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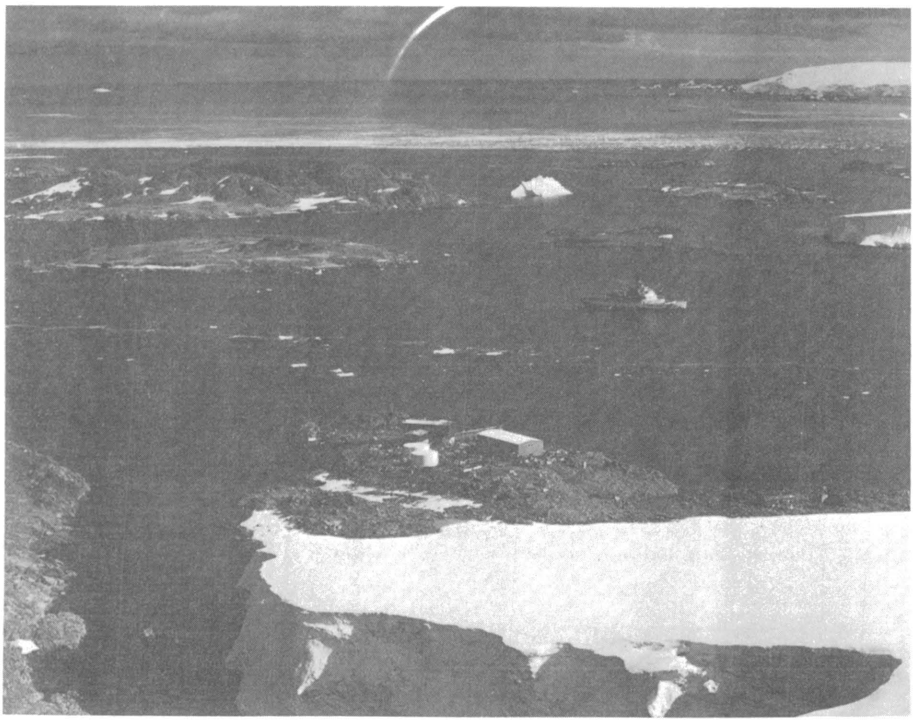


NSF photo by Wiliam Curtsinger.

Palmer Station, as it looked in its early years, lies at the tip of Gamage Point. R/V *Hero* is docked, while a Coast Guard icebreaker is in Arthur Harbor.

Palmer: an Antarctic Peninsula research station

On 16 and 17 November 1820 a 21-year-old Connecticut sealing captain named Nathaniel B. Palmer sailed his 14-meter-long sloop, the *Hero*, southward from the South Shetland Islands. His objective was new sealing grounds, but he found new land—the Antarctic Peninsula. Palmer may have been the first person to see Antarctica, but English, Russian, Australian and other American ships were in the area at about the same time. Reports of these early sealing voyages showed the way for further voyages of discovery in the Antarctic Peninsula area. One hundred and forty-five years after Nathaniel Palmer made his sighting, the United States established a year-round station next to the Antarctic Peninsula and named it Palmer.

Early non-U.S. explorations

Halfway between the tip and the base of the peninsula, off its western coast, lies Anvers Island, the site of the modern-day Palmer Station. This island, 70 kilometers long, is the largest and southernmost of the Palmer Archipelago, an island group extending 250 kilometers along the peninsula. Nathaniel Palmer never saw this archipelago. The first probable landing on Anvers Island was by Captain John Biscoe of England in February 1832. Biscoe, thinking Anvers Island was part of the mainland, took possession in the name of King William IV, and called it Graham Land. Not until 1898 did Lt. Adrien de Gerlache of Belgium in his ship *Belgica* discover that Anvers Island was indeed an island.

Other early explorers who saw Anvers Island were Nordenskjold of Sweden during a 1901-1903 expedition and Charcot of France in 1904 and again in 1908-1910. The British research ships *Discovery* and *William Scoresby* did physical and biological oceanography nearby in the late 1920s. From 1934 to 1937 the British Graham Land Expedition had a base on Wiencke Island, 30 kilometers east of where Palmer Station was to be set up 30 years later; scientific research included geology, glaciology, biology, and tidal observations.

The first occupation of Anvers Island began during the 1954-1955 summer, when Britain established Base N and operated it through the 1957-1958 International Geophysical Year (IGY). Base N occupied a rocky point at the northwestern corner of Arthur Harbor, near where Palmer Station later would be placed.

During the IGY Argentina, Britain, and Chile operated approximately 17 stations up and down the coasts of the Antarctic Peninsula and on adjacent islands, giving the area more centers of population than any other part of Antarctica.

U.S. explorations before the IGY

After voyages to the southern ocean by Nathaniel Palmer and other sealers, an expedition using the schooner *Penguin* and the brig *Annawan* combined U.S. sealing and exploration and reached King George and Deception Islands in February 1830. James Eights of Albany, New York, trained as a physician and later a geologist, accompanied this expedition as scientist and wrote remarkably perceptive reports. In March 1839 two ships of the United States Exploring Expedition, led by Lt. Charles Wilkes, made oceanographic and biological investigations near the tip of the Antarctic Peninsula. U.S. exploration in the peninsula area languished for the rest of the century, although the American Frederick A. Cook accompanied the Belgian expedition in 1898.

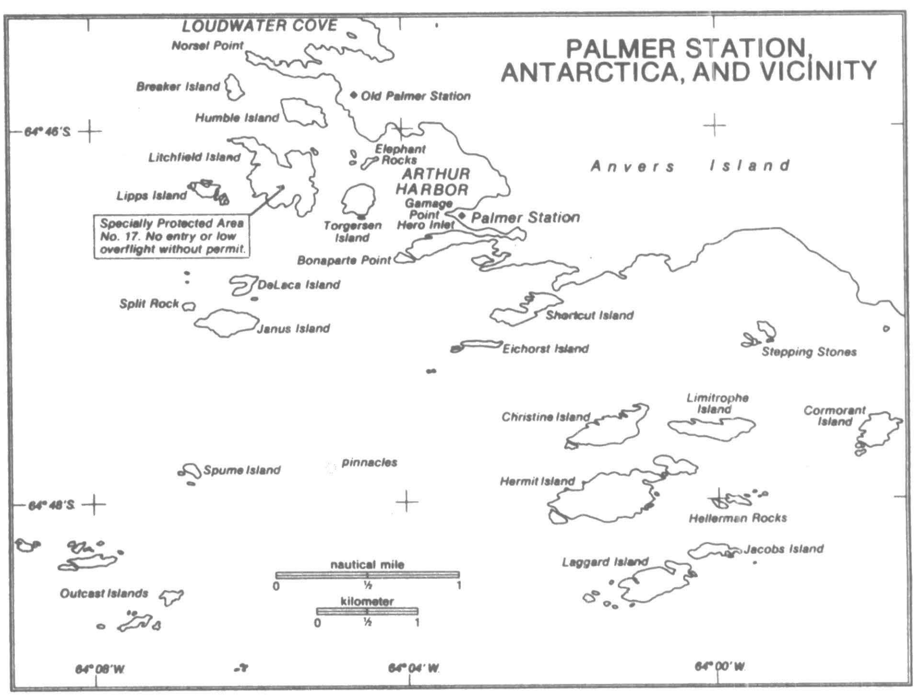
During the 1928-1929 and 1929-1930 summers the American Geographical Society sponsored expeditions led by Hubert Wilkins, an Australian, whose objective was to cross Antarctica by airplane. Bad weather and lack of firm sea ice for takeoffs prevented the transantarctic flight, but several exploratory flights were made from Deception Island over the Antarctic Peninsula in December 1928. On 19 December 1929, an exploratory flight was made from the southern end of Neumeyer Channel, which separates Anvers and Wiencke Islands.

Between 21 November and 5 December 1935, Lincoln Ellsworth completed a flight along the east coast of the peninsula and the transantarctic flight envisioned by Wilkins. He began at Dundee Island (at the tip of the Antarctic Peninsula) and ended at Little America on the Ross Ice Shelf with four landings made enroute. The flights provided much new information about the peninsula and the interior of Antarctica.

The first U.S. station in the Antarctic Peninsula area was established in March 1940 as part of the United States Antarctic Service, a government expedition. Named East Base, it was located on Stonington Island (68°11'S 67°00'W), a 300 by 600 meter rock connected to the mainland by a snow slope. (This location is 410 kilometers south of the site at which Palmer Station would later be located.) Twenty-six men wintered, performing observations at the station and at a smaller camp inland. Extensive explorations were made by foot, airplane, and dog sledge, to the east and west and as far south as the base of the peninsula. Accomplishments included surveys and mapping of most of the area, biological and geological observations and specimen collections, meteorological observations, and tidal and magnetic measurements. The men departed in March 1941.

During the 1946-1947 antarctic summer the Navy's Operation Highjump, an extensive exploration of Antarctica that deployed 13 ships and 4,700 men, included operations by three ships with airplanes in the Antarctic Peninsula area. Charcot and Alexander Islands were photographed from the air, and the ships passed Anvers Island and through Bransfield Strait on their way to the Weddell Sea for further operations.

The final U.S. expedition in the peninsula area before the establishment of Palmer Station was the Ronne Antarctic Research Expedition, which reoccupied East Base on 12 March 1947 and stayed until 20 February 1948. Expedition personnel numbered 23 and included two women. Though small by modern standards, this expedition accomplished much, extending greatly the area explored by Americans in Palmer Land (the southern half of the Antarctic Peninsula) and adjacent areas. Photographic flights ranged as far as the Filchner Ice Shelf and Ellsworth Land, and surface traverses explored both coasts of the peninsula. Unique among U.S. expeditions, the party's ship, a wood tug 56-meters long, was intentionally frozen in the ice near Stonington Island for the duration of the stay at East Base. There were three ski-equipped planes, of which the largest was a twin-engine Beechcraft C-45 with trimetrogon cameras for aerial photography. Dog sledges and two Weasels were used for the traverses. U.S. operations in Antarctica during the International Geophysical Year (1957-1958) did not include activities in the Antarctic Peninsula area.



Palmer Station (64°46'S 64°3'W) is located on the 70-kilometer-long Anvers Island. This map shows the station and islands surrounding it.

Editor: Winifred Reuning

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Palmer's climate compares with that of Nome, Alaska, a town of about 2,500 people on the Bering Sea. Mean annual temperatures of these locations are about the same, although Palmer's summers are cooler, and winters warmer.

	Palmer	Nome
latitude	64°46′S	64°30′N
extreme low temperature	−31°C	−43°C
mean temperature, coldest month	−10°C	−16°C
mean annual temperature	− 3°C	−3.5°C
mean temperature, warmest month	2°C	10°C
extreme high temperature	9°C	30°C
precipitation, cm water equivalent	61	42
snow, cm (included in precipitation, above)*	360	140

* 10 cm snow = 1 cm water

Planning and building Palmer Station

The biological richness of the Antarctic Peninsula area as documented by pre-IGY and IGY stations and research, together with the possibility for productive work in other disciplines, led the United States in 1962 to begin serious consideration of an Antarctic Peninsula station. U.S. biologists working at McMurdo, a U.S. station at 78°S nearly halfway around the continent from the peninsula, perceived great value in comparative studies at lower antarctic latitudes. Also in 1962, the USNS *Eltanin*, an ice-strengthened research ship, began its decade of antarctic cruises, which included occasional work in light pack ice. A station on the peninsula, together with the *Eltanin* and McMurdo Station, would provide a spectrum of opportunities for marine biology and other disciplines ranging from the Antarctic Convergence to practically the highest southern latitude touched by the sea.

The immediate question was: where might a station be put? Literature on the peninsula area was studied, and nations with stations in the region were queried. The principal requirements for a station were established as follows: the site must be biologically rich, there must be access by ship and a potential for access by heavy aircraft, there must be building areas on ice-free land, and access by boat was needed from a main station to "places of biological interest at a reasonable distance."

After these investigations a team of two scientists, an engineer, a pilot, and a naval logistics expert used the Coast Guard icebreaker *Staten Island* to survey 33 prospective sites between 18 January and 5 March 1963. The sites ranged from Adelaide Island in the south to King George Island in the South Shetlands and even around into the Weddell Sea on the eastern side of the peninsula. *Staten Island* spent more time at the Arthur Harbor site on Anvers Island than anywhere else: over 4 days. Biological and geological collections were made, and general reconnaissance including hydrographic surveys was done.

By the spring of 1963 Arthur Harbor, Anvers Island, had been chosen as the site for the new station. In a memorandum in April 1963, T. O. Jones, the head of the Office of Antarctic Programs, wrote to the Director of the National Science Foundation that "The Arthur Harbor area comes closest to meeting all critical requirements for a main biological station site . . . although . . . no area meets all the requirements." And he summed up the site this way: the land is rocky and uneven, but adequate; the shores are rough and rocky, but a landing can be prepared easily; the harbor is sufficient for large ships, with protection given by the outside islands; fresh water is available in a pond by the ice cliff or by melting ice; there is a varied biological environment; and satellite camps may be placed at biologically interesting places within 50 miles.

His specific recommendation was to begin by establishing a small station and keeping it from getting too large and sophisticated for the available land and logistics. He cited McMurdo as the kind of a station not to build.

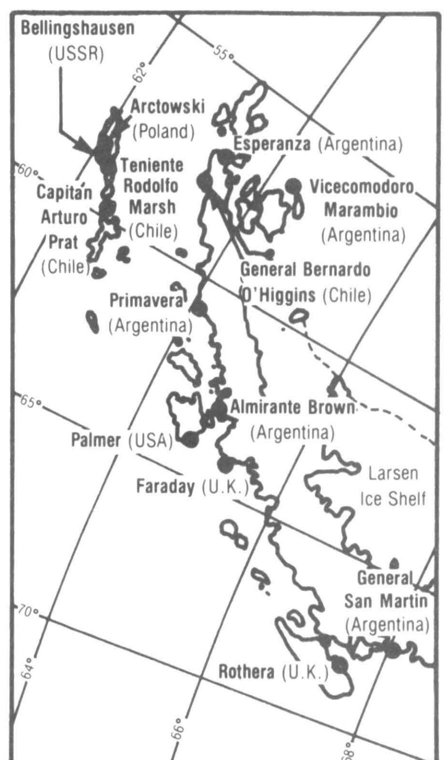
He also recommended that the Foundation consider building a 30- to 38-meter ship fitted for biological work that would operate mainly during the "open" or ice-free season but also could operate in winter if the ice conditions permitted.

In January 1964 the icebreaker *Eastwind* landed a survey team at the Anvers Island site to continue the hydrographic and topographic surveys begun by *Staten Island* the previous year and to erect a temporary Jamesway (a prefabricated canvas and wood building) on Bonaparte Point to house the shore party. On 12 January 1965 the icebreaker *Edisto* arrived with men, equipment, and supplies, and on 16 January the USNS *Wyandot*, a cargo ship, followed. Eight days later the work was finished on a 25- by 11-meter prefabricated T-5 building that was to be Palmer Station. The station, the only U.S. antarctic station north of the Antarctic Circle, was opened with ceremonies on 25 February 1965. The old British hut Base N, just meters away, was later to be made into a laboratory.

The first winter's staff consisted of three glaciologists (who also performed meteorological duties), two biologists, and four Navy men: a medic, a radioman, a cook, and a mechanic. The scientific work was mostly reconnaissance—snow accumulation, weather recording, biological collections—and included journeys as far as 50 or 60 kilometers from the station. A Jamesway was built 13 kilometers inland for glaciology, but poor weather made visits difficult. Snow half covered the Jamesway by March and completely covered it by April 1965, just 2 months after it was built. Above freezing temperatures and rain were recorded at Palmer every month of the first winter.

The next summer the icebreaker *Eastwind* spent January and February 1966 performing biological and oceanographic studies up and down the peninsula between Marguerite Bay in the south and the South Shetlands. During that time *Eastwind* and USNS *Wyandot* resupplied the station. Palmer's second winter passed much as the first, with a station population of eight.

Meanwhile, plans were being drawn up for a larger station to provide for an expanded scientific staff and for sophisticated laboratory spaces. Also, the Foundation was going ahead with plans for the 38-meter sail-equipped trawler recommended for re-



The Antarctic Peninsula is the most populated region in Antarctica. Six nations maintain 13 year-round stations in this region.

R/V *Hero*, launched on 28 March in South Bristol, Maine, arrives in Arthur Harbor for the first time on 25 December 1968.

search use in conjunction with Palmer. The keel for this ship, to be called the *Hero*, was laid in October 1966.

Although the ship would be used mainly in the austral summer, winter operations appeared feasible. Information and photos obtained during winter overflights in September 1964 and August 1966 indicated that there were open water areas along the peninsula where a vessel such as *Hero* could operate, and those aboard the 1966 flight concluded that ship operations could have been conducted in the Bransfield and Gerlache Straits and in the vicinity of Arthur Harbor. Further, the people at the station in August 1965 had concluded that "a small vessel could have eased through the lightly frozen surface of Arthur Harbor, although the heavy floes at sea probably would have been hazardous."

Construction of the new station, at 64°46'S 64°03'W on Gamage Point, took four seasons. In January, February, and March 1967, 26 Navy Seabees helped by the crew of the icebreaker *Westwind* put up a construction camp, built the wharf, finished the subfloor of the first building, and completed the fuel tanks and most of the salt water intake line. In 3 months during the 1967-1968 season, 32 Seabees and the *Southwind* crew finished the first building, called the biolab building. In the 1968-1969 season, 31 Seabees got the second building, containing a garage, a warehouse, and recreation areas, about two-thirds complete. They also got a Christmas present. R/V *Hero*, launched 28 March in South Bristol, Maine, arrived at its new home port of Palmer Station, Antarctica, on 25 December 1968. (An article on pages 65-69 of the May/June 1975 *Antarctic Journal* describes *Hero* and its work.) The following season 28 Seabees completed construction of the new station in January, February, and March 1970.

Station facilities

Palmer Station is centrally located for operations up and down the west side of the Antarctic Peninsula and in the South Shetland Islands. It serves as a primary shore facility and as an operational base for R/V *Hero*. Ship and station together comprise a research system that can support ship-based and shore-based research projects throughout the peninsula area.

The biolab building is a two- and three-story steel frame building with 888 square meters (9,559 square feet) of floor space. Biological laboratories, a storage area for laboratory equipment, electronics workshop, radio room, photo lab, and two offices are in one wing of the building. In 1981, the station's wet biological laboratory was named in honor of Mary Alice McWhinnie for her significant contributions to antarctic marine biology. The center (three-story) section has living quarters for 22 people, a dining room, kitchen, lounge, dispensary, machine/carpenter shop, and utilities for the building including a standby generator. The other wing has small boat supplies, dry and refrigerated stores, diving locker, and boatshop. Adjacent to this building is a van serving as science library and two small prefabricated buildings containing sea-water aquaria for experimentation with marine organisms, particularly krill.

The second major building at Palmer, a two-story steel frame building, has 743 square meters (8,000 square feet) of floor space. It contains a vehicle maintenance facility, storage space, frozen and dry food storage, recreation room, station store, ham radio room, laboratory spaces for meteorology and upper atmosphere physics, sleeping quarters for 10, and utilities including the main power plant (two 150-kilowatt generators). Each building is capable of operating independently and could support all station personnel in an emergency.

Other installations include two 470,000-liter (125,000-gallon) steel tanks for storage of diesel fuel marine (DFM), which is used both by the station generators and furnaces and by *Hero*.

Fresh water is piped in summer from a glacial melt pond and is available in quantities exceeding the needs of the station and *Hero*. In winter, sea water is desalinated using shipboard-type equipment, which delivers as much as 1,900 liters (500 gallons) a day; rationing is required infrequently.

Wastewater is discharged into Arthur Harbor, ungrindable kitchen waste is sealed in drums and dumped in the deep sea, and trash is burned, compacted, and placed in a dump. Accumulated items having scrap value are removed to South America from time to time.

Rolling stock comprises a Galion mobile crane (8,600 kilograms or 9.5 ton capacity), Caterpillar 910 and 944 wheeled loaders, and a rough-terrain forklift.

Zodiacs (inflatable rubber boats) transport scientists to local islands (within 3 kilometers or 2 miles) for research. The Mark II (14-foot) and Mark III (16-foot) models are used; they are powered by 9 and 25 horsepower outboard motors and can be driven slowly through the brash ice that occurs commonly in and around Arthur Harbor.

Year-round operation of Palmer requires six people: a station manager, a medic, a facility engineer, a mechanic, a communications coordinator, and a cook. In summer, the increased level of scientific activity, boating, resupply, and *Hero* calls require these additional support personnel: boating coordinator, materials person, mess person, laborer, and craftsperson. All these personnel are employed by the Foundation's contractor for support in Antarctica—currently ITT Antarctic Services, Inc. The Palmer station manager reports to the contractor's deputy program director for *Hero*/Palmer, who most of the year is at headquarters in Paramus, New Jersey. During part of the summer season a staff member of the Division of Polar Programs serves at Palmer as NSF Representative, Antarctic Peninsula, to oversee operations and coordinate use of facilities by science parties.

The main resupply of Palmer Station takes place once a year (usually in January). Currently one of the new U.S. Coast Guard icebreakers (*Polar Star* or *Polar Sea*) delivers fuel and cargo. *Hero* delivers additional cargo during its trips between Palmer and ports at the southern tip of South America, and it is usually *Hero* that "deep-sixes" Palmer's drummed kitchen wastes during crossings of the Drake Passage.

Palmer Station is operated almost completely independent of the rest of the land-based part of the United States Antarctic Research Program. McMurdo Station, the logistics hub of the majority of the program, is 2,000 miles away. The other two U.S. stations—Siple (in Ellsworth Land) and South Pole—are fully dependent logistically on McMurdo. U.S. antarctic aircraft operations—a squadron of UH-1N helicopters and ski-equipped C-130 airplanes—are centered at McMurdo. U.S. aircraft have never landed at Palmer. The Marr Ice Piedmont, adjacent to the station, is suitable for a skiway but can become soft and sticky during Palmer's relatively warm summer. Winter flights to the station have never been attempted because of the lack of operational need and the large expense involved in sending out a plane from California, the squadron's austral winter headquarters. Small ski-equipped airplanes—particularly Twin Otters of Britain and Argentina—and Chilean helicopters visit several times a year, contributing to the neighborly atmosphere of the many-stationed Antarctic Peninsula area. Other visitors nearly every summer include ships operated by the other nations with stations in the area, tourist ships, and privately-operated sailboats.

Scientific research

When *Hero* and the laboratory at the station became available to scientists in late 1968, the research emphasis at Palmer turned to biology. Of particular interest was the marine ecosystem, and in the years that followed nearly every level from microbes to seals was studied to reveal population characteristics, physiology, and interrelationships. Many of these projects—lasting as long as 5 years—relied on *Hero* for the collection of specimens and for on-board lab work, then performed further research in the laboratory at Palmer. Others made their collections near the station—in Arthur Harbor and at the numerous small islands within a few kilometers of the station.

Following are a few highlights of research performed primarily at Palmer Station since its establishment in 1965.

Oregon State investigators collected daily water samples at Arthur Harbor from May 1970 to February 1971 and analyzed them for dissolved oxygen, pH, salinity, and temperature. They observed three distinct periods in the dissolved oxygen content and pH—gradual reductions from May to August, a sharp increase starting in mid-September, and a steep decrease starting in January. Primary production in summer was intense.

Florida State University researchers collected terrestrial and marine samples during the 1966-1967 season to study the role of microorganisms in weathering of rocks, biochemistry of guano formation, microbial content of raw soils, and nutrient contribution of the land to the near-shore sea environment.

Investigators from the University of California at Davis made more than 1,300 scuba dives from 1971 to 1975 to study the distribution and ecology of shallow-water benthos, with emphasis on foraminifera—tiny, shelled sea animals. Foraminifera have an important role in the marine community, serving as the main food for some worms and mollusks and a secondary food for other animals. The work described and quantified Arthur Harbor's ecosystem and showed it to be typical of much of the Antarctic Peninsula area; the scientists identified six depth-related zones with representative distributions of species and trophic relationships. The California group also performed quantitative and taxonomic studies of diatoms, microscopic algae that dominate Arthur Harbor's microalgae community. Sea ice formation proved of immense importance for diatom blooms and other life forms: it reduces the light entering the water, changes salinity, denudes the nearshore zone, and limits vertical migration of plants and animals.

Oregon State University scientists spent several years investigating the macrobenthic assemblages of Arthur Harbor and other Antarctic Peninsula locations. They found the density of macrofauna (worms, mollusks, sea spiders, sponges, etc.) in soft-bottom areas of Arthur Harbor to be four times greater than that of the inner continental shelf off New England. The slow growth of benthic animals possibly due to low temperatures is offset by physical stability of the environment (except for iceberg groundings). The community makes rapid and efficient utilization of organic matter.

Antarctic krill did not get much attention at Palmer until 1974, when the University of California at Davis group collected 130 individuals 19 kilometers west of Palmer and used electrophoresis to study genetic variability, which they found to be low. This finding fit the hypothesis that a varying food supply forces individuals to be highly flexible; selection thus favors genes that code for generalized functions. In the 1977-1978 season seawater aquaria were installed at Palmer, and DePaul University biologists began a study of krill reproduction, food consumption, and rate of growth. Krill populations were kept alive in the tanks for 2 years, enabling study of maturation, lifespan, and response to light and other environmental factors. In one experiment adult krill were found to decrease in length when poorly fed.

The three-story portion of the main building at Palmer Station houses living quarters for 22 people, a dining room, kitchen, lounge, dispensary, machine and carpenter shop, and utilities for the building. The biology laboratories, laboratory equipment storage, an electronics workshop, radio room, photo darkroom, and two offices are in the left wing; small boat supplies, dry and refrigerated stores, a diving locker, and a boatshop are in the right wing.

NSF photo by Erick Chiang.

The blood of chaenichthyid fishes, or "icefishes," is cloudy white because it has no hemoglobin—the protein that makes other animals' blood red and transports oxygen and carbon dioxide. Fish research at Palmer has centered on this family. During the early 1970s investigators from the University of Missouri and Scripps Institution of Oceanography studied the physiology of these unusual fishes and determined how they survive without red blood cells. The metabolic rate, already low because of the cold water, is reduced further in specific adaptation that reduces demands for oxygen transport. Blood pressure is strikingly lower than that of other fishes, yet volume and flow are higher. The icefish moves slowly: at rest, the energy cost for cardiac and respiratory function represents half or more of total oxygen consumption.

The numerous moss- and lichen-covered rocky peninsulas and islands around Palmer, coupled with a sea extraordinarily rich in marine life, provide a haven for birds. Twenty-two species have been seen near Palmer; of these, several are year-round residents and 11 breed in the neighborhood. Research on birds has included extensive studies of population, behavior, ecology, physiology, and presence of pollutants. Institutions involved include the University of Minnesota, University of California (Bodega Marine Laboratory, Scripps Institution of Oceanography), and Case Western Reserve University.

Seal studies, centering on leopard and elephant seals common to the area, have included behavior and physiology, seal/penguin interactions, and respiration studies using a chamber to simulate dives. Institutions involved include University of Minnesota, State University of New York (Syracuse), and Scripps Institution of Oceanography.

The land ecosystem also has received attention. Researchers principally from Clark University and Ohio State University have studied the photosynthesis, respiration, and physiology of lichens, mosses, algae, and fungi. Antarctica's only land animals—springtails, midges, and mites—abound at Palmer and have been studied to determine population density, energy flow, and cold survival strategies; the Bishop Museum (Honolulu) and the University of Houston are the major institutions involved. Virginia Tech limnologists investigated the ecology of freshwater lakes in the Palmer area and chose for intensive study two lakes 0.6 kilometers apart with strikingly different trophic states. Study of natural eutrophication (oxygen deficiency) in these simple antarctic lakes has contributed to an understanding of accelerated eutrophication caused by pollution of lakes in other parts of the world.

Winter personnel, Palmer Station

	Science	*Support*	*Total*
1965	5	4	9
1966	4	4	8
1967	5	4	9
1968	3	6	9
1969[1]	4	8	12
1970	1	7	8
1971	2	9	11
1972	4	9	13
1973	5	10	15
1974[2]	3	6	9
1975	4	6	10
1976	1	5	6
1977	2	5	7
1978	3	6[3]	9
1979	4	6	10
1980	1	6	7
1981	4	6	10
1982	2	6	8

[1] First winter in new building on Gamage Point.
[2] First winter of contractor support, replacing U.S. Navy support.
[3] Support staff in 1978 and following years includes a U.S. Navy corpsman (medic).

While biology has been emphasized at Palmer, the other disciplines have not gone unstudied. University of California (Davis) investigators made physical and chemical oceanographic determinations and solar radiation measurements in Arthur Harbor to assist the biological work. Ohio State glaciologists measured snow accumulation, ice movement, strain, and ice thickness on the Marr Ice Piedmont adjacent to the station. Geophysical work has included an Ohio State gravity survey of Anvers Island, magnetometer observations, and geodetic studies including operation of a satellite observatory by the University of Texas. Real-time voice and data transmission between the United States and Palmer, using the ATS-3 satellite, came in 1977 with a University of Nevada project to study weather phenomena and air-sea interactions. The following year Stanford University physicists established a very-low-frequency radio observing program to complement similar work at Siple Station. The Nevada group introduced laser profiling of atmospheric constituents in 1979. Ohio State meteorologists made extensive surface weather observations during the station's first 2 years; standard observations have continued to the present.

Scientific research at Palmer Station has increased with time as scientists have recognized the natural advantages of the station's location and have focused on research problems identified in earlier work. During the 1981-1982 summer season, research was conducted on metabolism and behavior in crustacea including krill, early larval survival of krill, trophodynamics of marine fauna, reproductive patterns in seals, insect resistance to freezing, protein adaptations, presence of hydrocarbons in birds, very-low-frequency waves in the ionosphere, air chemistry, and meteorology. These scientific challenges are different from the contrary winds, fogs, and icebergs that challenged Nathaniel Palmer in 1820, and they bring different problems. In late 1981 the 40-odd scientists and support personnel at Palmer established an informal consortium to consider their major challenge: not ice, or cold, or lack of fresh food, but crowding in the station's research laboratories during the busy summer season.

—Guy G. Guthridge, Division of Polar Programs, National Science Foundation.

Antarctic mineral resources focus of the Eleventh Antarctic Treaty Consultative Meeting

At the Eleventh Antarctic Treaty Meeting in Buenos Aires, Argentina, representatives of the 14 Antarctic Treaty consultative nations emphasized the need to begin negotiations for a regime governing mineral resource activities in Antarctica. Other topics discussed at the meeting, held from 23 June to 7 July 1981, included the Convention on the Conservation of Antarctic Marine Living Resources, improved telecommunications for collecting and distributing meteorological data, oil pollution in antarctic waters, sites of special scientific interest and specially protected areas, tourism and nongovernmental expeditions, exchange of information, public availability of consultative meeting documents, and the status and appointment of observers to Treaty meetings.

Three recommendations and a special statement commemorating the twentieth anniversary of the entry into force of the Antarctic Treaty were developed and adopted by the representatives. These new recommendations increase to 130 the number of Treaty recommendations made since the first consultative meeting in 1962.

Recommendations to the Treaty extend its principles and objectives. The Antarctic Treaty reserves the area south of 60° South for peaceful purposes, sets aside territorial claims, ensures free access throughout the area, permits member nations to inspect installations, prohibits military participation except in support of peaceful activities, and encourages scientific investigation and international cooperation. The nations which are signatories to the Antarctic Treaty are Argentina, Australia, Belgium, Chile, France, Federal Republic of Germany, Japan, New Zealand, Norway, Poland, the Republic of South Africa, the Soviet Union, the United Kingdom, and the United States.

In their commemoration of the twentieth anniversary of the Treaty's entry into force, the representatives emphasized that recommendations to the Treaty have a crucial role in the continuing evolution of the consultative process. They recognized the International Geophysical Year (1957-1958) as the model for the Treaty's foundation of continued, peaceful cooperation and freedom of scientific investigation. With these principals as its basis, the treaty system has made possible rapid growth of knowledge about Antarctica and has enabled the consultative nations to develop successful methods to protect the environment and ecosystems of Antarctica.

At the Tenth Treaty Meeting in 1979, representatives stressed the need to develop as quickly as possible a system for managing mineral resource activities in Antarctica. During the Eleventh Treaty Meeting representatives recommended that a Special Consultative Meeting convene to determine the form that this system should take, to establish a negotiation schedule, and to take any necessary steps to facilitate the conclusion of the regime. The recommended principles guiding the formation of this management regime are that—

- the consultative parties will continue to take an active and responsible role in any question relating to antarctic mineral resources;
- the Antarctic Treaty will be maintained;
- the antarctic environment and its ecosystems will be protected;
- the consultative parties will not prejudice the rights of all mankind in Antarctica when dealing with mineral resource questions;
- the contracting parties of the agreement will not prejudice the recognition or nonrecognition of antarctic territorial claims.

The management system must provide for means to assess the possible environmental impact of mineral resource activities, determine the acceptability of mineral resource activities, and govern the ecological, technological, political, legal and economic aspects of accepted activities. As a part of this system procedures that protect the antarctic environment will be developed and will apply to all mineral resource activities. The area covered by the management regime will include the continent and adjacent offshore areas, not including the deep seabed, although the precise limitations of the area of application have not yet been determined. Other provisions include arrangements between an antarctic mineral regime and other relevant international organizations, consideration of commercial exploration and exploitation, and resource management decisions. Special attention will continue to be given to the requirements identified in the Report of Ecological, Technological, and other Related Experts on Mineral Exploration and Exploitation in Antarctica and to developing new programs to improve predictions of environmental impacts of activities, events, and technologies associated with mineral resource exploration and exploitation.

The first Special Consultative meeting, similar to those held to discuss the Convention on the Conservation of Antarctic Marine Living Resources, will be held in Wellington, New Zealand, in late May or early June 1982.

In a second recommendation, representatives urged their governments to seek the earliest possible entry into force of the Convention of the Conservation of Antarctic Marine Living Resources. The convention was concluded in May 1980. Eight of the 15 participating nations must ratify the convention before it enters into force; as of December 1981, six countries had ratified it.

Krill are brought aboard a Japanese fishing boat. One of the recommendations at the XIth Antarctic Treaty Consultative Meeting focuses on the Convention on the Conservation of Antarctic Marine Living Resources, which would limit the number of these creatures that could be harvested.

Other recommendations made at the Tenth Treaty meeting were reviewed. The group noted that new telecommunication stations had been established in Antarctica and that some countries had improved their telecommunications systems and the flow of their meteorological data to the Global Telecommunications System of the World Meteorological Organization. Plans have also been made by the Working Group on Logistics of the Scientific Committee on Antarctic Research (SCAR) to prepare a telecommunications manual for distribution at the Twelfth Consultative Meeting.

In their discussion of oil pollution's effect on the marine environment, the representatives agreed that SCAR should be encouraged to develop guidelines for hydrocarbon baseline measurements and to consider operating techniques and other pertinent information at its 1982 logistics symposium in Leningrad. They also discussed whether existing international conventions for the prevention of oil pollution at sea were applicable in the Antarctic and concluded that these conventions presently are adequate to minimize risks of marine pollution. However, the consulatative parties will continue to review preventative and remedial measures and procedures for oil spill clean-up used in other areas of the world.

The representatives discussed a variety of subjects related to tourism and the increased number of nongovernmental expeditions seeking help from the consultative parties. To express their sympathy to those people affected by the November 1979 air disaster on Mount Erebus, the representatives recommended that the crash site on the mountain's northern slopes be designated a tomb and left undisturbed.

Work was begun on principles that might be adopted if Areas of Special Tourist Interest were established. Discussions among the representatives pointed to a number of questions about creating these special areas, and they decided to study the subject further and discuss it again at the Twelfth Treaty Meeting.

Although all present recognized the importance of a common response to inquiries for assistance by nongovernmental expeditions, representatives decided to take this discussion up again at the next consultative meeting.

Various aspects of the Treaty system were discussed. These topics included the need for timely and complete information exchanges between consultative parties, publication, dissemination and availability of consultative meeting documents, and observers at consultative meetings. All of these topics will be studied in greater detail and discussed again at the Twelfth Consultative Meeting.

The next meeting of the consultative parties will be held in Australia in the latter part of 1983.

The texts of the three recommendations adopted at the meeting follow this article.

XI-1. Antarctic mineral resources

The Representatives,

Recalling the provisions of the Antarctic Treaty, which established a regime for international cooperation in Antarctica, with the objective of ensuring that Antarctica should continue forever to be used exclusively for peaceful purposes and should not become the scene or object of international discord;

Convinced that the framework established by the Antarctic Treaty has proved effective in promoting international harmony in furtherance of the purposes and principles of the United Nations Charter, in prohibiting *inter alia* any measures of a military nature, in ensuring the protection of the Antarctic environment, in preventing any nuclear explosions and the disposal of any radioactive waste material in Antarctica, and in promoting freedom of scientific research in Antarctica, to the benefit of all mankind;

Convinced further of the necessity of maintaining the Antarctic Treaty in its entirety and believing that the early conclusion of a regime for Antarctic mineral resources would further strengthen the Antarctic Treaty framework;

Desiring without prejudice to Article IV of the Antarctic Treaty to negotiate with the full participation of all the Consultative Parties to the Antarctic Treaty an appropriate set of rules for the exploration and exploitation of Antarctic mineral resources;

Noting the unity between the continent of Antarctica and its adjacent offshore areas;

Mindful of the negotiations that are taking place in the Third United Nations Conference on the Law of the Sea;

Reaffirming their commitment to the early conclusion of a regime for Antarctica mineral resources which would take due account of the respective interests of the Consultative Parties as regards the form and content of the regime, including decision-making procedures, as well as the special characteristics of the Antarctic area;

Recalling Recommendations VII-6, VIII-14, IX-1, and X-1;

Recalling further Recommendations VI-4, VII-1, VII-11, VII-13, IX-5, IX-6 and X-7;

Recommend to their Governments that:

1. They take note of the progress made toward the timely adoption of a regime for antarctic mineral resources at the Eleventh Consultative Meeting and related meetings and the importance of this progress.

2. A regime on antarctic mineral resources should be concluded as a matter of urgency.

3. A Special Consultative Meeting should be convened in order:

(a) to elaborate a regime;

(b) to determine the form of the regime including the question as to whether an international instrument such as a convention is necessary;

(c) to establish a schedule for negotiations, using informal meetings and sessions of the Special Consultative Meeting as appropriate; and

(d) to take any other steps that may be necessary to facilitate the conclusion of the regime, including a decision as to the procedure for its adoption.

4. The Special Consultative Meeting should base its work on this Recommendation and the relevant Recommendations and Reports of the Eighth, Ninth and Tenth Antarctic Treaty Consultative Meetings.

5. The regime should be based on the following principles:

(a) the Consultative Parties should continue to play an active and responsible role in dealing with the question of antarctic mineral resources;

(b) the Antarctic Treaty must be maintained in its entirety;

(c) protection of the unique antarctic environment and of its dependent ecosystems should be a basic consideration;

(d) the Consultative Parties, in dealing with the question of mineral resources in Antarctica, should not prejudice the interests of all mankind in Antarctica;

(e) the provisions of Article IV of the Antarctic Treaty should not be affected by the regime. It should ensure that the principles embodied in Article IV are safeguarded in application to the area covered by the Antarctic Treaty.

6. Any agreement that may be reached on a regime for mineral exploration and exploitation in Antarctica elaborated by the Consultative Parties should be acceptable and be without prejudice to those states which have previously asserted rights of or claims to territorial sovereignty in Antarctica as well as to those States which neither recognize such rights of or claims to territorial sovereignty in Antarctica nor, under the provisions of the Antarctic Treaty, assert such rights or claims.

7. The regime should *inter alia*:

I. Include means for:

(a) assessing the possible impact of mineral resource activities on the antarctic environment in order to provide for informed decision-making;

(b) determining whether mineral resource activities will be acceptable;

(c) governing the ecological, technological, political, legal and economic aspects of those activities in cases where they would be determined acceptable, including:

—the establishment, as an important part of the regime, of rules relating to the protection of the Antarctic environment; and

—the requirement that mineral resource activities undertaken pursuant to the regime be undertaken in compliance with such rules.

II. Include procedures for adherence by States other than the Consultative Parties, either through the Antarctic Treaty or otherwise, which would:

(a) ensure that the adhering State is bound by the basic provisions of the Antarctic Treaty, in particular Articles I, IV, V and VI, and by the relevant Recommendations adopted by the Consultative Parties; and

(b) make entities of that State eligible to participate in mineral resource activities under the regime.

III. Include provisions for cooperative arrangements between the regime and other relevant international organizations.

IV. Apply to all mineral resource activities taking place on the Antarctic Continent and its adjacent offshore areas but without encroachment on the deep seabed. The precise limits of the area of application would be determined in the elaboration of the regime.

V. Include provisions to ensure that the special responsibilities of the Consultative Parties in respect of the environment in the Antarctic Treaty area are protected, taking into account responsibilities which may be exercised in the area by other international organizations.

VI. Cover commercial exploration (activities related to minerals involving, in general, retention of proprietary data and/or non-scientific exploratory drilling) and exploitation (commercial development and protection).

VII. Promote the conduct of research necessary to make environmental and resource management decisions which would be required.

8. They promote and cooperate in scientific investigations which would facilitate the effective operation of the regime taking into account, *inter alia*, the relevant parts of the Report of Ecological, Technological and Other Related Experts on Mineral Exploration and Exploitation in Antarctica (Washington, June 1979), attached as an annex to the Report of the Tenth Consultative Meeting.

9. With a view to improving predictions of the environmental impacts of activities, events and technologies associated with mineral resource exploration and exploitation should such occur, they continue with the assistance of the Scientific Committee on Antarctic Research, to define programs with the objectives of:

(a) Retrieving and analyzing relevant information from past observations and research programs;

(b) Ensuring in relation to the needs for information identified by the Experts Report, that effective use is made of existing programs;

(c) Identifying and developing new programs that should have priority, taking account of the length of time required for results to become available.

10. In elaborating the regime, they take account of the provisions of Recommendations IX-1, paragraph 8.

XI-2 Antarctic marine living resources

The Representatives,

Recalling the responsibilities of the Consultative Parties regarding the conservation of Antarctic marine living resources;

Recalling further the history of actions taken by Consultative Parties concerning protection of the Antarctic ecosystem, including in particular, Recommendations III-VIII, VIII-10, VIII-13, IX-2, IX-5 and X-2;

Welcoming the conclusion of the Convention on the Conservation of Antarctic Marine Living Resources at a diplomatic conference held in Canberra, Australia in May 1980 and the signature of that convention, also in Canberra, Australia in September, 1980;

Noting that a meeting is to be held later this year in Hobart, Tasmania to consider steps to facilitate the early operation of the Commission, the Scientific Committee and the Executive Secretariat to be established under the Convention on the Conservation of Antarctic Marine Living Resources;

Recommend to their Governments that:

1. They seek the earliest possible entry into force of the Convention on the Conservation of Antarctic Marine Living Resources; and

2. They take all possible steps to facilitate the early operation of the bodies to be established by the Convention on the Conservation of Antarctic Marine Living Resources upon entry into force.

XI-3 Air disaster on Mount Erebus

The Representatives,

Recalling with respect that in the years of exploration and research many have travelled to and worked in Antarctica and not returned;

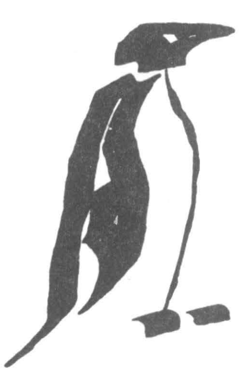
Noting that on November 28, 1979, two hundred and fifty-seven people of several nationalities lost their lives when the aircraft in which they were travelling crashed into the slopes of Mount Erebus, Ross Island, Antarctica;

Aware that in spite of the determined and courageous action of members of the New Zealand and United States Antarctic expeditions the bodies of some of those who died could not be recovered;

Aware, too, that no permanent memorial may be placed on the ice slopes at the site of the tragedy;

Express, their deep sympathy with the relatives of those who died and with the Government and people of New Zealand; and

Recommend to their Governments that the site on the northern slopes of Mount Erebus where the accident took place be declared a tomb and that they ensure that the area is left in peace.



U. S. Navy photo (700094) by PH2 Jolin

For the last 8 years, the U. S. Geological Survey has tracked satellites continuously at Amundsen-Scott South Pole Station. Because South Pole Station is on a moving ice sheet, the position of the tracking antenna is recomputed monthly. Using data from the satellites, researchers have recomputed the elevation of the snow surface at the South Pole and found it to be 2,835 meters. This aerial photo was taken in 1976.

Elevation of Amundsen-Scott South Pole Station: 2,835 meters

In 1957 when regular meteorological measurements at Amundsen-Scott South Pole Station were begun, the elevation (height above mean sea level) of the site was not known with desirable exactness. An approximate value, 2,800 meters (9,200 feet) was assumed, corresponding to 2,808 geopotential meters (gpm) (*Smithsonian Meteorological Tables*, fifth edition, 1958, Tables 49 and 50). Geopotential height is the height of a given point in the atmosphere in units proportional to the potential energy of unit mass (geopotential) at this height relative to sea level.

In the following 18 years, this value was employed for pressure-height computations, in particular the heights of the so-called standard pressure levels, 700 millibars, 500 millibars, and so on. Such height values are used to construct geopotential contour maps (absolute topographies) of constant pressure levels, provided simultaneous data are available for several stations. The reliability of such maps depends on the correctness of the measurements and on the distance between the individual stations. Until 1970, the place with radiosonde ascents nearest to the South Pole was Byrd Station (80°S 120°W). Since then the nearest station is the USSR station Vostok (78°28′S 106°48′E, 3,488 meters). An error in any of the basic values, such as the elevation of a station, would affect the contour on the upper air maps over a large part of the interior of Antarctica, as well as the geostrophic winds computed from such maps. For instance, this statement applies to the numerical data, maps, and graphs for the area south of 75°S in the valuable and often quoted volumes of *Climate of the Upper Air, Southern Hemisphere*, volumes I to IV, 1969 and 1971 (jointly produced by National Center for Atmospheric Research, National Oceanic and Atmospheric Administration (NOAA), and Department of Defense). Likewise it applies to the widely distributed NOAA-World Meteorological Organization series *Monthly Climatic Data for the World* and consequently to some monographs and many papers in meteorological journals.

In the early 1970s, the elevation of the South Pole station was determined to be close to 2,846 meters. That value was introduced, without any further comment or explanation, as 9,340.6 feet in the station description on page VII of the NOAA publication *Climatological Data for Amundsen-Scott, Antarctica, for 1974 and 75*, No. 14, June 1977, while the other periodical published by NOAA (*Monthly Climatic Data for the World*) did not take notice of the change. Nevertheless, the value of 2,846 meters is the basic value employed since 1 January 1975 in the evaluation of the daily upper air soundings at the South Pole.

In the meantime, the situation has become more confusing and in need of repair, because two recent National Science Foundation publications (U.S. Antarctic Research Program, Personnel Manual, and *Antarctic Journal of the U.S.*, Vol. 15, numbers 2, 3, and 4) give the South Pole elevation as 2,912 meters. In fact, the appearance of that value and the possibility of a discrepancy as large as 112 meters raised new questions and provided the impulse for an inquiry and this note.

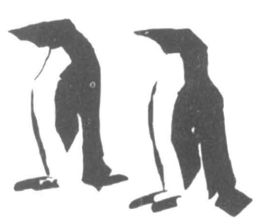
Fortunately, a well-founded answer can now be given, thanks to the valuable cooperation of the Chief of the Field Instrumentation Section, U.S. Geological Survey, in Reston, Virginia, William H. Chapman, who contributed the following information:

"*South Pole Station elevation*: For over 8 years the U.S. Geological Survey has continuously operated a satellite tracking instrument at the Amundsen-Scott Station, Antarctica, at the South Pole. The instrument is a Geoceiver and is part of the TRANET network that consists of 20 to 30 such instruments distributed about the earth. The main purpose of this network is to monitor selected satellites of the U.S. Navy Navigational Satellite System so that precise orbit parameters for these satellites can be computed and made available for applications requiring accurate positioning.

"Because the South Pole Station is on a moving ice sheet, it is necessary to recompute the tracking station position at monthly intervals. Twenty positions have been computed during the last 2 years. The height value has varied from 2,805.8 to 2,807.4 meters above the adopted ellipsoid; the mean is 2,806.6 meters. Several corrections to this value are required to obtain an elevation, a height above sea level. These are for antenna height (-3.0 meters), for difference in ellipsoids (5.0 meters), and for the geoid height (26.6 meters). The last correction was obtained from the National Aeronautics and Space Administration's GEM 10B geoid model. These values combine to give an estimate of the elevation (height above the geoid) of the snow surface at the South Pole of 2,835 meters. This method of computing elevations was tested at two antarctic coastline stations where sea level heights are easily obtained. The agreements were good, and therefore we estimate the computed elevation of the South Pole Station is within 5 meters."

Hence, 2,835 meters (2,843 gpm) is the value for the elevation of the snow surface at the South Pole which should be used in the coming years. For this reason the following corrections should be applied to all geopotential height values obtained by radiosondes released at Amundsen-Scott Station—1957-74: +35 gpm and 1975-81: -12 gpm.

—Werner Schwerdtfeger, Department of Meteorology, University of Wisconsin.



Federal Republic of Germany establishes antarctic program

German interest in antarctic research began 100 years ago, when Georg von Neumyer, for whom a newly established German station is named, helped promote the first International Polar Year in 1882-1883. In 1902-1903, Georg von Drygalski on the *Gauss* led the first German expedition to the continent primarily to study geophysics. During a 1911-1912 expedition, Wilhelm Filchner aboard the *Deutschland* penetrated the Weddell Sea as far south as the ice shelf which now bears his name. His party did some surveying in the area of the ice shelf and began their northward return trip, during which the ship became trapped in the pack ice for nine months. The "Schwabenland Expedition" (1938-1939) under the leadership of A. Ritscher was the last prewar expedition and completed a large-scale aerial photo survey. Forty years after the Ritscher expedition, the Federal Republic of Germany decided to renew antarctic research efforts. In early 1981 the country established its first year-round station in Antarctica, at Atka Iceport (70°35'S 7°51'W), for a cost equivalent to $10 million U.S. dollars and by late 1982 will have its first polar research and supply ship, the *Polarstern*.

Early German research in the Antarctic mainly comprised earth magnetic and other geophysical studies, investigations of deep water circulation, and comparative biology of arctic and antarctic planktonic fauna and flora. Since World War II research has concentrated on krill as one of the most important marine living resources. In 1975-1976 and 1977-1978 seasons, two German ships went to the Scotia Sea to investigate krill and fish stocks. In 1980-1981 two Federal Republic research vessels, *Meteor* and *Walther Herwig*, participated in the First International BIOMASS Experiment (FIBEX), which was devoted primarily to krill studies. At the same time, the German Federal Institute for Geosciences and Mineral Resources of Hannover sponsored a number of geological and geophysical expeditions to the Weddell and Ross Seas and northern Victoria Land. More and more German scientists also participate in the polar geology and biology programs of other countries, some as exchange scientists with the United States Antarctic Research Program. With the opening of the year-round station, German antarctic research has expanded to include glaciology and meteorology at the station and in the surrounding areas. A summer station, to be established on the Filchner Ice Shelf, will further extend research capabilities.

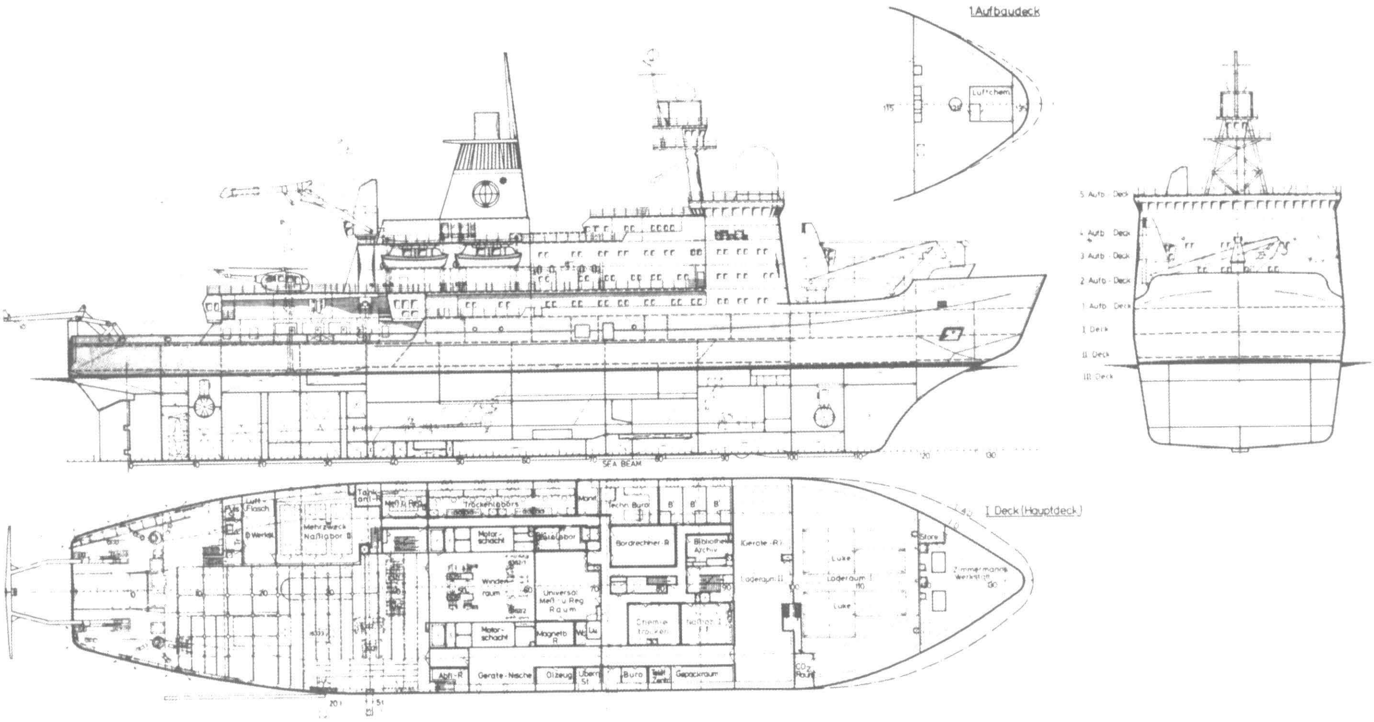
The construction of the Atka Iceport year-round station involved interesting engineering problems. The core of the station consists of two 50-meter-long tubes in which containers are placed for living quarters, workshops, a power plant, and a garage for snow vehicles. Over the years the station will slowly but steadily sink into the ice and move with the ice shelf toward the sea. During the 1981 winter five people occupied the station; in the future, the station will house up to 40 persons in summer and 10 in winter.

Both the station and the 118-meter, $80-million (U.S. dollars) research and supply vessel will be under the supervision of the Alfred Wegener Institute for Polar Research, established in Bremerhaven in 1980. Over the next few years, the Institute will expand its staff to 150 scientists, technicans, and others. Besides providing logistics, the Institute also will sponsor scientific research in all natural sciences and conduct seminars, workshops and other meetings. Visiting scientists and postdoctoral and other students, many from foreign countries, will be invited to participate in the research institute's programs.

German polar research will not be completely centralized in the Institute for Polar Research. Individual scientists or small scientific groups, scattered throughout universities and federal and independent institutions, are funded by the German Research Society (Deutsche Forschungsgemeinschaft), which has developed a special antarctic research program and has made available each year the equivalent of $1 million U.S. dollars for scientific investigations. The logistic needs of these activities will be met by the Institute for Polar Research.

Specifications of the Polarstern

Over all length	118.00m
Length on deck	102.20m
Width	25.00m
Height of gunnal to the main deck	13.60m
Draft	10.50m
Load carrying capacity	3900 metric tons
Speed	15.50 knots
Power	4x3670kW
Total passenger capacity	106
Crew	36
Scientific personnel	40
Replacement crew for polar station	30



The *Polarstern*, the new 118-meter-long West German research ship, is ice-strengthened and will be used for research and station resupply.

Two other federal institutes, one for geosciences in Hannover and one for fisheries research in Hamburg, have already conducted important applied research in Antarctica, and have received strong support from the Ministries of Commerce and of Food. It is envisioned that the new Institute for Polar Research will coordinate all of these activities, on both a national and international level.

The Institute's research program encompasses arctic as well as antarctic studies. Planned research projects include investigations of trace elements in the polar atmosphere, water, sediments, and organisms, and studies of Mesozoic rocks in the area between the Weddell and Ross Seas.

Marine geophysics will be linked to onshore investigations, the ice dynamics of the Filchner Ice Shelf will be studied, and climatological and paleoclimatological observations will be made, particularly in support of the international World Climate Program. Air-ice-sea interactions and the formation of bottom water and small scale inhomogeneities of the surface water as they relate to phytoplankton and krill also will be investigated. Satellite observations will augment the study of surface ice drift patterns and temperature distribution. In biology three fields will receive attention: cold adaptation on the cellular level, ecophysiology of marine organisms particularly krill, and interactions on the community level. In all this work, close cooperation with other countries interested in polar research is planned, either in the framework of international programs or through bilateral cooperation at the national and institutional levels.

—Gotthilf Hempel, Director of the Alfred-Wegener Institute of Polar Research, Bremerhaven, Federal Republic of Germany.

Antarctic Bibliography volume 11 published

Volume 11 of the *Antarctic Bibliography* has been published by the Library of Congress and is available for sale from the Government Printing Office. Supported by the National Science Foundation, the Cold Regions Bibliography Project of the Library of Congress Science and Technology Division has compiled indexes and abstracts of current antarctic literature and published this information in the *Antarctic Bibliography* since 1965. The edition is generated from a computerized data base.

Volume 11 contains 2,362 abstracts covering the world's current antarctic literature through 1980. The 468-page, hard bound book is arranged by 13 subject headings: general; biological sciences; cartography; expeditions; geological sciences; ice and snow; logistics, equipment, and supplies; medical sciences; meteorology; oceanography; atmospheric physics; terrestrial physics; and political geology. Items that apply to more than one subject are listed only in one section but are cross-referenced at the end of the pertinent sections. Abstracts are designed to be informative, although no attempt is made to verify or critically evaluate the author's statements or conclusions. Author, subject, geographic (place, station, or geographic feature), and grantee (organization or institution performing NSF-supported work) indexes are provided.

In addition to publications in the Library of Congress collection and those received from institutions and other federal agencies, review copies and reprints are solicited from publishing companies and authors. These contributions help significantly to make the *Bibliography* complete and current. Publishers and authors are encouraged to send review copies and reprints to the Library of Congress, Science and Technology Division, Cold Regions Bibliography Project, Washington, D.C. 20540.

The *Antarctic Bibliography*, Volume 11, is available for $15 from the Government Printing Office, Washington, D.C. 20402. Cite document number SN 030-018-00021-4 when ordering.

Antarctic and arctic proposals invited

U. S. scientists are invited by the National Science Foundation to submit proposals for research in the Antarctic and the Arctic.

Antarctic

For projects within the U. S. Antarctic Research Program (USARP), the target date for properly prepared proposals is 1 June of each year. Project descriptions for NSF proposals are limited to 15 single-spaced pages. Proposals received by 1 June 1982 will be considered for:

- research in Antarctica during the 1983-1984 austral summer season (September 1983 through March 1984) and extending through the southern hemisphere winter of 1984;
- research or data analysis in the United States to commence early 1983.

Projects requiring large amounts of equipment in Antarctica may not be fielded until 1 year later than above so that equipment may be transported by ship. Grant award notifications for 1982 proposals will be made beginning in early 1983.

Since photographic services at McMurdo Station have been greatly reduced, investigators whose projects require such services should include photography in their proposal budgets.

Interested scientists should investigate requirements for eligibility before submitting proposals in conjunction with their institutions. Proposals should follow the instructions given in the National Science Foundation booklet *Grants for Scientific and Engineering Research* (NSF 81-79). Proposal preparation kits, available through the Division of Polar Programs, must be used; they include this booklet, descriptions of antarctic research opportunities and activities, and all necessary forms and instructions.

Arctic

U. S. scientists who wish to perform research as a part of the Foundation's Arctic Research Program should submit their proposals by 1 September to request awards in the fiscal year beginning 1 October. The National Science Foundation is one of about 10 Federal agencies that sponsor or conduct arctic research. While other agencies support research in areas related to their missions, Foundation support is broader because of its assigned objective to initiate and support basic scientific research.

A list of fiscal 1981 projects supported by the Foundation may be obtained from the Division of Polar Programs. A discussion of Foundation-supported arctic research and a list of fiscal 1978 projects are available in *Arctic Research Programs* (*National Science Foundation Program Report*, vol. 3, no. 9) from the Government Printing Office. Cite stock number 038-000-00434-4 when ordering. Proposals should follow the format in the NSF *Guide to Programs* and should be submitted by investigators in conjunction with their institutions. Award notifications will be made by early 1983 for proposals received by 1 September 1982.

To obtain antarctic proposal preparation kits and announcements or arctic proposal preparation kits, contact the Polar Information Service, Division of Polar Programs, National Science Foundation, Washington, D. C. 20550 (202/357-7817).

Using a microscope in one of Palmer Station's biology laboratories, Margret Amsler studies the development of krill.

NSF photo by Erick Chiang

NSF International Travel Grants

The National Science Foundation's centralized International Travel Grant program was discontinued on 1 October 1981. Although a separate budget for international travel awards will no longer exist, policies for handling proposals and inquiries from the scientific community have been established by each NSF directorate.

Under the policy established for the Division of Polar Programs, only proposals for group travel organized through a university, professional society, or other nonprofit institution will be considered. These proposals will compete directly with research proposals for funding.

When an organization requests funds for group travel to international meetings, it must define the criteria by which U.S. scientists will be selected to participate. Generally, employees of Federal agencies will not be supported under group travel grants; however, U.S. scientists whose research is Federally supported are eligible for participation. All travel to international meetings should contribute basically to the objectives of NSF.

For more detailed information contact the appropriate program manager at the Division of Polar Programs.

Eltanin retired from antarctic service

After 15 years of service to antarctic research, the ice-strengthened ship *Eltanin* has been returned to the U.S. Navy by the National Science Foundation.

The 81-meter-long ship was built in 1957 by the Navy to support arctic operations and was converted in 1961 to meet the National Science Foundation's need for a research platform in antarctic waters. The *Eltanin's* strengthened hull, cutaway icebreaker bow, wide beam, and flat bottom provided a stable research platform that could withstand the heaviest seas and move safely through the southern ocean. Up to 38 science personnel along with a crew of 48 licensed civilian seamen could be accommodated on board, and space was available for laboratories, storage, and support facilities.

The Military Sealift Command operated the *Eltanin* for the National Science Foundation from 1962 to 1972. During this time the ship made 55 cruises totalling 410,000 nautical miles (3,014 days at sea). In December 1972 the Foundation was forced to stop operating the ship because of a budget cut.

In 1974 the *Eltanin* returned to service under a 5-year agreement between the U.S. Antarctic Research Program and the Argentine Navy in cooperation with the U.S. Navy. The *Eltanin*, renamed the ARA *Islas Orcadas*, was loaned to the Argentine Naval Hydrographic Service, which was responsible for the ship's operation. The Argentine Naval Hydrographic Service and the Argentine Antarctic Institute divided half of the ship-time between them, with the remaining time available to U.S. researchers. The United States made an annual contribution towards operating costs.

Between 1974 and 1979 the *Islas Orcadas* made eight U.S. research cruises (420 days) and six Argentine research cruises (288 days). The ship covered 116,736 nautical miles.

Data collected from aboard the *Eltanin/Islas Orcadas* increased scientific understanding of the antarctic marine environment. Research included physical oceanography, marine geology, marine geophysics, and marine biology. One major accomplishment was the completion of a circumantarctic survey, which had been an objective of the U.S. program since the late 1950's. Physical oceanography surveys by both the *Eltanin* and the *Islas Orcadas* emphasized the physical and chemical characteristics of antarctic water masses and the influence of bottom topography on current patterns and directions. A Weddell Sea survey revealed a cyclonic eddy, 28 kilometers in diameter and 300 meters deep, and demonstrated the existence of open ocean mixing processes which supplement Antarctic Bottom Water formation on the continental margin and are important to the circulation dynamics of the Weddell Sea.

NSF photo.

A researcher lowers a coring device into the water from aboard the *Eltanin*. Sediment cores obtained during the *Eltanin*'s cruises continue to provide clues to the geologic and climatic history of Antarctica.

Eltanin was used as a research platform in antarctic waters for 15 years.

NSF photo

Geophysical data obtained from the South Pacific Ocean was instrumental in establishing a reliable record of sea floor spreading and plate tectonic movement along the antarctic plate margin. From sediment cores taken by the *Eltanin* and *Islas Orcadas* scientists have produced a detailed evolutionary history of the circumantarctic current and variations in the current in response to climate change.

Initial biological studies were limited to gathering quantitative data on the flow rate of energy through the food chain, the types and quantities of standing stocks, mineralization processes, distribution of organic materials in the water column, and other biochemical and physiological characteristics of the marine environment. In the last half of the *Eltanin*'s decade and during the *Islas Orcadas* cruises the focus shifted to integrated studies of the nature and function of the entire antarctic marine ecosystem.

The *Islas Orcadas* was returned to U.S. custody in August 1979. Since that time, the ship has been stored and maintained with support from the National Science Foundation at the Navy's Inactive Ship Facility in Portsmouth, Virginia. In October 1981, the Foundation informed the Navy that budgetary constraints and rising operating costs precluded modernization and further operation of the ship. Although the U.S. antarctic program does not have an ice-strengthened research ship at this time, the program continues to support substantial marine research conducted from U.S. Coast Guard icebreakers, research ships of the U.S. academic fleet, and research ships of opportunity from the United States and other countries.

Polar archivist dies

Gerald Pagano, staff member of the Center for Polar Archives of the National Archives since 1972, died in the early morning of 17 October 1981 in Washington, D.C. Mr. Pagano, 68 years old, had worked in various polar programs for nearly 30 years.

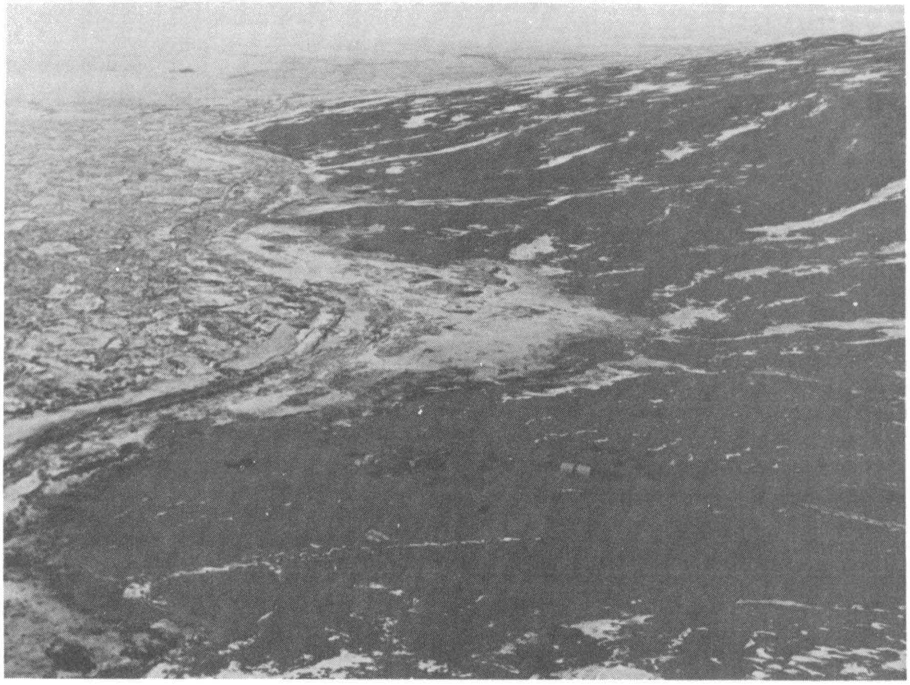
As a member of the U.S. Army (1935-1936, 1940-1965), Mr. Pagano worked with both arctic and antarctic programs. In 1955 and 1956 he was public information officer and adjutant of the U.S. military base in Thule, Greenland. After serving as military assistant to the scientific advisor of the Army Research Office, Office of the Chief, Research and Development from 1956 to 1959, he moved on to become technical information officer of the U.S. Antarctic Projects Office. In 1960, he became assistant plans and operations officer for the U.S. Naval Support Force, Antarctica (1960-1965). Before joining the staff of the Center for Polar Archives in 1972, he was on the staff of the Research Analysis Corporation (1965-1972).

Mr. Pagano was known for his keen interest in and enthusiasm for the polar regions. Because of his dedication and intellectual curiosity many valuable papers by and much information from notable polar specialists have been preserved at the National Archives. A close associate who provided him with an opportunity to become well versed in the history of antarctic exploration was Paul Siple. Because he shared this knowledge with his colleagues and others through his work, he enriched the historical record of polar exploration and research.

In recognition of his contributions to the U.S. effort in Antarctica, the U.S. Board on Geographic Names has named Pagano Nunatak in the Thiel Mountains in his honor.

Dry Valley Drilling Project volume completed

The American Geophysical Union has announced that an Antarctic Research Series volume on the Dry Valley Drilling Project has been completed and is available for purchase. The research series, supported by a National Science Foundation grant since 1963, is designed to serve scientists and graduate students, actively engaged in antarctic or closely related research, and other interested researchers in biological and physical sciences.



U. S. Navy photo (XAM 5011667-19-74) by K. K. Thornsley.

In 1974, as a part of the Dry Valley Drilling Project, this drill site was set up in Taylor Valley, southern Victoria Land.

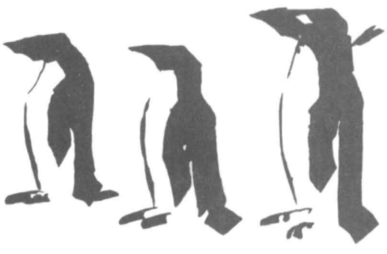
The Dry Valley Drilling Project (DVDP), begun in 1971, was a 3-year subsurface geological and geophysical investigation by scientists from the United States, Japan, and New Zealand. The first deep-rock drilling in Antarctica, the project was divided in 3 phases: geophysical and geochemical exploration of drilling sites; test drilling near McMurdo Station and limited drilling in southern Victoria Land's dry (ice-free) valleys; and drilling into sediments and basement rock in the valleys. Two kilometers of core were retrieved from the 15 DVDP holes and have provided important data on antarctic geology of the past 10,000,000 years.

The 465-page volume focuses on core analysis but includes regional geophysical surveys and downhole geophysical logging that augment understanding of the geologic setting. It contains 29 papers by U.S., Japanese, and New Zealand researchers. The papers are divided into seven categories—exploration geophysics; lithologic, geophysical, and geochemical logs; lake chemistry and hydrogeology; analyses of crystalline rocks; analyses of sedimentary rocks; glacial and geologic history; and DVDP core storage. A bibliography of other DVDP publications is included.

Preliminary analysis and other investigations of DVDP data have been published in scientific journals of the three participating nations and symposia and seminar reports. This volume does include final reports by U.S. scientists with the exception of final heat flow analysis and a synthesis of dry valley geology.

The American Geophysical Union (AGU) publishes the Antarctic Research Series as a continuing, authoritative medium for the presentation of extensive and detailed scientific research results from Antarctica. The Board of Associate Editors of the series works with individual editors to insure the quality and timeliness of each volume, and each paper is critically reviewed by two or more experts.

Dry Valley Drilling Project, edited by Lyle D. McGinnis of Northern Illinois University, is volume 33 of the Antarctic Research Series. It may be purchased for $30 from the American Geophysical Union, 2000 Florida Avenue, N.W., Washington, D.C. 20009.



Foundation awards of funds for antarctic projects, 1 July 1981 to 30 September 1981

Following is a list of National Science Foundation antarctic awards made from 1 July to 30 September 1981. Each item contains the name of the principal investigator or project manager, his or her institution, a shortened title of the project, the award number, and the amount awarded. If an investigator received a joint award from more than one Foundation program, the antarctic program funds are listed first, and the total amount of the award is listed in parentheses. Awards were initiated by the Division of Polar Programs.

Glaciology

Brooks, Ronald. Geoscience Research Corp., Salisbury, Maryland. Ice-sheet surface mapping with satellite altimetry. DPP 80-20384. $53,946.

Fireman, Edward L. Smithsonian Institution, Cambridge, Massachusetts. Composition and carbon-14 content of gas in ice at meteorite sites. DPP 80-25234. $65,975.

Kuivinen, Karl C. University of Nebraska, Lincoln, Nebraska. Coordination of ice core drilling. DPP 74-08414. $77,966. ($1,077,966).

Schubert, Gerald. University of California, Los Angeles, California. Shear heating instability in glaciers and ice sheets: a possible triggering mechanism for the inception of ice ages. DPP 80-23723. $28,103.

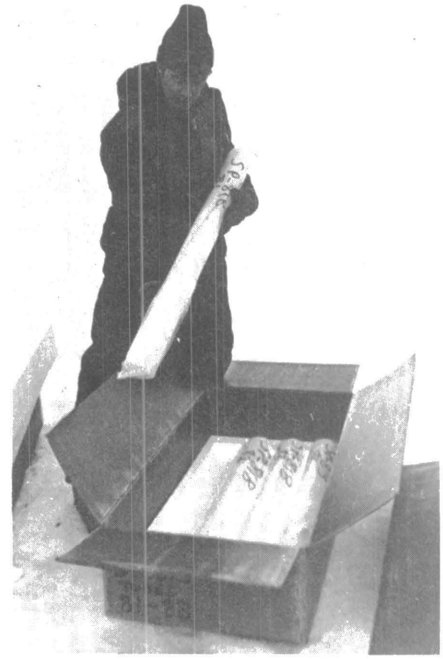
Atmospheric sciences

Doupnik, Joe R. Utah State University, Logan, Utah. Digital ionosonde studies of the ionosphere from Siple Station and Roberval, Quebec. DPP 81-00220. $168,545.

Helliwell, Robert A. Stanford University, Stanford, California. Active and passive very-low-frequency wave-particle experiments on the magnetosphere from Siple Station. DPP 80-22282. $232,552.

Mende, Stephen B. Lockheed Missle and Space Company, Inc., Palo Alto, California. Auroral imaging. DPP 80-16574. $50,000.

Pomerantz, Martin A. Bartol Research Foundation, University of Delaware, Newark, Delaware. Investigations of cosmic ray intensity variations. DPP 79-23218. $169,310.



U. S. Navy photo (XAM 0721-D-12-80) by E. R. Smith.

Karl Kuivinen from the Polar Ice Coring Office at the University of Nebraska packs ice cores, bored from the ice at South Pole Station.

Rosenberg, Theodore J. University of Maryland, College Park, Maryland. Naturally and artificially stimulated electron precipitation near the plasmapause. DPP 80-12901. $70,000.

Marine life from New Harbor near McMurdo Station. The photo was taken at a depth of 29 meters.

NSF photo by Robert. K. Cowen.

Biology and medicine

Bengtson, John L. University of Minnesota, Minneapolis, Minnesota. Changes in reproductive patterns of certain seal species as indicators of shifts in ecosystem structure and function. DPP 80-20087. $78,492.

Biggs, Douglas C. Texas A&M University, College Station, Texas. Physiological ecology of zooplankton: impact of zooplankton excretion on NH_4^+ (ammonium ion) nutrient concentration and epipelagic nitrogen cycling. DPP 79-21355. $45,123.

DeVries, Arthur L. University of Illinois, Urbana, Illinois. The effect of temperature on levels of glycoprotein anti-freeze in fishes inhabiting different thermal environments. DPP 78-23462. $7,170.

Haschemeyer, Audrey E. Hunter College, New York, New York. Adaptations in protein metabolism of organisms. DPP 80-21454. $103,232.

U. S. Navy photo (XAM 08 60-A-01-81) by Brad F. Guttilla.

William Green and Don Caufield from Miami University collect water samples from Lake Vanda in Wright Valley, southern Victoria Land. The water samples provide information on the distribution and type of trace metals in the lake and the Onyx River, which feeds the lake.

Parker, Bruce C. Virginia Polytechnic Institute and State University, Blacksburg, Virginia. Lake physiological adaptations. DPP 79-20805. $105,741.

Silver, Mary W. University of California, Santa Cruz, California. Ice algae and phytoplankton communities in the Weddell Sea. DPP 80-20616. $103,808.

Earth sciences

Cassidy, William A. University of Pittsburgh, Pittsburgh, Pennsylvania. Search for meteorites. DPP 78-21104. $46,191.

Elston, Donald P. U.S. Geological Survey, Denver, Colorado. Dry valley and McMurdo Sound magnetostratigraphy. DPP 79-07253. $24,389.

Hammer, William R. Wayne State University, Detroit, Michigan. Vertebrate paleontology of the Permian-Triassic Gondwana sequence in northern Victoria Land. DPP 80-19996. $22,207.

McKenzie, Garry D. Ohio State University, Columbus, Ohio. Intergovernmental Personnel Act mobility assignment. DPP 81-16268. $23,000. ($35,120).

Quaide, William L. National Aeronautics and Space Administration, Washington, D.C. Support of the Lunar and Planetary Institute. DPP 79-19075. $36,400.

Stump, Edmund. Arizona State University, Tempe, Arizona. Petrology and regional geology of Early to Middle Paleozoic magmatic rocks, northern Victoria Land. DPP 80-19991. $102,365.

Meteorology

Bromwich, David H. Ohio State University, Columbus, Ohio. Precipitation over the coastal areas of East Antarctica. DPP 81-00142. $83,425.

Support and services

Hushen, W. Timothy. National Academy of Sciences, Washington, D.C. Support for the Polar Research Board. DPP 79-13076. $114,520. ($155,000).

Two translations published

Problems of the Arctic and the Antarctic, 49 and *Problems of Physiographic Zoning of Polar Lands* have been translated for the National Science Foundation from Russian into English and may be purchased from the National Technical Information Service.

Problems of the Arctic and the Antarctic, 49 (1977, 167 pp., TT 77-52041, $15 domestic, $30 foreign), edited by A. F. Treshnikov, is comprised of 22 articles that cover three subject groups. The first group focuses on oceanography with particular attention to water mass circulation and heat exchange of Atlantic Ocean water in the Arctic Basin, long-term changes in thermohaline properties, and long-range tides. In the second group, the authors discuss arctic and antarctic sea ice and emphasize different aspects of sea ice and puddle formation, spatial inhomogeneity of old sea ice, and the compression strength of various samples. The third group highlights the problems of 3-day meteorological forecasts in the Arctic and Antarctic.

Problems of Physiographic Zoning of Polar Lands (1971, 242 pp., TT 75-52080), was edited by L. S. Govorukha and Yu. A. Kruchinin. Natural territorial complexes of different ranks and elementary landforms make up the basic components of physiographic investigations. The polar regions with their predominantly oceanic character and the presence of sea ice and glacial cover present scientists with a variety of unresolved problems in physiographic classification. This book's 12 articles are directed towards developing general principles that can be employed in zoning arctic and antarctic regions. Three articles examine the complex zoning principles, natural factors, and characteristics of different physiographic regions. Six articles focus on analysis of such special factors as hydrometeorological, glaciological, and biological characteristics. In another three articles specific schemes for polar zoning are developed. Throughout the book, authors emphasize the importance of a quantitative analysis of the natural components in polar regions and the parameters used to describe these components.

(continued on page 18)

(continued from page 17)

The National Science Foundation administers the translation program, which employs overseas contractors with foreign currencies held by the United States. Scientists are encouraged to suggest titles of significant works for translation. Suggestions should be in the form of a short letter that gives full bibliographic information on the titles, describes the work's scientific importance, and states the anticipated audience in and benefit to the United States. The letter should be sent to the Polar Information Service, Division of Polar Programs, National Science Foundation, Washington, D. C. 20550. At least 6 months is required for translation and publication.

These two books may be purchased from the National Technical Information Service (NTIS), 5852 Port Royal Road, Springfield, Virginia 22151; telephone 703/487-4835.

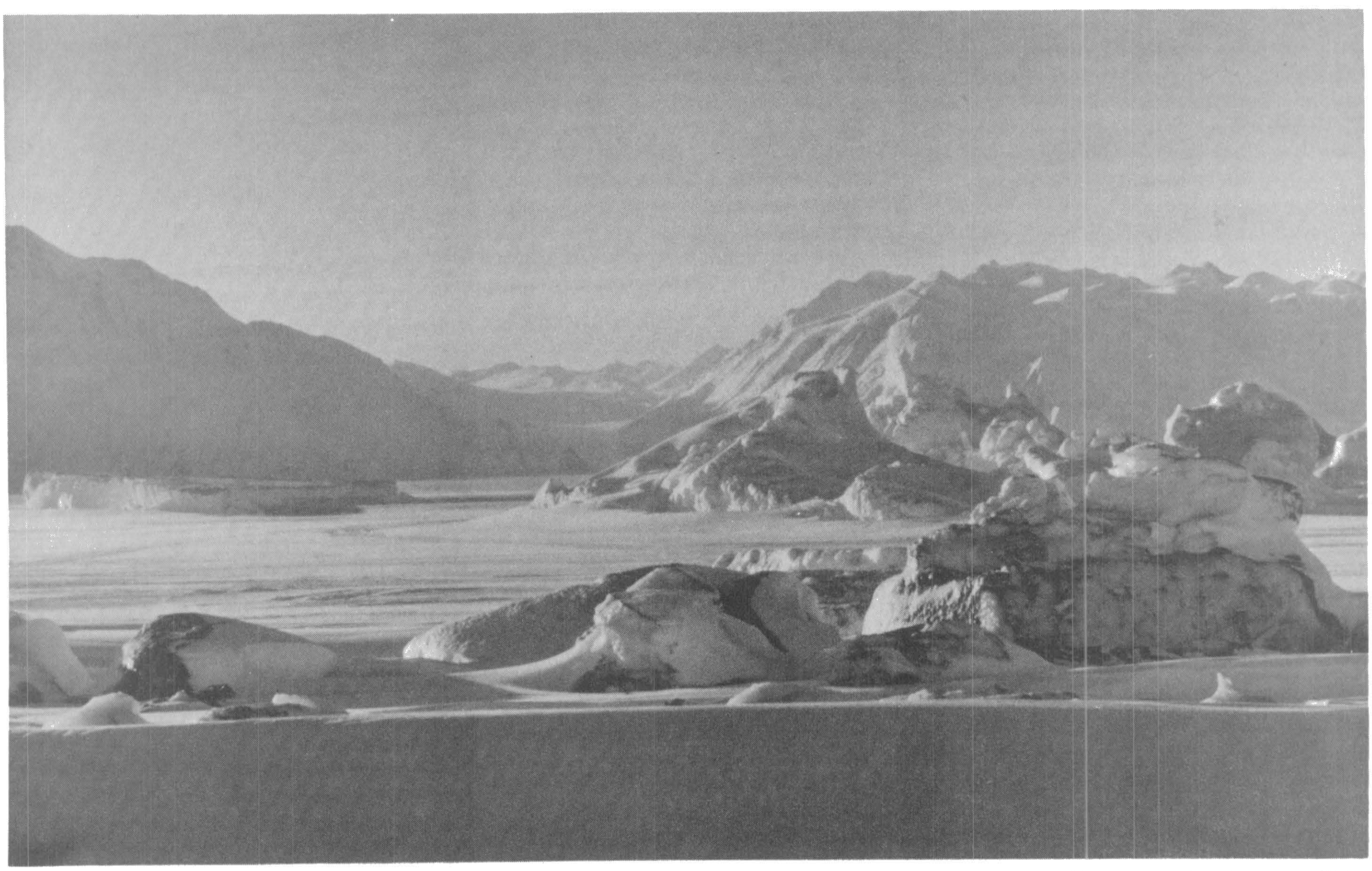
When ordering, cite TT number. Because prices change periodically, please contact NTIS for more current information when ordering. A list of other books published in this program appeared in the March 1981 *Antarctic Journal of the United States*.

Fire destroys garage at McMurdo Station

On the evening of 1 December 1981 a fire of unknown origin destroyed one of McMurdo Station's two garages. Although the night crew noticed smoke and flames coming from the garage's metal shop and evacuated the building, the garage and its contents could not be saved. The building housed vehicles and heavy equipment repair facilities along with a technical library, shops for sheet metal work, welding and fabrication, and other machine work, and a battery room. Five vehicles (two passenger vans, a jeep, a dump truck, and a fire truck) were inside and were lost in the fire. Three firefighters sustained minor injuries; two were treated for smoke inhalation and one for a facial cut.

Temporary facilities were established immediately so that the station's transportation and repair needs could be adequately met. As a safety precaution, the remains of the destroyed building will be demolished before the end of the 1981-1982 austral summer.

Snow and ice landscape taken near McMurdo Station, Ross Island.



U. S. Navy photo (K-41885) by J. B. Clarke.

Weather at U.S. stations

Feature	August 1981			September 1981			October 1981		
	McMurdo	Palmer	South Pole	McMurdo	Palmer	South Pole	McMurdo	Palmer	South Pole
Average temperature (°C)	-24.7	-8.8	-55.3	-28.2	- 8.3	-62.1	-15.97	-5.3	-55.7
Temperature maximum (°C) (date)	- 5.5 (3)	2.0 (30)	-42.5 (18)	-14.1 (9)	1.0 (16)	-46.3 (2)	- 6.1 (6)	6.0 (20)	-42.0 (27)
Temperature minimum (°C) (date)	-38.7 (24)	-2.2 (5)	-67.6 (13)	-43.5 (23)	-23.1 (27)	-76.7 (14)	-35.1 (4)	-2.1 (4)	-67.9 (5)
Average station pressure (mb)	996.5	987.4	684.4	989.8	988.5	672.9	981.0	988.1	675.6
Pressure maximum (mb) (date)	1023.7 (16)	1021.0 (31)	702.5 (16)	1006.9 (21)	1025.0 (1)	687.9 (25)	1003.6 (1)	1007.0 (5)	694.8 (8)
Pressure minimum (mb) (date)	974.2 (31)	962.0 (27)	665.9 (24)	975.3 (8)	952.0 (23)	662.7 (18)	967.3 (28,29)	965.0 (29)	657.0 (22,23)
Snowfall (mm)	53.3	22.9	Trace	175.3	40.6	Trace	104.1	762.0	Trace
Prevailing wind direction	045°	030°	045°	070°	150°	020°	070°	010°	020°
Average wind (m/sec)	5.0	4.5	5.9	5.1	2.0	4.5	3.5	2.7	3.2
Fastest wind (m/sec) (date)	23.2 (21) 070°	31.3 -- 030°	21.1 (26) 360°	26.4 (2) 070°	26.8 -- 360°	19.5 (2,4) 360°	12.1 (6) 180°	24.6 (28) 020°	13.9 (2) 360°
Average sky cover	3.8	7/10	4.0	6.6	8/10	3.7	5.1	9/10	--
Number clear days	15	3	17.4	4	1	17.9	4	1	13.7
Number partly cloudy days	10	12	3.5	11	13	4.9	10	4	7
Number cloudy days	6	16	10.1	15	16	7.2	17	26	9.9
Number days with visibility less than 0.4 km.	0	0	2.4	0.0	1	2.1	0.5	0	1.0

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

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