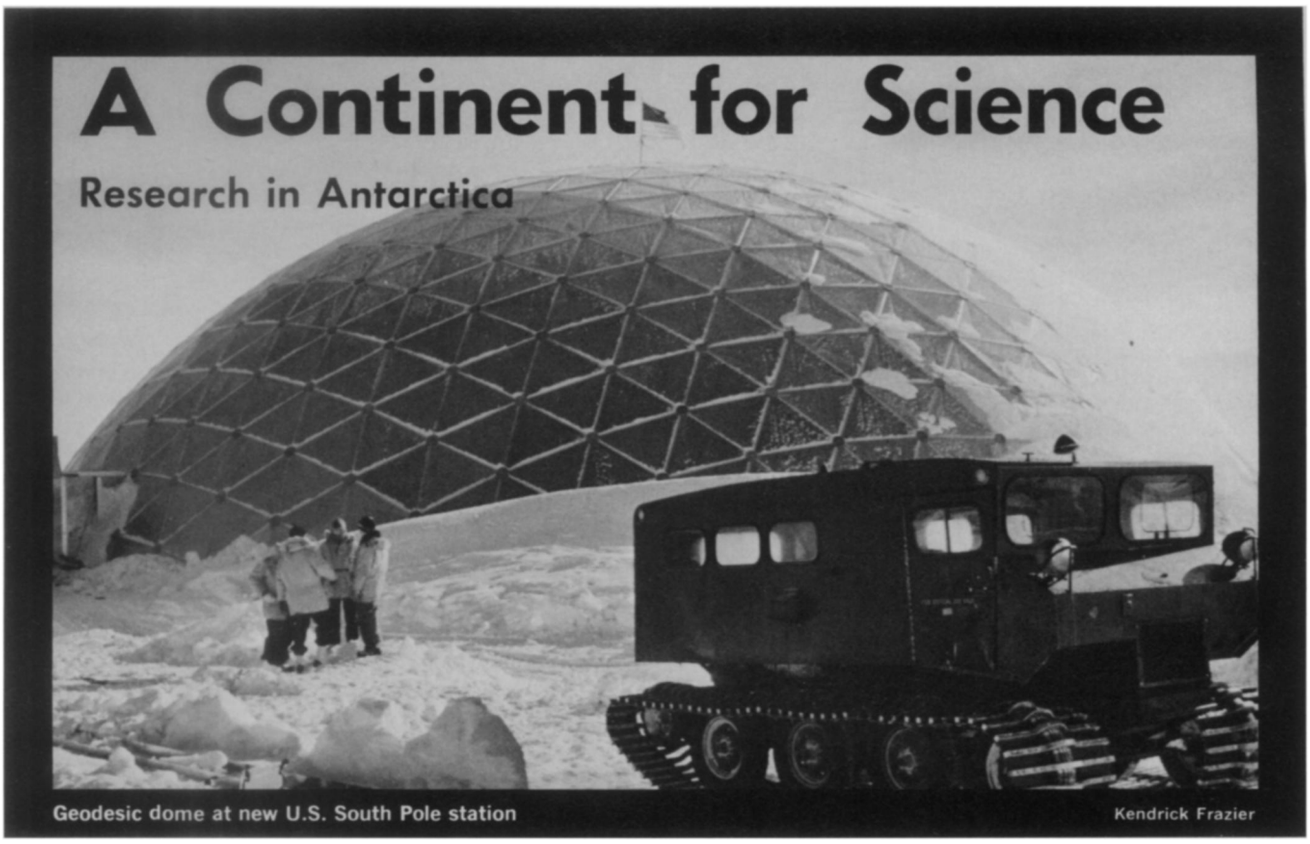
A Continent for Science

Research in Antarctica



Geodesic dome at new U.S. South Pole station — Kendrick Frazier

by Kendrick Frazier

The second of a series of articles based on the author's reporting trip to Antarctica.

At 5:39 a.m. Dec. 10 a new ski-equipped LC-130 Hercules transport plane purchased by the National Science Foundation only 20 days earlier touched down on the open snow at the newest and most remote U.S. scientific station in Antarctica, reversed its props and slid bumpingly to a halt.

Inside the aircraft, atmospheric physicist Theodore J. Rosenberg and three University of Maryland colleagues were rejoicing. They and some 11,000 pounds of their scientific equipment were at last at Siple Station. After a year's delay, they would be able to begin their two-month project to launch high-altitude balloons with counters to measure X-rays produced by electrons streaming down from the atmosphere above Siple.

A year earlier, they and their equipment had three times made the same 1,550-mile flight. But each time bad weather had prevented a landing, and they had to turn around and go back. By the time the weather had cleared, too little time was left in the season. The project was scrubbed for one year.

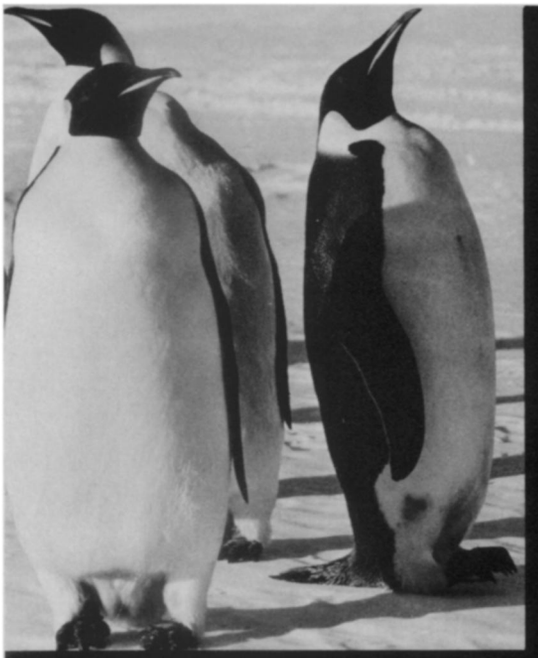
Antarctica is the coldest, windiest, most inhospitable place on the surface of the earth. Scientists who come here to do research must do so on the continent's own terms. It sets all the ground rules. Its vast distances and harsh environment establish strict limits on the duration, location and extent of the research.

Yet despite these conditions, 175 U.S. scientists are in Antarctica during these months of the Southern Hemisphere summer studying the ice, the land, the air, the water and the life in, on and around the frozen continent. Technicians and Navy logistics support personnel swell the number of Americans in Antarctica this summer to perhaps 1,000, all participating in or aiding the U.S. Antarctic Research Program, conducted by NSF to the tune of $7.5 million for research grants and $16 million for logistics support. Counting the scientists and support personnel of all the nations with research programs in Antarctica, the total population of the continent this summer is about 3,000. All of them are here on behalf of scientific research.

What is this fascination with Antarctica? What does such a cold, formidable place have to offer science? The answers are almost as numerous as there are fields of scientific study.

To climatologists and glaciologists, Antarctica is a history book of past world climate. Locked in its cover of ice, which in places is nearly three miles thick, is a record of temperature variations over the surface of the earth for hundreds of thousands, and even millions, of years. Antarctica, still in an ice age, thus holds many secrets toward understanding the ice ages of the past that affected vast areas of the earth, and perhaps ice ages of the future. The continent contains 95 percent of all the permanent ice in the world. Whether the ice cap is growing or shrinking is a question of vital long-term importance. If just a fourth of it melted, sea levels throughout the world would rise 50 feet, and many coastal cities would be threatened.

To meteorologists, Antarctica is a weather factory for the entire Southern Hemisphere. Warm air flows south toward Antarctica, cools, descends, and flows back toward the tropics, setting up a global circulation of the atmosphere. The fierce weather of Antarctica is an object of study in itself. The coldest temperature recorded on earth was at the Soviet Union's Vostok Station—a minus 126.9 degrees F. on Aug. 24, 1960. The winter of 1973 was considerably warmer. The temperature dropped only to minus 115.6 degrees F.



Photos by Ralph Payne and Ken Thornsley (U.S. Navy) and by Kendrick Frazier

Clockwise: Emperor penguins

Mt. Erebus, active volcano

Ice caves near Scott Base

Soviets welcome Americans to Vostok

Frazier at South Pole

Entrance to South Pole station

Winds of 100 miles an hour are frequent along the part of the Antarctic coast facing Australia.

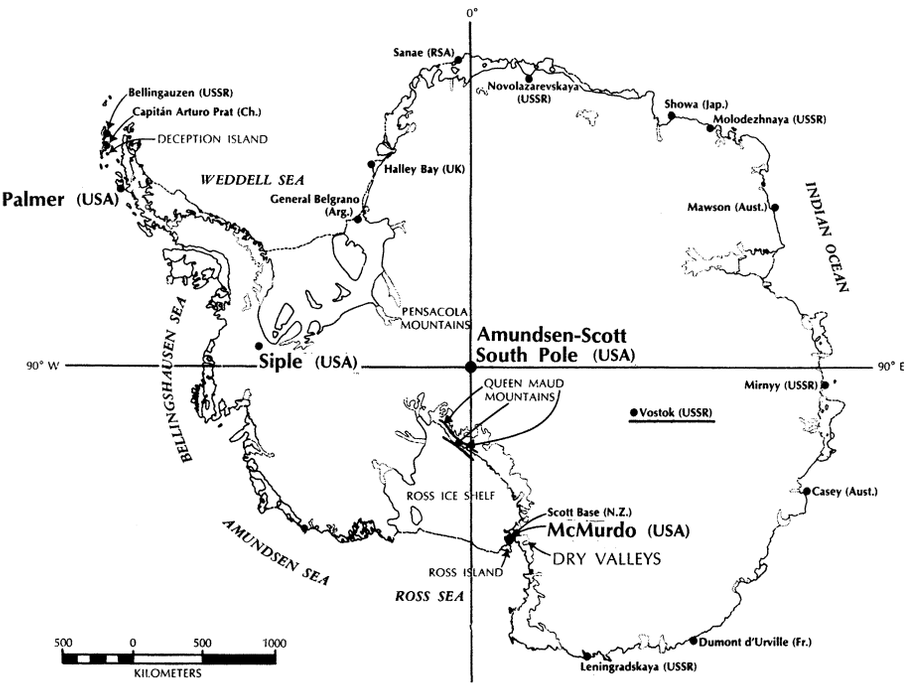
To marine biologists, the waters around Antarctica are the most biologically rich in the world. Cold water sinking to the ocean floor causes upwelling of nutrients to provide abundant food for the entire chain of sea life.

For zoologists, the seals and penguins that live on the sea ice and the fish that live in the ice water below it are a source of endless studies of biological adaptation to extreme environmental conditions.

To the microbiologist, the bacteria and other microorganisms that tenaciously cling to life where soil and rock are exposed hold clues to how primitive organisms might exist on other planets, particularly Mars, whose climate is similar in many ways to that of Antarctica. In 1968, biologists found microorganisms in the southernmost exposed soil in the world, on Mt. Howe, 160 miles from the South Pole.

To ecologists, the fragile and simple ecosystems of the small lakes in the ice-free valleys of Antarctica are natural outdoor laboratories for the study of the relationships between organisms and their environment. Scientific groups at Lake Bonney this year are studying the metabolism of the lake's aquatic organisms, including an entire community of life that lives in conjunction with a mat of algae attached to the sediments on the lake bottom. Says one biologist, "They're studying everything in the lake, and trying to relate all the factors in the system. Practically every day they're discovering another species of organism."

For environmentalists, Antarctica, far from any sources of local industrial pollution, is an ideal place to monitor the degree to which pollutants have spread throughout the entire global atmosphere. This year at the South Pole the National Oceanic and Atmospheric Administration has set up one of six "clean air" geophysical monitoring observatories that will make long-term measurements of carbon dioxide, ozone, particulates, and solar radiation. Other instruments are measuring trace elements in the Antarctic atmosphere.



NSF

Research stations of the United States and other nations dot Antarctica.

To geologists, who this summer are conducting the first scientific drilling into the continent itself, Antarctica holds clues to a better understanding of sea-floor spreading and continental drift. Antarctica was once linked to Australia, India and Africa.

And to geophysicists, Antarctica is a unique place where magnetic field lines reach down to the earth's surface, allowing low-energy cosmic rays to penetrate the atmosphere and setting the stage for a whole array of studies of the planet's electrical and magnetic properties. Siple Station, for instance, is located at one end of a magnetic field line that arches far out into space to a distance of four earth radii (17,000 kilometers) above the equator, then curves back down to earth at Roberval, Quebec, Canada, where there is a similar observation station. Scientists at Siple use a 100-kilowatt transmitter and a 13-mile-long, very-low-frequency antenna spread out above the snow to send signals up along the magnetic field line and back down to Roberval, where they are examined to see how the upper atmosphere alters them.

In 1973, for the first time, Siple was operated throughout the winter. The scientists discovered that the signals they sent up were amplified in power 1,000 times by some unknown process in the earth's magnetosphere. "This was the first time that it has ever been proven that a transmitter could send up radio waves and have them amplified," station leader Jack Bowers of Stanford University told the only group of reporters ever to visit Siple, in December. The phenomenon could foreseeably have communications applications in the future.

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Scientific research is not new to Antarctica. When Robert F. Scott and his four men died in 1912 on their way back from the South Pole, they had with them 30 pounds of rocks collected along the way for their scientific interest. But the first full-scale scientific effort was the International Geophysical Year of 1957-58, in which 12 nations

A continent of contrasts

To the visitor, Antarctica is a land of often dramatic contrasts. The continent holds 7 million cubic miles of freshwater ice, yet it is a desert; annual precipitation ranges from 2 inches at the South Pole to less than 2 feet in coastal areas on the northward-jutting Antarctic Peninsula. Ice covers some mountain ranges so thoroughly that only the tops of high peaks are exposed, yet there is an extensive area of completely ice-free valleys covered with coarse sand and speckled with lakes and streams.

The continent itself is nearly devoid of any but microscopic plant and animal life, but the teeming waters around Antarctica are the most biologically abundant on earth.

It is the coldest continent on earth, yet all the buildings at U.S. research stations tend to be needlessly overheated. Pilots find flying in Antarctica challenging at first, but many admit to being soon bored by the monotonous terrain of unrelieved snow and ice.

A blizzard that strikes during the six-month Antarctic night can be almost unbelievably bitter, yet a calm, sunny summer day in January during the period of perpetual daylight can be far more pleasant than what millions of winter-bound Americans are experiencing at the same time in the United States. Depending on one's situation, Antarctica can be awesomely beautiful and peaceful or terrifyingly formidable and hazardous. —*K.F.*

joined in an all-out assault on the scientific secrets of the frozen continent. The years since the IGY was planned have seen an enormous advance in the scientific understanding of Antarctica.

"We've taken an unknown continent and made it known in 20 years," says University of Nebraska geologist Samuel B. Treves, who himself has made seven trips to Antarctica.

This is the age of systematic scientific study in Antarctica. Research now focuses not so much on *what* is there, but on the *why* and the *how*—and what it all means for the rest of the planet.

With the help of modern aircraft, modern communications and experienced support personnel, scientists now can use Antarctica as an extension of their own laboratories. They are well-fed, well-clothed, and well-cared-for—one logistics aide admitted they might be "a little spoiled." Temporary field research camps are heated with oil stoves or furnaces, and even tents are usually fitted with plywood floors. But everyone seems to realize the goal of such comfort is efficiency—to allow the scientists to spend as much of their time as possible doing research.

The largest project under way to make living in Antarctica easier is the construction of a new U.S. station at the South Pole. The existing Amundsen-Scott South Pole Station, first occupied in 1957, shows scarcely any evidence of its existence to the visitor to the South Pole. Over the years it has become deeply buried by the blowing snow and the only things protruding above the surface are ventilator pipes, chimneys, and a small plywood entranceway through which one enters the station by way of a long sloping tunnel. The station is succumbing to the fate that eventually dooms all habitations in the interior of the continent—crushed under the weight of the blown snow.

The new South Pole station consists of two large exterior snow shields—one a 52-foot-high geodesic dome, the other a metal semi-cylinder 800 feet long and 46 feet wide. The dome houses three prefabricated buildings that will be the main living, sleeping and laboratory areas for up to 50 persons. The long tube houses fuel (150,000 gallons have to be left before each winter), vehicles, generators and some laboratories.

Capt. William Kay, head of the Navy Seabees in Antarctica, calls the building of the new South Pole station "the most challenging construction project ever done by the Seabees anywhere in the world." He and his men are unabashedly proud of their work at the South Pole. Temperatures rarely rise above 20 below zero, winds average 14 miles an hour, and the elevation is 9,186 feet. Under such conditions the men can work outside at most three hours at a time. The efficiency of powered equipment is only a third what it is at normal temperatures and elevations. A crane that normally can lift 15 tons can lift only 5 tons at the South Pole.

Nevertheless, thanks to good weather this summer and a steady flow of materials (86 flights of cargo were flown into the South Pole construction site during the first two months of the season, Oct. 9 to Dec. 9), construction is well ahead of schedule. No problems are anticipated in occupying the new station later this year during the 1974-75 summer research season. The new station will probably be dedicated a year from now, in January 1975.

The Seabees were also spurred on by the knowledge that this is their last season in Antarctica. The Navy is withdrawing the Seabees from Antarctica. All construction remaining next season, plus the installation of building interiors and the conduct of all support services at the new South Pole station, will be conducted in the future by a private company, Holmes & Narver of Anaheim, Calif., under contract, as the Navy is now, to the National Science Foundation.

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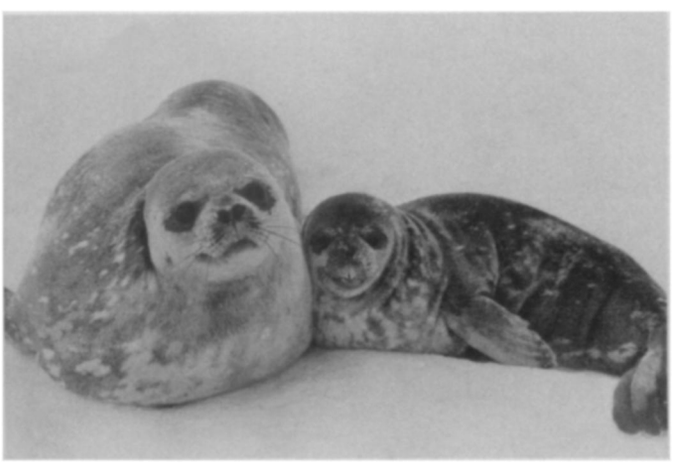
Antarctica is unique in more than its physical setting. Under terms of the Antarctic Treaty of 1959, the entire continent is to be used "for peaceful purposes only." Military operations and weapons tests are prohibited (the use of military personnel or equipment for logistical support of the scientists is allowed). Freedom of scientific investigation is encouraged. Plans for research programs and scientific observations and results are exchanged and made freely available. Scientists are exchanged between the expeditions and stations of the dozen nations doing research in Antarctica. All territorial claims in Antarctica are in abeyance as long as the treaty is in force.

Antarctica is, in short, a continent devoted to scientific research, with no political boundaries. The high purposes of the treaty seem to be cheerfully adhered to in both fact and spirit. A U.S. flight from the U.S.'s McMurdo Station to the U.S.S.R.'s Vostok Station on Dec. 14 (the first airplane of any sort to reach that isolated outpost since February 1973) took a group of American visitors to Vostok, where they were greeted with "Merry Christmas" signs, vodka toasts and caviar. The plane left behind one U.S. scientist who will stay at Vostok for the next year, and returned to McMurdo with four Russian scientists, who spent the next two weeks visiting U.S. field research sites. One of them, Peter Astakov, saw many familiar faces among the Americans. He had been at McMurdo several times before, and in 1967 he "wintered over" at the U.S. South Pole station.

This experience in cooperation throughout Antarctica is often seen as a model for greater world brotherhood. American scientists might not share all his political views, but many would echo these words of Ye. K. Fedorov, a prominent Soviet meteorologist: ". . . . The unification of mankind . . . will be possible . . . if, over the entire globe, there is installed . . . roughly the same type of interaction among countries as we have already attained and are realizing over a period of almost two decades in Antarctica." □



Ralph Payne/Navy

Above right: Portion of Antarctica's pristine Lake Bonney, one of the few lakes in the world not influenced by human pollution. Its biologically simple ecosystem is the subject of a detailed study. Left: A Weddell seal and her pup.

Kendrick Frazier