

## Antarctic Treaty nations meet in Rio de Janeiro; adopt 10 recommendations

Participation of observers at the meetings, the need for an organizational infrastructure, and human impact on the environment were three of the major issues discussed at the 14th Antarctic Treaty Consultative Meeting, hosted by Brazil in Rio de Janeiro, 5–16 October 1987.

Currently, 37 nations recognize the treaty. Treaty nations are designated as either consultative parties or acceding nations. The consultative parties are the original 12 signatories to the treaty along with 8 other nations which conduct substantive research programs in Antarc-

tica. The 17 acceding nations are those nations which agree to abide by the treaty but do not participate in its operation. As of October 1987, there are 20 consultative nations:

- Argentina
- Australia
- Belgium
- Brazil
- Chile
- Federal Republic of Germany
- France
- German Democratic Republic (changed status on 5 October 1987)
- India

- Italy (changed status on 5 October 1987)

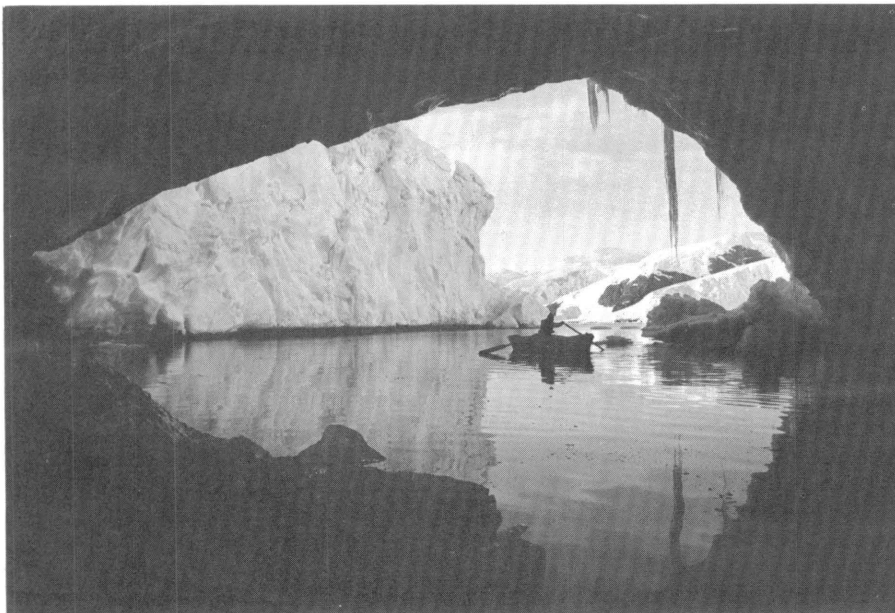
- Japan
- New Zealand
- Norway
- People's Republic of China
- Poland
- Republic of South Africa
- Union of Soviet Socialist Republics
- United Kingdom
- United States of America
- Uruguay

The 17 acceding nations including 5 nations that have joined the other contracting parties since the last treaty meeting in 1985 are:

- Austria (acceded 25 August 1987)
- Bulgaria
- Czechoslovakia
- Democratic People's Republic of Korea (acceded 21 January 1987)
- Denmark
- Ecuador (acceded 15 September 1987)
- Finland
- Greece (acceded 8 January 1987)

The Antarctic Peninsula. At the 14th meeting of the Antarctic Treaty consultative parties in October 1987, representatives recommended that three sites in the Antarctic Peninsula region be designated new Sites of Special Scientific Interest (SSSIs). The designation of these sites, as well as discussions of a new special site category—marine sites of special interest—and of man's impact on the environment, reflect the continuing concern of the consultative parties for the protection of the antarctic environment.

NSF photo by William Curtsinger.



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- Hungary
- The Netherlands
- Papua New Guinea
- Peru
- Republic of Cuba
- Republic of Korea (acceded 28 November 1986)
- Romania
- Spain
- Sweden

Before the opening of the 14th treaty meeting, the Seventh Special Consultative Meeting was held to review applications from Italy and the German Democratic Republic for consultative status. Both countries notified the consultative parties that they had been conducting substantive research and considered themselves to be eligible for consultative party status. Both applications were approved.

All of the treaty nations except four of the acceding parties (the Democratic

People's Republic of Korea, Hungary, Papua New Guinea, and the Republic of Cuba) attended the 1987 meeting. The 8-person U.S. delegation was led by R. Tucker Scully.

#### The 14th Antarctic Treaty Consultative Meeting rules of procedure/international organizations

The 1987 treaty meeting saw major progress in making the Antarctic Treaty system more open and accessible. New rules of procedure were adopted; these allow the participation of observers and experts from international organizations. Thus, for the first time at a treaty meeting, representatives of outside organizations were allowed to attend and participate in the sessions.

Representatives from the World Meteorological Organization (WMO), the Scientific Committee on Antarctic Research (SCAR), and the International Union for the Conservation of Nature and Natural Resources (IUCN) were invited to participate in discussions about issues within their areas of expertise. The delegates also heard reports from several international organizations on how to improve coordination within the Antarctic Treaty system, in accordance with Recommendation XIII-2. These organizations included representatives from the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR), SCAR, and the Convention for the Conservation of Antarctic Seals. In addition, reports of activities were provided on the antarctic minerals resource negotiations by New Zealand, antarctic issues in the United Nations by Australia, and the status of treaty recommendations by the United States.

#### Availability of information

The delegates of the 1987 treaty meeting took steps to improve the public availability of documents. They agreed that all documents from treaty meetings IV-VII would no longer be treated as confidential and that documents from treaty meetings VII-XIV would be reviewed for release at the next meeting. Further, they agreed that in the future the public availability of documents from the immediately preceding treaty meeting would be considered by each subsequent treaty meeting. Additionally, the delegates ruled that at future meetings it would be assumed that all documents were public unless they are otherwise marked (Recommendation XIV-1). This decision reverses the previous practice.

In a related action, the delegates also agreed to improve the availability of information about the Antarctic Treaty system by compiling a list of national contact points to whom interested citizens might write for information. A

complete list is published in the report of the treaty meeting. Finally, the delegates agreed to send copies of the relevant parts of the final report to various specialized agencies of the United Nations and other international organizations to improve cooperation with these bodies. Besides the organizations that had been invited to participate in the 1987 treaty meeting, these include the U.N. Environmental Program, the International Council of Scientific Unions (ICSU), the Intergovernmental Oceanographic Commission (IOC), the International Telecommunications Union (ITU), the International Civil Aviation Organization (ICAO), and the International Maritime Organization (IMO).

The delegates also discussed the possibility of producing a "white book," a publication that would summarize and highlight the accomplishments of the Antarctic Treaty over the past quarter of a century. Most countries, including the United States, agreed with the need for highlighting the Treaty's accomplishments, but raised questions about cost, acceptability to all parties, distribution, and related problems. The United States emphasized that the treaty nations should continue to ensure the public availability of accurate information about the Antarctic Treaty system. Chile indicated that it would seek to prepare an illustrative draft by the next treaty meeting, but it was agreed in the final report that rather than concentrating upon a collective publication, parties should emphasize national efforts to draw attention to the accomplishments of the system.

#### Organizational issues

The need to consider some type of infrastructure generated much discussion. To address the question of whether or not such an organizational structure is needed, the United States submitted a working paper on the functions necessary to support the Antarctic Treaty consultative mechanism. The four major areas of concern were support for meetings, archives and information, coordination and interaction with other organizations, and financial administration.

Several countries suggested that the Antarctic Treaty system has expanded to the point where some type of small or modest secretariat or office is necessary (i.e., possibly one person, plus secretarial support). While most countries agreed that a treaty system that has grown from 12 to 37 countries might need some type of permanent organization, several countries spoke against the need for, or establishment of, such an organization. These parties pointed out that the treaty has been very successful to date and that a structure could alter the present system in unforeseen ways. The



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issue will be discussed at the next treaty meeting.

All parties agreed that the increasing cost of hosting a meeting needs to be considered, especially because the number of member countries has grown. In addition, many countries cannot host a meeting because they do not have diplomatic relations with some of the other parties. This issue will also be discussed at the next treaty meeting.

The delegates debated the need for guidelines for nonconsultative parties that are considering requesting consultative party status. It was pointed out that such guidelines would in no way interpret Article IX of the Antarctic Treaty but would serve only to assist countries seeking consultative party status. The United States submitted a separate paper listing three guidelines, which were incorporated into the final report. The guidelines deal with past scientific activities, ongoing and planned activities, and management of activities and programs in Antarctica.

In its role as depositary, the United States noted the increasing delays in the time needed for approval of treaty meeting recommendations. As a result of these delays, some recommendations are outdated before they are approved by all consultative parties. According to Article XI of the Treaty consultative parties meet for the purpose of "exchanging information, consulting together on matters of common interest pertaining to Antarctica, and formulating and considering, and recommending to their Governments, measures in furtherance of the principles and objectives of the Treaty. . . ." (Article XI-1.) Recommendations become effective "when approved by all the Contracting Parties whose representatives were entitled to participate in the meetings held to consider those measures." (Article XI-4.)

It was suggested to overcome the delays that consultative parties consider using the final report to reflect some decisions of the treaty meeting. Several countries stressed that the process of developing agreed recommendations set forth in the Antarctic Treaty must not be adversely affected. The final report, incorporating the U.S. views, noted that, in the future, parties should focus more attention on the content of final report as well as the content of the recommendations. It was agreed that, in the future, such decisions should be made on an *ad hoc* basis.

### Inspections

The United States presented a paper on its inspection procedure, stressing the importance of inspections and their role in the Antarctic Treaty. The paper included information on how the United States plans Antarctic Treaty inspections and provided a list of the observations

U.S. inspectors are expected to make. (These were included in the final report.)

A number of delegations agreed that inspections are vital to ensure compliance with the principles and purposes of the treaty and to promote an exchange of information about potential problems, as well as on possible solutions. The Soviet Union stressed the importance of the inspection system of the treaty as a precedent for other arms control agreements.

The United States related that it makes reports of its inspections publicly available and urged other countries to do the same. In this regard, the United States noted that a copy of the U.S. 1985 inspection report will be circulated to the United Nations. During the meeting the U.S. delegation distributed information copies of this report to participants. It was also suggested that countries might consider providing copies of their inspection reports at the preparatory meetings for treaty meeting to allow all parties the opportunity to examine the reports before each treaty meeting.

### Human impact on the environment

The treaty nations adopted a recommendation concerning environmental impact assessments (EIAs), which included guidelines for national organizations. The guidelines reflect principles for EIAs described by the U.N. Environmental Program and are consistent with the U.S. domestic EIA criteria. They provide for notification and exchange of information by countries preparing environmental evaluations (Recommendation XIV-2).

The meeting adopted a U.S. proposal calling for SCAR to consider the topic of waste disposal. The proposal asks the SCAR panel to include in its work developing possible waste-disposal standards and examining obligations derived from other international agreements. Parties were urged to clean up existing waste disposal sites, minimize the quantity of waste generated, reuse and recycle material, and remove from the treaty area all wastes that cannot be disposed of in an environmentally sound manner. However, the treaty meeting was unable to undertake a comprehensive review, because SCAR has not completed its study of the problem. This is due primarily to slow or incomplete responses by national operators, who were urged to respond promptly to SCAR's questionnaire. SCAR hopes to complete its review by its August 1988 meeting.

There was a lengthy discussion of protected areas, which centered on the SCAR paper, "The Protected Area System in the Antarctic," which contained five recommendations:

- It was agreed that Specially Protected Areas (SPAs), Sites of Special Scientific Interest (SSSIs), and Historic Monuments (HMs) should be visited as frequently as possible in the next 2 years. This will allow discussion at the 15th Antarctic Treaty consultative meeting of whether objectives of the designations are being met.

- The delegates agreed that any information resulting from these site visits should be publicly available.

- The desirability of management plans for SPAs was discussed, but it was suggested that this might require an amendment to the Agreed Measures (Article VIII). Draft plans will be developed for further consideration at the next treaty meeting.

- Parties were urged to conduct surveys and take other necessary action to identify potential areas for additional SPA and SSSI designation, to achieve the representative geographical balance, as envisioned in Recommendation VII-2.

- Delegates discussed at length the proposal to create a new multipurpose protected area. They agreed to review the possibility of "Special Reserves" at the 1989 meeting.

The interim SCAR report on data management was welcomed by the delegations. SCAR's final report is expected in 1988. Two major goals were delineated: identify the specific types of data most useful for planning, managing, and evaluating activities in Antarctica and develop a directory indicating where and how these data can be obtained. In this regard, it was stressed that national contact points could be of great assistance.

The concentration and siting of stations were discussed. Because the number of consultative parties has increased, the number of stations in easily accessible areas such as King George Island has also increased. It was noted that this concentration of stations has caused health hazards (through pollution of water supplies), adverse environmental impacts, and interference with existing stations and science programs. During debate on this matter, it was noted that the principles of the Antarctic Treaty, including the freedom of scientific investigation, impose an obligation on parties establishing new stations as well as on parties operating existing stations. Those countries establishing new stations must consider possible impact on existing stations and programs, while those countries with existing programs and stations must be receptive to proposals for new stations.

The United States emphasized that consultations should be initiated early in the planning stage and continued as needed, as stations are built, occupied, or operated. Participating delegates generally agreed with this statement. In regard to planning, the Republic of Korea

outlined steps that it has taken to site its planned station.

Discussion of scientific drilling focused on a proposed recommendation, sponsored jointly by the United States and New Zealand, calling for adoption of guidelines for scientific drilling to reduce the risks of encountering hydrocarbons and polluting the antarctic environment. The proposal received wide support, and a slightly modified recommendation was adopted (Recommendation XIV-3).

The meeting also drew attention to the problem of depletion of the ozone layer above Antarctica, and it was agreed to place it on the agenda of this meeting.

#### SSSI designations

The treaty nations approved the following SSSI designations: extension of the expiration date of the SSSI at Arrival Heights, Ross Island, to 31 December 1997; establishment of four new SSSIs; and establishment of the three marine SSSIs. Designation of these marine SSSIs had been long pending (Recommendations XIV 4-6). The United States informally circulated a draft proposal to reclassify Cape Shirreff, Livingston Island, from an SPA to an SSSI. This designation will be discussed after SCAR has reviewed it at its next meeting.

#### Tourism, safety, and telecommunications

The effects of tourism and nongovernmental expeditions were discussed. A British proposal to codify the provisions of previous Antarctic Treaty recommendations was considered but not adopted. Increasing problems, such as concentration of tourist activities, environmental damage, the disruption to scientific research, and liability were raised. Members agreed to consider the matter further at the next treaty meeting.

Delegates approved a recommendation responding to the September 1987 report of the WMO Executive Committee Working Group on Antarctic Meteorology (WGAM). The recommendation, much of which was highly technical, updates the descriptions of the existing basic synoptic network and system of telecommunications. In addition, it called on WMO to examine telecommunications problems between Antarctica and the Global Telecommunications System (GTS) and indicated a willingness to review proposals to designate Antarctic Meteorological Centers (AMC), consistent with Article IV of the Antarctic Treaty (Recommendation XIV-7).

In a related action, the treaty nations discussed the need to improve marine meteorological data to increase the efficiency and safety of navigation in the

Antarctic Treaty area. The representatives adopted a recommendation that invites SCAR and WMO to consider this topic, in coordination with the Intergovernmental Oceanographic Commission, and includes the possibility of calling for a meeting of experts (Recommendation XIV-10).

On the issue of air safety, there was general support for increased coordination of air traffic within Antarctica, improved communications, and more coordinated search-and-rescue procedures. The delegates adopted a recommendation to convene a meeting of operational experts (possibly to include ICAO, WMO, and ITU experts) to consider these matters and prepare a report before the 1989 treaty meeting. The recommendation also calls upon parties to provide relevant technical information on a list of topics in advance of the experts' meeting (Recommendation XIV-9).

#### Historic sites

Three proposals were considered—a New Zealand proposal to establish buffer zones to regulate activities near potentially vulnerable historic sites and monuments; a Chilean proposal to establish a marker on Elephant Island near the site where the cruiser *Yelcho* rescued the survivors of the Shackleton Expedition; and a Federal Republic of Germany proposal indicating that it planned to replace the plaque commemorating the Dallmann Expedition of 1874. The first proposal was deferred to the 15th Antarctic Treaty consultative meeting, but the second two were approved (Recommendation XIV-8).

#### Next meeting

France agreed to host the 15th Antarctic Treaty consultative meeting in Paris in the spring or summer of 1989. The exact dates will be determined later.

—R.V. Arnaudo, Office of Oceans and Polar Affairs, U.S. Department of State.

*The text of the 10 recommendations adopted at the meeting follows this article; annexes and maps for Recommendations XIV-5 and XIV-9 follow the recommendations. Annexes to Recommendation XIV-7 were not included because of format restrictions. Copies of the final report of the 14th Antarctic Treaty Consultative Meeting, including the 14 recommendations, all annexes, and maps, may be obtained from the Polar Information Program, National Science Foundation, Washington, D.C. 20550 (202/357-7817).*

## 14th Consultative Meeting recommendations

### XIV-1. Operation of the Antarctic Treaty System: Public availability of the documents of consultative meetings

The Representatives,

*Conscious* of the value of increasing public knowledge of the achievements and operation of the Antarctic Treaty System;

*Noting* operative paragraph 4 of Recommendation XII-6, subparagraph (c) of which is no longer relevant;

*Desiring* to modify subparagraphs (a) and (b) of the said operative paragraph 4, which deals with the handling of Information Documents;

*Recommend* to their Governments that operative paragraph 4 of Recommendation XII-6 be replaced by the following: "4. Starting with the XVth Consultative Meeting, Delegations should indicate, when submitting an Information Document, if they intend that document not to be made public. In the absence of such an indication, the Document will be publicly available as from the closure of the Meeting at which it was submitted."

### XIV-2. Human impact on the antarctic environment: Environmental impact assessment

The Representatives,

*Recalling:*

(i) Article II of the Antarctic Treaty, Recommendations VI-4, VIII-11, VIII-13, IX-5, and XII-3;

(ii) the work of SCAR with respect to the elaboration of procedures for evaluating impacts from scientific and logistic activities;

(iii) the United Nations Environment Program (UNEP) "Goals and Principles on Environmental Impact Assessment" adopted by the UNEP Governing Council at its Fourteenth Session (June 1987);

*Reaffirming* that, before decisions are taken by their respective national organizations responsible for antarctic activ-

ities to undertake scientific research or associated logistic activities that are likely significantly to affect the antarctic environment, the environmental effects of such activities should be identified so that such effects may be carefully weighed against the advantages that are expected to be derived from the activity in question;

*Desiring:*

(i) to promote the implementation by Consultative Parties of appropriate procedures consistent with national laws and decision-making processes, through which the foregoing goal may be realized;

(ii) to encourage the development of reciprocal procedures for information exchange and comment between Parties when proposed activities are likely to have significant effects on the antarctic environment;

(iii) to introduce a measure of comparability between environmental impact assessment procedures for use with respect to the scientific research and associated logistic activities of Consultative Parties;

(iv) to ensure that in the implementation of such procedures due account is taken of *inter alia* the cumulative impact such activities may have in the antarctic environment and of their possible impact on other uses of Antarctica and on dependent and related ecosystems;

*Recommend* to their Governments that:

1. In the planning process leading to decisions about scientific research programs and their associated logistic support facilities, their respective national antarctic organizations responsible for antarctic activities evaluate the environmental impact of such activities in accordance with the procedural guidelines set out below:

**Guidelines for environmental impact assessment**

(i) the proposed activity should be defined and described, such description to include information on the needs to be met by the proposed activity and features of the activity that might cause impacts on the environment;

(ii) A first evaluation, termed an "Initial Environmental Evaluation," should be performed to determine whether the activity might reasonably be expected to have a significant impact;

(iii) If this Initial Environmental Evaluation indicates that the proposed activity is likely to have no more than a minor or transitory effect on the environment, March 1988

the activity may proceed, with the proviso that appropriate monitoring of the actual impact should take place;

(iv) Otherwise, a "Comprehensive Environmental Evaluation" should be prepared;

(v) Such a Comprehensive Environmental Evaluation should include:

(a) descriptions of the proposed activity and feasible alternatives, including the alternative of not proceeding, and their respective consequences on antarctic research;

(b) a description of the initial environmental reference state with which predicted changes are to be compared and a prediction of the future environmental state in the absence of the proposed activity;

(c) estimation of the nature, extent, duration, and intensity of the likely direct environmental effects resulting from the proposed activity;

(d) consideration of possible indirect or second-order effects;

(e) consideration of cumulative impacts of the proposed activity in the light of existing activities and other known planned activities;

(f) identification of measures, including monitoring programs, that could be taken to minimize or mitigate impacts and detect possible unforeseen effects;

(g) identification of unavoidable impacts;

(h) evaluation of the significance of the predicted environmental effects in relation to the advantages of the proposed activity.

(vi) On the basis of the Comprehensive Environmental Evaluation, a decision would be made by the appropriate national authority whether the activity should proceed and, if so, in its original or in a modified form;

(vii) Key indicators of the environmental effects of the activity should be monitored and, where possible, environmental impacts should, as in all antarctic activities, be minimized or mitigated.

2. In the process of preparing a Comprehensive Environmental Evaluation, Parties concerned shall be informed, and be given the opportunity to comment, either directly or through their national contact points.

3. Final Comprehensive Environmental Evaluations shall be transmitted as part of the annual exchange of information provided for under the Antarctic Treaty.

**XIV-3. Human impact on the antarctic environment: Safeguards for scientific drilling**

The Representatives,

*Recalling* Article II of the Antarctic Treaty and Recommendations VIII-13, IX-5, X-7, and XII-3;

*Recognizing* the knowledge of the tectonic, geochemical, and climatic evolution of the antarctic region that can be obtained from scientific drilling;

*Bearing in mind* the potential risk to the antarctic environment in cases where such drilling could result in hydrocarbons being released into the antarctic environment;

*Conscious* of the need for adequate preparation and planning of such drilling to ensure the best possible scientific results and protection of the antarctic environments;

*Conscious* also that planning such drilling will require preparation of a Comprehensive Environmental Evaluation as provided for in Recommendation XIV-2.

*Recommend* to their Governments that they adopt and use the following Guidelines to assist in evaluating and avoiding the potential risk for significant adverse environmental impacts resulting from such drilling.

**Guidelines for scientific drilling**

1. Before undertaking any scientific drilling that may have significant adverse environmental effects, adequately detailed geophysical surveys shall be performed of the sites in question to enable any potential hazard associated with any specific drill site within the area of interest to be evaluated along with any other information available about that particular site.

2. All feasible precautions shall be taken to locate such drill sites offstructure to reduce the possibility of encountering hydrocarbons.

3. Such planned drill sites and operational drilling plans, including the geophysical survey results and other information, shall be reviewed by a body of appropriate experts to identify potential hazards and to assess the potential risk to the environment resulting from the proposed drilling and how those risks can be minimized.

4. If any significant potential hazard is identified which cannot be avoided by modifying the planned drilling procedure or equipment, the location of the proposed drill site shall be abandoned and any recommendations of the reviewing body shall be considered in connection with the choice of an alternative site.

5. Contingency plans shall be prepared to deal with any problems that may develop during the drilling process.

6. The drilling process shall be continuously monitored for potential hazards and necessary action shall be taken if problems occur.

7. Notification shall be provided to the responsible national agency by those conducting drilling operations of all hazards encountered, including the location of the site at which they were identified, and a description of the actions taken.

#### **XIV-4. Facilitation of scientific research: Sites of Special Scientific Interest Interim guidelines: Extension of designation**

The Representatives,

*Recalling* Recommendations VIII-3, VIII-4, X-6, XII-5, and XIII-7;

*Noting* that:

(i) in accordance with paragraph 2 of Recommendation VIII-3 the Scientific Committee on Antarctic Research (SCAR) at its Nineteenth Meeting at San Diego, USA in June 1986, had reviewed the Site of Special Scientific Interest No. 2 and had noted the importance of protecting this site from manmade electromagnetic interference over a range of frequencies from 10.2 hertz to 10.8 hertz in view of the value of the site for the study of natural electromagnetic phenomena of relevance to ionospheric and magnetospheric physics;

(ii) experience of the practical effect of the management plan for the site had shown it to be an effective means of reducing the risks of harmful interference with the scientific research being undertaken in it;

(iii) no change to the management plan had been proposed by SCAR;

*Recommend* to their Governments that:

1. The date of expiry of designation of Site Number 2 be extended from 31 December 1987 to 31 December 1997;

2. They use their best endeavors to ensure, in accordance with paragraphs 3 and 4 of Recommendation VIII-3 that the management plan for this Site is observed.

#### **XIV-5. Facilitation of scientific research: Sites of Special Scientific Interest Interim guidelines: Additional sites**

The Representatives,

*Recalling* Recommendations VIII-3 and VIII-4;

*Noting* that management plans have been prepared and approved by the Scientific Committee on Antarctic Research (SCAR) for certain Sites of Special Scientific Interest additional to those already designated;

*Considering* that it would be advantageous to gather experience of the practical effect of the management plans prepared for these Sites;

*Recommend* to their Governments that they voluntarily take account of the management plans, annexed to this Recommendation for the following Sites:

Site No. 22: Yukidori Valley, Lanhovde, Lutzow-Holm Bay

Site No. 23: Svarthamaren, Mühlig-Hofmannfjella, Dronning Maud Land

Site No. 24: Summit of Mt. Melbourne, North Victoria Land

Site No. 25: Marine Plain, Mule Peninsula, Vestfold Hills, Princess Elizabeth Land

Site No. 26: Chile Bay (Discovery Bay), Greenwich Islands, South Shetland Islands

Site No. 27: Port Foster, Deception Island, South Shetland Islands

Site No. 28: South Bay, Doumer Island, Palmer Archipelago  
(See Annex.)

#### **XIV-6. Marine Sites of Special Scientific Interest**

The Representatives,

*Recalling* Article II of the Antarctic Treaty, Recommendation VII-3 and VIII-3;

*Conscious* of the need to protect marine scientific investigations which might suffer from willful or accidental interference;

*Desiring* to protect inshore marine sites of scientific interest where harmful interference is generally recognized to be likely;

*Recognizing* the need to protect such marine scientific investigations;

*Recognizing* that a limited number of inshore marine sites of exceptional scientific interest may require long-term protection from harmful interference;

*Recommend* to their Governments that:

1. They invite SCAR through their National Committees, to have regard to the following when considering proposals for Marine Sites of Special Scientific Interest.

(a) Marine sites should be proposed only when:

(i) Marine scientific investigations are being carried out or are planned to begin before the SCAR meeting following the 1988 meeting, and there is a demonstrable risk of interference which would jeopardize those scientific investigations; or

(ii) they are of exceptional scientific interest and therefore require a measure of long-term protection from harmful interference;

(b) Marine sites should be proposed for designation up to a specified date, which may be extended following a review by SCAR:

(c) Proposals for the designation of Marine Sites should be accompanied by management plans which should include *inter alia*, and where applicable, the following details:

(i) a description of the Marine Site, together with a map delimiting its boundaries;

(ii) a statement setting out the reasons in conformity with paragraphs 1 (a) (i) and (ii) above for designation of the Marine Site;

(iii) a description of the scientific investigations being carried out or planned;

(iv) the proposed date at which the designation will expire unless extended;

(v) if adjacent to the coast, proposed points of access;

(vi) other kinds of scientific investigations which would not cause harmful interference with the investigations described at paragraph (c) (iii) above;

(vii) whether specific kinds of scientific sampling may take place and guidelines for such sampling.

2. They invite SCAR, through their National Committees, to initiate review of those Marine Sites whose designation is likely to terminate before the second following Antarctic Treaty Consultative Meeting;

3. They request their national offices responsible for antarctic activities to maintain a record of activities within each Marine Site of Special Scientific Interest in which their scientists are active;

4. Scientists wishing to work within Marine Sites of Special Scientific Interest should consult, to obtain authorization, their national offices responsible for antarctic activities.

## XIV-7. Antarctic meteorology and telecommunications

The Representatives,

*Recalling* Article IV of the Antarctic Treaty and Recommendations VI-3, X-3, and XII-1;

*Noting* the Final Report of the World Meteorological Organization (WMO) Executive Council Working Group on Antarctic Meteorology, Fourth Session (EC/WGAM-IV), (September 1986) and subsequent action taken by the WMO Tenth Congress (May 1987), relating to Antarctic Meteorology.

*Recommend* to their Governments that:

1. Having regard to Recommendations 6 and 8 of EC/WGAM-IV (reproduced at Annex C to the Final Report of Antarctic Treaty Consultative Meeting XIV), they accept Annex 1 to this Recommendation as a current statement of the Basic Synoptic Network and the Network of Climat and Climat Temp Reporting Stations in the Antarctic and that, as a consequence, Annex 1 to Recommendation XII-1 be withdrawn;

2. Annexes 1, 2, and 3 to Recommendation X-3 and Annexes 2 and 3 to Recommendation XII-1 be withdrawn and replaced by Annexes 2 and 3 to this Recommendation as a current statement of the "Existing links for the daily international exchange of meteorological data within the Antarctic" and the "Principal routes by which Antarctic meteorological data enter the GTS" (Global Telecommunications System of the WMO World Weather Watch);

3. Annexes I and II to Recommendation VI-3 be withdrawn and replaced by Annexes 4 and 5 to this Recommendation as current statements of Requirements for Observational Data and Requirements for Processed Information;

4. Having regard to paragraph 4.1 and Annex I to the Final Report of EC/WGAM-IV (reproduced at Annex D to the Final Report of Antarctic Treaty Consultative Meeting XIV), they:

(a) respond expeditiously in respect to paragraph 288, sub-paragraphs (a) and (e);

(b) invite WMO to identify such areas of difficulty as there may be in respect to the transmission of meteorological data inside Antarctica, between the Antarctic

and the outside world (in both directions) and in the operation of the GTS and to use all feasible means, through the exercise of their good offices, to see if such difficulties can be resolved;

(c) also be ready to consider a joint meeting of WMO and SCAR telecommunication experts, convened in accordance with Recommendation IV-24, in the light of any report which may be prepared reflecting action taken in accordance with sub-paragraph (b) above;

(d) respond positively to requests received in accordance with sub-paragraph (b) and (c) of paragraph 289, subject to overriding scientific, administrative, or budgetary considerations;

(e) request WMO, when passing to Antarctic Treaty Consultative Parties their recommendations arrived at in accordance with sub-paragraph (d) of paragraph 289, to set out in specific terms the technical functions, capacities, and services of proposed "Antarctic Meteorological Centers" and WMO's view on the justification for the designation of each proposed Center;

(f) be prepared to respond to any request for designation received from WMO, in accordance with sub-paragraph (e) of paragraph 289, on the understanding that any such designations and activities carried out accordingly, will be subject to Article IV of the Antarctic Treaty.

## XIV-8. Historic Sites and Monuments

The Representatives,

*Recalling* Recommendations I-IX, V-4, VI-14, VII-9, XII-7, and XIII-16;

*Recommend* to their Governments that the following historic monuments be added to the "List of Historic Monuments Identified and Described by the Proposing Government or Governments" annexed to Recommendation VII-9 and that thereafter they be accorded the respect and protection required by the Recommendations recalled above:

53. Monoliths and Commemorative Plaques celebrating the rescue of survivors of the British ship *Endurance* by the Chilean Navy cutter *Yelcho* displaying the following words:

"Here, on August 30th, 1916, the Chilean Navy cutter *Yelcho* commanded by Pilot Luis Pardo Villalón rescued the 22 men from the Shackleton Expedition who survived the wreck of the *Endurance* living for four and one half months on this Island."

The Monolith and the plaques have been placed on Elephant Island (61°03'S 54°50'W) and their replicas on the Chilean bases "Arturo Prat" (62°30'S 59°49'W)

and "Lieutenant Rodolfo Marsh" (62°12'S 62°12'W).

## XIV-9. Air safety in Antarctica

The Representatives,

*Recalling* Recommendation I-X;

*Recognizing* the importance of safe air operations in the Antarctic and:

(i) that there is a wide range of problems in air operations which are becoming more important and urgent with increasing activity;

(ii) that the principal body of knowledge and experience of antarctic air operations, and its current problems, lies with the operators of national antarctic programs;

*Recommend* to their Governments that:

1. Arrangements be made for a meeting of experts in accordance with Recommendation IV-24, to be held well in advance of the Fifteenth Consultative Meeting, at a time and place to be decided through diplomatic channels, and that the host Government for the Fifteenth Consultative Meeting should initiate the necessary consultations;

Delegations from Consultative Parties to the meeting should include experts with direct experience in antarctic operations. In the course of preparing for the meeting, consideration shall be given to the invitation of ICAO and other experts to attend the meeting in accordance with paragraph 1 of Recommendation IV-24 (e.g., WMO, ITU);

2. The terms of reference for the meeting shall be to provide for:

(i) avoidance of inter-operator air incidents;

(ii) mutual assistance in the course of antarctic operations, including medical evacuations;

(iii) coordinated measures to improve search-and-rescue procedures.

3. In the fulfillment of these terms of reference, the meeting shall have regard to:

(i) existing systems for safe air operations;

(ii) means of mutually coordinating air traffic movements in Antarctica;

(iii) means of ensuring adequate communications between operators originating air traffic movements, between aircraft and stations in the vicinity of their operations and between aircraft, including consideration of the possible advantages of satellite communications and adoption of predetermined radio frequencies;

(iv) means of rapidly initiating search-and-rescue operations, including the ad-

vantages of using common dedicated calling frequencies and of coordinating subsequent operations;

(v) how best to ensure that all operators in the Antarctic are aware of air-operational safety requirements and search-and-rescue procedures;

(vi) air operations from ships.

4. In order to facilitate the work of the meeting they provide relevant information to the host government, preferably 3 months in advance of the meeting, for circulation to other Consultative Parties. An indicative list of such information is set out in the Annex to this recommendation.

5. The report of the meeting be circulated to all Consultative Parties and be referred for consideration at the Fifteenth Consultative Meeting in accordance with paragraphs 3 and 4 of Recommendation IV-24.

(See Annex.)

## XIV-10. Marine meteorological and sea-ice information services for navigation in the Treaty area of the Southern Ocean

The Representatives,

Recalling Article II of the Antarctic Treaty and Recommendations relating to cooperation with regard to antarctic logistics (II-V, III-3, IV-25) and antarctic meteorology and telecommunication (I-II, II-3, III-5, IV-26, V-2, VI-1, VI-3, VII-7, IX-3, X-3, XII-1, XII-2);

Aware of numerous cases when ships have been lost or beset in antarctic sea ice for long periods;

Aware (i) of increasing interest in the science and operational relevance of antarctic meteorology and sea-ice studies on the part of the WMO, SCAR, and IOC as indicated by existing research projects of these international bodies;

## Annex to Recommendation XIV-5.

### Site of Special Scientific Interest—No. 22 Yukidori Valley, Langhovde, Lutzow-Holm Bay

#### Management Plan

(i) Description of site

(ii) of advances in satellite monitoring of marine meteorological and sea-ice conditions and of the consequent improvement in the quality, reliability, and content of their assessment and prediction;

(iii) of the strides that have been made in predicting optimal ship routings with respect to marine meteorological and sea-ice conditions;

(iv) of existing marine meteorological and sea-ice services;

Considering advances in telecommunication and the exchange of marine meteorological and sea-ice information;

Desiring to apply the benefits of these developments to the improvement of real-time data utilization and prediction of weather, sea ice, currents and sea-state conditions (particularly in the sea-ice zone) with a view to further increasing the efficiency and the safety of navigation;

Recommend to their Governments that:

1. They invite WMO and SCAR (through their Permanent Representatives and their National Committees, respectively) to consider ways of improving or developing operational marine meteorological and sea-ice information services in the Treaty Area of the Southern Ocean;

2. Any such consideration should take into account the Implementation Program for the Antarctic described in Annex I of the Final Report of the Fourth Session of the EC Working Group on Antarctic Meteorology (September 1986), and subsequent pertinent decisions of the Tenth WMO Congress (May 1987);

3. Such consideration be coordinated with the IOC;

4. After receiving a response from WMO and SCAR, they convene, if necessary, in accordance with Recommendation IV-24, a meeting of experts to consider how an improved approach to marine meteorological and sea-ice information services in the Treaty Area of the Southern Ocean could be implemented.

#### Physical Features

Yukidori Valley (lat. 69°14'30"S, long. 39°46'00"E), is situated in the middle part of Langhovde, on the east coast of Lutzow-Holm Bay, Greater Antarctica.

The site encompasses an area of 3 kilometers by 0.5–1.5 kilometers located between a tongue of the ice cap and the sea at the western end of the valley; it extends up to 50 meters offshore near

the mouth of the stream. The location of the site and its boundaries are shown on the attached maps.

**Topography.** The valley is about 3 kilometers in length from east to west and 0.5 to 1.5 kilometers in width and contains a prominent melt stream and two lakes; the head of the valley, about 200 meters above sea level, abuts the edge of the ice cap. Lake Higashi Yukidori lies north of the head of the valley. The stream flows from the ice cap towards the sea through V-shaped and U-shaped sectors of the valley and enters Lake Yukidori, in the middle of the valley, 125 meters above sea level; it then flows from the south-west corner of the lake and runs through the lower valley formed by steep cliffs. Fluvioglacial terraces in the lower part of the valley consist of fine sand and gravel. There is a dissected deltaic fan formed at the mouth of the stream.

**Geology and soils.** The valley is underlain by well-layered sequences of late Proterozoic metamorphic rocks, consisting of garnet-biotite gneiss, biotite gneiss, pyroxene gneiss and hornblende gneiss with metabasite. The foliation of the gneisses strike N 10°E and dips monoclinal to the east.

**Meteorology.** A continuous climatic record has been maintained since 1957 at Syowa Station, Ongul Island, 30 kilometers north of the site (published as "Antarctic Meteorological Data" by the Japan Meteorological Agency).

#### Biological Features

**Terrestrial.** Almost all of the plant species recorded from the Langhovde area occur within the site. They include the mosses *Bryum pseudotriquetrum* (= *B. algens*), *B. argenteum*, *Ceratodon purpureus*, *Pottia Heimii*, *Grimmia lawiana*, and the lichens *Usnea sphacelata* (= *U. sulphurea*), *Umbilicaria antarctica*, *U. decussata*, *Alectoria* (= *Pseudephebe*) *minuscule*, *Xanthoria elegans*. There are no liverworts or vascular plants. Two species of free living mites (*Nanorchestes antarcticus* and *Tydeus erebus*) have been reported.

**Inland waters.** Sixty-four species of microalgae, including cyanobacteria and green algae, have been reported from Lake Yukidori and the adjacent area. Among them were one new species of *Cosmarium* (*C. yukidoriense*) and three new varieties of *C. clepsydra*.

**Marine.** No information

**Birds and seals.** Several pairs of the south polar skua (*Catharacta mac Cormicki*) and numerous snow petrels (*Pagodroma nivea*): Note "Yukidori" is Japanese for the snow petrel) breed in the site. The excrement of snow petrels is especially important as a major supply of nutrients for lichens and mosses. There is no information on seals.

(ii) Reason for designation

Yukidori Valley is representative of the typical continental antarctic fellfield ecosystem. The area has been chosen for an on-going biological research program and for long-term monitoring studies. It is therefore necessary to afford protection to the site so as to minimize human impacts. With more extensive expeditions in the ice-free areas, pedestrian traffic is increasing in the vicinity of the exceptional stands of vegetation. A biological research hut has been constructed near the beach at the mouth of the valley, 250 meters from the western boundary of the site, for the purpose of minimizing impact on the fauna, flora, and terrain of the site. Pedestrian access has been limited and no vehicular access has been permitted since the construction of the hut. The valley has not been subjected to any environmental disturbance, with the exception of carefully controlled small-scale biological sampling of lake water, soil, lichens, mosses, invertebrates, and sea birds.

(iii) Outline of research

Field surveys of geoscience and biological science have been carried out in the Langhovde area, including the site, since the first Japanese Antarctic Research Expedition in 1957.

A preliminary biological survey of the site was made during JARE 15 and 16 (1973–75). This survey obtained information on the pristine state of the terrestrial ecosystem to compare with that influenced by man around Syowa Station on East Ongul Island. The studies were mainly undertaken in summer, and terminated after two seasons. A three-

year intensive study of the ecosystem commenced during the 1985–86 season. The present program is planned to gain a deeper understanding of the terrestrial ecosystems in this site; it consists of several ecological studies on fauna and flora in relation to the climatic and edaphic environmental conditions. Long-term monitoring of fauna and flora in some selected areas has been conducted from the early stages of the investigation and will be continued.

(iv) Date of expiry of designation  
31 December 1992.

(v) Access points  
None specified.

(vi) Pedestrian and vehicular routes  
Pedestrians should enter the site only in connection with research activities. Surface vehicles should not be operated and helicopters should not land within the site.

(vii) Other kinds of scientific investigations which would not cause harmful interference

Research of other disciplines that would not affect the continuing biological studies for the protection of which the site has been designated.

(viii) Scientific sampling

This should be restricted to the minimum required in connection with the program. No rock samples may be obtained.

(ix) Other restraints  
None specified.

## Site of Special Scientific Interest—No. 23 Svarthamaren, Mühlig-Hofmannfjella, Dronning Maud Land

### Management Plan

(i) Description of site

#### Physical Features

Svarthamaren is an ice-free area (lat. 71°53'S, long. 5°10'E) situated in Mühlig-Hofmannfjella, Dronning Maud Land. The distance from the ice front is about 200 kilometers. The site consists of about 3.9 square kilometers of the north-eastern facing cliffs and screes north of the summit of Svarthamaren. The location of the site and its boundaries are shown in the attached maps.

*Topography.* Svarthamaren is surrounded by ice and is about 6 kilometers long along a NW-SE axis, with the highest point at 2,195 meters above sea level. The northern part of the NE side is dominated by screes (slope 31–34°), extending 240 meters upwards from the base of the mountain at about 1,600 meters above sea level. Above these screes are almost vertical cliffs. Beneath the screes is a narrow area of flat ground bordered by glacier ice. The major feature of this site are two rock amphitheatres inhabited by breeding antarctic petrels.

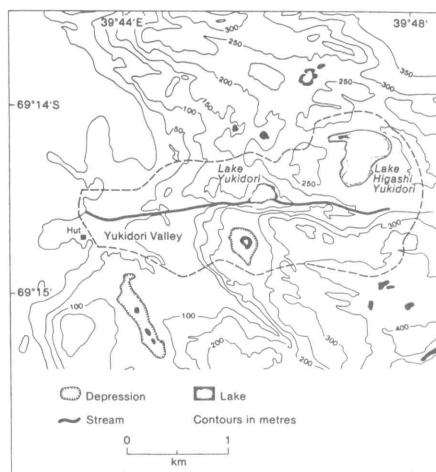
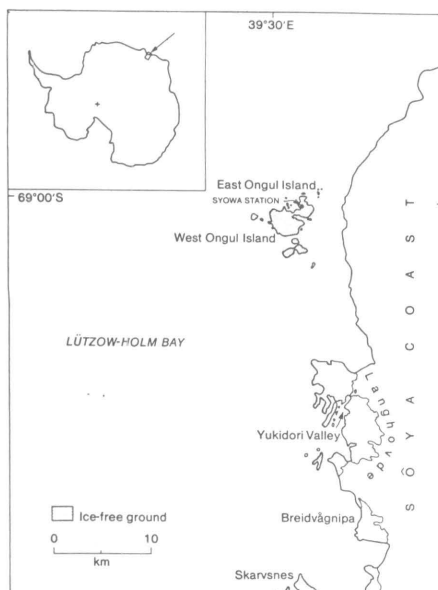
*Geology and soils.* The main rock types are coarse and medium grained charnockitoids and small amounts of xenoliths. Banded gneisses, biotite amphibolites, and granites of the amphibolite facies mineralogy are included in the charnockitoids. The slopes are covered by decomposed feltspathic sand.

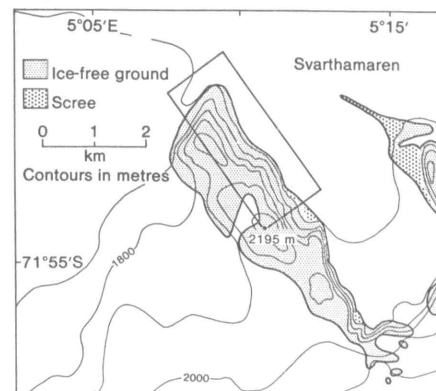
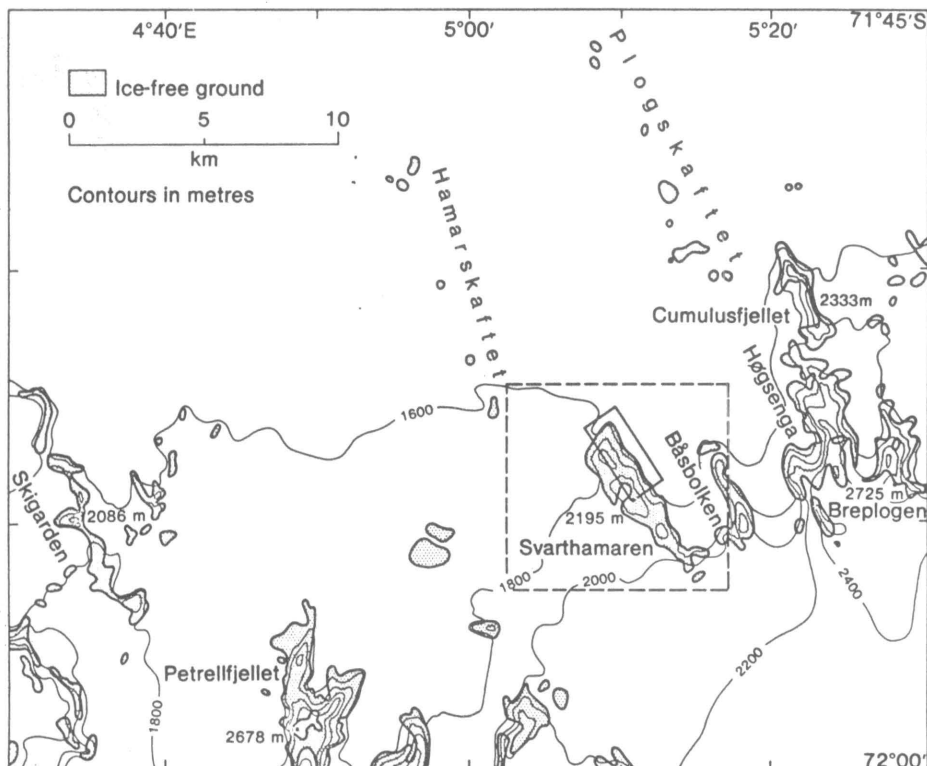
*Meteorology.* Data exist for the period 13 January to 15 February 1985 (prevalent air temperature ranged between -5°C and -15°C). An automatic weather station was set up by the Norwegian Antarctic Research Expedition 1984–85 in an analogous situation at Jutulsessen, 100 kilometers west of Svarthamaren, to obtain long-term weather statistics.

#### Biological Features

*Terrestrial.* The flora and vegetation at Svarthamaren are sparse compared with other areas in Mühlig-Hofmannfjella and Gjelsvikfjella to the west of the site. This is apparently due to the elevation of Svarthamaren, the shortage of meltwater, and the excessive nutrient deposition from the bird colonies. The only plant species occurring in abundance, but peripherally to the most manured areas, is the foliose green alga, *Prasiola*

SSSI site number 22—Yukidori Valley (69°14' S 39°46'E), Langhovde, Lutzow-Holm Bay.





SSSI site number 23—Svarthamaren (71°53'S 5°10'E), Mühlig-Hofmannfjella, Dronning Maud Land.

*crispa*. There are a few lichen species on glacier-borne erratics 1–2 kilometers away from the bird colonies: *Candelariella hallettensis* (= *C. antarctica*), *Rhizoplaca* (= *Lecanora melanophthalma*, *Umbilicaria* spp.), and *Xanthoria* spp. Areas covered with *Prasiola* are inhabited by *Collembola* (*Cryptopygus sverdrupi*) and a rich fauna of mites (*Eupodes angardi*, *Tydeus erebus*), protozoans, nematodes, and rotifers.

*Inland waters*. A shallow pond measuring about 20 by 30 meters, lying below the middle and largest bird subcolony, is heavily polluted by petrel carcasses, and supports a strong growth of a yellowish-green unicellular algae, *Chlamydomonas* sp. Smaller concentrations of algae occur on the fringes of a small frozen lake below the northern face of the mountain. No invertebrates have been recorded.

*Birds*. There are important breeding colonies of seabirds. The north-east slopes of Svarthamaren are occupied by a densely populated colony of antarctic petrels (*Thalassoica antarctica*), divided into three separate subcolonies. Less than ten breeding colonies of antarctic petrels are described in the literature, and the Svarthamaren colony is by far the largest known. The colony was first closely examined in January/February 1985 by Norwegian ornithologists. The total number of breeding pairs was estimated to be 208,000. In addition, 500–1,000 pairs of snow petrels (*Pagodroma nivea*) and 50 pairs of south polar skuas (*Catharacta*

*maccormicki*) were breeding in the area. The antarctic petrels nest in the two rocky amphitheatres with a mean density of 0.75 nest per square meter. Most of the snow petrels nest in separate parts of the scree characterized by larger rocks. The south polar skuas nest on the narrow strip of flat, snow-free ground below the screes.

(ii) Reason for designation

The Svarthamaren antarctic petrel colony is the largest known seabird colony situated inland on the antarctic continent, and probably represents a significant proportion of the world population of this species.

The site is of exceptional scientific interest and provides for research on the antarctic petrel, snow petrel, and south polar skua and the study of adaptations in seabirds breeding inland on the antarctic continent.

(iii) Outline of research

A study of the breeding biology and ecophysiological adaptations in the antarctic petrel was initiated in 1985. This is planned to continue during future Norwegian Antarctic Research Expeditions. The accessibility of the site is limited by its location far inland.

The antarctic petrel colony was discovered by Soviet geologists in January 1961 when a party landed in the area with an AN-2 aircraft and unexpectedly encountered thousands of birds. During the period 9 January to 16 February 1985

ten of the scientists of the Norwegian Antarctic Research Expedition worked in Mühlig-Hofmannfjella and Gjelsvikfjella, and established a base camp (Camp Norway 5) on the glacier approximately 500 meters north-east of the northernmost slope of the site.

Three ornithologists, a botanist and an invertebrate zoologist worked in the area and researchers of other disciplines surveyed this and nearby areas. Helicopter landings during the period were kept to a minimum. A wooden laboratory hut has been left to be used by future parties.

(iv) Date of expiry of designation  
31 December 1997.

(v) Access points

The site may be entered from any direction but access should cause minimum disturbance to the bird colonies.

(vi) Pedestrian and vehicular routes

Vehicles should not enter the Site. Pedestrians should not move through the populated areas except in the course of scientific investigations. Helicopters and low-flying aircraft should avoid the bird colonies in accordance with the Agreed Measures for the Conservation of Antarctic Fauna and Flora.

(vii) Other kinds of scientific investigations which will not cause harmful interference

Any scientific investigation which will not cause significant disturbance to the biological programs for which the site has been designated.

(viii) Scientific sampling

Taking samples of the bird population by killing, capture, or taking of eggs should be done only for a compelling scientific purpose and in accordance with the Agreed Measures for the Conservation of Antarctic Fauna and Flora.

(ix) Other restraints

None specified.

## Site of Special Scientific Interest—No. 24 Summit of Mt. Melbourne, North Victoria Land

### Management Plan

#### (i) Description of site

#### Physical Features

Mt. Melbourne, North Victoria Land (lat. 74°21'S, long. 164°42'E) is situated between Wood Bay and Terra Nova Bay, on the west side of Ross Sea, and Campbell Glacier, about 10 kilometers to the west. The site comprises all terrain above the 2,200-meter contour surrounding the main crater of Mt. Melbourne. The location of the site and its main features are shown in the attached maps.

**Topography.** In profile, Mt. Melbourne is an almost perfect low-angle volcanic cone rising to 2,732 meters above sea level, showing only slight dissection and little or no glacial erosion. Many smaller basaltic cones and mounds occur near the base and on the flanks of the mountain. The summit caldera is about 1 kilometer in diameter and forms a névé for a glacier flowing westward. The two areas of ice-free steaming ground (at A - "Cryptogam Ridge" and B on the accompanying map) are on the edge of the caldera, with a third area (C) 250 meters lower on the northern slopes. "Cryptogam Ridge," on the southern side of the main crater, is an area of geothermal activity. About 300–400 meters of this ridge is ice-free with the remainder covered by numerous ice hummocks. These hummocks are hollow, contain fumaroles, and are 1–6 meters in diameter and up to 4 meters high.

**Geology and soils.** Mt. Melbourne is part of the McMurdo Volcanics which are a line of dormant and extinct volcanoes running along the coast of Victoria Land. The Mt. Melbourne area is more likely to be late Quaternary than late Tertiary in age, and the most recent eruption may have been only about 150 years ago. The

mountain is a large low-angle strato-volcano containing basalt, trachyandesite, and trachyte flows and including pyroclastics. Small basalt scoria cones are scattered around the base, some of which appear to be very recent as they are undisturbed. Several older slightly dissected cones occur on the summit caldera.

Surface ground temperatures vary markedly over distances of centimeters on ice-free warm ground, up to a recorded maximum of 47°C. Random probing to depths of 1 meter and detailed temperature transects to depths of 15 centimeters indicate substrate temperatures of up to 60°C. Within the ice pinnacles soil surface temperatures range from 10°C to over 40°C. Frost heave occurs at some warm areas.

Although the substratum is classified as azonal, there are two distinct soil zones within some areas of hot ground probably caused by heat, moisture and gases from below. A typical profile comprises an upper 0–5-centimeter layer of dark sandy soil with a lower 6–30-centimeter horizon consisting of large lighter colored scoria gravels. The upper layer contains organic matter in which there is microbiological activity, including cyanophaecean nitrogen fixation. No clay minerals have been detected.

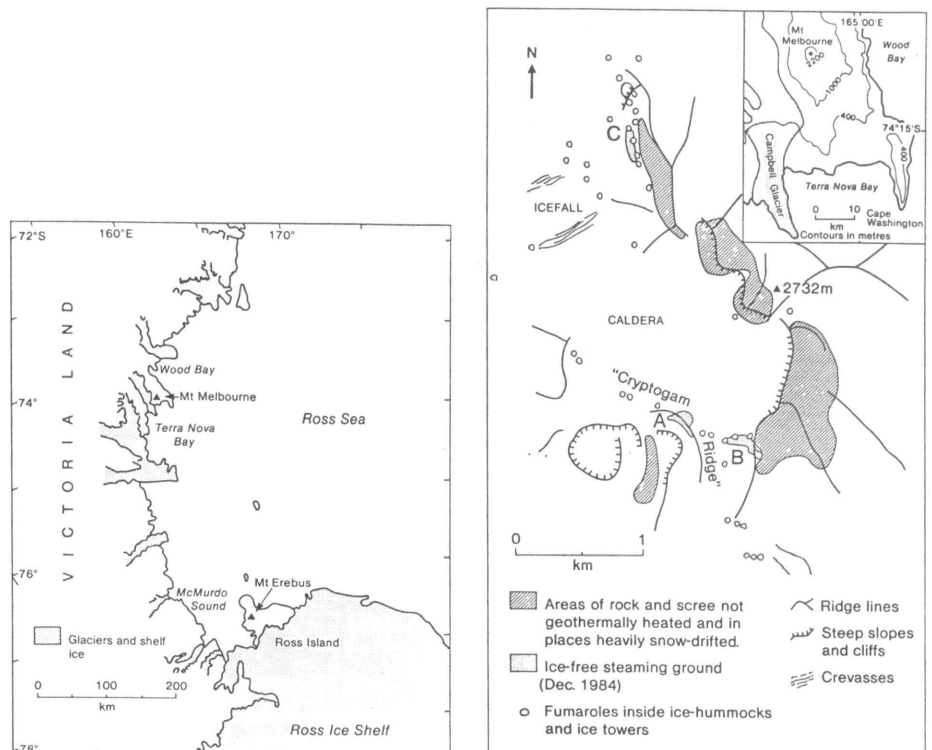
**Meteorology.** No detailed data are available for the site. Field party records, during one week in late November 1984, indicate summer air temperatures in the caldera area of -6°C to -20°C, with an absolute minimum of -32°C.

### Biological Features

**Terrestrial.** The warmest areas of ground support patches of yellow-green moss, liverwort, and brownish crusts of algae. The site contains an unique bryophyte community comprising the moss *Campylopus pyriformis* and the liverwort *Cephaloziella exiliflora*. *C. pyriformis* is not known elsewhere in the antarctic biome, and *C. exiliflora* is known from only three other (low altitude) areas of continental Antarctica. Other than at a similar geothermal site at the summit of Mt. Erebus (protonemata only) this is the highest altitude at which bryophytes have been found in Antarctica. A single unidentified lichen has been observed as a component of black crusts over small areas of warm soil. The unusual occurrence of shallow peat is evidence of bryophyte growth having taken place over at least several decades.

Algae grow over wide areas of the warm ground and on the surface of warm rocks in some fumaroles. The microflora comprises a range of unicellular and filamentous algal, including the green *Chroococcus sp.*, *Tolypothrix sp.* and *Stigonema sp.* and the cyanobacteria *Mastigocladus laminosus* and *Pseudococcomyxa simplex*. Thermotolerant and thermophilic micro-organisms have been isolated from the soil. The only invertebrate reported is a testate amoeba, *Corythion dubium*, amongst the vegetation. The occurrence of plant life is made possible only by the water droplets formed by the condensation of steam. Very small

SSSI site number 24—Mt. Melbourne (74°21'S 164°42'E), northern Victoria Land.



“pools” up to about 50 square centimeters and about 1 centimeter deep have been observed on occasions where dripping condensate gathered in small depressions.

*Birds.* No observations of birds have been made near the summit of the volcano.

(ii) Reason for designation

The site is of exceptional scientific interest because of its extensive ice-free geothermal areas, at high altitude, supporting a unique cryptogamic flora and microbiota and accumulations of organic matter. The closest documented, high-altitude fumarolic ground is 400 kilometers to the south of the summit of Mt. Erebus (see SSSI No. 11, Tramway Ridge Mt. Erebus), but there the organisms differ significantly from those on Mt. Melbourne. Elsewhere in Antarctica vegetation on steam-warmed ground is known only in low altitude maritime areas of the Antarctic Peninsula region where, again, the vegetation differs significantly from the Mt. Melbourne community. The site is scientifically significant for botanists, microbiologists, volcanologists, and geophysicists. Uncontrolled human activity within this area could cause severe damage by trampling of plants, compacting soil and altering soil temperature gradients, changing rates of steam release and possibly causing the introduction of alien micro-organisms and cryptogamic plants.

(iii) Outline of research

There has been little previous research activity in the site. The studies that have been undertaken have involved investigations of geothermal and volcanic activity and a survey of the plant and microbial communities. Future research is likely to include studies of soil microbiology and microfauna, vegetation, volcanology, and the geophysics of the area.

Mt. Melbourne was first sighted in 1841 by James Ross and first climbed in January 1967 by a New Zealand party. Since then the summit area has been visited by New Zealand parties in December 1972 and November 1984. The 1984 party surveyed the biota on “Cryptogam Ridge.” Brief visits were also made in January 1983 by a United States party and more recently by West German (1984–85) and Italian (1985–86) parties.

(iv) Date of expiry of designation  
31 December 1997.

(v) Access Points

Access to the site is normally by icoppter and landings should be made on the glacier ice in the caldera, there avoiding any of the vegetated or ot sensitive areas.

(vi) Pedestrian and vehicular routes  
No vehicle should be used within the site. Pedestrians should avoid, whenever possible, walking on any obvious areas of warm ground or disturbing any vegetation. Entry to the “Cryptogam Ridge” area of the site should be made only from either end of the ridge. Entering the ridge directly up its slopes should be avoided.

(vii) Other kinds of scientific investigations which would not cause harmful interference  
Low-impact studies having a minimal effect on the environment of the site.

(viii) Scientific sampling  
Samples should be taken only for compelling scientific reasons.

(ix) Other restraints  
To prevent the introduction of foreign organisms, sterile protective overclothing should be worn and footwear should be sterilized before entering the site. Sterilized sampling equipment should also be used. All wastes should be removed from the site.

**Site of Special Scientific Interest—No. 25  
Marine Plain, Mule Peninsula, Vestfold Hills, Princess Elizabeth Land**

**Management Plan**

(i) Description of site

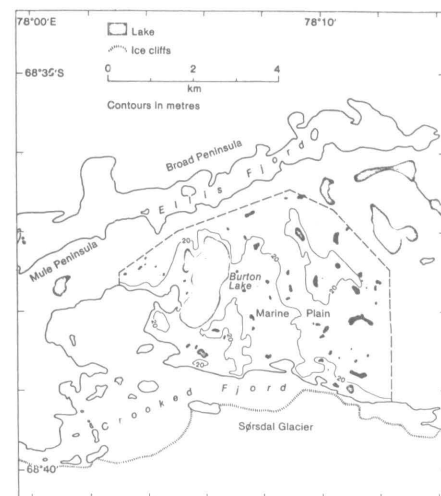
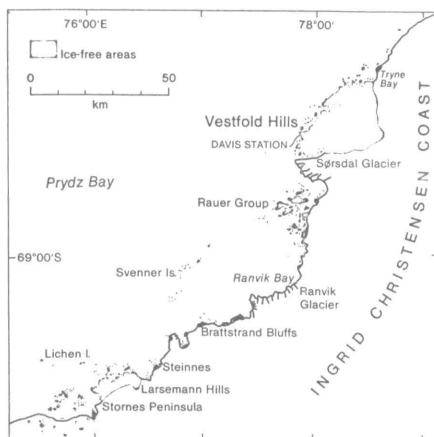
**Physical Features**

Marine Plain (23.4 square kilometers, lat. 68°38’S, long. 78°08’E) opens into an arm of Crooked Fjord on the southern side of Mule Peninsula, the southernmost of the three major peninsulas which comprise the Vestfold Hills. The Vestfold Hills comprise an essentially ice-free oasis (approximately 400 square kilometers) of bedrock, glacial debris, lakes, and ponds at the eastern side of Prydz Bay, Princess Elizabeth Land.

The boundary of the site is as follows: commencing at lat. 68°36’30’’S, long. 78°09’00’’E it runs south-easterly to lat. 68°36’45’’S, long. 78°10’30’’E; thence south-easterly to lat. 68°37’30’’S, long. 78°10’30’’E, then south along the parallel of long. 78°12’30’’E to its intersection by the low-water mark on the northern shore of Crooked Fjord; from here it follows the low water mark of the northern shore of Crooked Fjord to its intersection with the meridian of long. 78°03’00’’E; thence north along the meridian of long. 78°03’00’’E to its intersection with the parallel of lat. 68°37’30’’S, then north-easterly to lat. 68°37’00’’S, long. 78°05’00’’E, and finally north-eastwards to the point of commencement.

*Topography.* The site includes Burton Lake (surface at sea level) as a major component of the western part of the region. An extensive low level (less than 20 meters above sea level) area occupies the center of the site with a north-south orientation. In the north-east is another area below 10 meters. Areas above 10 meters are mostly low, rugged hills of Precambrian rock acting as divides between the lower part and characterized at their base by a marked change in their slope, probably representing an old (Holocene?) shoreline. The surface of the

SSSI site number 25—Marine Plain, (68°38’S 78°8’E), Mule Peninsula, Vestfold Hills, Princess Elizabeth Land.



lower areas below 20 meters is marked by a series of concave-to-the-south recessional moraine ridges.

**Geology.** The Precambrian rock consists for the most part of 3,000 million year old gneisses from both igneous and metamorphic protoliths intruded in the course of at least three intervals between 1,800 and 1,375 million years ago by numerous metabasalt dykes with a rough north-south orientation. These dykes are a major feature of the Vestfold Hills. Low-lying areas consist of at least 8 meters of early Pliocene (40–46 million years) diatomites and, less commonly, lenticular sandstone overlying the Precambrian rock and occupying the sites of what were embayments in the early Pliocene. In the western part of the central area below 20 meters above sea level, the Pliocene deposits are overlain by a thin veneer of Holocene (6,490 ± 130 years ago) glacial debris covering an area of 8–10 square kilometers, in places containing a few molluscs (*Laternula elliptica* King and Broderip) *in situ*. Low scarps in the Pliocene adjacent to small lakes have yielded remains of a new genus, species and probably family—all extinct—of dolphin, and there is evidence of another larger, fossil form.

**Meteorology.** No data are available from the area, but conditions are similar to those at Davis station, 6 kilometers to the north-west.

### Biological Features

**Terrestrial.** Reconnaissance studies have reported few species and no significant stands of vegetation within the site.

**Inland Waters.** There are many small lakes and ponds.

**Marine.** Burton Lake opens to Crooked Fjord at its south-western corner and is affected by tides in summer. It has been the site of biological research for several years.

**Birds and seals.** No bird or seal surveys have been conducted but it is relatively devoid of birds and sea mammals. Wilson's storm petrels (*Oceanites oceanicus*) and snow petrels (*Pagodroma nivea*) occur sporadically and nest in the Precambrian hills.

#### (ii) Reason for designation

The site is of exceptional scientific interest because of its vertebrate fossil fauna. In addition to the dominant important fossils such as molluscs and diatoms, which define the age of the Pliocene marine sediments, the site has yielded well-preserved vertebrate remains of a new species, genus and probably family of fossil dolphin and evidence of at least one other vertebrate species.

Burton Lake, as a hypersaline lake which is still in seasonal connection with sea, presents the opportunity for important limnological research. It repre-

sents a unique stage in the biological and physico-chemical evolution of a terrestrial water body from the marine environment. Burton Lake together with several of the smaller lakes, provides important examples of the spectrum of lake types in the Vestfold Hills.

Davis (68°85'S, 77°58'E), a permanently occupied Australian scientific station, is located on Broad Peninsula, the central peninsula of the Vestfold Hills, 6 kilometers to the north-west of the site. It is the focus of continuing biological, including limnological, studies within the Vestfold Hills. As a result of its proximity to Davis Station, the scientific value of the site could be diminished by accidental interference. The site lies on the frequently used pedestrian route to the Mule Peninsula lakes (Clear, Laternula, Cemetery, and McCallum) from Ellis Rapids and it is critical that fossil fauna should be protected from unrecorded sampling or collection.

#### (iii) Outline of research

A palaeontological research program has commenced following the initial discovery of vertebrate fossils at the site in 1985. The program consists of the collection of well-preserved fossil molluscs and diatoms and, in particular, fossil vertebrates, with the aim of documenting the fauna of the epoch. Oxygen isotope studies on the well-preserved bivalve fauna will be employed to help quantify water temperature at that time.

Burton Lake is the subject of detailed year-round research as part of a program aimed at understanding the evolution of the hydrological system in the Vestfold Hills, by looking at various stages of isolation from the marine environment.

#### (iv) Date of expiry of designation 31 December 1997.

#### (v) Access points

Access should, where possible, be from the sea ice in Ellis Fjord or Crooked Fjord, or by helicopter at places where no disturbance can be caused by the aircraft to water bodies, vegetation, or sediment deposits. If these means of access are not possible, access by land, either by vehicle or on foot, should be via Ellis Rapids at the eastern end of Ellis Fjord.

#### (vi) Pedestrian and vehicular routes

Vehicles should not be used within the site except for over-snow travel by motorized toboggan. Pedestrians or vehicles must not damage areas of vegetation, or disturb steep inclines marking sediment outcrops or the lake margins near these outcrops.

(vii) Other kinds of scientific investigations which would not cause harmful interference

Research on the ecology of Wilson's storm petrels, snow petrels, mosses and lichens, and other biota, and investigation of water bodies other than Burton Lake. Other scientific investigations which do not disturb the palaeontological, ecological, and limnological programs being conducted.

#### (viii) Scientific sampling

Scientific sampling should be restricted to that required for the programs described in (iii) and (vii) above.

#### (ix) Other restraints

All waste materials taken into, or generated within the site should be removed as soon as practicable. No fuel depots should be made within the site, nor should refueling operations be undertaken. No permanent buildings should be erected within the site. Power boats should not be used on Burton Lake and use of other boats should be restricted to the minimum necessary to support programs consistent with this plan.

## Site of Special Scientific Interest—No. 26 Chile Bay (Discovery Bay), Greenwich Island, South Shetland Islands

### Management Plan

#### (i) Description of the site

#### Physical Features

The site comprises two small areas of benthic habitat in Chile Bay located as follows. Benthic habitat A: Between 50- and 100-meter depths and the following coordinates: Lat. 62°28.9'S, Long. 59°41'12"W and Lat. 62°29.3'S, Long. 59°41'43"W. Benthic habitat B: Between 100- and 200-meter depths and between the following coordinates: Lat. 62°28.3'S, Long. 59°40'15"W and Lat. 62°28.7'S, Long. 59°40'47"W.

The bottom of both sites consists of coarse to fine silt. The lithological and mineralogical composition of the sediments shows their provenance from the outcrops and littoral deposits surrounding Chile Bay, i.e., porphyritic andesite, aphanitic andesite, diorite and andesitic volcanic breccia and tuffs. This material is transported to the coastline mainly by glaciers, solifluction, and mud flows. These processes are intensified in the inner part of the bay where the glacier terminates. Chile Bay has a transverse submarine barrier, possibly a submerged moraine separating habitats A

and B dividing the bay into an inner and an outer part. Sediments in the inner bay are protected from the action of waves and currents, thereby preserving the grain size distribution, sorting, and shape of the contained material.

### Biological Features

The benthic assemblages have high species diversity and biomass. Bottom topography and sediment features influence the structure of the communities and distribution pattern. Two assemblages have been recognized: one, dominated by the polychaete *Maldane sarsi antarctica*, is located in the outer part of the bay, mainly below 100-meter depth; other characteristic species are *Genaxinus bongranii*, *Cyamonactra denticulum*, *Typhlotanais greenwichensis* and *Pycogonida* spp. The inner assemblage, on the other hand, is not dominated by any one species but contains *Yoldia eightsi* and *Eudorella gracilor* as characteristic fauna.

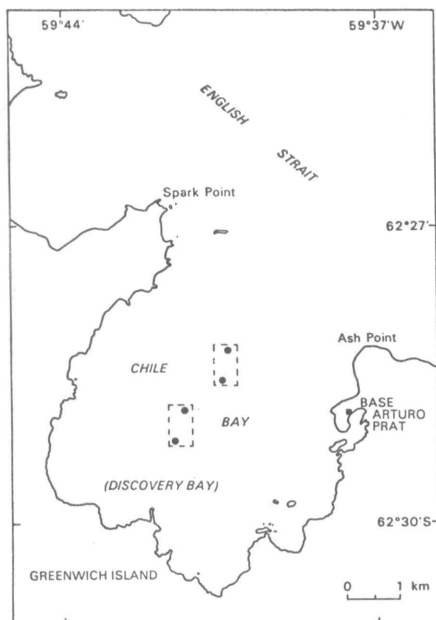
#### (ii) Reason for designation

In Chile Bay there has been continued quantitative and qualitative benthic research since 1967. Data being accumulated provide a baseline for long-term investigations. The site is of exceptional scientific interest and therefore requires long-term protection from possible harmful interference.

#### (iii) Outline of research

A long-term research program was started in 1967 in connection with the

SSSI site number 26—Chile Bay (Discovery Bay), Greenwich Island, South Shetland Islands. This site comprises Benthic Habitat A (between 62°28.9'S 59°41'12"W and 62°29.3S and 59°41'43"W) and Benthic Habitat B (between 62°28.3'S 59°40'15" and 62°28.7'S 59°40'47"W).



study of benthic fauna re-establishment within Port Foster, Deception Island, following the volcanic eruption of December 1967.

Chile Bay has been designated a control area. These studies are performed yearly in the summer. Community studies to observe biota changes will be augmented with other relevant studies to suit the requirements of a long-term biological monitoring program.

(iv) Date of expiry of designation  
31 December 1997.

#### (v) Access Points

Although access points as such are not applicable, free passage of ships through these areas is not in any way prejudiced.

(vi) Pedestrian and vehicular routes.  
Not applicable.

(vii) Other kinds of scientific investigations that would not cause harmful interference

Scientific research other than that disturbing benthic habitats and communities.

#### (viii) Scientific sampling

Samples from the benthic habitats should be taken only for compelling scientific purposes.

#### (ix) Other restraints

The dumping of waste from ships and bottom hauling should be avoided. Anchoring should be avoided except in compelling circumstances. Siting of bottom devices should be avoided.

## Site of Special Scientific Interest—No. 27 Port Foster, Deception Island, South Shetland Islands

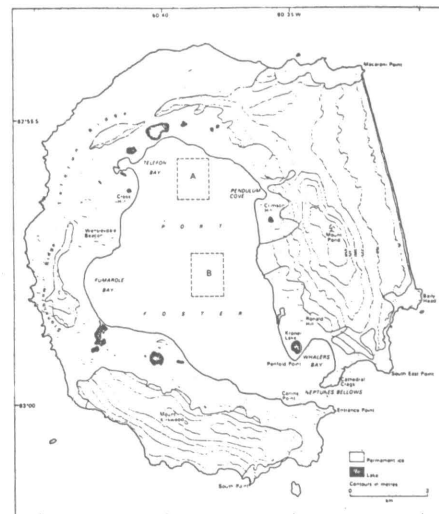
### Management Plan

#### (i) Description of site

#### Physical Features

The site comprises two small areas of benthic habitat located in Port Foster as follows. Benthic habitat A: Between 50- and 150-meter depths and coordinates: Lat. 62°55.5'S, Long. 60°38'00"W and Lat. 62°56.2'S, Long. 60°37'00"W. Benthic habitat B: Between 100- and 150-meter depths and the coordinates: Lat. 62°57.2'S, Long. 60°37'20"W and Lat. 62°57.9'S, Long. 60°36'20"W.

Deception Island is a caldera formed by subsidence of a group of Cenozoic volcanoes superimposed along radial



SSSI site number 27—Port Foster, Deception Island, South Shetland Islands. This site comprises Benthic Habitat A (between 62°55.5'S 60°38'W and 62°56.2S and 60°37'W) and Benthic Habitat B (between 62°57.2'S 60°37'20" and 62°57.9'S 60°36'20"W).

faults. Port Foster is an almost entirely enclosed body of water which receives large volumes of fresh water during periods of melt. In several places there is geothermal activity. The bottom of habitat A consists of coarse to medium-sized, poorly sorted volcanic sediment, and that of habitat B or medium to fine, better sorted volcanic ash.

### Biological Features

The composition of the benthic assemblages has varied greatly since the volcanic eruption of December 1967. The most recent data indicate a high dominance of polychaetes, both in terms of numbers and biomass. The most conspicuous macrofauna in dredge samples include the nemertean *Lineus* sp. and *Paraborlasia corrugatus*, the isopod *Serolis kemp*; the bivalve *Yoldia eightsi*, the echinoids *Abatus agassizi* and *Sterechinus neumayeri*, the asteroids *Lysasterias perrieri* and *Odontaster validus*, the ophiuroid *Ophionotus victoriae* and the holothurian *Ypsilothuria* sp.

#### (ii) Reason for designation

The area is of exceptional ecological interest because of its actively volcanic character. The two habitat areas are subject to long-term research programs and the purpose in designating them is, as far as is possible, to reduce the risk of accidental interference which could jeopardize these scientific investigations.

#### (iii) Outline of research

Following the volcanic eruption of December 1967, at Deception Island, a long-term program of research was initiated at Port Foster to study the mechanism

and paths of the re-establishment of the benthic communities. Community studies to observe biota changes, augmented with other relevant studies to suit the requirement of a long-term biological monitoring program, are performed periodically.

(iv) Date of expiry of designation  
31 December 1997.

(v) Access Points

Although access points as such are not designated, free passage of ships through these areas is not in any way prejudiced.

(vi) Pedestrian and vehicular routes  
Not applicable.

(vii) Other kinds of scientific investigation that would not cause harmful interference

Scientific research other than that disturbing benthic habitats and communities.

(viii) Scientific sampling

Samples from the benthic habitats should be taken only for compelling scientific purposes.

(ix) Other restraints

The dumping of waste from ships and bottom trawling should be avoided. Anchoring should be avoided except in compelling circumstances. Siting of bottom devices should be avoided.

## Site of Special Scientific Interest—No. 28 South Bay, Doumer Island, Palmer Archipelago

### Management Plan

(i) Description of site

#### Physical Features

Doumer Island lies at the south-west entrances to Neumayer Channel. It is separated from Wiencke Island by the Peltier Channel. South Bay lies on the south coast of Doumer Island. The site consists of a small area of coastal and sub-tidal benthos down to 45-meter depth as follows: Lat. 64°51'42"S to the North, between Long. 63°34'00"W and Long. 63°35'20"W, and to the South by a diagonal line that starts at a point 100 meters north of the Refuge (Sub-base Yelcho) on the southern shore of South Bay and extends to Lat. 64°51'58"S and Long. 63°34'00"W. Boundaries are shown on the attached map.

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### Biological Features

Four different kinds of bottom surface have been described: rocky with algae growth, from 0-to 30-meter depth; predominantly rock, covered by algae, silt and large quantities of sponges, from 30-to 110-meter depth; mixed bottoms with predominantly deposits of mud and few rock outcrops with sponges, from 100-to 150-meter depth; soft bottoms of silt and mud, from 150-to 200-meter depth, corresponding to the deepest depression, occurs near the center of the bay just outside the site. The benthic macrofauna richness increases with depth and is accentuated in bottoms with a steep slope. Ice scour exerts a strong influence on the patterns of distribution and the abundance of benthic fauna. Seals, in particular Weddell seals, *Leptonychotes weddellii*, visit the area to feed. Cetaceans, like killer whales, *Orcinus orca* and humpback whales, *Megaptera novaeangliae* enter the bay. Many antarctic seabirds occur transiently in the site.

(ii) Reason for designation

The site is the subject of a long-term research program on marine ecology and the purpose of designating it is to reduce, as far as is possible, the risk of accidental interference which might jeopardize these scientific investigations.

(iii) Outline of research

The research covers the study of the relationships of the marine organisms in the area. This was started by scuba diving in 1972. Since 1981 advanced experiments to elucidate community structure and functioning have been in progress and will continue in the future.

(iv) Date of expiry of designation  
31 December 1997.

(v) Access points

None specified. The area is not affected by the passage of boats.

(vi) Pedestrian and vehicular routes  
Not applicable

(vii) Other kinds of scientific investigation that would not cause harmful interference

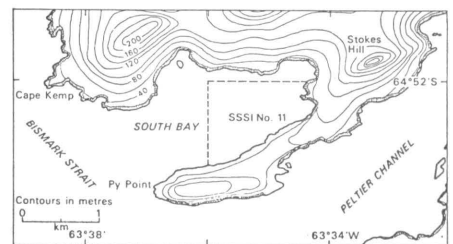
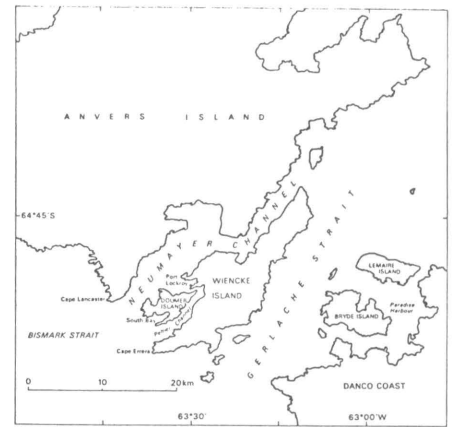
Scientific research other than that disturbing benthic habitats and communities.

(viii) Scientific sampling

Collection of samples should be made only for compelling scientific purposes.

(ix) Other restraints

The dumping of wastes from ships or boats and bottom trawling should be avoided. Anchoring should be avoided except for compelling reasons.



SSSI site number 28—South Bay, Doumer Island, Palmer Archipelago. This site is a small area of coastal and sub-tidal benthos down to 45-meters depth at 64°51'42"S to the North, between 63°34'W and 63°35'20"S, and to the South along a diagonal line that begins at approximately 100 meters north of the Refuge (Sub-base Yelcho) on the southern shore of South Bay and extends to 64°51'58"S and 63°34'W.

## Annex to Recommendation XIV-9.

The following information is an indicative list of the relevant information to be circulated to all Consultative Parties Prior to the Meeting of Experts on Air Safety in Antarctica as recommended at the 14th Antarctic Treaty Consultative Meeting.

- (i) current areas of air operation;
- (ii) period and frequency of operation;
- (iii) types of aircraft used and their navigation and communication equipment;
- (iv) operating altitudes and ranges;
- (v) other airborne devices (e.g. balloons, rockets) or other uses of air space in Antarctica;
- (vi) runway length, width, slope, orientation, surface type and condition, load capacity and markings;
- (vii) Radio Direction Finding and Distance Measuring equipment;

(viii) navigation aids, including beacon power and frequencies and communications equipment;

(ix) features in the vicinity of landing facilities which could be hazardous to aircraft;

(x) prevailing weather conditions of significance to air operations in the vicinity of landing facilities;

(xi) service facilities;

(xii) type and specification of fuel used; (xiii) operating times of landing and communication facilities;

(xiv) available air navigation charts and published visual and instrument approach procedures;

(xv) medical facilities available, including medical personnel, and whether stations have trained search-and-rescue personnel.

only be seen in the Southern Hemisphere. At the time of the launch the supernova was directly above Antarctica.

The gamma-ray detector was originally developed by University of Florida scientists for experiments on the National Aeronautics and Space Administration's space shuttle. Because NASA postponed space shuttle flights, the researchers needed to find another way of testing their equipment. Because radiation levels above Antarctica more closely approximate those in space than levels above northern latitudes, Antarctica provided the group with the opportunity to conduct materials tests now rather than delay their project.

Although they had hoped that the balloon would stay aloft for 21 days, on 11 January, only 3 days after the launch, the team was forced to bring the balloon's payload down about 200 miles from the Soviet station Vostok in East Antarctica. Released on a radio signal from the scientists, a parachute attached to the gondola holding the detector brought the payload safely to the snow surface. A 13 January flight by U.S. Navy pilots enabled the team to retrieve their equipment and data.

#### Supernova 1987A

On 23 February 1987 an amateur Canadian astronomer recorded the first observations of Supernova 1987A while

## Largest high-altitude balloon ever launched in Antarctica retrieves supernova data

Just after noon (McMurdo local time) on 8 January 1988, the largest high-altitude, helium balloon ever launched in Antarctica ascended from Williams Field, the U.S. ice-shelf skiway near McMurdo Station. Joined by interested observers from McMurdo Station and New Zealand's Scott Base, a team of 20 scientists and engineers from seven organizations watched as the 11.6-million-cubic-foot balloon carried aloft an advanced gamma-ray detector.

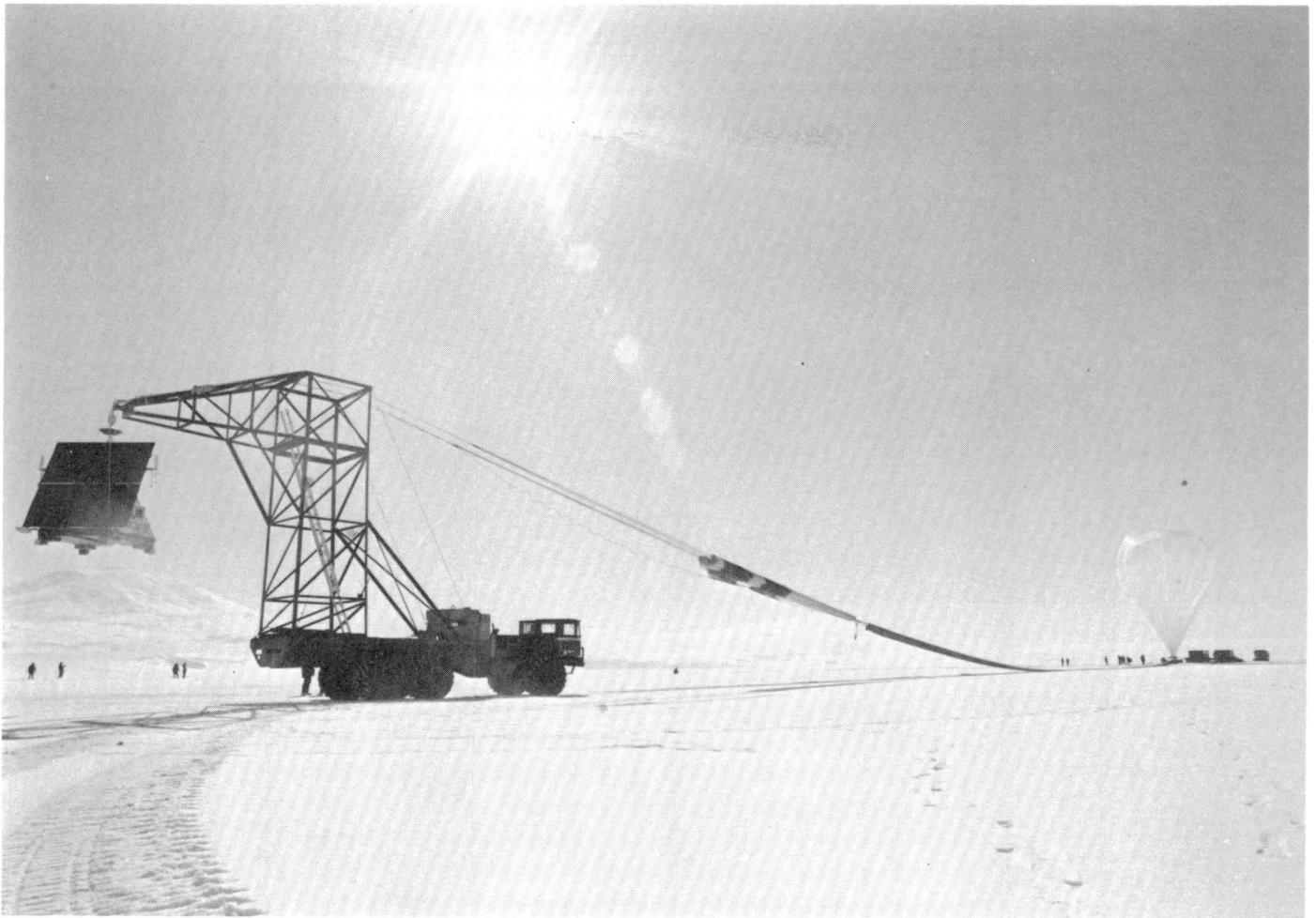
The project had two primary objectives—to acquire data on the spectrum of gamma-ray emissions from Supernova 1987A and to test the gamma-ray detector, which is of a design that has never been flown in space. To accomplish these objectives, it was necessary for the balloon to rise into the Earth's stratosphere. Shortly after the launch, the instruments at the research team's base at Williams Field indicated that the balloon had carried its payload to an altitude of 115,000 feet and had ascended at a rate of 1,000 feet per minute.

The investigators selected Antarctica for the experiment and for testing the new detector technology because the southern continent offers advantages not found at other sites. First observed on 23 February 1987, supernova 1987A can

To prepare their equipment and to track the 11.6-million-cubic-foot, helium balloon, the Supernova research team maintained a base camp at Williams Field, the U.S. Antarctic Program's skiway. In the center of the photograph, above the central structure, is the wind sensor used to determine wind speed for the project. The sensor, which rose to altitude of 500 feet, relayed data on wind conditions to a ground station. Because the helium balloon could not be launched if the wind speed exceeded 5 knots, these data were essential for determining the best launch time.

U.S. Navy photo by PHAN Craig Peterson.





U.S. Navy photo by PHAN Craig Peterson.

A view of the entire launch assembly—from left to right) gondola, parachute, and balloon, which is being inflated.

### Equipment and field work

To acquire the data on SN1987A, the research team required not only the newly designed gamma-ray detector but also a special array of equipment and logistic support. Before going to Antarctica, the team worked closely with employees of the National Science Foundation and ITT/Antarctic Services Inc. (ANS) and members of the Naval Support Force (NSFA) and the Antarctic Development Squadron Six (VXE-6). Together this group developed a system to launch the 11.6-million-cubic-foot balloon and planned special ski-equipped Hercules airplane flights that would be needed to track the balloon during its flight. With support from the U.S. Air Force a special C-141 airplane flight to McMurdo Station was scheduled to transport from the United States to Antarctica the large helium containers to fill the balloon.

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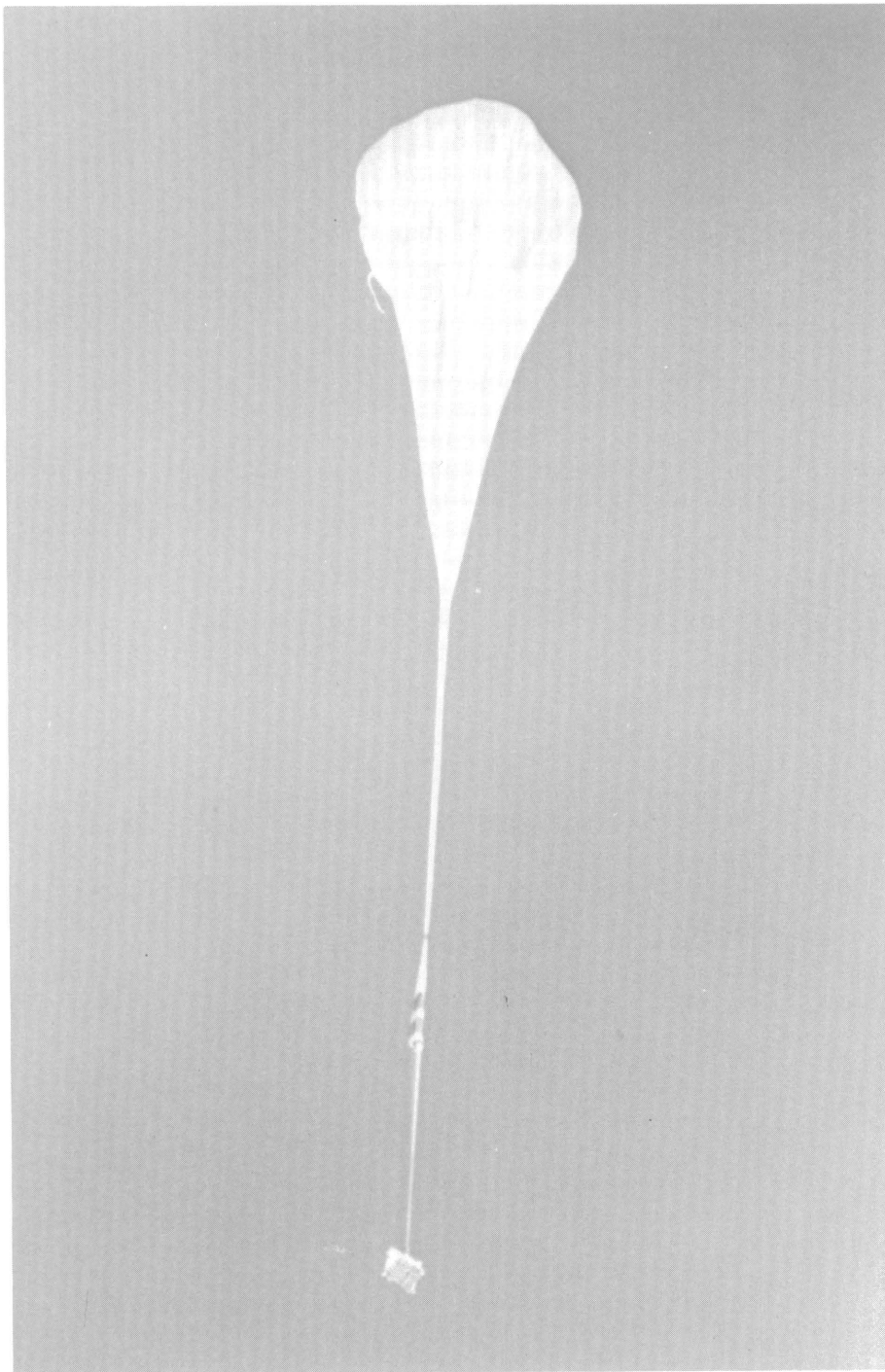
The balloon, which when inflated is large enough to hold inside of it one 747 airplane and two DC-9 airplanes, was made of a very thin plastic that is durable in extremely cold conditions. It was 0.8 mils thick, about as thick as a heavy-duty garbage bag, except at the top where it was 1.6 mils thick. To launch the balloon, ANS/ITT employees modified a "Delta," a large-wheeled, low-pressure vehicle commonly used by the U.S. Antarctic Program to transport people and equipment.

The solar-powered, gamma-ray detector, which was modified for use in Antarctica, was housed in a gondola attached to the balloon and suspended on a parachute. The gondola was designed and constructed by engineers from the University of Florida, and the solar power system and panels by engineers from New Mexico State University.

While the balloon was in sight of McMurdo Station, the system onboard

the gondola telemetered data directly to the team's base at Williams Field. For the first two days, the scientists received 12 hours of gamma-ray data from the supernova and 10 hours of data on background gamma-ray emissions. Once the balloon passed the horizon at Williams Field early on the morning of 11 January, the instruments began to operate automatically, as planned. Data was stored in memory. To retrieve the data, the scientists planned an LC-130 flight to fly under the balloon and enable them to communicate with the detector's data collection instruments.

Because the position and altitude of the balloon were tracked through the ARGOS satellite system, the researchers were able to trace the balloon's path. On 11 January, they flew under the balloon to receive data. When they linked up with the data retrieval system, they discovered that the power supply to the gamma-ray detector had failed. Instead



U.S. Navy photo by PHAN Craig Peterson.

The 11.6-million-cubic-foot, helium balloon begins its ascent. This balloon carried the gondola containing the gamma-ray detector to an altitude of 115,000 feet at a rate 1,000 feet per minute.

of providing a required 3,000 volts, the power source was delivering only 1,135 volts to the central detector.

Their choices were to leave the instrument package aloft and allow it to circle the geographic South Pole to collect data

on circumpolar wind patterns, or to bring it down in an area where they could retrieve it. Opting for retrieval, they surveyed the surface of the plateau beneath the balloon and release the gondola. The parachute attached to gondola brought

the detector to a soft landing on the east antarctic plateau at 78°18'S 80°53'E.

Two days later a second LC-130 airplane transported members of the research team to the remote landing site, so that they would be able to collect the equipment. By retrieving the detector, the group will be able to study the radioactivity induced in the detector by exposure to radiation belts.

Despite the short flight of the balloon, the team was pleased with the project and its results. They successfully launched the largest high-altitude balloon ever used in Antarctica, tracked the balloon, and communicated with their instruments. They also learned that the University of Florida's design for the gamma-ray detector works effectively in a near-space environment. With the retrieval of the detector, they accomplished the major goals of the original space shuttle experiment for which the equipment and experiment were designed. Finally, a preliminary review of their data suggest that they have acquired supernova data that are of a higher quality than any of the other data sets on Supernova 1987A recorded at other southern hemisphere sites.

#### Participants and support

The 20-person project team included an experimenter team of eight scientists and engineers from the University of Florida, the Goddard Space Flight Center, the Catholic University of America, and the Defense Advanced Research Projects Agency (DARPA) Nuclear Monitoring Office (NMO). A team of 12 balloonists from the Air Force Geophysics Laboratory, New Mexico State University, and Oklahoma State University assembled and launched the balloon and its payload. They also operated the tracking and telemetry station during the project.

This project, the Supernova Observer Project, was among the 69 research projects supported by the National Science Foundation as part of the U.S. Antarctic Program during the 1987–1988 austral summer. Funding for the University of Florida's part of the project was provided through an experimental program that NSF and other Federal agencies are conducting to streamline the administration of university research. The project also received support from DARPA/NMO and the Space Test Program of the Department of Defense through contracts with the Office of Naval Research and the Air Force Geophysics Laboratory.

## Two killed in airplane crash in East Antarctica

While attempting to land near a remote site in East Antarctica on 9 December 1987, a ski-equipped Hercules (LC-130) airplane, owned by the National Science Foundation (NSF) and operated by U.S. Navy pilots of the Antarctic Development Squadron Six (VXE-6), crashed. Two of the 11 Navy personnel who were on board the airplane were killed, and one was seriously injured. The airplane, which was completely destroyed, was the only one of NSF's LC-130 airplanes that was configured for aerial photography and other science projects.

The LC-130 airplane was making a routine supply delivery to the field camp at the site (called D-59) where Navy personnel, employees of Lockheed Georgia Company, and employees of NSF's antarctic contractor ITT/Antarctic Services Inc. were working to repair a LC-130 that had crashed in 1971. D-59 is approximately 750 nautical miles (860 statute miles) northwest of McMurdo Station and about 110 nautical miles (125 statute miles) inland from the Adélie Coast. Since mid November, Navy pilots had been making regular flights to the site to bring supplies and equipment.

### Rescue efforts at the site

Among the first people from the D-59 camp to arrive at the crash site were U.S. Navy Corpsman Second-Class Barney Card and two Lockheed employees Brad Honeycutt and Johnny Howard. Card, the only person at the camp who was qualified to provide medical assistance, and Honeycutt began searching one side of the cockpit of the smoking airplane for survivors, while Howard searched the other. Howard was the first to see the crew struggling to find a way out.

As they searched for a way to reach the trapped crew, these three along with others from camp realized that they had very little time. Fuel was already leaking into the cockpit, and the airplane's electrical power was still operating. Finally, they found a small hole in the cockpit and began to pull out the victims one by one.

They moved the victims from the wreckage to snowmobiles so that they could make the mile-long trek to the camp. The litters were only 15 feet from the airplane when first explosions rocked the burning airplane. All of the victims and some of the cargo, however, had been removed.

The men were taken to a makeshift emergency room where they were treated by Card and others under his direction. Although McMurdo Station had been notified, a rescue airplane crew with doctors and other corpsman was de-

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layed by bad weather and did not arrive until eight and half hours after the crash. According to Lt. David S. Kermode, the Navy doctor who cared for the victims at McMurdo, "This was a situation that would have tasked a hospital emergency room. Card had nine cases—four of them

serious, one who would have died without him."

Four of the more seriously injured were transported from McMurdo Station to Christchurch, New Zealand, for further treatment. The others were treated at McMurdo Station.

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## Foundation awards of funds for antarctic projects, 1 October to 31 December 1987

Following is a list of National Science Foundation antarctic awards made from 1 October to 31 December 1987. Each item contains the name of the principal investigator or project manager, his or her institution, a shortened title of the project, the award number, and the amount awarded. If an investigator received a joint award from more than one Foundation program, the antarctic program funds are listed first, and the total amount of the award is listed in parentheses. Award numbers for awards initiated by the Division of Polar Programs contain the prefix DPP, those initiated by the Division of Ocean sciences contain the prefix OCE, and those initiated by the Division of Atmospheric Sciences contain the prefix ATM.

### Biology and medicine

Ainley, David G. Point Reyes Bird Observatory, Stinson Beach, California. Antarctic marine ecosystem research at the ice-edge zone (AMERIEZ): distribution of seabirds. DPP 84-19894. \$75,184.

Detrich, H. William. Northeastern University, Boston, Massachusetts. Assembly and stability of microtubules from antarctic fish at low temperatures. DPP 86-14788. \$107,493.

Ross, Robin M. University of California, Santa Barbara, California. Energetics of adult and larvae krill. DPP 85-18872. \$171,545.

### Earth sciences

Dalziel, Ian W. University of Texas, Austin, Texas. Multichannel seismic study of the deep structure of a cordilleran orogeny: the southernmost Andes. OCE 87-16557. \$75,000 (\$117,500).

Mutter, John C. Lamont-Doherty Geophysical Observatory, Columbia University, Palisades, New York. Multichannel seismic study of the deep structure of a cordilleran orogeny: the southernmost Andes. OCE 87-17627. \$75,000 (\$289,264).

Sears, Derek W. University of Arkansas, Fayetteville, Arkansas. Natural thermoluminescence levels in antarctic meteorites and related studies. DPP 86-13998. \$21,000

### Upper atmosphere research

Helliwell, Robert A. Stanford University, Stanford, California. Support and operation of an extreme-low-frequency/very-low-frequency radiometer at Arrival Heights, McMurdo Station, Antarctica. DPP 87-20167. \$7,864.

Inan, Umran S. Stanford University, Stanford, California. Lightning-induced burst particle precipitation from the magnetosphere. DPP 86-11623. \$83,554.

Pomerantz, Martin A. Franklin Institute—Bartol Research Foundation, Newark, Delaware. Observations from the South Pole of ultra-high-energy gamma-ray sources. DPP 86-13231. \$89,280.

### Support and services

Becker, Robert A. ITT/Antarctic Services, Inc., Paramus, New Jersey. Specialized support to the U.S. Antarctic Program. DPP 80-03801. \$20,000,000.



NSF photo by Russ Kinne.

With the number of nations working in Antarctica increasing, consultative parties have focused on improving air safety. Their concerns include coordinating air traffic around the continent, improving communications between stations and aircraft, providing search-and-rescue support, and ensuring that all aircraft operators in Antarctica are aware of safety procedures.

Fisher, Dwight D. Department of Defense, Washington, D.C. Logistic support of the U.S. program in Antarctica. DPP 76-10886. \$27,000,000

Geddes, Barry A. Air New Zealand, Christchurch, New Zealand. Standard depot-level maintenance of USAP ski-equipped C-130 airplanes. DPP 88-02543.

Link, Lewis E. U.S. Army Cold Regions Research and Environmental Laboratory, Hanover, New Hampshire. Technical support to the U.S. Antarctic Program. DPP 87-20063

Zinsmeister, William J. Purdue University, West Lafayette, Indiana. Paleontologic investigation of the Cretaceous/Tertiary boundary on Seymour Island, Antarctica. DPP 84-16783. \$97,564.

#### Glaciology

Bentley, Charles R. University of Wisconsin, Madison, Wisconsin. Glacio-

physical survey of the interior Ross embayment. DPP 86-14011. \$365,279.

Imbrie, John. Brown University, Providence, Rhode Island. Correlation and chronology of the Vostok ice-core record. ATM 87-06394. \$45,000 (\$90,000.)

#### Meteorology

Radke, Lawrence F. University of Washington, Seattle, Washington. Maintenance of the data acquisitions and display system for the National Science Foundation's research-equipped LC-130 airplane. DPP 85-07730. \$7,580.

Stearns, Charles R. University of Wisconsin, Madison, Wisconsin. Radiometer sonde soundings at Amundsen-Scott South Pole Station. ATM 88-01427. \$5,000 (\$20,000).

Warren, Stephen G. University of Washington, Seattle, Washington. Solar and infrared radiation modeling for the polar regions. ATM 86-05134. \$5,000 (\$80,000).

#### Ocean sciences

Biggs, Douglas C. Texas A&M University, College Station, Texas. A cooperative study of upper ocean particulate fluxes. DPP 86-02762.

Brozena, John M. Naval Research Laboratory, Arlington, Virginia. DPP 86-00663. \$353,4000.

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### Weather at U.S. stations

Feature	November 1987				December 1987				January 1988			
	McMurdo <sup>*</sup>	Palmer	Siple <sup>**</sup>	South Pole	McMurdo	Palmer	Siple	South Pole	McMurdo	Palmer	Siple	South Pole
Average temperature (°C)		0.8	-18.9	-42.1		1.8	-13.2	-29.0		2.3	-11.9	-27.5
Temperature maximum (°C) (date)		10.0 (3)	-12.7 (19)	-31.2 (30)		8.0 (23)	- 2.5 (17)	-21.6 (21)		8.0 (17)	- 2.9 (8)	-22.3 (9)
Temperature minimum (°C) (date)		- 6.0 (8)	-28.1 (14)	-54.8 (2)		-3.0 (12)	-20.8 (26)	-33.7 (1)		- 2.0 (20)	-22.1 (17)	-34.0 (31)
Average station pressure (mb)		978.0	852.7	679.4		984.6	864.9	687.8		993.3	870.5	691.3
Pressure maximum (mb) (date)		1009.0 (1)	869.2 (28)	689.2 (26)		999.2 (29)	870.8 (16)	694.5 (9)		1011.0 (28)	879.9 (9)	697.2 (15)
Pressure minimum (mb) (date)		957.0 (7)	837.5 (1)	667.6 (1)		970.0 (30)	855.2 (1)	679.0 (13)		977.9 (1)	861.8 (1)	681.99 (5)
Snowfall (mm)		119.4	NA	TRACE		132.1	NA	TRACE		165.1	NA	TRACE
Prevailing wind direction		350°	171°	050°		020°	180°	050°		340°	192°	360°
Average wind (m/sec)		7.0	5.4	3.0		4.5	6.2	2.3		2.0	3.9	4.7
Fastest wind (m/sec) (date)		40.7 (14) 030°	21.1 (17) 170°	17.0 (6) 020°		30.4 (2) 030°	25.7 (6) 150°	8.8 (2) 020°		20.1 (21) 070°	14.4 (2) 170°	13.9 (19) 360°
Average sky cover		9/10	8/10	3.6		8/10	7.5/10	3.5		8/10	7/10	7.9
Number clear days		0.3	1.4	18.3		2.0	6.0	19.8		3.25	2.9	6.2
Number partly cloudy days		7.7	1.6	5.0		7.5	1.4	3.1		6.25	1.9	4.2
Number cloudy days		22.0	15.0	6.7		21.5	23.6	8.2		21.50	17.2	20.6
Number days with visibility less than 0.4 km.		---	6.1	0.3		---	9.8	---		---	2.6	0.9

Prepared from information received by teletype from the stations. Locations: McMurdo 77°51'S 166°40'3E, Palmer 64°46'S 64°3'W, Amundsen-Scott South Pole 90°S. Elevations: McMurdo sea level, Palmer sea level, Amundsen-Scott South Pole 2835 meters. Siple Station (75°55'S 83°55'W) was closed for the winter in January 1987 and will reopen in November 1981. For prior data and daily logs, contact National Climate Center, Asheville, North Carolina 28801.

\*McMurdo Station: McMurdo Station climate data was not available before press time. Missing 1987 data for McMurdo Station will be published in the December 1988 issue of the *Antarctic Journal*.

\*\*Siple Station opened 13 November 1987 and closed 22 January 1988.

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