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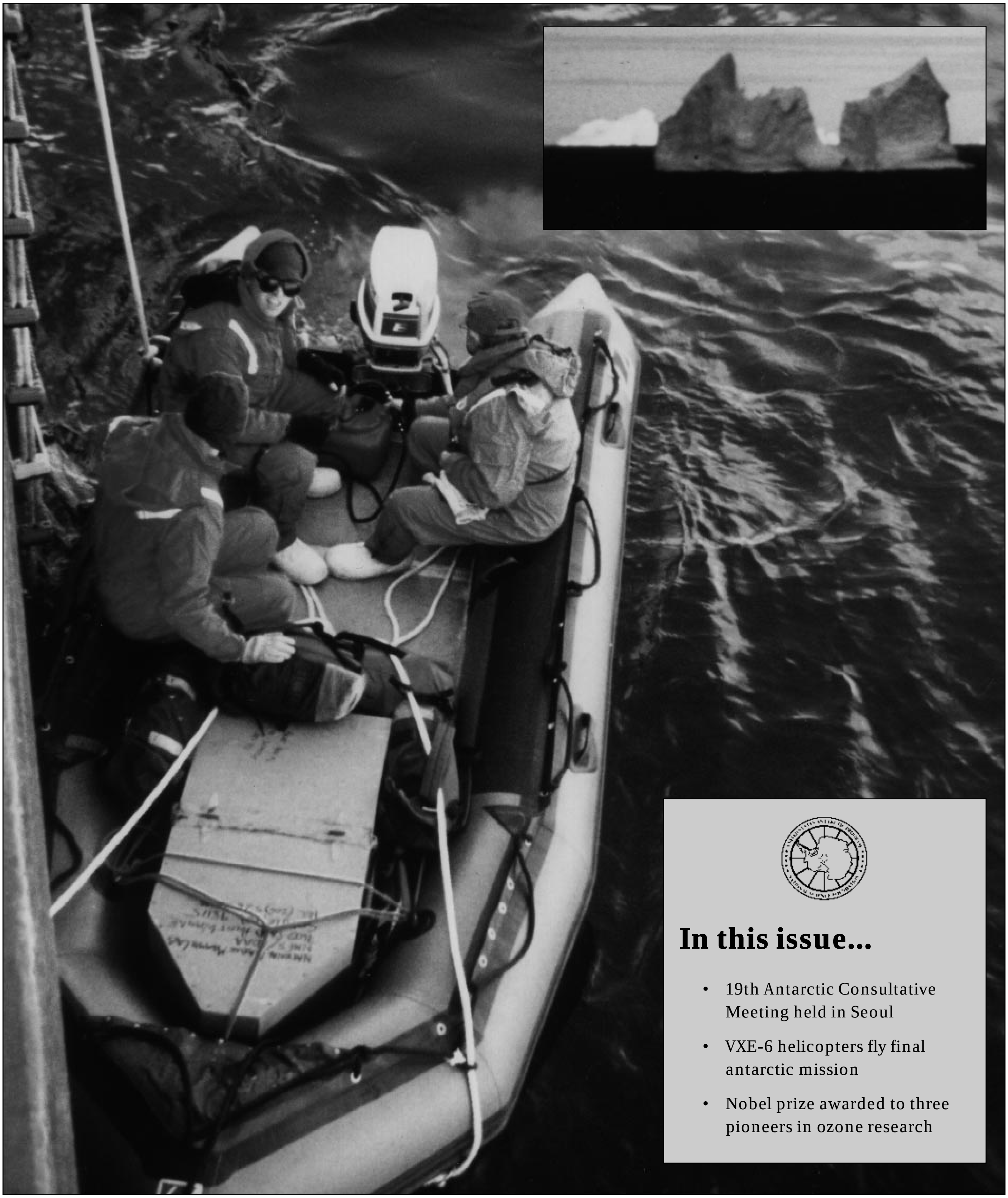

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Editor, Winifred Reuning

Antarctic Journal of the United States, established in 1966, reports on U.S. activities in Antarctica, related activities elsewhere, and trends in the U.S. Antarctic Program. The Office of Polar Programs (National Science Foundation, Room 755, 4201 Wilson Boulevard, Arlington, Virginia 22230; telephone 703/306-1031) publishes the journal five times a year (March, June, September, December, and an annual review issue).

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Submitting manuscripts to the *Antarctic Journal* quarterly issues

The editor of the *Antarctic Journal* will consider unsolicited manuscripts for publication in the *Antarctic Journal*. Format and content requirements for articles are summarized below. Interested authors should review previous issues for style and content or contact the editor directly.

The audience for the quarterly issues is broad in background and interests, so authors should make sure that their articles will be intelligible to readers outside of their scientific discipline or other area of expertise. Avoid specialized jargon and abbreviations, but use technical terms as necessary. Define terms likely to be known only by readers who are familiar with subject. Spell out acronyms when they first appear, including standard scientific terms and chemical abbreviations, as well as names of organizations.

Papers will be edited to improve style, clarity, and grammar. Authors will have the opportunity to review their edited manuscripts before publication, but galley proofs are not furnished.

Articles: Feature articles should be no longer than 1,500 words, but there is no limit on the number of illustrations (figures, tables, or photographs). Appropriate topics include recent or significant science discoveries or advancements, cold-regions engineering, special support activities or issues, history, environmental topics, and policy issues.

Notes: Shorter articles, 500 to 800 words, will also be considered. Illustrations may be submitted with these articles, but notes should not include more than three figures. Appropriate topics for notes include meeting reports or announcements, new or improved technology, polar publications, and support or related activities.

Manuscripts may be submitted in various formats. For additional information, contact Winifred Reuning, Editor; *Antarctic Journal*; National Science Foundation; Office of Polar Programs; Room 755; 4201 Wilson Boulevard; Arlington, Virginia 22230 (telephone, 703/306–1031; Internet, WReuning@NSF.gov).

Contents...

Cover: In February and March 1995, the U.S. inspection team sailed eastward around the continent from McMurdo Station and stopped at eight stations to conduct inspections under the auspices of the Antarctic Treaty. The U.S. team was made up of representatives from the Department of State (which leads the team), the Coast Guard, the Environmental Protection Agency, the Fish and Wildlife Service, the National Oceanic and Atmospheric Administration, the National Science Foundation, and the U.S. Arms Control and Disarmament Agency. During the inspection tour, John Bengtson of the National Oceanic and Atmospheric Administration and fellow researchers (shown here) took advange of the ship's passage through poorly documented areas to survey seal populations. Inset: Sea ice spotted off the coast of Antarctica during the inspection cruise.

Photos courtesy of the U.S. inspection team.

National Science Board: Federal investments in science and engineering

[Editor's note: The following statement was adopted by the National Science Board at its 333rd Meeting on 14 December 1995. The Board, which is composed of 24 members who are appointed by the President and confirmed by the Senate, has the dual responsibilities of advising the President and Congress on science policy and governing the National Science Foundation.]

For half a century, a national consensus—firmly founded and widely shared—has affirmed that investment in research and education in science and engineering is an investment in America's future. Today we face the prospect of an unprecedented decline in Federal support for civilian science and engineering. Long-term budget constraints could have a serious impact on our Nation's future well-being and the life and health of all its citizens. The consequences for our technological and economic leadership as we move into the twenty-first century could be devastating.

During the Second World War, our leaders turned to science and technology to assure the security and defense of our country. Since then, a consistent and bipartisan policy of Federal investment in research and education for civilian needs has built a research and education enterprise of unparalleled scope and quality. This policy has directly contributed to our economic growth, the productive use and husbanding of our resources, and the health and well being of our people. The new ideas, products, and processes resulting from this national investment are responsible for much that we take for granted today: the information super highway, television sets and transistors, miracle drugs and microsurgery, and automated teller machines, composite materials, and spectacular agricultural productivity. These innovations illustrate one inescapable fact—science and technology are uniquely important to our Nation's future.

The challenge confronting the Nation today is not only to reduce Federal spending, necessary as that is. It is, also, to undergird the strength of those industries in which we are still world leaders—such as computers, telecommunication, chemicals, aerospace, and biotechnology—and to assure our readiness to capitalize on new scientific discoveries, innovative processes, and emerging technologies. These industries and others like them are the foundation of our national prosperity. Scientific and technical education and a vigorous research enterprise are critical for positioning ourselves to meet future challenges.

The National Science Board urges that decisions on Federal research and development budgets be framed with explicit attention to the fundamental importance of U.S. leadership in research, for the economy and for the well being of the Nation. The Board pledges continuing commitment to strong support of our vital national scientific capacity. The Board will work with Congress, the Administration, business and civic leaders, and the public to raise awareness of the critical need to make and sustain a strong investment in science for our future.

Seoul hosts 19th Antarctic Treaty Consultative Meeting

[*Editor's note: The complete texts of the five measures, two decisions, and nine resolutions, along with associated annexes, follow this synopsis of the meeting. Maps and other materials presented at the 19th Antarctic Treaty Consultative Meeting are contained in the complete final report, which along with the previous treaty meeting final reports can be obtained through the "Antarctic Bibliography," published by the Library of Congress with support from the National Science Foundation. The material published here is based on the text of the final report.*]

Protecting the environment and improving the Antarctic Treaty mechanism were chief among the issues addressed by the 19th Antarctic Treaty Consultative Meeting (ATCM) held from 8 to 19 May 1995 in Seoul. Delegates from all 26 Consultative Parties and 11 Non-Consultative Parties to the Antarctic Treaty, as well as invited observers and experts, attended (*see* table).

The protocol

The implementation of the Protocol on Environmental Protection to the Antarctic Treaty was the primary concern of the delegates. Adopted by consensus on 4 October 1991, the protocol extends and improves the treaty system to preserve the antarctic environment. It will enter into force when all 26 Consultative Parties have ratified or acceded to it. By the 19th ATCM, 16 parties had ratified the protocol (Argentina, Australia, Chile, the People's Republic of China, Ecuador, France, Germany, Italy, the Netherlands, New Zealand, Norway, Peru, Spain, Sweden, the United Kingdom, and Uruguay), and others are expected to ratify it before the next meeting.

Some parties reported on measures their governments had taken to act in accordance with the provisions of the protocol even before its entry into force.

A legal experts group, which has been analyzing the issue of liability for environmental damage under the protocol and developing procedures to implement the protocol's environmental impact assessment system, reported on their progress during the preceding year. The delegates discussed this and other practical aspects of implementing the protocol, including the environmental impact assessment requirements.

The Transitional Environmental Working Group met for the first time during the 19th ATCM, addressing the functions of the Committee for Environmental Protection, which will come into being once the protocol has entered into force.

Attendance at the 19th Antarctic Treaty Consultative Meeting

Nations and organizations in attendance

Consultative Parties	Non-Consultative Parties	Observers	Experts from
Argentina	Austria	Chairman, Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)	Antarctic and Southern Ocean Coalition (ASOC)
Austrialia	Bulgaria	President, Scientific Committee on Antarctic Research (SCAR)	International Association of Antarctic Tour Operators (IAATO)
Belgium	Canada	Chairman, Council of Managers of National Antarctic Programs (COMNAP)	International Hydrographic Organization (IHO)
Brazil	Colombia		International Union for Conservation of Nature and Natural Resources (IUCN)
Chile	Czech Republic		United Nations Environmental Program (UNEP)
China, People's Republic of	Denmark		World Meterological Organization (WMO)
Ecuador	Greece		
Finland	Guatemala		
France	Papua New Guinea		
Germany	Slovak Republic		
India	Switzerland		
Italy			
Japan			
Korea, Republic of			
Netherlands			
New Zealand			
Norway			
Peru			
Poland			
Russian Federation			
South Africa, Republic of			
Spain			
Sweden			
United Kingdom			
United States of America			
Uruguay			

Nations and organizations unable to attend

Consultative Parties	Non-Consultative Parties	Observers	Experts from
	Cuba		International Maritime Organization (IMO)
	Hungary		Intergovernment Oceanographic Commission (IOC)
	Korea, Democratic People's Republic of		Pacific Asian Travel Association (PATA)
	Romania		World Tourism Organization (WTO)
	Ukraine		

Tourism and non-governmental activities

In conjunction with resolutions passed at the 18th ATCM, several working groups presented drafts of standardized reporting forms designed for use by non-governmental groups visiting Antarctica. The delegates debated the level of detail of information needed from these groups to ensure that their activities would conform to the protocol and voted to require all visitors to file a postvisit report.

Recognizing the major role that the National Science Foundation (NSF) has played in surveying and coordinating tourism in Antarctica, the delegates asked COMNAP to explore ways that the NSF initiative might be broadened to help other treaty parties more effectively enforce treaty regulations in regard to tourism.

Although tourism in Antarctica has increased steadily in recent years, no good measures of its effect on the antarctic environment are available. To gather baseline information about tourism's impact, Consultative Parties were asked to

- identify sites that possibly have been or may be affected by tourism and control sites that may be used for comparison;
- survey selected sites and, if possible, determine indicator variables most likely to be sensitive to tourism activities; and
- determine and evaluate the effectiveness of measures taken to minimize the impact of different types, frequencies, timing, and levels of tourism activities.

In addition to evaluating the effects of tourism, the delegates concluded that all human activity in Antarctica—including scientific research—must be analyzed for its effect on the environment. The baseline measurements must be detailed enough to distinguish tourism's effect from the cumulative effect.

The issues of monitoring tour operators' activities and ensuring their compliance to the protocol, educating visitors about antarctic travel, and providing training materials for tour operators were also addressed by the delegates.

Operation of the Antarctic Treaty System

Important reforms enacted at the Seoul ATCM will change the decision-making processes of the ATCM, enabling certain decisions to be brought into force more rapidly and making the Consultative Meetings more effective. The long-held procedure of adopting Recommendations was replaced by a three-tiered structure of Measures, Decisions, and Resolutions. Each will be numbered consecutively, followed by the year of adoption.

- *Measures* are legally binding once they have been adopted by all Consultative Parties. Designating a new Site of Special Scientific Interest is an example of a Measure.
- *Decisions* relate to internal organizational matters of the ATCM and will be operative immediately upon being adopted at the Treaty Meeting (or at the time specified in the text of the Decision). Changing ATCM practice from using Recommendations to using Measures, Decisions, and Resolutions is an example of a Decision.
- *Resolutions* are, in the words of the Treaty Meeting, "hortatory text" adopted by an ATCM, and they deal with matters Representatives are urged to present to their respective governments. Advocating a ban on disposing nuclear waste in the Antarctic Treaty region is an example of a Resolution.

Work continued to establish a permanent Secretariat for the Antarctic Treaty. No consensus was reached about the location of the Secretariat, although delegates were in agreement on the urgency of the matter. The working group charged with resolving the organizational issues—such as legal status, functions, financing, composition of the Secretariat, diplomatic privileges and immunities, and the appropriate type of international agreement under which the Secretariat would be established—will meet before the next ATCM in an attempt to speed resolution. Because the need for a Secretariat will be greater once the protocol comes into force, the working group will also meet with the group of legal experts on liability before the 20th meeting.

ATCM delegates also expressed a need for a more timely exchange of information about environmental issues in the Arctic and Antarctic. The Government of Canada, which will host the Ministerial Meeting of the Arctic Environmental Protection Strategy, was asked to ensure that the final report of the 19th ATCM and any other relevant materials be made available to the Ministerial Meeting and that all relevant Ministerial Meeting documents be made available to delegates at the next ATCM.

Inspections under the Antarctic Treaty

During 1995, the United States inspected eight stations under the authority of the Treaty: Dumont d'Urville (France), Mirnyy (Russia), Davis (Australia), Zhongshan (China), Syowa (Japan), Neumayer (Germany), Signy (United Kingdom), and Orcadas (Argentina). No treaty violations or military activities were found at any of the stations. Station personnel openly granted the inspection team access to all areas and freely discussed all station activities from research to logistics. The inspection team noted that waste management at all sites already showed the impact of annex 3 of the protocol, even though it is not yet in force. Fuel storage facilities and transfer practices could be improved, in the opinion of the inspection team, which asked parties to work through COMNAP to improve their fuel handling practices.

Argentina also submitted a report on inspections it had conducted at three stations: King Sejong (Republic of Korea), Rothera (United Kingdom), and Signy (United Kingdom).

In conducting inspections, the teams used a checklist for operating stations that had been approved at the 18th ATCM. Draft checklists for vessels, abandoned stations and associated installations, and waste disposal sites were submitted to the 19th meeting; their usefulness was debated by the delegates; and a motion was passed to approve all three.

Other ATCM actions to protect the antarctic environment

Measures to ensure complete reporting on and environmental-impact assessment of all construction and drilling projects in Antarctica and a report on how to ensure the use of proper incineration practices were considered by the delegation.

New Specially Protected Areas and Sites of Special Scientific Interest were approved, and the delegates also reviewed a report from SCAR on improving the Antarctic Protected Area System. Oil spill prevention and control measures, waste disposal and management measures, and conservation of antarctic flora and fauna were all addressed.

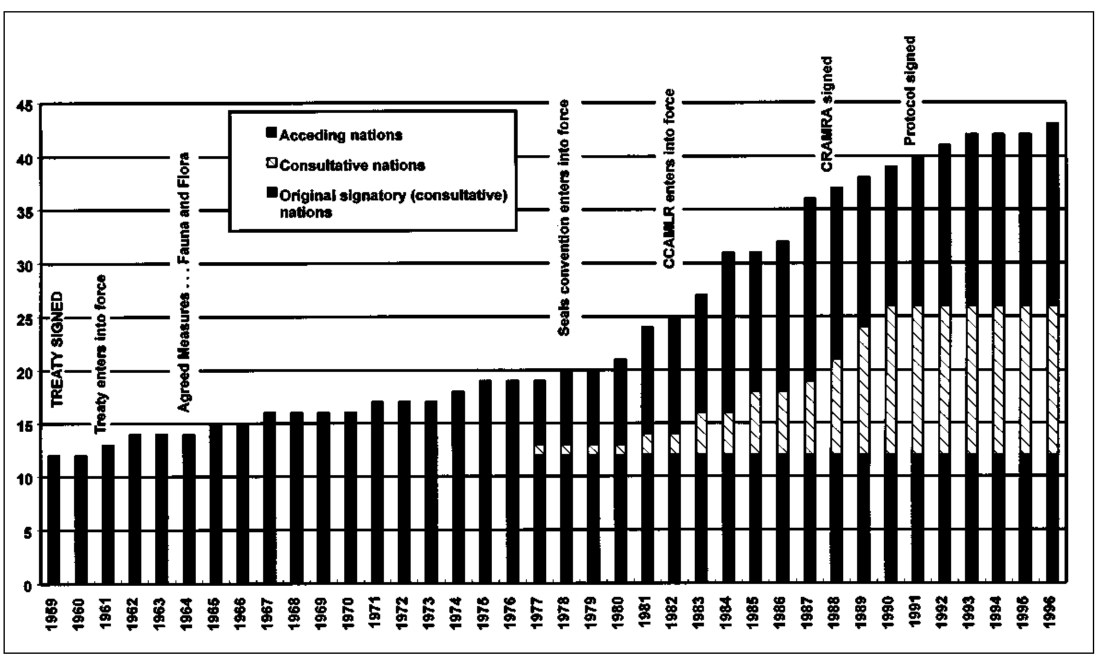
Reports by SCAR and ASOC examined the effects of global change in the Antarctic. Significant regional changes in the antarctic climate were reported for the Antarctic Peninsula region. The reports emphasized the potential significance of changes detected in polar regions, stressing that recorded changes in Antarctica, such as increasing world ocean levels and changing weather patterns, could signal future changes for the rest of the world. Coherent and sustained research to understand and accurately predict global trends and efforts to convey that knowledge to legislative bodies are imperative, according to the reports.

International cooperation and exchange of information

Recognizing the benefits of exchange programs for scientists, international peer review of research studies, dissemination of information over the World Wide Web, and shared logistics, the delegates encouraged continued and further cooperation between parties to the treaty. Article 2 of the Antarctic Treaty calls all parties to international cooperation, and a declaration at the 16th ATCM (1991) reaffirms that call, resolving that "in the interest of all mankind, Antarctica shall continue to be used exclusively for peaceful purposes, and in this regard, [the parties] dedicate themselves to enhancing further the record of cooperation in a decade of international scientific cooperation, 1991 to 2000."

Plans for the 20th Treaty Meeting

Utrecht, The Netherlands, will host the next Antarctic Treaty Consultative Meeting, 29 April through 10 May 1996.



Number of Antarctic Treaty nations, 1959–1996. (Source: National Science Foundation, Arlington, Virginia 22230.)

Measures, Decisions, and Resolutions adopted at the 19th Antarctic Treaty Consultative Meeting

Measures

Measure 1 (1995): Revised Descriptions and Management Plans for Specially Protected Areas

The Representatives of the Consultative Parties,

Recalling Recommendations XV-8 and XV-9/VIII-3;

Noting that revised Area Descriptions and proposed Management Plans have been approved by the Scientific Committee on Antarctic Research (SCAR);

Noting also that the format of these revised Area Descriptions and proposed Management Plans accord with Article 5 of Annex V of the Protocol on Environmental Protection to the Antarctic Treaty adopted under Recommendation XVI-10;

Recommend to their Governments the following Measure for approval in accordance with paragraph 4 of Article IX of the Antarctic Treaty:

For the Specially Protected Areas listed below

(i) the Descriptions inserted in Annex B, Specially Protected Areas, of the Agreed Measures for the Conservation of Antarctic Fauna and Flora shall be deleted;

(ii) the Descriptions and Management Plans of Specially Protected Areas, annexed to this Measure, shall be inserted in Annex B, Specially Protected Areas, of the Agreed Measures for the Conservation of Antarctic Fauna and Flora.

The Specially Protected Areas concerned are:

- Area No. 13—Moe Island, South Orkney Islands (Annex A);
- Area No. 15—Southern Powell Island and adjacent islands, South Orkney Islands (Annex B).

Annex A to Measure 1 (1995): Management Plan for Specially Protected Area (SPA) No. 13, Moe Island, South Orkney Islands

1. Description of Values to be Protected

The Area was originally designated in Recommendation IV.13 (1966, SPA No. 13) after a proposal by the United Kingdom on the grounds that Moe Island provided a representative sample of the maritime antarctic ecosystem, that intensive experimental research on the neighboring Signy Island might alter its ecosystem, and that Moe Island should be specially protected as a control area for future comparison.

These grounds are still relevant. Whilst there is no evidence that research activities at Signy Island have significantly altered the ecosystems there, a major change has occurred in the low-altitude terrestrial system as a result of the rapidly expanding antarctic fur seal (*Arctocephalus gazella*) population. Plant communities on nearby Signy Island have been physically disrupted by trampling by fur seals, and nitrogen enrichment from the seals' excreta has resulted in replacement of bryophytes and lichens by the macroalga *Prasiola crispa*. Low-lying lakes have been significantly affected by enriched run-off from the surrounding land. So far, Moe Island has not been invaded by fur seals to any great extent and its topography makes it less likely that seals will penetrate to the more sensitive areas.

The values to be protected are those associated with the biological composition and diversity of a near-pristine example of the maritime antarctic terrestrial and littoral marine ecosystems. In particular, Moe Island contains the greatest continuous expanses of *Chorisodontium-Polytrichum* moss turf found in the Antarctic. Moe Island has been visited on few occasions and has never been the site of occupation for periods of more than a few hours.

2. Aims and Objectives

Management of Moe Island aims to

- avoid major changes to the structure and composition of the terrestrial vegetation, in particular the moss turf banks;
- prevent unnecessary human disturbance to the Area;
- permit research of a compelling scientific nature which cannot be served elsewhere, particularly research related to determining the differences between the ecology of an undisturbed island and that of an adjacent occupied and fur-seal-perturbed island.

3. Management Activities

Ensure that the biological condition of Moe Island is adequately monitored, preferably by noninvasive methods, and that the signboards are serviced.

If fur seals were to gain access to the interior of Moe Island, it would be necessary to take action to prevent damage to the vulnerable moss banks. This action would most likely consist of the erection of a seal-proof fence at the head of the gully at the northeast corner of Landing Cove. Any direct management activities in the Area would be subject to an environmental impact assessment before any decision to proceed is taken.

4. Period of Designation

Designated for an indefinite period.

5. Maps

[*Editor's note: Maps are not reprinted here. Please refer to the "Final Report of the Nineteenth Antarctic Treaty Consultative Meeting.*"]

Map 1 shows the location of Moe Island in relation to the South Orkney Islands. Map 2 shows Moe Island in greater detail.

6. Description of the Area

6(i). *Geographical coordinates, boundary markers, and natural features*

Moe Island, South Orkney Islands, is a small, irregularly shaped island lying 300 meters off the southwestern extremity of Signy Island, from which it is separated by Fyr Channel. It is about 1.3 kilometers from the northeast to southwest and 1 kilometer from northwest to southeast. Its position on Admiralty Chart No. 1775, latitude 60°44'S, longitude 45°45'W, does not agree closely with that in Map 2 (latitude 60°44'S, longitude 45°41'W).

The island rises precipitously on the northeastern and southeastern sides to Snipe Peak (226 meters altitude). There is a subsidiary summit above South Point (102 meters altitude) and lower hills on each of three promontories on the western side above Corral Point (92 meters), Conroy Point (39 meters), and Spaull Point (56 meters). Small areas of permanent ice remain on the east- and south-facing slopes with late snow lying on the steeply dipping western slopes. There are no permanent streams or pools.

The rocks are metamorphic quartz mica schists, with occasional biotite and quartz-rich beds. There is a thin bed of undifferentiated amphibolite on the northeastern coast. Much of the island is overlain with glacial drift and scree. Soils are predominantly immature deposits of fine to coarse clays and sands intermixed with gravels, stones, and boulders. They are frequently sorted by freeze-thaw action in high or exposed locations into small-scale circles, polygons, stripes, and lobes. There are deep accumulations of peat (up to 2 meters thick on western slopes), considerable expanses of the surface of which are bare and eroded.

The dominant plant communities are Andreaea-Usnea fellfield and banks of *Chorisodontium-Polytrichum* moss turf (the largest known example of this community type in the Antarctic). These moss banks constitute a major biological value and the reason for the designation of the Area. The cryptogamic flora is diverse.

The mites *Gamasellus racovitzai* and *Stereotydeus villosus* and the springtail *Cryptopygus antarcticus* are common under stones.

There were five colonies of chinstrap penguins (*Pygoscelis antarctica*) totaling about 11,000 pairs in 1978–1979. A more recent visit (February 1994) noted fewer than 100 pairs on the northern side of Landing Cove and more than a thousand on the southern side. Numerous other birds breed on the island, notably about 2,000 pairs of cape petrels (*Daption capensis*) in 14 colonies (1966) and large numbers of antarctic prions (*Pachyptila desolata*).

Weddell seals (*Leptonychotes weddellii*) and leopard seals (*Hydrurga leptonyx*) are found in the bays on the west side of the island. Increasing numbers of fur seals (*Arctocephalus gazella*), mostly juvenile males, come ashore on the north side of Landing Cove and have caused some damage to vegetation in that area. However, it is possible that the nature of the terrain will restrict these animals to this small headland where damage may intensify.

6(ii). *Restricted Zones within the Area*

None.

6(iii). *Location of structures within the Area*

A marker board is located at the back of the small shingle beach in the northeast corner of Landing Cove, beyond the splash zone on top of a flat rock, to which it is bolted. The board was erected on 2 February 1994.

There is a cairn and the remains of a survey mast, erected in 1965–1966, on Spaull Point. This mast is of interest for lichenometric studies and should not be removed. There are no other structures on Moe Island.

6(iv). *Location of other Protected Areas within close proximity*

SPA No. 14, Lynch Island, lies about 10 kilometers north-northeast of Moe Island. SPA No. 18, North Coronation Island, lies about 19 kilometers away on the northern side of Coronation Island. SPA No. 15, Southern Powell Island, is about 41 kilometers to the east.

7. Permit Conditions

Entry into the Area is prohibited except in accordance with a permit issued by appropriate national authorities.

Conditions for issuing a permit to enter the Area are that

- it is issued only for a compelling scientific purpose which cannot be served elsewhere;
- the actions permitted will not jeopardize the natural ecological system in the Area;
- any management activities are in support of the objectives of the Management Plan;
- the actions permitted are in accordance with this Management Plan;
- the permit, or an authorized copy, must be carried within the Specially Protected Area;
- a report or reports are supplied to the authority or authorities named in the permit.

7(i). *Access to and movement within the Area*

There are no restrictions on landing from the sea, which is the preferred method. No special access points are specified, but landings are usually most safely made at the northeast corner of Landing Cove.

Helicopter landings should be avoided where practicable. Helicopters may land only on the col between the hill at 89 meters and the western slope of Snipe Peak. To avoid overflying bird colonies, approach should preferably be from the south, though an approach from the north is permissible.

It is forbidden to overfly the Area below 250 meters altitude above the highest point except for access to the landing point specified above.

No pedestrian routes are designated, but persons on foot should at all times avoid disturbances to birds or damage to vegetation and periglacial features. Vehicles are prohibited on Moe Island.

7(ii). *Activities which are or may be conducted within the Area, including restrictions on time and place*

- Compelling scientific research which cannot be undertaken elsewhere and which will not jeopardize the ecosystem of the Area.
- Essential management activities, including monitoring.

7(iii). *Installation, modification, or removal of structures*

No structures are to be erected in the Area, or scientific equipment installed, except for essential scientific or management activities, as specified in the permit.

7(iv). *Location of field camps*

Parties should not normally camp in the Area. If this is essential for reasons of safety, tents should be erected having regard to causing the least damage to vegetation or disturbance to fauna.

7(v). *Restrictions on materials and organisms which may be brought into the Area*

- No living animals or plant material shall be deliberately introduced into the Area.
- No poultry products, including food products containing uncooked dried eggs, shall be taken into the Area.
- No herbicides or pesticides shall be brought into the Area. Any other chemicals, which may be introduced for a compelling scientific purpose specified in the permit, shall be removed from the Area at or before the conclusion of the activity for which the permit was granted.
- Fuel, food, and other materials are not to be deposited in the Area, unless required for essential purposes connected with the activity for which the permit was been granted. All such materials introduced are to be removed when no longer required. Permanent depots are not permitted.

7(vi). *Taking of or harmful interference with native flora and fauna*

This is prohibited, except in accordance with a permit. Where animal taking or harmful interference is involved this should be in accordance with the SCAR "Code of Conduct for Use of Animals for Scientific Purposes in Antarctica," as a minimum standard.

7(vii). *Collection and removal of anything not brought into the Area by the permit holder*

Material may be collected or removed from the Area only in accordance with a permit, except that debris of human origin may be removed from the beaches of the Area, and dead or pathological specimens of fauna or flora may be removed for laboratory examination.

7(viii). *Disposal of waste*

All nonhuman wastes shall be removed from the Area. Human waste may be deposited in the sea.

7(ix). *Measures that may be necessary to ensure that the aims and objectives of the Management Plan continue to be met*

Permits may be granted to enter the Area to carry out biological monitoring and site inspection activities, which may involve the collection of small amounts of plant material or small numbers of animals for analysis or audit, to erect or maintain notice boards, or to carry out protective measures.

7(x). *Requirements for reports*

The principal permit holder for each issued permit shall submit a report of activities conducted in the Area using the accepted "Visit Report Form" suggested by SCAR. This report shall be submitted to the authority named in the permit as soon as practicable but not later than 6 months after the visit has taken place. Such reports should be stored indefinitely and made accessible to interested Parties, SCAR, CCAMLR, and COMNAP, if requested, to provide the documentation of human activities within the Area necessary for good management.

Annex B to Measure 1 (1995): Management Plan for Specially Protected Area (SPA) No. 15, Southern Powell Island and Adjacent Islands, South Orkney Islands

1. Description of Values to be Protected

The Area was originally designated in Recommendation IV-15 (1966, SPA No. 15) after a proposal by the United Kingdom on the grounds that southern Powell Island and the adjacent islands support substantial vegetation and a considerable bird and mammal fauna. The Area was representative of the natural ecology of the South Orkney Islands and was rendered more important by the nucleus of an expanding colony of antarctic fur seals (*Arctocephalus gazella*).

These grounds are still relevant, though the expansion of the fur seal colony is progressing only slowly.

The values to be protected are primarily those associated with the large concentrations of breeding birds and seals and, to a lesser extent, the terrestrial vegetation.

2. Aims and Objectives

Management of southern Powell Island and adjacent islands aims to

- avoid major changes in the structure and composition of the terrestrial vegetation;
- prevent unnecessary human disturbance to the Area;
- permit research of a compelling scientific nature which cannot be served elsewhere.

3. Management Activities

Because of its use as an anchorage in the past, it is important that the signs, which identify the Area as a Specially Protected Area and point out that landing without a permit is forbidden, are maintained.

Visits should be made as necessary to assess the biological composition of the Area, in particular the state of the fur seal colony, and to maintain the signboards.

4. Period of Designation

Designated under ATCM Recommendation IV-5 for an indefinite period.

5. Maps

[*Editor's note: Maps are not reprinted here. Please refer to the "Final Report of the Nineteenth Antarctic Treaty Consultative Meeting."*]

Map 1 shows the location of southern Powell Island in relation to the South Orkney Islands. Map 2 shows the Area in greater detail.

6. Description of the Area

6(i). *Geographical coordinates, boundary markers, and natural features*

The Area, which is centered on latitude 60°42'S and longitude 45°01'W includes all of Powell Island, South Orkney Islands, south of the latitude of the southern summit of John Peaks (375 meters altitude), together with the whole of Fredriksen Island, Michelsen Island (a tidal peninsula at the southern tip of Powell Island), Christoffersen Island, Grey Island, and unnamed adjacent islands. All but the Crutchley Ice Piedmont of southern Powell Island are ice-free in summer, though there are patches of semipermanent or late-lying snow in places.

The rocks of southern Powell Island, Michelsen Island, and Christoffersen Island are conglomerates of Cretaceous-Jurassic age. The two promontories to the west of John Peaks are carboniferous greywacke-shales. There are boulders containing plant fossils in the glacial deposits around Falkland Harbor. Much of central and southern Fredriksen Island is composed of sandstone and dark phyllitic shales. The northeast, and probably most of the north, of this island is highly sheared conglomerate with laminated mudstone. The Area has only a thick mantle of glacial till, strongly influenced by seabird guano.

Michelsen Island is almost devoid of land vegetation, although on the rocks there are extensive communities of lichens dominated by nitrophilous crustose species. These are also widespread on Fredriksen Island and elsewhere on bird-influenced cliffs and rocks near the shore. The most diverse vegetation on Powell Island occurs on the two promontories and associated scree west of Falkland Harbor. Here, and on Christoffersen Island and the northern part of Fredriksen Island, moss banks with underlying peat occur. Wet areas support stands of moss carpet. There are extensive areas of the nitrophilous macroalga *Prasiola crispa* associated with the penguin colonies in the Area. Snow alga are prominent on the ice piedmont and snow patches in late summer.

No information is available on the arthropod fauna, but it is probably very similar to that at Signy Island. The springtails *Cryptopygus antarcticus* and *Parisotoma octoculata* and the mites *Alaskozetes antarcticus*, *Stereotydeus villosus*, and *Gamasellus racovitzai* occur in great numbers beneath stones.

There are few observations on marine biota in the Area, but this is likely to be very similar to the well-researched Signy Island area. The relatively enclosed Falkland-Ellefsen Harbor area and the bay on the east side of the peninsula are highly influenced by glacial run-off from the ice piedmont.

Large numbers of penguins and petrels breed throughout the Area. There are many thousand pairs of chinstrap penguins (*Pygoscelis antarctica*), mostly on Fredriksen Island. Similarly large numbers of Adélie penguins (*P. adeliae*) occur principally on the southern Powell-Michelsen Island area. Here there are also several thousand pairs of gentoo penguins (*P. papua*) and a very few scattered pairs of macaroni penguins (*Eudyptes chrysolophus*) breeding among the gentoos.

Other breeding birds include southern giant petrels (*Macronectes giganteus*), cape petrels (*Daption capensis*), snow petrels (*Pagodroma nivea*), Wilson's storm petrels (*Oceanites oceanicus*), blue-eyed shags (*Phalacrocorax atriceps*), dominican gulls (*Larus dominicanus*), brown skuas (*Catharacta lonnbergi*), sheathbills (*Chionis alba*), and possibly antarctic prions (*Pachyptila desolata*) and black-bellied storm petrels (*Fregatta tropica*).

Michelsen Island is the longest known breeding site in the Antarctic of fur seals since their near-extermination in the 19th century. The number of pups born annually has increased slowly but fairly steadily from 11 in 1956 to about 60 in 1989. Thirty-four live pups were recorded in January 1994. Many nonbreeding males visit the Area during the summer. Other seals are frequently on the beaches, mainly elephant seals (*Mirounga leonina*) and Weddell seals (*Leptonychotes weddellii*). Leopard seals (*Hydrurga leptonyx*) and crabeater seals (*Lobodon carcinophagus*) are occasionally seen on ice floes.

6(ii). *Restricted Zones within the Area*

None

6(iii). *Location of structures within the Area*

A marker board (erected January 1994) is positioned on southern Powell Island on top of a small rock outcrop at the back of the shingle beach on the east side of the southern promontory of the island.

On Michelsen Island the marker board (erected January 1994) is situated on a low-lying rock about 50 meters from the shoreline at the back of a high shingle beach at the southern tip of the island.

On Christoffersen Island the marker board (erected January 1994) is located on a small promontory on the northeastern shore of the island at the entrance to Falkland Harbor. The board is located at the back of the beach just below a small Adélie penguin rookery.

On Fredriksen Island a marker board (erected January 1994) is located at the northern end of the pebble/boulder beach on the western side of the island, below a small chinstrap penguin rookery. The board is at the back of the beach on top of a small rock outcrop.

There are no other structures within the Area, but various mooring chains and rings, which are associated with the use of Ellefsen and Falkland Harbors by floating whale factories in the 1920s, are to be found on the shore.

6(iv). *Location of other Protected Areas within close proximity*

SPA No. 13, Moe Island, and SPA No. 14, Lynch Island, are about 35 kilometers west by south and about 35 kilometers west of the Area, respectively. SPA No. 18, North Coronation Island, is about the same distance away on the northern side of Coronation Island.

7. Permit Conditions

Entry into the Area is prohibited except in accordance with a permit issued by appropriate national authority.

Conditions for issuing a Permit to enter the Area are that

- it is issued only for a compelling scientific purpose which cannot be served elsewhere;
- the actions permitted will not jeopardize the natural ecological system in the Area;
- any management activities are in support of the objectives of this Management Plan;
- the actions permitted are in accordance with this Management Plan;
- the permit must be carried within the Specially Protected Area;
- a report or reports are supplied to the authority or authorities named in the permit.

7(i). *Access to and movement within the Area*

Anchoring within Falkland Harbor and Ellefsen Harbor is prohibited except in emergency.

No pedestrian routes are designated within the Area, but persons on foot should avoid walking on vegetated areas or disturbing wildlife wherever possible. Vehicles are not allowed in the Area.

It is forbidden to overfly the Area below 250 meters altitude above the highest point except for purposes of landing (when essential) on the beach on the east side of the southernmost tip of Powell Island.

7(ii). *Activities which are or may be conducted within the Area, including restrictions on time and place*

- Compelling scientific research which cannot be undertaken elsewhere.
- Essential management activities, including monitoring.

7(iii). *Installation, modification, or removal of structures*

No structures are to be erected in the Area or scientific equipment installed, except for essential scientific or management activities, as specified in the permit.

7(iv). *Location of field camps*

Parties shall not camp in the Area, except in an emergency for reasons of safety. In this case, tents should be erected having regard to causing the least damage to the vegetation or disturbance to fauna.

7(v). *Restrictions on materials and organisms which may be brought into the Area*

- No living animals or plant material shall be deliberately introduced into the Area.
- No poultry products, including food products containing uncooked dried eggs, shall be taken into the Area.
- No herbicides or pesticides shall be brought into the Area. Any other chemicals, which may be introduced for a compelling scientific purpose specified in the permit, shall be removed from the Area at or before the conclusion of the activity for which the permit was granted.
- Fuel, food, or other materials are not to be deposited in the Area, unless required for essential purposes connected with the activity for which the permit has been granted. All such materials are to be removed when no longer required.

7(vi). *Taking of or harmful interference with native flora and fauna*

This is prohibited except in accordance with a permit. Where animal taking or harmful interference is involved this should be in accordance with the SCAR "Code of Conduct for Use of Animals for Scientific Purposes in Antarctica," as a minimum standard.

7(vii). *Collection and removal of anything not brought into the Area by the permit holder*

Material may be collected or removed from the Area only in accordance with a permit, except that debris of human origin may be removed from the beaches of the Area and dead or pathological specimens of fauna or flora may be removed for laboratory examinations.

7(viii). *Disposal of waste*

All nonhuman wastes shall be removed from the Area. Human waste may be deposited in the sea.

7(ix). *Measures that may be necessary to ensure that the aims and objectives of the Management Plan continue to be met*

Permits may be granted to enter the Area to carry out biological monitoring and site inspection activities, which may involve the collection of small amounts of plant material or small numbers of animals for analysis or audit, to erect or maintain notice boards, or to carry out protective measures.

7(x). *Requirements for reports*

The principal permit holder for each issued permit shall submit a report of activities conducted in the Area using the accepted "Visit Report Form" suggested by SCAR. This report shall be submitted to the authority named in the permit as soon as practicable but not later than 6 months after the visit has taken place. Such reports should be stored indefinitely and made accessible to interested Parties, SCAR, CCAMLR, and COMNAP, if requested, to provide the documentation of human activities within the Area necessary for good management.

Measure 2 (1995): Revised Description and Management Plan for Sites of Special Scientific Interest

The Representatives of the Consultative Parties,

Recommend to their Governments the following Measure for approval in accordance with paragraph 4 of Article IX of the Antarctic Treaty:

For the Site of Special Scientific Interest mentioned below:

(i) the Management Plan inserted in the Annex to Recommendation XIII-8 Facilitation of scientific research: Sites of Special Scientific Interest, be deleted;

(ii) the Management Plan of the Site of Special Scientific Interest, annexed to this Recommendation, be inserted in the Annex to Recommendation XIII-8 Facilitation of scientific research: Sites of Special Scientific Interest.

The Site of Special Scientific Interest concerned is:

- SSSI No. 11 Tramway Ridge, Mount Erebus, Ross Island.

Annex to Measure 2 (1995): Management Plan for Site of Special Scientific Interest (SSSI) No. 11, Tramway Ridge, Mount Erebus, Ross Island

1. Description of Values to be Protected

The lower end of Tramway Ridge was originally designated in Recommendation XIII-8 (1985, SSSI No. 11) after a proposal by New Zealand on the grounds that the Area supports an unusual ecosystem of exceptional scientific value to botanists, physiologists, and microbiologists. Mount Erebus (3,794 meters) is one of only three known high-altitude localities of fumarolic activity and associated vegetation in the Antarctic. Tramway Ridge is an ice-free area of gently sloping warm ground 1.5 kilometers to the northwest of the main crater of Mount Erebus, located at an elevation of between 3,350 and 3,400 meters. The single, as yet unidentified, moss species found in the Area is unusual in that it persists in the protonematal stage. An unusual variety of a common thermophilic cyanobacterium is especially noteworthy. The plant communities which have developed on the fumarolic soils within the Area differ significantly from those found elsewhere in Antarctica. The regional uniqueness of the communities is of substantial scientific interest and value. The very limited geographical extent of the ecosystem, its unusual biological features, its exceptional scientific values, and the ease with which is could be disturbed through trampling or alien introductions are such that the Area requires long-term special protection.

2. Aims and Objectives

Management at Tramway Ridge aims to

- avoid degradation of, or substantial risk to, the values of the Area;
- prevent unnecessary human disturbance to the Area;
- permit research on the unique vegetation and microbial communities while ensuring they are protected from over-sampling;
- minimize the possibility of introduction of alien plants, animals, and microbes to the Area;
- preserve a part of the Area, which is declared a Restricted Zone, as a reference site for future studies;
- permit visits for management purposes in support of the objectives of the Management Plan.

3. Management Activities

The following management activities are to be undertaken to protect the values of the Area:

- Durable wind direction indicators should be erected close to the designated helicopter landing site whenever it is anticipated there will be a number of landings near the Area in a given season. These should be replaced as needed and removed when no longer required.
- Markers, which should be clearly visible from the air and pose no significant threat to the environment, should be placed to mark the helicopter landing pad.
- A line of flags should be placed to mark the preferred snowmobile route (Map A) between the USAP Upper and Lower Erebus Huts, which should pass no closer than 200 meters to the Area.
- Signs illustrating the location and boundaries and clearly stating entry restrictions shall be placed on posts marking the boundaries of the Area.
- Signs showing the location of the Area (stating the special restrictions that apply) shall be displayed prominently, and a copy of this Management Plan should be kept available, in all of the research hut facilities located close to the summit of Mount Erebus.
- Markers, signs, or structures erected within the Area for scientific or management purposes shall be maintained in good condition.
- Visits shall be made as necessary (no less than once every 5 years) to assess whether the Area continues to serve the purposes for which is was designated and to ensure management and maintenance measures are adequate.
- National antarctic programs operating in the region shall consult together with a view to ensuring these steps are carried out.

4. Period of Designation

Designated for an indefinite period.

5. Maps

[*Editor's note: Maps are not reprinted here. Please refer to the "Final Report of the Nineteenth Antarctic Treaty Consultative Meeting.*"]

Map A: Tramway Ridge, Mount Erebus, location image-map. Image is rectified by affine transformation, and scale is approximate. (Photography, USGS/DOSLI (SN7842) 11 November 1993.)

Map B: Tramway Ridge, protected area orthophotograph. Orthophoto and protected area boundary coordinates are tied to the Camp Area Plane Datum 1981, a local framework, using the WGS72 spheroid. Precise global positioning system coordinates for the site will differ: these were unavailable at the time of mapping. (Photography, U.S. Navy (SN6480) 9 February 1980.)

Map C: Tramway Ridge, protected area map. Contours are derived from a digital elevation model generated using a 10-meter grid for the orthophotograph in map B: accuracy ±2 meters. Precise area of warm ground is subject to variation seasonally and interannually.

Figure 1: Perspective view of the Tramway Ridge area from an elevation of 6,200 meters, 5,000 meters out from the Area at a bearing of 215°SW, showing the protected area boundary, the location of the USAP Erebus Huts, and the preferred helicopter landing site and snowmobile route. (Image source: map A.)

6. Description of the Area

6(i). *Geographical coordinates, boundary markers, and natural features*

The boundary of the designated Area is defined as a square of 200 meters by 200.8 meters which encompasses most of the warm-ground area of lower Tramway Ridge (77°31'05"S, 167°06'35"E; map B). The Area is divided into two parts of almost equal size, the northern half being a Restricted Zone. The boundaries of the Area and the Restricted Zone (marked by signposts at each corner) and prominent features are shown on map B. Several boundary signposts have been offset owing to dangerous ground at the actual corner point.

The Area is in general on a gentle slope of about 5°, with much of the ice-free ground in the form of terraces which have a typical vertical height of about 0.5 meters and steeper sides of up to 30° in slope. The steep sides of the terraces have the maximum development of crusts of vegetation, and it is from these sides that visible steam emissions occur. Visible vegetation covers about 16 percent of the Area. Low ice hummocks of up to about 1 meter high are distributed over the Area where steam has frozen. Surface ground temperatures are up to about 75°C.

The steam-warmed lithosols in the Area provide an unusual habitat of limited extent. The acid reaction of the soils, the constant supply of moisture by condensation of steam, and the regular supply of geothermal heat produce conditions which contrast markedly with most antarctic soils. There is no evidence of the presence of microinvertebrate animals in the soils. The vegetation comprises protonematal moss and diverse microalgae, which has developed on the fumarolic soils and differs significantly from other antarctic plant communities. The single moss species, which has not yet been identified, is unusual in that it has never been seen to produce leaves but persists in the protonematal stage. The vegetation occurs in zones related to surface temperature. Warmest ground, from about 35°C to 60°C, is colonized by dark blue-green and reddish-brown mats of cyanobacteria, whereas cooler surfaces of about 10°C to 30°C are dominated by green crusts of coccoid chlorophytes and moss protonema. Bare ground lacking a macroscopically visible vegetation occurs between 0°C and 20°C.

The algal flora comprises four cyanobacteria and 11 coccoid chlorophytes. The presence of a thermophilic cyanobacterium is especially noteworthy because it is an unusual variety of the hot-spring cyanobacterium *Mastigocladus laminosus*, which is common elsewhere in the world. Thermophilic bacteria have been isolated at 60°C. These include heterotrophic and a thiosulfate-utilizing autotrophic species.

6(ii). *Restricted Zones within the Area*

The northern half of the Area is designated a Restricted Zone in order to preserve part of the Area as a reference site for future comparative studies, whereas the southern half of the Area (which is essentially similar in biology, features, and character) is available for research programs and sample collection. The south boundary of the Restricted Zone is defined by a line that bisects the Area into two halves (map B) and is marked at both ends by signposts. This boundary may be identified on the ground approximately as an extension westward of the south ridge line of lower Tramway Ridge. The other three boundaries of the Restricted Zone are defined by the boundaries of the Area. Access to the Restricted Zone is strictly prohibited until such time it is agreed by Management Plan review that access should be allowed.

6(iii). *Location of structures within the Area*

Signposts mark the corner points of the boundaries. The USAP Lower and Upper Erebus Huts are located approximately 1 kilometer to the northeast (3,400 meters) and southeast (3,612.5 meters), respectively.

6(iv). *Location of other Protected Areas within close proximity*

None

7. Permit Conditions

Permits may be issued only by appropriate national authorities. Conditions for issuing a permit to enter the Area are that

- it is issued only for scientific study of the ecosystem or for a compelling scientific or management purpose that cannot be served elsewhere;
- access to the Restricted Zone shall be prohibited;
- the actions permitted are not likely to jeopardize the natural ecological system or scientific values of the Area;
- any management activities are in support of the objectives of the Management Plan;
- the actions permitted are in accordance with the Management Plan;
- any permit issued shall be valid for a stated period.

7(i). *Access to and movement within the Area*

Landing of helicopters within the Area is strictly prohibited. Helicopter overflight of the Area should be avoided, except for essential scientific or management purposes when helicopters shall in no instance fly lower than 30 meters above the ground surface of the Area. Use of helicopter smoke bombs is strictly prohibited within 200 meters of the Area and is discouraged nearby. For short-duration visits, which do not require camp establishment, access by helicopter should be to a designated landing site, located outside of the Area and 300 meters to the northwest (map A and figure 1). For visits which require camp establishment, helicopter access should be to the USAP Upper or Lower Erebus Huts, and thence on foot or by land vehicle to the edge of the Area at Tramway Ridge. Landing of helicopters at other sites close to the Area is strongly discouraged. Only those persons specifically authorized by permit are allowed to enter the Area. No special restrictions apply to the air or land routes used to move to and from the Area, although those traveling between the Upper and Lower Erebus Huts should keep to the preferred snowmobile route and stay at least 200 meters from the protected area boundary.

Access into the Area shall be on foot and land vehicles are prohibited. Visitors should avoid walking on visible vegetation and, as far as practicable, areas of warm ground. Visitors should be aware that walking in the Area can compact soil, alter temperature gradients (which may change rates of steam release), and break thin ice crusts which may form over warm ground, with resulting damage to soil and biota below. The presence of snow or ice surfaces is not a guaranteed indication of a suitable pathway: therefore, every reasonable effort should be made to minimize the effects of walking activity. Pedestrian traffic should be kept to the minimum necessary consistent with the objectives of any permitted activities.

7(ii). *Activities that are or may be conducted in the Area, including restrictions on time or place*

- Scientific research which will not jeopardize the ecosystem of the Area.
- Essential management activities, including monitoring.
- Entry to the Restricted Zone is prohibited.

7(iii). *Installation, modification, or removal of structures*

No structures, except boundary markers and signs, are to be erected within the Area except as specified in a permit. All scientific equipment installed in the Area must be approved by permit and clearly identified by country, name of the principal investigator, and year of installation. All such items should be made of materials that pose minimal risk of contamination of the Area. Removal of specific equipment for which the permit has expired shall be the responsibility of the authority which granted the original permit.

7(iv). *Location of field camps*

Camping required for work in the Area should be near the existing USAP Upper or Lower Erebus Hut sites and is discouraged anywhere within 500 meters of the boundaries of the Area (map A).

7(v). *Restrictions on materials and organisms which may be brought into the Area*

To avoid compromising the microbial ecosystem for which this site is protected, no living animals, plant material, or microorganisms shall be deliberately introduced into the Area and precautions shall be taken against accidental introductions. No herbicides or pesticides shall be brought into the Area. Any other chemicals, including radionuclides or stable isotopes, which may be introduced for scientific or management purposes specified in the permit, shall be removed from the Area at or before the conclusion of the activity for which the permit was granted.

Fuels are not to be brought into the Area. Food shall not be consumed within the Area. Equipment and other materials are not to be stored in the Area, unless required for essential purposes connected with the activity for which the permit has been granted. All such materials introduced shall be for a stated period only, shall be removed at or before the conclusion of that stated period, and shall be stored and handled so that risk of their introduction into the environment is minimized.

7(vi). *Taking of or harmful interference with native flora or fauna*

Taking of or harmful interference with native flora or fauna is prohibited, except in accordance with a permit. Where taking of animals or harmful interference is involved, this should be in accordance with the SCAR "Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica," as a minimum standard.

7(vii). *Collection and removal of anything not brought into the Area by the permit holder*

Material may be collected or removed from the Area only in accordance with a permit. Material of human origin, not brought into the Area by the permit holder, but which is likely to compromise the values of the Area, may be removed from any part of the Area, including the Restricted Zone.

7(viii). *Disposal of waste*

All wastes, including all human wastes, must be removed from the Area. Excretion of human wastes is prohibited within the Area.

7(ix). *Measures that may be necessary to ensure that the aims and objectives of the Management Plan continue to be met*

1. The permit, or an authorized copy, must be carried within the Area.
2. Permits may be granted to enter the Area to carry out biological monitoring and site inspection activities, which may involve the collection of small samples for analysis or audit, to erect or maintain signposts, or to carry out protective measures.
3. To help maintain the scientific value derived from the unique communities found at Tramway Ridge visitors shall take special precautions against introductions, especially when visiting several thermal regions in a season. Of particular concern are microbial or vegetation introductions sourced from
    - thermal areas, both antarctic and nonantarctic;
    - soils at any other antarctic sites, including those near stations;
    - soils from regions outside Antarctica.

   To this end, visitors shall take the following measures to minimize the risk of introductions:
   (a) Any sampling equipment or markers brought into the Area shall be sterilized and maintained in a sterile condition before being used within the Area. To the maximum extent practicable, footwear and other equipment used or brought into the Area (including backpacks or carry-bags) shall be thoroughly cleaned or sterilized and maintained in this condition before entering the Area;
   (b) Sterilization should be by an acceptable method, such as by ultraviolet light, autoclave, or by washing exposed surfaces in 70 percent ethanol solution in water.
   (c) Sterile protective overclothing shall be worn. The overclothing shall be suitable for working at temperatures of –20°C or below and comprise at a minimum sterile overalls to cover arms, legs, and body and sterile gloves suitable for placing over the top of cold-weather gloves.

7(x). *Requirements for reports*

Parties should ensure that the principal holder of each permit issued submits to the appropriate authority a report describing the activities undertaken. Such reports should include, as appropriate, the information identified in the "Visit Report Form" suggested by SCAR. Parties should maintain a record of such activities and, in the "Annual Exchange of Information," should provide summary descriptions of activities conducted by persons subject to their jurisdiction, in sufficient detail to allow evaluation of the effectiveness of the Management Plan. Parties should, wherever possible, deposit originals or copies of such original reports in a publicly accessible archive to maintain a record of usage, to be used both in any review of the Management Plan and in organizing the scientific use of the Area.

Measure 3 (1995): Antarctic Protected Area System: Specially Protected Areas

Specially Protected Area No. 24: Pointe Géologie Archipelago (*Geographic Names of the Antarctic* listing: Géologie Archipelago) (Jean Rostand, Alexis Carrel, Lamarck, and Claude Bernard Islands, Bon Docteur Nunatak)

The Representatives of the Consultative Parties,

Recalling Recommendation XV-8 and XV-9;

Noting that a Management Plan for the above Area has been approved by the Scientific Committee on Antarctic Research (SCAR);

Considering that the Point Géologie Archipelago is important as a representative area of considerable biological, geological, and aesthetic value; that it contains a high diversity of animals and plants and is an important area for scientific research; and that long-term research and monitoring programs on bird colonies and geology have been conducted in the area since 1952.

Recommend to their Governments the following Measure for approval in accordance with paragraph 4 of the Article IX of the Antarctic Treaty:

That the following area shall be inserted in Annex B, Specially Protected Areas, of the Agreed Measures for the Conservation of Antarctic Fauna and Flora, together with the annexed Management Plan: Specially Protected Area No. 24, Jean Rostand (*Geographic Names of the Antarctic* listing: Rostand Island), Alexis Carrel (*Geographic Names of the Antarctic* listing: Carrel Island), Lamarck, and Claude Bernard (*Geographic Names of the Antarctic* listing: Bernard Island) Islands, Bon Docteur Nunatak, and Breeding Marine Emperor Penguin Colony (66°39'30" to 66°40'30"S, 140° to 140°02'E) in the heart of Pointe Géologie Archipelago, coastal area of Adélie Land in the vicinity of Astrolabe Glacier.

Annex to Measure 3 (1995): Specially Protected Area No. 24, Pointe Géologie Archipelago, Jean Rostand, Alexis Carrel, Lamarck, and Claude Bernard Islands, Bon Docteur Nunatak, and Marine Emperor Penguins Breeding Colony, Management Plan

1. Description of Values to be Protected

Four islands and the breeding site of emperor penguins are proposed for a new Specially Protected Area on the ground that it provides a representative sample of aesthetic, biologic, and geologic values of terrestrial antarctic ecosystems.

One mammal species, Weddell seal (*Leptonychotes weddellii*) and various bird species are nesting here: emperor penguin (*Aptenodytes forsteri*), south polar skua (*Catharacta maccormicki*), Adélie penguin (*Pygoscelis adeliae*), Wilson's storm petrel (*Oceanites oceanicus*), southern giant petrel (*Macronectes giganteus*), snow petrel (*Pagodroma nivea*), and cape petrel (*Daption capensis*).

Well-marked hills display asymmetrical transverse profiles with gently dipping northern slopes compared to the steeper southern ones. The terrain is affected by many cracks and fractures leading to very rough surfaces. The basement rocks mainly consist of sillimanite, cordierite, and garnet-rich gneisses which are intruded by abundant dikes of pink anatexites. The lowest parts of the islands are covered by morainic boulders (a few centimeters to more than a meter across).

Long-term research and monitoring programs have been continuing a long time already (since 1952 or 1964 according to the species). A data base implemented in 1981 is directed by C.E.B.C. (Centre d'Etudes Biologiques de Chize).

The emperor penguins breeding colony is a Site of Special Scientific Interest which could further be included in the Convention on Conservation of Antarctic Marine Living Resources Environmental Monitoring Program (CCAMLR/CEMP) in order to achieve the Convention requirements.

2. Aims and Objectives

Management of Pointe Géologie area aims to

- prevent unnecessary disturbance on the Area face to the growing flux of cruising tourist ships.
- permit research of a compelling scientific nature which cannot be served elsewhere.
- avoid major change to the structure and composition of flora and fauna and the association of different species of vertebrates harbored in the Area, which therefore constitutes one of the most representative for both faunistic and scientific interest on Adélie coast.

- permit research on ethological, ecological, physiological, and biochemical programs in progress especially those related to demographic monitoring and impact assessment of surrounding human activities comprising tourism. Physiology and biochemistry programs relating to fasting mechanisms and thermogenesis of emperor penguins could be pursued in compliance with permit provisions.
- permit research in geology with a particular attention to the programmation of visits, especially when thermomechanical means for sampling are required.

3. Management Activities

The plan is kept under review to ensure that the values of the Area are wholly protected. Any direct management action to the Area would be subject to an environmental impact assessment before being undertaken.

Inspection visits are restricted to essential management purposes.

4. Period of Designation

The Area is designated for an indefinite period.

5. Maps

[*Editor's note: Maps are not reprinted here. Please refer to the "Final Report of the Nineteenth Antarctic Treaty Consultative Meeting.*"]

The map shows with dotted lines the location of each island and other zones of the Area inside Pointe Géologie Archipelago.

6. Description of the Area

6(i). *Geographical coordinates, boundary markers, and natural features*

Jean Rostand, Alexis Carrel, Lamarck, and Claude Bernard Islands, Bon Docteur Nunatak, and emperor penguins breeding colony are situated in the heart of Pointe Géologie Archipelago, coastal area of Adélie Land (66°39'30" to 66°40'30"S, 140° to 140°02'E;).

The Area consists of the southernmost rock exposure of the Pointe Géologie Archipelago, between Pétrel Island and the western edge of the Astrolabe glacier. It is a very large ice-free ground within Adélie Land.

As a whole, the surface of the outcropping rocks does not exceed 2 square kilometers. The highest points are distributed along northeast-southwest ridges (Bernard Island: 47.6 meters; Lamarck Island: 22.2 meters; Rostand Island: 36.39 meters; Carrel Island: 28.24 meters, and Bon Docteur Nunatak: 28.50 meters). During the summer, only the southern flanks of the islands are still covered by compressed snow caps. There are no boundary markers since natural features delimit the wholly protected islands. However, markers could further be set up in Bon Docteur Nunatak. No tracks of roads exist in the Area.

6(ii). *Restricted Zones within the Area*

Access to every part of the Area is prohibited unless authorized by a permit.

Location of breeding colonies is shown on the map. (See also table 1.) The birds are present on colonies from October to March, except emperor penguins which breed in winter (table 2). Their sensibility to human disturbance varies depending on the species (table 3). The implantation of the Dumont d'Urville station has resulted in a drastic decrease of the populations of emperor penguins and southern giant petrels in Point Géologie Archipelago. Since the last 10 years the breeding areas of these birds are protected and the populations are now consecutively stable (table 3).

No one, except permit holders, is allowed to approach or to disturb the emperor penguins colony in any manner, from mid-July to mid-December, when eggs are incubating and when the chicks fledge. The particularly sensitive emperor penguins are equally protected beyond the definite limits of their breeding area since the colony is not always located at the same place.

The southeastern part of Jean Rostand Island is designated as a Restricted Zone in order to preserve the remaining breeding colony of southern giant petrels. All access to the Restricted Zone is prohibited during the breeding period from August to February. The access is restricted to one ornithologist permit holder in order to monitor the population three times each year. The boundary off the Restricted Zone is defined by a 20-meter width buffer zone around the colony and is marked on the soil. The prohibition of access to the Restricted Zone shall

Table 1. Annual breeding pairs of seabirds in the French Specially Protected Area (SPA). The population breeding within the SPA is given compared to the Pointe Géologie (PG) population (from Thomas 1986).

Islands	Emperor penguin	Adélie penguin	South polar skua	Snow petrel	Cape petrel	Wilson's storm petrel	Southern giant petrel
Claude Bernard	—	3,421	5	153	192	178	—
Lamarck	—	1,007	1	38	15	45	—
Jean Rostand	—	4,793	3	53	18	35	11
Alexis Carrel	—	4,075	6	25	—	72	—
Nunatak	—	1,961	1	11	—	41	—
Emperor penguin breeding colony	3,119	—	—	—	—	—	—
Total	3,119	15,257	16	280	225	371	11
%SPA/PG	100	71	67	36	68	31	79

Table 2. Presence of birds on breeding colonies.

Islands	Emperor penguin	Adélie penguin	South polar skua	Snow petrel	Cape petrel	Wilson's storm petrel	Southern giant petrel
First arrival	March	October	October	September	October	November	July
First laying	May	November	November	November	November	December	October
Last departure	January	March	March	March	March	March	April

Table 3. Sensibility to human disturbance and status of the Pointe Géologie populations.

Islands	Emperor penguin	Adélie penguin	South polar skua	Snow petrel	Cape petrel	Wilson's storm petrel	Southern giant petrel
Sensibility to human disturbance	High	Medium	Low	Medium	High	High	High
Status 1952–1984	Decreasing	Increasing	Stable	?	?	?	Decreasing
Status 1984–1993	Stable	Increasing	Stable	Stable	Stable	?	Stable

be for an indefinite period but shall be subject to reevaluation each time the Management Plan is reviewed.

6(iii). *Location of structures within the Area*

Prevost hut and a shelter are located on Rostand Island. There are no other buildings anywhere else in the Area.

6(iv). *Location of other Protected Areas in close proximity*

The region nearby is being considered for an Antarctic Specially Managed Area (ASMA) including Dumont d'Urville Station and other surrounding areas of activities.

7. Permit Conditions

7(i). *Access to and movement within the Area*

No helicopters nor terrestrial vehicles are authorized either to access or to traverse within the Area. No overflight all over the Area, either by helicopters or other airplanes is authorized.

Access to the Area is therefore only permitted by foot or by zodiacs (in summer).

However, very rare departures of terrestrial vehicles from Bon Docteur Nunatak could be allowed, only when sea-ice conditions hinder from proceeding otherwise and with a special attention to the presence of birds in the Area.

Access to and movement within the Area shall, in any case, be limited and vigilant in order to avoid unnecessary disturbance to birds, especially by crossing their pathways, and to ensure that breeding areas or their access are not damaged or endangered.

7(ii). *Activities which are or may be conducted within the Area, including restrictions on time and place*

- Compelling scientific activities that cannot be conducted elsewhere and necessary management activities with regard to the special provisions relating to emperor penguins and the Restricted Zone of southern giant petrels (see 6.ii).
- Visitors granted entry in the Area by a permit shall ensure that no disturbance will occur from their visits to monitoring programs.

7(iii). *Installation, modification, or removal of structures*

No structures are to be erected in the Area or scientific equipment installed except for essential scientific or management activities as specified in the permit.

7(iv). *Location of field camps*

Only in the case of safety should tents be erected having regard to causing the least damage or disturbance to fauna.

7(v). *Restriction on materials and organisms which may be brought into the Area*

- No living animals or plant materials shall be deliberately introduced in the Area.
- No poultry products including food products containing uncooked dried eggs should be taken into the Area.
- No chemicals shall be brought into the Area, except chemicals which may be introduced for a compelling scientific purpose as specified in the permit. Any chemical introduced shall be removed from the Area at or before the conclusion of the activity for which the permit was granted.
- Fuel, food, and other materials are not to be deposited in the Area, unless required for essential purposes connected with the activity for which the permit has been granted. Such materials introduced are to be removed when no longer required. Permanent depots are not permitted.

7(vi). *Taking of or harmful interference with native flora and fauna*

Taking of or harmful interference with native flora and fauna is prohibited, except in accordance with a permit. Where animal taking or harmful interference is involved, this should be in accordance with SCAR "Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica," as a minimum standard.

7(vii). *Collection or removal of anything not brought into the Area by the permit holder*

Collection or removal of anything not brought into the Area by a permit holder is prohibited unless specified in permit for scientific or management purposes. However, debris of human origin may be removed from the Area and dead or pathological specimens of fauna or flora may be removed for laboratory examination.

7(viii). *Disposal of waste*

All nonhuman wastes shall be removed from the Area.

7(ix). *Measures that may be necessary to ensure that the aims and objectives of the Management Plan continue to be met*

Permits may be granted to enter the Area to carry out monitoring, other scientific programs, and site inspection activities, which may involve the collection of small amounts of biological materials and animals.

Permits shall specify the maximum number of persons allowed entry at any one time.

Visits to the Area should be kept to the minimum necessary to achieve the scientific and management objectives.

7(x). *Requirements for reports*

Parties should ensure that the principal holder of each permit issued submits to the appropriate authority a report describing the activities undertaken. Such reports should include, as appropriate, the information identified in the "Visit Report Form" suggested by SCAR. Parties should maintain a record of such activities and, in the "Annual Exchange of Information," should provide summary descriptions of activities conducted by persons subject to their jurisdiction, in sufficient detail to allow evaluation of the effectiveness of the Management Plan. Parties should, wherever possible, deposit originals or copies of such original reports in a publicly accessible archive to maintain a record of usage, to be used both in any review of the Management Plan and in organizing the scientific use of the Area.

Measure 4 (1995): Antarctic Protected Area System: New Historic Sites and Monuments

The Representatives of the Consultative Parties,

Recalling the Measures adopted in Recommendations I-IX, V-4, VI-14, VII-9, XII-7, XIII-16, and XIV-8;

Recommend to their Governments the following Measure for approval in accordance with paragraph 4 of Article IX of the Antarctic Treaty; 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.

- *Port Lockroy, Base A*, on Goudier Island, off Wiencke Island, Antarctic Peninsula (latitude 64°49'S, longitude 63°31'W). Of historic importance as an Operation Tabarin base and for scientific research.
- *Argentine Islands, Base F (Wordie House)*, southwest corner of Winter Island, one of the group known as the Argentine Islands (latitude 65°15'S, longitude 64°16'W). Of historic interest as an example of an early British scientific base.
- *Horseshoe Island, Base Y*, Marguerite Bay, west Graham Land (latitude 67°49'S, longitude 67°18'W). Noteworthy as a relatively unaltered and

completely equipped base of a later period. Blaiklock, the refuge hut nearby, is taken to be an integral part of the base.

- *Stonington Island, Base E*, northern end of Stonington Island, Marguerite Bay, west Graham Land (latitude 68°11'S, longitude 67°00'W). Of historical importance in the early period of exploration and later British Antarctic Survey history of the 1960s and 1970s.
- *Message Post, Svend Foyn Island* (*Geographic Names of the Antarctic* listing: Foyn Island). A pole with a box attached was placed on 16 January 1895 during the whaling expedition of Henryk Bull and Captain Leonard Kristensen of the ship *Antarctica*. It was examined and found intact by the British Antarctic Expedition of 1898–1900 and then sighted from the beach by the USS *Edisto* in 1956 and USCGC *Glacier* in 1965 (latitude approximately 71°52'S, longitude 171°10'E).
- *Prestrud's Cairn*, at the foot of main bluff Scott Nunataks, Queen Alexandra Mountains. A small rock cairn at the foot of the main bluff on the north side of the nunataks found by Lieutenant K. Prestrud on 3 December 1911 during the Norwegian Antarctic Expedition of 1910–1912 (latitude 77°12'S, longitude 154°30'W).
- *Rock Shelter "Granite House,"* Cape Geology, Granite Harbor. This shelter was constructed in December 1911 for use as a field kitchen by Taylor's second geological excursion during the British Antarctic Expedition of 1910–1913. It was enclosed on three sides with granite boulder walls and used as a sledge to form a roof tree which supported seal skins anchored by heavy rocks (latitude 77°00'S, longitude 162°32'E). A 1981 inspection of the "house" found it in good condition although the sledge had begun to disintegrate. The most recent visit to the site in 1990 reported that this deterioration was accelerating.
- *Depot, Hells Gate Moraine,* Inexpressible Island, Terra Nova Bay. An emergency depot, consisting of a sledge loaded with supplies and equipment, was placed on 25 January 1913 by the British Antarctic Expedition at the close of the 1910–1913 expedition. The depot was established by the crew of the *Terra Nova* to provide security in the event the ship was unable to return and pick them up (latitude 74°56'S, longitude 163°48'E). In 1994, the sledge and supplies were removed in order to stabilize their condition because wind and scoria particles had started to cause rapid deterioration.
- *Message Post, Cape Crozier*. Erected on 22 January 1902 by Captain Robert F. Scott's Discovery Expedition (the National Antarctic Expedition of 1901–1904) and consisting of a post to which a metal cylinder was attached containing an account of the expedition's movements. It was intended to provide information for the expedition relief ships (latitude 77°27'S, longitude 169°16'E). The message post, although weathered, still stands, its grain blasted into high relief by countless storms. The record cylinder no longer exists.
- *Message Post, Cape Wadworth,* Coulman Island. A metal cylinder nailed to a red pole 8 meters above sea level placed by Captain Robert F. Scott on 15 January 1902. He also painted the rocks behind the post red and white to make the spot more conspicuous (latitude 73°19'S, longitude 169°47'E).
- *Whalers Bay Whaling Station,* Whalers Bay, Deception Island. Established in 1906 by Captain Adolfo Andresen. Of historical importance as an example of an antarctic whaling station.

Measure 5 (1995): Historic Sites and Monuments: Amendment

The Representatives of the Consultative Parties,

Recalling Recommendations I-IX, VI-14, VII-9, XI-7, XIII-16, and XIV-8;

Recommend to their Governments the following Measure for approval in accordance with paragraph 4 of Article IX of the Antarctic Treaty:

> That an amendment of the description of Historic Site Number 14, which is contained in the "List of Historic Monuments Identified and Described by the Proposing Government or Governments" annexed to Recommendation VII-9, be amended to read:
>
> "Site Number 14: Inexpressible Island,
> Terra Nova Bay, Scott Coast
>
> Site of ice cave at Inexpressible Bay, Terra Nova Bay, constructed in March 1912 by Victor Campbell's Northern Party, British Antarctic Expedition, 1910–13 (Lat 70°54'S, Long 163°43'E). The Party spent the winter of 1912 in this ice cave."

Decisions

Decision 1 (1995): Measures, Decisions, and Resolutions

1. Measures

(a) A text which contains provisions intended to be legally binding once it has been approved by all the Antarctic Treaty Consultative Parties will be expressed as a Measure recommended for approval in accordance with paragraph 4 of Article IX of the Antarctic Treaty, and referred to as a "Measure."
(b) Measures will be numbered consecutively, followed by the year of adoption.

2. Decisions

(a) A decision taken at an Antarctic Treaty Consultative Meeting on an internal organizational matter will be operative at adoption or at such other time as may be specified, and will be referred to as a "Decision."
(b) Decisions will be numbered consecutively, followed by the year of adoption.

3. Resolutions

(a) A hortatory text adopted at an Antarctic Treaty Consultative Meeting will be contained in a Resolution.
(b) Resolutions will be numbered consecutively, followed by a year of adoption.

4. Final Reports of ATCMs

(a) Part II, Annex A of the Final Report of each Antarctic Treaty Consultative Meeting will contain the full text of Measures adopted at the Meeting.
(b) Part II, Annex B of the Final Report of each Antarctic Treaty Consultative Meeting will contain the full text of any Decisions adopted at that Meeting.
(c) Part II, Annex C of the Final Report of each Antarctic Treaty Consultative Meeting will contain the full text of any Resolutions adopted at that Meeting.

5. Nothing in this Decision affects in any way anything done by previous Antarctic Treaty Consultative Meetings.

6. This Decision will be operative at adoption.

Decision 2 (1995): Rules of Procedure: Amendment

Rule 24 of the Rules of Procedure, as amended at the XVIIth Antarctic Treaty Consultative Meeting, shall be replaced by the following.

> "Measures, Decisions, and Resolutions and Final Report
>
> 24. Without prejudice to Rule 21, Measures, Decisions, and Resolutions, as referred to in Decision 1 (1995), shall be adopted by the Representatives of all Consultative Parties present and will thereafter be subject to the provisions of Decision 1 (1995)."

Resolutions

Resolution 1 (1995): Strengthening Cooperation in Hydrographic Surveying and Charting of Antarctic Waters

The Representatives of the Consultative Parties,

Having noted that as an implementation of the Recommendation XV-19 the International Hydrographic Organization (IHO) has established within its Member States a Permanent Working Group on Cooperation in Antarctica (PWGCA) with the aim of coordinating hydrographic surveys and producing international nautical charts along the standards of the IHO;

Recognizing the significant step forward made by the IHO PWGCA, which has established a scheme of international (INT) charts to ensure safe navigation in antarctic waters;

Considering that the INT chart scheme for Antarctica has been agreed to by IHO Member States and that a number of them volunteered for chart production;

Considering that the PWGCA permanently liaises with SCAR for supporting scientific research which needs hydrographic products;

Noting that the IHO INT chart scheme for the antarctic region has the support of COMNAP;

Considering that the antarctic waters require a considerable effort in human resources and equipment to carry out hydrographic surveys adequate for nautical chart production,

Recommend that

1. All Consultative Parties with hydrographic surveying and charting capability in Antarctica are encouraged to stress nationally that their surveying and charting activities in Antarctica are being coordinated through the IHO's PWGCA. In particular, they should emphasize the INT chart scheme initiative and their national contribution to it, which international cooperation through the IHO implements Recommendation XV-19 of the XVth Antarctic Treaty Consultative Meeting, and emphasizes the international commitment and nature of their antarctic activities particularly when seeking national support for hydrographic surveying and charting priorities and budget.
2. That the IHO PWG on Antarctica should continue its endeavors to achieve comprehensive, updated coverage of hydrographic charting, as envisaged by Recommendation XV-19, through the INT chart scheme.

Resolution 2 (1995): Nuclear Waste Disposal

The Representatives,

Recalling the provisions of Article V of the Antarctic Treaty;

Recalling Recommendation VIII-12;

Aware that Article 4.6 of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal prohibits the export of hazardous wastes or other wastes for disposal within the area south of 60° south latitude, whether or not such wastes are subject to transboundary movement;

Aware also that, according to Article 1.3 of the Basel Convention, wastes which, as a result of being radioactive, are subject to other international control systems, applying specifically to radioactive materials, are excluded from the scope of this Convention;

Noting that in September 1994 the International Atomic Energy Agency's General Conference adopted a resolution inviting the Board of Governors and the Director General to commence preparations for a convention on the safety of radioactive waste management;

Urge their Governments to

Coordinate their positions in any negotiations relating to the disposal of nuclear wastes in which they participate, with the objective of the inclusion of provisions prohibiting the transfer of nuclear waste to and the disposal of nuclear waste in the Antarctic Treaty Area.

Resolution 3 (1995): Reporting of Tourism and Non-Governmental Activities

The Representatives:

Considering that there would be an advantage in standardized reporting of information on tourism and non-governmental activities;

Noting that Attachment A to ATCM Recommendation XVIII-1 outlines the requirements for advance notice of tourism and non-governmental activities but does not outline requirements for postactivity reports;

Acknowledging that there are obligations of national legislation such as environmental impact assessment and reporting that must be met by tourist and non-governmental operators;

Recommend that

Tourist and non-governmental operators when reporting on visits to Antarctica should provide the following information to the relevant national authorities:

1. Name, details, and state of registration of each vessel
2. Name of captain or commander of each vessel
3. Name and organization of observer/Government representative (if present)
4. Actual itinerary
5. Number and nationalities of passengers, staff, and crew
6. Places, dates, and duration of ship landings, small boat cruises and/or flights, and the number of visitors landed
7. WMO meteorological report (yes/no)
8. Action taken in the event of an emergency
9. Comments (e.g., impacts observed, changes to planned itinerary)

Resolution 4 (1995): Fuel Storage and Handling

The Representatives,

Noting advice in inspection reports that fuel storage facilities and fuel transfer practices are the components of station activities with the greatest potential for causing significant adverse impacts;

Recalling that pending its entry into force the parties have committed themselves to implement the Protocol on Environmental Protection to the Antarctic Treaty to the extent practicable; and,

Acknowledging that Article 3 of the Protocol provides that activities in the Antarctic Treaty area shall be planned and conducted so as to limit adverse impacts on the antarctic environment and dependent and associated ecosystems;

Recommend that

The Consultative Parties ask COMNAP, through their members, to identify steps that could be taken to improve fuel storage and handling and that this item be included on the Agenda for the next ATCM.

Resolution 5 (1995): Antarctic Inspection Checklists

The Representatives:

Considering that inspection checklists are useful as guidelines for those planning and conducting inspections under Article VII of the Antarctic Treaty and in assessing implementation of the provisions of the Environmental Protocol pending its entry into force;

Noting that inspection checklists are not mandatory and are not to be used as a questionnaire;

Recommend that

The Consultative Parties should encourage the use of the checklists attached:

- Checklist A—Permanent Antarctic Stations and Associated Installations
- Checklist B—Vessels Within the Antarctic Treaty Area
- Checklist C—Abandoned Antarctic Stations and Associated Installations
- Checklist D—Waste Disposal Sites

Antarctic Inspection Checklists

These checklists, which are not intended to be exhaustive, are designed to provide a guideline to observers conducting inspections in Antarctica in accordance with the provisions of Article VII of the Antarctic Treaty.

Not all items in the checklists are necessarily applicable to the activity being inspected or directly related to Article VII of the Antarctic Treaty or the requirements of the Protocol on Environmental Protection to the Antarctic Treaty. It is recognized that some of the items could be addressed through the Antarctic Treaty Exchange of Information. It is also recognized that the purpose of an inspection is to verify through observation. Therefore, any inspection report should clearly identify which information was observed and which was taken from documents.

It is recommended that observers seek out and examine all relevant documents prior to undertaking inspections, including the Antarctic Treaty Exchange of Information, the relevant national Annual Reports to SCAR, and the COMNAP/SCALOP Advance Exchange of Information.

Checklist A—Permanent Antarctic Stations and Associated Installations

1. General information
    - 1.1 Name of station visited
    - 1.2 Operating nation
    - 1.3 Location
    - 1.4 Date established
    - 1.5 Primary aim of the station (scientific, logistic, etc.)
    - 1.6 Plans for future use of the station
    - 1.7 International logistic cooperation
    - 1.8 Availability of the Antarctic Treaty Exchange of Information
2. Inspection details
    - 2.1 Date
    - 2.2 Time of visit
    - 2.3 Duration of visit
    - 2.4 Last inspection [nation(s), date]
3. Personnel
    - 3.1 Name of person in charge
    - 3.2 Total number of personnel on station
    - 3.3 Number of scientists on station
    - 3.4 Number of over-wintering personnel
    - 3.5 Maximum capacity of station
    - 3.6 Responsible agencies or ministries
    - 3.7 Training (survival, first-aid, environmental protection, etc.)
4. Scientific research
    - 4.1 Major scientific programs supported by the station
    - 4.2 Dedicated permanent scientific facilities on the station
    - 4.3 Number and nationality of exchange scientists from other antarctic programs
    - 4.4 Advance notice, use, and control of radioisotopes
5. Physical description of station
    - 5.1 Area covered by station
    - 5.2 Approximate number and type of buildings
    - 5.3 Age and state of buildings
    - 5.4 New or recent construction
    - 5.5 Sketch or map of buildings
    - 5.6 Major aerial systems
    - 5.7 Landing or dock facilities
    - 5.8 Roads
    - 5.9 Airstrips
    - 5.10 Helipads
    - 5.11 Nearby facilities (refuges, field huts, etc.)
6. Communications
    - 6.1 Communication facilities
7. Transport
    - 7.1 Number and type of ground vehicles
    - 7.2 Number and type of small boats
    - 7.3 Number and type of fixed- and rotary-wing aircraft
    - 7.4 Number of aircraft movements per year
    - 7.5 Cargo-handling and earth-moving equipment
    - 7.6 Frequency and method of resupply
8. Station facilities—Fuel storage/usage
    - 8.1 Types, amount, and use of fuel (diesel, petrol, aviation fuel, etc.)
    - 8.2 Types and capacity of station storage containers
    - 8.3 Monitoring of fuel pumping systems and storage tanks (method)
    - 8.4 Background information on fuel pipe-work (material, above ground, gravity feed, valves, etc.)
    - 8.5 Transfer of bulk fuel (include transfer method)
    - 8.6 Methods of emptying fuel lines (gravity, compressed air, etc.)
    - 8.7 Field fuel depots (quantity and type)
    - 8.8 Responsibility for fuel management
    - 8.9 Protection against leaks and spills
9. Station facilities—Water system
    - 9.1 Type of water supply and storage facility (RO, distillation, snow melt, chemical treatment, etc.)
    - 9.2 Availability and quality of water supply
    - 9.3 Consumption of water per person/day
10. Station facilities—Power generation
    - 10.1 Number, type, and capacity of generators
    - 10.2 Annual fuel consumption for power generation (tones)
    - 10.3 Alternative energy sources
    - 10.4 Filtering and monitoring of emissions
11. Station facilities—Medical
    - 11.1 Medical facilities and personnel
    - 11.2 Number of patient beds
12. Station facilities—Hazardous chemicals
    - 12.1 Types and quantities of chemicals
    - 12.2 Storage and monitoring arrangements
    - 12.3 Protection against leaks and spills
13. Firearms/explosives
    - 13.1 Number, type, and purpose of firearms and ammunition
    - 13.2 Amount, type, and use of explosives
    - 13.3 Storage of explosives and method of disposal
14. Military support activities
    - 14.1 Describe any military support to the station
    - 14.2 Details of military equipment held at station
15. Antarctic Treaty legislation
    - 15.1 Understanding of the provisions of the Antarctic Treaty and related agreements
    - 15.2 Availability of Antarctic Treaty documentation on station
16. Emergency response capability
    - 16.1 General
        - a. Search-and-rescue capability
        - b. Incidents in the last year resulting in significant damage to station facilities or the environment
        - c. Method of reporting incidents
    - 16.2 Medical
        - a. Mobile medical emergency response capability
        - b. Evacuation plan for medical emergencies

16.3 Fire
   a. Fire emergency plan
   b. Fire-fighting equipment
   c. Training of personnel for fire fighting
   d. Fire-fighting exercises (frequency)
16.4 Pollution (oil and chemical spills)
   a. Risk assessment for spills
   b. Spill response plan
   c. Training of personnel to deal with spills
   d. Spill response exercises (frequency)
   e. Mobile spill response capability

17. Environmental impact assessment (EIA)
   17.1 Awareness of station management personnel of the requirement to conduct an EIA for all new activities
   17.2 EIAs prepared for activities currently being undertaken
   17.3 Environmental monitoring of indicators of possible environmental impacts of the station or associated activities
18. Conservation of flora and fauna
   18.1 Methods of making station personnel aware of the rules relating to the conservation of antarctic flora and fauna
   18.2 Details of any native mammals, birds, or invertebrates that have been killed, injured, captured, handled, molested, or disturbed during the past year; methods used to kill, capture, or handle animals; issue of permits and reasons for their issue
   18.3 Harmful interference with animals and plants in the vicinity of the base; issue of permits and reasons for their issue
   18.4 Nonindigenous animals or plant species present; issue of permits and reasons for their issue
   18.5 Actions taken to avoid accidental introduction of nonindigenous species
   18.6 Nearby, important wildlife or plant sites
   18.7 Local guidelines controlling the use of aircraft and vehicles close to concentrations of wildlife
19. Waste management
   19.1 Waste management plan for the separation, reduction, collection, storage, and disposal of wastes
   19.2 Responsibility for waste management on the station
   19.3 Production of an annual waste management report
   19.4 Training of personnel in waste management and the need to minimize the impact of wastes on the environment
   19.5 Publicly displayed notices concerning waste management
   19.6 Current waste disposal methods:
      a. Radioactive materials
      b. Electrical batteries
      c. Fuel (both liquid and solid) and lubricants
      d. Wastes containing harmful levels of heavy metals or acutely toxic or harmful persistent compounds
      e. Polyvinyl chloride (PVC), polyurethane foam, polystyrene foam, rubber
      f. Other plastics
      g. Treated wood
      h. Fuel drums
      i. Other solid, noncombustible wastes
      j. Organic wastes
         — Residues of carcasses of imported animals
         — Laboratory cultures of microorganisms and plant pathogens
         — Introduced avian products
         — Other organic wastes (food waste, etc.)
      k. Sewage and domestic liquid wastes
      l. Waste produced by field parties
   19.7 Production of waste per person per day
   19.8 Use of open burning; disposal of ash; alternatives planned for by 1998–1999
   19.9 Use of incineration; disposal of ash; control and monitoring of emissions
   19.10 Treatment of sewage and domestic liquid wastes; monitoring of effluent
   19.11 Use of landfill or ice pit
   19.12 Recycling of wastes
   19.13 Measures taken to prevent wastes which are to be removed from the Treaty area being dispersed by wind or accessed by scavengers
   19.14 Inventory of the locations of past activities (abandoned bases, old fuel depots, etc.)
   19.15 Clean-up of past activities and future plans
20. Management of protected areas
   20.1 Protected area(s) in the vicinity of, or containing, the station (type, name, site number)
   20.2 Relevant management plans and maps of protected areas held on the station
   20.3 Entry by station personnel to protected areas within the past year; issue of permits and reasons for their issue
   20.4 Problems with station personnel or visitors not observing the restrictions of protected areas
   20.5 Marking of the protected area(s) in the vicinity of, or containing, the station
   20.6 Monitoring or management of protected areas
   20.7 Information as to whether the protected areas continue to serve the purpose for which they were designated
   20.8 Additional steps that should be taken to protect the areas
21. Tourist and non-governmental activities
   21.1 Visits to the station by tourists or non-governmental expeditions during the past year
      — Total number of people
      — Number ashore at any one time
      — Number of cruise ships
      — Number of yachts
      — Number of aircraft
   21.2 Procedures developed to facilitate or control tourist and non-governmental activities
   21.3 Advance permission required for visits to the station
   21.4 Operational problems for the station caused by visitors (unannounced visits, etc.)
   21.5 Environmental impact of visitors at the station or nearby

Checklist B—Vessels Within the Antarctic Treaty Area

Observers undertaking an inspection of a vessel in the Antarctic Treaty Area should bear in mind that

i) only a vessel flying the flag of a Treaty Party can be inspected;
ii) an inspection can only be undertaken under the terms of Article VII (3) of the Antarctic Treaty which states that inspections can only be carried out at points of discharging or embarking cargoes or personnel in Antarctica, and;
iii) Article VI of the Antarctic Treaty safeguards High Sea rights under international law within the Antarctic Treaty Area.

Inspections which are not in accord with (i) and (ii) above, including inspections of vehicles chartered by Treaty Parties, can only be carried out with the explicit consent of the master of the vessel.

1. General information
   1.1 Name of ship visited
   1.2 Radio call sign
   1.3 State and/or Port of Registration
   1.4 Owner, manager, and/or charterer of vessel
   1.5 Ship type (general cargo, scientific research, etc.)
   1.6 Date launched, if known
   1.7 Primary activity of vessel at time of inspection (scientific research, logistic support, tourism, etc.)
   1.8 Planned itinerary
   1.9 Expected length of annual operating period in the Antarctic
   1.10 Area of operation in the Antarctic in past year
   1.11 International logistic cooperation
   1.12 Presence of mandatory documentation (e.g., IMO inspection reports)
2. Inspection details
   2.1 Date
   2.2 Time of visit

- 2.3 Location of visit
- 2.4 Duration of visit
- 2.5 Last inspection [nation(s), date]
- 2.6 Persons conducting inspection

3. Personnel
   - 3.1 Name of captain
   - 3.2 Name of expedition leader or person in charge
   - 3.3 Total number of personnel onboard
     - — Crew (e.g., captain, officers, crew, and catering staff)
     - — Staff (e.g., scientists, expedition or tour staff, helicopter pilots)
     - — Passengers (e.g., members of the expedition that are not crew or staff)
   - 3.4 Maximum accommodation capacity of vessel
   - 3.5 Previous antarctic experience of captain and deck officers
   - 3.6 Previous antarctic experience of other crew and staff
   - 3.7 Training of crew, staff, and passengers (safety, life-boat drills, emergency response, etc.)
4. Scientific research
   - 4.1 Principal scientific programs undertaken by the vessel
   - 4.2 Dedicated scientific facilities on the vessel
   - 4.3 Number of research cruises planned during the season
   - 4.4 Number and nationality of scientists
   - 4.5 Advance notice, use, and control of radioisotopes
5. Physical description of vessel
   - 5.1 Basic dimensions (gross tonnage, length, beam, draught, etc.)
   - 5.2 Marine classification, including ice strengthening classification
6. Navigation aids
   - 6.1 Navigation aids and equipment [radar, sonar, depth sounding equipment, weather facsimile receiver, weather/ice satellite picture facilities, global positioning system (GPS) or similar]
   - 6.2 Back-up or emergency equipment carried
   - 6.3 Availability and currency of hydrographic charts
   - 6.4 Availability and currency of antarctic pilot reference material
7. Communications
   - 7.1 Communication facilities
   - 7.2 Presence of emergency beacons (EPIRBS, etc.)
8. Transport
   - 8.1 Type and number of small craft (landing craft, inflatables, survey launches, etc.)
   - 8.2 Total capacity of lifeboats and liferafts; whether lifeboats are motorized, open or enclosed, and covered by a relevant survey certificate
   - 8.3 Type and number of helicopters
   - 8.4 Number of helicopter movements per antarctic season
9. Vessel facilities—General cargo
   - 9.1 General cargo—types, amount
   - 9.2 Presence and use of Cargo Record Book
   - 9.3 Cargo handling equipment
   - 9.4 Frequency and method of resupply to shore stations
10. Vessel facilities—Fuel bunkers and cargo
    - 10.1 Fuel bunkers—types, amount and use of fuel (marine gas oil, petrol, etc.)
    - 10.2 Fuel cargo—types, amount (aviation fuel, etc.)
    - 10.3 Types and capacity of fuel tanks; use of double-bottomed tanks
    - 10.4 Deck storage or fuel
    - 10.5 Prevention and protection against leaks and spills
    - 10.6 Monitoring of fuel pumping systems and storage tanks (method)
    - 10.7 Transfer of bulk fuel (include transfer method)
    - 10.8 Responsibility for fuel management
    - 10.9 Processing of oily water (oily water separator, direct to storage tanks, etc.)
    - 10.10 Capacity to retain onboard all oily waste whilst in the Antarctic Treaty Area
    - 10.11 Presence and use of Oil Record Book
11. Vessel facilities—Engines and power generation
    - 11.1 Number, type, and capacity of engines and generators
    - 11.2 Subsidiary propulsion (bow and/or stern thrusters, etc.)
    - 11.3 Daily fuel consumption of engines and power generation (tons)
    - 11.4 Filtering and monitoring of engine emissions (method)
12. Vessel facilities—Medical
    - 12.1 Medical facilities (e.g., number of patient beds)
    - 12.2 Medical personnel
13. Vessel facilities—Hazardous substances
    - 13.1 Responsibility for management of hazardous substances
    - 13.2 Types and quantities of hazardous substances being transported or used onboard ship
    - 13.3 Storage and monitoring arrangements
    - 13.4 Protection against leaks and spills
14. Firearms/explosives
    - 14.1 Number, type, and purpose of firearms and ammunition
    - 14.2 Amount, type, and purpose of explosives
    - 14.3 Storage of explosives and method of disposal
15. Military support activities
    - 15.1 Describe any military support to the vessel (e.g., personnel)
    - 15.2 Details of military equipment held on the vessel
16. Antarctic Treaty System legislation
    - 16.1 Availability of Antarctic Treaty System documentation on the vessel
    - 16.2 Understanding and application of the provisions of the Antarctic Treaty and related agreements
17. Emergency response capability
    - 17.1 General
      - a. Search-and-rescue capability
      - b. Incidents in the current antarctic season resulting in damage to the vessel or impact on the antarctic environment
      - c. Method of reporting incidents
    - 17.2 Medical
      - a. Evacuation plan for medical emergencies
      - b. Ship's capacity to mobilize in support of medical emergencies elsewhere
    - 17.3 Fire
      - a. Fire emergency plan
      - b. Fire-fighting equipment
      - c. Training of personnel for fire fighting
      - d. Fire-fighting exercises (frequency)
    - 17.4 Pollution (oil and chemical spills)
      - a. Shipboard oil pollution contingency plan
      - b. Spill response materials and equipment available onboard
      - c. Training of personnel to deal with spills
      - d. Spill-response exercises (frequency)
      - e. Ship's capacity to mobilize in support of spill response elsewhere
18. Environmental impact assessment (EIA)
    - 18.1 Awareness of captain (and deck officers), and chief scientist and/or expedition leader of EIA
    - 18.2 EIAs prepared for activities currently being undertaken (e.g., research cruise)
    - 18.3 Environmental monitoring of activities undertaken by the vessel (e.g., monitoring of seismic surveys)
19. Conservation of flora and fauna
    - 19.1 Methods of making crew, staff, and passengers aware of prohibited activities and guidelines relating to the conservation of antarctic flora and fauna
    - 19.2 Vessel guidelines regarding the use of aircraft, small boats, and ship's personnel close to concentrations of wildlife
    - 19.3 Details of any native mammals, birds, or invertebrates that have been killed, injured, captured, handled, or disturbed during the past year; methods used to kill, capture, and or handle animals; issue of permits and reasons for their issue
    - 19.4 Harmful interference with animals and plants due to vessel activities; issue or permits and reasons for their issue
    - 19.5 Whether nonindigenous animals or plants carried onboard the vessel (dogs, birds, ornamental plants, etc.)
    - 19.6 Actions taken to avoid accidental introduction of nonindigenous species (animals, plants, microorganisms)
20. Waste management

20.1 Waste management plan for the separation, reduction, collection, storage, and disposal of wastes
20.2 Responsibility for waste management on the vessel
20.3 Availability of an up-to-date waste management report
20.4 Training of crew, staff, and passengers in waste minimization and management and the need to minimize the impact of shipboard wastes on the environment
20.5 Publicly displayed notices concerning waste management practices onboard
20.6 Current waste disposal methods:
  a. Radioactive materials
  b. Electrical batteries
  c. Fuel (both liquid and solid) and lubricants
  d. Wastes containing harmful levels of heavy metals or acutely toxic or harmful persistent compounds
  e. Polyvinyl chloride (PVC), polyurethane foam, polystyrene foam, rubber
  f. Other plastics
  g. Treated wood
  h. Fuel drums
  i. Other solid, noncombustible wastes
  j. Organic wastes
    — Residues of carcasses of imported animals
    — Laboratory cultures of microorganisms and plant pathogens
    — Introduced avian products
    — Other organic wastes (food wastes, etc.)
  k. Sewage and domestic liquid wastes
  l. Waste produced by field parties
20.7 Adequate storage space onboard to retain all wastes onboard whilst in the Treaty Area
20.8 Equipment for waste management (compactors, shredders, comminuters, etc.)
20.9 Type of incineration; disposal of ash; control and monitoring of emissions
20.10 Type of sewage treatment; disposal of sludge; presence and currency of sewage record book
20.11 Recycling of wastes
20.12 Whether contractual arrangements have been made for the use of Port Reception facilities

21. Management of protected areas
  21.1 Responsibility for ensuring compliance with management plans for protected areas
  21.2 Current management plans and maps of relevant protected areas held on the vessel
  21.3 Entry by crew, staff, or passengers to protected areas during the current antarctic season; issue of permits and reasons for their issue
  21.4 Problems with crew, staff, or passengers not observing the restrictions of protected areas (e.g., lack of supervision)
  21.5 Monitoring or management of protected areas

22. Tourist and non-governmental activities
  22.1 Advance notification provided as required under the Antarctic Treaty
  22.2 Number of tourist or non-governmental expedition cruises already undertaken or planned by the vessel in the current antarctic season
  22.3 Location, date, number, and nationality of research stations visited
  22.4 Location, date, and number of wildlife or other sites visited
  22.5 Total number of tourists or expedition personnel carried
  22.6 Number of tourists ashore at any one time
  22.7 Normal ratio of staff to tourists during visits ashore
  22.8 Procedures used to facilitate and control tourist and non-governmental activities, in implementation of Recommendation XVIII-1
  22.9 Indications of environmental impact of crew, staff, and passenger during visits ashore
  22.10 Affiliation of tour organizer, ship owner, or operator to any tourism association (e.g., International Association of Antarctic Tour Operators)

Checklist C—Abandoned Antarctic Stations and Associated Installations

This checklist is designed for abandoned antarctic stations and associated installations which are considered to be stations which have been given up altogether and are now unused. The checklist does not cover stations which are operated each summer or infrequently used over a number of years.

1. General information
  1.1 Name of station visited
  1.2 Location
  1.3 Nation responsible, if known
  1.4 Date established, if known
  1.5 Date abandoned, if known
  1.6 Reason for abandonment, if known
  1.7 Plans for future use of the station, if known
  1.8 Plans to clean up the station, if known
2. Inspection details
  2.1 Date
  2.2 Time of visit
  2.3 Duration of visit
  2.4 Last inspection [nation(s), date]
  2.5 Persons conducting inspection, if known
3. Physical description of station
  3.1 Area covered by station
  3.2 Number and type of buildings
  3.3 Sketch or map of buildings
  3.4 Age and state of buildings (structural damage, state of roofing, state of fittings and fixtures, condition of internal walls and floors, internal accumulation of snow, ice, etc.)
  3.5 Hazards to visitors (dangerous buildings, materials, or wastes)
  3.6 Notable historic buildings, facilities, or artifacts
  3.7 Evidence of measures to conserve notable historic buildings, facilities, or artifacts
  3.8 Signs of theft or vandalism, including graffiti
  3.9 Use of information signs (interpretation, unsafe buildings, toxic waste, etc.)
  3.10 Major aerial/antennae systems (structural damage, etc.)
  3.11 Landing or dock facilities
  3.12 Roads
  3.13 Airstrips and associated facilities (markers, windsocks, hangars, tie-downs, etc.)
  3.14 Helipads and associated facilities (markers, windsocks, hangars, tie-downs, etc.)
  3.15 Nearby facilities (refuges, field huts, etc.)
4. Station facilities—Fuel
  4.1 Types, quantity, and location of fuel (diesel, petrol, aviation fuel, etc.)
  4.2 Type and condition of storage containers (drums, tanks, etc.)
  4.3 Existence and condition of bunding and other spill containment facilities
  4.4 Evidence of leaks and spills and their environmental impact
5. Station facilities—Hazardous substances
  5.1 Types, quantities, and location of hazardous substances (e.g., chemicals)
  5.2 Type and condition of storage facilities buildings, drums, tanks, etc.)
  5.3 Evidence of leaks and spills and their environmental impact
6. Station facilities—Emergency supplies
  (*Do not break open supplies; if sealed, contact national program*.)
  6.1 List and location of emergency supplies
  6.2 Capacity and condition of emergency accommodation
  6.3 Types, quantities, and condition of food supplies
  6.4 Cooking equipment
  6.5 Availability and quality of water supply
  6.6 Heating and generating plant (heaters, stoves, etc.)
  6.7 Sleeping bags and blankets
  6.8 Communications (emergency radio, etc.)
  6.9 Medical supplies
  6.10 Clothing

7. Environmental impact assessment (EIA)
    7.1 EIAs prepared for station (clean-up activity, removal of redundant structures, etc.)
    7.2 Environmental monitoring of remedial activities undertaken at the station (e.g., hydrocarbon contamination of soils)
8. Conservation of flora and fauna
    8.1 Areas of water (lakes, streams) which could be affected by the station (fuel spill, dispersion of waste, etc.)
    8.2 Description of flora near the station (moss banks, etc.)
    8.3 Description of fauna near the station (seabird colonies, seal haul-out sites, etc.)
    8.4 Scientific research carried out nearby which could be affected by the station (fuel spill, dispersion of waste, etc.)
    8.5 Potential hazards to wildlife (loose wire, aerials/antennae, broken glass, leaking fuel drums, etc.)
    8.6 Indications of impact of the station on local wildlife (animals entangled, etc.) and any remedial action taken
    8.7 Colonization of station site by wildlife (species, numbers, etc.)
    8.8 Entry by wildlife into buildings
9. Waste
    9.1 Types, quantities, condition, and location of wastes (empty fuel drums, etc.); if a waste disposal site is found, then use the Waste Disposal Site Inspection Checklist.
    9.2 Type and quantities of scattered debris
    9.3 Evidence of measures to maintain the site and prevent dispersal of wastes
    9.4 Evidence of clean-up activities or the removal of structures
10. Protected areas
    10.1 Protected areas including or near the station (type, name, site number)
    10.2 Marking of protected area(s) in the vicinity of, or containing, the station
    10.3 Evidence of monitoring or management of protected areas
    10.4 Impact of station on protected areas
11. Tourist and non-governmental activities
    11.1 Evidence of visits to the station during the past year, and possible origin of these visits
    11.2 Indications of environmental impact of visitors at the station or nearby

Checklist D—Waste Disposal Sites

1. General information
    1.1 Name of site (if any)
    1.2 Location (geographical coordinates)
    1.3 Map or sketch of site in relation to nearby landmarks
    1.4 Description of waste disposal site (include general topography and area covered)
    1.5 Estimate of total area and volume of the waste disposal site
    1.6 Description of substrate of the waste disposal site
    1.7 Nation responsible for site, if known
2. Inspection details
    2.1 Date
    2.2 Time of visit
    2.3 Duration of visit
    2.4 Persons conducting inspection
    2.5 Last inspection [nation(s), date]
3. Physical description of waste disposal site
    3.1 Is the site marked? How?
    3.2 Has the waste been covered by soil or rock?
    3.3 Are there any unused or unusable buildings at the site?
    3.4 Areas of water around waste disposal site, including distance of the site from sea and freshwater bodies and possible drainage into these areas
    3.5 Distribution and description of flora near waste disposal site
    3.6 Distribution and description of fauna near the waste disposal site (seabird colonies, skua, and other scavengers' nests, seal haul-out sites)
    3.7 Scientific research carried out near the waste disposal site
    3.8 Means of containment, including means of avoiding scattering by wind and run off
4. Contents of waste disposal site
    4.1 Estimate of contents
    4.2 Age and state of contents
    4.3 Types and quantities of:
        a. Radioactive materials
        b. Electrical batteries
        c. Fuel (both liquid and solid) and lubricants
        d. Fuel drums
        e. Gas cylinders
        f. Wastes containing heavy metals or toxic substances
        g. Polyvinyl chloride (PVC), foam, polystyrene, rubber, plastics
        h. Treated wood
        i. Other hazardous materials (medical wastes, broken glass, wire, etc.)
        j. Other solid noncombustible wastes
        k. Organic wastes (bones, nonnative plant material, etc.)
        l. Sewage and domestic liquid wastes
        m. Indications of soil from outside Antarctica
5. Any evidence of environmental impacts of waste disposal site
    5.1 Current impacts, e.g.:
        a. Birds scavenging
        b. Contamination of soil
        c. Wind-scattered debris
        d. Run-off, seepage, oil slicks
        e. Smell
        f. Dead vegetation
        g. Dead, injured, sick, or contaminated native birds or other animals
        h. Potential for microbial contamination
    5.2 Possible future impacts, e.g., oil seeping into the ground
    5.3 Are there any sensitive sites nearby, that may be vulnerable to impacts? e.g., wildlife habitat
6. Evidence of environmental assessment and/or corrective and preventive measures
    6.1 Is the site included in a Waste Management Plan?
    6.2 What measures have been taken to rehabilitate the site or prevent dispersal of wastes? Written or physical evidence of these measures.
    6.3 Has a contaminated site assessment been done on the waste disposal site; is the report available?
    6.4 Has an EIA or EIAs been prepared on removal of the waste disposal site (clean-up, removal of toxic materials, etc.)
    6.5 Are the waste disposal site and nearby areas being monitored to verify that no hazardous substances are being dispersed and their contents do not pose a hazard to human health or the environment (e.g., monitoring of hydrocarbon, heavy metal, or microbial contamination of soil, ground water, or meltwater)?
7. Future plans
    7.1 Future plans for the site, for cleaning up, analyzing environmental effects, and minimizing environmental effects
    7.2 Heritage/historic considerations which might need to be taken into account before removal
    7.3 Priority of action, that is, urgency of clean-up action
    7.4 Recommendations for additional steps that should be taken to manage the impacts of the waste disposal site and protect adjacent areas

Resolution 6 (1995): Environmental Impact Assessment (EIA): Circulation of Information

The Representatives of the Consultative Parties,

Recalling Articles III and VII of the Antarctic Treaty and Articles 3.6(2) and 17 of the Protocol on Environmental Protection to the Antarctic Treaty;

Noting that numerous recommendations of Consultative Meetings have established requirements for exchange of information between Governments;

Noting also that Annex 1 to the Protocol creates further obligations to exchange information annually, including information on Initial Environmental Evaluations and Comprehensive Environmental Evaluations;

Desirous that such information should be easily accessible and in a comprehensive and uniform format so that the scale and trend of activities and developments in Antarctica can be readily monitored;

Recommend that

1. The Governments of the Consultative Parties should provide, through diplomatic channels, a list of the Initial Environmental Evaluations (IEEs) and Comprehensive Environmental Evaluations (CEEs) prepared by or submitted to them during the preceding calendar year.
2. The list, as a separate document, should be transmitted to the host Government of the next ATCM not later than 1 March.
3. The list should, at minimum, contain the following information: a short description of the development or activity; the type of environmental impact assessment undertaken (IEE or CEE): the location (name, latitude, and longitude) of the activity; the organization responsible for the EIA; and the decision taken following consideration of the environmental impact assessment.
4. The lists should be collated by the host Government of the ATCM and circulated as an information paper to the ATCM and thereafter, if the ATCM so agrees, be published as an Annex to the Final Report of the ATCM.
5. The above procedures should be reviewed following the establishment of a permanent Secretariat.

Resolution 7 (1995): Extension of the Expiry Dates for Sites of Special Scientific Interest

The Representatives of the Consultative Parties,

Recalling Recommendations VIII-3 and XII-5;

Noting that:

i) experience of the practical effect of the Management Plans for these sites has shown them to be an effective means of reducing the risks of harmful interference in areas of special interest;

Recommend that:

1. The date of the expiry of Site Numbers 1, 3, 8, 9, 14, 15, 16, 17, 19, 21 be extended from 31 December 1995 to 31 December 2000.
2. The Governments of the Consultative Parties should use their best endeavors to ensure, in accordance with paragraphs 3 and 4 of Recommendation VII-3, that the Management Plans are complied with.

Resolution 8 (1995): New Historic Sites and Monuments: Suggested Guidelines for the Designation of Historic Sites

The Representatives of the Consultative Parties,

Recalling Recommendations I-IX, V-4, VI-14, VII-9, XII-7, XIII-16, and XIV-8;

Recommend that the following Guidelines for the Designation of Historic Sites and/or Monuments should be used by the Governments of the Consultative Parties in proposing sites for the "List of Historic Monuments Identified and Described by the Proposing Government or Governments."

Guidelines

Proposals for Historic Sites and/or Monuments should address one or more of the following:

- A particular event of importance in the history of science or exploration of Antarctica occurred at the place;
- A particular association with a person who played an important role in the history of science or exploration of Antarctica;
- A particular association with a notable feat of endurance or achievement;
- Representative of, or forms part of, some wide-ranging activity that has been important in the development of knowledge of Antarctica;
- Particular technical or architectural value in its materials, design, or method of construction;
- The potential, through study, to reveal information or has the potential to educate people about significant human activities in Antarctica;
- Symbolic or commemorative value for people of many nations.

Resolution 9 (1995): Uniform Model for Management Plans

The Representatives of the Consultative Parties,

Recalling the requests made by ATCM XVII and ATCM XVIII that SCAR should assist Parties in reviewing and revising Management Plans to conform with the provisions of Annex V of the Protocol on Environmental Protection to the Antarctic Treaty and consider how a model could be developed to facilitate the preparation of new and revised Management Plans;

Recognizing that a uniform model for such plans would eliminate repetition and would make them easier to use;

Recommend that:

The structure of the Management Plan for Specially Protected Area No. 13, adopted under Measure 1, be regarded as a model for the preparation of all new and revised Management Plans for protected areas for the purpose of Annex V.

U.S. Navy presence in Antarctica marks a milestone and notes a passing

VXE-6 helicopters fly final science support mission

A ceremony at McMurdo Station's helicopter pad on Saturday 3 February 1996 marked the U.S. Navy's last helicopter support mission in Antarctica, ending a half-century's tradition of naval rotary-wing aircraft support to antarctic science. The Navy had introduced helicopters to Antarctica during Operation Highjump 49 years ago and, in the following season of 1947–1948, built an entire mapping and reconnaissance mission—Operation Windmill—around two HO3S-1 Sikorskys and one HTL-1 Bell.

Next year, a civilian contractor will provide helicopter service to the United States Antarctic Program (USAP). The end came as part of the Navy's planned withdrawal from antarctic research support. The National Science Foundation (NSF) is evaluating bids from private firms to replace the Navy's helicopter role, and next season will usher in what everyone expects will be a seamless transition to the new operator. The change will save money because the type and number of helicopters can be altered to meet research needs and because the contractor will be on duty only during the summer season.

Antarctic terrain requires the use of helicopters for transportation throughout the McMurdo area, especially in the dry valleys region. Helicopters assist USAP in a variety of ways including transportation to field camps and research sites, and on search-and-rescue missions. Since the 1960s, the Navy's Antarctic Development Squadron 6 (VXE-6), lately with a fleet of six HH-1N twin-engine Hueys, had supported remote science in the U.S. Antarctic Program—all summer, every summer. Particularly for geologists, VXE-6 helicopters defined the entire field careers of some investigators. Hueys, which during the last season were flown and maintained by 13 pilots and 25 enlisted personnel, carried enough fuel to fly within a 240-kilometer radius of McMurdo. Such a range allowed scientists the necessary support to conduct sophisticated projects in the nearby area.

"We're sad to be leaving," VXE-6 Helicopter Operations Officer LT Adam Paterson said. "Almost every VXE-6 helo pilot specifically requested this duty because of the flying time and interesting work it offers." During its final deployment in Antarctica, the VXE-6 Hercules Operation had a busy season, one that rivaled Operation Deep Freeze II when Navy aircraft airlifted 760 tons of materials to build Amundsen–Scott South Pole Station.

Navy helicopter operations typically began each year after the arrival of VXE-6 in early October when U.S. Air Force jets flew the Hueys to Antarctica from VXE-6's homeport in Point Mugu, California. During the 1995–1996 season, however, operations started in August for the winter fly-in. "This is only the second season in the Division's 30-year history that has happened," said LT Dan Rolince, Helicopter Division Officer. "It allowed us to open up most of the field camps and stay ahead of schedule."

At season's end, Al Sutherland, the NSF Representative, wrote this in his weekly report: "The most touching event was the ceremony commemorating the last VXE-6 helo flight. Of all the services, I believe that the Navy is best when it comes to tradition—and this was certainly no exception. There was a gathering to watch the last helo come in—not a staged

OFFICE OF POLAR PROGRAMS
3 February 1996

To the men and women of Antarctic Development Squadron 6:

Today's last helicopter support mission by Antarctic Development Squadron 6 is not just a milestone in antarctic aviation. It also marks the end of a very large chapter in the history of antarctic scientific research and exploration. It was the United States Navy that introduced helicopter operations to Antarctica during Operation Highjump—49 austral summers ago. But Operation Windmill in the following season of 1947–1948 proved their great utility. The historians tell us that the two HO3S-1 Sikorskys and one HTL-1 Bell of Operation Windmill "proved indispensable in landing shore parties to establish control points or do other exploratory work, and for ice reconnaissance while the ships were in the pack."

Since the 1960s the Squadron's own fleet of helicopters has both defined and made possible much of the present-day United States Antarctic Program. Particularly for the geologists, but for other scientific disciplines as well, VXE-6 has been both the essential ingredient and the stalwart companion to the entire research careers of many antarctic investigators. The value of these helicopter missions to the understanding of Antarctica is incalculable. We can say, for sure, that every research paper, every map has a roster of co-authors, too often unnamed. These co-authors are the men and women—from pilots to crew chiefs to mechanics—of the helicopter detachment of Antarctic Development Squadron 6.

I salute you as you commemorate today the Navy's conclusion of half a century of helicopter support of antarctic science. Those of you assembled here are the standard bearers of that history. You own it, and you deserve to be proud of it. Some of VXE-6's best seasons of helicopter performance have been among its most recent ones. The societal and economic forces that have made necessary the transition now under way are not of your doing. On behalf of the National Science Foundation and the Nation, I thank you for your exemplary performance and extend best wishes to you all.

Sincerely,

Cornelius W. Sullivan
Director
Office of Polar Programs

flight, a real job, right to the end. Then a Herc [LC-130 Hercules airplane] overflight." At the ceremony, Sutherland read messages from wellwishers, including one from Neal Sullivan, director of NSF's Office of Polar Programs. (See the sidebar on page 23 for this message.)

When the field camps closed on 5 February 1996, the Helicopter Division officially ceased its operations in Antarctica.

Operation Deep Freeze still going strong at 40

In 1955, a task force of seven ships and approximately 1,800 men arrived on the shores of Ross Island, Antarctica, with a mission to establish an airfield and base of operations for the International Geophysical Year. This base would then be used to help establish the first scientific station at the geographic South Pole the following summer. The sailors of the first Operation Deep Freeze succeeded in not only building an air base at what is now known as McMurdo Station, but they also opened up Antarctica for scientific exploration. The U.S. Navy's legacy in Antarctica continues today as Operation Deep Freeze celebrates its 40th Anniversary.

Today, sailors from U.S. Naval Support Force, Antarctica (NSFA) and VXE-6 continue to make scientific research in Antarctica possible and make the U.S. Antarctic Program the largest and most ambitious antarctic program in the world. "Our scientists can virtually come and go as their science dictates, rather than suffer the enormous periods of time needed to transit to and from the continent by ship," said Erick Chiang, Manager of the Office of Polar Programs, Polar Research Support Section.

More than 535 U.S. Navy personnel from NSFA and VXE-6 went to Antarctica during the 1995–1996 summer season. NSFA provided essential communications, weather information, air traffic control services, medical care, and administrative assistance, and VXE-6 flew and maintained six ski-equipped (LC-130) "Hercules" aircraft and six HH-1N "Huey" helicopters.

USAP requires a contingent of this size to support a wide variety of science projects at the stations and at remote sites. The helicopters make flights to numerous research camps within a 240-kilometer radius of McMurdo including the dry valley sites, and the LC-130 transports fly to more distant locations such as the South Pole, Shackleton Glacier, Byrd Surface Camp, and the Siple Coast in West Antarctica.

This season alone, Hueys transported personnel and equipment for more than 40 projects, and Hercules aircraft shuttled equipment and personnel for at least a dozen. "This mobility has made USAP foremost in antarctic research among the 26 nations that support a program on the continent," Chiang said.

U.S. Navy activity on the continent has steadily increased since Operation Deep Freeze I in 1955–1956. Although the early years saw a good deal of construction during the creation of McMurdo Station, intensive scientific research has recently called for more flight operations.

Fourteen-year veteran of Antarctica, Antarctic Support Associates Laboratory Science Manager Steve Kottmeier voices a common opinion. "Civilians might have the know-how to do the job, but since the Navy has worldwide experience, they have solutions to the problems Antarctica can bring."

Prepared using information from JO2 Trevor Poulsen, U.S. Navy, and Guy Guthridge, NSF Information Program Manager

A 5-year review of regulator performance in the U.S. Antarctic Program

Open-circuit scuba diving has been used as a research tool along the Antarctic Peninsula since 1958 (64°51'S 62°54'W; 1.0 to –1.5°C) (Neushul 1961) and at McMurdo Station since 1961 (77°51'S 166°40'E; –1.8 to –1.9°C) (Peckham 1964). Early cold-water experience indicated that the U.S. Divers Royal Aquamaster (RAM) double-hose regulator was substantially less susceptible to failure than were the available single-hose regulators (Bright 1972, pp. 145–157; Andersen 1974, pp. 325–340). On the basis of this experience, the RAM regulator became the standard regulator of the U.S. Antarctic Program.

Over time, however, as the available stock of RAM parts declined, reports of failure became more common (Berkman 1985, pp. 123–132; Pollock 1993, pp. 7–16). Beginning in the 1989–1990 austral summer season, a testing program was undertaken at McMurdo Station to evaluate regulator performance and identify alternatives to the aging RAMs (Bozanic and Mastro 1992, pp. 18–27).

Regulator performance was evaluated through review of a database constructed from dive-log information. Dive logs were submitted by all research divers operating out of McMurdo Station. Beginning in the 1990–1991 season, regulator-specific information collected included model used, whether a failure had occurred, and if so, at what depth and how long into the dive. Records were maintained by the McMurdo-based scientific diving coordinator.

Between the 1990–1991 and 1994–1995 seasons, a total of 2,457 dives were recorded, and divers reported 153 regulator failures, typically uncontrolled free flow, for an overall failure rate of 6.2 percent. Table 1 ranks regulators according to the total number of dives completed. Of those accumulating at least 100 dives, the Poseidon Thor and Sherwood Maximus were the most reliable, with failure rates of 1.1 and 1.7 percent, respectively. The RAM, used last in the 1990–1991 season, had the highest failure rate—27.8 percent. Many regulators have been tried on a limited number of dives. Given the unforgiving nature of under-ice operations, regulators that fail during their first few trials will generally not be used again.

The combined performance of Maximus and Thor regulators against all others used is presented in table 2. The difference in Maximus/Thor and "all other" failure rates (1.6 percent versus 11.6 percent) is substantial ($\chi^2[1]=144.3$, $p<0.0001$). The "all other" failure rate shows a marked decline in the 1994–1995 season as the range of regulators used decreased. The progressive decline in the Maximus/Thor failure rate primarily reflects improved reliability of the Maximus regulator. The addition of

Table 1. Regulator performance summary. (Listed are the number of dives, number of failures, and percentage of failures.)

Regulator	1990–1991	1991–1992	1992–1993	1993–1994	1994–1995	Total
Sherwood Maximus		54 (0) 0%	345 (10) 2.9%	642 (12) 1.9%	300 (1) 0.3%	1,341 (23) 1.7%
Poseidon Cyklon 300	201 (13) 6.5%	218 (17) 7.8%	48 (3) 6.3%	16 (3) 18.8%	1 (0) 0%	484 (36) 7.4%
Poseidon Thor	87 (1) 1.1%			48 (1) 2.1%	47 (0) 0%	182 (2) 1.1%
USD RAM	126 (35) 27.8%					126 (35) 27.8%
DSI EXO-26		5 (4) 80%	30 (3) 10%	6 (0) 0%	65 (4) 6.2%	106 (11) 10.4%
Poseidon Odin	99 (6) 6.1%	3 (1) 33.3%		4 (0) 0%		106 (7) 6.6%
Scubapro Mk 10/G200	27 (13) 48.1%					27 (13) 48.1%
Dacor Extreme Ice				25 (4) 16.0%		25 (4) 16.0%
Scubapro Mk 10/D350	14 (2) 14.3%		3 (1) 33.3%			17 (3) 17.6 %
AGA			2 (0) 0%	7 (0) 0%		9 (0) 0%
Scubapro Mk 200/G200	7 (7) 100%					7 (7) 100%
Scubapro Mk 10/D400				7 (1) 14.3%		7 (1) 14.3%
Scubapro Mk 10/Polar			1 (1) 100%	5 (1) 20%		6 (2) 33.3%
USD Arctic Supreme				4 (0) 0%		4 (0) 0%
USD Pro Diver	3 (2) 66.7%					3 (2) 66.7%
Mares MR-3			2 (2) 100%			2 (2) 100%
Sherwood Blizzard				2 (2) 100%		2 (2) 100%
USD Conshelf Supreme		2 (2) 100%				2 (2) 100%
Scubapro Mk 10/G250	1 (1) 100%					1 (1) 100%
Total[a]	565 (80) 14.2%	282 (24) 8.5%	431 (20) 4.6%	766 (24) 3.1%	413 (5) 1.2%	2,457 (153) 6.2%

[a]Dives conducted with surface supplied systems are not included in this assessment.

Thor dives to this category decreases the overall failure rate by 0.1 percent, with no effect on the seasonal rates.

The Sherwood Maximus and Poseidon Thor regulators have proved to be the most reliable of the regulators used in the U.S. Antarctic Program. The annual decline in overall regulator failure rate is likely due to several factors, the most significant of which is user care. Regulator reliability is strongly dependent on handling. This chronic problem is unchanged from the earliest cold-water trials (Bright 1972, pp. 145–157). The available records indicate that most failures are associated with water inside the regulator mechanism. The generally improved performance is attributed largely to appreciation of this issue. The U.S. antarctic diving program is relatively small and cohesive (26±5 divers participated annually between 1990–1991 and 1994–1995), and the heightened awareness generated by the monitoring program undoubtedly played a role.

Table 2. Performance of Maximus/Thor compared with all other regulators. (Listed are the number of dives, number of failures, and percentage of failures.)

Season	Maximus/Thor			All other			Total		
1990–1991	87	(1)	1.1%	478	(79)	16.5%	565	(80)	14.2%
1991–1992	54	(0)	0%	228	(24)	10.5%	282	(24)	8.5%
1992–1993	345	(10)	2.9%	86	(10)	11.6%	431	(20)	4.6%
1993–1994	690	(13)	1.9%	76	(11)	14.5%	766	(24)	3.1%
1994–1995	347	(1)	0.3%	66	(4)	6.1%	413	(5)	1.2%
Total	1,523	(25)	1.6%	934	(128)	11.6%	2,457	(153)	6.2%

Another factor in the declining failure rate is the willingness of manufacturers to work with the antarctic program to improve the cold-water performance of their products. Sherwood released an exhaust valve heat retention plate designed to maintain higher second-stage temperatures and decrease the risk of second-stage freezeup. Sherwood also developed guidelines for cold-water adjustment to reduce the risk and severity of free-flow failure. Both developments were introduced to the U.S. Antarctic Program during the 1993–1994 season. Preliminary results of the exhaust plate trials are promising. The effectiveness of the cold-water adjustment is less clear.

General performance of the Poseidon Thor requires further evaluation, because 92 percent of the Thor dives were conducted by only two individuals. Unfortunately, like all Poseidon regulators used in cold water, the Thor requires a rubber environmental cap and antifreeze solutions for the first stage. More careful handling and a greater overall maintenance effort are required. Because of these factors and others, the Thor is seldom used in the U.S. Antarctic Program.

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Nobel Prize awarded to pioneers in ozone research

The Royal Swedish Academy of Sciences has awarded its 1995 Nobel Prizes in Chemistry to Paul Crutzen, Mario Molina, and F. Sherwood Rowland for their work in atmospheric chemistry, particularly concerning the chemical processes that deplete Earth's ozone layer. The three are noted for their pioneering contributions to explain how ozone forms and decomposes through chemical processes in the atmosphere. They have shown how sensitive the ozone layer is to the influence of manmade emissions of certain compounds. The thin ozone layer has proven to be a vulnerable barrier that may be seriously damaged by moderate changes in the composition of the atmosphere.

Ozone's protective shield

The atmosphere surrounding Earth contains small quantities of ozone—a gas with molecules consisting of three oxygen atoms (O_3). If all the ozone in the atmosphere were compressed to a pressure corresponding to that at the Earth's surface, the layer would be only 3 millimeters thick.

Although ozone occurs in such small quantities, it plays a fundamental role in life on Earth because ozone, together with ordinary molecular oxygen (O_2), is able to absorb most of the Sun's ultraviolet radiation and prevent this dangerous radiation from reaching the surface. Without a protective ozone layer in the atmosphere, animals and plants could not exist, at least not on land.

The Achilles heel of the biosphere

Ozone is formed in the atmosphere when ultraviolet radiation from the Sun splits ordinary oxygen molecules (O_2). The liberated oxygen atoms then react with the molecular oxygen.

In 1930, the English physicist Sidney Chapman formulated the first photochemical theory for the formation and decomposition of ozone in the atmosphere. This theory, which describes how sunlight converts the various forms of oxygen from one to another, explains why the highest contents of ozone occur in the layer between 15 and 50 kilometers, termed the "ozone layer."

Later measurements, however, showed appreciable deviations from Chapman's theory. The calculated ozone contents were considerably higher than the observed ones. Thus, scientists realized, other chemical reactions must be at work contributing to the reduction of the ozone content. Some years later, Belgian Marcel Nicolet contributed important knowledge about how the decomposition of ozone was enhanced by the presence of the hydrogen radicals OH and HO_2.

The scientist to take the next fundamental step toward a deeper understanding of the chemistry of the ozone layer was one of the 1995 Nobel Prize recipients, Paul Crutzen. In 1970, he showed that the nitrogen oxides NO and NO_2 react catalytically (without themselves being consumed) with ozone, thus accelerating the rate of reduction of the ozone content. His work spurred the rapid development of research on global biogeochemical cycles.

The first threat noted: Supersonic aircraft

The power of nitrogen oxides to decompose ozone was also noted early by American researcher Harold Johnston, who carried out extensive laboratory studies of the chemistry of nitrogen compounds. In 1971, he pointed out that the planned fleet of supersonic aircraft could possibly threaten the composition of the ozone layer. These aircraft would be capable of releasing nitrogen oxides right in the middle of the ozone layer at altitudes of 20 kilometers.

Crutzen's and Johnston's work gave rise to a fervent debate among researchers as well as among technologists and decision-makers. This was also the start of intensive research into the chemistry of the atmosphere which has made great progress during the past several years. (The subsequent cancellation of plans for a large supersonic transport fleet came for reasons other than the environmental risks they involved.)

Molina and Rowland move ozone research ahead

In 1974, Mario Molina and F. Sherwood Rowland, 1995's other two recipients of the Nobel Prize in Chemistry, published a widely noted *Nature* article on the threat to the ozone layer from chlorofluorocarbon (CFC) gases known as "freons." These gases were used as propellants in spray bottles, as the cooling medium in refrigerators and air conditioners, and in the manufacture of plastic foams.

The two scientists realized that CFCs, which are chemically stable, could gradually be transported through normal air circulations to the stratosphere. There, intense ultraviolet light could break up the molecules, releasing chlorine, which catalyzes ozone destruction. They calculated that if human use of CFC gases was to continue at an unaltered rate, the ozone layer could be vastly depleted in a few decades. Molina's and Rowland's 1974 *Nature* article led eventually to certain restrictions on CFC release during the late 1970s and early 1980s.

Molina and Rowland based their conclusions on two important contributions by other researchers:

- James Lovelock (England) had recently developed a highly sensitive device for measuring extremely low organic gas contents in the atmosphere, the electron capture detector. Using this device, he could now demonstrate that the exclusively manmade, chemically inert CFC gases had already spread globally throughout the atmosphere.
- Richard Stolarski and Ralph Cicerone (United States) had shown that free chlorine atoms in the atmosphere can decompose ozone catalytically as nitrogen oxides do.

Molina's and Rowland's prediction that human actions could severely deplete the ozone layer created enormous attention because CFC gases were used in many technical processes and their chemical stability and nontoxicity were thought to render them environmentally ideal. In science and industry, many were critical of Molina's and Rowland's calculations, but even more were seriously concerned by the possibility of a depleted ozone layer. Today, scientists know that the two chemists were right in all essentials. It was to turn out that they had even underestimated the risk.

Ozone content over Antarctica

Not until 1985 did the international negotiations on release restrictions take on any urgency. Then, British re-

Three chemists hailed for planet-saving work

When the Royal Swedish Academy of Sciences named Paul Crutzen, Mario Molina, and F. Sherwood Rowland as recipients of the 1995 Nobel Prize, the prestigious organization credited the three chemists with contributing to "our salvation from a global environmental problem that could have catastrophic consequences." Because of the work Crutzen, Molina, and Rowland have done, the Academy said, "it has been possible to make far-reaching decisions on prohibiting the release of gases that destroy ozone."

Colleagues, too, praise their work both in and for the atmospheric sciences. Only one other Prize has been awarded for atmospheric research, and the 1995 Prize is the first ever given for work related to the environmental sciences. National Center for Atmospheric Research (NCAR) atmospheric chemist Jack Calvert, who has worked with all three Nobel recipients, said of the impact their work has had, "I was impressed that they not only discovered the ozone threat but were willing to go to the government and say, 'We need to do something about this.' They are really heroes to us."

For Crutzen, Molina, and Rowland, the Nobel Prize acknowledges not only their pioneering findings about the role of chlorofluorocarbons in the atmosphere but also their decades of continued atmospheric research that helped to gather evidence substantiating their initial theories.

Paul Crutzen was born in 1933 in Amsterdam and is still a Dutch citizen. Crutzen received his doctorate in meteorology from Stockholm University in 1973. He is a member of the Royal Swedish Academy of Sciences, the Royal Swedish Academy of Engineering Sciences, and Academia Europaea. Crutzen is a professor at the Max-Planck-Institute for Chemistry, Mainz, Germany.

Mario Molina, born in 1943 in Mexico City, Mexico, is now a U.S. citizen. Molina received his doctorate in physical chemistry from the University of California, Berkeley. He is a member of the U.S. National Academy of Sciences. Molina is a professor in the Department of Earth, Atmospheric, and Planetary Sciences at the Massachusetts Institute of Technology, Cambridge, Massachusetts.

F. Sherwood Rowland, born in 1927 in Delaware, Ohio, is also a U.S. citizen. Rowland received his doctorate in chemistry in 1952 from the University of Chicago. He is a member of the American Academy of Arts and Sciences and the U.S. National Academy of Sciences, where he is serving a term as foreign secretary. Rowland is a professor in the Department of Chemistry at the University of California, Irvine, California.

Austral spring 1995 registers worst ozone depletion yet

Depletion of Earth's ozone layer over Antarctica during the period between July and September 1995 was the most severe ever recorded, according to a recent report by the World Meteorological Organization (WMO). The Geneva, Switzerland, based group said new data indicated the area of ozone depletion, 16.12 million square kilometers, was nearly twice the size of the "hole" in the ozone layer seen during the austral springs of 1993 and 1994.

Strong winds that circulate high in the atmosphere and vortex around Antarctica each winter control the size of the area affected by the ozone depletion, but even with the winds limiting how far the ozone hole could spread, the 1995 hole sometimes extended far enough to cover parts of South America and the Falkland Islands.

Deep, swift, and long-lasting as well as broad

"The ozone decline over the Antarctic, which started at the end of July and continued through early September, was so far the most rapid depletion on record," a WMO statement announced. The report noted that levels of ozone in August 1995 were as much as 30 percent lower than during the "pre–ozone-hole" period before July. Further, levels recorded in August 1995 were 10 percent lower than levels recorded in August 1994. The data collected by WMO indicated that the ozone layer, at an altitude of 15 to 18 kilometers, showed a 50 percent deficiency in several locations.

Research by Anna Jones and Jonathan Shanklin of the British Antarctic Survey (BAS) supports the WMO findings. Austral spring 1995 values of ozone recorded at Halley Research Station in Antarctica fell to less than 40 percent of the values seen in the 1960s. Jones and Shanklin also note that new research shows that the decline is no longer restricted to the spring but has extended into the summer, increasing the amount of harmful ultraviolet radiation reaching the surface of Antarctica and its surrounding oceans. The increased ultraviolet light reaching the ground poses a medical hazard. "When I'm out in the sunshine, especially in the Antarctic," Shanklin commented, "I wear a hat and make sure that I'm protected by sunblocking cream."

Long-term records

Having measured ozone levels for nearly 40 years, the BAS research stations have the longest record of ozone measurements in the Antarctic. Evidence of some ozone destruction was recorded in the early 1970s, but no "hole" was noted until the end of the decade. BAS researchers believe that the ozone hole is unlikely to get much deeper because all of the ozone that is easily destroyed already disappears each spring. According to Jones, "It is only because of restrictions of the Montreal Protocol and its Amendments, controlling chlorine and bromine emissions, that we can expect the antarctic ozone hole to disappear. Even though these controls are coming into effect, the ozone hole is likely to appear for many decades." The Montreal Protocol is a 1987 international agreement to reduce the global production of ozone-depleting substances.

Positive effects of the protocol

According to David Hofmann, director of the National Oceanic and Atmospheric Administration's Climate Monitoring and Diagnostics Laboratory (NOAA/CMDL) in Boulder, Colorado, although chlorine levels from manmade chlorofluorocarbons (CFCs) continue to increase in the antarctic stratosphere, the increase is now very slow and large changes in the magnitude of springtime antarctic ozone depletion are not expected. Hofmann believes that ozone depletion at the South Pole, where NOAA researchers measure ozone and other atmospheric gases year-round, should level off over the next few years and that the global measures taken in response to the Montreal Protocol will begin to heal the ozone layer within 5 years or so.

On 5 October 1995, balloon soundings conducted by the NOAA/CMDL wintering team indicated a total ozone value of 98 Dobson units (DU) in the column of air above the measuring site at the South Pole. Hofmann says this is only slightly less than the 102 DU recorded in October 1994 and somewhat more than the record low of 91 DU observed in October 1993. Before the springtime period in Antarctica, the normal Dobson unit reading is about 275.

Hofman's team evaluates natural, as well as manmade, forces that attack Earth's ozone layer. In the past 2 years, Hofmann says, antarctic ozone has recovered from the effects of the Mount Pinatubo volcanic eruption of 1991, particularly in the lower stratosphere (10–14 kilometers), where most of the volcanic particles were located. Volcanic particles appear to enhance the chemical reactions that occur in the polar stratospheric clouds, which form in the cold, dark antarctic winter. The ice crystals making up these clouds provide the surface on which the ozone-destroying reactions occur when the Sun comes up in spring. Absence of the volcanic particles reduces the chlorine conversion processes and reduces ozone depletion, according to Hofmann.

searcher Joseph Farman and his colleagues, using data obtained from ground-based observations made at Halley Station beginning in the 1950s, noted that stratospheric ozone levels above Antarctica had fallen 40 percent between 1975 and 1985. Satellite data from the south polar region obtained by the National Aeronautics and Space Administration (NASA) beginning in 1978 supported Farman's analysis. The phenomenon was quickly labeled the "ozone hole." The depletion was, at least periodically, far greater than expected from earlier calculations of the CFC effect. To learn more about the phenomenon, potential changes in antarctic atmospheric chemistry, and related dynamic weather processes, the National Science Foundation in cooperation with NASA and the National Oceanic and Atmospheric Administration (NOAA), launched two large expeditions—the National Ozone Expedition I (NOZE I) and NOZE II—in the 1986 and 1987 austral springs. Besides these two expeditions and continued monitoring by satellites, NASA sent the Antarctic Ozone Experiment to the Southern Hemisphere in 1987 to record changes in the atmosphere from a specially instrumented airplane. These three expeditions added important new information to the existing database.

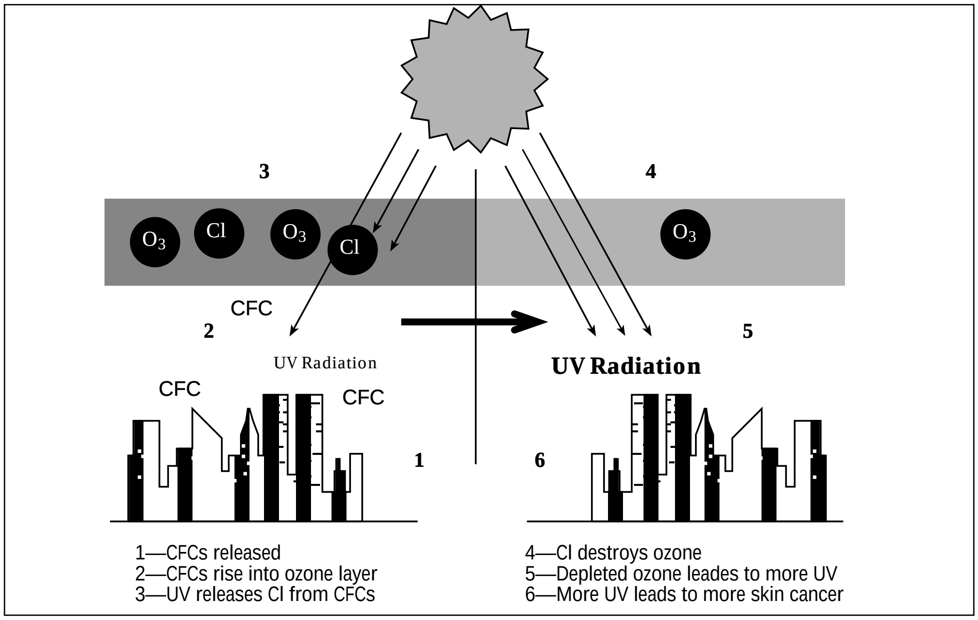
The surprisingly rapid depletion of the ozone layer over Antarctica could not be explained by transport processes or by gas-phase chemical reactions. An alternative mechanism must exist, researchers reasoned, to accelerate the decomposition of ozone. Crutzen and colleagues identified this mechanism as chemical reactions on the surface of cloud particles in the stratosphere. Thus, they concluded, the antarctic ozone depletion appears to be connected with the extremely low prevailing temperatures (–90°C and lower), which lead to condensation of water and nitric acid to form "polar stratospheric clouds" (PSCs). The ozone-decomposing chemical reactions are reinforced by the presence of cloud particles. This understanding has led to an exciting new branch of atmospheric chemistry—"heterogeneous" chemical reactions on particle surfaces.

The debate among researchers also focused on the source of the problem. Was this a natural climatic variation or was it chemical decomposition brought about by humankind? Thanks to pioneering research by many researchers, among them Crutzen, Molina, and Rowland, as well as Susan Solomon and James Anderson, both from the United States, manmade causes were pinpointed. Although natural cycles and natural phenomena (such as volcanic eruptions) do play a role, researchers said, chlorine and bromine from industrially manufactured gases were the chief causes of the annual springtime depletion.

The ozone layer and the climate

The ozone problem also has interesting connections with the issue of how humankind is affecting the climate. Ozone, like carbon dioxide and methane, is a greenhouse gas that contributes to high temperatures at the surface of the Earth. (CFC gases have a similar effect.)

Model calculations have shown that the climate is especially sensitive to changes in the ozone content in the lower layers, the troposphere. Here, the ozone content has increased markedly during the past century, chiefly because of the release of nitric oxide, carbon monoxide, and gaseous hydrocarbons from vehicles and industrial processes and from the combustion of biomass in the tropics.



The Environmental Protection Agency's (EPA) Stratospheric Protection Division uses this illustration to describe the ozone depletion process. For further information, visit the EPA home page on the World Wide Web.

The elevated ozone content in lower atmospheric layers is itself an environmental problem for the damage it can cause to crops and human health. Paul Crutzen has been the world's leading researcher in mapping the chemical mechanisms that determine the ozone content at these levels.

What does the future hold for Planet Earth?

Thanks to an improved scientific understanding of the ozone problem, making far-reaching decisions to prohibit the release of gases that destroy ozone has been possible. An international protocol—the Montreal Protocol on Substances That Deplete the Ozone Layer—was negotiated under the auspices of the United Nations and signed into effect in 1987. The protocol contains measures to control and reduce the production and use of the more destructive forms of halocarbons. Two amendments, in London in 1990 and in Copenhagen in 1992, have tightened the controls on halocarbon emissions. The latest amendment bans the most dangerous gases totally from 1996 on, allowing developing countries a few years' grace to introduce substitutes that do not harm the ozone layer.

Because it takes some time for the ozone-destroying gases to reach the ozone layer, scientists expect the depletion, not only over Antarctica but also over parts of the Northern Hemisphere, to continue to worsen for the next few years. Given compliance with the prohibitions, the ozone layer should gradually begin to heal within the next 5 years. At least a century will be needed, however, for it to recover fully.

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Information from the Nobel Foundation and the American Geophysical Union was used in the preparation of this article.

Science news from The Ice

Antarctica online

Computer access to antarctic information is growing fast. If you can get on the Internet's World Wide Web, you can—with a few clicks of a mouse—find out today's noon position of Australia's antarctic icebreaker, the latest astronomy at South Pole Station, the availability of research samples at the National Ice Core Laboratory in Denver, Belgium's antarctic plans for the next 5 years, and lots more. National Science Foundation (NSF) grantees have set up many of the U.S. Web home pages. NSF's own polar site (*http://www.nsf.gov:80/opp/start.htm*) is modest yet, but it's a place to start because it has hyperlinks to some other antarctic sites. Or you can use Netscape's search tools to find what you need. There's a tourist's page or two, and at least two antarctic educational sites—one on the Scholastic, Inc., home page *(http://www.scholastic.com/public/Home-Page.html)* and one called Blue Ice at *http://www.mecc.com/blueice.html*.

"One nearly perfect submarine volcano"

The age of exploration is not over yet. America's antarctic research icebreaker *Nathaniel B. Palmer* has a new profiler called Seabeam 2112™ that records not just the bottom beneath the ship but a wide swath, churning out accurate topographic maps, in color, of the seafloor for immediate use onboard. The Earth, as a whole, is dominated by the ocean basins. Ocean crust is the most dynamic part of the solid Earth—encompassing 70 percent of Earth's surface area—and has been formed entirely in the last 5 percent of geologic time. As part of a continuous worldwide process, new ocean crust forms at ocean ridges and is destroyed in the deep ocean trenches. Despite its dominance, the ocean floor is largely unexplored and unmapped. Lack of detailed seafloor maps has limited the ability of scientists to address such basic questions about how the Earth works as an integrated system as

- what happens when continents break apart?
- how does continental drift work?
- how does the ocean floor form?
- what controls the path of deep ocean currents?
- what kind of ecological niches exist in the oceans to harbor exotic life forms?
- what processes shape the ocean floor?

Recent advances in technology that uses sound waves to measure distance in water has led to remote-sensing systems, like the Seabeam 2112™, that can produce detailed seafloor maps. This system, which uses 120 beams to produce maps up to 15 kilometers wide along a ship track, is an enormous improvement over traditional methods that are limited to single-depth profiles beneath the ship. The resulting maps provide an unprecedented view of undersea features ranging from small-scale textures of the bottom deposits to underwater fault lines and undersea volcanoes. The seafloor mapping system on the *Nathaniel B. Palmer* allows researchers supported by the U.S. Antarctic Program to explore and map previously unknown regions and to study these globally important questions.

Lawrence A. Lawver of the University of Texas at Austin and Gary Klinkhammer of Oregon State took the *Palmer* into Bransfield Strait in November 1995 looking for hydrothermal vent fields in a unique marginal basin setting. They found, among other things of scientific significance, "lineated pillow piles* interspersed with one nearly perfect submarine volcano and one apparently dissected submarine volcano." The better preserved volcano is about 3 nautical miles across at its rim and stands 900 meters above the bottom but is still 600 meters beneath the ocean surface. The investigators write that "lineated seafloor pillow piles of these lengths are completely unknown in the world's oceans. Perhaps as more areas are surveyed they may turn out to be more common, but so far the central Bransfield Basin is unique." Then, using a towed water-chemistry and transmissivity-monitoring sled, they found two hydrothermal vent fields whose sizes rival the largest geothermal field on the Mid-Atlantic Ridge. Turning again to the Seabeam mapper, they found a compressional ridge that is the equivalent of the San Bernadino Mountains of southern California.

*Pillow piles are volcanic rock flows formed as a result of underwater eruptions.

Budget cuts cause cancellation of midwinter airdrop

Since 1980, a U.S. Air Force C-141 transport airplane has delivered fresh food, mail, supplies, and equipment via a midwinter airdrop to the wintering populations on Ross Island—at both McMurdo Station and New Zealand's Scott Base—and at the South Pole. This year, however, like many other Federal programs, the National Science Foundation's U.S. Antarctic Program (USAP) is faced with increasing costs and a diminishing budget, and because of budget limitations imposed by Congress, the Foundation decided to cancel the midwinter airdrop.

The airdrop, which is a complex logistic operation, usually occurs on or about Midwinter's Day, the austral winter solstice, in late June. At this time of year, temperatures are too low for airplanes to land at the South Pole, so refueling at the station is not possible. A tanker airplane accompanies the C-141 and refuels it in flight. Materials for the drop are packed in sturdy cargo containers that have parachutes attached to them and loaded into the cargo hold of the airplane. In the meantime, personnel at Amundsen–Scott South Pole Station mark an area near the station as a target for the drop. Flying low over the marked area, the air crew pushes the cargo containers out of the airplane and the parachutes open, carrying the supplies to the waiting crew on the ground.

For the previous few years, these flights have also carried biologists who are studying emperor penguins, the only penguin species that breeds during the austral winter. By using a night-vision "intensifier," the biologists were able to observe one of the six emperor colonies along the western Ross Sea. Until now, the winter lives of the Ross Sea emperors have remained somewhat of a mystery because the frigid, dark polar winter restricted scientists to ground observations at sites near a few rookeries. The scientists had hoped to make use of these resupply flights again this austral winter to learn more about this important part of the penguin breeding cycle.

A year of extremes for Amundsen–Scott South Pole Station's weather

The coldest place on Earth hit some record lows—and a few record highs—during 1995. Although no record low- or high-pressure readings were taken, temperatures dipped to the record lows for the day 33 times during the year and reached record highs 3 times. Wind speeds broke peak records for 9 days. Victoria Campbell compiled the weather statistics for the year into the following chronicle. Her narrative is summarized in the table.

January

The year began with the second coldest January ever recorded, based on climatological records dating back to 1957. Fifteen low-temperature records were broken during the month. The average monthly temperature was 4.1°C colder than normal. The average station pressure was 7.2 millibars lower than normal.

February

Seven record low temperatures were set in February. On 23 February 1995, a peak wind of 30 knots occurred, breaking the previous peak wind record for the day—23 knots—set in 1959.

March

The temperatures for March were near normal. Only one record low temperature was set during the month. Winds in March were above average. On 13 March, a peak wind of 28 knots broke the previous record, set in 1988, of 26 knots. The average station pressure for the month was 1.2 millibars higher than normal.

April

Four record low temperatures were set in April. The lowest temperature, –74.8°C, occurred on 23 April and broke the previous record for the day of –72.2°C set in 1961. The average winds for April were higher than normal, and two peak wind records were set during the month. The average station pressure was 3.8 millibars lower than normal.

May and June

Five peak wind records occurred for both May and June. In May, the lowest temperature occurred on the 11th with –76.9°C, breaking the previous record of –73.0°C set in 1987. This is the second lowest temperature ever recorded during the month of May. The station pressure for May was 7.2 millibars lower than normal. In June, –39.4°C broke the previous record high of –40.6°C, which had been set in 1972.

July

The average temperature of –56.2°C made this the warmest July on record. Two record high temperatures were set. The warmest, –34°C occurring on 2 July, broke the previous record of –43.0°C set in 1958 and was the second warmest temperature ever recorded during the month of July. The average station pressure was 10.6 millibars higher than normal.

August

The average temperature for the month was –62.3°C, 2.5°C colder than normal, making this the coldest August on record. Two record low temperatures were set. The lowest, –73.9°C on 31 August, broke the previous record for the day of –70.5°C set in 1991. The average station pressure for the month was 2.5 millibars higher than normal.

September

With an average monthly temperature 6.3°C colder than normal, September 1995 was the coldest September on record. Three record low temperatures were set. The lowest, which occurred on 3 September, was –78.2°C, breaking the previous record low of –77.8°C set in 1968.

October, November, and December

No records were broken during the 3-month period that ended the year. Both temperatures and winds were near normal.

Number of record-breaking days at Amundsen–Scott South Pole Station in 1995

Month	Number of record low temperatures	Number of record low air pressure readings	Number of record peak winds
January	15	—	—
February	7	—	1
March	1	—	1
April	4	—	2
May	1	—	5 (May and June)
June	—	—	
July	—	—	—
August	2	—	—
September	3	—	—
October	—	—	—
November	—	—	—
December	—	—	—
Totals for 1995	33	0	9

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