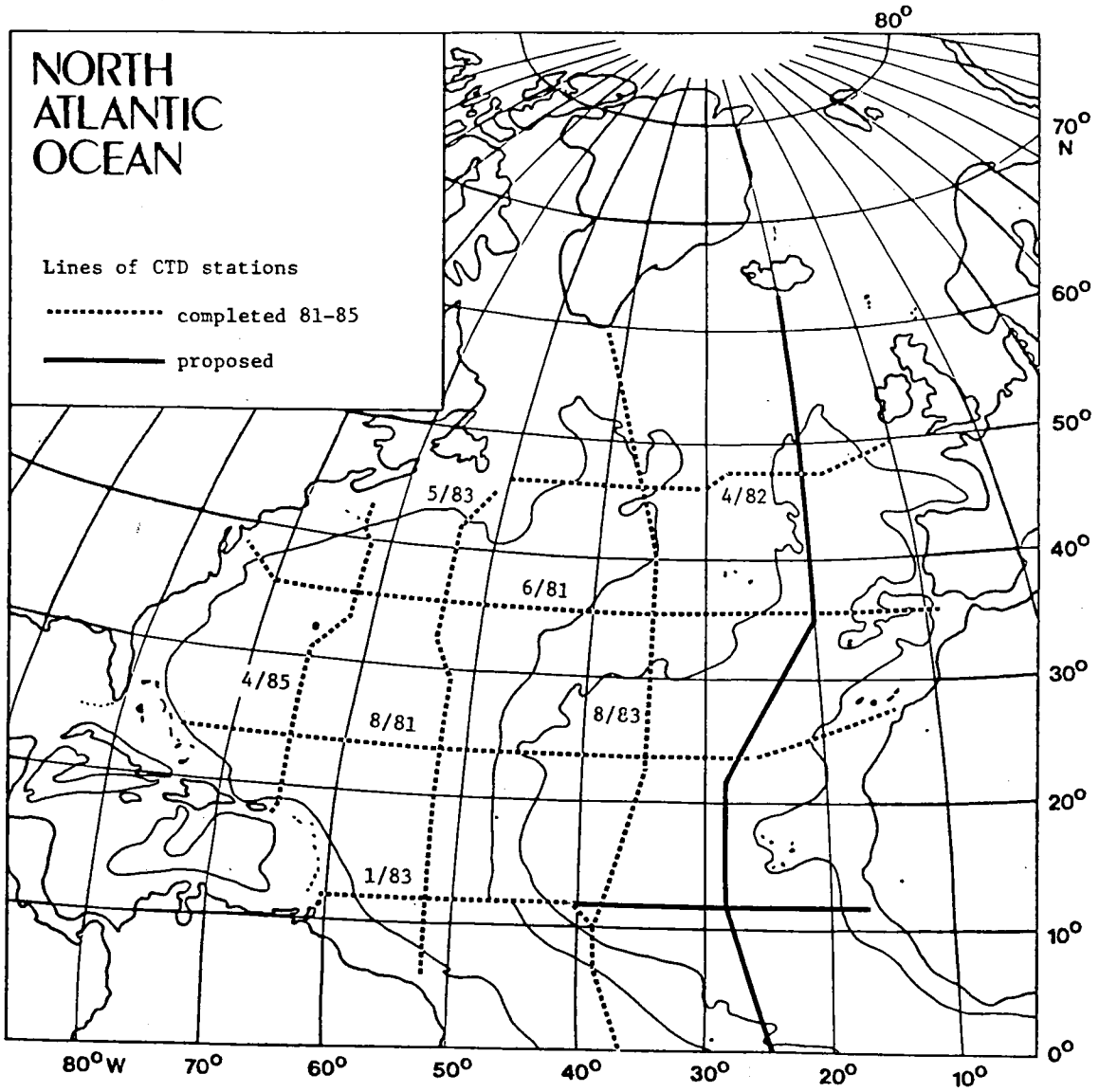


Figure 4.

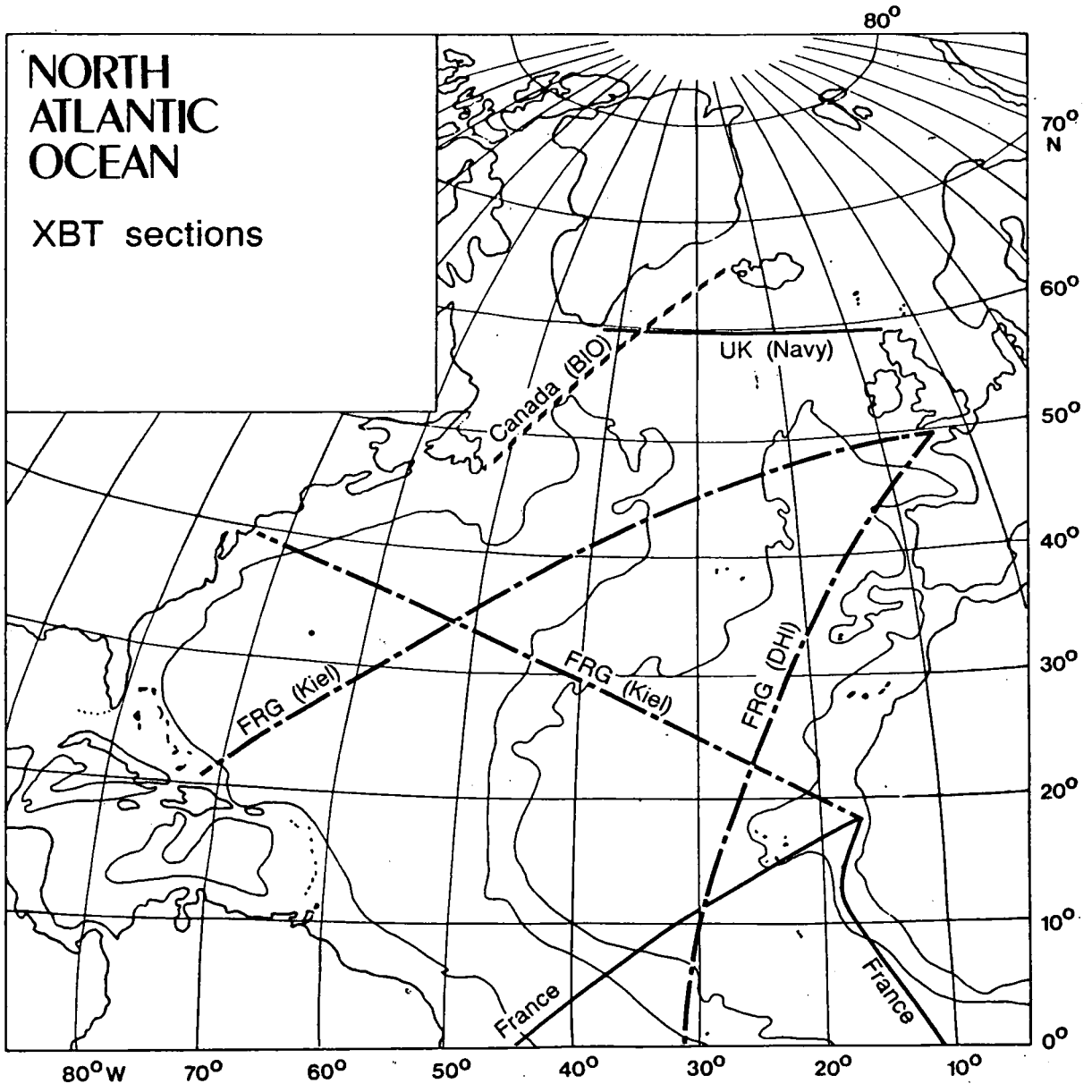


Figure 5.

ANNEX VIII

WORKING GROUP 72

THE OCEAN AS A SOURCE AND SINK FOR ATMOSPHERIC CONSTITUENTS

The Working Group 72 was set up during the 16th General Meeting of SCOR held in Halifax, 1982. The terms of reference were:

To review the present knowledge of processes and measurements related to:

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

Members of the working group are: R. Duce (USA), R. Chesselet (France), M.O. Andreae, P. Liss (UK), A. Tsyban (USSR), and O. Zafiriou (USA).

The group had first met in July 1983 at Jouy-en-Josas (France), in conjunction with a workshop on "Dynamic Processes in the Chemistry of the Upper Ocean." The working group discussed its possible future activities and agreed to organize an international workshop on air-sea exchange, with the main emphasis on processes interacting with the flux of trace substances through the air-sea interface. There was general consensus that the performance of such a workshop would provide a good opportunity to:

- review the present knowledge in different fields contributing to air-sea exchange
- present most recent results
- make this information available to the whole scientific community involved in this research area
- encourage interdisciplinary discussions among biologists, chemists, physicists and meteorologists

It was recommended to hold a workshop in Mainz, FRG.

The group had convened for a second time in September 1985 at Bombanne in conjunction with a workshop on "The role of air-sea exchange in geochemical cycling." The major item of discussion was the preparation of the proposed workshop in Mainz, FRG. It was agreed that:

- the proposed international workshop would focus on the interaction between the biosphere and atmosphere
- particular emphasis should be given to the flux of trace constituents across the air-sea interface
- the members of WG 72 will act as the programme committee with W. Seiler as the local organizer

A list of invited speakers was composed and a preliminary programme of the workshop was set up. Furthermore, the working group decided to prepare a document summarizing the present knowledge concerning the terms of reference of this working group. The document should be presented as a final report to SCOR.

The proposed international symposium was held in Mainz on 16-21 March 1986, and was entitled "Biosphere-Atmosphere Exchange." Major sessions were:

- Biosphere and particles.
- Global distribution of biospheric trace constituents.
- Deposition of trace constituents in terrestrial ecosystems.
- Production of trace constituents in terrestrial ecosystems.
- Oxidation of biogenic trace gases in the atmosphere.
- Flux of trace gases from freshwater ecosystems.
- The ocean as a source of trace substances.
- Global aspects, budgets.

The meeting was attended by about 150 participants from 25 countries, including Brazil, India, People's Republic of China. Because of the financial support by SCOR, scientists from several developing countries had been invited to participate. The symposium was sponsored by:

- SCOR
- Federal Ministry for Research and Technology (BMFT, Bonn, FRG).
- German Meteorological Society (DMG, Frankfurt, FRG).
- Fraunhofer-Society (FhG, Munich, FRG).
- Max-Planck Society (MPG, Munich, FRG).

The symposium provided an excellent opportunity for discussions among scientists from different disciplines which resulted in the planning of several cooperative, international projects which may contribute to the IGBP (International Geosphere-Biosphere Programme). The chairman, as well as the participants, of the individual sessions emphasized the great need for such an interdisciplinary symposium and expressed their hope that future symposia on this topic will follow in the near future.

Following the symposium on "Biosphere-Atmosphere Exchange," the Working Group 72 met in Mainz on the 22nd of March, 1986. The meeting was attended by the group members: Duce, Liss, Andreae, Norkrans and Seiler. In addition, Dr. Roether (FRG), Dr. Buat-Menard (France) and Dr. Conrad (FRG) were invited as experts to participate in the meeting and to contribute to the proposed summary report on the present knowledge in air-sea exchange. The results of discussions are summarized as following:

1. The working group reviewed the symposium which had brought together scientists from different scientific fields. There was general agreement that the symposium was very successful and covered many aspects of air-sea exchange and the biospheric role within the flux of trace constituents between the ocean and the atmosphere. The symposium benefited from the presence of scientists working in terrestrial ecosystems, e.g., on dry deposition, presenting new techniques on deposition studies which may be applied after some modification for flux measurements of trace constituents between ocean and atmosphere. There was consensus that the interaction between the participants of the symposium was excellent and that their discussions among the scientists will likely initiate future cooperative efforts in biosphere-atmosphere exchange with particular emphasis on the marine environment. The group recommended the continuation of the present series of symposia on biosphere-atmosphere exchange at time intervals of two years.

2. The chairman informed the group that Drs. Chesselet and Zafirou had resigned from Working Group 72 so that the working group presently consists only of 6 members, i.e. Andreae, Liss, Duce, Tsyban, Norkrans and Seiler. It was recognized that several areas important for the terms of reference of this WG were not covered. The members, therefore, recommended nomination of the following experts to become members of WG 72:

- | | | |
|--------------------|----------|-----------------------|
| Dr. B. Holligan | (U.K.) | - Phytoplankton |
| Dr. R. Zika | (USA) | - Photochemistry |
| Dr. P. Buat-Menard | (France) | - Particle Transfer |
| Dr. B. Hicks | (USA) | - Exchange Mechanisms |

In addition, W. Roether (FRG), B. Dahlback (Sweden), and R. Conrad (FRG) should be invited to be corresponding members of WG 72. The members of the working group thanked the previous members, Chesselet and Zafiriou, for their important contributions to the group activities.

3. Contributions by the group members and invited experts to the proposed document on the "Present state of knowledge in air-sea exchange" were presented and discussed. Contributors were asked to modify their contributions according to the recommendations of the group and to submit the final version to the chairman. The final report should be ready at the end of 1986.

4. The group members discussed the present knowledge and future needs in air-sea exchange. After consideration of papers presented at the symposium on "Biosphere-Atmosphere Exchange," the discussion focussed on four important areas for future research on which this group proposes to concentrate its future efforts. These areas are:

- Improvement and development of techniques for measuring transfer velocities at the air-sea interface.
- Studies on the role of atmospheric input of nutrients on the marine productivity and ocean fluxes.
- Studies on the role of photochemical processes in the air-sea exchange of chemical species.
- Studies on the role of biological activities in the exchange of trace constituents between ocean and atmosphere.

5. Dr. Roether (University of Heidelberg, FRG) proposed a field study on Atmosphere-Ocean Gas Transfer which received attention and in general is supported by WG 72. The group agreed that improved gas exchange measurements are essential for understanding the contribution of ocean to global budget of atmospheric trace constituents. A close cooperation with the WOCE Working Group on Atmospheric-Ocean Exchange is recommended.

6. The group members recommended the continuation of WG 72 for a second period for:

- Continuing discussions on scientific problems important in the field of air-sea exchange.
- Finalizing planning of collaborative, international experiments in air-sea exchange.
- Coordinating these efforts on an international basis with ongoing or planned international efforts, e.g., IGPB.

ANNEX IX

WORKING GROUP 76

ECOLOGY OF THE DEEP-SEA FLOOR

The first meeting of the WG, in Hamburg in June 1985, resulted in a report which was disappointing to both the WG members and to the SCOR Executive Committee. The WG felt that the main reason for this was the nebulous nature of achievable goals.

The SCOR Executive Committee acknowledged this problem and felt that the WG should be terminated at the General Meeting in 1986 unless the group could formulate a set of terms of reference which would identify more specific problems in benthic biology which the WG might be able to solve within a reasonable time.

Accordingly, the group suggests the following new terms of reference under the same general title:

1. To make recommendations on the extent and type of information necessary to describe deep-sea benthic and benthopelagic communities to enable significant future changes, from whatever cause, to be detectable.
2. To identify those areas of research in which current knowledge or technology are not adequate to enable these recommendations to be fulfilled.
3. To identify those areas of research, relevant to the above, which would be best tackled by international collaboration.

These terms of reference provide a much more focussed set of objectives than did the earlier ones. If the continuation of the WG is approved, considerable progress in answering several basic questions could be made during the coming year without the need for a meeting.

These questions include the following:

1. Is the current taxonomic knowledge and expertise in the deep sea adequate for the aims addressed in item 1 of the terms of reference?

There is a fundamental dichotomy of opinion within the WG on this issue which reflects a similar dichotomy among deep-sea biologists as a whole. Some members feel that "better" taxonomy is urgently needed and should be encouraged since the validity of such apparently non-taxonomic indices as diversity/species richness, demography and the recognition of functional groups of organisms is ultimately dependent upon sufficient taxonomic knowledge to allow individual species to be recognised as such (even if they are not named). Other members within the group would argue that only the numerically or gravimetrically dominant species need to be studied and that a lack of taxonomic knowledge of the rarer species is not therefore crucial. Between these two extreme views, other members feel that while a complete taxonomic treatment is desirable, this is not achievable within a reasonable time scale and a compromise must be adopted (see below).

2. What structural and/or functional features of deep sea communities could or should usefully be examined in addition to or instead of the taxonomic description?

The raw data for diversity/species richness indices, which are themselves potential indicators of stress, would automatically be generated by general taxonomic treatments of communities. Other features of community structure would not result from such a treatment, nor do they require a taxonomic treatment as a necessary prerequisite.

One such feature is the particle size distribution biomass spectrum which, according to modern ecological theory, provides an alternative "taxonomy" to the traditional one and has much more immediate ecological relevance. However, although it is acknowledged that the size-dependent structure of benthic communities is better understood than that of pelagic communities, there are serious methodological problems requiring solution before adequate biomass spectra for deep sea communities can be obtained. By chance, the traditionally accepted size distinction between meiofauna and macrofauna (in the range 250-500+um) seems to correspond to a division between two functional groups and there is some evidence for a similar division between the macrofauna and megafauna. Nevertheless, there are still considerable variations in the mesh sizes used to deal with samples by different groups of workers so that direct comparison of data sets is difficult. However, while there is clearly a need for agreement on standardization of techniques (e.g., mesh sizes) as noted in last year's report, the group would probably stress the importance of treating the size spectrum as a continuum while acknowledging the practical need to split it into sections.

More difficult problems include the adequate sampling and analysis of the extremes of the size range. If the WG is to make significant recommendations at the lower end of this range, advice from microbiologists will be required. At the upper end of the range the group probably includes sufficient expertise and experience to make valid recommendations without recourse to outside help.

While extensive biomass spectra for deep-sea communities would provide much more information on the structure of such communities than is usually obtained, they would have little value in elucidating how the various compartments interact and how mass or energy flow through the systems. For such information it is necessary to measure fluxes such as ingestion, excretion, production, and respiration. Measurement of these fluxes in the deep sea is difficult and the only one so far tackled with any significant success is respiration (O_2 consumption), for which a number of measurements have been made for the total benthic community (microbiota to macrofauna), and for a few individual megafaunal organisms. The WG would attempt to determine whether the other fluxes could be measured with the available or newly developed technology and whether such measurements would be worthwhile.

Other dynamic features of populations/communities, such as the rates of recruitment, growth, reproduction, and mortality, could clearly be addressed with existing technology, but require a sampling and analysis commitment which has so far been achieved to some extent for only one deep sea locality, the Rockall Trough. The WG would try to determine whether such studies in other regions are necessary or desirable for the purposes identified in the terms of reference.

With its present make-up the WG should be able to make considerable progress in answering these questions by drawing on the expertise of other specialists by correspondence. However, it is likely that by the next SCOR General Meeting it will be necessary to obtain more permanent help from such specialists by changing the membership of the group to include at least a mathematical ecologist and a microbiologist.

ANNEX X

WORKING GROUP 77

LABORATORY TESTS RELATED TO BASIC PHYSICAL MEASUREMENTS AT SEA

Opening of the Meeting

The Chairman opened the meeting on 4th November 1986, 9.30am, in the "Klubhaus der Warnowwerft," Warnemunde. All of the members of the group were present. Arrangements had been made for a visit to the laboratories of the IfM and for a discussion with instrument development engineers.

1. Priorities of sensors to be investigated

After some discussion the group established the following list of priorities:

- Group I: Conductivity, temperature and pressure sensors
- Group II: Dissolved oxygen sensors

The general opinion was that current velocity meter intercomparisons would be beyond the scope of WG 77. Dr. Dauphinee was asked to contact IEEE Oceanic Engineering Society/Current Measurement Subcommittee in order to get "state of the art" information.

The majority of the group rejected the proposal to use the difference between measured and calculated sound velocities as a rough check of the C-, T-, and p-sensors. It was noted that many side effects, including those caused by microbubbles, made such a check of uncertain validity.

2. Concept for a laboratory intercomparison of basic sensors

There was general agreement to the concept of carrying out CTD-sensor laboratory intercomparisons. After some amendment of the original proposal, the objectives of such an experiment were defined (Appendix 1).

A lengthy discussion ensued to determine target precisions and accuracies for CTD-instrument intercalibrations (Appendix 2).

It was quickly realised that for intercomparison purposes currently available CTD-systems could be divided into two types: those which could be separated from their electronics and still operate, and those where this was not possible. The "separable" CTD's (Guildline, Seabird, DDR OM-75, etc.) would allow the use of a small tank for intercomparisons, a point of particular importance at high pressures. Dr. Striggow offered the facilities of the Institute for Marine Research of the Academy of Sciences of the GDR for an intercomparison of separable CTD systems.

With regard to the very commonly used CTD-instruments (e.g. Neil Brown), Dr. Mahrt proposed that intercomparisons be carried out at the Institute for Applied Physics of the University of Kiel, FRG, where the pressure tank would allow complete insertion of CTD-instruments. The group felt that advantage should be taken of this singular facility as soon as possible; Dr. Mahrt stated that the second half of 1987 would be a suitable time for the experiments.

In the discussion it was recommended that the following types of instruments, after being fully calibrated, should be delivered to Kiel:

- NEIL BROWN (WHOI, IOS, UK)
- GUILDLINE (BIO, and maybe IOS Sidney, B.C.)
- BATHYSONDE 2000 (IfM Kiel)
- SEABIRD
- OM-75 (sensors only; IfM Warnemunde)

Group members thought it essential that each CTD should be accompanied to Kiel by a technician/scientist trained in its use to ensure that intercomparisons were made of fully operating, properly calibrated, instruments. Although the group felt that laboratory intercalibration of the listed CTD-instruments would be expensive, they would welcome further instrument types. The chairman was asked to invite Soviet institutes to participate as well as the Scripps Oceanographic Institution.

Regarding the dissolved oxygen sensor, Dr. Striggow expressed the interest of the IfM Warnemunde to carry out an intercomparison, provided that the necessary electric and electronic adaption of the Sensor to the IfM measuring system is not too complex. However, the majority of the group recommended postponement of a decision on this matter.

3. Tests of sea-going transfer standards for CTD operational checks

After discussion the group recommended:

- not to consider reversing thermometers as a suitable means of checking CTD thermometers, due to their lower inherent accuracy
- not to carry out an intercomparison of bench type salinometers, due to the outstanding capability of the AUTOSAL instrument (cf. ICES/Hydrogr. Comm. Report C. M. 1986/C: 31)
- the use of the triple-point of water cells as a temperature standard rather than the ice point as the latter has a much lower inherent precision in the hands of the average operator.

4. Reviewing the accuracy and precision of existing STD, CTD, and related instruments

The group felt that discussion of this point at the present time would be premature, as it could only be on the basis of information given by the manufacturer. It was decided to postpone this item until the laboratory intercomparisons/intercalibrations have been carried out.

5. Other matters

The group felt that the title and terms of reference of WG 77 should not be changed; regarding its membership, the SCOR Executive Committee is asked to remind the Soviet National Committee to nominate an expert.

The second meeting of WG 77 should be arranged at the Institut für Angewandte Physik der Universität Kiel, Kiel, Federal Republic of Germany, at the end of 1987 or beginning of 1988, followed by the third meeting about half a year later. None of these meetings should be longer than three days.

The need for two meetings was assessed on the experience of many members that experimental programmes inevitably produce a need for further work, to clarify the results then to hand. Often such additional work is essential in order to allow proper interpretation of the data.

Funding by SCOR (and other sources, if possible) is necessary for the:

- CTD-sensor laboratory intercomparison experiment (1987) Estimates are not yet possible, but it is anticipated that all the institutes involved in supplying CTD equipment will do so without any charges for transport of men or materials, and application for support in the experimental programme will be made by Dr. Mahrt to the appropriate authorities in F.R.G.
- 2nd meeting (end of 1987 or early 1988) 18 mandays + 6 travel costs
- 3rd meeting (1988) 18 mandays + 6 travel costs

6. Closing of the Meeting

The Chairman closed the meeting at 3pm on the 6th November 1986.

Appendix 1. Objectives of CTD-Sensor Laboratory Intercomparison Experiments.

| sensor | test conditions | errors to be detected |
|------------------------|---|--|
| 0. all sensors | vibration and mechanical shock | sensitivity to mechanical forces |
| 1. temperature sensor | 1.1 temperature cycling at constant pressures | instability of the thermometer calibration curve |
| | 1.2 pressure cycling at constant or near - adiabatic temperatures | effect of pressure on the thermometer |
| 2. pressure sensor | 2.1 (near-adiabatic) pressure cycling at different starting temperatures | hysteresis of pressure sensor; shifting of zero point; static effect of temperature on the pressure sensor |
| | 2.2 temperature cycling at constant pressures | effect of temperature on the pressure sensor |
| 3. conductivity sensor | 3.1 temperature cycling at constant salinities and pressures | effect of temperature on the conductivity sensor |
| | 3.2 pressure cycling at constant salinities and constant or near-adiabatic temperatures | effect of pressure on the conductivity sensor |

Appendix 2. Target Precisions and Accuracies for CTD Instrument Intercalibrations.

| Quantity (Dimension) | Range | Laboratory Standards | | Laboratory Transfer to Field Instruments | |
|-----------------------|----------|----------------------|------------------------------------|--|-----------|
| | | Precision | Accuracy | Precision | Accuracy |
| T (°C) | -1 to 30 | ±.0005 | ±0.001 at 0 °C ±0.0015 at 30 °C | ±.001 | ±.002 |
| P* (MPa) | 0-60 | ±.02 %** | ±.05 %** | ±.02 %** | ±.05 %** |
| C ($\frac{mS}{cm}$) | 2 - 65 | ±.0005 | ±.0015 | ±.001 | ±.003 *** |
| S (-) | 2 - 42 | ± 0.0005 | ±.001 | | ±.0035 |

* Values given are after correction for atmospheric pressure reading

** of reading

*** This figure does not include proximity effects

ANNEX XI

WORKING GROUP 78

Determination of Photosynthetic Pigments in Seawater

OPENING

The session was opened by the Chairman, Dr. Fauzi Mantoura, who briefly reviewed the aims of the present meeting and informed the Members that the need for such a working group had arisen in order to inform the wider community of advances in techniques for the determination of the photosynthetic pigments of chlorophylls and carotenoids which represent perhaps the most frequently measured biological oceanographic parameter. The need for transferring this information would perhaps place more emphasis on the operational and analytical aspects of pigment methodology rather than the marine biogeochemical processes.

AGENDA AND BACKGROUND TO WG 78

Dr. Selim Morcos, the representative of UNESCO, informed the members that the Working Group was sponsored both by SCOR and UNESCO and he apologized that the formation of the group had taken some time. He recapped the events leading to the present meeting, informing the group that the preliminary proposal prepared by Drs. Dawson and Mantoura had been submitted by UNESCO to the SCOR Assembly in 1983. This was subsequently reviewed widely by the SCOR National Commissions and the IABO and, with Terms of Reference suggested by Dr. Mantoura, was adopted by the SCOR General Meeting in 1984.

Certain criticisms had been raised during the course of the reviews including the connection of these techniques to estimates of biomass and the adaptation of techniques to recommend the simplest procedures for widespread adoption.

During the discussion on how the products of the Working Group will be disseminated, various modes of publication and information dissemination were considered. These included UNESCO Monographs in Oceanographic Methodology, the UNESCO Technical Papers in Marine Science, a dedicated issue of an international science journal with additional exposure through a dedicated symposium, or even a critical multi-author review volume on methodologies in marine pigment analysis. The advantages and disadvantages of these options were discussed and it was concluded that this decision should be deferred until the products of the Working Group had been more clearly defined. This was considered to be of particular importance since the early recommendations of this group may have significant impact on, and be particularly relevant to, major oceanographic experiments planned for the coming years (e.g., GOFs). It was noted in this context that a final report to SCOR of the Working Group's progress could be made available through UNESCO Technical Series in a timely fashion if camera ready materials were provided for review by the SCOR Publication Office in which case publication and dissemination could be effected within three to six months.

REVIEW OF TERMS OF REFERENCE

The Working Group reviewed the Terms of Reference as tabled by the Chairman to SCOR and distributed to WG members.

The first Term of Reference was modified to allow for a critical evaluation of the accuracy of the historical data since it was pointed out that the Working Group was charged with taking a constructive approach for scientists to reassess the accuracy of existing data sets in the light of intercomparison made by this Working Group and provide guiding principles for quality classification of those data. It was pointed out that the original SCOR-UNESCO procedure of 1968 was indeed extensively intercalibrated in 1978

(UNESCO Technical Papers in Marine Science No. 35, 1980).

It was felt unnecessarily restrictive at this stage to identify an isocratic approach as the only chromatographic system available.

Referring to previous concerns raised in the initial evaluation of the proposals by the SCOR Executive Committee, that the Terms of Reference of the Working Group should include an extension to relate chlorophyll estimates to various indices of biomass, it was concluded that emphasis should be placed on ensuring accurate measurements of photosynthetic pigments and breakdown products by the marine community, rather than on the problems of biomass conversion for which these data are frequently used. Nevertheless, it was felt that progress by this Group could benefit from ancillary back-up with commonly adopted techniques for estimation of indices of biomass.

It was proposed that the absence of a phycobiliprotein expert be rectified by proposing Dr. W. Siegelmann or Dr. Elizabeth Gant to provide critical reviews on recommended methodologies.

The Group felt that it should take into account the relevance of accurately determined concentrations in relation to the in situ fluorescence, remote sensing and flow cytometric techniques, but need not be concerned with establishing firm relationships between these methods.

PRESENTATION OF MINI-REVIEWS

The Chairman had previously requested individual members to provide succinct written reviews of a number of topics which were presented orally for discussion. A summary of principal points made in the oral presentation of reviews is presented below:

- a. A significant amount of unpublished, additional information had been obtained by Dr. Jeffrey and other co-workers with a view to further updating the UNESCO 1980 report and this could now be conveniently incorporated in the work of this Group.
- b. Additional "new" chlorophylls have been reported in the literature which may affect light harvesting properties and which could provide a basis of an update of their chemotaxonomic importance.
- c. A distinction is clearly warranted between artifactual breakdown products (e.g., solvent allomerisation, filtration-induced chlorophyllide production) and those produced by natural catabolic processes.
- d. The utility of traditional and modern forms of TLC separations need to be placed in perspective with high performance liquid chromatography and other techniques.
- e. A critical compilation of essential but scattered information on pigment properties (spectral, extinction coefficients, solvent systems, etc.) should be compiled as an Annex to any monograph prepared by the Working Group. A list of their recommended algal and perhaps commercial sources should be included.
- f. Links should be forged with experts in similar efforts being undertaken in the freshwater phycology fields, with possible future reciprocal representation on these committees.
- g. A clear evolution to aqueous phase compatible systems of reversed phase chromatography has evolved over the last few years. This approach has been widely adopted for a variety of reasons, mainly because of its ability to separate compounds spanning a wide range of polarities and its compatibility with accepted solvent extraction systems. It is, therefore, recommended, that this will be the method of choice for routine HPLC analysis

of pigments in seawater.

h. Although good separation can be obtained for all known chlorophylls, their breakdown products and the principal algal carotenoids, a crucial requirement for accurate quantification requires the wide availability of certified pigment standards to the marine science community at large. Therefore, the Working Group should consider its fourth term of reference, and means for characterizing and disseminating information on these materials as one of its key goals.

i. Clear guidance should be provided on the notation and quantification of unidentified pigments in natural samples. Only tentatively identified compounds should be indicated as such by use of terminology such as "chlorophyll-like," for the sake of clarity in the literature.

j. The greatest discrepancy between spectrophotometric and HPLC techniques occurs in samples containing significant amounts of pigment degradation products. Their characterization and quantification in these types of samples should be included in the intercomparison efforts.

k. In view of observed inconsistency between the fluorescence methods and other methods (including HPLC), it is felt that a methodological update would be timely and that this should include any updated details of acidification procedures.

l. It was pointed out that HPLC analysis has been instrumental in a wide range of ecological studies, some of these important in concepts of biomass and production estimates. These include the determination of C^{14} incorporation into specific pigments indicative of taxonomic groups, indication of grazing selectivity and pressure and in cluster analysis for finger printing and identification of water masses, source specific markers of terrestrial plant input to estuarine environments and sedimentary diagenesis.

m. The wide range of time and space scales of pigment information required by the oceanographic community requires that the coordinating groups consider optimally matching the precision and accuracy of the techniques to application at hand. For example, satellite imagery may require a precision of 100-200% whereas primary production estimates require precisions <10% and photophysiological experiments at the cellular level require "maximum" accuracy <1%.

n. Flow cytometry offers the opportunity of discerning cellular levels of pigment fluorescence (including the phycobiliprotein fluorescence); however, a distinct need exists for accurate standardization of these techniques with authentic chlorophyll particles in conjunction with accurate assays.

o. Future high resolution satellite colour imagery of the sea surface requires accurate sea-truthing with accurate chlorophylls and carotenoids.

p. The Group was reminded of the rigorous chemical criteria for the unambiguous chemical structural identifications of carotenoids, normally undertaken by structural organic chemists. However, advantages could be taken of the body of reliable literature on the carotenoid distribution pattern of defined algal species as a means of obtaining reliable and reproducible algal sources of reference pigments. The number of species required to cover this range is not expected to exceed it.

q. The provision of authenticated carotenoid standards was not deemed practical at this time since few are commercially available and their shelf lifetimes are variable. However, this was considered to be an important gap for this Working Group to consider and efforts in this regard are strongly encouraged.

r. The minimum acceptable identification criteria for a known pigment is co-chromatography on at least two separate chromatographic systems, together with matching of absorbance spectra, either as discrete samples or by diode array spectroscopy.

s. A range of additional simple chemical and physical tests, diagnostic of pigment types, should also be highlighted.

t. The absence of spectral data in acetonitrile, a popular eluent in HPLC, was noted.

u. Analysis of carotenoid breakdown products can yield information on the fate of phylogenetic organic matter in the sea. Unknown carotenoids and carotenoid breakdown products are formed via a wide variety of routes, and yield a large number of products whose separation and identification requires refined and specialized techniques (GC-MS-NMR) not readily available to the marine student.

v. Resuspended sediment may introduce large quantities of transformed pigments into bottom waters of many marine systems and complicate the interpretation of pigment distributions in seawater in some localities.

w. In a discussion of problems of intercalibration, the need for certified and uncompromised standards and reference materials was strongly emphasized.

x. A true intercalibration amongst laboratories was perhaps premature and an intercomparison of techniques could only reasonably be carried out at an on-site workshop when sampling and storage problems may be overcome.

y. Basic suites of biomass indices including taxonomy, cell numbers, volumes, and derived cell carbon estimates are useful correlative indices for the proposed intercomparative pigment workshop.

INTERSESSIONAL ACTIVITIES AND TASKS

It was felt hasty and premature to proceed directly to an Intercalibration Workshop since considerable amounts of methodological updates, data compilation, and preliminary analyses could be done intersessionally.

The WG then briefly split into two sub-groups (carotenoids, chloropigments) in order to identify intersessional tasks for completion before any Intercalibration Workshop.

THE FOLLOWING TASKS AND RESPONSIBILITIES WERE IDENTIFIED

1. Reference Phytoplankton Cultures - In view of the importance of phytoplankton as primary natural source of pigments in the sea, it was felt useful to compile a list of strains which could represent a practical, easy-to-grow, and taxonomically representative source of marine pigments.

2. Natural Pigment Samples - spanning a range of environments, including marine estuarine water samples, surficial sediments, sediment traps, faecal matter, detritus, will be provided also by Mantoura/Jeffrey for analyses by WG.

3. Preliminary Pigment Analyses - The object is to conduct an analytical intercomparability exercise involving qualitative and, at best, semiquantitative analyses by existing and new methods. HPLC, (NP and RP), TLC, spectrophotometry, and fluorometry will be compared by WG members and volunteers as a preliminary test bed for the experimental workshop.

It is proposed that samples from phytoplankton cultures and natural environments (approximately six) will be provided as freeze dried material on GF/F filters, and shipped desiccated in dark containers to participating laboratories in January 1987. The results,

which should be sent to Fauzi Mantoura, would only be for internal use and serve as a guide for identifying key experiments/analyses needed for the Intercalibration Workshop.

4. Methodological Updates

- Invite Dr. W. Sieggelmann (or Dr. E. Gant) to provide critical review on phycobiliprotein methodology (Mantoura).
- Report updated list of spectrophotometric equations for the determination of chlorophyll *a*, *b* and *c* in various solvents, together with their accuracy and historical derivations (Jeffrey) (see 4a).
- Recommend protocols for the isolation of pure chlorophyll *a*, *b* and *c* and the preparation of their major degradation products (chlorophyllides, phaeophytins, phaeophorbides, and allomers) (Jeffrey).
- Update the acid-fluorometric determination of chlorophyll and phaeopigments (Lorenzen).
- Recommend calibration procedures for HPLC with fluorescence detection of chlorophylls and breakdown products (Mantoura).
- Specify the extraction and clean-up protocols recommended for the isolation of principal marine carotenoids: fucoxanthin, fucoxanthin esters, peridinin, lutein, prasinoxanthin (Liaaen-Jensen, Repeta).
- List purity criteria and simple purity checks for marine chlorophyll (Jeffrey) and marine carotenoid (Liaaen-Jensen) standards including $E_{1\%}^{1\text{cm}}$, T_{max} , nmr and ms properties.
- Update list of commercially available carotenoids documenting reliability, availability and diagnostic purity tests (Repeta, Liaaen-Jensen).
- Prepare glossary of pigment terminology. Recommend notation and quantitation procedures (eg., $E_{1\%}^{1\text{cm}}$ values) for unknown pigments (Liaaen-Jensen, Mantoura, Jeffrey).

PROPOSED INTERCALIBRATION WORKSHOP

Following a period of intersessional work and a review of the accomplishments at a small meeting of the Workshop Group, suggested for March 1987, preparations should be made for an intercalibration workshop after September 1987.

The objectives of the workshop would be defined in greater detail after the review. However, the Group considered that a workshop would be necessary to compare HPLC techniques with spectrophotometric and fluorometric techniques using well characterized individual pigments, reference algal cultures, and assemblage of these together with natural algal populations and detrital material.

This would hopefully lead to a reappraisal of equations currently used for evaluation of spectrophotometric data and an estimation of the types of situations where existing data may be considered reliable; conversely, the types of situations where these techniques are erroneous.

Emphasis should be placed on chlorophylls and their principal degradation products but techniques for carotenoid identification, e.g., on different column phases and by TLC, should also be included in the practical workshop.

Additional aims of the Workshop might include the establishment of relative response factors for HPLC determinations, examinations of sampling, filtration, length of storage and storage conditions, and comparison with *in vivo* and remote sensing techniques.

It was concluded that such a workshop would, of necessity, be of a duration of three weeks but that not all investigators would be required to be on site for the various aspects of the study.

Both the Chesapeake Biological Laboratory, University of Maryland, Solomons, Maryland, and the CSIRO Laboratory in Hobart, Tasmania, indicated their willingness to host and provide facilities for the Workshop; the availability of the algal reference collection in Hobart and the preparative pigment procedures currently undertaken were

considered advantageous. Costs of transporting equipment and personnel were factors to be considered at a future date as well as budgetary implications such that final decision regarding these offers has not been reached at the present meeting.

CLOSURE

The Chairman thanked Dr. S. Morcos, UNESCO, and all the observers for their invaluable contribution to WG 78's first meeting and looked forward to their continual involvement in future WG activities.

The meeting was closed at 1230 hrs on 20 March 1986 prior to tours of the facilities at IMER and MBA. The Chairman expressed his thanks and satisfaction for what he considered a productive and effective start to the tasks of the Working Group.

ANNEX XII

WORKING GROUP 79

GEOLOGICAL VARIATIONS IN CARBON DIOXIDE AND THE CARBON CYCLE

The Working Group held its first meeting at Woods Hole on 8 September 1986, during the Second International Palaeoceanography Conference. Five members attended, and one additional member was represented by proxy.

Membership and meetings The following individuals are currently members of WG 79:

| | | | |
|------------------------|---------|---------------|---------------|
| E. Sundquist, Chairman | (USA) | J. McKenzie | (USA) |
| E. Barron | (USA) | H. Oeschger | (Switzerland) |
| E. Borisenkov | (USSR) | N. Shackleton | (UK) |
| E. Degens | (FRG) | He Qixiang | (China) |
| D. Lal | (India) | | |

M. Budyko (USSR), who has not yet responded to an invitation to join the group, will be informed of all group activities pending his response. In addition, the members present at the meeting agreed that the group would benefit from an additional member with expertise in the geologic record of terrestrial processes. The consensus was that land plants and soils cannot be ignored in our assessment of geologic carbon cycle variations. This opinion was reinforced by results presented at the Symposium: foraminiferal Cd/Ca and $^{13}\text{C}/^{12}\text{C}$ ratios (presented by E. Boyle and A. Mix, respectively) suggest that internal oceanic "nutrient pump" mechanisms cannot account for the glacial-to-interglacial atmospheric CO_2 changes inferred from ice core measurements. Accordingly, the chairman recommends that Professor J. Kutzbach (University of Wisconsin, USA) be invited to join the group.

The group requests formal SOOR cosponsorship of a symposium in 1987 on "The Global Carbon Cycle: Palaeoclimatic Perspectives." This meeting is being organized for the INQUA Congress (30 July - 9 August 1987) in Ottawa, Canada, by Dr. Sundquist and Dr. Alan Hecht, Director of the U.S. National Climate Programme Office. Speakers at the symposium will include several members of WG 79, and the papers will be published as a group in the new AGU journal Palaeoclimatology. The next meeting of WG 79 will be held in conjunction with this symposium. Both the symposium and the working group meeting will emphasize Quaternary time scales ($10^3 - 10^6$ years); it is expected that the focus of WG 79 will shift primarily to longer time scales ($10^6 - 10^9$ years) in 1988.

Discussion of research status and needs

The members agreed that a bibliography and mailing list should be compiled as a means of disseminating information on current research on geological variations in carbon dioxide and the carbon cycle. Dr. Sundquist distributed a draft bibliography listing references selected, mostly according to the following criteria:

1. Publication was subsequent to AGU Geophysical Monograph 32 (The Carbon Cycle and Atmospheric CO_2 : Natural Variations Archean to Present, edited by E. Sundquist and W. Broecker).
2. Subject matter includes explicit consideration of global carbon cycle and/or CO_2 variations.

3. Subject matter emphasizes variations that occurred over geologic time scales (10^3 years or longer).

The members of WG 79 will update this draft with references through 1986. The bibliography will be divided into four subject areas, and working group members will work on updating in their areas of expertise, as follows:

1. Quaternary: Borisenkov, He, Lal, Oeschger
2. Tertiary and Mesozoic: Barron, McKenzie, Shackleton
3. Palaeozoic and Precambrian: Degens, Sundquist
4. Application of geologic knowledge to historical and modern biogeochemistry: Sundquist.

It is hoped that Drs. Borisenkov and He will also contribute references that will improve the draft bibliography's incomplete representation of relevant publications by Russian and Chinese scientists. Dr. Sundquist will compile a mailing list from various sources, and the bibliography will be prepared and mailed by the U.S. Geological Survey in early 1987.

The group expressed a particular interest in two books recently published in Russian: History of the Atmosphere, by Budyko, Ronov, Yanshin; and Planetary Gas Exchange of O_2 and CO_2 , by Byutner. WG 79 recommends that English translations of these books be made available through appropriate channels. Dr. Sundquist will follow up on this recommendation by contacting the authors.

Professor Oeschger, although not present at the meeting, provided a written summary of his views on current studies of ice cores and carbon isotopes. Ice core gas measurements show a strong correlation between atmospheric CO_2 and major climatic changes over the last 150,000 years. Together with studies of atmospheric and oceanic ^{13}C and ^{14}C , these measurements yield valuable insights regarding carbon cycle mechanisms and their relation to climatic change. Major periods of geologic interest are the Little Ice Age and Medieval Optimum, the Climatic Optimum of 6000 - 8000 years BP, the glacial-interglacial transitions, and rapid northern hemisphere changes during the Wisconsin. Problems of dating air in ice might be greatly reduced by accelerator ^{14}C measurements in newly formed ice from large diameter ice cores. In view of the importance of ice core measurements to understanding carbon cycle and CO_2 variations, WG 79 support efforts by Professor Oeschger and others to expand ice drilling in Greenland and Antarctica.

Carbon isotope measurements in sediments are also emerging as an important key to understanding global cycle variations. However, interpretation of these measurements is clouded by limited knowledge of carbon isotope systematics in modern ocean and lake waters and organisms. WG 79 strongly recommends that current and planned oceanographic surveys of dissolved inorganic carbon be expanded to include collection of samples for isotope measurements. This recommendation was also discussed and adopted by WG 81, and should be considered a joint action by both working groups. J. Duplessy will convey this recommendation to the CCCO, and Dr. Sundquist will communicate it to WG 71 and WG 75.

ANNEX XIII

REPORT OF THE

SCOR/IOC COMMITTEE ON CLIMATIC CHANGES AND THE OCEAN

This report summarizes the activities of CCCO in 1986, presents a programme outlook for 1987 and beyond, and identifies a number of new thrusts being considered by CCCO. Supplementary information (publications, for example) is contained in other documents of the General Meeting. The seventh session of CCCO took place at UNESCO Headquarters in January 1986. The primary task of CCCO-7 was to evaluate the development and implementation of the large-scale experiments within the WCRP: the Study of the Interannual Variability of the Tropical Ocean and Global Atmosphere (TOGA), and the World Ocean Circulation Experiment (WOCE). This session addressed a number of other topics including: palaeoclimatology; training, education and mutual assistance associated with the ocean components of the WCRP; the International Geosphere Biosphere Programme (IGBP); a host of data questions; and WCRP ocean data management. The last subject was given special attention as it is essential that the large quantities and various types of ocean data required by the WCRP be handled efficiently and made readily available to scientists and for practical applications.

Tropical Ocean Global Atmosphere

The ten year observational period of TOGA began in January 1985 and international data centres are beginning to assemble special data sets and produce analyses of indicators of climate variability. While there are many encouraging TOGA actions underway, CCCO noted that there are also significant gaps in the ocean observational programmes and urged both the intergovernmental and scientific communities to intensify their efforts to obtain the data required for TOGA studies. CCCO will undertake, based on two years of experience, a major review of TOGA in 1987 to determine whether it will meet the scientific objectives as presently designed and operating.

The fourth Session of the TOGA Scientific Steering Group (SSG) was held in New Delhi, February 1986. The purpose of the session was to review progress in implementing TOGA and to reassess and prepare a comprehensive statement on the TOGA scientific strategy. The SSG decided to establish prototype modelling centres for each ocean basin on an informal basis. These centres will generate experimental operationally useful products on forcing fields, sea level, etc. The USA has already begun experimental runs for the Pacific Ocean. A similar modelling effort for the Atlantic is being undertaken in France.

The TOGA SSG held its fifth session September 1986 in Abingdon, UK, at which it decided to focus the TOGA objectives by defining two main "thrusts," namely:

- (i) Developing an operational capability for dynamical prediction of the coupled tropical ocean/global atmosphere system, starting with the current state of the system and focussing on prediction of time-averaged anomalies, on monthly-to-seasonal time scales, up to several months in advance.
- (ii) Exploring the predictability of longer time-scale variations of the tropical ocean/atmosphere system, on time scales of one to several years, and understanding the mechanisms and processes underlying this predictability (e.g., the series of ENSO cycles).

For the purposes of "Thrust 1," considerable knowledge of mechanisms explaining the monthly-to-seasonal variability has already been gained. A basic requirement to achieve

the goals of "Thrust 1" is the maintenance, upgrading and development of TOGA observing and data systems, as described in the TOGA Implementation Plan. On the other hand, "Thrust 1" is exploratory in nature. Progress will result from diagnostic studies based on a variety of available data, and theoretical investigations based on a hierarchy of coupled ocean-atmosphere models.

The IOC and WMO have established an Intergovernmental TOGA Board to provide a forum for international consultations to assure coordination of national resources that may be applied to TOGA, to review progress made in the implementation of TOGA, and to take action to correct deficiencies. Fourteen countries will be invited to nominate representatives at the first meeting of the TOGA Board in mid-1987. The scientific community will be represented by the Chairmen of JSC and CCCO. In addition, the chairman of the TOGA Scientific Steering Group will attend the sessions of the Board in the capacity as the main scientific expert or advisor.

World Ocean Circulation Experiment

The planning for WOCE passed a milestone with the finalization of the scientific plan (issued in September 1986). The WOCE Scientific Steering Group is now concentrating on the implementation and detailed planning of the experiment which will be focussed on three core projects, each discussed at major workshops in 1986. These were 1) Global Description (November, Washington), 2) the Southern Ocean (May, Bremerhaven), and 3) Gyre Dynamics (September, London). The plan will be completed by mid-1987 and submitted to an international conference early in 1988. A seventh session of the Steering Group was scheduled to take place 2-5 December 1986.

A WOCE Workshop on Assimilation of Satellite Wind and Wave Data in Numerical Weather and Wave Prediction Models was held in March 1986, at the European Centre for Medium Range Weather Forecasting, Reading, U.K. The Workshop identified the steps needed for the development and implementation of a comprehensive data assimilation system for the effective processing of the wind and wave data which will become available with the next generation of oceanographic satellites.

CO₂ Biogeochemical Activities

A new endeavour studied at CCCO-7 was an oceanic CO₂ Monitoring Research Programme. The CCCO CO₂ research proposal deals with measurements needed to determine and understand the changes in oceanic carbon resulting from human activities - principally fossil fuel combustion and deforestation. The Committee accepted responsibility for planning studies of the changing CO₂ content of the ocean on climatic time scales and requested its Carbon Dioxide Advisory Panel to consider the possibility of obtaining ocean-wide measurements of atmospheric and oceanic partial pressure of CO₂, with the objective of determining seasonal and interannual changes and rates of net flux from the sea to the air and from the air to the sea.

The CO₂ Panel met in October to consider a programme that would define the fundamental controls on the ocean CO₂ system and its temporal variability taking into account influences of thermodynamic and chemical processes as well as wind, insolation, and productivity. The outlines of a field and laboratory programme were developed taking into consideration the measurement opportunities offered by TOGA and WOCE and the potential contribution of modelling groups. A specific sampling and analysis strategy was developed for incorporation in the WOCE implementation planning process.

Several research programmes or study groups such as ICSU/IGBP, GOFs, SCOR WG 71, and IOC/GIPME refer to long range transport of various substances and their cycling through geo- and biochemical processes and associated "global fluxes." Similarly, the oceanographic experiments of the WCRP include a major measurement programme of passive and

transient tracers, in particular WOCE, which addresses the global circulation of the ocean and its variability due to natural processes and due to anthropogenic factors like the CO₂ content in the atmosphere. The improved OGCM expected from WOCE will be widely used for global flux estimates, and tracer measurements are an essential component of the WOCE observational programme.

The CCCO officers, therefore, have decided to invite an expert to review the various projects of IGBP and other global ocean programmes, to define the potential interaction with CCCO programmes. As the IOC's Committee for GIPME had also decided to undertake a similar review, it was agreed that a single CCCO/GIPME review would be appropriate. Accordingly, GIPME, CCCO, and SCOR representatives were scheduled to meet in Washington D.C., 14-15 November, to review the international planning and coordination of global studies including IGBP, GOFs, and WOCE. Their findings will be presented to the SCOR General Meeting.

Training and Assistance Associated with the WCRP

At its seventh session, CCCO made several proposals for training and assistance to strengthen the participation of developing countries in the field activities of the WCRP and enhance their ability to apply forthcoming research results and data products to their own region's problems. The secretariat subsequently addressed specific requests to thirty-two scientists worldwide to determine whether opportunities and resources for training exist. The many initial responses have been encouraging. Major computing/modelling facilities have indicated their willingness to accept students to study new ways to manage TOGA and WOCE data, applying the latest technologies in computers, communications, and distributed systems. Among the other offers were opportunities for shipboard training associated with the EPOCS cruises. These responses will form the basis for a major project proposal to be submitted to the IOC and UNESCO Division of Marine Sciences for 1987-1989 support.

Ocean Observing System Development Programme

Steady progress is evident toward developing the various components of the ocean observing system. The TOPEX-POSEIDON satellite programme, critical to the success of the WCRP, has passed crucial budget tests in the U.S.A. and France. The eventual operational implementation of the key remote sensing systems, then, seems to be well in hand.

With respect to *in situ* components, notable advances are evident in several areas. In particular, persistent efforts by a community of users working together have brought the acoustic doppler current profiler (ADCP) close to being a fully operational tool capable of measuring ocean currents to 500 meters or more from ships underway. Effort is currently being devoted toward integrating the ADCP with the SEAS system used with XBT's on ships of opportunity (S00) to automatically format and transmit data in real time. Although the BATHY/TESAC programme has experienced a slight decline in the number of reports since the peak year of 1983, twelve new S00 lines identified as priority XBT tracks in the Atlantic, Pacific, and Indian Oceans are about to become operational.

The drifting buoy programme has continued its trend of expansion. The number of 1986 platform/years based on the ARGOS joint tariff agreement rose to 490, an increase of 20% over 1985. The problem of why a large proportion of drifting buoy data does not get distributed on the Global Telecommunication System (GTS) or archived at the Marine Environmental Data Service (MEDS) in Canada was the subject of an investigation undertaken by the CCCO Secretariat. A questionnaire distributed to ARGOS users for the purpose of determining what the impediments were to data sharing was revealing. Simple lack of awareness of MEDS was one factor. A second more fundamental problem was the unwillingness by some investigators to agree to automatic distribution by Service ARGOS of their raw data via GTS (the source of most MEDS data). In their view an archive of data of unknown

quality was of little value. The subject of quality control needs further study.

Completion of the global sea level network is not progressing as well due to lack of funds. Moreover, many of the high priority stations are in remote areas where problems associated with installing and maintaining gauges are unusually difficult even when gauges can be made available. At its seventh session, the CCCO endorsed an initiative to establish two prototype stations at Hawaii and Bermuda equipped with inverted echo sounders (to distinguish steric change from mass changes) and VLBI/GPS (to detect gauge movement due to tectonic activity). The U.S.A. is proceeding with plans to include these two stations in its VLBI/GPS linked network.

Modelling Activities

CCCO has reorganized its modelling activities under two Numerical Experimentation Groups, one each for TOGA and WOCE. CCCO's original Modelling Panel was reduced to three persons: the chairmen of the TOGA and WOCE Groups and one CCCO member. Their function is coordination and stimulation of needed activities not undertaken by the WOCE and TOGA groups.

WOCE-NEG is continuing its work on the intercomparison of models for the North Atlantic (see also Annex VII, report of WG 68). It involves four models: the GFDL model, the Hamburg geostrophic model, and two isopycnal models (Miami and Hamburg). The models are integrated for 150 years and use both steady and seasonal climatological forcing. A number of problems are noted. The GFDL primitive equation model gives slow diffusion warming, a non-physical salinity maximum, and a noisy equatorial structure. These might be improved by changing the diffusive and frictional parameters. The Hamburg geostrophic model shows rapid warming and too strong a meridional cell. Using Bunker's 1948-72 anomalous wind and SST forcing, the models gave predicted fluctuations that agree in magnitude but not in phase with those observed.

In order to address some of the questions raised by low resolution models, a high resolution "Community Model" is being considered. The objectives would include studying the role of eddies on circulation dynamics, the vorticity budget, and the heat and salt budgets. Questions remain as to the specifications for the model (open boundary conditions, topography, mixed layer physics, etc.), and whether to have a portable model used for parallel experiments or a model at one location with the output distributed for analysis. Interested groups include GFDL, NCAR, Oxford, and Hamburg/Kiel.

WOCE-NEG has not thus far considered in detail the field of tracer modelling. Input would be required from experts in surface forcing. Future meetings organized by the group could address this topic and that of inverse modelling.

The purpose of TOGA-NEG is to provide support and advice to the TOGA Scientific Steering Group on numerical modelling and to promote the following activities:

- Development and verification of ocean models suitable for TOGA purposes.
- Development of data assimilation procedures for tropical ocean models.
- Liaison with the JSC Working Group on Numerical Experimentation (WGNE) for exchanging information on modelling techniques and for developing coupled ocean-atmosphere models.

Specific questions and activities that might be taken up by TOGA-NEG include:

- (i) investigation of deterministic predictability of the tropical ocean surface circulation starting from a specified initial state and/or known history of

atmospheric forcing,

(ii) assessment of relative performance of different types of models of varying complexity and sensitivity to such aspects as model resolution, boundary conditions, specification of model geometry, mixing parameterizations,

(iii) organization of experiments to make use of the oceanographic data being gathered in TOGA for validation and initialisation.

Informal Planning Meeting on the WCRP

The first Informal Planning Meeting on the World Climate Research Programme was held in Geneva, May 1986. The objective of the meeting, - to assess WCRP requirements, commitments and gaps - was essentially achieved and the overall feeling of the meeting was one of optimism. Sufficient commitments of resources have already been made or are being seriously considered by participating nations to allow the planning and implementation of the programme to proceed along the lines described in the First Implementation Plan for the WCRP with relatively minor adjustments. The Informal Planning Meeting highlighted activities requiring consideration and active support by WMO Members and IOC Member States, including the development of the IOC Global Sea Level Observing System (GLOSS) and the IOC/WMO Integrated Global Ocean Services System (IGOSS), especially in the Indian Ocean region. A second IPM was not recommended for the foreseeable future as other coordination mechanisms now exist such as the Intergovernmental TOGA Board.

Work Programme and Resources

The planned CCCO Programme of work for 1987 through 1989 will require about \$200,000 annually. This is only possible because forty percent of the participants in CCCO activities provide their own support. Staff support has continued at an acceptable level and is expected to increase in 1987. The Secretariat is supported by the USA (2) and France (1); the WOCE office by Canada (1), UK (1) and FRG (1 as of January 1987); and the TOGA office by the USA (2). It should be noted that an Indian expert was provided to the TOGA office for two years. He completed his assignment in August. Negotiations are presently underway to move the TOGA office to Europe from the USA and to designate a new Director. The USA has indicated it will continue to provide both staff and financial support for the office.

CCCO Members

Several changes in the membership of CCCO have taken place or will take place in the next several months. Due to normal rotation, as many as six new members could be appointed between November 1986 and mid-1987. All membership selections are being made in consultation with the Secretary of IOC and the President of SCOR.

ANNEX XIV

REPORT OF THE UNESCO/SCOR/ICES/IAPSO JOINT EDITORIAL PANEL ON "THE MANUAL ON PROCESSING OF OCEANOGRAPHIC STATION DATA"

After the completion of the main tasks arising from endorsement of new standards, i.e. Practical Salinity Scale, 1978, and International equation of State of Sea Water, 1980 and subsequent publication of UNESCO Technical Papers in Marine Science, Nos. 36, 39, 40 and 44, the Joint Panel on Oceanographic Tables and Standards at its meeting in July 1983, came to a decision that an additional important source for the users of PSS-78 and EOS-80 is needed to provide guidance on implementing the new standards into oceanographic science and that this might take the form of a manual somewhat similar to the manual "Processing Oceanographic Data" published by Dr. E.C. LaFond in 1951, but updated and duly reconstituted.

SCOR at its meeting in Paris in September 1983, discussed this matter (noting inter alia that IAPSO had passed a recommendation to this effect at its General Assembly in Hamburg) and came to a conclusion 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. Since that meeting, through active consultations between UNESCO, SCOR, IAPSO and ICES a JPOTS Editorial Panel was established and the following members of this Panel were nominated:

| | | | |
|----------------------|----------|---------------------|---------|
| Dr. H. Dooley | (ICES) | Dr. R. Millard, Jr. | (SCOR) |
| Professor O. Mamayev | (UNESCO) | Dr. K. Taira | (IAPSO) |

Dr. S. Morcos, UNESCO, has been designated by SCOR to coordinate the work of the Editorial Panel and started correspondence on the substance of the work on the Manual in March 1985.

Following discussions on the venue of the first meeting of the Panel, the Oceanographic Committee of the Soviet Union invited UNESCO to convene it in Moscow, and it was hosted by the Geographical Faculty of Moscow State University from 30 June to 4 July 1986. All the members of the Panel, as well as Dr. Morcos, UNESCO coordinator, were present. The Panel elected Professor O. Mamayev the Chairman of the Editorial Panel and of this meeting; Dr. H. Dooley was elected the Rapporteur of the meeting.

The members of the Panel then extensively discussed the problem of what the Manual actually should be and what are the guidelines (or the terms of reference) of the Panel itself. The general consensus was that the Manual should concentrate on the processing of real oceanographic data collected in the ocean (deep oceanographic stations) and should go beyond volume 4 of the Tables in the sense that it shall illustrate the numerical processing of data to get basic oceanographic quantities in use in modern physical theories of the stratified ocean, all based on the new standards developed by JPOTS.

It was also agreed that the Manual should be addressed to the individuals not necessarily being highly trained physical oceanographers and those having immediate access to computer facilities, but to a much wider audience, including marine biologists, fisheries scientists etc., and also students and teachers; it was considered "that such a Manual would provide an invaluable educational tool for the training of future generations of oceanographers for whom a fundamental grasp of the basic calculation processes was considered essential".

The Panel, in discussing the new approach, reviewed the existing manuals and guides, including the Manual by LaFond, Zubov's "Oceanological Tables" and other manuals prepared

by data centres, as well as several modern atlas-type publications and data reports (such as Fuglister's Atlas, GEOSECS Atlases etc).

Due to the advent of the CTD, there has been "... a fundamental departure from the depth parameter used hitherto in most manuals on oceanographic data processing"; therefore it was decided that the pressure, not the depth, be regarded as an independent parameter and starting point of calculations (together with temperature and conductivity/salinity). A provision was left for the data collected by conventional means, i.e., from water-bottle casts (wire-out depth information). Thus the starting point of the Manual will be selected pressure data (low resolution) derived from two decibar-spaced CTD casts (high resolution); "adopting this approach would provide an additional benefit to the reader with information on the loss of precision as a result of large integration intervals that are the norm in 'water-bottle oceanography'".

Considerable attention of the Panel was focussed on the contents and details of the Manual. The proposal was laid by the Chairman that it should consist of three parts, namely: I) Scientific background; II) Processing procedures (with worked examples), and III) Oceanographic tables and graphs.

In discussing the contents of Part I, it was made clear that the Editorial Board cannot be the sole author of the Manual, and will, therefore, seek the assistance of individual scientists in the preparation of various sections. Several names were suggested during the course of the meeting.

Part II, containing processing procedures, will start with the data of a pair of neighbouring oceanographic stations (or two pairs of stations in the Atlantic and the Pacific) which will be fully processed onwards. These stations shall be selected from the data collected in the deep ocean, made to the bottom and not less than 4000 decibars pressure and located in the dynamically active areas so as to exhibit a complex pattern of the vertical stratification and significant geostrophic shear. The procedure of smoothing and interpolation of non-standard to standard pressures shall be described, covering the smoothing of the CTD data as well as interpolation of water-bottle casts to standard pressure levels. All the computations in Part II will be done by hand, using a pocket calculator, cross-checked by machine computations and illustrated with diagrams, if necessary.

Part III, Tables and Graphs: its contents were not yet fully agreed in detail. It is supposed that it might contain several general tables supplementary to those of Vol. 4 of "International Oceanographic Tables" and graphs on square paper, from which necessary functions can be easily read. The contents of Part III will be decided upon after the Chairman has drawn together all the material that may be included in it.

In discussing the overall layout of the Manual the Editorial Panel decided that the title of the Manual which will fully describe its objectives and contents will be; "Manual on Processing of Oceanographic Station Data" (later remark of the Chairman; the word "International" might be added).

In finalizing its first meeting the Editorial Panel noted that some additional computational work might be needed, but this will not become clear until after the Chairman has proposed the detailed contents of Part III.

The Panel also noted that the work on the Manual might be completed by the end of 1988, but it was made clear that this would not be possible without, at least, one further meeting. Accordingly, the Panel accepted the invitation by Dr. H. Dooley to hold the next meeting at the ICES Headquarters in Copenhagen at the end of June 1987 with an aim to review the progress.

ANNEX XV

REPORT ON MARINE POLLUTION

This report is based on a decision of the SCOR Executive Committee taken at its 27th meeting in Seattle, 10-12 September 1985 (SCOR Proceedings, volume 21). To produce the report, a small group was established, consisting of Dr. H. Postma (Chairman) Dr. A. McIntyre, Dr. R. Chesselet and Dr. B. Dybern, members. It will be presented to the 18th General Meeting of SCOR in Hobart, Australia. The task of the group was defined as follows:

"A second review of the "health" of the oceans will be carried out in the future by GESAMP. For this reason, a review by SCOR of its role in studies of marine pollution would be especially timely. The group may also consider the question of SCOR's role as an advisory body to IOC and UNESCO in matters related to marine pollution and the activities in which the interests of SCOR and SCOPE may overlap."

SCOR is for three main reasons interested in marine pollution affairs. First, all oceanographers are interested in a healthy marine environment. Secondly, many pollution projects and international organizations concerned with marine pollution need input of oceanographers. Third, pollution studies often contribute to our basic knowledge of the oceans. Because of these reasons most, if not all, major oceanographic and fisheries institutions in the world have departments concerned with pollution studies.

Without being exhaustive, this report will give a number of examples; however, to begin with, the structure of international organizations interested in marine pollution will be summarized.

International organizations concerned with marine pollution

The leading intergovernmental agency regarding pollution in general in the UN family is UNEP (UN Environment Programme), but seven other organizations are active in the field including IMO, FAO, UNESCO, WMO, WHO, IAEA and the UN itself. These organizations all have their own programmes, but scientific aspects of marine pollution are chiefly discussed in the Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP) sponsored by the above-mentioned agencies. This group provides scientific advice to the agencies and also to the IOC (Intergovernmental Oceanographic Commission) of UNESCO. It meets approximately once a year and in the course of a decade has published close to thirty reports. Whereas the first reports strictly reviewed harmful chemical substances and criteria for water quality, later reports kept the pollution of the oceans under constant review and aimed at descriptions of concentration distributions, taking into account the state of knowledge of oceanic processes. A very good example is the "Reports and Studies No. 19" on an "Oceanographic Model for the Dispersion of Wastes Disposed in the Deep Sea" which gives a list of recommendations which could serve as a guide for future fundamental research in oceanography. It is now part of GESAMP's terms of reference to produce regularly updated reviews of the state of the marine environment.

The IOC is represented in GESAMP, but, as an organization directly serving a large number of its own member countries and promoting field measurements, it has its own marine pollution programme. This programme is coordinated in GIPME (Global Investigation of Pollution in the Marine Environment) which has a number of sub-programmes. These are concerned with mass balances and effects of pollutants, methodology, baseline studies and the development of a global monitoring system. The GIPME group took the initiative for a study on the state of marine pollution (the health of the ocean) by E.D. Goldberg, published under the auspices of the IOC in 1976. An interesting result of this study was the proposal for an international programme, using mussels as indicators of coastal

pollution, called "Mussel Watch" and such programmes have now been conducted at regional levels.

The IOC programme has ties with several regional programmes, among which are those of UNEP itself. In addition, the above-mentioned agencies have their own programmes. Moreover, ICES (International Council for the Exploration of the Sea), in the North Atlantic, has a standing Committee on Marine Environmental Quality and working groups on marine chemistry, on marine sediments, and on monitoring, which do work comparable with GIPME. There is a tendency toward increased cooperation between IOC and ICES.

A non-governmental commission operating on a global scale is SCOPE (Scientific Committee on Problems of the Environment). In ICSU (International Council of Scientific Unions), this committee has the same status as SCOR. To avoid duplication, SCOPE is mainly concerned with terrestrial and atmospheric programmes. However, there is some overlap in a programme called "Biogeochemical Cycles," which is a research programme on global cycles of elements, including the processes in rivers and estuaries. This programme is of importance for the behaviour of pollutants in the coastal zone and bears a similarity to a former SCOR programme of WG 46 called RIOS (River Inputs into Ocean Systems). Another SCOPE programme, still in a preparatory phase, will study changes in deltas and estuaries, especially in connection with the rise of sea level.

It seems pertinent to mention here two other global programmes in which ICSU is involved. One is the World Climate Research Programme (WCRP) developed together with WMO (World Meteorological Organization) and UNESCO. In this programme the so-called "greenhouse effect" caused by the increase of carbon dioxide and other trace gases in the atmosphere receives much attention. These trace gases can be considered as pollutants which are exchanged between the atmosphere and the oceans. Their behaviour is for a large part regulated by oceanic processes. SCOR is already involved in WCRP through the Joint SCOR/IOC Committee on Climatic Changes and the Ocean (CCCCO). It must also be mentioned that quite recently (September 1986) the ICSU General Assembly has adopted a programme called "Global Change" which is even more encompassing than WCRP. Again, the project has not yet been sharply defined, but its adoption by the assembly implies participation of all ICSU members concerned, including SCOR and SCOPE. A number of processes are indicated as core projects.

Integration of marine pollution research in marine science

The main trend that can be observed is the rapid integration of marine pollution studies within the marine sciences as a whole. This holds for coastal and shelf research as well as for that in the world ocean and for all marine disciplines. The few examples mentioned below serve as illustration.

In marine biology, pollutants have two main effects. Increase of nutrient inputs increases the area of eutrophic waters at the expense of oligotrophic waters. Studies of the transition areas have led to better insight into marine productivity, including fisheries. Input of toxic or foreign substances causing additional stresses on individual organisms and marine communities has increased our knowledge of the resilience of these organisms and communities. Marine ecology has greatly profitted from such studies. Expensive experiments, as for example those in "mesocosms," would perhaps never have been started, or would have been carried out on a smaller scale, without the pollution stimulus. The same holds for aspects of marine microbiology, for example, that under anaerobic conditions.

In marine chemistry, and especially marine geochemistry, subtle changes in biogeochemical cycles, as for example an increased input of metals into the oceans through rivers or the atmosphere, added to our knowledge of chemical equilibria, "speciation," and transport paths. Regarding the latter, two critical steps have received great attention. The first is the retention and recycling of (toxic) elements in estuaries and coastal

water; the second is the transport of elements from the ocean surface to the deep sea. Application of sensitive analytical techniques has been greatly promoted by the study of pollutant concentrations. The same holds for the application of some experimental techniques, such as sediment traps.

Since small particles are important carriers of pollutants, studies on sediment behaviour and properties have greatly been accelerated. This is also the case with sedimentation rates, since profiles of deposits often reveal the history of pollution loads in a specific region.

In physical oceanography, pollutants have been used successfully in following water movements and mixing processes. Examples are radioactive elements, especially tritium and cesium-137, but also other man made substances. In addition to providing a better insight into transport directions, more information has thus been obtained about rates of water renewal in the mixed layer and on continental shelves, and on the deep ocean circulation.

The position of SCOR

Several working groups of SCOR have, in the course of the years, given advice on marine pollution although, with one or two exceptions they were not especially established for that purpose. In this manner SCOR has had some influence on the direction of marine pollution research and has certainly contributed to a greater awareness in the oceanographic community of the close connection between general oceanographic and specific pollution problems.

To remain well informed on the activities of international organizations SCOR has sent observers to pollution meetings of GESAMP, GIPME, ICES, and recently, SCOPE. Moreover, over several years a special SCOR rapporteur on marine pollution has been keeping contact with international activities.

One may ask whether in the present situation, characterized by a broader view on pollution research, only observing and reporting is sufficient. One aspect of this broader view is that the danger of unnecessary duplication should certainly be avoided in periods when funding is scarce.

It seems, therefore, that a more active coordination of the work of SCOR and various international bodies is needed. To achieve this, the following suggestions may be worth while:

1. At present SCOR is an advisory body only of UNESCO and IOC. This advisory function could be extended to the marine affairs of other agencies mentioned above.
2. A second possibility is that SCOR be represented in GESAMP and GIPME meetings not only by an observer, but as a member.
3. New working groups set up by SCOR and other international bodies should be mutually coordinated, for example, by regular contacts between the Chairmen of these bodies. By discussing terms of reference and membership, duplications of effort could be traced.
4. SCOR should establish a panel on marine pollution affairs with the task to keep an inventory of international activities and to ensure participation in these affairs.

A choice between these and perhaps other suggestions should be made by SCOR in dialogue with interested parties.

ANNEX XVI

COMMISSION FOR THE CONSERVATION OF ANTARCTIC MARINE LIVING RESOURCES (CCAMLR)

Cooperation of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) with both the Scientific Committee on Antarctic Research (SCAR) and the Scientific Committee on Oceanic Research (SCOR) was formally established at the Second Meeting of CCAMLR in 1983. It was envisaged that the main cooperation should be through the BIOMASS programme, i.e. indirectly with SCOR WG 54 and WG 74.

In subsequent years, cooperation has developed between the three organizations with observers being reciprocally represented at meetings. Dr. K. Kerry (Australia) will represent CCAMLR at the XVIII General Meeting of SCOR.

The principle objective of the CCAMLR Convention is the conservation of Antarctic marine living resources and to this end all harvesting and associated activities in the Convention Area should be conducted in accordance with the principles of conservation formulated in Article 2 of the Convention.

The first conservation measures were adopted by CCAMLR at its Third Meeting in 1984 which imposed mesh-size regulations for trawl fishing and prohibited fishing within twelve nautical miles of South Georgia. Since that time, a number of other conservation measures have been adopted. A total of seven measures will be in force for the 1987/88 fishing season.

With the introduction of these measures, the stocks of one of the important commercial fish, Notothenia rossii, will be protected in all areas where this species has been commercially harvested. Another conservation measure, adopted at the last CCAMLR meeting in September 1986, permits the Commission, at its next meeting, to fix limitations of catches around South Georgia for the 1987/88 fishing season. A similar procedure will be used for future seasons after 1987/88.

The proper implementation of the conservation principles depends on the availability of reliable assessments of the status of each individual stock and its interaction with other components of the Antarctic ecosystem. This is the ultimate goal of the Long-Term Programme of Work of the CCAMLR Scientific Committee. The following specific elements of the programme are currently being undertaken.

The CCAMLR Ecosystem Monitoring Programme is a long-term programme to detect and record changes in critical components of the Antarctic ecosystem as a basis for the sound management of its marine living resources. The purpose is divided into monitoring of parameters of selected indicator species and monitoring of harvested species.

The programme has been developed over the last two years by a specifically established Working Group on Ecosystem Monitoring. Three areas have been identified for monitoring predator-prey interactions in the Southern Ocean system: Prydz Bay, Antarctic Peninsula, and South Georgia.

In the coming season (1986/87), thirteen CCAMLR members will be involved in work on various aspects of the Ecosystem Monitoring Programme as part of existing national research activities. Tasks of immediate importance are to standardize data collection, handling, and analysis, so as to facilitate the integration of the results of this work, and to examine developments in technology for remote-sensing. These tasks will be pursued by the Working Group at a meeting in mid-1987.

Fish Stock Assessment Surveys are planned by seven countries in 1986/87 in support of the CCAMLR management objectives. Joint operations will be conducted in the Kerguelen area by France and the USSR. In the South Georgia area, three fish stock assessment surveys will be conducted: one by Spain, another in a joint effort by Poland and the USA, and a third by the German Democratic Republic. In the South Orkney Islands area, the USSR and Spain will each conduct a survey. A survey will be conducted by Spain in both the South Shetland Islands area and the South Sandwich Islands area. Australia will survey fish stocks in the Prydz Bay area.

The surveys will concentrate on stock distribution and abundance recruitment, and mesh selectivity experiments. It is expected that the results of this research will considerably improve the CCAMLR data-base for fish stock assessment.

Reliable assessment of the status of krill stocks in various parts of the Southern Ocean is vital for conservation of the marine living resources in Antarctica. In 1985, the Scientific Committee decided to undertake a special Theoretical Study to evaluate the possibility of using catch per unit effort data (CPUE) from the krill fishery as an index of krill abundance. The study involves the analysis of all aspects of krill fisheries. A combined mathematical model will be developed to explore the relationships between various measures of CPUE with changes in simulated krill abundance.

Another objective of the study will involve determination of the extent to which the CPUE of individual vessels and fleets can be used as an index of krill abundance over large-scale areas of the Southern Ocean. This aspect of the study will require data from independent research vessel surveys for comparison with results obtained from the analysis of data from the commercial fishery. A special joint CCAMLR/BIOMASS Workshop, under the convenorship of Dr. I. Everson (UK), has been tentatively planned for 1988 to compare data obtained during BIOMASS surveys with that from commercial fishing. The study is due to be completed before the 1988 meeting of CCAMLR.

A Scientific Seminar on Antarctic Ocean Variability and its Influence on Marine Living Resources, Particularly Krill, jointly organized by CCAMLR and the International Oceanographic Commission (IOC) in cooperation with SCAR and SCOR, will be held at UNESCO Headquarters in Paris from 2-6 June 1987. The topics which will be discussed at the Seminar include the structure and processes in the Antarctic Ocean circulation system and its variability, and the influence of Antarctic Ocean variability on primary production, zooplankton, and other organisms. Special attention will be given to the distribution and abundance of krill and krill predators in relation to oceanographic conditions and their changes.

The following CCAMLR meetings are scheduled for 1987:

2-6 June: CCAMLR/IOC Scientific Seminar on Antarctic Ocean Variability and its Influence on Marine Living Resources, Particularly Krill, UNESCO Headquarters, Paris.

10-16 June: Working Group for the CCAMLR Ecosystem Monitoring Programme, Paris.

Tentatively scheduled for Hobart, 19-22 October: Ad Hoc Working Group on Fish Stock Assessment.

26 October - 6 November: CCAMLR-VI and SC-CAMLR-VI

ANNEX XVII

REPORT ON THE ACTIVITIES OF THE COMMISSION OF MARINE GEOLOGY (CMG)

The Commission on Marine Geology has been established by the International Union of Geological Sciences to promote marine geosciences. Of particular relevance to SCOR are our activities in the field of ocean history. The notable activities and achievements during the year are as follows:

1) Working Group on History of Oceans, Lithosphere Commission, ICSU.

The interim report, filed at mid-term, has been edited and published as the Geodynamics Monograph v.15 by the American Geophysical Union, with the title, Mesozoic and Cenozoic Oceans. The work of the WG is being continued under the chairmanship of Professor J. Thiede, General Secretary of CMG.

2) Working Group on Rare Events in Earth History, International Geological Correlation Project.

The WG, under the chairmanship of K. Hsu, is preparing its second workshop at Beijing, China, in March 1987. Notable progress has been made in establishing rare perturbations of global carbon cycles as registered by sharp carbon-isotope anomalies in the sedimentary record.

3) International Geosphere and Biosphere Programme on Global Changes (IGBP).

K. Hsu as chairman of CMG, was appointed a member of the IGBP's ad hoc Working Group 3, on Geological Processes: Past and recent (chaired by Dr. Ray Price). The report of the WG was presented to the ICSU's General Assembly in September, 1986 at Bern, Switzerland. The CMG has been consulted by the IUGS President, concerning the further progress of the IGBP Programme.

4) Workshop on shelf seas and continental margins, to be scheduled as CMG's Fourth Workshop of Marine Geosciences, is being planned for 1988 or 1989. Professor Thiede has been in contact with IOC and DMS of UNESCO.

5) Global Sedimentation Programme.

A project to study the history of sedimentation in the oceans has been proposed by the Society of the Economic Palaeontologists and Mineralogists. K. Hsu, as chairman of CMG, has been asked for advice.

6) Ocean Drilling Programme.

After a meeting of CMG at Kiel in March, 1985, it was felt that the development of marine geosciences in developing countries is being left farther behind with the continuation of the Ocean Drilling programme. The ODP activities were planned and carried out by scientists of the member countries of JOIDES, which included then only the USA, France, FRG and Japan. The UK has since rejoined JOIDES. The CMG chairman, K. Hsu, and the former CMG member, Professor E. Seibold who is now the President of the European Science Foundation, have actively worked toward the establishment of a consortium of 12 smaller or economically weaker countries of Europe to join JOIDES; those are Norway, Denmark, Sweden, Iceland, Finland, The Netherlands, Italy, Switzerland, Belgium, Spain, Greece, Turkey. The USSR will join JOIDES in January, 1987. Scientists of other countries are, however, still deprived of the use of this new research instrument, and they are practically excluded from working in this frontier of marine geosciences. K. Hsu contacted the JOIDES Executive Committee and requested help. A very friendly answer came with the suggestions:

a) CMG national correspondents of non-JOIDES nations may receive JOIDES journals, through requests to JOIDES by CMG.

b) Scientists from coastal nations will be given opportunity to work on D/V JOIDES Resolution, when scientific drilling is being carried out in or near the coastal waters of those nations. As many as 5 Peruvian scientists were invited to join the recent drilling of the Peru Trench.

7) ECOD Workshop on the Future of Ocean Drilling.

K. Hsu secured funding from the Swiss National Science Foundation for an ECOD workshop on the future of ocean drilling to be held in Gwatt, Switzerland, March 1987, to be cosponsored by CMG.

8) Palaeoceanography, journal and conference.

a) K. Hsu submitted a proposal to the American Geophysical Union in 1985 for the establishment of a new journal, Palaeoceanography. The request was approved, and a CMG member, Professor J. Kennett, has been nominated and appointed Chief-Editor. The first issue of the new journal appeared in 1986.

b) The Second International Conference on Palaeoceanography was held at Woods Hole, Mass., September 1987, and was a great success. Three SCOR working groups (79, 81, 82) had their first meetings at Woods Hole.

9) SCOR Activities.

J. Thiede suggested to the JOA Programme Chairman 5 symposia with emphasis on geological oceanography, and his suggestions have been incorporated into the JOA programme.

J. Thiede and K. Hsu reactivated the proposal for the establishment of a SCOR WG on hydrothermal activities at plate-boundaries and persuaded Professor E. Suess as the chairman of the proposed WG. The CMG amendment of the original Canadian proposal has been accepted by the SCOR General Assembly.

ANNEX XVIII

LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---------|--|
| ACMRR | Advisory Committee on Marine Resources Research (FAO) |
| ACR | Antarctic Climate Research (SCAR) |
| ADCP | Acoustic Doppler Current Profiler |
| AGU | American Geophysical Union |
| AOML | Atlantic Oceanographic and Meteorological Laboratories (NOAA) |
| AOSE | Arctic Ocean Sciences Board |
| ARGOS | Satellite location and data collection system (CNES and NOAA) |
| ASLO | American Society for Limnology and Oceanography |
| ATOLL | Analysis of Tropical Oceanic Lower Layer |
| BAS | British Antarctic Survey |
| BATHY | WMO Code Form for Temperature versus Depth Data |
| BIO | Bedford Institute of Oceanography (Canada) |
| BIOMASS | Biological Investigations of Marine Antarctic Systems and Stocks |
| CACGP | Commission for Atmospheric Chemistry and Global Pollution (IAMAP) |
| CCAMLR | Commission for the Conservation of Antarctic Marine Living Resources |
| CCCO | Joint SCOR/IOC Committee on Climatic Changes and the Ocean |
| CLS | Collecte Localisation Satellites (Service ARGOS) |
| CMG | Commission for Marine Geology (IUGS) |
| CMM | Commission for Marine Meteorology (WMO) |
| CNC | Canadian National Committee for SCOR |
| CNES | Centre National d'Etudes Spatiales (France) |
| COB | Centre Oceanologique de Brest |
| COMAR | Coastal Marine Research (UNESCO) |
| CONA | Comite Argentino de Oceanografia |
| CONACyT | Consejo Nacional de Ciencia y Tecnologia (Mexico) |
| COSPAR | Committee on Space Research (ICSU) |
| CPUE | Catch per Unit Effort |
| CSIRO | Commonwealth Scientific and Industrial Research Organization (Australia) |
| CTD | Conductivity/Temperature/Depth |
| CUP | Cambridge University Press |
| CZCS | Coastal Zone Colour Scanner |
| DHI | Deutsches Hydrographisches Institut |
| DRIBU | WMO Code Form for Drifting Buoy Data |
| ECMWF | European Centre for Medium-range Weather Forecasting |
| ECOR | Engineering Committee on Oceanic Resources |
| EEZ | Exclusive Economic Zone |
| EKE | Eddy Kinetic Energy |
| ENSO | El Nino - Southern Oscillation |
| EOF | Empirical Orthogonal Function |
| EOS-80 | International Equation of State of Seawater 1980 |
| EPOCS | Equatorial Pacific Ocean Climate Studies Programme |
| ERS-1 | Earth Remote Sensing Satellite (of ESA) |
| ESA | European Space Agency |
| FACTS | Florida Atlantic Coast Transport Study |
| FAO | Food and Agricultural Organization |
| FASINEX | Frontal Air-Sea Interaction Experiment |
| FIBEX | First International BIOMASS Experiment |
| GARP | Global Atmospheric Research Project |
| GC | Gas Chromatography |
| GEMSI | Group of Experts on Methods, Standards and Intercalibration |
| GEOSECS | Geochemical Ocean Sections Study |

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|--------|--|
| GESAMP | Group of Experts on the Scientific Aspects of Marine Pollution |
| GFDL | Geophysical Fluid Dynamics Laboratory (NOAA) |
| GIPME | Global Investigation of Pollution in the Marine Environment (IOC) |
| GLOSS | Global Sea Level Observing System (IGOSS) |
| GOFs | Global Ocean Flux Study (USA) |
| GPS | Global Positioning System |
| GSP | Greenland Sea Project (AOSB) |
| GTS | Global Telecommunications System |
| HPLC | High Performance Liquid Chromatography |
| IABO | International Association for Biological Oceanography |
| IAEA | International Atomic Energy Agency |
| IAMAP | International Association for Meteorology and Atmospheric Physics |
| IAPSO | International Association for the Physical Sciences of the Ocean |
| ICES | International Council for the Exploration of the Sea |
| ICSPRO | Inter-Secretariat Committee on Scientific Programmes Relating to Oceanography (UN) |
| ICSU | International Council of Scientific Unions |
| IETE | Institute of Electrical and Electronic Engineers |
| I/F | Iceland/Faroe |
| IfM | Institut für Meereskunde (University of Kiel) |
| IGBP | International Geosphere-Biosphere Programme (ICSU) |
| IGOSS | Integrated Global Ocean Services System (IOC/WMO) |
| IMER | Institute for Marine Environmental Research (UK) |
| IMS | International Marine Science Newsletter (UNESCO) |
| INQUA | International Union for Quaternary Research |
| IOC | Intergovernmental Oceanographic Commission |
| IODE | Working Committee on International Oceanographic Data Exchange (IOC) |
| IOS | Institute of Oceanographic Sciences (UK or Canada) |
| IPM | Informal Planning Meeting |
| ISOS | International Southern Ocean Studies |
| IUGG | International Union of Geodesy and Geophysics |
| IUGS | International Union of Geological Sciences |
| IUPAC | International Union of Pure and Applied Chemistry |
| JOA | Joint Oceanographic Assembly |
| JOIDES | Joint Oceanographic Institutions for Deep Ocean Sampling |
| JPOTS | Joint Panel on Oceanographic Tables and Standards |
| JSC | Joint Scientific Committee for the WCRP (ICSU/WMO) |
| LEPOR | Long-term and Expanded Programme of Oceanic Exploration and Research |
| MAFF | Ministry of Agriculture, Fisheries and Food (UK) |
| MAR | Mid-Atlantic Ridge |
| MEDS | Marine Environmental Data Service (Canada) |
| MODE | Mid-ocean Dynamics Experiment |
| MS | Mass Spectrophotometry |
| NAC | North Atlantic Current |
| NADW | North Atlantic Deep Water |
| NASA | National Aeronautics and Space Administration (USA) |
| NATO | North Atlantic Treaty Organization |
| NCAR | National Centre for Atmospheric Research (USA) |
| NMR | Nuclear Magnetic Resonance |
| NOAA | National Oceanographic and Atmospheric Administration (of USA) |
| NODC | National Oceanographic Data Centre |
| NRC | National Research Council |
| NSCAT | NASA Advanced Scatterometer |
| NSF | National Science Foundation (USA) |
| ODP | Ocean Drilling Programme (JOIDES) |
| OGCM | Ocean General Circulation Model |
| ONR | Office of Naval Research (USA) |

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| OOSDP | Ocean Observing System Development Plan |
| ORSTOM | Office de la Recherche Scientifique et Technique d'Outre Mer (France) |
| OSNLR | Ocean Science in Relation to Non-living Resources (IOC) |
| OWSE-NA | Operational WWW System Evaluation for the North Atlantic |
| PEGASUS | A profiling instrument |
| PMEL | Pacific Marine Environmental Laboratory (NOAA) |
| RAFOS | Backwards SOFAR (float) |
| RIOS | River Inputs to Ocean Systems |
| RSMAS | Rosenstiel School of Marine and Atmospheric Sciences (Univ. of Miami) |
| SCAR | Scientific Committee on Antarctic Research (ICSU) |
| SCGB | Special Committee for the Geosphere-Biosphere Programme (ICSU) |
| SCOPE | Scientific Committee on Problems of the Environment (ICSU) |
| SCOR | Scientific Committee on Oceanic Research (ICSU) |
| SCUBA | Self-contained Underwater Breathing Apparatus |
| SEAMAB | Sea Atmosphere Optical Monitoring Above the Baltic |
| SEASAT | Oceanographic Satellite (USA) |
| SIBEX | Second International BIOMASS Experiment |
| SOFAR | Sound Fixing and Ranging (float) |
| SOO | Ships of Opportunity |
| SPC | Scientific Programme Committee (for JOA) |
| SSG | Scientific Steering Group (for WOCE and/or TOGA) |
| SST | Sea Surface Temperature |
| STACS | Subtropical Atlantic Climate Studies |
| SYNOP | Synoptic Ocean Prediction |
| TEMA | Training, Education and Mutual Assistance |
| TESAC | WMO Code Form for Temperature, Salinity and Current Data versus Depth |
| TLC | Thin Layer Chromatography |
| TOGA | Interannual Variability of the Tropical Oceans and Global Atmosphere |
| TOPEX | Ocean Surface Topography Experiment |
| UN | United Nations |
| UNEP | United Nations Environment Programme |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| URSI | Union Radio Scientifique Internationale |
| VLBI | Very Long Baseline Interferometry |
| VOS | Voluntary Observing Ship |
| WAM | Wave Modelling Group |
| WCP | World Climate Programme |
| WCRP | World Climate Research Programme (WMO/ICSU) |
| WDC | World Data Centre |
| WESTBIN | Western Boundary Indices |
| WGNE | Working Group on Numerical Experimentation (WMO/JSC) |
| WHO | World Health Organization |
| WHOI | Woods Hole Oceanographic Institution |
| WMO | World Meteorological Organization |
| WOCE | World Ocean Circulation Experiment |
| WOCE IPO | WOCE International Planning Office |
| WOCE-NEG | WOCE Numerical Experimentation Group |
| WWW | World Weather Watch (of WMO) |
| XBT | Expendable Bathythermograph |
| XCTD | Expendable CTD |