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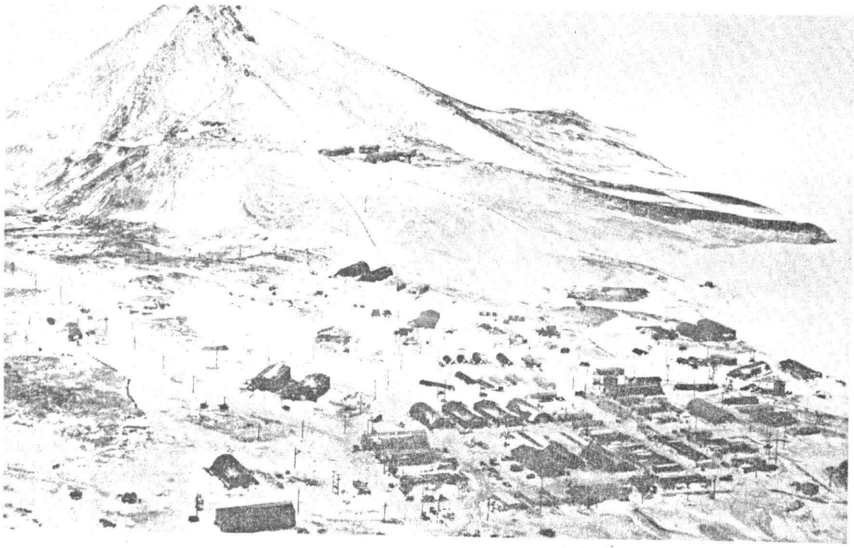

U.S. Navy photograph XAM-42342-9-64
Halfway up Observation Hill, the four buildings of the PM-3A nuclear power plant were a McMurdo Station landmark. For a decade, PM-3A supplied McMurdo's fresh water and electrical power. In this southward-viewing September 1964 photograph, the station is in the foreground and the Ross Ice Shelf in the background.

McMurdo Station reactor site released for unrestricted use

The site of the nuclear reactor that powered McMurdo Station from 1962 to 1972 has been released for unrestricted use following a 6-year cleanup and an independent radiological survey of the area. According to the final decommissioning report filed by the U.S. Navy with the Department of Energy, the site has been decontaminated to levels as low as reasonably achievable. The Department of Energy's 25 May 1979 authorization to release the site marks the end of the only experiment ever attempted to power an antarctic station with a nuclear reactor.

The U.S. experiment with nuclear power in Antarctica began as an attempt to find a cheaper way to maintain stations in remote locations. In the late 1950s, almost half the supplies hauled from the United States to Antarctica consisted of fuel oil to provide heat and power. Logistic costs could not be cut by reducing the amount of fuel shipped because without a minimum fuel supply antarctic stations could not survive the austral winter. Other remote stations faced the same dilemma: fuel costs had to be absorbed without serious question.

That condition applied at Camp Century, Greenland, where the Army, also intent on developing a cheap, reliable power source for remote stations, had just installed a portable nuclear reactor. According to the Army's early cost analysis, the electricity generated by the nuclear plant cost about 0.564 cents per kilowatt hour.

By the time diesel fuel, then selling at 12 cents a gallon, was transported to McMurdo, its cost had risen to 40 cents a gallon. As a result, each kilowatt hour produced at McMurdo's diesel plant cost about 0.975 cents.

Promise of nuclear power

McMurdo Station, it seemed then, was one of the few places in the world where, given the price of diesel fuel after it had reached Antarctica and given the existing state of nuclear technology, a nuclear power plant promised to be more economical than a fossil fuel plant.

Because the promise of nuclear power for remote regions seemed so great in the late 1950s, the U.S. Congress also showed considerable interest in developing nuclear reactors for antarctic and other remote operations. With Congressional approval, the Navy commissioned a reactor for McMurdo Station. At the time, both Congress and the Navy were confident that, if the McMurdo reactor worked, more reactors for South Pole and Byrd Station would follow.

Martin Marietta Corporation of Baltimore, Maryland, developed the reactor, called PM-3A. It was a pressurized-water reactor: one system of pipes circulated water under pressure near the core of the reactor. That water, heated by the core, turned water in a second piping system into steam. The steam from the second piping system then drove a turbine which produced electrical power for the station.

This reactor was more powerful than the previous portable, medium-power reactors that had been developed. Its capacity was about 1.8 megawatts and its life expectancy was about 20 years. PM-3A also could be loaded onto a C-130 airplane and flown wherever it was needed. It was designed so that packing, transportation, assembly, and disassembly could be accomplished under all environmental conditions.

Editor: Richard P. Muldoon

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The reactor arrived at McMurdo on 12 December 1961 by ship. The first "criticality" in the core was achieved on 3 March 1962, and the plant began producing power for the station on 10 July. Initially, the reactor was operated by Navy crews under the direction of the Martin Marietta Corporation and the Atomic Energy Commission. On 27 May 1964, under a memorandum of agreement between the Atomic Energy Commission and the Department of Defense, the Naval Nuclear Power Unit took over the reactor and operated it until the plant was decommissioned in September 1972.

Record for continuous operation

By 1966, despite frequent temporary shutdowns, the plant had broken the record for the longest continuous operation of a military nuclear reactor. In 1971 the Navy increased the reactor's power output by 10 percent through new operating techniques, and so kept pace with McMurdo's energy demand. That same year the reactor set another record for continuous operation: it produced 1600 kilowatts for 172 days without a stoppage.

Never in the operation of the reactor was there a release of radiation in excess of the safety levels set by the Atomic Energy Commission, nor was there a single injury caused by or related to the reactor. PM-3A operated for 10 years in complete compliance with all Atomic Energy Agency regulations.

Over its 10-year life the reactor produced approximately 78 million kilowatt hours of electricity. From 1966 to 1972 a water distillation plant, using steam from the nuclear reactor, produced 13 million gallons of fresh water by evaporative distillation. Over its career the reactor ran at 78 percent availability; that is, power was produced over the life of the reactor about 4 days out of every 5. When the reactor was running, it produced enough electricity to satisfy almost all of McMurdo's heat and power needs.

Throughout the life of the reactor, successive issues of the *Antarctic Journal* contained tables detailing how much power the reactor produced, how much fresh water was distilled from seawater, how many consecutive days of operation were achieved, and, of course, how much diesel fuel it would have taken to produce the power supplied by the plant.

The record indicates that PM-3A was, in fact, successful at powering McMurdo Station and at saving money by reducing the amount of diesel fuel required at McMurdo. But the plant never replaced the diesel engines that had to be maintained as backup generators for use during scheduled or unscheduled shutdowns of the nuclear plant.

From 1962 to 1966, operating malfunctions and scheduled maintenance shutdowns kept the reactor from becoming a continuous source of power. The only serious problem occurred in 1962, when hydrogen produced by the radiolytic decomposition of water under high gamma radiation caught fire in the containment vessel. Apparently hydrogen decomposition had not been encountered even theoretically at that stage in nuclear technology, but it was quickly mastered by installing a hydrogen recombiner. The problem never recurred. Damage to the reactor was slight. There were no injuries and there was no release of radioactivity. The reactor, however, was put out of commission for 8 weeks.

Diesel powered backup plant

During that time, McMurdo had to fall back on its diesel plant for heat and power, but the diesel fuel supply that year was low and the icebreakers, which were to lead the tanker and cargo ships through the sea ice in McMurdo Sound, were unable to clear a channel through the ice until late in the season. Helicopters ferried diesel in 55 gallon drums from the tanker, anchored beyond the sea ice, to the station. The episode illustrated the need for a reliable source of heat and power for an antarctic station.

After 1966, when the reactor had attained some reliability, it was still subject to precautionary shutdowns, inspections, and core changes, none of which ever indicated a serious or dangerous problem. But it was becoming increasingly apparent that the costs involved in maintaining the plant were making the reactor more expensive than had been expected.

In 1970, when the President consolidated the management of the United

States Antarctic Program under the National Science Foundation, the Office of Management and Budget also asked NSF to analyze the costs involved in maintaining an influential U.S. presence in Antarctica.

Decommissioning

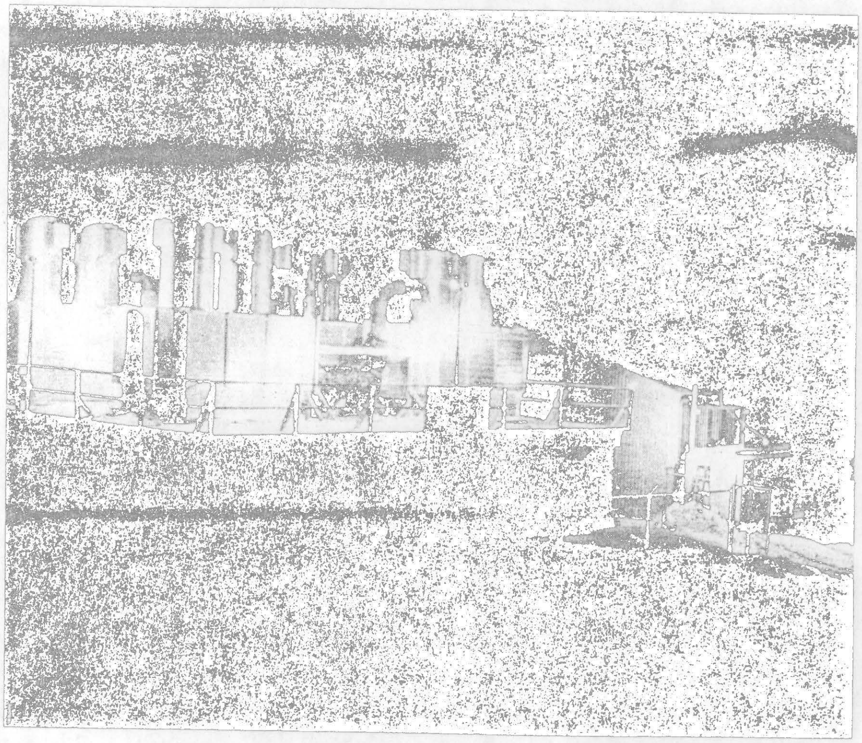
In May 1972 NSF published an analysis of the U.S. Antarctic Program, which included a cost-effectiveness study of the reactor performed by Bechtel Incorporated. The report concluded that PM-3A should be decommissioned as soon as possible because operation of the facility was not economical. The report recommended that PM-3A be replaced with an up-to-date turbine or diesel-electric generator to supply power and heat and an oil-fired boiler to operate the water distillation plant. Not only would the diesel plant be more reliable, but fewer personnel would be required to man it.

The Navy and NSF never came to a conclusion based on the report. Instead, the decision to abandon the reactor was made after a scheduled routine inspection in September 1972 revealed wet thermal insulation around the reactor pressure vessel. Since the shield water—not primary coolant, but water in the shield surrounding the pressure vessel—contained chlorides, and since all conditions favorable to chloride stress corrosion cracking were present, the reactor remained down.

Inspection of the visible components revealed that no cracking had occurred, not even at the junction of the piping and the reactor vessel where temperatures and stresses were greatest. But the Navy inspection team refused to rule out the possibility of cracking on surfaces which could not be inspected visually. They called for complete dismantling of the reactor and inspection of otherwise inaccessible surfaces before they could authorize a restart. The cost of the inspection and the costs possibly involved in repairing or replacing any reactor components were the major factors in the decision to decommission the reactor and trust a diesel plant to provide power.

Antarctic Treaty provisions

Plans for the decommissioning were made in March 1973. While the Antarctic Treaty did not specifically require the removal of the reactor, Article V stated, "Any nuclear explosions in Antarctica and the disposal there of radioactive waste material shall be prohibited." The United States felt that the spirit of the treaty made it proper to remove not only the reactor, but also soil at the site that received the normal discharge of effluents from the reactor. The Navy and NSF also decided that after all the removal efforts had been completed, a contractor would perform an independent radiological survey of the area.



U.S. Navy photo by R. L. Boone

The PM-3A nuclear reactor was housed in the building to the rear. The condenser system in the foreground was later covered by a similar building.

The effluents discharged during operation never contained radioactivity in excess of the applicable standards, but small quantities of artificial isotopes from the effluents had been reconcentrated in the rock surrounding the site. In addition, cracks in the shield containment walls were discovered and repaired three times; each time some of the (again nonradioactive) shield water had leaked out and frozen to the foundation. But when the Navy tried to find a U.S. standard to apply to the soil, they found that standards for maximum permissible concentrations (below which something is not considered radioactive) of various radionuclides had been developed for air and water, but not for soil.

The Navy turned to the guidelines and regulations of the Antarctic Treaty nations for a standard. The only existing standard for minimal radiation levels in soil was an extremely conservative Soviet *de minimus* standard of 10 picocuries per gram. That meant that any rock with a radiation level below 10 picocuries a gram would not be considered radioactive. The Navy set a *de minimis* standard of radioactivity for the principal contaminant in the antarctic rock, which was cesium-137, at 10 picocuries per gram.

Disassembly and removal

During the 1973-74 season the Navy dismantled all of the reactor's secondary systems and most of the reactor vessel itself. Those components and all of the fuel were shipped to the Department of Energy's Savannah River Plant near Barnwell, South Carolina, for disposal. In 1974-75 the rest of the reactor components were shipped. In 1975-76 the buildings that surrounded the reactor were shipped along with their foundations. All of the backfill from the site which contained more than 2000 picocuries per gram of radioactivity was boxed and shipped as low specific activity waste. All of this material ended up at the Savannah River Plant.

What remained after the 1975-76 season was rock which contained less than 2000 picocuries per gram. Since International Atomic Energy Agency regulations consider material containing less than 2000 picocuries per gram nonradioactive for shipping purposes, the rock was marked for bulk loading on the annual departing cargo ship. From 1976-77 to 1978-79, about 11,800 cubic yards of this low-level contaminated rock were collected and shipped to Port Hueneme, California.

Radiological survey

In January and February 1978, while the cleanup was still in progress, the NUS Corporation of Rockville, Maryland, conducted an independent radiological survey of the area. Later that year NUS tested samples in laboratories in the United States. The two-volume NUS report appeared in June 1978.

A thorough review and analysis of the NUS report, combined with Navy survey and sample data, made it clear that the goal of removing all rock containing cesium-137 with more than 10 picocuries per gram radioactivity was not reasonably achievable. Because the natural background concentrations of radionuclides varied significantly and at the same order of magnitude as cesium-137 concentrations, it had been difficult both for the Navy and for NUS to determine actual cesium-137 concentrations in the field. Naturally occurring uranium and thorium and their radioactive daughters are present in the rock at levels of 1 to 3 picocuries per gram; potassium-40 is present in concentrations ranging from 20 to 40 picocuries per gram. After the 1978-79 cleanup, the maximum concentration of cesium-137 on the site was 29 picocuries per gram. The average concentration was 8.1 picocuries per gram.

The review prompted the Navy to abandon the *de minimus* limit and substitute a hazard analysis based on the contaminants remaining and an evaluation of the potential exposure pathways to man. The goal was to ensure that the potential radiation dose to a person would be extremely low, rather than to apply a *de minimus* standard to radiation in the soil.

According to the NUS study, the natural background radiation at the reactor site would result in an average radiation exposure of 63 millirems per year with a range from 25 to 149 millirems. Away from the site the average exposure due to naturally occurring radiation would average 105 millirems a year with a range of 21 to 149 millirems. The hazard analysis started with those figures and determined the risks to man by calculating the amount of additional radioactivity caused by remaining artificially induced isotopes.

The NUS report shows that the concentrations of manmade radionuclides remaining on the site would result in a maximum additional radiation dose of less than 15 millirems per year. The most probable value, according to the study, is 6 millirems per year. The low dosages are the result of extremely low levels of radionuclides (an average of 8 picocuries per gram of crushed rock for cesium-137 and even less for other nuclides such as cesium-134, cobalt-60, and strontium-90) and the lack in the antarctic environment of any significant pathway to man.

Navy and Department of Energy reviews

On the basis of the maximum figure, the Navy determined that there is minimal risk to man from exposure to radioactivity remaining on the site. In addition, these low doses of radioactivity would normally be experienced only once in a lifetime by a very limited adult population. On that basis the final report submitted by the Navy to the Department of Energy concludes that the PM-3A decommissioning is complete and that the site has been decontaminated to levels as low as reasonably achievable.

The Department of Energy, after evaluating the Navy's final report, determined that the site could be released for unrestricted use in accordance with the Radiation Protection Guidance for Federal Agencies developed by the Federal Radiation Council, and with all other guidelines for release of sites for unrestricted use. All conditions of the memorandum of agreement between the Department of Defense and the Atomic Energy Commission were declared fulfilled.

Meanwhile, McMurdo and all other U.S. antarctic stations continue to rely upon diesel power plants for heat and electricity. During the 1979-80 season new diesel engines were installed at McMurdo. They are more powerful and more economical than the plants previously used but they still force the U.S. Antarctic Research Program to expend much of its logistic budget on fuel and its transportation.

During the 1979-80 season diesel fuel cost about 61 cents per gallon. During the 1980-81 season the cost will probably be about $1.29 per gallon at McMurdo. The rising cost of fuel will have severe impact upon the scope of research conducted during the coming field season. Once again, as in the early 1960s, those involved in maintaining an effective U.S. presence in Antarctica must be alert to better, more economical ways to power antarctic stations.

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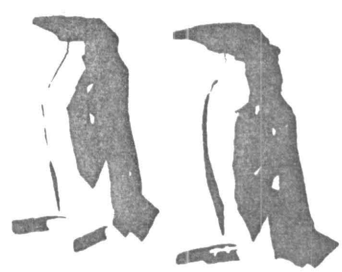

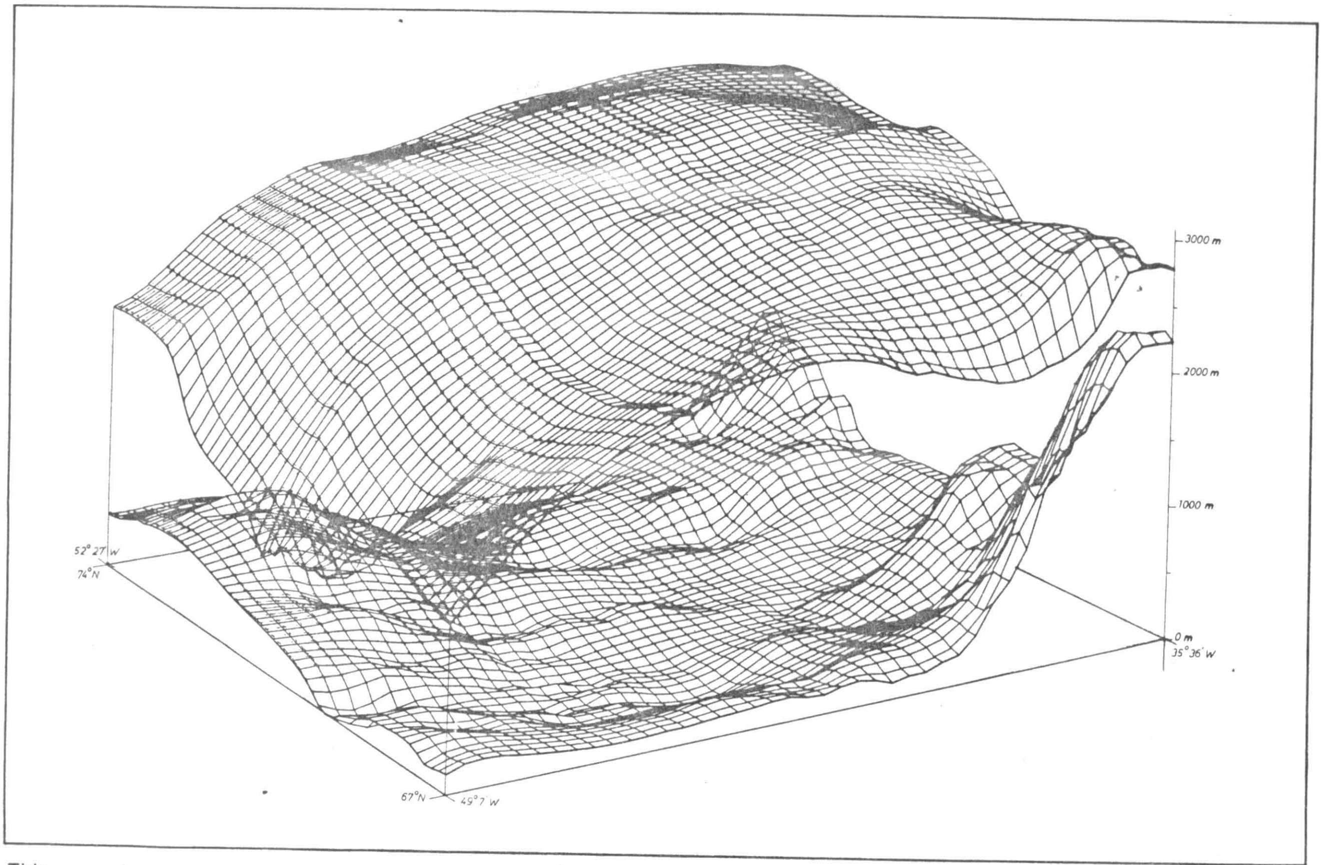

This computer-generated cross section of a central portion of the Greenland ice sheet was based on radio echo sounding data collected by USARP LC-130 airplanes. The diagram shows the relation between the ice surface and bedrock. Such ice thickness data, combined with ice flow studies and other measurements, will enable Greenland Ice Sheet Project investigators to determine the history of an ice core drilled from the surface to bedrock at a single point on the ice sheet.

Greenland research team plans ice core drilling to bedrock

In June and July 1980, if the Danish Commission on Scientific Research approves their application, researchers from Denmark, Switzerland, and the United States will attempt to drill an ice core from the surface of the Greenland ice sheet to bedrock at site Dye-3 in southern Greenland. By comparing the Greenland core with cores from Antarctica, researchers hope to improve understanding of global climate over the last 100,000 years.

The Greenland Ice Sheet Program, while not an extension of the U.S. Antarctic Research Program, is complementary to it. The Greenland program uses the support capability of the antarctic program (including ski-equipped airplanes) at a time when winter scales down antarctic operations. The scientific results of the Greenland investigations also are relevant to antarctic studies of climate and glacial history and dynamics.

The deep drilling constitutes the final phase of the Greenland Ice Sheet Program, which itself is the culmination of research begun 14 years ago.

In 1966 scientists and engineers from the U.S. Army's Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire, recovered an ice core 1,387 meters in length completely through the ice sheet at Camp Century in northern Greenland. The ice at the base of the column was about 120,000 years old, older than the onset of the last advance of the ice age (the Wisconsin stage). Their studies of the Camp Century core convinced researchers that polar ice cores, like deep-sea sediments and tree rings, could be used as natural climatic indicators.

Atmospheric record

Precipitation in the dry snow zone of a high polar glacier buries previous accumulations. As the density of underlying snow increases by compaction, the annual layers of snowfall gradually are transformed into glacier ice. The layers or stratigraphic sequences that result from compaction are aggregates of snow and ice crystals.

Trapped within these aggregates is atmospheric air plus all of the foreign material that fell with precipitation or was otherwise deposited on the surface during a given year. When researchers examine a deep ice core, therefore, they are examining a unique record of the physical and chemical nature of the atmosphere as it changed year by year.

Determining differences in cores from Greenland and from Antarctica enables scientists to discern local from global atmospheric changes in climate.

Scientists seeking a Greenland core to bedrock this summer, then, could provide a continuous record of several climatic parameters extending from the present into the Pleistocene. Using techniques refined since the analysis of the Camp Century core, they could reconstruct variations in the composition of the atmosphere, the influx of soluble and insoluble cosmic particles, the levels of airborne radioactivity and atmospheric pollution, and the distribution of volcanic dust.

Plan conceived in 1970

The drilling planned for this summer was conceived in 1970 when scientists and engineers from Denmark, Switzerland, and the United States met to discuss efficient and economical ways to determine the dynamics and history of the Greenland ice sheet. Out of that meeting came the Greenland Ice Sheet Program (GISP) planning document that was presented to the National Science Foundation in February 1972.

GISP was a plan to study the nature, composition, and behavior of the Greenland ice sheet by examining its glaciological regimes, its geophysical and thermal dynamics, its paleoclimatic history, and its geochemical constituents.

The objective of the Greenland Ice Sheet Program ever since has been to select one or more sites in a glaciologically simple area where it would be possible to obtain a deep ice core to bedrock. The bottom of the ice core ideally would be over 100,000 years old. At the same time, field and laboratory projects would address the surface, near surface, inner structure, and subsurface character of the ice sheet. Cores from other locations would provide checks on acquired data and provide more information on distortions caused by movement of ice within the ice sheet. Eventually enough knowledge about the physical and chemical characteristics of the Greenland ice sheet would be amassed to enable a proper interpretation of the climatic record contained in a deep ice core.

Drill development

Obtaining a deep ice core, however, is a difficult task since ice drilling is not an off-the-shelf technology. Ice coring drills usually must be designed to meet environmental conditions that exist at a particular site. Even then, low temperatures within an ice sheet can cause drills to freeze in; hole closure because of ice flow also can grip the drill and prevent the retrieval not only of ice core but of the drill itself. On-site experimentation usually leads to improvements in drill technology, but those improvements may be limited to drilling in a specific location.

Because drill technology in many ways determines what can be accomplished scientifically in the glaciological investigation of an ice sheet, a subsidiary goal of the Greenland Ice Sheet Program has been to develop the specialized equipment, such as ice drills and ice sounding radars, needed to obtain or interpret such a core.

During the summer of 1979, GISP investigators tested a new Danish deep ice drill, developed after years of experimentation with a unique shallow drill. The deep drill is a lightweight, battery-powered electromechanical mechanism which takes an ice core 10 centimeters in diameter at about 2 meters of ice per run.

The Greenland drill test was conducted during August 1979 at Dye-3, the site in south Greenland selected by GISP participants for drilling to bedrock, 2100 meters below the surface at Dye-3.

Testing began 2 August and ended 20 days later when the main shaft of the drill was damaged. The final hole depth of 224.86 meters was attained in 141 drilling runs. The average "round trip" to bring up an ice core took 35 to 40 minutes. Portions of the core were flown to the State University of New York at Buffalo for analysis primarily by Chester C. Langway of that university. Willi Dansgaard of the University of Copenhagen, and Hans Oeschger of the University of Bern also acquired samples.

Any deep ice core from Greenland will provide data only at a single point on an ice sheet that is approximately 2 million square kilometers in area. Although some extrapolation is possible on the basis of internal radar reflection, additional fundamental measurements extending over a greater area are needed to determine the dynamic behavior of the ice sheet, particularly within 50 to 150 kilometers of the drill site. Such projects include surface measurements to provide data on snow accumulation, ice velocity and strain, and deep sounding measurements (seismic shooting, radio-echo sounding, gravity mapping, and electrical resistivity profiles) to characterize the internal structure of the ice sheet in the drill hole vicinity.

Ice dynamics model

To achieve its goal, GISP researchers need to refine current understanding of the parameters that govern the behavior of ice sheets, their interrelationships, and their relation to changing environments and climates. This requires development of an ice dynamics model and analysis of various ice core time series to determine their relationships with present and past world climatic variations. The ice-dynamics model will be used to separate dynamical effects from climatic information in the ice core time series. This information will in turn be used to analyze present and past world climates as they are evidenced in deep ice cores.

The ice dynamics model eventually will define the mechanical and thermal characteristics of an ice sheet (such as deformation, flow rates, accumulation rates, vertical temperature profiles, and isotopic diffusion rates). To produce the model, a set of ice surface, bed topography, surface accumulation, and temperature data was acquired using the airborne radio echo sounding techniques developed during a similar survey of the antarctic ice sheet. Radio echo sounding provided detailed morphological information on the upper and lower surfaces of the ice sheet and the reflections from within the ice mass, which at this time are not completely understood.

The Greenland data were obtained by a U.S. Antarctic Research Program LC-130 airplane equipped with the necessary special antennas. Dr. Gudmansen of the Technical University of Denmark is preparing an ice thickness map based on the soundings.

To determine whether the past changes in climate studied in Greenland deep ice cores are of global or more regional character, scientists will compare deep cores from Greenland with deep cores from Antarctica.

An additional benefit of the Greenland drilling will be the technical and operational knowledge gained by developing a successful deep drill. Such expertise eventually could be applied to antarctic coring projects.

1979-1980 Antarctic Conservation Act permits granted

The following investigators were granted permits during the 1979-80 field season under regulations which implement the Antarctic Conservation Act of 1978. This was the first season that the regulations have been in effect. The regulations appeared in full in the June 1979 *Antarctic Journal*.

- David G. Ainley, Point Reyes Bird Observatory, Stinson Beach, California, received a permit to take Adelie and emperor penguins, petrels, albatross, fulmars, prions, and skuas in the Ross Sea area and to import specimens into the United States.

- John G. Baust, University of Houston, Houston, Texas, received a permit to enter and to collect moss and algae samples from Litchfield Island (a Specially Protected Area) and from Byers Peninsula (a Site of Special Scientific Interest).

- Charlene J. Denys, DePaul University, Chicago, Illinois, received a permit to collect adolescent Adélie penguins in the Antarctic Peninsula area and to import retinal and liver samples into the United States.

- Arthur L. DeVries, University of Illinois, Urbana, Illinois, received a permit to introduce a nonindigenous species *(Notothenia angustata)* into Antarctica for laboratory studies at McMurdo Station.

- David H. Elliot, Ohio State University, Columbus, Ohio, received a permit to enter and to collect geological samples at Cape Shirreff (a Specially Protected Area) and Byers Peninsula (a Site of Special Scientific Interest).

- David E. Murrish, State University of New York, Binghamton, New York, received a permit to take giant petrels and penguins on Anvers Island.

- David F. Parmelee, University of Minnesota, Minneapolis, Minnesota, received a permit to take skuas, gulls, sheathbills, terns, shags, storm-petrels, and penguins on Anvers Island and on Litchfield Island (a Specially Protected area) and to import specimens into the United States.

- Robert E. Ricklefs, University of Pennsylvania, Philadelphia, Pennsylvania, received a permit to take penguins, giant fulmars, blue-eyed shags, south polar skuas, and antarctic terns on and near Anvers Island and to import specimens into the United States.

- Robert W. Risebrough, Bodega Marine Laboratory of the University of California, Bodega Bay, California, received a permit to take specimens of eggs and of adult Wilson Petrels and Adelie penguins and import them into the United States. A permit was also granted for entry into Litchfield Island (a Specially Protected Area) to take a census of Adelie penguins.

- Donald B. Siniff, University of Minnesota, Minneapolis, Minnesota, received a permit to tag and release and/or to collect dead specimens of leopard, Weddell, crabeater, and Ross seals in the Antarctic Peninsula and McMurdo Sound areas and to import specimens into the United States.

- Jonathan Ward, CBS Evening News, New York, New York, received a permit to enter and photograph penguins at Cape Royds (a Specially Protected Area) and/or at the Cape Bird rookery, both on Ross Island.

NSF, NASA, Smithsonian sign meteorite agreement

The National Science Foundation, the National Aeronautics and Space Administration, and the Smithsonian Institution signed an interagency agreement in January 1980 that will ensure the proper collection, curation, and analysis of meteorites found in Antarctica.

Meteorites found in Antarctica since 1969 represent an accumulation span of several million years. Searches since 1976 have yielded hundreds of specimens—more than a third of all meteorites known to science (see articles by W. A. Cassidy in the *Antarctic Journal* annual review issues for 1977, 1978, and 1979). These meteorites have unique significance for determining the age, stability, and flow pattern of the antarctic ice sheets; the radiation regimes in space in the geologic past; and the distribution of meteorite types over time.

Recent field and laboratory studies indicate that meteorite accumulations on the antarctic ice sheet occur where certain rare sets of conditions are met. These conditions also may occur outside polar regions.

The meteorite agreement enlists the continued support of the best available scientific, technical, and laboratory resources in the United States for the discovery, collection, preservation, and study of these relatively uncontaminated extraterrestrial materials.

The antarctic meteorite agreement provides a formal statement of the goals of the three participating agencies. Their goals are:

- to collect antarctic meteorites and preserve portions of them under controlled conditions so that the scientific information they may contain is not compromised;

- to distribute loan samples for research and exhibit to scientists and museums as generously as possible;

- to process and document a portion of the samples for scientific study in a noncontaminating environment; and

- to facilitate international scientific investigations of the meteorite collection.

Under the agreement, the National Science Foundation will continue to support the recovery of meteorites from Antarctica. These meteorites will be stored at the NASA Johnson Space Center in Houston, Texas, where they will be kept in a sterile, cold environment or in other appropriate conditions to preserve their original geochemical characteristics. Gradually, portions of each meteorite which no longer need storage in sterile conditions will be transferred to the Smithsonian Institution and accessioned into the Smithsonian collections for curation and further distribution to the scientific community.

Information about the meteorites will continue to be disseminated to scientists in more than 20 countries through the Antarctic Meteorite Newsletter, published by the Johnson Space Center. For more information write Code SN2, Johnson Space Center, National Aeronautics and Space Administration, Houston, Texas 77058.

Federal Electric Company named new support contractor

Antarctic Services Inc., a newly formed subsidiary of the Federal Electric Corporation, has been selected as the new support contractor for the United States Antarctic Research Program. The company will assume full responsibility for contracted support of the program beginning 1 April 1980.

Antarctic Services Inc. replaces Holmes & Narver Inc. of Orange, California, as the major support contractor for the U.S. Antarctic Research Program. Holmes & Narver provided support for the program from early in 1968 through the end of the 1979-80 field season.

The contract calls for the new company to provide procurement and supply services, to manage seasonal construction activities and provide maintenance and operational support at Palmer, Siple, South Pole, and McMurdo Stations, and to operate R/V *Hero*. The contractor will manage warehousing and staging facilities at Port Hueneme, California, Christchurch, New Zealand, and Ushuaia, Argentina, and provide technical and administrative support to USARP year-round.

The Federal Electric Company, through another subsidiary, has had 20 years experience in the Arctic, furnishing operational and maintenance services to the U.S. Air Force's Distant Early Warning and Ballistic Missile Early Warning systems.

Rodney E. Gray, previously the project director for Federal Electric's arctic involvement, has been named project director for the antarctic support contract. Other officials are Art Brown, deputy director; E. (Mickey) Finn, construction manager; John Ojariit, logistics manager; and James Straut, administrative supervisor. Headquarters for Antarctic Services Inc. are in Paramus, New Jersey.

Federal Electric Company is a wholly owned subsidiary of the International Telephone and Telegraph Corporation (ITT).

Francis S. Johnson named Assistant Director AAEO

Francis S. Johnson, a professor of natural sciences at the University of Texas at Dallas, became Assistant Director for the Astronomical, Atmospheric, Earth, and Ocean Sciences Directorate (AAEO) at the National Science Foundation on 16 November 1979 when he was sworn in before the National Science Board. His appointment had been confirmed by the U.S. Senate on 31 October 1979.

Dr. Johnson was named President of the University of Texas at Dallas in 1969 and served in that capacity until 1971. In 1974 he was named the Cecil H. and Ida M. Green Honors Professor of Natural Sciences as well as graduate dean at the University of Texas. His main research interests are upper atmosphere and space physics, planetary science, and solar radiation.

The Division of Polar Programs is part of the AAEO Directorate at the Foundation. The Assistant Director for AAEO is responsible for ensuring the proper management of DPP and therefore of the U.S. Antarctic Research Program.

Dr. Johnson replaces John B. Slaughter as Assistant Director for AAEO. Dr. Slaughter left NSF in June 1979 to become Academic Vice President and Provost at Washington State University in Pullman, Washington. Dr. Slaughter served as Assistant Director of AAEO from September 1977 until his departure.

Obituaries

Pete Demas

Epaminondas James Demas, a native of Allisos, Greece, died at age 74 on 17 November 1979 in Granada Hills, California. Mr. Demas was a close and long-time associate of Admiral Richard E. Byrd throughout his explorations.

Mr. Demas had accompanied Richard E. Byrd on his North Pole Expedition in 1926 and was with Byrd as he prepared for his Trans-Atlantic flight in 1927. He went south with Byrd on both the 1928-1930 and 1933-1935 expeditions.

Casey A. Jones

Casey A. Jones, the Holmes & Narver Inc. cook assigned to Amundsen-Scott South Pole station, died 9 January 1980 when he was caught under a collapsing column of snow. Mr. Jones was removing snow that had plugged a vertical air intake shaft when the column gave way.

This was Mr. Jones's second tour in Antarctica. He wintered at Palmer in 1979.

At the request of his family, Mr. Jones's body was cremated in New Zealand. His ashes were committed to the Antarctic from an LC-130 airplane in flight over the Beardmore Glacier on 25 January.

Flags of the United States, the U.S. Antarctic Research Program, and Holmes & Narver were presented to Mr. Jones's family along with a posthumous Antarctica Service Medal.

Holmes & Narver employees in Antarctica prepared a memorial plaque that was mounted at South Pole Station in honor of Casey Jones's service to the U.S. Antarctic Research Program.

Finn Ronne

Captain Finn Ronne, U.S. Navy, the explorer who traveled nearly 3,600 miles across Antarctica by ski and dog sled, died at his home in Bethesda, Maryland, 12 January. He was 80 years old.

Finn Ronne first went to Antarctica in 1923 as a ski expert, dog driver, and radio operator with Richard E. Byrd's second antarctic expedition. He returned eight more times, wintering on four occasions.

Captain Ronne led his own 22-member Ronne Antarctic Research Expedition to the Antarctic Peninsula in 1947-1948. Durings its 15-month stay, the expedition performed extensive geographic surveys. The expedition produced about 14,000 aerial photographs, including some photographs of parts of the Weddell Sea that had never before been visited. The team investigated the geology, meteorology, seismology, terrestrial magnetism, and solar radiation of the Peninsula region.

New translations from the Soviet Union

Investigations of the POLEX-South-75 Program (1976, 176 p, TT 77-52006, $9 hard copy, $3 microfiche), edited by A. F. Treshnikov, was translated into English and published in 1979. The volume contains 18 papers discussing the first full-scale experiments of the POLEX-South-75 program in the Drake Passage. The joint Soviet–U.S. research was performed aboard the Soviet ship *Professor Zubov* from December 1974 through February 1975.

The papers discuss processes in the free atmosphere, the use of satellite data to obtain trajectories of cyclonic formations, the variability of processes in the near-water layer of the atmosphere, the structure and monthly variability of ocean currents, the classification of water masses, and some hydrochemical characteristics of the Drake Passage region.

Problems of the Arctic and the Antarctic 45 (1974, 172 p, TT 75-52083, $12 hard copy, $3.50 microfiche), edited by A. F. Treshnikov, was translated into English and published in 1979. The volume contains 16 papers devoted to arctic and antarctic climatology.

The papers treat glacial water reserve and discharge in the Arctic, large-scale sea level and cyclic oscillations, the conjunction of certain centers of atmospheric action, and changes in wind speed and direction during geomagnetic disturbances. Other papers treat the ionosphere and various aspects of sea ice.

Problems of the Arctic and the Antarctic 46 (1975, 166 p, TT 76-52023, $11 hard copy, $3.50 microfiche), edited by A. F. Treshnikov, was translated into English and published in 1979. The volume contains 17 papers devoted to hydrometeorological investigations in the northern and southern hemispheres.

Included are papers on hydrodynamic forecasting for high latitudes, winter meridional air circulation, the vertical structure of the troposphere, and pack ice formation as an index of climatic cooling.

Copies of these books can be purchased from the National Technical Information Center, Springfield, Virginia 22161. Cite TT numbers when ordering.

The National Science Foundation arranged for the translations under a program that employs overseas contractors using foreign currencies held by the United States. Scientists are invited to recommend candidates for translations to the Division of Polar Programs.

DPP/NSF publications available from GPO

Four National Science Foundation publications dealing with Antarctica are now available from the Government Printing Office.

Survival in Antarctica, a 99-page booklet, is distributed free to participants in the United States Antarctic Research Program. The 1979 revision includes new material on the treatment of hypothermia and a completely revised chapter on crevasse detection and rescue techniques. It is available for $3.50. Cite stock number 038-000-00424-7.

Antarctic Program (Program Report, vol. 3, no. 6, September 1979) and *Arctic Research Programs* (Program Report, vol. 3, no. 9, January 1980) are edited transcripts of reviews of U.S. antarctic and arctic research activities presented by the Division of Polar Programs to the Director of the National Science Foundation. Included are sections on program management, logistics and support operations, and the results of selected science programs. The 48-page antarctic book (stock number 038-000-00425-5) is available for $2.50. The arctic review (52 pages, stock number 038-000-00434-4), which covers arctic research supported throughout the Foundation, costs $3.50.

Flight to the South Pole, a 12-page illustrated brochure, tells the story of Richard E. Byrd's 29 November 1929 flight over the South Pole. The brochure also describes the role that airplanes now play in the support and conduct of research in Antarctica. It is available for $1. Cite stock number 038-000-00420-4.

All four publications are available from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.

Translations in progress

The following foreign polar literature is being translated into English for the National Science Foundation under the Special Foreign Currency Program (Public Law 480). Photocopies of microfiche of these typescripts will be available from the National Technical Information Service, Springfield, Virginia 22161. Cite TT numbers when ordering.

Treshnikov, A. F., ed. *Problems of the Arctic and the Antarctic*, Vol. 54, 1978. 104 pp. TT 79-52026.

Ravich, M. G., D. S. Solovev, and L. V. Fedorov. *Geological Structure of Mac. Robertson Land (East Antarctica).* Hydrometeorological Publishing House, Leningrad, 1978. 232 pp. TT 79-52027.

Soviet Committee of Antarctic Research. *The Antarctic: Main Results of the 20 Years Investigations in the Antarctic.* Committee Report No. 17, Moscow, 1978. 276 pp. TT 79-52012.

Korotkevich, S., D. Morev, and P. Vostretsov. "Drilling through the ice shelf in the vicinity of Novolazarevskaya Station," and "Deformation of the deep borehole walls in the antarctic ice sheet at Vostok Station" in *Soviet Antarctic Expedition Information Bulletin* No. 98, 1978. pp. 49-52 and 53-57. TT 79-59003.

Antarctic film wins top prize

Antarctica: Laboratory for Science was awarded the Great Prize (first place) at the 17th International Festival of Films on Scientific and Technological Progress (TECHFILM '79). The festival was held in Pardubice, Czechoslovakia, 21-26 October 1979. About 200 films from 36 countries were entered in the competition.

The 27-minute color film describes selected aspects of U.S. antarctic research. It was produced in 1978 for the National Science Foundation by Image Associates. The film is available on loan from Modern Talking Pictures, 1145 N. McCadden Place, Los Angeles, California 90038.

Foundation awards of funds for antarctic projects 1 October 1979 to 31 December 1979

Following is a list of National Science Foundation antarctic awards made from 1 October to 31 December 1979. 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, its duration, 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. Amounts followed by an asterisk are funding increments. International Southern Ocean Studies awards were made by the Division of Ocean Sciences. All other awards were made by the Division of Polar Programs.

Support and services

Gray, Rodney F., Antarctic Services Inc., Paramus, New Jersey. Support of the U.S. Antarctic Research Program. DPP 80-03801. 6 months. $1.

Johnson, James R., Holmes & Narver Inc., Orange, California. Station operation and other support. DPP 73-07187. 6 months. $3,000,000.

Johnson, James R., Holmes & Narver Inc., Orange, California. Operation of Palmer Station and research ship *Hero*. DPP 74-03237. 6 months. $1,035,000.

Thuronyi, Geza T., Library of Congress, Washington, D.C. Abstracting and indexing services for current antarctic literature. DPP 70-01013. 12 months. $147,493.

Westbrook, Darrel E., Department of Defense, Washington, D.C. Logistics and support. DPP 76-10886. 6 months. $25,000,000.

Glaciology

Bentley, Charles R., University of Wisconsin, Madison, Wisconsin. Analysis of Ross Ice Shelf geophysical and glaciological data. DPP 79-20736. 12 months. $63,400.

Hughes, Terence J., University of Maine, Orono, Maine. Interaction of the Ross Ice Shelf and Byrd Glacier. DPP 77-22204. 12 months. $96,390.

Meteorology

Wendler, Gerd, University of Alaska, Fairbanks, Alaska. Katabatic winds. DPP 77-26379. 12 months. $59,700.

Ocean sciences

Gordon, Arnold L., Lamont-Doherty Geological Observatory, Columbia University, Palisades, New York. Processing of ARA *Islas Orcadas* hydrographic circumpolar data set. DPP 78-24832. 12 months. $106,717.

Kellogg, Thomas B., University of Maine, Orono, Maine. Quantitative paleoclimatic analysis of Ross Sea continental shelf sediments. DPP 79-20112. 12 months. $39,942.

Staff changes at DPP

John Brennan, Jr., U.S. Navy, served as staff associate for policy and plans in the Division of Polar Programs (DPP), National Science Foundation, from October 1977 to March 1979. Commander Brennan now is assigned to the Navy's Discharge Review Board.

David M. Bresnahan was promoted from field projects manager to special projects manager within the Operations section of DPP in October 1978.

Erick Chiang joined DPP in May 1979 as field projects manager in the Operations section. Mr. Chiang was associated with the ice core storage facility at the State University of New York at Buffalo.

Gisela Dreschhoff, who joined DPP as program associate for polar earth sciences in March 1978, left the Foundation in June 1979 at the end of her Intergovernmental Personnel Act assignment. Dr. Dreschhoff returned to her position at the University of Kansas as deputy director of the Radiation Physics Laboratory.

Jerry W. Huffman, station projects manager in the Operations section, returned to his position in October 1979. Mr. Huffman had been seriously burned in April 1979 in an automobile fire.

Bernhard Lettau, program manager for ocean sciences, who joined DPP in August 1976 under the Intergovernmental Personnel Act, was named a permanent member of the staff in August 1979.

Richard P. Muldoon, who joined DPP in June 1978 as writer-editor in the Polar Information Service, left DPP in February 1980 for the Office of Government and Public Programs at the Foundation.

Luther D. Pullen, U.S. Navy, joined DPP as aviation projects manager in June 1979. Commander Pullen was officer in charge of the student brigade, Naval Air Technical Training Center, Memphis, Tennessee.

Richard H. Schaus, U.S. Navy, was with DPP from April 1979 to March 1980 as polar oceanography consultant (DOD). Commander Schaus had been commander of the Naval Arctic Research Laboratory, Barrow, Alaska. He is now deputy director of research programs at the Office of Naval Research.

D. Christopher Shephard, special projects manager in the Operations section from July 1970 to October 1978, left NSF to join Rockwell Industries in Denver, Colorado.

Francis S. L. Williamson was named chief scientist of DPP in November 1979. Dr. Williamson replaces Duwayne Anderson, who left the Foundation in January 1979 to become dean of the Faculty of Natural Sciences and Mathematics at the State University of New York at Buffalo. Dr. Williamson joined DPP in April 1978 as program manager for polar biology and medicine. Before he joined the Foundation, Dr. Williamson was commissioner of the Alaska Department of Health and Social Services. Prior to that he had been director of the Chesapeake Bay Center for Environmental Studies of the Smithsonian Institution.

Monthly climate summary

Feature	November 1979				December 1979				January 1980		
	McMurdo (date)	Palmer (date)	Siple (date)	South Pole (date)	McMurdo (date)	Palmer (date)	Siple (date)	South Pole (date)	McMurdo (date)	Palmer (date)	Si (d
Average temperature (°C)	-9.6	0.0	-18.6	-37.7	-3.9	1.7	-12.8	-27.0	-3.7	1.9	-1
Temperature maximum (°C)	1.2 (27,30)	6.0 (26)	2.4 (29)	-27.8 (27)	2.3 (24)	6.0 (17,19)	-1.8 (13,24)	-19.6 (23)	2.8 (6,8)	5.0 (14,16, 17,19)	1 (
Temperature minimum (°C)	-23.5 (2)	-9.0 (12,13)	-33.5 (2)	-52.1 (4)	-10.6 (31)	-3.0 (14)	-21.7 (3)	-32.8 (5,6,10,11)	-11.7 (11)	-2.0 (22,24)	-2 (2
Average station pressure (mb)	984.5	992.5	864.5	684.7	992.7	994.4	870.1	688.7	989.8	988.7	86
Pressure maximum (mb)	1001.2 (5)	1020.8 (23)	877.5 (24)	697.2 (23)	1005.0 (6)	1012.3 (16)	881.0 (10)	702.0 (18)	997.8 (18)	1003.3 (31)	87 (1
Pressure minimum (mb)	963.7 (17)	968.8 (4)	849.0 (19)	671.3 (10)	980.2 (23)	982.2 (26)	857.8 (4)	678.1 (24)	982.1 (3)	973.8 (19)	85 (15
Snowfall (mm)	38.1		299.7	Trace	38.1		119.4	Trace	167.6		14
Prevailing wind direction	090°	330°	155°	045°	045°	150°	180°	045°	020°	350°	16
Average wind speed (m/sec)	4.1	2.6	5.3	4.6	3.8	2.6	4.3	3.3	3.9	2.7	4
Fastest wind speed (m/sec)	30.0 135° (16)	13.0 030° (26)	16.1 090° (23)	14.8 020° (20)	14.8 045° (22)	18.0 030° (20)	18.8 160° (27)	14.4 010° (25)	16.5 070° (10)	14.4 360° (7)	14 25 (
Average sky cover	6.3	9.0/10	8.0	5.3	6.6	9.0/10	6.4	5.0	6.2	8/10	6
Number clear days	2	.3	3.5	10	0	.7	3	9	8	.3	4
Number partly cloudy days	9	7.7	3.25	10	12	9.0	10	12	6	13.7	5
Number cloudy days	19	22.0	23.5	10	19	21.3	18	10	17	17.0	20
Number days with visibility less than 0.4 km	0	0	6.9	.8	0	0	3.6	0	.1	1.0	4

Prepared from information received by teletype from the stations. Locations: McMurdo 77°51'S, 166°40'E. Palmer 64°46'S, 64°03'W. Siple 75°55'S, 83°55'W. Amundsen-Scott South Pole 90°S. Elevations: McMurdo sea level. Palmer sea level. Siple 1000m. Amundsen-Scott South Pole. 2850m. For prior data and daily logs contact National Climatic Center, Asheville, North Carolina 28801.

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Laclavere appointed vice president of SCAR

Ing-Gen G. R. Laclavere of France was appointed Vice President of the Scientific Committee on Antarctic Research (SCAR) on 12 September 1979. He replaces Peter Welkner of Chile who served as Vice President from October 1976 to September 1979.

Dr. Laclavere was elected the first President of SCAR at its inception in 1958. He acted in that capacity until 1963, when he was elected an honorary member of SCAR. He has served as a SCAR delegate since 1964.

SCAR is a nongovernmental organization created in 1958 as a committee of the International Council of Scientific Unions to further "the coordination of scientific activity in Antarctica with a view to framing a scientific program of circumpolar scope and significance."

The members of SCAR are Argentina, Australia, Belgium, Chile, the Federal Republic of Germany, France, Japan, New Zealand, Norway, Poland, South Africa, the United Kingdom, the U.S.S.R., and the United States. The Polar Research Board serves as the U.S. National Committee for SCAR on behalf of the National Academy of Sciences.

SCAR recommendations, resolutions, reports, and other related materials are entirely of an advisory nature. They are forwarded by the Polar Research Board to the Consultative Parties for consideration, possible support, or such other actions as may benefit the U.S. Antarctic Research program. The National Science Foundation exercizes overall management responsibility for the United States Antarctic Research Program.

Final reports required of NSF grantees

NSF grantees must submit two reports—a federal cash transactions report and a final project report—within 90 days of the expiration of a grant.

The federal cash transactions report includes information related to the disbursement of grant money by the grantee and his or her institution.

The final project report calls for a brief summary of the completed project. The summary is supplied to Congress and the public in response to requests for information. The summaries also are published annually by the Foundation.

The final project report requests technical information which may not be available at the time the final report is submitted. Technical information need not, therefore, be filed with the final project report.

The Division of Grants and Contracts at the Foundation monitors the status of report submissions. If these two final reports have not been submitted for an expired grant, no new award will be made on behalf of the grantee.

Copies of forms on which to submit these reports normally are provided to the grantee institution by the Foundation. Extra forms may be obtained by writing Forms, National Science Foundation, Washington, D.C. 20550.

Proposals due 1 June 1980

Proposals for scientific research projects in the U.S. Antarctic Research Program that are received by 1 June 1980 will be considered for performance periods as follows:

- for research *in Antarctica* during the 1981-82 austral summer season (September 1981 through March 1982) and extending, if appropriate, through the antarctic winter of 1982;
- for research or data analysis *in the United States* beginning approximately January 1981.

In some cases an additional year of lead time is necessary if projects require substantial preparation of facilities, extensive use of vehicles, transporation of large amounts of cargo or equipment, and so forth. Some researchers may have to allow time in advance of the season in which fieldwork will take place for the procurement and transport of supplies to Antarctica via the annual cargo ship.

Scientists who wish to perform antarctic research should investigate eligibility requirements and submit proposals in collaboration with their institutions as specified in the National Science Foundation booklet *Grants for Scientific Research* (NSF 78-41 or NSF 78-41A). A proposal preparation kit, which includes copies of this booklet, a description of antarctic research opportunities, and other necessary forms and instructions is available from the Division of Polar Programs (telephone 202/357-7817), National Science Foundation, Washington, D.C. 20550.