International Council of Scientific Unions

SCAR report

No. 5

June 1989

Contents

Published by the

SCIENTIFIC COMMITTEE ON ANTARCTIC RESEARCH

at the

Scott Polar Research Institute, Cambridge, England

SCAR Working Group on Biology
Meeting at Hobart, Tasmania
5-9 September 1988

Attendees

a). Members: G. Hempel (Chairman), Federal Republic of Germany; A.S. Blix, Norway; W.N. Bonner, Chairman, Sub-Committee on Conservation; J.P. Croxall, Chairman, Sub-Committee on Bird Biology; C. De Broyer, Belgium; I. Gurgel, Brazil; J.C. Hureau, France; K.R. Kerry, Australia; G. Knox, New Zealand; R.M. Laws, U.K.; P. Lu, China; E.R. Marschoff, Argentina; Y. Naito, Japan; S. Rakusa-Suszczewski, Poland; W.R. Siegfried, South Africa; D.B. Siniff, U.S.A.; J. Valencia (Secretary), Chile.

b). Observers: S.B. Abbott, U.S.A.; W.S. Benninghoff, U.S.A.; P.A. Berkman, U.S.A.; M. De Poorter, Belgium; G. Di Prisco, Italy; J.P. Dragonetti, Uruguay; S.Z. El Sayed, Chairman BIOMASS Executive; K. Fabing, U.S.A.; W.T. Hushen, U.S.A.; R.I. Lewis-Smith, Co-ordinator, BIOTAS Programme; A. Mircha, Poland; E. Sabourenkov, CCAMLR; W. Slozarsky, Poland; H. Soldi, Peru; J.O. Strömberg, Sweden; C. Sullivan, U.S.A.; D.W.H. Walton, U.K.; J.J. Zijlstra, Netherlands.

Meeting Agenda

1. Welcome and adoption of the agenda
2. Report of 1986 meeting, San Diego
3. Matters arising
   - 3.1 Fifth SCAR Symposium on Antarctic Biology
   - 3.2 BIOMASS Programme
   - 3.3 SCAR Manual on Monitoring
   - 3.4 Information Management
   - 3.5 European Science Foundation
   - 3.6 International Geosphere-Biosphere Programme
   - 3.7 Antarctic Sea-Ice Zone
   - 3.8 Additional protective measures
   - 3.9 Waste disposal
4. Group of Specialists on Southern Ocean Ecology*
5. Group of Specialists on Seals *
6. Group of Specialists on Sea Ice Ecology
7. Sub-Committee on Bird Biology *
8. Sub-Committee on Conservation *
9. BIOTAS Programme
10. CCAMLR
11. New Matters
    - 11.1 Antarctic Science Conference
    - 11.2 Group of Specialists on Environmental Affairs and Conservation
    - 11.3 Establishment of *ad hoc* Committee for ethics on animal research in the Antarctic
12. Exchange of Information
13. Other matters
14. Next meeting
15. Review of Recommendations
16 Election of Chairman and Secretary
17. Approval of the report and closure

* Reports from the 1988 meetings of these groups.

1. Adoption of Agenda

The Chairman welcomed members and observers. The draft agenda was adopted.

2. Report of 1986 meeting, San Diego

The Chairman reported the publication of the proceedings of the meeting in SCAR report No.2 November 1986.

3. Matters arising

3.1. Fifth SCAR Symposium on Antarctic Biology

Dr Hempel on behalf of the Steering Group reported on the 5th Symposium on Antarctic Biology held in Hobart, 28 August - 3 September. The Symposium was attended by more than 200 scientists. Out of over 250 offered contributions about 80 has been selected by the local organising committee for oral presentation. Almost 100 posters were on display and were discussed during well attended poster sessions. About half of the contributions referred to the theme of the Symposium *Ecological Change and the Conservation of the Antarctic Ecosystems.*

In a summing up session speakers emphasized the particular progress made in the study of terrestrial habitats of the Antarctic and sub-Antarctic islands, in the sea-ice and in the ecology of Antarctic seals and birds. The need for long time series of observations on terrestrial systems and of the ice seals was stressed. In the marine field further studies in the sea-ice, and in benthos seem particularly important. The carbon flux through the water column should be studied as part of IGBP. The scientific basis for conservation in the Antarctic was developed by various contributors and received considerable attention during the discussions.

A compilation of about 60 selected theme oriented contributions to the Symposium will be published by the end of 1989. Dr K. Kerry together with Dr G. Hempel will be editors of the volume. The publisher has not yet been decided upon, but an offer has already been obtained from Springer Publishers.

The Working Group expressed its warm thanks to Dr Kerry and to the Australian Antarctic Division for preparing and hosting the Symposium.

It was agreed that the Chairman would contact members of the Working Group in 1989 to seek their views on a theme, structure and venue for the next symposium which should be held in 4-5 years time.

3.2. Report on BIOMASS Programmes (Data Centre, Publications, Planned meetings for 1989)

Dr S.Z. El Sayed presented his report. The BIOMASS Data Centre was established in 1985 to provide a central computer service to the BIOMASS community by holding all data from the First-(FIBEX) and Second-(SIBEX) International BIOMASS Experiments in an easily accessible form. Data on many aspects of marine biology and oceanography from the Southern Ocean are now held on the central database housed in the British Antarctic Survey. This database allows data from several scientific disciplines to be inter-related in order to examine causes and effects in different parts of the marine ecosystems. This makes the BIOMASS Data Centre unique among world data centres and the experience developed as a result is now available to other data centres which might wish to emulate/adopt the Cambridge experience and to other large-scale programs such as the International Geosphere-Biosphere Program. The Centre has been the focal point for nine data-analysis workshops since SCAR XIX. As to the future of the BIOMASS Data Centre, there are several options that are now being considered by the BIOMASS Executive. The recommendations of the BIOMASS Executive will be submitted to SCAR in due course.

BIOMASS Publications included nine reports in the BIOMASS Report Series, and three volumes in the BIOMASS Scientific Series. *Review of the Biology and Present Status of Antarctic Krill* (BIOMASS Sc. Ser. 9)will be available in early November 1988). Six issues of the BIOMASS Newsletter have been produced.

The BIOMASS Program, as envisaged by the SCAR/SCOR Group of Specialists on Southern Ocean Ecosystems and their Living Resources in 1976, will come to an end in 1990. Arrangements are underway to hold the BIOMASS Evaluation Meeting in Bremerhaven, F.R.G., in 1990. This meeting will address the accomplishments of the program during the 'BIOMASS Decade'.

The W.G. on Biology welcomed the productivity of the programme and thanked Dr S.Z.El Sayed and members of the BIOMASS Programme for the report, and recognized the need for further analysis of the data.

The SCAR Working Group on Biology, noting the great scientific value of holding the BIOMASS workshops and the invaluable service rendered to the BIOMASS Program by the BIOMASS Data Centre, underscores the necessity of continuing contributions to the BIOMASS Special Fund which are needed to support the important activities of the BIOMASS program as it enters its final phase.

3.3. SCAR Manual on Monitoring

The Working Group recognized that no progress has been made towards the production of the Manual, but it was

still hoped it would materialise.

3.4. Information Management

Dr W.S. Benninghoff presented the report of the *ad hoc* group on Data Management. The Working Group thanked Dr Benninghoff. It recognized the importance and implications of Antarctic data management. A proposal to refer the recommendations contained in the report to the new Group of Specialists on Environmental Affairs and Conservation was discussed. The report will provide the basis for the reply to XV ATCM. This reply has to be prepared by an inter-disciplinary group to be established by SCAR as a matter of urgency.

3.5. European Science Foundation

Dr Hempel reported on the preparation for the European *Polarstern* Study (EPOS) 1988/89. More than 120 scientists from eleven European countries will participate in the expedition to the Weddell Sea. One major objective of EPOS is to investigate the biological role of sea-ice biota, another is to make a detailed study of the pelagic system in the open water, the marginal ice zone and the pack-ice itself, while a third objective is to study fish and benthos in the south eastern Weddell Sea and off eastern Queen Maud Land. Dr J. Strömberg, on behalf of SCOR, underlined the importance of the expedition as an early contribution to the Joint Global Ocean Flux Study (JGOFS).

3.6. International Geosphere-Biosphere Program

The Chairman referred to SCAR Circular 559 containing the Background document on IGBP prepared by the U.S. National Committee for SCAR and reported on the discussions held by the *ad hoc* SCAR Steering Committee on IGBP.

The Working Group expressed its deep regret over the late arrival of the document which did not permit a thorough study and appropriate action. The Working Group noted deficiencies in the document particularly regarding the role of Antarctic terrestrial and marine biota and of the bio-geochemical fluxes in the Southern Ocean. Various members of the Working Group proposed substantial amendments and additions to the document. The Working Group expressed interest in a large scale and well integrated involvement of Antarctic biologists in IGBP. The recent planning activities for BIOTAS and JGOFS will contribute to the development of an Antarctic component of IGBP.

3.7. Report from Group of Specialists on the Antarctic Sea Ice Zone (ASIZ)

Dr W.F. Budd presented the report to the W G on Biology. The report included the progress in planning a concentrated programme of research for the Antarctic Sea Ice Zone during the 1990s, the observation requirements and methods to be employed, the new satellite schedule and field observations and the intention to seek national contributions to an ASIZ programme. It is anticipated that the necessary input to finalize a SCAR plan for the ASIZ programme will take place at a meeting to be held in Seattle, Washington on August 1989. The field phase for this programme will probably start in 1992.

The discussion by the W.G. on Biology included the necessity of a well defined principal objective, possible overlap with activities of other groups focusing on sea-ice research, the desirability of development of a data centre compatible with existing biological data banks, the magnitude of the data produced by such a programme and its handling, and the implications from global climate change.

Dr T. Hoshiai informed the W.G. he had resigned from this Group of Specialists. The W.G. on Biology accepted this request and thanked Dr Hoshiai for his participation.

The W G on Biology proposed that a member of the Group of Specialists on Southern Ocean Ecology should replace Dr Hoshiai in the ASIZ Group.

3.8. Additional Protective Measures

Mr Bonner introduced the report of the *ad hoc* group on this subject, which had been submitted by SCAR to the Fourteenth Antarctic Treaty Consultative Meeting (XIV ATCM). The group had consisted of Dr W.S. Benninghoff, Mr W.N. Bonner, Dr P.R. Condy and Dr K.R. Kerry.

The main items were its recommendations.

The first called for the periodic assessment of existing and proposed provisions for Antarctic conservation (including site visits) to determine whether the objectives of conservation were being achieved and the extent to which existing regulations were being observed. This was well received by XIV ATCM, but was interpreted as referring to protected sites only. In paras 77-81 of the Final Report of the ATCM, Contracting Parties were urged to undertake site visits and provide reports on these to the Preparatory Meeting of XV ATCM in Paris in March, 1989.

The second SCAR proposal was that the information resulting from such assessment should be made freely available. This was acceded to by the ATCM (paras 82-84).

The third recommendation was for the preparation of management plans for Specially Protected Areas (SPAs). This met with a mixed reception at the ATCM (paras 85-87), but the ATCM did request that examples of possible

management plans should be prepared and submitted to XV ATCM. The fourth recommendation was a renewed plea for the designation of protected areas to provide representational geographical coverage of the Antarctic. This was in general approved by the ATCM (paras 88-91), but there was no agreement on whether it was possible to designate marine SPAs

The fifth SCAR proposal was the most important. This called for the designation of a new type of protected area, which might be called an Antarctic Protected Area (APA). APAs would be managed, multi-use, zoned areas with differing degrees of protection for different zones. They could incorporate existing categories of protected areas, as well as structures such as refuge huts, roads, or even permanent base installations. APAs could include, *inter alia*, areas or features of significance by virtue of their scenic beauty, inspirational quality, potential for recreation, or their status as wilderness. There was keen discussion of this proposal at the ATCM (paragraphs 92-97). Further consideration was deferred until XV ATCM but Parties were asked to provide draft management plans for examples of APAs.

The following areas were noted as potentially providing useful insights into the value of such plans:

Arthur Harbour, Anvers Island
Beardmore Glacier
Deception Island, South Shetland Islands
Dry Valleys, Victoria Land
Ross Island
Signy Island, South Orkney Islands
Vestfold Hills, Princess Elizabeth Land.

A draft management plan for Signy Island, prepared by British Antarctic Survey, was circulated for information to the Working Group.

The Working Group noted the responses of the ATCM and congratulated the *ad hoc* group on the production of the report.

The W.G. on Biology, also considered and endorsed a statement of Objectives of Conservation in the Antarctic. There are contained in an Appendix to this report.

3.9. Waste Disposal

Mr. J.E. Bleasel presented the report of the 'ad hoc' panel of experts on waste disposal. The panel had conducted an enquiry to assess the kinds of waste products, their potential toxic effects, quantities, disposal methods and sites of disposal. On the basis of this review, guidelines on ecologically, logistically and economically acceptable methods and standards had been developed and the existing Code of Conduct on Waste Disposal was reviewed. It was noted that the standard for waste disposal in the Antarctic is higher than in any other region of the world.

The W.G. on Biology agreed that Dr R.M. Laws, Dr E.R. Marschoff and Dr Strömberg would meet with the W.G. on Logistics to further discuss the implications of the report.

The Working Group endorsed the recommendations of the report on waste disposal with certain proposed amendments.

The W.G. on Biology thanked Mr. Bleasel for his presentation.

4. Group of Specialists on Southern Ocean Ecology

The Group was established in 1986 during XIX SCAR. It met for the first time in May 1987 in Paris. The report of that meeting had been published in SCAR Report No. 3. The Convener summarised the principal features of the Group's report to be presented to the SCAR Executive.

The second meeting of the Group was held in Hobart on 3-5 September, 1988.

To evaluate the potential for collaborative multinational studies, the Group prepared a draft questionnaire to solicit basic information on national marine research programmes in the Antarctic. It is recommended that SCAR requests National Committees to ensure that these questionnaires are completed and returned to the Convener of the Group before 31 December 1988. At its last meeting the Group reviewed fields for Antarctic marine ecological research and identified four principal systems.

It is now very important to identify priorities and to propose new Antarctic research initiatives on topics of global concern. A pre-eminent concern relates to biogenic fluxes in the Southern Ocean. The pulses of high primary production, based on availability of 'new' nutrients, form the basis for rich pelagic and ice communities and, by sedimentation, re-suspension and advection, rich benthic communities. A substantial, undefined, part of the sinking material will be subject to long-term storage in sediments, and represents carbon dioxide trapped from the atmosphere or water column.

The Group agreed that the Antarctic system selected for priority study should be that of the zone of sea-ice cover, which includes the sea-ice itself, the water column below the sea-ice and the continental shelf with its sediments and benthic biotas. To proceed with the development of this research programme, the Group is recommending that SCAR sponsors a workshop entitled *Ecology of the Antarctic Sea Ice Zone* in Norway in August or September 1989. The proposed terms of reference of this workshop are:

- to review and evaluate past, present and future research on the Antarctic sea-ice zone.
- to develop an action plan to direct and implement research initiatives in the Antarctic sea-ice zone focussed on the ecology and its relevance to assessment of global changes.
- to develop a suitable structure to undertake such research both on a national and multi-national basis.

The co-convenors of the workshop to be Dr E. Sakshaug and Dr C. Sullivan, the latter also being chairman of SCOR WG86 on The Ecology of Sea Ice. The workshop will have to be confined to a limited number of participants, with three keynote speakers to address the workshop on the IGBP, JGOFS and ASIZ programmes. The Group invited suggestions from members of the Working Group on Biology for potential attendees. A meeting of the Group of Specialists will be held following the workshop.

The Group also examined the participation of Antarctic marine biologists to the IGBP and agreed that research plans developed above would provide the most appropriate input into the planned activities of the IGBP. The Group recognised also the importance of research in several other key fields:

(a) the measurements and monitoring of pollutants in various habitats associated with the sea-ice zone (benthos, fish, macrophytes and sediments),

(b) the investigation of the effects of environmental change on the community structure and life cycles of key species and

(c) the effects of UV radiation on Antarctic biota.

The Group, responding to the request of several important groups of scientists from numerous countries, established sub-groups on:

- Fish Biology and Physiology
- Krill Biology and Physiology

Each Sub-group will have a limited number (4 or 5) of members who will have the responsibility to co-ordinate the research action plans of the antarctic specialists in their respective fields. The Sub-groups will be required to carry out most of their business by correspondence and to arrange their meetings in conjunction with appropriate international meetings and/or workshops.

The Group noted with satisfaction the developments within CCAMLR during the last year : formation of an *ad hoc* Working Group on Krill, reviewing of the current status and trends of Antarctic seabirds and seals, and defining methods to be used to monitor selected parameters of the biology of several vertebrate species in specified areas.

The Group, in response to a request from the Convener of the BIOMASS Executive, is recommending that the Data Centre should continue to function in its present form until the main SIBEX Workshops and final BIOMASS evaluation conference have been held.

Finally, the Group recommended that SCAR nominate Dr P. Nichols (Australia) in replacement of Dr Y. Gudoshnikov who will be in Antarctica until 1990. It is also recommended that SCAR invites Dr P.K.Dayton (U.S.A.) to become a member.

The Working Group welcomed the proposals of the Group of Specialists, particularly with regard to the Workshop on the Ecology of the Antarctic Sea Ice Zone and to the establishment of the Sub-groups on Fish and Krill. After discussion, it was agreed that a Sub-group on Evolutionary genetics be established as an *ad hoc* Group of the W.G. on Biology..

5. Group of Specialists on Seals

Dr R.M. Laws (Convener) presented the report of the Group of Specialists on Seals. In addition to 8 members of the Group, 14 invited observers had participated.

The Handbook on Antarctic Seal Research Methods and Techniques is expected to be published in 1989.

Some returns of seals killed continued to be inadequate or late. Of 17 expected returns for 1985/86 only 14 actual returns had been submitted; the figures for 1986/87 were 17 and 15. The report of the Soviet commercial sealing expedition, 1986/87 was discussed and the collaborative analysis of teeth by the U.S.A. and U.S.S.R. was commended.

Recommendations on the information which should be sought from commercial sealing operations were prepared, listing information required before (at least 60 days in advance), during and following the expedition. For a sub-sample of 10% of the total catch full data and biological material were specified; ideally these data and specimens would be

Concerning the status of stocks, the number of seals reported killed or captured for scientific research or dog food in the period 1964-1985 was 10,142. The annual average for 1964-1974 was 695 per year; for 1974-1985 it was 290 per year. The sustained reduction in average take confirms the group's view that there was no concern that these catches were having a significantly harmful effect on the total stocks of seals, nor on the ecological system in any locality.

New information on the status of seal populations was reviewed. The abundance of Antarctic fur seals continues to increase throughout the species' range.Elephant seal populations in the Indian Ocean Sector continue to decline. The South Georgia elephant seal population appears to be stable.

For crabeater, leopard, Ross and Weddell seals further analysis has been carried out on census data obtained up to 1983. Revised correction factors have been developed for time of day of counting, related to seal haulout curves. This re-analysis has had the general effect of lowering previously published population density estimates. Comparison of the corrected density data from the Western Weddell Sea in 1968-69 and in 1983 show declines in density from 11.38 per square nautical mile (SNM) to 4.28 per SNM; for the Pacific Ocean Sector the decline is from 4.93 per SNM in 1973/74 to 1.95 per SNM in 1983. Two possible explanations are suggested for the apparent decline. First, a change in the distribution of seals, either a movement from one area to another or a new pattern in local distribution might have occurred. This may be related to the fact that 1983 was a very anomalous year with krill absent from areas where they were formerly abundant. A second possible explanation is that crabeater seals in these two areas may have declined in abundance in recent years. It is conceivable that increased competition for food could have contributed to a real decline. There is an immediate need for specific research to assess and monitor the Antarctic ice seals. This will be expensive, and funds and logistics will have to be provided.

To assist discussions during the forthcoming CCAS Review Meetings, the Group considered the principal scientific issues and prepared a report to that meeting. The purpose of that report is twofold. First to describe how SCAR has discharged its responsibilities under CCAS; secondly to offer information and views on scientific matters to be considered by the Review Meeting. The Group regretted that the dates of the Review Meeting conflicted with previously scheduled SCAR meetings. Despite the late notification of the Agenda for the Review Meeting, the Group considered the papers made available to it. It offered advice on Special Permits, exchange of information, sealing zones and the problem of catch concentration, the definition of commercial sealing, consistency and co-operation within the Antarctic Treaty System. The Group thought it possible that it might be given an increasing consultative role under a revised CCAS. Problems would arise if there is inadequate funding provision to meet these obligations and SCAR should be aware of this in deciding how to respond. Dr Siniff (Deputy Convener) was recommended as the SCAR observer to the CCAS Review Meeting.

Eighteen progress reports on seal research from nine countries were received and considered.

Satellite telemetry is developing rapidly. The progress of work in the U.K. on the UNEP-funded project was reviewed, and also reports on the status of the U.S., South African and Australian projects.

Research priorities recommended at the May 1985 meeting were considered. Good progress had been made in 4 of the 6 priority areas (population trends, Antarctic fur seals and their prey, feeding and reproductive ecology of pack-ice seals, and development of satellite-linked telemetry). No progress has been made in the other two areas (stock segregation of crabeater seals, repeated censuses of pack-ice seals to determine population trends). High priority should be given to these.

Co-ordinated principal studies in which progress is being made include: the Antarctic principal tagging and data-base, CCAMLR Ecosystem monitoring programme, southern elephant seal studies, censuses of southern fur seals, long term fluctuations in cohort strengths of leopard seals, Weddell seals and crabeater seals. Entanglement of seals in marine debris might have a significantly adverse effect in future. The Group commended the CCAMLR initiative to collect and promote the reporting of information on this matter so as to identify the causes of entanglement and trends in the frequency of its occurrence over time. It offers to assist CCAMLR in designing a suitable report form to circulate to countries operating in the Antarctic.

The CCAMLR Scientific Committee had sought information from the Group on the present status and trends of Antarctic seal populations. This information was transmitted to CCAMLR. Membership of the Group was considered and no changes are proposed; in future, if responsibilities of the Group change there may be a need to add particular expertise. Depending on the outcome of the Review Meeting it may be necessary to hold a meeting of the Group, preferably in early 1989. The Group requests SCAR to make provision for adequate funding for such a meeting.

The Working Group, in discussing the report, noted in particular the uncertainties involved in the population estimates and the need for further censuses to determine population trends. The question of the membership of the Group was also discussed.

The Working Group discussed membership of the G of S on Seals. It recommended that, in order to help individual seal biologists to attend, an additional, but limited number of experts should be invited to become 'Corresponding

seal biologists to attend, an additional, but limited number of experts should be invited to become 'Corresponding Members' and to attend meetings at their own organisation's expense. In this way knowledge of research activities could be received from all countries active in Antarctic seal research, and in turn such countries could be more directly informed of the activities of the G of S on Seals.

The Working Group thanked Dr Laws for the very informative report.

6. SCOR WG86 on the Ecology of Sea-Ice Ecology (in cosponsorship with SCAR)

Dr C. Sullivan reported the establishment of SCOR WG86, which is co-sponsored by SCAR. The terms of reference for this group include the review of present knowledge of sea-ice biology in Arctic and Antarctic regions, as related to the physical and chemical properties of sea-ice, the review of sampling methods, *in situ* observations, and field experiments and to explore the desirability and feasibility of co-operative multi-disciplinary studies. Reference was made to the desirability of relationships with SCAR Groups of Specialists that focus interest on sea-ice such as Antarctic Sea Ice Zone and Southern Ocean Ecology: a link with the latter is provided by Dr Sullivan being a member of both.

The Working Group accepted the report and thanked Dr Sullivan for his presentation.

7. Report of the Sub-Committee on Bird Biology

Dr J.P. Croxall (Chairman of the Sub-committee) presented the report, which it was proposed be published in full in *Cormorant*. The main elements of the Report related to:

(a) The summary of current and prospective population census operations, including the proposal to prepare a new synthesis of the penguin data.
(b) A review of current monitoring studies.
(c) A review of CCAMLR proposed monitoring operations, which incorporate numerous study sites where monitoring was started in response to earlier SCAR initiatives.
(d) A review of status and trends of Antarctic seabirds in response to a request from CCAMLR.
(e) The report from the Central Data Bank for Antarctic Bird Banding.
(f) The status of the International Giant Petrel Dispersal Project, due to occur in 1988-89.
(g) BIOMASS-related activities, especially relating to a SIBEX Data Analysis Workshop.
(h) Co-ordination of ornithological research on King George Island.
(i) Plastic pollution in Antarctic seabirds

The Working Group welcomed this detailed report and thanked the Sub-committee for its work. It approved publication in *Cormorant* which would ensure widespread dissemination of the text and the valuable data appendices. Professor M. Sander was added to the membership of the Sub-committee.

Rec. XX - Biol. 1

SCAR views with concern the alarming declines in the numbers of certain albatrosses and petrels, believed to be caused by mortality associated with fishing operations mainly outside the SCAR area of interest. SCAR recommends that this be brought to the attention of National Committees, with a request that they contact relevant bodies with a view to taking action to reduce this mortality.

The Working Group agreed that priority should be attached to contining the long term monitoring studies, including those not currently the subject of the CCAMLR programme..

The Working Group on Biology discussed the recommendations from the Sub-Committee on Bird Biology and agreed to the following:

Recommendations to SCAR

7.1. Support the production of, and consider funding, at a level of US$5,000, an updated synthesis of the numbers and distribution of sub-Antarctic and Antarctic penguins.

7.2. Remind National Committees of the requirement to submit either copies of primary banding schedules or species summaries of sub-Antarctic and Antarctic birds banded to the Central Data Bank for Antarctic Bird-Banding (CDB) on an annual basis.

7.3. Request National Committees to supply relevant information on colour-banding of sub-Antarctic and Antarctic birds to the CDB, so that an up-dated colour-banding inventory can be prepared.

7.4. Request the U.S. National Committee to ask the U.S. National Science Foundation to inform its principal investigators conducting ornithological research of the existence of the CDB and both the banding and color-banding inventories.

7.5. Request National Committees to lend logistic support, whenever feasible, to facilitate the banding of giant petrel chicks, as part of the International Giant Petrel Dispersal Project, to take place in the 1988/89 austral summer.

7.6. Request Australian and South African National Committees to arrange to send their outstanding SIBEX seabird data to the BIOMASS Data Centre as soon as possible.

7.7. Request National Committees to supply as much prior information as possible to the Chairman of the Bird Biology Sub-Committee of planned ornithological activities on King George Island, South Shetland Islands, so that undesirable overlaps in avian research at that island can be minimized.

7.8. Request CCAMLR to consider initiating programmes to monitor the levels and effects of plastic pollution in sub-Antarctic and Antarctic seabirds, both from the ingestion of plastic particles and from entanglements.

8. SUB-COMMITTEE ON CONSERVATION

The Working Group welcomed and accepted this report (Appendix 2) and congratulated the group through its Chairman, Mr.Bonner, and the rapporteur, Dr Condy.

8.1. It was noted that "Conservation in the Antarctic" (a revision of "Conservation Areas in the Antarctic") will be published by Cambridge University Press about October 1990. US$6,000 is requested from SCAR to support this publication.

8.2. Recommendations from XIV ATCM strengthening environmental protection were noted and welcomed.

Rec. XX - Biol 2

SCAR recommends that national committees urge operators of Antarctic programmes to accept and begin implementing the guidelines and procedures for environmental impact assessment set forth in ATCM Recommendation XIV-2; and to this end, that national committees discuss with their operating agencies the types of activities that should be subjected to evaluation and the types of monitoring programme that would be required to verify the predicted effects and detect the unforeseen effects of activities.

8.3. Existing and proposed SSSIs were reviewed and various proposals (detailed in the report) were made by the Sub-committee and accepted by the Working Group. Of particular interest was a proposal to reclassify SPA No. 11 as a SSSI, to facilitate important monitoring studies without lessening the degree of protection provided to the fur seals in the area. The Working Group noted that the proposed monitoring studies were of relevance not only to the study of the seals, but also potentially as an indicator of possible relationships in the southern Ocean ecosystem and could contribute to the management of marine living resources under CCAMLR.

The Working Group considered a proposal from Poland for the designation of a Specially Protected Area at Lion's Rump , King George Bay, King George Island. This proposal had been submitted too late to be considered by the Sub-Committee on Conservation.

Mr Bonner introduced the proposal. Its purpose was to protect a presently unspoiled and biologically rich area typical of the ecosystems occurring in the South Shetland Islands. It could serve as a refuge for animals such as elephant seals and birds disturbed from their breeding grounds in Admiralty Bay and Maxwell Bay. After further contributions from Dr Rakusa Susczewski and Dr Lewis Smith, the Working Group approved the designation in principle, subject to minor editorial amendments.

Rec. XX - Biol. 3

SCAR recommends that, after further development by the appropriate SCAR body, the proposals for the four new SSSIs (Battleship Promontory, Ablation Point, Avian Island and Mount Flora) and the proposed SPA at Lion's Rump, examined and supported by the Working Group on Biology, be submitted through National Committees to Government for consideration at XV ATCM.

8.4. Antarctic Protected Areas

(a) SCAR Principles for the Protection of the Environment. The Working Group approved a revised version of the statement prepared by the Conservation Sub-committee for consideration by SCAR.

(b) Management of Protected Areas. The Working Group noted the papers by Dr Lewis Smith and by P.L. Keage *et al.* It was agreed that a specimen of the proposed register should be developed and submitted to the proposed new SCAR Group of Specialists on Environmental Affairs and Conservation. The W.G. on Biology proposed that SCAR consider producing a guide manual on the preparation of management plans, and suggested that Keage and Abbott might develop the text for it. The Working Group requests a sum of US$4,000 to cover the costs of the production of the manual.

8.5. Draft plans for Antarctic Protected Areas (APAs). The Working Group noted the request by the XIV Antarctic Treaty Consultative Meeting that examples of draft management plans for Antarctic Protected Areas, as described in the report of the SCAR *ad hoc* group on Additional Protective Measures, should be prepared and submitted for

consideration by the Preparatory Meeting of XV ATCM in March, 1989.

Rec. XX - Biol. 4

National Committees use their best efforts to ensure that such plans are prepared for areas with which they are familiar, and which in their opinion would benefit from the application of multiple-use zoning techniques for their better conservation.

8.6. SCAR/IUCN Collaboration. It was agreed that the SCAR Executive should be asked to consider communicating to the IUCN the willingness of SCAR to continue to collaborate. However, it was noted that there were other international agencies with which SCAR could collaborate on the matter of Antarctic conservation. This should be considered as a matter of urgency by the proposed new Group of Specialists on Environmental Affairs and Conservation. In the meantime SCAR should continue to pursue the development of conservation in the Antarctic.

8.7. SCAR/IUCN Workshop on the Biological Basis for Conservation in the Sub-Antarctic Islands, Paimpont, France, September 1986. The W.G. on Biology noted the recommendations from this workshop, and agreed that SCAR should take the initiative in bringing relevant national operators together to consider these since IUCN appeared not to be able to do this at the moment.

8.8. IUCN Workshop on Antarctica, Costa Rica, February 1988. The Working Group thanked Dr Benninghoff for his participation in, and report on, this meeting. It seemed clear from his report that SCAR continues to fill its role in collaboration with IUCN.

8.9. Antarctic Airstrip Construction. The W.G. on Biology noted reports on construction and proposals for these.

8.10. The Introduction of Non-Indigenous Organisms into the Antarctic. The W.G. on Biology viewed with concern the greatly increased potential for the introduction of non-indigenous organisms. A statement expressing this concern, annexed to the report of the Conservation subcommittee as approved. The W.G. agreed to establish an *ad hoc* group:

(a) Examine the implications and limitations of present measures limiting introductions of non-indigenous organisms to the Antarctic.

(b) Assess the present extent of contamination by non-indigenous organisms, including micro-organisms.

(c) To provide a list of potentially harmful and/or invasive organisms.

(d) To provide recommendations for controlling the introduction, and limiting the spread, of non-indigenous organisms in the future.

The composition of the group should reflect the interests of the SCAR WGs on Biology, Human Biology and Medicine, Logistics, and the Group of Specialists on Environmental Affairs/Sub-Committee on Conservation. D.W.H. Walton was asked to convene the group and co-opt such members as were necessary.

9. Report on BIOTAS Programme

Dr R.I. Lewis-Smith, Convenor, reported on the progress of the BIOTAS Programme since it was approved at SCAR XIX. Following extensive correspondence with all national representatives of the Biology Working Group and research principal investigators, the first two issues of the BIOTAS Newsletter were produced in 1987 (co-edited by Dr Lewis-Smith and Dr Wynn-Williams); No. 1 comprised 48 pages (150 copies circulated) and No. 2 comprised 74 pages (300 copies circulated). The third Newsletter has been delayed but is expected in November 1988. The demand for copies has been substantial and future issues should increase to 500 copies (expected cost *c.* US$1000-1400 depending on size). SCAR has so far met the cost of production and mailing, but financing of future issues may require further consideration.

BIOTAS now proposes to focus on a research strategy which aims to address specific problems of major importance in terrestrial, limnological and littoral ecosystems. Following a BIOTAS meeting at SCAR 5th Symposium in Antarctic Biology, the consensus was that a key factor is colonization processes, with particular emphasis on ecological and environmental change. The research theme proposed was *Colonization in Antarctic Terrestrial Systems*. The need to integrate this programme with IGBP was emphazised. It is intended to hold a planning workshop in 1989 (provisionally in late September) to agree a framework for an international field programme, standardized methodology, and an *ad hoc* Steering Committee. To achieve this workshop, US$12,500 are requested. The British Antarctic Survey will be prepared to offer a venue for the first workshop.

The Biology Working Group gave its approval for the development of the BIOTAS Programme.

10. CCAMLR

A report was received from Dr J.-C. Hureau, SCAR observer to the 6th meeting of the Scientific Committee of CCAMLR, Hobart 25 October to 3 November 1987. The meeting was preceded by a meeting of the Working Group on Fish Stock assessment. The Working Group made assessments of exploited fish stocks around South Georgia, the

South Orkneys, the Antarctic Peninsula and Kerguelen Islands.

Following the recommendations of the Scientific Committee, the Commission has taken several measures in order to protect the fish stocks:

- The existing measures concerning *Notothenia rossii* around South Georgia have been maintained.
- A total allowable catch (TAC) of 35,000 tonnes of Champsocephalus gunnari has been fixed for the period July 1987 to June 1988, around South Georgia.
- Complete closure of the fishing grounds when this TAC is attained.
- Complete closure of the fishing grounds around South Georgia from April to September, 1988.
- Setting up of a system of catch reporting (on a 10-day basis).
- Acknowledgement of the validity and efficiency of the measures implemented by the French Authorities around Kerguelen Islands.

The statistical sub-area 58.5 (Kerguelen and Heard) has been divided into two sub-sub areas.

The establishment of an observation and inspection system has not yet been achieved but an *ad hoc* group has been established to elaborate an appropriate system.

The CCAMLR Scientific Committee has studied the reports of the consultants appointed in 1986 to undertake a simulation study of krill catch indices as these may relate to estimation of areal abundance. It was concluded that it was necessary to elaborate further models to describe the behaviour and distribution of krill, the operations of the fishing fleets and the reasons for variations in krill abundance variations of krill.

An *ad hoc* Working Group on krill has been established under the convenorship of Dr D. Miller (South Africa) to evaluate the results of the recent studies on krill demography to estimate the abundance of various krill stocks, to examine mortality and fecundity rates and to evaluate existing data on krill catches.

This Group will also recommended that action to be taken by the Scientific Committee with respect to krill stock assessment and ecosystem monitoring.

The Scientific Committee examined the results of the Working Group on Ecosystem Monitoring which met in Paris in June 1987 and recommended that the Programme should be implemented as soon as possible. Some technical methods have been standardized and a manual has been prepared.

Additional topics discussed included the monitoring of depleted or declined populations (particularly the southern elephant seal in the Indian Ocean), the need to establish a system to assess incidental mortality e.g. caused by entanglement with pelagic refuse, in Antarctic marine organisms and the planning of future co-operative programmes to fulfil the Convention's objectives.

The Working Group on Biology thanked Dr Hureau for his report.

11. New Matters

11.1 Antarctic Science Conference. The Chairman addressed the meeting about the SCAR Executive proposal of a Conference on Antarctic Science to be held in May or June 1991. The proposal included the main objectives, themes, time of venue, duration and the establishment of a Steering Group to promote further planning of the Conference.

The Working Group agreed to contribute with suggestions for the biological themes of the conference, and the inclusion of structured time of discussion and due written proceedings of them. Dr W.R. Siegfried volunteered to chair an *ad hoc* group to provide such advice as needed. Members of the group are Dr J. Croxall, Dr J. Valencia, Dr D. Siniff and Dr S.Z. El Sayed.

11.2 Group of Specialists on Environmental Affairs and Conservation. The W.G. Biology noted that this matter was informally treated at last meeting in San Diego. The SCAR Executive had circulated a proposal to establish such a Group of Specialists, taking into account the intensification of activities in the Antarctic and their possible impact. The proposal included the terms of reference and objectives for this Group, pointing out its role as a link with other international bodies concerned with environmental matters.

It was noted that membership arrangements for this Group are still being treated by SCAR Executive.

The discussion within the W.G. on Biology included the subsequent disbanding of the Sub-Committee on Conservation, and the need for consultation among members of both groups. These discussions were followed by a proposal to retain the Sub-Committee on Conservation for the period of transition, to see that proper arrangements and follow-up on ATCM matters, such as dates of expiry of SSSI are not left to lapse. Specific reference was made to the need for careful planning of meetings in order not to interfere with other groups activities.

11.3 Establishment of ad hoc Committee on Ethics For Animal Research in the Antarctic. Dr K. Kerry proposed to the meeting the need to discuss the problem of minimum standards for the conduct of experiments involving Antarctic animals.

After due consideration of the matter, the meeting decided that an *ad hoc* committee on ethics for animal research in the Antarctic shall be established, with the following terms of reference:

(a) Review the 'international guiding principles for biomedical research involving animals' and other relevant material,

(b) Evaluate their relevance and adaptability to the Antarctic.

(c) Collect and evaluate existing national guidelines (Code of Conduct) of the member nations of SCAR and on this basis

(d) Recommend to SCAR proper guidelines for the handling and care of animals employed in scientific studies in the Antarctic.

Towards this end funding is requested from SCAR to cover in part the expenses of one meeting of the committee.

It was agreed that the membership of this committee will be Dr A.S. Blix (Chairman), Dr W.R. Siegfried, Dr K.R. Kerry and Dr J.P. Croxall.

The W.G. on Biology thanked Dr Blix for his prompt response in preparing the proposal.

12. Exchange of Information

The Chairmen of the Sub-Committees of Conservation and Bird Biology drew the attention of the Working Group to the following problem.

For scientific and practical reasons there is a need for the early exchange of information on certain research activities which are likely to overlap and possibly to interfere with each other. The formal National reports and programmes under the ATC and SCAR are often not detailed enough for this purpose.

The Working Group agreed that this matter should be considered at its next meeting. In preparation, the Secretary will solicit suggestions for improvements of the exchange of information amongst the leaders of field programmes.

13. Other Matters

Dr G. Di Prisco reported that a Conference on "Marine Biology of Antarctic Organisms" took place in Ravello, Italy, in 1986 and that the proceedings were published as a special issue of Comparative Biochemistry and Physiology (B) including twenty one contributed papers. Dr Di Prisco also announced that a conference focused on Antarctic Fish Biology would take place in 1990. The W.G. Biology thanked Dr Di Prisco for this information and noted that it is of interest to SCAR members, and expressed its satisfaction for these initiatives that promote Antarctic research.

The W.G. on Biology received the first announcement and call for papers of the "**International Symposium on Antarctic Research**", that is to be organized and sponsored by the Chinese National Committee of SCAR. This scientific event will take place in May 1989 in Hangzhou, China, deadline for registration is November 1, 1988. Topics for this Symposium include Biology, Meteorology, Glaciology Geodesy, Geology and Geophysics.

14. Next Meeting

Taking into account the important matters being considered by the W.G. it was agreed to request the approval to hold the next meeting in association with SCAR XXI.

15. Review of Recommendations

The recommendations arising from the meetings XVII (1982) and XVIII (1984), were noted. It was agreed that:

a) Rec. XVII - Biol-2 should stand

b) Rec. XVIII - Biol-1 should stand

c) Rec. XVIII - Biol-2 should stand

16. Election of Chairman and Secretary

The W.G. on Biology re-elected Dr G. Hempel (Chairman) and Dr J. Valencia (Secretary) for another term and expressed gratitude for the work accomplished.

17. Approval of the Report and Closure

The W.G. adopted the report submitted by the Chairman and the Secretary and expressed great appreciation for its rapid production by the Secretary, who was well supported by local staff.

Dr G. Hempel (Chairman) and Dr J. Valencia (Secretary) thanked the W.G. for its co-operation and support and for

being re-elected. The Chairman adjourned the meeting.

APPENDIX 1

Objectives of Conservation in the Antarctic

(identified by the SCAR *ad hoc* Group on Additional Protective Measures and endorsed by the SCAR Working Group on Biology)

1. Background

1.1 With the increase of the human population and the development of sophisticated technology (both products largely of the last two centuries), human ability to modify the environment has achieved such potential that there is now a risk that the environment will be damaged to the extent that it could no longer support human life and culture at those levels which are now seen as desirable.

1.2 With this in mind the International Union for the Conservation of Nature and Natural Resources (IUCN), in collaboration with the United Nations Environment Programme (UNEP), the World Wildlife Fund (WWF), the Food and Agriculture Organisation of the United Nations (FAO) and the United Nations Educational, Scientific and Cultural Organisation (Unesco), published in 1980 the World Conservation Strategy (WCS) (IUCN, 1980). The three main objectives of WCS are:

- to maintain essential ecological processes and life-support systems;
- to preserve genetic diversity;
- to ensure the sustainable utilisation of species and ecosystems.

1.3 WCS is concerned with resource conservation; it is a strategy to allow the material processes of life on this planet to continue. Other, aesthetic, factors are also important to humankind, however. With a human population increasingly concentrated in urban centres, a trend which seems likely to continue, "wilderness" is seen to have intrinsic value. Scenic resources (which may overlap with wilderness) are also valued for their aesthetic appeal. Places or objects which have important historical or cultural associations are other features valued by society.

1.4 The Antarctic shares with other parts of the world the general needs expressed in the WCS. It possesses unusual ecological processes and unique genotypes that have arisen as a result of rigorous natural selection processes resulting from the extreme environmental conditions. Sustainable utilisation in the Antarctic will be confined to marine resources. The Southern Ocean may have the potential to provide a significant contribution to the World's marine harvest, and preserving this potential must be a high priority.

1.5 Antarctica comprises the last remaining extensive terrestrial wilderness on Earth and while not entirely pristine, is the area by far the least affected by human activity. As such, it is a reference standard for monitoring studies which assess the way in which industrial societies are affecting the global environment. It provides unparalleled opportunities for scientific research on systems and processes, the understanding of which may be vital to our future well being.

1.6 The scenic values of the Antarctic are especially high and it has some, through because of its recent discovery, few, historical and cultural sites.

2. Objectives

The objectives of conservation in the Antarctic are to minimise disturbance by human activity so that:

2.1 the diversity of natural phenomena and systems, both in the context of the Antarctic and the Planet Earth can be maintained;

2.2 genetic diversity can be preserved by ensuring that adequate representative populations of animals and plants are maintained under natural conditions;

2.3. unique features, localities or complexes of features and sites of historical importance are undisturbed;

2.4 scientific research, including the provision of baseline data against which to measure change can be supported;

2.5. cultural values, such as scenic beauty, inspirational quality, wilderness status and recreational potential can be maintained.

3. Nature of Antarctic Systems

3.1 The Antarctic consists of two types of system:

(i) Small, but numerous, terrestrial areas including inland waters, where human activity can have a considerable impact, even if it is itself on a relatively modest scale;

(ii) Large, broadly uniform marine and terrestrial (icecap) areas capable of absorbing substantial human activity with little or no impact (Heap & Holdgate, 1986).

The first category comprises the 2% of the Antarctic's 14 million km^2 that are free of permanent snow or ice. This is made up of a number of coastal strips and islands, mountainous rock outcrops and remarkable inland areas where ablation outstrips snowfall and 'dry valleys' result. Terrestrial vegetation (apart from some snow algae) is necessarily confined to these places. The vegetation may in turn support lower forms of animal life of which the most highly developed are tiny mites and primitive insects. In the most favoured coastal areas quite extensive stands of bryophytes, together with sparse occurrences of two flowering plants, may be found. In a few places higher insects (midges) occur. Coastal (and some inland) areas may contain small freshwater bodies whose ice-cover thaws briefly in the summer. In some of these areas the majority of the biota is concentrated in the lakes. Exposed rock areas such as these are needed as breeding sites by seabirds (except emperor penguins) and some seals. The excreta of these animals, which feed at sea, modify and fertilise the primitive soils of the terrestrial environment.

3.2 The ecological interactions and physiological adaptations of such communities are of especial interest to scientists, since the extreme environmental conditions, coupled with the fact that relatively few species are involved, tend to simplify processes, making their understanding easier than in other parts of the world and providing relatively simple analogues with which to interpret more complex systems. The presence of many large tame vertebrates offers incomparable opportunities for the study of their behaviour, physiology and ecology. These examples could be multiplied almost indefinitely. They have basic importance to the study of biology and the understanding of the environment.

3.3 Because of the discontinuous nature of these habitats, their low species diversity, the relative lack of species competition and the very low growth rates of the terrestrial biota, their communities are exceedingly vulnerable. Physical fragility is evidenced in the way that passage of vehicles, or even human feet, compacts soil structure, dislodges lichens or disrupts moss carpets. The communities of these areas are ecologically fragile in the sense that they have small capacity to absorb change without themselves being profoundly altered. Such systems are particularly vulnerable to introductions, since because of their low species diversity, there may be many unoccupied niches and the indigenous species, through lack of adaptation to competition, will have little ability to resist invaders.

3.4 The second category comprises two distinct sub-categories, the ice-cap and the sea, where conditions are very different.

3.4.1 The ice-cap, apart from some snow algae and bacteria and occasional transient organisms, mostly dispersed by the wind, is devoid of life. Its remote areas are the most sterile part of the Earth's surface. However, it is resilient to human pressures. There are no living systems to disrupt, and introductions cannot establish themselves. The marks of man or vehicles are soon obliterated by snow or scoured away by the wind. Foreign bodies (waste, etc.) are frozen and entombed in ice, delaying the spread of pollution. Dispersion from catchments to sumps cannot occur in this frozen world. The ice-cap is, of course, liable to general pollution from the atmosphere. This provides an important scientific resource, since cores of the ice-cap can provide a dated record of fluctuations of substances in the atmosphere.

3.4.2 The sea is resilient in a very different manner. The Southern Ocean is a high-energy system that has great buffering capacity and general ability to disperse pollution. It is most unlikely to suffer any detectable general impact from localised human activities (Heap and Holdgate, 1986). Environmental conditions in the sea are less extreme, more uniform and more continuous than on land, all factors that make for stability (Bonner, 1984). The marine ecosystem, in comparison with the terrestrial one, has a rich and diverse biota with a capacity to absorb change. The continuous nature of the marine environment and the mobility of most of its organisms ensure that local depletions are more likely to be restored, while high levels of competition and niche occupancy lessen the possibility of the establishment of alien introductions.

3.4.3 A characteristic of the Southern Ocean ecosystem is the dominance of a single member of the zooplankton, the shrimp-like krill, *Euphausia superba*. Krill represents a very important link in the Southern Ocean food web and the consequences of a major reduction of this species would be severe. It is conceivable that such a reduction could be brought about by commercial exploitation.

3.4.4 The shallow seas represent a special case. At depths deeper than the limit of iceberg scour they support a rich marine fauna. This is localised, discontinuous and sessile, all factors which render it relatively fragile. Not enough is known of the vulnerability of such benthic communities to perturbation, but it is certainly much greater than that of the pelagic system and is greater still when the waters are enclosed in a bay or fjord.

4. Threats to Antarctic Systems

4.1 The threats against which protection is required include physical damage, disturbance of wildlife, the introduction of alien species, including micro-organisms, and pollution by natural or man-made substances. Environmental impacts which might occur in the Antarctic as a result of scientific research or the logistical support of such research are listed in Table 4 in Benninghoff & Bonner (1985). Such a list would need to be expanded should mineral resources development activities occur in the Antarctic.

4.2 Although disturbance to the environment is an inevitable consequence of any activity, it is the degree of disturbance which is of primary concern. Thus it is necessary for there to be a very clear idea of what the values to be protected area, and the effect on those values that any activity or combination of activities will be likely to have.

5. Application of conservation measures

5.1 A clear definition of what is to be protected is necessary in order to determine whether the existing protective measures can achieve the objectives and guard against the threats, and whether their enforcement is adequate. Having done this, the fundamental requirement is information about the value, how it is manifested in an area and what are the potential threats to it. Since the value itself and threats posed to it will not be constant over time, it may be necessary to review the requirements for the protection of the particular value and to monitor the effectiveness of protective measures which have been taken.

5.2 The shape and size of the appropriate area to be protected will depend on a number of factors, including the nature of the value to be protected, topography and water catchment, prevailing winds, proximity to threats (e.g. stations, traverse routes, airfields) and ecological relationships and other factors such as the foraging ranges of birds.

5.3 Different values will require differing levels and categories of protection. When more than one value is found in an area, arrangements should be made for the adequate protection of each of these values.

5.4 The freedom to conduct those activities that do not adversely affect those values to be protected should be maintained.

References

Benninghoff, W.S. and Bonner, W.N. 1985. *Man's Impact on the Antarctic Environment: A Procedure for Evaluating Impacts From Scientific and Logistic Activities*, Scientific Committee on Antarctic Research, International Council of Scientific Unions, Cambridge.

Bonner, W.N. 1984. Conservation. In: Laws, R. M. (Ed.) 1984, *Antarctic Ecology*, Vol. 2, p.821-850. Academic Press, London and New York.

Heap, J.A. (Ed.). 1987. *Handbook of the Antarctic Treaty System*. Fifth Edition, February 1987, Scott Polar Reserach Institute, Cambridge.

Heap, J.A. and Holdgate, M.W., 1986. The Antarctic Treaty System as an Environmental Mechanism - an approach to environmental issues. In: *Antarctic Treaty System: An Assessment*, Polar Research Board, Washington D.C.

IUCN, 1980. World Conservation Strategy. International Union for the Conservation of Nature and Natural Resources (IUCN), Gland, Switzerland.

APPENDIX 2

SUB-COMMITTEE ON CONSERVATION
Report of the meeting held 24-26 August 1988 at Hobart, Australia.

Members: W.N. Bonner (Chairman); S.B. Abbott; W.S. Benninghoff; P.R. Condy; V.A. Gallardo; K.R. Kerry; R.I. Lewis Smith.

Observers: W .R. Siegfried; P. L. Keage; L. D. Goldsworthy; P. M. Heyward; D. W. H. Walton.

Apologies were received from G. Hempel, T. Hoshiai, and R. W. Risebrough.

1. Adoption of Agenda

The agenda as circulated previously and modified in discussion was adopted.

2. Matters Arising from the Report of the Previous Meeting, San Diego, 1986

2.1. Future of "Conservation in the Antarctic". It was noted that a revised edition had not yet been published. However, the authors (Bonner and Smith) had negotiated the publication of a two-volume revision by Cambridge University Press, to be released about October 1990. New SSSIs and SPAs approved at XV ATCM in Paris in 1989 would be included in this revision. All SSSIs and SPAs would be described in Volume 2 of the set.

It was suggested that the authors consider inclusion of ATCM-approved Historic Monuments, Tombs, and Seal Reserves, as well as CCAMLR-approved areas set aside for scientific study or conservation, in the volume of SSSI and SPA descriptions.

3. XIV Antarctic Treaty Consultative Meeting, Rio de Janeiro, October 1987

3.1. Rec XIV-2 Environmental Impact Assessment. The meeting welcomed this recommendation. It was agreed that its existence should be brought to the attention of national operators through national committees, in the form of a formal SCAR recommendation. A proposed text for such a recommendation was drafted — see Addendum 2.

3.2. Rec XIV-3 Safeguards for Scientific Drilling. The meeting noted this recommendation.

3.3. Rec XIV-4 SSSI Interim Guidelines: Extension of Designation. The meeting welcomed the extension of designation of SSSI No 2 (Arrival Heights, Hut Point Peninsula, Ross Island) from 31 December 1987 to 31 December 1997.

3.4. Rec XIV-5 SSSI Interim Guidelines: Additional Sites. The meeting welcomed the designation of the following new SSSIs:

No. 22 - Yukidori Valley, Lutzow-Holm Bay;
No. 23 - Svarthamaren, Dronning Maud Land;
No. 24 - Summit of Mt Melbourne, North Victoria Land;
No. 25 - Marine Plain, Vestfold Hills, Princess Elizabeth Land;
No. 26 - Chile Bay (Discovery Bay), Greenwich Island, South Shetland Islands;
No. 27 - Port Foster, Deception Island, South Shetland Islands;
No. 28 - South Bay, Doumer Island, Palmer Archipelago.

3.5. Rec XIV-6 Marine SSSIs. The meeting noted that this recommendation firmly established the principle of protecting Antarctic benthic communities, and that three of the new SSSIs (Nos 26, 27 and 28) designated under ATCM Rec XIV-5 (see 3.4 above) were for this purpose.

It was recalled that the original proposal for SSSI No 14 (Harmony Point, Nelson Island, South Shetland Islands) had included the marine area of Harmony Cove, but that this area had been excluded from the SSSI designated at that time through ATCM Rec XIII-8 (1985). In view of this new recommendation, it was noted that the possibility now existed of re-incorporating this marine area.

4. Review of Existing SSSIs and Proposals for New SPAs and SSSIs

4.1. Review of existing SSSIs. The meeting reviewed the designations of all existing SSSIs (Nos 1 to 28). It was noted that the designations of Nos 4 to 7, 10 to 12, and 18 expire on 31 December 1991, with the designations of the rest expiring at later dates. Therefore, it was recognised that the designations of SSSIs expiring in 1991 would have to be considered for possible extension by SCAR at its next meeting in 1990 so that extensions considered desirable could be dealt with at XVI ATCM in 1991.

In the meantime it was urged that members of WG BIOL should use their utmost endeavours to ensure that these SSSIs be reviewed and if possible visited through national programmes, and reports on them submitted to SCAR to assist the consideration of designation extensions at the next SCAR meeting in 1990.

4.2. Proposals for new SPAs and SSSIs. It was noted that no new SPA proposals have been placed before the Sub-Committee. However, there were a number of proposals for new SSSIs as follows:

(i) Battleship Promontory, Convoy Range, Victoria Land - supported in principle.

(ii) Re-classification and extension of Cape Shirreff SPA as an SSSI (including the Telmo Islands Group) — supported, noting that the re-classification does not change the level of conservation of the area and might, through the mechanism of management plans, even enhance this. It was also noted that the reason for the re-classification, namely the desire to initiate long-term monitoring studies of fur seals and penguins, was very important for thefurtherance of Antarctic conservation in the longer term.

(iii) Ablation Point – Ganymede Heights, Alexander Island — supported in principle.

(iv) Avian Island, north-west Marguerite Bay — supported in principle.

(v) Shackleton Range, Coats Land — the proposal was noted with interest but it was agreed that it should be re-

re-drafted for consideration as a proposed Antarctic Protected Area (APA) at XV ATCM in 1989.

(vi) Mount Flora, Hope Bay, Trinity Peninsula — supported in principle, noting that this proposal should be referred to the SCAR WG on Geology for an opinion on the given reason for designation.

(vii) Proposed extension to SSSI No 21, Deception Island, South Shetland Islands — the proposed extension was noted with interest. However, it wasagreed that it too should be postponed pending the further consideration of the APA concept at the next ATCM.

(viii) Candlemas Island, South Sandwich Islands - since this island falls outside the Antarctic Treaty area, it was suggested that the proposer (British Antarctic Survey) refer the proposal to the relevant administration.

(ix) Palmer Station - Arthur Harbour area - the six SSSI proposals in this area put forward by the US National Committee for SCAR were noted with interest. However, the meeting agreed that the proposals be referred back to the proposer with the suggestion that their incorporation into a draft APA proposal for the whole Palmer Station - Arthur Harbour area, including the existing designated sites in the area, be considered. In doing this it should be noted that the report of XIV ATCM , Rio de Janeiro, 1987 (paragraph 97) listed this area as one for which provisional APA management plans would provide useful insights into the value of such plans for the further consideration of the APA concept at the XV ATCM in 1989. Arthur Harbour provided a notable example of an area where demands for multiple use (scientific research, logistic support, and recreational/tourist activities) made management zoning appropriate.

(x) Ardley Island, Maxwell Bay, King George Island — the scientific importance of this site and the research conducted there were agreed to be sufficient to justify status as an SSSI. However, the management plan provided insufficient detail for the proposal to be supported. It was agreed that the originator should be asked to provide more information on the research programmes and particularly to clarify what restrictions should apply to tourists in the proposed site.

5. Reports on Activities of Relevant SCAR *ad hoc* Groups

5.1 Ad hoc group on Additional Protective Measures. The report "The Protected Area System in the Antarctic" of the *ad hoc* group convened by W N Bonner was noted by the meeting, which expressed its congratulations to the *ad hoc* group on an excellent report.

The extract (paras 75 to 97) from the final report of XIV ATCM on the *ad hoc* group's report was noted. The meeting was generally encouraged by the treatment the report had received at the ATCM. It was agreed that it was now important that draft management plans, according to the APA concept, particularly for the areas mentioned in the ATCM report (para 97), should be prepared for XV ATCM in order to assist further consideration of the APA concept at that meeting.

It was agreed that it would be useful if SCAR could indicate that it was willing to assist with review of existing areas, sites and monuments as recommended by XIV ATCM (paras 77 to 81 of ATCM XIV final report).

5.2 Ad hoc group on Data Management. W S Benninghoff was invited to comment on the report of the *ad hoc* Group on Antarctic Data Management, which will be delivered to the SCAR WG BIOL. The report identifies salient problems with current management of Antarctic data and information and it lists essential needs for improvements, such as directories to data and collections and use of geographic information systems. From the conservation viewpoint, development of the recommended environmental data system is of outstanding importance.

6. Antarctic Protected Areas

6.1 SCAR principles for the protection of the environment. The meeting noted the principles of protection of the environment recommended by SCAR, and agreed that there was a need for a better and more appropriate statement of these. A revision of the present statement was drafted for the consideration of XX SCAR.

6.2 Management of protected areas. The meeting noted the paper by R I Lewis Smith (SC-CONS/88/5/REV.1). It was agreed that matters raised in the paper should be considered by the proposed SCAR Group of Specialists on Environmental Affairs and Conservation. In the interim, the meeting noted that:

(i) The responsibility for erection and maintenance of site or area boundary markers might be that of the country proposing the designation of the site or area;

(ii) While a standardized permit form for approved visits to protected areas was preferable, it was recognised that this was not a matter for SCAR's jurisdiction. On the other hand, a standardized form for information about the status of a visited area and about the visit/visitors, which could be submitted to SCAR after the visit, was a measure which SCAR could consider introducing;

(iii) A review of the reasons for designating SPAs was necessary, but that this should be held back until the APA concept had been further considered at the next ATCM;

(iv) The question of human intervention, when the features for which a site was designated are threatened, was

a difficult one. In the particular case of Lynch Island (SPA No 14) human intervention to prevent further damage by fur seals of the unique Antarctic grassland, especially afforded protection by the SPA designation, might be justified;

(v) There was a need to review waste disposal procedures within SPAs and SSSIs, especially in terms of microbial contamination;

(vi) The possibility of SCAR appointing/employing a person to collate information relevant to Antarctic conservation should be further considered.

6.3. Management plans for protected areas - the meeting noted the paper presented by P L Keage *et al* (SC-CONS/88/61/REV.1), and complimented the authors on a valuable contribution. It was agreed that:

(i) The authors be encourage to further develop the paper for publication in a suitable journal;

(ii) That a specimen of the proposed register be developed and submitted to the proposed new SCAR Group of Specialists on Environmental Affairs and Conservation;

(iii) That the publication by SCAR of a guide manual on the preparation of management plans be considered by the SCAR WG BIOL at its forthcoming meeting. It was suggested that Keage and Abbott develop the text for the manual.

6.4 Draft plans for Antarctic Protected Areas (APAs). The meeting noted that the report of XIV ATCM , 1987 (paras 96 and 97) indicated that it would be helpful to the next ATCM to have before it draft management plans for a number of possible APAs.

A draft management plan for an APA at Signy Island, prepared by British Antarctic Survey, was tabled.

It was agreed that management plans for the following examples of APAs should be prepared:

- Arthur Harbour area (USA)
- Shackleton Range (UK)
- Deception Island (UK/Chile)

It was noted with regret by the Sub-Committee that it had not received provisional APA management plans for other areas listed in para 97 of the final report of ATCM XIV The meeting expressed its hope that APA-concept management plans for these would be made available by relevant parties for the next ATCM in 1989. To this end it was agreed that the SCAR WG BIOL should be asked to urge its national representatives to consider this.

7. SCAR/IUCN Collaboration

The meeting recalled the progress that had been made over recent years, and expressed the hope that this might be continued. It was agreed that the SCAR Executive should be asked to consider communicating to the IUCN the willingness of SCAR to continue to collaborate

However, it was noted that there were other international agencies with which SCAR could fruitfully collaborate on the matter of Antarctic conservation. This should be considered as a matter of urgency by the proposed new Group of Specialists.

In the meantime SCAR should continue to pursue the development of conservation in the Antarctic.

8. SCAR/IUCN Workshop on the Biological Basis for Conservation in the Sub-Antarctic Islands, Paimpont, France, September 1986

The meeting noted the report (SC-CONS/88/8) from this workshop, and congratulated Dr Walton on this excellent product.

It was agreed that SCAR should take the initiative in bringing relevant national operators together to consider the recommendations of the report, since IUCN appeared not to be able to do this as was originally agreed.

9. IUCN Workshop on Antarctica, Costa Rica, February 1988

In February 1988 the IUCN supported participation of a representative, William S Benninghoff, from the joint IUCN/SCAR Working Group on Long Term Conservation in the Antarctic, at the General Assembly of the IUCN in San José, Costa Rica. Three sessions were given to a Workshop on Antarctic conservation, resulting in confirmation of approaches recommended by the joint IUCN/SCAR Working Group as well as development of a working plan and writing schedule for the IUCN group which will take over the task of the former IUCN Antarctic Advisory Group. In summary, it seemed clear from these meetings in Costa Rica that SCAR continues to fill its role adequately as scientific advisor and monitor for conservation matters in the collaborative arrangement with the IUCN.

10. Antarctic Airstrip Construction

10.1. Pointe Géologie (SC-CONS/88/10). It was noted that construction work was in progress. The meeting understood that provisions had been made to minimise adverse impact on the penguins. A photograph showing the site as of March, 1988, was circulated.

10.2 Marion Island. The meeting noted with approval the South African government's treatment of this environmentally sensitive issue. The quality of the EIA produced was applauded.

10.3 Other plans. A description of Project Oasis, which would involve an airstrip and visitor facilities in the Vestfold Hills, was received with interest. The Sub-Committee was assured that should these plans proceed further, both Australian law and ATCM Recommendation XIV-2 would require the preparation of an EIA. This would be publically available. It was stressed that the provision and utilisation of such a facility in the Antarctic could be on the same scale as that of existing tourist facilities in Australia.

The meeting was told of the existence of a preliminary plan for a gravel runway at Rothera Point, Adelaide Island. An Initial Environmental Evaluation (IEE) had been prepared and was with external reviewers. Should it be decided to proceed further with this development the procedure stated in ATCM Rec XIV-2 would be followed.

11. The Introduction of Non-Indigenous Organisms into Antarctica

Increasing scientific and associated logistic activities, together with tourism, have greatly increased the potential for the introduction of non-indigenous organisms. The Sub-Committee viewed this with concern and recommended that a review of this subject be undertaken urgently, with the following objectives:

(i) To examine the implications and limitations of present measures limiting introductions of non-indigenous organisms to the Antarctic.

The current restrictions on importation of non-indigenous biota into the Antarctic terrestrial environment is regulated by Article IX (with Annexes C & D) of the Antarctic Treaty, by SCAR recommendations, and by some national legislation. In some instances local codes of conduct exist for individual national Antarctic stations. No wide-ranging or comprehensive assessment has ever been made of the application of these regulations and their enforcement, despite official Treaty inspections of areas containing known introductions.

(ii) To assess the present extent of contamination by non-indigenous organisms, including micro-organisms.

Although general reviews have been made of the introduction and impact of alien species on sub-Antarctic islands, comparable information is not available for the Antarctic. To establish present conditions, which could provide a baseline for future monitoring activities, a literature and information survey is required. The survey should include investigation of potential sources of, and routes for, transfer of organisms, the availability of habitats, and the persistence of populations.

(iii) To provide a list of potentially harmful and/or invasive organisms.

Within constraints set by present logistic and support capabilities and the selective pressure of the Antarctic environment, potentially harmful species of macro and micro-organisms should be identified.

(iv) To provide recommendations for controlling the introduction, and limiting the spread, of non-indigenous organisms in the future.

In order to strengthen the provisions in the Antarctic Treaty, to provide uniform guidance to all Antarctic operators on codes of conduct, and to propose where practicable additional measures to limit the introduction and spread of alien species.

The composition of the group established to undertake this review should reflect the interests of the SCAR WGs on Biology, Human Biology and Medicine, Logistics, and the Group of Specialists on Environmental Affairs/Sub-Committee on Conservation.

12. Any Other Business

12.1 Ethical considerations in animal experimentation. The meeting noted that there has been concern about the nature and extent of experiments involving animals. This has been particularly so in Australia where, for the past 8 months, press reports have caused the Minister responsible for science to place a ban on a variety of experiments and to institute an enquiry. The Committee conducting the enquiry has produced its report but the report has yet to be tabled in parliament. It is expected that one of the recommendations will be the requirement to establish an Ethics Committee to which all proposals for animal (birds, mammals, fish?) experiments must be presented for approval.

The meeting recognised that similar events may take place in other countries, and that SCAR may wish to consider questions of ethics and consider producing guidelines which might be used by those involved in Antarctic research.

The following list indicates activities which might require such consideration:

(i) Intrusive procedures – collecting food samples by water offloading, the use of emetics and cathartics, etc, collecting blood, administering drugs, etc;

(ii) Administering anaesthetics – particularly those not used on the species before;

(iii) Use of radio isotopes – which isotope and dose rate, environmental effects;

(iv) Restraining of animals – cages, drugs, harness, etc;

(v) Application of instrument packages:

(a) attached only by glue or harness;

(b) connected by electrodes, canuli etc. for physiological experiments;

(vi) Minor mutilation of animals – e.g. toe punch in penguins;

(vii) Killing – methods to be employed for the proper detection of death;

(viii) Other – e.g. banding, wing tags, flipper tags, etc.

12.2 SCAR Executive proposal for a Group of Specialists on Antarctic Environmental Affairs and Conservation. The meeting noted the proposal, as described in the report on the SCAR Executive Meeting of March 1988 which was distributed to national committees as SCAR Circular No. 544.

It was agreed that this proposal needed to be fully discussed by the SCAR WG Biol and the full scope of the business of the new Group of Specialists be clarified.

It was also noted that this Sub-Committee might be disbanded on the creation of the Group of Specialists. However, the appropriateness of this might depend on the scope of business of the new group.

12.3. Waste disposal. The meeting noted and commended the draft report of the SCAR panel of experts on waste disposal.

It was agreed that the report could give rise to a better Code of Conduct on Waste Disposal, that could also be more environmentally sensitive than the present code. In addition, it was recognised that the report was not simply one that should be of interest to logisticians only, but deserved consideration by all concerned with Antarctic environmental research and management.

12.4 Ozone and CO2. The Sub-Committee expressed concern over certain potential effects on conservation activities in Antarctica, arising from CO_2 - induced global warming and the "ozone-layer hole". The meeting also noted that SCAR was developing research projects designed to contribute to international programmes, such as the IGBP, which dealt with aspects of these two topics. It was also agreed that research in Antarctica by SCAR members that would contribute to a better understanding of these topics was to be encouraged.

13. Closure

The meeting closed at 18h15 on 26 August 1988, with members and observers expressing their sincere thanks and appreciation to the Chairman of the Sub-Committee for his major contribution to the Sub-Committee's work throughout the term of his chairmanship, and to the Australian Antarctic Division, the University of Tasmania and its School for Environmental Studies for hosting the meeting.

ANNEX

Introduction of non-indigenous biota into the Antarctic

Restrictions and precautions on the introduction of non-indigenous living material into the Antarctic are included in ATCM Recommendation I-VIII (general rules of conduct for preservation and conservation of living resources in Antarctica), and in the Agreed Measures for the Conservation of Antarctic Fauna and Flora, Article IX (introduction of non-indigenous species, parasites and diseases). These recommendations are very broad in outlook and may be easily misconstrued; they do not include introduced soils or related substrates. More seriously, they are not being followed, with the consequence that many instances have recently been noted of deliberate introductions to Antarctic stations which not only contravene the Agreed Measures but also create a potential ecological hazard in terms of biological contamination of local Antarctic systems.

This Sub-Committee on Conservation of the SCAR Working Group on Biology is deeply concerned by this worsening situation and identifies the following examples to illustrate its concern:

(i) the introduction of unsterilised non-Antarctic soils, peat, compost and other natural substrates (for use in greenhouse cultivation of vegetables and other non-indigenous plants);

(ii) the introduction of non-indigenous plants, other than seeds (e.g. bulbs, tubers, and rooted flowering plants,

shrubs, trees) for aesthetic purposes in stations and on ships operating within the Treaty Area.

(iii) the introduction of domestic animals (other than sledge dogs) as pets (e.g. tropical birds, dogs);

(iv) the introduction of non-indigenous birds for release into the Antarctic environment (e.g. pigeons - in large numbers).

(v) the introduction of non-indigenous micro-organisms into the environment during the disposal of waste food (on land and at sea)

It was noted that specific examples of introductions are generally not noted in reports prepared on official station inspections.

Examples of the consequences of some of these introductions include: the growth of alien plants (e.g. mosses, vascular plant weeds) from spores or seeds contained in unsterilised introduced soil in greenhouses; the release from such soils and introduced plants of invertebrate fauna (e.g. flies, aphids, mites, lice); the disposal of non-indigenous substrates and of visible disease – infected (notably fungal) greenhouse plants into the local environment without incineration; the disposal of dead sledge dogs without burial or incineration.

There are serious problems arising from the presence, handling, or disposal of such introduced materials. Article IX of the Agreed Measures states that after an introduced plant or animal "has served its purpose, it shall be removed from the Treaty Area or destroyed". It is not specified how these should be destroyed, while disposal of introduced soils is not considered as there is no preclusion to their introduction.

Group of Specialists on Southern Ocean Ecology
(Cosponsored by SCOR)
Meeting at Hobart, Tasmania, 3–5 September 1988

1. Introduction

1.1. Opening of Meeting

Dr J. C. Hureau, the Convenor, welcomed the members of the Group and observers invited for the first part of the meeting (names and addresses at Annex 1). The Agenda adopted is at Annex 2; a list of tabled papers forms Annex 3.

1.2. Membership of the Group

In response to the recommendations of the last meeting (SCAR Report No. 3:16-17) SCAR had nominated Dr A. Piola (Argentina) and Dr Y. Gudoshnikov (USSR) to the membership of the Group. During the present meeting Dr Piola had notified his acceptance but was unable to attend. A response received from Dr Gudoshnikov during the meeting indicated that he will be in the Antarctic until early 1990 and it is **recommended** that, to replace him, SCAR should invite Dr P Nichols (Australia) to become a member. The remaining recommendation was to add a benthic ecologist to the Group membership. **It is recommended** that SCAR should invite Dr P. K. Dayton (USA) to become a member.

2. Co-ordination Between Existing Research Programmes

In order to evaluate the potential for collaborative multi-national studies, the Group recommended at its last meetings that SCAR should arrange the provision of suitably detailed summaries of national research programmes in Antarctic marine ecology, highlighting those involving international collaboration.

The only response to this request had been the provision, to the Convenor, of the National Reports to SCAR. These summaries are inadequate for the Group's purposes. As a first step towards acquiring appropriate information the Group prepared a draft questionnaire (Annex 4) to solicit basic information on national marine research programmes in the Antarctic. This document also includes the request to nominate appropriate scientists who can provide the Group with more detailed information on the main research programmes. It is **recommended** that SCAR requests National Committees to ensure that these questionnaires are completed and returned to the Convenor of the Group of Specialists on Southern Ocean Ecology before 31 December 1988.

The Convenor will then circulate to the members a synthesis of these responses. In the meantime, the Group will develop, by correspondence, a follow-up questionnaire designed to provide appropriately detailed information on programmes of relevance to research on the ecology of the Antarctic sea-ice zone (for the purposes of this report the sea-ice zone is defined as the region influenced by both seasonal and more permanent ice-cover).

3. International Collaboration in Antarctic Marine Ecology

At its last meeting the Group reviewed fields for Antarctic marine ecological research (SCAR Report 3:3-13) and identified four principal systems: Sea-ice Zone, Continental Shelf, Open Ocean Pelagic Zone, Sub-Antarctic Islands. The Group did not attempt then to identify priority systems for study or to develop proposals for integrated research programmes in Antarctic marine research. It is now very important to identify priorities and to propose new Antarctic research initiatives on topics also of global concern and priority (see item 3 below).

A pre-eminent concern relates to biogenic fluxes in the Southern Ocean. The key factors in these processes are light and plant nutrient availability, modified by both ice cover and hydrographical processes. The resulting primary production is seasonally highly pulsed albeit restricted geographically.

The pulses of high primary production, based on availability of "new" nutrients, form the basis for rich pelagic and ice ecosystems and, by sedimentation, resuspension and advection, rich benthic ecosystems. A substantial but undefined part of the sinking material will be subject to long-term storage in sediments, and this part represents CO_2 trapped from the atmosphere/water column. Thus the biogenic fluxes are of climatological as well as biological significance. Because the Southern Ocean is vast and its diatomaceous sediments rich, trapping of CO_2 in this area is likely to be of global significance. It is also likely that environmental changes which might lead to changes in primary production and ecosystem structure might also lead to changes in the CO_2 entrapment rates of the Southern Ocean.

The Group agreed that it was essential that the Antarctic system selected for priority study should be that of the zone of sea-ice cover. The influence of ice cover is demonstrably great for the earth's heat budget but its effects on associated ecosystems have hardly been investigated. In particular we must understand how the presence of

sea-ice and seasonal ice dynamics influence ecosystem structures and the fluxes of matter and energy in the Southern Ocean.

Furthermore, sea-ice dynamics is closely coupled to pelagic processes of physics, chemistry and biology. For instance, we need to know how sea-ice influences the nature and rates of biological processes in the ice, water column and benthos during its annual expansion and retreat.

In order to proceed with the development of this research programme, the Group **recommends** that SCAR sponsor a Workshop entitled "Ecology of the Antarctic Sea Ice Zone" to be convened not later than October 1989. The Terms of Reference of this Workshop are:

- To review and evaluate past, present and future research on the Antarctic sea-ice zone, especially including the relevance of such research to investigating global changes;
- To develop an action plan to direct and implement research initiatives in the Antarctic sea-ice zone focussed on the ecology of the Antarctic sea ice zone and its relevance to assessment of global changes;
- To develop a suitable structure to undertake such research both on a national and multi-national basis.

It is **recommended** that Drs E. Sakshaug (Norway) and C. Sullivan (USA) be appointed as Co-Convenors of the Workshop.

It is envisaged that a 4-day Workshop will be held in Norway, and will be followed by a 3-day meeting of the Group of Specialists.

The Workshop will, of necessity, have to be confined to a limited number of participants. The Group of Specialists will solicit suggestions from members of national delegations for potential invitees. In addition to the appropriate Antarctic specialists, the Group proposes to invite three keynote speakers to address the Workshop on the IGBP, JGOFS and ASIZ programmes.

The scientific objectives of the workshop should include examination of the consequences of sea-ice cover and its seasonal dynamics on the following:

1. Fluxes of matter and energy

A. Spatial and temporal characteristics of productivity and sedimentation rates.
B. Trophodynamic relationships
C. Biogeochemical cycles of matter

2. Structure and function of Southern Ocean sea-ice covered ecosystems

A. Availability of sea-ice as a habitat
B. Horizontal and vertical distributions of biomass and activities of organisms
C. Reproductive strategies and recruitment
D. Foraging strategies

With respect to these objectives areas of special interest within the Sea-ice zone are, ice edge zone dynamics, the sea-ice as an ecosystem, and the continental shelfs and associated polynyas.

The Group requests the sum of US$18,000 to cover the organisation of the Workshop, the attendance of three keynote speakers and the meeting of the Group of Specialists.

4. Participation of Antarctic Marine Biologists in the International GeosphereBiosphere Programme (IGBP)

Having reviewed two submissions dealing with the implementation of IGBP (tabled documents 1 & 2), the Group agreed that research programmes developed under (3) above would provide the most appropriate input into the planned activities of the IGBP.

In addition the Group recognised the importance of research in several other key fields, which, if implemented in the Antarctic, would provide a significant contribution to IGBP. Briefly, such research could focus on (a) the measurements and monitoring of pollutants in various habitats associated with the sea-ice zone (eg the benthos, fish, macrophytes and sediments), (b) investigation of the effects of environmental change (eg. sea temperature) on the community structure and life-histories of key species confined to this zone, and (c) effects of UV radiation on Antarctic biota.

The Group felt that to implement effectively the above, the following requirements should be taken into account:

- adequate standardisation of methods;
- identification of key interactions;
- establishment of adequate baselines against which to assess global change(s);
- implementation of long-term research programmes, and

. identification of key sites/areas where such research should be undertaken

With respect to the last point the Group agreed that research should be carried out at as many sites within the circumpolar sea-ice zone (e.g. see Annex 5 concerning current/planned research on benthos).

5. Proposals for Establishments of Sub-Groups

5.1 Sub-group on Evolutionary Genetics of Antarctic Marine Organisms

The Convenor had received a request, from a group of geneticists currently working on Antarctic marine biota, that SCAR should support the formation of a sub-group to coordinate and develop such studies (tabled document 4).

The Group noted that:

i) The Antarctic sea-ice is a unique habitat, especially in terms of adaptational constraints, and sea-ice biota may exhibit specific genetic characteristics which distinguish them from pelagic flora and fauna.

ii) The Antarctic Polar Front strongly reduces gene flow between the Southern Ocean system and adjacent regions.

iii) The genetic studies of Antarctic taxa may greatly contribute to our knowledge of stock separation and breeding systems.

Accordingly, the Group proposed that the Working Group on Biology establish an *ad hoc* group on Evolutionary Genetics of Antarctic Marine Organisms, with the following terms of reference:

i) to identify priority areas of research

ii) to determine appropriate models for study, focussing on taxa where genetic comparisons could be made with organisms in other environments.

iii) to review genetic study methods and make recommendations on standardised methods (eg new electrophoretic techniques for measuring genetic variation; analyses of mitochondrial DNA and RNA sequences; study of chromosomal variations), including those relating to stock separation.

iv) to select species suitable for studies of evolutionary genetics of populations and for cross-breeding experiments in the laboratory.

The *ad hoc* group should report annually to the Working Group on Biology and should comprise a limited number of members. The Group of Specialists proposed Dr B. Battaglia (Italy) be appointed as Convenor of the Sub-group.

5.2 Sub-group on Fish Biology and Physiology

In recent years, ichthyological research in the Antarctic has developed in several directions. Some of these investigations were previously co-ordinated by the now disbanded BIOMASS Working Party on Fish Biology.

Following the BIOMASS Post-SIBEX Fish Data Evaluation Workshop (Cambridge, August 1987) and the Workshop on Antarctic Fish held during the Sixth European Congress of Ichthyology (Budapest 1988), a strong request has been forwarded to the Group of Specialists to create a forum for the discussion and co-ordination of various fields of research on Antarctic fish, excluding fishery-related studies (eg fish stock assessment). Accordingly, the Group decided to establish a Sub-group on Fish Biology and Physiology under the auspices of the Group of Specialists, with the following terms of reference:

i) to co-ordinate research on Antarctic fish with special emphasis on ecology and physiology;

ii) to review existing methods and promote new methods for use in Antarctic fish research, emphasising experimental studies at sea and in the laboratory;

iii) to develop research projects within the framework of the Group of Specialist's recommended research programme on the Antarctic sea-ice zone (e.g. by developing approaches to detect changes in fish demography in relation to environmental changes, and by developing research projects on the role of fish in the transfer of energy between subsystems of the Antarctic sea-ice zone);

iv) to disseminate information on programmes and new aspects of research concerning Antarctic ichthyology and to organise appropriate specialised workshops.

The Sub-group should report on an annual basis to the Group of Specialists and should comprise a limited membership. The Group of Specialists appointed Dr J. C. Hureau (France) as Convenor of the Sub-group, and nominated Dr M. White (UK) as Secretary.

5.3 Sub-group on Krill Biology and Physiology

At its last meeting the Group recommended that a planning meeting for a Workshop on krill biology should be held in conjunction with the present SCAR meetings. The report from an informal group which met to plan this

workshop (27 August 1988) (tabled document 6) and from a subsequent meeting (2 September) at which this document was discussed, recommended that a major workshop on krill biology and physiology should be held in 1991 and established a Steering Committee to organise this. It was emphasised that this initiative is complementary to the establishment of the CCAMLR ad hoc Working Group on Krill (which deals with fishery-related matters) and to any possible BIOMASS krill workshop (which will deal with the analysis of FIBEX and SIBEX data).

In view of these developments there is now a serious need for a permanent group within SCAR to co-ordinate krill research; the Group of Specialists therefore decided to establish a Sub-group on Krill Biology and Physiology, with the following terms of reference:

(i) to co-ordinate research on Antarctic krill with special emphasis on ecology and physiology;

(ii) to review existing methods and, wherever appropriate, promote new methods for use in Antarctic krill research, emphasising experimental studies and evaluation of methods for sampling within the sea-ice zone.

(iii) to develop research projects within the framework of the Group of Specialists' recommended research programme on the Antarctic sea-ice zone, (e.g. by developing approaches to detect changes in krill demography in relation to environmental changes, and by developing research projects on the role of krill in energy transfer between subsystems within the Antarctic sea-ice zone), and

(iv) to disseminate information on programmes and new lines of research on Antarctic krill, and whenever necessary organise specialised workshops.

The Sub-group should report to the Group of Specialists on an annual basis and be limited to a small number of members. The Group appointed Dr D. Miller (South Africa) as the Convenor of this Sub-group, and nominated Dr D. Morris (UK) as Secretary.

5.4 General

In recommending the formation of the three Sub-groups detailed above, the Group of Specialists recognised that funds to support Sub-group activities will be severely limited. The Sub-groups will thus be required to carry out most of their business by correspondence and to arrange their meetings in conjunction with appropriate international meetings and/or workshops.

6. Interaction of the SCAR Marine Biology Community with CCAMLR.

The main features of the relationship between SCAR and CCAMLR were reviewed by the Group at its last meeting (SCAR Report No. 3:16) and have not changed in any substantive way. The Group noted three main relevant developments within CCAMLR during the last year.

(a) An *ad hoc* Working Group on Krill has been formed , with the following terms of reference:

- review and evaluate the results of recent studies on krill population structure, abundance estimation and stock separation;
- review and evaluate the results of krill growth and age determination studies:
- review and evaluate estimates of reproductive and mortality rates in krill;
- review and evaluate the results of studies on behaviour, distribution, and reproduction in relation to krill swarming and dispersal;
- review and evaluate existing data on the size, distribution and composition of catches of krill;
- review and evaluate the importance of sea-ice to krill ecology;
- report to the CCAMLR Scientific Committee on the results of the Working Group's activities, and as appropriate, recommend actions to be taken by the Committee with respect to krill stock assessment and ecosystem monitoring.

It was noted that the CCAMLR Group would be in a position to benefit significantly from close links with the proposed new SCAR sub-group on Krill Biology and Physiology whose operations would be substantially complementary.

(b) CCAMLR has initiated a review of the current status and trends of Antarctic seabird and seal populations. The main elements in this review have been the detailed evaluations of existing data conducted by the SCAR Group of Specialists on Seals and the SCAR Sub-committee on Bird Biology.

(c) The CCAMLR Ecosystem Monitoring Programme (CEMP) has made substantial progress in defining the methods to be used to monitor selected parameters of the biology of certain species of seabirds and Antarctic fur seals in specified areas. CCAMLR will now be seeking commitments from member nations to undertake these tasks. Concurrently the CEMP is developing proposals for surveys to monitor abundance of krill and possibly of other potential 'indicator' organisms.

7. Future of the BIOMASS Data Centre after 1990

In response to a request from the Convenor of the BIOMASS Executive, the future of the BIOMASS Data Centre after 1990 was discussed. Having considered the report of the BIOMASS Data Manager to the Convenor of the Group of Specialists, (tabled document 5), the Group noted the four options outlined therein:

- Continue the system in its present form.
- Merge the Database with another Data Centre (e.g. CCAMLR)
- Divide the Database into component parts
- Archive the system at some agreed centre.

Having reviewed the various options, it is **recommended** that the Data Centre should continue to function in its present form until the main SIBEX Workshops, and especially the inter-disciplinary workshop synthesising the comprehensive SIBEX results have been held. This was considered to be essential for the fulfillment of BIOMASS' original objectives and to ensure maximum use is made of a unique facility.

The fate of Data Centre after this should be considered as part of a review by SCAR of its general requirements for data collection, management and analysis.

8. Recommendations

The Group **recommends** that:

- Drs P. Nichols (Australia) and P. K. Dayton (USA) should be invited to join the Group;
- the questionnaire (Annex 4) to solicit basic information on national marine research programmes should be circulated and that SCAR request National Committees to ensure that replies are returned to the Group's Convenor by 31 December, 1988;
- SCAR sponsor a Workshop on the "Ecology of the Antarctic Sea-Ice Zone" under the Co-Convenorship of Drs E. Sakshaug (Norway) and C. Sullivan (USA) to be held in Norway for a period of 4-days not later than October 1989. A financial allocation of US$18,000 is requested from SCAR to cover the organisation of this Workshop, the attendance of three keynote speakers and a meeting of the Group of Specialists for 3 days immediately following the Workshop;
- the BIOMASS Data Centre should continue to function in its present form until all the planned SIBEX workshops are completed.

Annex 1

Members (*) and Observers at the Group of Specialists Meeting Hobart, 3-5 September, 1988

Patrick ARNAUD
Station marine d'Endoume
rue de la Batterie des Lions
13007 MARSEILLE
France

(*) John P. CROXALL
British Antarctic Survey
High Cross, Madingley Road
CAMBRIDGE CB3 OET
United Kingdom

(*) Gerd HUBOLD
Institut für Polarökologie
Olshausenstrasse 40
D-2300 KIEL 1

(*) Jean-Claude HUREAU (Convenor)
Museum national d'histoire naturelle
Ichtyologie générale et appliquée
43 rue Cuvier
75231 PARIS Cedex 05
France

Enrico MARSCHOFF
Instituto Antartico Argentino
Cerrito 1248
BUENOS AIRES 1001
Argentina

(*) Denzil MILLER (Rapporteur)
Sea Fisheries Research Institute
Private Bag X2, Rogge Bay
CAPE TOWN
Republic of South Africa 8012

Peter NICHOLS
CSIRO, Division of Oceanography
HOBART TASMANIA 7000
Australia

(*) Egil SAKSHAUG
Universitetet i Trondheim Museet
Trondhjem Biologiske Stasjon
Bynesvn. 46
7018 TRONDHEIM
Norway

(*) Cornelius W. SULLIVAN
Marine Biology Research Section
Department of Biological Sciences
University of Southern California
University Park
LOS ANGELES California 90089-
0371 U.S.A.

Annex 2

Group of Specialists on Southern Ocean Ecology
Hobart, 3-5 September, 1988

AGENDA

1. Membership of the Group.
2. Co-ordination between existing research programs.
3. International co-operation in Antarctic marine biology.
4. Participation of Antarctic marine biologists in the IGBP (International Geosphere-Biosphere Program: A study of global change).
5. Proposals for the establishment of Sub-groups.
6. Interactions of the SCAR marine biology community with CCAMLR.
7. Future of the BIOMASS Data Centre after 1990.
8. Recommendations

Annex 3

Group of Specialists on Southern Ocean Ecology
List of Documents

1. International Geosphere-Biosphere Programme (IGBP): a study of global change. Document prepared by first meeting of the Special Committee ICSU Secretariat, Paris, 16-19 July 1987.
2. Antarctic Interactions. Background document for producing a SCAR plan outlining an Antarctic component of the IGBP. Document prepared by US National Committee for SCAR, Washington, DC, July 1988.
3. Circum-Antarctic Shallow-water Ecosystem Studies (CASE). Document prepared by Dr G. Hubold, Institut für Polarökologie, Universität Kiel, West Germany.
4. Proposal for a SCAR group on "Problems of evolutionary genetics of marine invertebrates in the Antarctic and Sub-Antarctic areas. Document prepared by Prof. B. Battaglia and Dr C. Thiriot..
5. BIOMASS Data Centre: current status. Document prepared by Dr D. Vaughan, August 1988.
6. Krill biology and physiology. Report of an informal Workshop held at Antarctic Division, Kingston, Tasmania, 27 August 1988. Document prepared by Dr D. J. Morris.
7. Atmospheric CO_2, oceanic fluxes and the Southern Ocean. Document prepared by Drs H. Marchant, J. Priddle and V. Smetacek.
8. Ecology of sea ice. Rationale and terms of reference for establishment of SCAR WG 86. Document prepared by Arctic Ocean Sciences Board.
9. SCOR Working Group 86: Ecology of Sea Ice. First circular to members. Document prepared by Dr C. Sullivan.

Annex 4

NATIONAL RESEARCH PROGRAMME QUESTIONNAIRE

COUNTRY

Please indicate the extent of your nation's involvement in marine research in the Southern Ocean.

AREA

	Location	Name of Ship or Base
A. Subantarctic islands		
B. Open-Ocean		
C. Antarctic coastal shelf zone		

TYPE OF RESEARCH (AS PER AREA IDENTIFIED ABOVE)

	A	B	C
Oceanography - physical			
- chemical			
Marine biology			
Sea-ice			
Long-term monitoring - environmental			
- biological			
Resource management			

N.B.: Where necessary please fill in more than one copy of this questionnaire.

FACILITIES (AS PER AREA)

	A	B	C
Antarctic station/home base			
Ship-based - designated cruises			
- ships-of-opportunity			
Home-based laboratory studies			
International co-operation - present			
- planned			

TIMING AND DURATION OF RESEARCH (AS PER AREA)

	A	B	C
Year round			
Austral winter only			
Austral summer only			
Short-to-medium term (5-10 years)			
Medium-to-long term (10-15 years)			

Please provide the name(s) and addresses of the senior research scientist(s) in your country best placed to provide the SCAR Group of Specialists with further details or information amplifying the above request.

Annex 5

A brief review of research on Southern Ocean Benthos

The following explicitly ignores past and present work at low latitude sub-Antarctic locations (S. Georgia, Marion, Crozet, Heard, Kerguelen and Macquarie). The list provided is compiled by location and/or national involvement.

1. **Syowa (Japan)** Inshore benthic work involving SCUBA. Occasional summer-only (generally) studies of major species. No details on long-term projects.
2. **South Shetland Is** Detailed descriptive studies (taxonomy and cluster analyses) of benthic communities and selected groups (eg. polychaets). One of the more active sites of investigation by several nations but no apparent ecological or energy flow studies yet.
3. **McMurdo (US, New Zealand?)** Episodic individual projects - (eg. community structure), productive biology. No long-term plan.
4. **Palmer (US)** Echinoderm taxonomy and biology. No long-term projects.
5. **South Orkneys (Signy, UK)** Year-round program of integrated research into ecological and physiological adaptations of nearshore benthos. Energy-flow studies are a major area of research, plus long-term monitoring of sea-ice, water column and vertical flux (latter about to start). Possibly only such program in the Southern Ocean.
6. **Adelie Land (France)** Taxonomy - general biology.
7. **Inner Weddell Sea (FRG)** Recent series of benthic work, still mainly at the descriptive and taxonomic stage (by necessity). A few studies of individual groups. Little biology/ecology/physiology as yet.

SCAR Working Group on Geology
Meetings at Hobart, Tasmania
5 and 9 September 1988

Meeting of 5 September 1988

1. APOLOGIES

Prof. F. Herve (Chile)

2. PRESENT

Members: R del Valle (Argentina); R J Tingey (Australia); C O Berbert (Brazil); X Liu (China); H Miller (Germany, F R); Y Yoshida (Japan); P Barrett (New Zealand); A Elverhoi (Norway); K Birkenmajer (Poland); D R Hunter (South Africa); M Thomson (UK); D H Elliot (USA); G E Grikurov (USSR); I W D Dalziel (IUGS).

Observers: B McKelvey (Australia); R Findlay (Australia); A Giret (France); F Tessensohn (Germany, F R); M Manzoni (Italy); R Funiciello (Italy); Y Kim (Korea); J Bradshaw (New Zealand); C Hjort (Sweden); W Le Masurier (USA); B F Molnia (USA); P Webb (USA); V Ivanov (USSR).

3. MINUTES

1987 meeting in Cambridge. The circulated minutes were approved.

MATTERS ARISING from those minutes

(a) Inventory of geological maps. A complete inventory could not be compiled as lists were only received from Federal Republic of Germany, UK and USA.

(b) IGC Field Excursion - Proceeding as planned.

(c) International Geosphere Biosphere Program (IGBP). After discussion it was agreed that geologists could contribute to IGBP by:-

(i) providing a long-term historical record of the extent of land and sea ice from the study of marine sediment cores;

(ii) studying the relationship between oceanographic, biological and sedimentological processes around Antarctica:

(iii) setting limits to the role and extent of changes in sea level, ice volume and climate.

The incomplete nature of, and the difficulty of dating the sedimentary record were emphasised.

(d) SCAR review of Antarctic Science. Attention was drawn to the publication by ICSU press of this book. It was noted that there was insufficient acknowledgement of the contributions of Working Group Secretaries to this project.

(e) Publication of Proceedings of 1987 Symposium. Dr Thomson reported on progress. Publication was expected in about July 1989. Dr Thomson suggested that Proceedings Volumes were no longer the appropriate medium for publishing symposium papers. The majority of members thought that providing extended abstracts, and publishing collections of papers in special issues of journals was a better alternative.

(f) Informal Working Group meeting at Gondwana symposium. Sao Paulo July 1988. Dr Berbert distributed a written report; a copy is attached.

(g) Antarctic Earth Science (AES) and Gondwana Symposia. The Working Group noted plans for the VIIIth Gondwana symposium to be held in Thailand in 1991 and a potential clash with the 6th AES in Japan also in 1991. After discussion it was recommended that the 6th AES steering committee should seek representation, on a reciprocal basis, of the VIIIth Gondwana Symposium Steering Committee. The Working Group felt that the topics to be addressed by 6th AES should not be restricted because of the clash with Gondwana VIII.

4. CORRESPONDENCE

This was noted and special reference was made to the letter to Prof Hempel regarding earth science representation on the SCAR Group on Conservation and Environmental matters. Prof. Hempel, the Group convenor, has yet to reply.

5. CONVENTION ON THE REGULATION OF ANTARCTIC MINERAL RESOURCE ACTIVITIES (CRAMRA).

WG members drew attention to and discussed various articles of the convention in preparation for further discussions on Tuesday 6th September at the Joint Meeting with the WG SEG.

6. SIXTH ANTARCTIC EARTH SCIENCE SYMPOSIUM, JAPAN 1991.

Professor Yoshida briefly addressed the meeting in preparation for the Joint Meeting and circulated a written statement to members.

7. FUTURE SCIENTIFIC MEETINGS.

Attention was drawn to:-
Marine Geology and Geophysics meeting, Bremerhaven. October 14-15 1988.
Glacial sediments meeting, Geological Society of London. March 15-16 1989.
Antarctic Science Symposium, China. May 8-12 1989.
International Volcanological Congress, Santa Fe, USA. June 1989.
International Geological Congress, Washington, D.C. July 1989.

8. SPECIALLY PROTECTED AREAS (SPA): SITES OF SPECIAL SCIENTIFIC INTEREST (SSSI): CONSERVATION ISSUES.

Geological SSSI's were discussed but the question of whether their identification would merely attract the unwelcome attention of non-research rock collectors was not resolved. On the wider issue of conservation the meeting agreed that there should be Geology WG representation on the SCAR 'Conservation' Group of Specialists. Concern was expressed about the future of Scientific Drilling and mention was made of the Polar Drilling Workshop at Ohio State University in November 1988. Environmental Impact Statements and guidelines for scientific drilling would be considered at this meeting. It was suggested that a Subcommittee on Environmental Safety and scientific drilling be formed with a membership of Geologists and Geophysicists.

The SCAR WG on Logistics paper on Antarctic waste disposal was considered and generally approved, although certain aspects would be difficult to implement.

9. ANTARCTIC DATABASES

The proposed Antarctic database of the Cambridge Arctic Shelf Project had been abandoned. The British Antarctic Survey and US Geological Survey both have plans for Antarctic databases and it was suggested that SCAR should fund an Antarctic Geographic Information System (GIS) database. Dr Molnia (USA) spoke about data directories and will distribute a questionnaire on the topic to find out about existing and available databases.

10. ANTARCTIC EARTH SCIENCE JOURNAL

Dr Barrett (NZ) spoke about the need for such a journal but the WG felt that it had, to some extent been preempted by the Journal of Antarctic Science to be published for the British Antarctic Survey. Some members took the view that Antarctic scientists should publish their results in widely circulated international journals wherever possible.

11. NATIONAL GEOLOGICAL SUMMARIES

WG members spoke briefly about their respective nations' recent and planned geological activities. Written reports were received from Argentina, Australia, Brazil, China, FRG, Japan, Norway, Poland, and USSR. It was felt that these should include a guide map and information on where to find more details. It was also reported that regional panels of the Ocean Drilling Program (ODP) were being disbanded and that in future ODP would be 'thematically driven', that is, organised around scientific topics rather than in respect of geographic areas.

M.R.A. Thomson (UK) was elected WG Secretary (Chief Officer) for a four year term. R. del Valle (Argentina) abstained from the vote. Prof P.N. Webb (USA) was co-opted to the Working Group as its link to the SCAR group considering IGBP. P G Barrett is to continue as chairman.

Meeting of September 9 1989

1. PRESENT

Members: R del Valle (Argentina); R J Tingey (Australia); P G Quilty (Alternate delegate, Australia); C O Berbert (Brazil); H Miller (Germany, F R); Y Yoshida (Japan); P J Barrett (New Zealand); A Elverhoi (Norway); K Birkenmajer (Poland); D R Hunter (South Africa); M Thomson (UK); D H Elliot (USA); G E Grikurov (USSR); I W D Dalziel (IUGS).

Observers: B McKelvey (Australia); R Findlay (Australia); M Manzoni (Italy); R Funiciello (Italy); J D Bradshaw (New Zealand); C Hjort (Sweden); J W Thomson (UK); W E LeMasurier (USA); P -N Webb (USA); V Ivanov (USSR).

2. IGBP

On behalf of GWG Prof P. N. Webb had attended yesterday's meeting of the SCAR IGBP committee and reported back. There were many new ideas to incorporate in the "Antarctic Interactions" document and it needed substantial revision. An executive summary would be prepared for submission to SCAR Executive at Hobart and the final document would be ready for the IGBP planning meeting in Stockholm in October 1988. There was a general feeling among GWG members that interdisciplinary studies of this kind were beneficial.

3. ANTARCTIC MINERALS CONVENTION

Profs A. C. Rocha-Campos and K. Birkenmajer and Drs Elliot and F. J. Davey and P. Conde met to discuss a SCAR response to the CRAMRA document. A major problem is that CRAMRA is political whereas SCAR is not and it was not clear how far we could/should become involved. However, there were a number of concerns with which members of GWG were in full agreement:

a. The need for proper archiving of any data obtained by companies exploring and perhaps operating in Antarctica.
b. Activities undertaken by commercial companies should not interfere with normal scientific activities.
c. SCAR should seek observer status on the Commission, Advisory Committee and regulatory committees
d. SCAR has much expertise in a wide variety of scientific and logistic fields which should be available to CRAMRA.
e. SCAR should be able to advise on the distribution of excess funds generated by revenues from companies (Art 35 para 7).

4. CONSERVATION

There was a lengthy discussion on the need for conservation in Antarctica. GWG are as mindful as any of the need to care for Antarctica and felt strongly that they should be represented on the Group of Specialists on Antarctic Environmental Affairs and Conservation (AEAC). Particular concerns were:

a. Problems of access for legitimate reserchers that might be caused by the setting up of protected areas.
b. The need to put the case for, and to provide expert advice on, scientific drilling and the use of explosives for scientific purposes. It is important to stress the need for such activities at sea, as well as on land.

Members of GWG were unanimous in nominating Dr P. J. Barrett as their representative for consideration as a member of the Group of Specialists on AEAC.

GWG members felt strongly that, as field scientists, all proposals for protected or specially managed areas in Antarctica should come to them through GWG Secretary for comment. They were informed by the secretary of several new proposals already in hand, but of which they were hitherto all unaware, to be considered at the preparatory meeting for XV ATCM in Paris next spring. Members urged that they be given the opportunity to comment on these proposals.

Until now most 'protected' areas in Antarctica had been proposed by biologists but there was considerable discussion on the need also to protect the geological environment. There were particular problems with indiscriminate collecting from fossil and mineral sites. What, if anything, should we do about it? Can we do anything effective anyway? Should we put forward some kind of blanket protective measures? - for example Denmark declared the whole of E. Greenland a national park. The wide body of concern required much more detailed discussion than was possible in the time available and it was resolved to set aside time for proper discussion at the next full meeting of GWG (Brasil 1990). Secretary GWG will prepare a background document for discussion.

5. WASTE DISPOSAL

Members of GWG felt that the aims set out in the document prepared by the SCAR Panel of Experts on Waste Disposal were laudable. However they noted that to put such measures into practice would require additional logistic effort and carry attendant costs, and that scientific programmes could suffer as a result. Nevertheless, these costs may have to be regarded as part of the normal costs of fieldwork.

6. REPORT TO SCAR

The report to SCAR should highlight the following items:

a. The WG's interest in IGBP.
b. Concern with the CRAMRA particularly the need for proper archiving and early release of data, and that minerals activities should not interfere with scientific programmes.
c. Concerns on conservation issues. WG members were generally supportive of conservation measures but felt very strongly the need to comment.

d. Concern was expressed about how best to coordinate programmes. It was noted that collaboration was best achieved through contacts between scientists. Despite the difficulties some nations may have with travel funds, it was felt that the pace of Antarctic research is such that WG members should seize every opportunity to meet - there should be formal WG meetings every two years.

e. Antarctic Science Conference: more thought had to be given to the audience SCAR wished to address and the best method of reaching that audience.

7. THANKS

A formal vote of thanks to Dr. P. G. Quilty for his efforts in arganizing the meeting was strongly endorsed. Special thanks were passed to Mrs Nolene Skegg, who single handedly produced such an excellent array of home-baked goodies for WG members.

A formal vote of thanks was proposed to Bob Tingey for many years of active service.

SCAR Working Group on Solid Earth Geophysics
Meetings at Hobart, Tasmania
5 and 9 September 1988

Present. Members: P. Quilty, AUSTRALIA (alternate); M.A. Keller, ARGENTINA; J.C. Parra, CHILE R. Schlich, FRANCE; F. Thyssen, F.R.G.; H.K. Gupta, INDIA; K. Kaminuma, JAPAN (alternate); F.J. Davey, NEW ZEALAND - Secretary; A. Guterch, POLAND; B. Corner, SOUTH AFRICA; P.F. Barker, U.K.; A.K. Cooper, U.S.A. (alternate). Observers: A. Rocha Campos, BRAZIL; A Meloni, ITALY; G. Brancolini, ITALY; R. Ramella, ITALY; Y. Kim, KOREA;

1. **Apologies for absence.** C.Bentley, U.S.A.

2. **Agenda.** The draft agenda was accepted with the additional items of Recommendation.

3. **Minutes.** The minutes of 30 August 1987 were confirmed.

4. **Matters Arising.** Items not already included in the Agenda and discussed under "Matters Arising" included National Reports, Sermology, and Antartic Minerals Convention.

4a. National Reports

National reports were circulated at the meeting or shortly afterwards to working group members. National reports are outstanding from Belgium, China, New Zealand and the U.K. Several reports of the present format of the report were discussed, the main general suggestion being an increase - the amount of information on the report especially for future work. Thyssen (FRG) proposed adding contact names and addresses for projects and theat more information would be useful in its 'future activities' section to aid project planning and cooperation. Some members thought the report was large enough already but Cooper (USA) rate the problem of scheduling seismic surbeys in the Ross Sea in the 1988–89 season with the possibility of 3 projects in the area which may overlap and may have interference problems with acoustic sources. Meloni (ITALY) outlined the proposed Italian seismic program for 1988–89 - phase I in the Balleny Islands region, Phase II in the Ross Sea region.

Rocha Campos (BRAZIL) suggested a periodic compilation of total data coverage for particular geophysical data could be useful, noting the efforts of Behrendt (USA) with multichannel seismic data. The W G members considered that this would be a very big job to bring together a single database of data coverage for several important geophysical data sets, that this would duplicate, in part, the work of the World Data Centres and that it would be preferable for the WG members to act as contact points for data enquiries and not to undertake at the present time any major data location compilations. It was considered valuable, however, for National Reports to include maps showing the location of data measurements - observatory or field survey measurements. The Secretary was instructed to produce guidelines for these maps to ensure compatability and clarity in presentation.

Verbal reports or additions to reports were presented by Parra (Chile), Davey (New Zealand), Guterch (Poland), Meloni (Italy), Ramella (Italy), Thyssen (FRG), and Kim (Korea). The Italian program included 2300 km of 24 fold seismic reflection data recorded in the Ross Sea during the 1987-88 season with a further 5000+ km planned for 1988-89 season. A 3 component broadband Streickheissen digital seismograph is planned for the Italian base in Terra Nova Bay in the early 1990's. Thyssen (FRG) noted the joint FRG-USA crustal seismic studies of western Ross Sea planned for 1988–89. Preliminary reports on Legs 119 and 120 of the Ocean Drilling Programme (ODP) at high southern latitudes are due out within the next 12 months. Most of the objectives were achieved, and additional data are available for these drill sites from the wide range of downhole logs (Cooper, USA; Schlich, France). No further high southern latitude drilling under the ODP is expected in the next 5+ years and the Southern Ocean Panel has been disbanded. Schlick (France) presented a new bathymetric map for Kerguelen Plateau and outlined the prepared two ship CDP and ESP project of France and USA in the area. Kaninuma (Japan) noted the installation of an 11m parabolic antanna for VLBI work and a broadband digital seismograph at Showa this year with satellite telemetry for the seismic data planned for 1989–90. A DSS profile, 300 km long, along 24°E is proposed for 1994-5.

4b. Seismology

No concern was expressed by WG members with regards to the cooperation between local seismograph network in the Antarctic Peninsula region and to the continuation of the second part of recommendation SGG 1987-1 was not supported. The Secretary agreed to produce a summary of seismograph networks in

Antarctica for the WG.

The WG noted that digital broadband seismographs were being installed or installation was planned at Showa Station (Japan), Terra Nova Bay (Italy) and Antarctic Peninsula (France). It considered additional installations were desirable and the continuation of the initial part of recommendation SEG 1987-1 was supported. Gupta (India) suggested the relocation of earthquakes in Antarctica using modern analysis techniques to give more accurate locations. Secretary noted the lack of historial seismicity in Antarctica and mentioned the program of Adams (ICS, IASPEI) to look for seismicity of medium-small magnitude which had missed detection by the standard International Seismological Centre (ISC) methods and criteria.

4c. Antarctic Minerals Convention

The Secretary outlined the main components of the recently adopted Convention on the Regulation of Antarctic Mineral Resources and Activities. The topic was held over for discussion at the joint meeting with Geology WG, after a general discussion of this document and the parts which could affect scientific programs in Antarctica. The points noted in particular were the requirement to archive data recorded during mineral resource activity; the minimum confidentiality period of 10 years for these data; the requirement for baseline environmental data before activities could commence and the possible effect of this on national science programs, the logistic requirements for inspection; and the requirement to return surplus operation funds of the institutions of the Convention to scientific research.

5. **Satellite Data.** After a brief discussion on the availability of satellite imagery, this topic was held over to the joint meeting with Geology WG. The Working Group considered support for the proposed NASA Geopotential Research Mission should be continued (Recommendation SEG 1987-2). Corner (South Africa) noted the importance of the Global Positioning System (GPS) for navigation and the WG expressed support for the timely introduction of the full system. Satellite information was discussed further during the informal meeting of the WG with the WGs on Geology and on Geology and Cartography on 8 September (see item 12). It was noted that the use of GPSinformation for scientific purposes could be greatly enhanced by the release of the accurate orbital parameter code set (P code) for the GPS satellites. Recommendation SEG 1987-7 expresses the WG's concern for getting the full and accurate GPS network operational as soon as possible with maximum accuracy. Thyssen (FRG) enquired whether a similar USSR system existed.

6. **Scientific Data Availability.** The continuing problem of 'freely available' scientific data was discussed. It was noted that one of the main distinctions between earth science data recorded under the adopted Antarctic Minerals Convention and that under a scientific research program is that the former may remain confidential for a minimum of 10 years and has major responsibilities such as liability for damage associated with it. The Working Group was sympathetic to the device of investigators to have a right to first publish the data they have acquired but considered that the data and particularly the location where data have been obtained, should be made immediately available for all to see. The Working Group also considered it appropriate to encourage cooperative and joint studies in Antarctica. Recommendation SEG 1988-4 refers.

7. **Cambridge Data Base.** The proposed commercial data base of Antarctic data is defunct and therefore was not discussed.

8. **Conservation and the Environment.** The implication and effect of recent recommendations or comments of the effect on the environment of scientific drilling and the use of explosives in marine seismic work were discussed. In particular the lack of clarity of the ATCM recommendation XIV-2 in drilling in Antarctica and the list of activities likely to cause major impact on the Antarctic environment annexed to the report of XIII ATCM which includes, unqualified, the use of explosives in Marine seismic surveys, are of great concern. These recommendations appear to have been used, and are likely to be used, to curtail or alter proposed earth seismic activities without a proper assessment of the environmental impacts being made. The WG also expressed concern on the lack of consultation about other conservation and environmental matters before they became SCAR policy noting in particular the lack of consultation on proposed SSSIs, SPAs and APAs which may affect proposed earth science research. The WG welcomes the setting-up of a Group of Specialists on Conservation and the Environment which should include earth science expertise. The WG decided to recommend a geophysicist should join the Group of Specialists and Dr P. F. Barker was proposed as a candidate. The Secretary is to contact Dr. G. Hempel (SCAR executive) regarding the proposal.

9. **Reports of the Group of Specialists on Cenozoic Geology and Antarctic Lithosphere.** These reports were held over to the joint meeting with Geology Working Group.

10. **South Antarctic Earth Science Symposium in Japan.** Kaninuma (Japan) outlined the planning schedule and possible program for the symposium. The timing of the symposium and the possible types of publications of proceedings, such as a single volume of proceedings or as special issues of international journals, were discussed. The possibility of distributing an extended abstract volume at the symposium was considered useful in the latter case. Themes focussing on the work of the earth science group of specialists were considered appropriate and the use of poster sessions very important.

11. **IGBP.** The Secretary outlined the proposed IGBP program. The WG noted the time scale (10-100 years) considered appropriate for the changes to be studied under this program and noted that it could at best only play a supporting role to other SCAR initiatives. Changes in the physical environment over this period may have some geophysical signature on a global basis but these signatures were considered minor or second order. The Working Group considered it best to await SCAR proposals and then see how it could assist in supporting these proposals.

12. **Joint meeting with WGs on Geology and on Geodesy and Cartography.** Four items arising out of the joint meeting were discussed:

12a. Satellite and geodesy

In addition to the topics noted under item 5, the use of satellite geodesy for measuring earth deformation was briefly discussed. The program of the WG on Geodesy and Cartography to locate points on the surface of the earth accurately relative to each other would be of significant use for defining earth deformation if a series of repeat measurements were made. The WG on Geodesy and Cartography is also aware of this possibility and the two WGs should investigate the possibility of a joint program on this topic.

12b. Gravity

The WG on Geodesy and Cartography is interested in gravity measurements to assist in defining the geoid. The SEG WG considers it useful to find out the requirements of the WG on Geodesy and Cartography with a view to assist them in their requirements, possibly summarizing gravity data coverage and sources for Antarctica. The WGs noted in addition the importance of obtaining absolute gravity measurements on the Antarctic continent and in ascertaining whether the geoid model, WGS84, should be used in gravity data processing.

12c. Cartography and Geography Information Systems were briefly discussed.

13. **Meetings - Antarctic Science Conference, China.** information circular on the planned Chinese Antarctic Science Conference for May 1989 was tabled. It was noted that no scientific program was set out.

14. **Databases.** A project to produce a list of geophysical databases for Antarctica was discussed. Cooper (USA) noted that Molnia (USA) was producing a directory of Antarctic earth science databases. It was decided to await details of this project before embarking on any further work.

15. **Waste disposal.** The WGs considered the recommendations contained in the Logistic WG's report on Waste Disposal. Some concern was noted with regards to recommendations 20 and 28 about the type and character of waste to be disposed of by dumping in the deep ocean. Waste which floats or does not disperse was identified as a potential problem.

16. **Review of geophysics in Antarctica.** Barker (UK) proposed that WG members should identify the area of their geophysical expertise and to set up a program to review the current state and possible future direction of Antarctic solid earth geophysics.

17. **Recommendations.** The recommendation of the 1987 meeting of the Working Group were reviewed and the following recommendations adopted.

SEG-1988-1 (modified from SEG-1987-1): Recognising the increasing activities in global seismic monitoring, the Working Group encourages the establishment of broadband seismographs on the Antarctic continent.

SEG-1988-2 (unchanged from SEG-1987-3): The Working Group, noting the need for an accurate geoid map of Antarctica so that heights above sea can be deduced from geodetic satellite measurements, recommends that all nations: (1) determine mean sea level at their coastal stations; (2) make accurate (about + 1m) geodetic satellite elevation measurements at points of known height above sea level; and (3) extend such measurements around the continent with an aim of establishing a net of stations, where both geodetic satellite elevations and heights above sea level are known, at a spacing of no more than 500 km.

SEG-1988-3 (unchanged from SEG-1987-3): The Working Group recommends that all marine geologists and geophysicists lodge their sample, station, and traverse locations with the World Data Center within one year using the International Geological/Geophysical Cruise Inventory (IGGCI), to assist others in planning forthcoming data collection cruises.

SEG-1988-4 (modified from SEG-1987-4): The Working Group recognises that digital multichannel seismic reflection profiling is essential to the study of the geological structure of Antarctica and its margin and urges the expansion of this activity, particularly on land. Recognizing the large resources required to acquire these and other types of geophysical data in Antarctica, and their possible importance as components of a planned, long-term, research project, and while supporting the concept of the prior right of the investigator to work on and publish the information gained in a project, either solely or in cooperation; nevertheless, in the spirit of the Antarctic Treaty, the WG recommends that all data acquired for scientific purposes should be made freely available at any time for examinationand strongly supports the concept of joint or cooperative investigations.

SEG-1988-5 (unchanged from SEG-1987-5): The Working Group recommends that the tracks and types of measurements of all airborne geophysical surveys are lodged with the World Data Center.

SEG-1987-6 (unchanged from SEG-1986-7): The Working Group recognises the great importance of NASA's Geopotential Research Mission (GRM) for studying the Antarctic lithosphere and gravity and magnetic fields, notes that for the current generation of geoscientists, the GRM satellite data may well represent the most comprehensive and consistent gravity and magnetic coverage that can be made available for Antarctica and adjacent marine regions, and recommends that NASA continues its efforts to implement the GRM satellite program as soon as possible and makes available to the scientific community the results of this mission in a timely fashion.

SEG-1988-7 (new): The WG recognizes the great value of NASA's Global Positioning System (GPS) both for the dynamic positioning of aircraft and ships used for geophysical surveys in Antarctica, and adjacent marine regions and, through the urgent release of the more accurate code (P Code), for the study of important geoscience problems and recommends that NASA continues it s efforts to implement the GPS program (with the accurate code) as soon as possible for the benefit of the Antarctic geoscience community.

18. **Next Meeting.** SCAR is requested to approve formal meetings at:
    a). Sixth International Antarctic Earth Science Symposium in Japan in September 1991
    b). XXI SCAR in Brazil in 1990.

The WG is aware that SCAR executive is not enthusiastic about WGs meeting frequently in association with SCAR meetings. The WG considers that there are special circumstances which are:
    a). the need for last-minute discussion, in association with the WG on Geology, on the program planned for the Sixth International Antarctic Earth Science Symposium in Japan in 1991:
    b). the need to follow up and expand the direct interaction with the WG on Geodesy and Cartography and to establish a direct interaction with the WG on Glaciology, both of these associations have the potential to develop important interdiscuplinary programs:
    c). reconsider the role of the Groups of Specialists on Cenozoic Geology and on Antarctic Lithosphere as their mandate expires in 1991
    d). no suitable earth science conference occurs in 1990.

Informal meetings which some members may attend could take place at:
IASPEI Meeting - Istanbul in 1989
IGC Meeting - Washington DC in 1989

19. Election of officers. F. Thyssen (FRG) was unanimously elected secretary of the WG, replacing F. Davey (NZ): proposed Davey (NZ), seconded Schlich (FRANCE).

NATIONAL REPORTS - MAP ATTACHMENTS - GUIDELINES

The meeting of the Solid Earth Geophysics WG on 5 September decided that maps defining:

1. The areas covered by surveys reported on in national reports
2. location of observatory stations noted in national reports,

should be attached to national reports. The following guidelines for the presentation of these maps have been drawn up to ensure accuracy and compatibility of the maps and hence their usefulness.

1. Maps of Surveys

a) Scale to fit on one page (A4 or quarto), scale to be quoted
b) some space around edge of track information
c) polar stereographic projection
d) latitude and longitude marks around all edges of map and where possible on the interior annotated
e) geographic features to be sketched in eg coastline, iceshelf edge, nunatak
f) all tracks to be shown - NOT shaded area of survey
g) more than one map if necessary to show detail.

2. Maps of observatories

a) for single observatory and other "repeat" stations use Antarctic or Antarctic sector base map with:
   i) latitudes and longitudes
   ii) coastlines, ice edge, rock outcrop
   iii) polar stereographic projection
b) for observatory networks (eg seismograph networks) use a regional base map (eg South Shetlands and Branfield Strait) with
   i) latitudes and longitudes
   ii) coastlines and other geographic features
   iii) polar stereographic

The base map should cover an area about 2 x area of network.

SCAR Working Groups on Geology and Solid Earth Geophysics
Joint meeting at Hobart, Tasmania
5–8 September 1988

1. **PRESENT:**

MEMBERS: R del Valle (G), M Keller (SEG)(Argentina); R J Tingey (G), P G Quilty (Alternate Delegate)(Australia); C O Berbert (G) (Brazil); J C Parra (SEG)(Chile); Liu X. (G)(P.R.China); R Schlich (SEG)(France); H Miller(G), F Thyssen (SEG)(F.R.Germany);H K Gupta (SEG)(India); Y Yoshida (G), K Kaminuma (Alternate SEG)(Japan); P Barrett (G), F.J. Davey (SEG)(New Zealand); A Elverhoi (G)(Norway); K Birkenmajer (G), A Guterch (SEG)(Poland); D R Hunter (G), B Corner (SEG)(S.Africa); M R A Thomson (G), P F Barker (SEG)(UK); D H Elliot (G), A Cooper (Alternate SEG)(USA); G Grikurov (G)(USSR); I W D Dalziel (IUGS).

(G) = W.G. Geology (SEG) = W.G. Solid Earth Geophysics

OBSERVERS: R H Findlay, B C McKelvey, R L Oliver (Australia); A C Rocha-Campos (Brazil); A Giret (France); D Fütterer (F.R. Germany); G Brancolini, R Funiciello, M Manzoni, A Meloni, R Ramella (Italy); Y Kim (Korea); J Bradshaw (New Zealand); C Hjort (Sweden); J W Thomson (U.K.); W E Le Masurier, B Molnia, P N Webb (USA); V Ivanov (USSR).

2. **APOLOGIES**

Prof F Herve (Chile)

3. **MINUTES OF THE LAST MEETING IN CAMBRIDGE, UK, 31 AUGUST 1987** were approved

4. **MATTERS ARISING**

5 Antarctic Earth Science Symposium (AES) Cambridge, August 1987: M R A Thomson gave a brief report on the status of the symposium volume. All papers had been refereed, edited and sent back to authors for correction. Most of these have been returned and are being passed in batches to Cambridge University Press for final editing and typesetting. The volume will be entitled ***Geological evolution of Antarctica*** and the editors are M R A Thomson, J A Crame & J W Thomson. Publication is anticipated in the middle of 1989.

Other matters were dealt with in the course of the remaining agenda items.

5. **MAP PROJECTIONS AND SATELLITE DATA**

a. **Map Projections**

Dr F J Davey drew attention to problems of incompatibility between map projections used onshore (Lambert conformal) and offshore (Polar stereographic). When the data are digital, as in the case of most geophysics, the problem is minimal but most geological data are in hand-drawn form and the production of composite onshore/ offshore geoscience maps is difficult. It was agreed to raise the matter in the joint meeting with the Geodesy and Cartography WG

b. **Satellite Imagery**

Dr B Molnia addressed the meeting on problems concerning the acquisition of satellite imagery. There is a need for a concerted effort to obtain imagery before LANDSAT 4 & 5 become defunct and Dr Molnia emphasized that it would not be long before this happened. Argentina, Australia, Norway, UK and the United States Geological Survey (USGS) have contributed funds to the central acquisition of satellite imagery. A group agreement has been negotiated so that all contributors may make free use of any scene once it has been purchased by the group. This may encourage others to join.

At present a 60° segment of Antarctica (the Wilkes Land area) is unavailable because the necessary Telemetered Data Relay Satellite TDRS was destroyed when "Challenger" blew up. Positioning of a new TDRS is anticipated in late September/early October 1988, and this will make it possible to receive data from this segment. Although coverage by images with less than 30% cloud cover is incomplete, (109 so far of the 150 possible), there are sufficient funds to meet the costs of complete coverage.

SOYUZ KARTA has 3000 high altitude photos of Antarctica: Karta 200, with a 20m resolution, covers about 80% of the area to 84°S, and Karta 1000, with a 100m resolution, also covers a substantial part of the continent. These photographic images are of high quality and can be digitized. SPOT Image (France) has acquired more than 300 images over Antarctica.

The USGS has just released the first volume of a series documenting satellite images of the world. This covers Antarctica and contains an index of all the images available.

Dr M R A Thomson informed the meeting that the UK Hydrographic Office had ordered SPOT imagery for the whole of the coastal region of the Antarctic Peninsula north of 70°S. So far about 30 more or less cloud-free scenes had been received. Dr Molnia suggested investigating the possibility of negotiating a group purchase of SPOT imagery.

It was agreed to keep recommendation GEOL SEG-1987-2 which relates to satellite imagery, in place with a view to encouraging SPOT to make tapes and imagery available to the Antarctic community on a group basis, as has been done with LANDSAT imagery.

6. GEOCHRONOLOGY MEETING - MUNICH 1989

Professor H. Miller outlined plans for the geochronology meeting next May. About forty participants were expected and it was planned that the Groups of Specialists on the Lithosphere and Cenozoic palaeoenvironments should meet at the same time. He has received grants of US$1000 from SCAR and DM3500 from the Deutsche Forschungsgemeinschaft, to cover administrative costs. However the Working Groups recommended that a further US$5000 should be requested from SCAR to subsidize travel costs for young scientists and participants from developing countries.

The proceedings will be published as a special issue of ***Zentralblatt für Geologie*** in March 1990. Abstracts will be published in time for the meeting. Dr P N Webb's request that the scope of the meeting be enlarged to include stable isotopes.was endorsed.

7. 6th INTERNATIONAL SYMPOSIUM ON ANTARCTIC EARTH SCIENCES

A formal invitation to hold the meeting in Tokyo, Japan, during September 1991 was made by Professor Y. Yoshida and accepted by the meeting. The venue is not yet decided but will be somewhere outside urban Tokyo. It is planned to issue the first circular in July/August 1989 and the second one in July 1990. Obtaining supporting funds from within Japan may prove difficult. In view of the high cost of travelling to Japan and taking into account inflation the Working Groups recommended that SCAR be asked to provide funds significantly above those provided for 5th AES in Cambridge, 1987, (these were US$10,000 for the year of the symposium and US$5000 for the following year).

Following discussion on the best method of publishing the proceedings a vote was taken on members preference for publication in (1) symposium volume or (2) the provision of cheaply produced extended abstracts at the meeting and publication of papers in relevant international journals. Preference for the second was indicated by a clear majority of the members.

Prof. Yoshida asked members to suggest themes they would like discussed. Dr Giret asked that subantarctic islands be included as many advances had been made in their study and they were an important part of the Antarctic plate.

8. SPECIALIST GROUP - Cenozoic palaeoenvironments.

Professor P N Webb (Group Convenor) outlined progress of his group and explained that they are looking to identifying a 5-year programme with emphasis on poorly known areas. The drilling workshop in Columbus, Ohio, November 1988 will create opportunities for geologists, geophysicists and drilling experts to discuss mutual problems. There is a particular need for geochronological control, and stable isotope event recognition and correlation.

SPECIALIST GROUP - Antarctic Lithosphere

Professor I W D Dalziel reviewed progress to date - meetings covering the Antarctic Peninsula and Weddell Sea have already been held in Bremerhaven and São Paulo. The present meeting will address East Antarctica. Ideas generated by the construction of geological transects need to be translated into facts and the development of an over-snow seismic programme is critical. This will be discussed at IGC, Washington, July 1989.

9. CONSERVATION AND THE ENVIRONMENT

Professor A C Rocha-Campos gave a brief outline of plans for the setting up of a Group of Specialists on Antarctic Environmental Affairs and Conservation. It was understood that this would include at least one earth science member.

In a general discussion of the need to protect the Antarctic environments and of the measures necessary to do this, members of both W.G.s expressed concern that protection measures had been passed without their consultation. There was a strong possibility that conservation measures proposed by one group of scientists could adversely affect the research of another and the Working Groups expressed the view that they should have the opportunity of commenting on all proposals for SSI's, SPA's and APA's before they were implemented, in order that they should not compromise geological and geophysical field work. They expressed concern that groups such as CCAMLR

could designate special conservation areas without discussion with SCAR.

There were particular concerns relating to access and controls on scientific drilling and the use of explosives. Guidelines for scientific drilling drawn up by the Antarctic Treaty Consultative Meeting (ATCM) were already in place, and were in hand for other earth science activities with a perceived high impact on the environment, e.g. the use of explosives in marine seismic investigations. Concern was expressed as to what might be considered a **significant** impact and how the restrictions might be used.

It was agreed that the Working Groups would write to SCAR expressing their concern and seeking clarification of the regulations relating to drilling and the use of explosives in Antarctica. Dr. D.H. Elliot urged that each working group should be represented on the Group of Specialists on Antarctic Environmental Affairs and Conservation, a view strongly endorsed by the meeting.

Attention of the Working Groups was drawn to the **Draft Report of the SCAR Panel of Experts on Waste Disposal** and particularly to the recommendations relating to the removal of waste from field locations.

10. MINERALS REGIME

Most members had at least glimpsed the **Convention on the Regulations of Antarctic Mineral Resource Activities**. Dr Davey drew attention to those articles he considered of special relevance to earth scientists. There was a general discussion of the document in which individual concerns were voiced. However, it was generally felt that there were sufficient safeguards to ensure that true scientific activities were not adversely affected.

It was felt that there were two main areas of concern:

(1) Confidentiality and the generation of large amounts of data. Whilst members did not welcome the 10-year limit on confidentiality of data, Article 16 is positive in encouraging the release of data by commercial companies. When data are released, has SCAR considered how they might be disseminated - through an Antarctic GIS, perhaps?

(2) With the regime in place, scientists of some countries might be forced by their governments to direct their science programmes more and more towards resource evaluation.

11. MEETING BETWEEN SCAR EXECUTIVE, CHIEF OFFICERS OF WORKING GROUPS AND CONVENORS OF GROUPS OF SPECIALISTS:

Working Group members were pleased that this meeting had taken place and felt that this was an important step forward in improving communication between the WGs and SCAR Executive. The main issues discussed at the meeting (conservation, Antarctic Science conference and frequency of meetings) were relayed to WG members. Notwithstanding the problems some nations have in attending meetings, it was generally felt that scientific progress was now so rapid that we had to take every available opportunity to meet, formally or informally. The increase in interdisciplinary studies, and particularly initiatives such as IGBP, underlined a necessity for greater collaboration between a wide range of WGs. Prof. Dalziel urged that at least **all** WG senior officers should meet at every SCAR. With reference to the **Antarctic Science conference**, both WGs would welcome further clarification of its aims and audience. Whatever these should be, it is important that the WGs should be involved in planning from an early stage.

12. HIGH-LATITUDE DRILLING:

Prof. Dalziel outlined the future plans for ODP. The next four years will concentrate on the Pacific, with almost no drilling south of the Equator. Regional panels are preparing a 10-year programme beyond 1993 - their white papers will be published in **Joides Journal**. There is considerable interest in drilling the Chile Rise triple junction (43°) in which case we should take the opportunity to propose further drilling in the Southern Ocean.

13. JOINT RECOMMENDATIONS

The Joint Working Groups amended the Recommendation adopted at Cambridge in August 1987 to read as follows:

Recommendation GEOL SEG-1988-1

RECALLING that Article III Section 1c of the Antarctic Treaty stipulates that scientific observations and results from Antarctica shall be exchanged and made freely available; ANTICIPATING that future activities under an Antarctic Mineral regime will, if they occur, generate a large body of geological and geophysical data from Antarctica and its continental margins;

RECOGNISING that these data would constitute an important component of information about the tectonic and palaeoenvironmental evolution of the Antarctic region; and FURTHER RECOGNISING that the timely release of such data will help minimise the risk to the Antarctic environment that are associated with minerals activities;

the SCAR Working Groups on Geology and Solid Earth Geophysics RECOMMEND that scientific data from

activities conducted in conformity with provisions of the Antarctic Minerals Regime be made available on request to the Antarctic and wider scientific communities as soon as possible, at the cost of reproduction.

Recommendation GEOL SEG 1988-2 SATELLITE DATA

The Working Groups

RECOGNIZING the international character of the Antarctic

NOTING Antarctic Treaty provisions for free exchange of scientific information,

RECOMMEND the unrestricted release of all satellite data collected south of 60°S to interested scientists at the cost of reproducing the data tapes and film products.

Recommendation GEOL SEG-1988-3 SCIENTIFIC DRILLING

RECOGNIZING the gains to our knowledge of the palaeoenvironmental history and tectonic evolution of Antarctica and the Southern Oceans achieved by recent scientific drilling, the Working Groups on Geology and Solid Earth Geophysics strongly endorse further scientific drilling in high southern latitudes.

The Working Groups also recognise that drilling carries with it environmental risks and therefore RECOMMEND that National Programmes ensure for scientific drilling which they propose in the Antarctic region :-

(1) that site selection is based on scientific data that is adquate for the the avoidance of hydrocarbon accumulations

(2) that drilling resources and procedures are sufficient to ensure environmental and industrial safety.

14. NEXT MEETING:

It was generally felt that there should not be more than a 2-year gap between meetings and we should therefore plan to meet at XX1 SCAR in Brazil, 1990. There could be opportunities for informal meetings at IGC, Washington in July 1989, and at the 3rd International Conference on Palaeo-oceanography, Cambridge, U.K. in September 1989.

SCAR Working Group on Logistics and Managers of National Antarctic Programmes Meeting at Hobart, Tasmania 5-9 September, 1988

The Working Group on Logistics (WGL) invited the Managers of National Antarctic Programs (MNAP) to be present as participating observers. The combined group met during the period 5 to 9 September. The list of those present is attached as Annex 1. The results of the meeting are summarised as follows:

1. Relative Roles of MNAPS and LWG

The Chairman opened the discussion of the combined group of MNAPS and LWG by explaining that it would be important to first define the relative roles of the two groups and consider the proposal of the SCAR Executive for a "Council of Operations Managers".

The reasons for the establishment of an MNAP group were re-iterated, namely:

A. To exchange information on those operational items or matters which have budgeting or operational significance and so to learn from the successes and failures of others.

B. To exchange information on, and resolve, joint operational problems.

C. To participate, with appropriate scientists, in discussions of proposed scientific projects requiring major international collaboration or large-scale operational support so as to determine their nation's resources for such projects.

D. To establish personal contacts so that in the event of any emergency requiring it, international collaboration can be achieved more rapidly and efficiently.

E. To facilitate responses to requests from ATCMs directed to "national Antarctic operating agencies".

Following discussion a structure was agreed containing many elements of the proposal by the SCAR executive. The meeting agreed that the proposed new structure should be recommended for acceptance by SCAR.

In discussing Terms of Reference for the Council of MNAPs, delegates noted that the group cannot make decisions binding on their governments.

Terms of Reference for the Council of MNAPs were agreed (see *SCAR Bulletin*). There were some minor revisions to the wording following discussions with the SCAR Executive. The wording revisions did not change what was agreed during the WGL/MNAP meeting but expressed that argument more clearly.

The group recommended disbanding the present WG Logistics and re-constituting it as a standing committee of the MNAP Council. A separate set of Terms of Reference was agreed (see *SCAR Bulletin*).

Dr Heinz Kohnen was elected as the Chairman of SCALOP for a four year term. The group decided to continue, at least for another year, the practice of having the member from the host country for the next meeting serve as the Chairman.

The group unanimously agreed to Mr A. Fowler as Executive Secretary to the council of MNAP's, which would be a part-time position, undertaken upon his retirement from the NSF. The NSF offered to fund the position of Executive Secretary in the early years, at least, and this offer was gratefully accepted by the group.

2. Review of Symposium on Space and Airborne Technology Applications

In reviewing the symposium it was felt that it served a definite purpose and might be presented at future meetings. New Zealand mentioned that they found it difficult to obtain information on current and future use of space and airborne technology, and it was agreed that in future, more emphasis should be placed on new developments in this field.

Another suggestion which was accepted was that this item should be placed on future agendas for discussion.

It was confirmed that the papers which were presented, during this meeting, by the various countries, will be published, and each country was requested to submit a document of about 200-500 words on the use of remote sensing in their programmes, within the next two weeks.

3. Review of the Report of the SCAR Panel of Experts on Waste Disposal

The meeting reviewed the report of the SCAR Panel of Experts, and incorporated comments from members specifically on the list of recommendations. A meeting was also held with representatives of the Biology Working Group to incorporate their comments. The revised report is attached with the recommendation that it be adopted by SCAR delegates and reprinted by the national Antarctic operators in their own languages. In addition the meeting also recommended that:

1. National Antarctic Operators annually exchange copies of their waste management plans with a

view to giving consideration in two years' time to drawing up a standardized format for waste management plans.

2. The logistics sub-group of MNAPs should convene a meeting to consider problems, prospects and opportunities for co-operation in Antarctic waste management as set out in Recommendations of the report of the Panel of Experts, and in the first meeting consider the effectiveness of the waste disposal classifications contained in Recommendation 3.

4. Air Operations Safety

The group took note of the fact that there will be an Antarctic Treaty Meeting of Experts on this topic. The member from France announced that this would be in April, 1989, at a city in France to be announced. Therefore, the recommendations of this meeting would facilitate the advice by members to their governments with regard to the preparation of persons who will take up the matter at the meeting in France.

The Chairman summarised some understandings that were previously reached: a) Air Traffic Control Areas or Flight Information Regions in the Antarctic are not acceptable, and b) there should be an advance exchange in information among the MNAPs. The ensuing discussion reflected the idea that the topic of air operations safety may present a serious problem with respect to non-governmental activities but is manageable in terms of governmental operations.

In addition, it was pointed out that the development of any sort of uniform code or published doctrine for air operations safety in Antarctica results in a legal risk since non-government operators may interpret the same to constitute an offer and/or an obligation to provide assistance, which may be found to be negligently deficient in case of mishap. It was suggested that the course of action by MNAPs to serve their common interests with regard to government program air operations could be based on using a system of exchanging flight advice.

The following recommendations were agreed upon:

1. There should be an annual exchange of flight operations plans and schedules by MNAPS.
2. Where these plans indicate the possibility of problems, i.e. flights in the same area on the same day, the operators concerned should exchange information, in Antarctica, on those plans so that problems may be avoided.
3. One common VHF frequency in addition to the 121.5 Mhz guard channel should be identified and used by all national program aircraft throughout the continent. The specific frequency may be determined at the scheduled ATCM meeting of experts on air operations safety.
4. Position fixing is not a problem; when in doubt, aircraft in contact should agree to altitude separation.
5. Information on situations which may involve overflight, during point-to-point operations, will be included in the flight advisory information exchanges and operators whose sites of air activity are to be overflown would be advised, in Antarctica, prior to such overflights.
6. Risks involving balloon and rocket operations in Antarctica are to be managed by recognising that many stations launch upper air soundings daily at the 00Z and 12Z standard synoptic time-slots. Planned scientific research campaigns using balloons or rockets, which may then occur outside standard times, should be included in annual flight advisory notification. Revisions to such plans should be detailed in flight advisory notifications between operating centres in Antarctica.
7. It was agreed that there was no problem with long range government aircraft operating into Antarctica, but that long range NGA aircraft operating into the interior of Antarctica are a problem.
8. It was agreed that countries from whose territory NGA southbound flights originate should provide information on those flights to nations whose Antarctic operations may be affected. This is, of course, a part of the Treaty requirement to provide information on NGA by one's nationals or originating on one's territory. Nevertheless, in doing so, care must be taken to avoid any implication of an assurance to NGAs of facilities, services, being available to them.
9. It was recognised that communications between stations is often a problem and it was suggested that this could be corrected by using INMARSAT. Portable INMARSAT stations cost about US$60k.

5. Compressed Snow and Ice Airstrips

The meeting was addressed by Prof. W. F. Budd who detailed the recent history of compressed snow, ice and rock airstrips. The technique for the formation of compressed snow airstrips was detailed, noting that every 15 °C reduction in temperature required double the amount of pressure to ensure comparable compactness of the snow.

Prof. E. Korotkevich briefed the meeting on USSR experience with construction of compressed snow airstrips. The USSR experience revealed that it was only practical to construct compressed snow airstrips in temperatures warmer than -30°C and therefore such airstrips are generally limited to coastal locations. Compaction

is required throughout the year to ensure efficient compression of old and new snow. It was stated that aircraft of 100 tonne weight could safely operate on airstrips with 1.5 metres compaction. A further factor in operation on compressed snow airstrips is the use of low pressure tyres.

In summarizing the Chairman noted that compressed snow airstrips had been proven in the Antarctic and suggested that further investigation should be undertaken by the Standing Committee on Antarctic Logistics and Operations.

The meeting agreed that all members should identify suitable sites for airstrips for both general and emergency use, eg areas of blue ice or lakes or sea areas which are permanently frozen with thick ice, and that this information be compiled for distribution to member nations. Co-ordination of this task is to be carried out by the New Zealand representative.

6. Tourism and Non-Governmental Activities

It was noted that the commercial age had arrived in the Antarctic and that tourism would increase in the future.

For the national operators the most constructive way to meet this increased interest in the Antarctic was considered to be to work together with the private tourist operators.

It was suggested that private operators should be encouraged to form an association through which they could receive information and assistance and in that way achieve self-regulation of the tourist industry in the Antarctic.

The U.S. delegate informed the meeting about a task force to be set up in the United States to advise the government on Antarctic tourism. A video on the Antarctic Conservation Act is under preparation. It will be used by private operators to inform tourists going to the Antarctic. The U.S. delegate expressed the hope that the task force group would be able to visit other countries to learn how tourism, science and conservation were handled in different parts of the world.

The Argentinian delegate informed the meeting that they had a governmental inspector travel with every tourist cruise that leaves for Antarctica.

Finally the meeting expressed disappointment that the Antarctic Consultative Treaty Meeting XIV in Rio did not resolve the problem of Antarctic tourism following receipt of the information paper prepared by SCAR XIX.

7. Low Emission Power Supply Systems

Dr Kohnen asked what experience the members had on developing and use of environmentally favourable power systems. Solar panels, wind generators and special battery technology (lithium) were the most common forms.

Propane gas generators had proved less effective and reliable.

As to bigger power supply systems, nobody had any in planning or operation.. However, some new developments were announced. Another aspect discussed was development of power plants to meet (future) environmental protection pressure. It was agreed that this item would be a useful topic for the next logistic symposium.

8. Proposal for an Annual Newsletter ("Antarctic Logistic Experience")

The proposal was made by Chile to create a Newsletter which would contain information on new polar techniques, their quality, costs etc to assist operators when dealing with new developments and products.

It was generally felt that such a newsletter could be very useful, particularly for newcomers. Doubts, however, were raised that there would be sufficient contributions of good quality as logistics experts are usually too busy to produce articles on relevant topics due to the pressure of their duties. An earlier exercise of this type failed because of the lack of input.

It was recognised that a good-quality newsletter has to be edited professionally, requiring considerable funds which cannot be provided by SCAR. It is doubtful whether resources from advertisements would be sufficient to cover the editing costs because the market for Antarctic specific technology is small.

Following the appointment of a Secretary to the MNAPs it was agreed that the production of a Newsletter may now be possible. Members wishing to contribute should forward material to the Secretary.

An existing journal which deals with polar technology, could also be used as a forum by extending it to Antarctic matters. This possibility has yet to be explored.

9. Fourth SCAR Logistics Symposium

Following an offer from Brazil, it was agreed that the logistics symposium would be held in Brasilia in 1990 in association with SCAR XXI.

The Standing committee on Antarctic Operations and Logistics would set up an international steering committee to call for papers, establish themes and co-ordinate international contributions to the symposium. This

international committee would be chaired by the Chairman of the Standing Committee on Antarctic Logistics and would receive support from the MNAPs secretary.

10. Environmental Issues: The proposed establishment of a SCAR Group of Specialists on Antarctic Environmental Affairs and Conservation

The working group reviewed the terms of reference for the proposed Group of Specialists as set out in SCAR Bulletin 1988. No. 2. The meeting recognised that the Group would address issues which were likely to become increasingly important in terms of their interaction with Antarctic research and research support.

Members of the combined MNAPs Working Group on Logistics have, as the prime users of the product of the work of the Group of Specialists, a major contribution to make to the Group. Consequently, the MNAPs/WGL recommends that there should be two representatives covering operational expertise and program management issues. The meeting proposed Mr. Hugh Logan from New Zealand and Dr. Carlos Rinaldi as its representatives.

The meeting noted also that the new group of specialists should adopt a wide brief in its deliberation, using as important source documents the Brintland Report (the United Nations Commission on the Environment and Development) and the Convention on the Regulation of Antarctic Mineral Resources and Activities.

11. Scientific Co-operation

a) The interest of the group in polar engineering research and applied scientific studies is to be the subject of MNAP tasking to the SCALOP.

b) Several of the MNAPs expressed the need to stay abreast of changes in national and international priorities and research strategies. They concluded that use of the MNAP network of communication should be exploited for more thorough preparation and to discuss this topic at their next meeting.

12. SCARCOM

The meeting was advised that the SCARCOM manual will be posted to members in the next few weeks.

13. Operational Marine Meteorological and Sea Ice Information Services.

The group discussed this topic and agreed to the draft SCAR recommendation attached as Annex 5.

14. LENINGRAD LOGISTIC SYMPOSIUM

The Australian Antarctic Division had reprinted the proceedings of the Leningrad Logistic Symposium and copies were distributed at the meeting.

15. LOGISTICS EXPOSITION

The exposition was considered a great success by the delegates and the exhibitors. It is recommended that a similar exposition take place at the next SCAR meeting.

16. Next Meeting

It was decided that the next meeting of the MNAP group would be held at Cambridge England at a time just before the ATCM presently planned for September 1989. The plan is for a three-day meeting at Cambridge from Wednesday through Friday of the week just prior to the ATCM in Paris.

Annex 1

Present:

Note: a = member of WGL, b = MNAP, c = Observer, d = Associate Member

Argentina	a. J.F. Gallo	**Brazil**	a. A.J. Teixeira
	b. C.A. Rinaldi		b. S. Tasso V. A.
	b. L. R. Fontana		
	c. R.H. Magnacca	**Chile**	a. S.M. Lizasoain
	c. C. A. Fernandez		b. P. Romero
			c. R. Peake
Australia	a/b J.E. Bleasel (Chairman)		c. E.V. Muhlenbrock
			c. J. Radic

Federal Republic of Germany	a. H. Kohnen b. G. Hempel
Finland	d. R. Mansukoski
France	a. M. Engler b. C. Corbier
German Democratic Republic	a/b. R. Meier
Italy	a/b C. Vallone a/b M. Zucchelli
Japan	a/b T. Hoshiai
Republic of Korea	b. B. Park
New Zealand	a. R.B. Thomson b. H. Logan c. D. Geddes
Norway	b. O. Rogne
Peoples' Republic of China	b. Q. Gao
Poland	a. S.M. Zalewski b. K. Birkenmajer
South Africa	a. D. J. van Schalkwyk b. F. Gaum
Sweden	d. A. Karlqvist d. O. Mellander
United Kingdom	a. J. Bawden b. D.J. Drewry
United States of America	a. A. Fowler b. P. Wilkness c. E. Chiang
Uruguay	a. R. Aita b. D. Almada
USSR	a. V. Klokov b. E. Korotkevich

Annex 5

RESPONSE TO ATCM XIV RECOMMENDATION 10: MARINE METEOROLOGICAL SERVICES

Draft Recommendations

The XXth SCAR Meeting considered Recommendation ATCM XIV-10 to establish an International Marine Meteorological and Ice Information Service in the Southern Ocean. It was also informed on the views of WMO and IOC.

XX SCAR agreed:

- To propose to WMO and IOC that a small joint *ad hoc* committee be established consisting of SCAR, WMO and IOC representatives to work out proposals for improving marine meteorological and ice information services for the Antarctic Treaty area of the Southern Ocean.
- To propose Professor Ye. S. Korotkevitch SCAR Vice President as Chairman and Convener of this Committee.
- To propose to WMO and IOC that a scientific meeting jointly sponsored by SCAR, WMO and IOC and hosted by the USSR be held in Leningrad at an agreed time early in 1989 to discuss the objectives and types of such information services.
- To request that following this meeting the *ad hoc* committee consider the information presented to the joint meeting and also the reports of appropriate groups of the WMO Commission for Marine Meteorology (CMM) which will be available in February 1989 and to submit their report respectively to SCAR and to WMO as soon as practicable. After endorsement by the SCAR Executive and the Executive Council of WMO, the joint response will be able to be considered by an ATCM.

THREE RECENT PUBLICATIONS

Waste disposal in the Antarctic

Antarctic Treaty Consultative meeting Recommendation XIII-4 invited SCAR to provide advice on the question of waste disposal in the Antarctic. To prepare this advice SCAR established a group of experts which consulted extensively with National Antarctic research programme operators seeking information on present practices and types and quantities of wastes produced. The compilation of this information, together with recommendations for improving waste disposal procedures constitutes SCAR's response to the Treaty Consultative Parties' request and has been published by the Australian Antarctic Division on behalf of SCAR.

WASTE DISPOSAL IN THE ANTARCTIC. SCAR, 1989. Hobart, Australian Antarctic Division for SCAR, illustrated. ISBN 0-642-14498-2. US$15.00 or £9.00. Orders, with remittances, to SCAR, the Distribution Centre, Blackhorse Road, Letchworth, Herts. SG6 1HN, UK. Price includes unsealed airmail postage.

The role of Antarctica in global change

The International Council of Scientific Unions is launching, in the 1990s, a major world-wide international collaborative study of the interactive physical, chemical and biological processes that regulate the total Earth system and the changes that are occurring in the system. The programme is to be known as 'The International Geosphere Biosphere Programme (IGBP): A study of Global Change'. The primary goal of the programme is, through an improved understanding of the Earth system, to advance the capability to predict changes on time scales of decades to centuries.

The polar regions are important for these studies. Major interaction between the atmosphere, ice, ocean and biota affect the entire global systems through feedbacks, bio-geochemical cycles, deep ocean circulation and changes in ice mass-balance. The effects of global climate change are predicted to be more pronounced in the polar regions than at mid latitudes and therefore will be better observed and monitored. Also, the Antarctic is a rich repository of palaeo-environmental information in its ice sheet and ocean and lake sediments.

As a contribution to the Programme planning, ICSU Press published, on behalf of SCAR, a review of those aspects of Antarctic scientific research that can make significant contributions to the 'Core Global Change' projects identified by the global programme planners. Over the coming years these proposals will have to be developed into an implementation plan, as the national Antarctic science programmes enter commitments to undertake the required research. (A comparable review of possible Arctic contributions to IGBP has been published under the title 'Arctic Interactions' by University Corporation for Atmospheric Research, Boulder, Colorado)

THE ROLE OF ANTARCTICA IN GLOBAL CHANGE. SCAR, 1989. Cambridge, ICSU Press, on behalf of SCAR, illustrated. ISBN 0-930-35718-3. US$10.00 or £6.00. Orders, with remittances, to SCAR, the Distribution Centre, Blackhorse Road, Letchworth, Herts. SG6 1HN, UK. Price includes unsealed airmail postage.

Antarctic krill

'Biology and Ecology of the Antarctic Krill (*Euphausia superba* Dana): a Review' has been produced largely in response to a request from the Commission for the Conservation of Antarctic Marine Living Resources. It follows an earlier publication in this series (Volume 6) reviewing the biology and status of exploited Antarctic fish stocks.

Reviewing the status of Antarctic krill, this book draws heavily on the historical data collected by J.W.S. Marr during his pioneering work on RRS *Discovery*, and succinctly summarizes recent information, gathered as a result of the International BIOMASS programme, on the biology, distribution, abundance, productivity and behaviour of one of the most important and enigmatic marine organisms. Attention is focused on topics which are either directly or indirectly applicable to the effective management of krill exploitation within the provisions set out by Article II of the Convention for the Conservation of Antarctic Marine Living Resources.

BIOLOGY AND ECOLOGY OF ANTARCTIC KRILL (*Euphausia superba* Dana): A REVIEW. D.G.M. Miller and I. Hampton , 1988. Cambridge, SCAR and SCOR (BIOMASS Scientific Series 9). ix + 166pp, illustrated. ISBN 0-948277-09-2. US$25.00 or £15.00. Orders, with remittances, to SCAR, the Distribution Centre, Blackhorse Road, Letchworth, Herts. SG6 1HN, UK. Price includes unsealed airmail postage.

SCAR Report

SCAR Report is an irregular series of publications, started in 1986 to complement SCAR Bulletin. Its purpose is to provide SCAR National Committees and others directly involved in the work of SCAR with the full texts of reports of SCAR Working Group and Group of Specialists meetings, which had become too extensive to be published in the *Bulletin*, and with more comprehensive material from Antarctic Treaty meetings.

SCAR Bulletin

SCAR Bulletin, a quarterly publication of the Scientific Committee on Antarctic Research, is published on behalf of SCAR by Polar Publications, at the Scott Polar Research Institute, Cambridge. It carries reports of SCAR meetings, short summaries of SCAR Working Group and Group of Specialists meetings, notes, reviews, and articles and material from Antarctic Treaty Consultative meetings, considered to be of interest to a wide readership. Selections are reprinted as part of *Polar Record*, the journal of SPRI, and a Spanish translation is published by Instituto Antártico Argentino, Buenos Aires, Argentina.

Polar Record

Polar Record appears in January, April, July and October each year. The Editor welcomes articles, notes and reviews of contemporary or historic interest covering the sciences and humanities in polar and subpolar regions. Recent topics have included polar aspects of agriculture, archaeology, biogeography, botany, ecology, geography, geology, glaciology, international law, medicine, politics, human physiology, psychology, pollution chemistry and zoology.

Articles usually appear within a year of receipt, short notes within six months. For details contact the Editor of *Polar Record*, Scott Polar Research Institute, Lensfield Road, Cambridge CB2 1ER, UK: Tel (0223) 336567, Fax (0223) 334748.

The journal may also be used to advertise new books, forthcoming events of polar interest, etc.

Polar Record is obtainable through the publishers, Cambridge University Press, Edinburgh Building, Shaftesbury Road, Cambridge CB2 2RU, or from booksellers. Subscription rates are: for individuals £25.00, for institutions £35.00; single copies cost £10.00.

Printed by The Chameleon Press Limited, 5–25 Burr Road, London SW18 4SG