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THE POLAR TIMES

The Transantarctic Mountains protrude through the east antarctic ice sheet near the Beardmore Glacier.

NSF photo by Ann Hawthorne.



National Oceanic and Atmospheric Administration

The Polar Times

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Panel seeks help with arctic policy

The Anchorage Times

Copies of the one-half page U.S. Arctic Research Policy proposed by The Arctic Research Commission were distributed recently at a public meeting in Seattle.

The policy reiterates information included in the Arctic Research and Policy Act of 1984 and serves as the first step in development of research priorities for the North.

"The Commission believes that Arctic research policy should flow from concerns expressed in the Arctic Research and Policy Act and policy guidance provided by National Security Decision Directive Number 90, which establishes U.S. Arctic policy," says Timothy Hushen, executive director of the Los Angeles based U.S. Arctic Research Commission.

In the nine months since conception, the ARC has conducted public meetings in Anchorage, Fairbanks, Seattle, Barrow and Prudhoe Bay.

"Information obtained from these meetings are incorporated in the policy," says Hushen.

The Arctic Research Commission is a presidential commission created with passage of the Arctic Research and Policy Act of 1984. As prescribed by the legislation, the five members have expertise in science and/or business with one member of the Alaska native community.

Members of the commission are J.H. Zumberge, scientist and president of University of Southern California in Los Angeles; Juan Roederer, director of the Geophysical Institute at University of Alaska, Fairbanks; Oliver Leavitt, Barrow resident and chairman of the Board of Alaska Federation of Natives; Elmer Rasmuson, chairman of the executive committee at National Bank of Alaska, and A. Lincoln Washburn, professor emeritus of geological sciences and Quaternary Research Center at the University of Washington in Seattle.

Greenland Under Thin Ice

It has long been assumed that the ice sheets of Greenland and Antarctica were thicker in the ice ages than today, but an analysis of ice obtained by drilling to bedrock through the crown of the Greenland ice sheet and through the ice cap on Canada's Devon Island suggests that the ice may actually have been thinner.

Such drilling has reached layers of ice formed in the last ice age and has shown it to be considerably softer than ice formed more recently from annual snow accumulations. According to Niels Reeh of the Geological Survey of Greenland, ice formed in the ice age flows three to four times more readily than that above it. This, he reports, has been confirmed by deformation tests on the ancient ice.

Such greater plasticity could help explain why, some 12,000 years ago, the ice flowed far enough south to gouge smooth troughs in the rocks of New York City's Central Park.

Even though the ice sheets became extensive, because the ice flowed more readily than today their central regions shed the accumulation rapidly. As time passes the underlying layer of more plastic ice becomes thinner and the modern, slower-flowing ice above it becomes thicker.

As a result, Mr. Reeh proposed in a recent issue of Nature, the rate at which ice flows to the sea is slowing down. Consequently the ice covering Greenland is becoming a half inch thicker each year and the Devon Island ice has thickened 15 percent. While he pointed out that other factors, such as temperature and snowfall, help determine ice accumulation, he suggested that the thickening trend in central Greenland should persist "for thousands of years."

Softness of the ancient ice has been attributed to the smaller size of its crystals and their more vertical ori-

entation. The ice is also more contaminated with particles. The ice ages were marked by extensive dust storms that covered much of the Middle West with fine-grained material known as loess.

Norway Bans Arctic Plans

OSLO, Nov. 17 (Reuters) — Norwegian authorities have effectively banned further oil and gas drilling operations this winter in its northern waters, calling exploration rigs off northern Norway unfit for harsh Arctic conditions.

The state-funded Norwegian Petroleum Directorate's decision to stop Arctic operations by the Exxon Corporation and the Royal Dutch/Shell Group halted what would have been the first winter drilling season off Norway's rugged northern coast.

The directorate said exploration rigs normally used in the North Sea had not been prepared for the hurricane-force gales and icy conditions in the Norwegian Sea.

Exxon's Norwegian subsidiary has protested, saying it had spent considerable sums modernizing its rig.

A safety official said the decision was not intended to spell an end to the Government's plan to open northern waters to winter exploration, but he criticized oil companies for using unsuitable rigs there.

Norway, which produces about 850,000 barrels of crude oil a day, is looking to Arctic discoveries to maintain production levels when its North Sea fields begin to decline.

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AUGUST HOWARD, Editor

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The Polar Times

No. 101

DECEMBER 1985

Arctic night envelops slope

by Dean Fosdick
Associated Press

PRUDHOE BAY — When the sun disappears beneath the frigid, wind-swept horizon of the North Slope tundra today, it will be gone for 56 days — not to reappear until Jan. 18.

The Land of the Midnight Sun in summer is also the Land of the Long Arctic Night in winter.

For the next couple of months, the few thousand or so people who inhabit this flat, treeless arctic desert will be working in a daytime twilight. It's a period of time just a few hours long that is more gray than black, but more night than day.

Headlights and office lights will burn around the clock. But it will be business as usual at Prudhoe Bay, some 250 miles north of the Arctic Circle, and 1,500 miles south of the North Pole. Sprawled along the edge of the Arctic Ocean, it's the largest oilfield yet discovered on the North American continent.

Donna Ford, a security guard, says, "Life goes on. Work goes on. You just look at your watch more often."

Ford, who lives near Anchorage, says it's just the reverse during the brief arctic summer. That's when the sun brings perpetual daylight for more than two months.

"My first year up here, 5½ years ago, I probably didn't get more than three hours of sleep a night," Ford said. "You'd be talking and looking at your watch, and it would be three in the morning."

ARCO Alaska Inc. operates the eastern half of the giant oil-

field as well as the neighboring Kuparuk River field, 40 miles to the west. The company shuttles more than 1,000 employees through rotating shifts of seven days on and seven off.

They work 12-hour days during their week on the slope, but flexibility is built into the system during winter.

John Marshall, assistant director of the public safety department responsible for seven outlying communities scattered throughout the North Slope Borough's 88,000 square miles of territory, says the crime rate

doesn't seem to fluctuate much when the sun stays down.

"People remain people," Marshall says. "The crime rate may go up a bit toward the end of winter when people try to shake off their cabin fever. But it's my feeling that crime has more to do with unemployment and paydays than the phases of the moon or the amount of light during the day."

In Anchorage, daylight hours will continue to taper off until winter solstice, Dec. 21. On that date, the city will see about five hours and 28 minutes of sunlight.

'Use it or lose it,' official says of Arctic

OTTAWA (AP)—If Canadians don't use the Arctic, they're going to lose it, University of Toronto professor Franklyn Griffiths has warned.

"We've got to get up there. We've got to put up or shut up about our Arctic sovereignty," Griffiths told a panel discussion on the voyage of the U.S. Coast Guard icebreaker Polar Sea through the Northwest Passage.

"To put it simply, use it or lose it for these waters."

The Seattle-based Polar Sea, which entered Canada's northernmost waters in August, has rekindled debate over Canada's sovereignty in the Arctic.

Canada considers the waters surrounding the Arctic islands as internal waters and under international law such waters are part of the sovereign territory of a country.

But the United States says the Northwest Passage is an international strait, part of the high seas. For that reason, it did not ask Canada's permission to undertake the voyage although it did give notification of its plans in May.

Griffiths, the political science professor who broke the story of the voyage, said he expected public opposition to be stronger, along the lines of the response to the 1969 voyage of the Manhattan, the American oil tanker which became the first commercial vessel to travel the Northwest Passage.

Tom Pullen, the former navy captain who was Canada's official representative on the Manhattan, said he thinks Canadians are overreacting to the Polar Sea.

The government may have long-term plans for the Arctic which are not hampered by this single trip, he said.

Griffiths said Canada's reaction to the voyage has been inadequate, ineffective and unworthy of a country trying to maintain its security.

He recommends Canada find countries or corporations interested in year-round shipping through the Northwest Passage.

Pullen, with the unanimous support of other panelists, said Canada needs to build an icebreaker capable of patrolling Arctic waters year round.

Arctic caribou increasing

JUNEAU (AP) — The Western Arctic caribou herd has been growing rapidly in size for the past 10 years, according to the state Department of Fish and Game.

The herd's numbers now exceed 200,000 animals, officials said. That's up from a low of 75,000 caribou in 1975.

Caribou increase their range as their herd size increases, officials said. Thus far this winter, caribou from the Western Arctic herd have been seen from Bettles to the southern portion of the Seward Peninsula.

Those are traditional ranges that the caribou haven't used in years, officials said.

The Western Arctic caribou herd provides meat and hides for residents of 25 or more villages during its annual migration across northwest Alaska, the state said.

Navy studying sound waves under strategic polar icecap

LOS ANGELES (AP) — The Navy has launched a scientific study of the Arctic region, an area where Soviet and American submarines could play a critical role in any military confrontation between the two superpowers.

Soviet and U.S. submarines have stepped up their cat-and-mouse game below the polar icecap, spurred by recent fears that the Soviets may have the capability to launch missiles toward previously unreachable targets in the United States.

Much of the five-year research program will focus on how sound travels from one point to another under the polar icecap, James Wilson of Los Angeles, chief scientist on the government-funded project, said last week.

Below the icecap, sound waves are guiding beacons for submarines that roam through treacherous underwater formations called "ice keels," often extending 150 feet deep.

The uneven features below the ice and other characteristics make sound waves behave differently under the icecap than in the open ocean, often clouding the image provided by sonar equipment.

"The transmission of sound is just totally different there," said Wilson, a physicist and oceanographer. "It's just a completely different world."

Scientific exploration of the Arctic has remained limited since the historic voyage of the Nautilus, the world's first nuclear-powered submarine. The Nautilus passed under the North Pole on Aug. 3, 1958, in a voyage from Pearl Harbor,

Hawaii, to Portland, England.

Navy submarines have operated in the Arctic since that time, and those operations under the ice have been stepped up in recent years, since the introduction of a new generation of Soviet submarines designed to break through the ice.

But "the Arctic has been a scientifically ignored area," said Wilson, who added that past expeditions have been of a "survival nature."

Wilson and other scientists spent six weeks last spring near the North Pole beginning their research. And they plan to return next spring, the only time of the year they can do their research.

"We're on the frontier of understanding what makes the Arctic work," Wilson said.

Wilson and his co-workers drilled holes in massive ice fields and set off underwater explosions to study sound waves below the ice. This spring's research also involved gray whales, which travel under the ice. The whales surface frequently in scattered areas of open sea to breathe.

Wilson said he suspects that whales, like submarines, rely on sound waves for direction, but "it's a complete mystery to us right now."

And if whales do rely on sound waves, they also understand how those waves differ in the far north, an ability Navy planners would like to give to listening devices aboard submarines.

Norway Will Increase Efforts to Secure Svalbard as a Community:

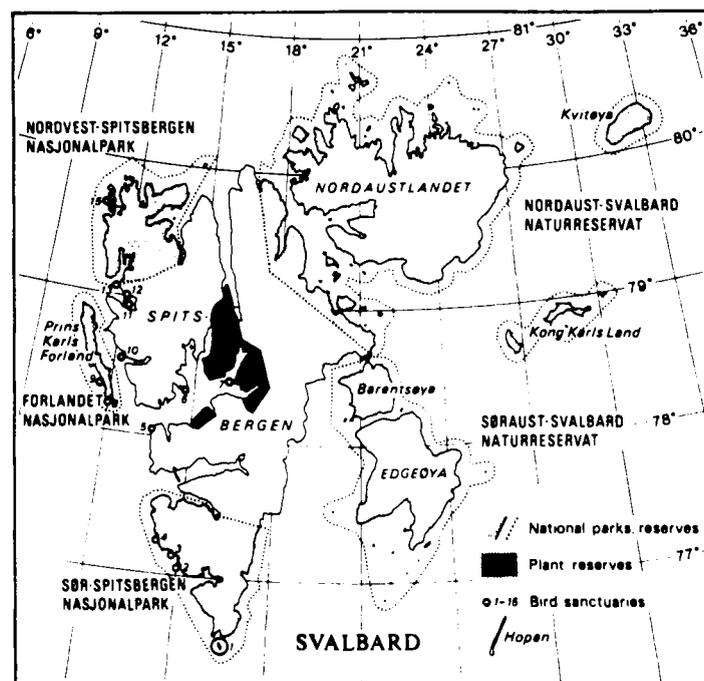
Development and Preservation of Svalbard

"Svalbard is a unique and impressive area with a nature and an atmosphere which cannot be experienced in mainland Norway," Prime Minister *Kåre Willoch* said August 14th in Longyearbyen on a visit celebrating 60 years of Norwegian sovereignty in the archipelago.

Mr. Willoch headed an official delegation of nearly 100 persons who were flown to the island in a chartered plane on August 14th, the date when in 1925 Norway was given sovereignty over Svalbard. Among the distinguished guests were representatives of the Government, Storting and Supreme Court, and former governors of Svalbard.

At the monument to those who gave their lives to defend the islands during World War II, Mr. Willoch remarked that "no one has assumed more demanding tasks or contributed more to our freedom than our fellow-citizens who fought and lost their lives at Svalbard."

The Prime Minister reminded his listeners that the Svalbard Treaty of 1920, to which 40 nations are now party, forbids the establishment of naval bases or forts on the islands, which are not to be used for purposes of war. There is agreement in the Storting, however, that mining should continue on Svalbard since it provides the basis for a viable community, and that research should continue and increase.



By the Treaty of Svalbard of 9 February 1920 Norway was granted sovereignty over Svalbard and the territorial waters of the archipelago.

The Svalbard Act of 17 July 1925 declares that Svalbard is part of the Kingdom of Norway.

News of Norway

Satellites Are Eyes in Sky for Wildlife Studies

ANCHORAGE, Sept. 21 (AP) — When caribou No. 5871 beds down for a nap on the tundra, Larry Pank knows it, 400 miles away in his Fairbanks office.

A fist-size transmitter on the caribou's neck and a pair of satellites in space chart the animal's every movement as it migrates across northeastern Alaska.

"With some degree of reliability, we can tell if he's standing, lying, running or walking," said Mr. Pank, a biologist with the United States Fish and Wildlife Service. "The amount of data you can collect from this is amazing."

Using a computer, Mr. Pank can pin down the caribou's location to within 1,600 feet. A thermometer in the transmitter tells him the approximate air temperature. A motion-sensing switch detects how many times, and to what degree, the animal moves its head each hour.

Safer and Cheaper Tracking

Tracking animals with data relayed by satellite has enabled Mr. Pank and researchers all over the world to study wildlife in ways never before possible. Not only can satellites chart a gray whale's wanderings in the Pacific, they can also tell how often and how deep it dives. They can follow African ele-

phants across hostile borders closed to biologists.

The use of satellites also makes routine tracking tasks safer and less expensive. Biologists have long used radios to track wildlife, but a radio transmitter's limited range forces researchers into the field, which often

means flying over remote country, in all seasons and weathers.

"They're going out in the worst environments — people get killed," said David Beaty, a partner at Telonics Inc., a manufacturer of animal-tracking devices. "Now they can sit back at their computer and collect two to six position fixes a day, and we don't lose any scientists."

Telonics, of Mesa, Ariz., has designed transmitters to fit humpback whales off Newfoundland, red deer in New Zealand, manatees in Florida, polar bears and musk oxen in Alaska, and many others.

Research on the North Slope

Satellite tracking is especially useful on Alaska's North Slope, where researchers are hurrying to study the environmental impact of oil and gas development.

Since last spring Mr. Pank and other scientists with the Fish and Wildlife Service and the Alaska Department of Fish and Game have been monitoring a herd of 150,000 caribou, the Porcupine Herd, which migrates between the North Slope and Canada's Yukon Territory.

They captured 10 animals, fitted them with transmitter collars and returned them to the herd. Now, about 25 times a day, one of two weather satellites streaks overhead hour picking up signals from the transmitters.

The messages are recorded, then transmitted to earth as the satellite passes over a ground receiver in the interior of Alaska. The data are relayed to Toulouse, France, where the French national space agency translates the encoded messages and stores them on

computers for retrieval by the researchers.

Transmitters Cost \$3,000

Experiments with satellite tracking of animals began in the early 1970's, Mr. Beaty said. The satellites were ready; the trick was to make transmitters powerful enough to reach into space yet small enough not to impede the animals.

There have been setbacks. Fish and Wildlife scientists last year tried solar-powered transmitters on swans in Alaska, but the transmitters failed in the cold.

But successes are starting to outnumber failures. Telonics says it has had a perfect record for three years with transmitters used on land animals. Also, the transmitters are shrinking in size and cost. The ones used on caribou, for example, now sell for \$3,000, down from \$12,000 two years ago.

Mr. Pank says that is a bargain. A comparable caribou study using radio transmitters would cost the Government five times as much, mostly for aircraft charters, he estimated.

South Pole Satellite

Two Government agencies, two universities and several commercial manufacturers have joined forces to give scientists stationed at the South Pole a reliable satellite link to the outside world.

According to an announcement by the National Aeronautics and Space Administration, an old satellite, the ATS-3, has been pressed into service for polar communications. The ATS-3 was launched in 1967 and has run out of maneuvering fuel, but is useful for relaying communications. ATS-3 is visible to both the University of Miami in Florida and the South Pole for about four hours every day, permitting data and voice transmissions between the two points in that period.

NASA cooperated with the National Science Foundation, the Universities of Texas and Miami and several aerospace companies that donated equipment to set up several new Antarctic communication links, including the one carried by satellite ATS-3. The combined cost of these projects was \$250,000, a fraction of the cost involved in orbiting a new satellite.

Although the the United States South Pole Station operates various radio systems, radio is generally unreliable on the South Pole.

C.J. MacGregor, Forecaster, Dies

The New York Times/Oct. 2, 1988

Clifford J. MacGregor, who led a pioneering expedition to the far north to show that Arctic weather had a strong effect on other parts of the world, died yesterday at the Wayne Memorial Hospital in Honesdale, Pa., after suffering a stroke. He was 80 years old and lived in Beach Lake, Pa.

Mr. MacGregor, who served in the Weather Bureau in Alaska in the early 1930's, became convinced that most of the weather conditions in the United States were a result of polar air masses moving south and interacting with warmer air.

He believed that the establishment of weather stations in the northern regions would make it possible to forecast weather two months in advance and even seasonally instead of 36 hours to 48 hours ahead of time.

To prove his idea, Mr. MacGregor took a leave from his job in 1937 as a United States Weather Bureau meteor-

ologist in Newark to lead a major expedition in the Arctic.

The expedition left New York on a three-masted schooner, the General Adolphus W. Greeley, and spent the winter frozen in the Arctic ice. From

its base on the ship and in a camp ashore the expedition sent back daily wireless reports on the conditions found.

The findings led to the establishment of a network of bases to monitor northern weather.

Mr. MacGregor went on to serve in the Navy World War II and rose to the rank of captain. He helped to establish bases first in Greenland to help fight the battle in Europe and later in Siberia in preparation for a planned invasion of Japan.

Mr. MacGregor is survived by his wife, Gertrude; a son, Clifford Jr. of Henderson, N.C. and a daughter, Martha Genevieve Razik of Ridgewood, N.J.

Greenland halibut

Greenland will issue a 10-kroner stamp depicting the Greenland halibut Oct. 10.

The two-color stamp was designed by Jens Rosing and engraved by Arne Kuhlmann. It was printed by intaglio by the Danish Post and Telegraph Office.

Eskimos View Radar Stations as Blots

By CHRISTOPHER S. WREN

The New York Times

FROBISHER BAY, Northwest Territories — When the United States and Canada announced plans last spring to overhaul the North American air-defense system, the news evoked little enthusiasm from the people who live in the region.

The Talk of Baffin Island The Baffin Islanders, who inhabit the barren, mostly Arctic island between the Canadian mainland and Greenland, felt as if they had seen it all before.

The radar stations of the original Distant Early Warning line, or DEW line, were built in the 1950's to give advance notice of Soviet bomber attack. Although the system changed the face of the Arctic, creating new communities in the Baffin region like Hall Beach, it did not usher in the prosperity and jobs expected by the Inuit, as Canada's Eskimos are called. Technicians imported from the south have done most of the work.

"It's going to create some short-term employment, for sure, but as far as long-term employment is concerned, I doubt it very much," said Louis Tapardjuk, the president of the Baffin Regional Inuit Association, as he discussed the new system.

Automation Replaces Workers

The modernized warning system will include a network of new long- and short-range radar stations overlapping across Alaska and northern Canada, including several stations on Baffin Island.

Frobisher Bay, Baffin Island's largest town, may also get a logistical support center and an upgraded airport runway to accommodate jet interceptors.

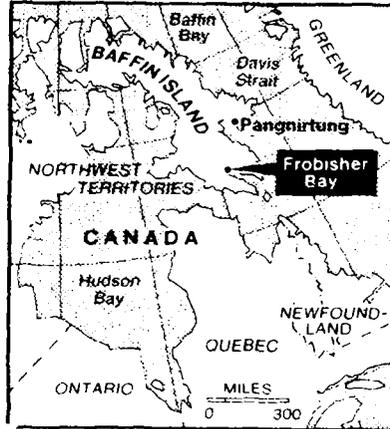
But of the 528 people employed on the present DEW line, only 18 are natives. The new system will need even fewer people, perhaps only 150, because the short-range stations will be automatic.

The Eskimos have worried that the fragile Arctic environment might be polluted by polychlorinated biphenyls, or PCB's, left at dismantled DEW line stations. The toxic chemical is used as a coolant.

Traces of PCB's have been found in the tissues of polar bears, seals and fish, though the source is unclear. The Canadian Government has started a \$370,000 cleanup of PCB from 24 abandoned DEW line sites.

After the new warning system was announced, the Baffin Islanders were upset by a report that small nuclear reactors would run the short-range radar stations. They said they feared a radioactive leak would contaminate the wildlife they rely on for food.

Government spokesmen went on the radio to assure everyone that conventional diesel generators would be used. Even so, said Jim Bell, who works for Baffin Island's weekly newspaper, *The Nunatsiag News*,



The New York Times/Aug. 17, 1985

Frobisher Bay has 2,500 residents.

"People are worried about how the small warning stations will be powered."

Such incidents underscore the extent to which a remote region like Baffin Island, which is as far north of Montreal as Florida is south, has become vulnerable to modern realities.

Frobisher Bay, less than 200 miles below the Arctic Circle, was named for Sir Martin Frobisher, an English swashbuckler who arrived in 1576 under the misapprehension that he had found the Northwest Passage to Asia.

The town itself, which now has about 2,500 inhabitants, sprang up when the United States built an airfield to refuel planes ferrying supplies to Europe during World War II.

"Frobisher Bay wouldn't be here if the Americans didn't need it," said John Rizzotto, the town manager. The Americans pulled out in the early 1960's, but a couple of junkyards are still called the "American dumps."

Frobisher Bay's hasty wartime origins are still obvious. Weatherbeaten buildings are scattered along the shore. The Government often changed its style of row housing, but old-timers can look at a building and tell its vintage. Only a small Anglican cathedral, built of wood to resemble an igloo, graces the scene.

Not a Place for Trees

Government offices are ensconced in a fortress-like concrete high-rise on the top of the hill, prompting local quips about climbing cap in hand to seek Government largesse.

Frobisher Bay lies too far north to support a tree. Mayor Bryan Pearson imported some grass seed and sheep manure from Montreal a few years ago. But his attempted greening of Frobisher Bay touched off one of the town's memorable controversies, because the seed and manure cost over \$500.

The town's beauty in the short summer lies in bright purple wildflowers that carpet the tundra and the mellow

sunsets that flare into sunrises.

To enhance the region's Eskimo character, the town council voted last year to change the name of Frobisher Bay to Iqaluit, an Eskimo word that means "fish." The Federal Government is still studying the idea.

The most talked-about topic on Baffin Island is the cost of living here, which runs at least 40 percent higher than in southern Canada. Most supplies, down to white fiberglass panels for the prefabricated schools, arrive aboard four or five ships, which ride in on the 30-foot tide in the summer and are unloaded when the low tide beaches them. Perishable goods must be flown in, and a head of lettuce in midwinter can cost more than \$3.

Spare parts get expensive or scarce, so the Eskimos, who make up the great majority of Baffin Island's population, lavish ingenuity on their snowmobiles, which have replaced dogsleds.

"Stories circulate about the jury rigging of Ski-dos with caribou bones and sinews," said Ron Mongeau, who estimated that a tenth of the snowmobiles in Frobisher Bay were kept running with such improvised parts.

Yet Eskimos have had trouble getting licensed as mechanics, because they could not pass a written English test drawn up in southern Canada.

Mr. Mongeau, who is the executive officer of the Baffin Regional Council, said his organization finally pushed through its own licensing criteria so

that self-taught mechanics are now tested and recognized where it matters in the Arctic — on the job.

The improvisational nature of life on Baffin Island extends to the television shows pulled in by Frobisher Bay's satellite dish, which taps channels from British Columbia, Alberta, Ontario, Quebec and Newfoundland.

But the most popular show on Baffin Island, according to Aimo Aimo Nookiguaq, the manager of the Inuit Broadcasting Company, is a locally produced current-affairs program called "Qagik." The word in Inuktitut means the entrance to an igloo.

When television carried the pictures of Ethiopians starving on the other side of the world, the response from the Eskimos was startling.

Frobisher Bay organized auctions of everything from homemade cakes to painstaking soapstone carvings donated by Eskimo artisans. It collected more than \$31,000, a lot of money for a small town with many families on welfare.

In the hamlet of Pangnirtung, which raised more than \$4,500, Meeka Kilabuk knew friends who wanted to catch a seal and send it as food to Africa or who offered their sealskin boots to keep Ethiopian children warm.

Walrus deplete food supplies

Fairbanks (AP) — Walrus populations ballooned to record levels this decade, but may be declining because of food shortages and increased hunting, says University of Alaska researcher John Sease.

Sease, of the university's Biology, Fisheries and Wildlife Department at Fairbanks, was participating in the three-day 1985 Arctic Science Conference.

Walrus are large marine mammals distantly related to seals. Adult bulls can weigh almost two tons. Newborn calves weigh between 100 and 160 pounds. Walrus are mostly known for their long tusks and bushy muzzles.

They are also important food for coastal and island villagers in the Bering and Chukchi seas, where they're hunted each spring. Two separate walrus populations live in Alaska waters. One winters in the Bristol Bay region and the other winters southwest of St. Lawrence Island, off the Siberian coast.

It is believed the populations were severely depleted immediately after the Civil War when Yankee whaling ships sailed the Bering Sea. The whalers probably cut the walrus populations in half, from 200,000 to 100,000 animals, Sease said.

The populations recovered by

1900, but commercial harvests in the 1930s reduced their numbers again.

"Since then, they have recovered rather spectacularly," Sease said.

In 1955, there were probably about 100,000 walrus and today there are probably in excess of 250,000 — and that's too many, he said.

The animals are depleting their food stocks, he said.

Fewer walrus are born each year and fewer are surviving, he said. Eskimo hunters report walrus calves are harder to find. That coincides with researcher data that shows drastically lowered numbers of calves and young walrus in relation to numbers of females.

In the mid-1970s, fish, seals and other animals started showing up in the stomachs of walrus killed by Eskimo hunters. That indicated clams, the walrus' standard food, were in short supply. The average blubber thickness of walrus began to decrease also, another indication that food was becoming scarce, Sease said.

During the past five years, the annual kill of walrus by Alaska Eskimos and Soviet hunters has almost reached the levels seen in the 1930s, which concerns walrus biologists, Sease said.

from Ottawa to Yellowknife in 1967, Frobisher Bay, the largest town in the eastern Arctic, was still more than 1,400 miles from the new capital. There are only two airline flights a week from Yellowknife to Frobisher Bay, as compared with nine from Montreal, 1,200 miles to the south.

While other residents of the Northwest Territories may view the Federal Government with suspicion, the Eskimos in the eastern Arctic tend to feel doubly estranged. "The enemy is Yellowknife and Ottawa," said Jim Bell, who works for the Nunatsiag News, Baffin Island's weekly newspaper. "People here feel ignored and misunderstood, particularly by southern Canadians but also by Yellowknife."

Resentments have been fueled by a bureaucratic paternalism, sometimes from Yellowknife but more often from Ottawa. Some say white civil servants tend to ignore the elders who run Eskimo society because they hold no formal office and may not even speak English. Before the white man intruded, the Eskimos lived north of the treeline, the Indians south of it. "Geographically, culturally and ethnically, there is a unique Indian territory and a unique Inuit territory," said Ron Mongeau, the executive officer of the Baffin Regional Council. "The needs and aspirations are so different that there is no way a central territorial government can deal with it."

The Eskimos began pressing for their own home more than a decade ago. In 1982, inhabitants of the eastern Arctic approved by 4 to 1 a proposal to split the Northwest Territories in two, with Nunavut in the east. Last February, Ottawa gave approval to a tentative boundary worked out a month earlier by delegates from both east and west. But negotiations stalemated after the Eskimos living along the northwestern Beaufort Sea objected to being left out of the homeland. Nor did the Indians and whites in the west want a boundary that took away the Beaufort Sea, with its oil, and left them with less than a third of the Northwest Territories.

Even if that problem is resolved, others remain. Frobisher Bay, the likeliest capital of Nunavut, is even more distant from some communities in the central Arctic than is Yellowknife. Government offices could be divided among various communities, but this could create a costly logistical problem. Beyond this, some southern Canadians worry where Nunavut could lead. Advocates have developed close relations with the Eskimos in Greenland and Alaska through an Inuit Circumpolar Conference.

The Eskimos have assured Ottawa that Nunavut will be just a territory, and perhaps eventually a province. "We've tried to find a way to place the Nunavut concept within the Canadian federal system in a nonthreatening way," said Peter Jull, an adviser to the conference. But the idea of a homeland also appeals to the Eskimo minorities in Quebec and Labrador. Mark R. Gordon, an Eskimo leader in northern Quebec, said that "we've limited ourselves to talking about an autonomous region in Quebec, although we are very eager for Nunavut to be formed."

It's Bleak and Barren, But Not to the Eskimos

By CHRISTOPHER S. WREN

FROBISHER BAY, Northwest Territories — An Eskimo homeland may seem a curious goal to those who conceive of the Arctic as a frozen wasteland. But that is the aim of the Inuit, as Canada's 25,000 Eskimos call themselves.

It is called Nunavut — "our land" in the Inuktitut language they speak. The homeland could encompass an area much larger than Alaska if all their traditional lands were included. The Canadian

Government has already agreed in principle to carve Nunavut out of the Northwest Territories and has even set a target of 1987 for its creation. Only the details have been intractable.

Nunavut makes a certain amount of geographic sense. The Northwest Territories include what was left over after the provinces of southern Canada were created. More than 18,000 of the territory's 49,000 inhabitants are Eskimos, living mostly in the eastern Arctic; the rest are Dene, or Indians, and whites. And even after the government of the Northwest Territories moved

Artist Gerhard Kleist is honored on a 9-krona stamp to be issued by Greenland Sept. 5.

Kleist, who lived from 1855 to 1931, painted scenes of catch, such as catching narwhal through openings in the ice and catching small game.

The watercolor depicted on the stamp shows hare hunting.

Low Ozone Level Found Above Antarctica

By WALTER SULLIVAN

Satellite observations have confirmed a progressive deterioration in the earth's protective ozone layer above Antarctica, according to scientists who analyzed data recently sent back from space.

Each October, the data show a "hole" appears in the ozone layer there, scientists say, and each year the layer in that area becomes less able to shield the earth from damaging solar ultraviolet rays.

Since 1974 scientists have been predicting a gradual depletion of stratospheric ozone as a result of increased pollution of the atmosphere. The new data have persuaded some researchers that the ozone loss is proceeding much faster than expected.

Link to Skin Cancer

It has been predicted that a significant depletion of the ozone layer would substantially increase the rate of skin cancer worldwide. Even under normal conditions, however, the ozone layer is subject to wide variations, and whether the recent depletion is part of a long-term trend is difficult to establish.

Several substances introduced into the atmosphere as pollutants are suspected of contributing to the depletion, chief among them fluorocarbons, such as the Freon used for refrigeration, and methane, nitrous oxide and a variety of bromine compounds.

The satellite measurements indicating a rapid decrease over Antarctica have been made by two devices riding the Nimbus-7 satellite, which was launched in 1978. Dr. Donald F. Heath of the Goddard Space Flight Center in Greenbelt, Md., who for several years has been monitoring the recordings, said yesterday a quick look at last month's data indicated that the decline is continuing.

In his view, however, the reason for it remains uncertain. It was first blamed on sulfur compounds and other particles ejected into the stratosphere by the 1982 eruption of El Chichon in Mexico.

Scientists Backs Theory

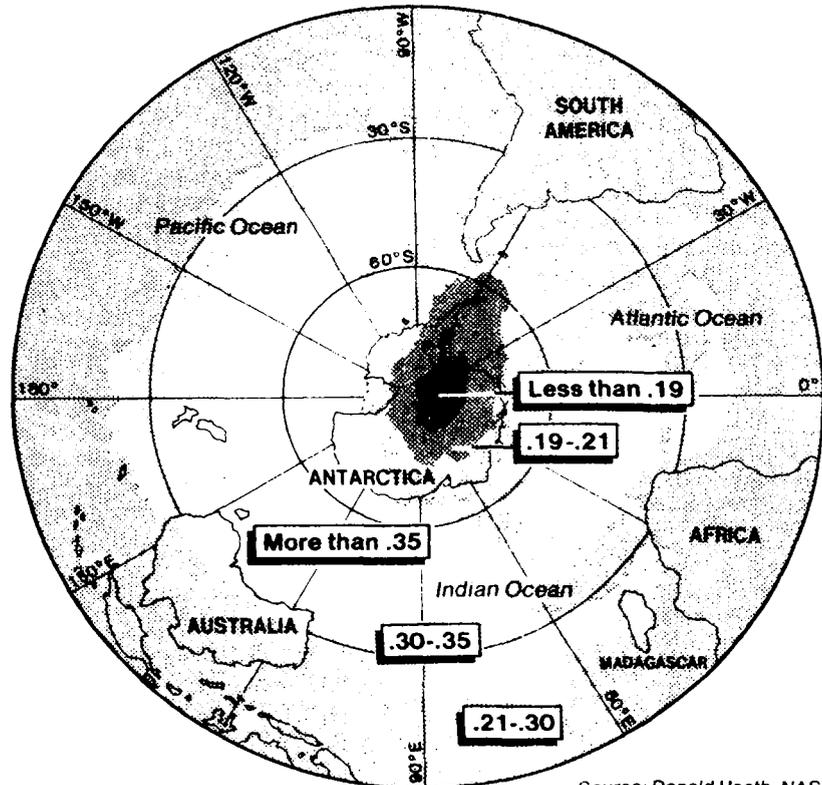
This explanation was also advanced by H. U. Dütsch of the Federal Institute of Technology in Zurich, Switzerland, based on ozone measurements at Arosa in the Swiss Alps.

The measurements there, as at numerous other ground stations, are based on recording two wavelengths of sunlight. Ozone absorbs sunlight at one of the wavelengths, so the relative strength of the two wavelengths is an indication of how much of the gas is in the atmosphere. The 1983 average was the lowest in 60 years. If that was entirely caused by material from El Chichon, Dr. Rowland said in a recent interview, the level should now be returning to normal, but it is not.

According to Dr. Heath, however, there are other possible explanations. The decrease could be linked to the sun-

Decrease in Ozone over Antarctica

Measurements from the Nimbus 7 satellite have shown a "hole" in the ozone layer over Antarctica. These, recorded on Oct. 4, 1983, and now confirmed, indicate ozone abundances in terms of how deep a layer would be formed by the gas, in centimeters, at normal atmospheric temperature and pressure. In addition to the depleted area near the South Pole, there is a persistent high concentration south of Australia.



Source: Donald Heath, NASA

The New York Times / Nov. 7, 1985

spot cycle, which is now near a minimum. According to a study by NASA scientists, the chemical reactions that produce stratospheric ozone are stimulated by a form of ultraviolet radiation that becomes weak when sunspots are fewest.

Unusual Conditions Noted

Nor is it clear, Dr. Heath said, whether the Antarctic readings manifest a local change in atmospheric circulation, rather than a global depletion. The condition of the winter atmosphere over Antarctica is not matched anywhere else. The atmosphere, immersed in the polar night, remains highly stable and becomes extremely cold. Then, when spring comes to the Southern Hemisphere about October, it is suddenly bathed in sunlight and, it is hypothesized, ozone depletion runs at full speed.

According to the report observations at Halley Bay in Antarctica, "Comparable effects should not be expected in the Northern Hemisphere where the winter polar stratospheric vortex is less cold and less stable." The report, published earlier this year in *Nature* was by J. C. Farman, B. G. Gardiner and J. D. Shanklin.

That fluorocarbons are responsible

for the newly observed depletion of the ozone layer has been proposed by scientists of the British Antarctic Survey, based on observations conducted since 1957 at Halley Bay, and by Dr. F. Sherwood Rowland of the University of California at Irvine. It was Dr. Rowland, Dr. Mario J. Molina and Dr. Harold Johnston who in 1974 first warned of such a danger.

In 1980 a committee of the National Academy of Sciences concluded that the projected ozone depletion, through increased ultraviolet radiation, could increase skin cancer, curtail crop production and destroy the larvae of some marine organisms. A 16 percent ozone reduction, it said, would probably produce each year "thousands" of additional cases of melanoma — the most lethal skin cancer.

Effect of Ban

In 1977 a ban was imposed on fluorocarbons as spray-can propellants, but it became evident that the ozone varies in response to a variety of interacting natural and human influences. By 1984

an academy report estimated ozone reduction, due to fluorocarbons, at only 2 percent to 4 percent.

An annual 20 percent increase in the atmospheric content of bromine com-

President's message highlights midwinter celebrations

On 21 June 1985, 115 U.S. citizens wintering at McMurdo, Amundsen-Scott South Pole, and Palmer stations received Midwinter's Day greetings from President Reagan.

In this year's message President Reagan commended the wintering community for accepting a challenge "to show the world that citizens of many nations can work together in peace." The President's message also was sent to personnel at 31 other antarctic stations operated by 12 countries.

Midwinter's Day marks the halfway point for personnel working in Antarctica during the austral winter. Traditionally, Midwinter's Day greetings have been sent by the President of the United States to the international wintering community to boost morale at the stations and to demonstrate the continuing interest that the United States has in Antarctica. The first message was sent by Dwight D. Eisenhower in 1959. The text of President Reagan's message follows:

"Thirty years ago expeditions from diverse nations converged on Ant-

arctica. This began the continuous occupation of the continent by men and women who probe the secrets of this unique natural laboratory. Here they observe and study the experiments that Nature has performed over millions of years. The results of their investigations have enabled them not only to describe the region but also to show that Antarctica is an integral part of the global environmental system.

"All of you now in Antarctica also are participants in another continuing experiment. You have accepted a challenge—to show the world that citizens of many nations can work together in peace. As more nations turn their attention southward, the example you set will guide them.

"On this Midwinter's Day 1985, I commend you for your efforts and dedication. I hope that this year will be especially productive and satisfying and that you will return to your homes enriched by this experience."

pounds that also endanger the ozone layer has been reported by a group from the Max Planck Institute for Aeronomy in Lindau, West Germany. Their instruments were lifted 15 miles above southern France by balloon in the fall of 1982, 1983 and 1984. Production of such compounds, including those used in fire extinguishers, appears to be increasing rapidly.

The original warning by Dr. Rowland and Dr. Molina concerned the chlorine that would be released when fluorocar-

bons are exposed to ultraviolet rays in the stratosphere. While those synthetic compounds are normally very stable, when exposed to ultraviolet light they break down and one of their constituents is chlorine, which can remove ozone from the atmosphere. The molecules of ozone gas are formed of three oxygen atoms, whereas oxygen gas contains only two of them. When chlorine reacts with an ozone molecule, breaking it up, the chlorine remains intact, ready to attack another one.



Photo by John Spletstoesser.

Eliason motor toboggans on the trail in Ellsworth Mountains.

Soviet Vessel Is Freed From Ice in Antarctic

MOSCOW, July 26 (AP) — A Soviet icebreaker sliced through the last stretch of a drifting Antarctic ice field surrounding the research vessel Mikhail Somov today, freeing the ship and its crew after 133 days.

A brief Tass press agency report announcing the rescue did not say how many crew members and researchers were still aboard when the icebreaker Vladivostok cleared a path to the ship. Previous reports said 53 Russians had remained with the vessel.

The Vladivostok was sent from the Soviet Far East on June 10, nearly three months after the Mikhail Somov was sealed into a huge ice floe in the Ross Sea area in a severe storm.

Viktor Gusev, a special Tass correspondent on the icebreaker, said, "We saw tired and hollow-cheeked but smiling and lively, faces of the people from the courageous vessel."

Those aboard the research ship will be transferred to a permanent ice station, Tass said. The one-paragraph report gave few details of the rescue.

The Mikhail Somov was trapped in mid-March while delivering supplies and personnel to the Russkaya research station in the Pacific sector of Antarctica. A heavy storm broke out during cargo handling on March 15, whipping winds to 112 miles per hour and making worse already dangerous ice conditions, Tass said at the time.

A Soviet Icebreaker Guides Ship Out of Antarctic Icefield

MOSCOW, Aug. 3 (Reuters) — The icebreaker Vladivostok conducted a Soviet research ship out of a thick Antarctic icefield today, freeing it after four months of captivity, a Tass correspondent aboard the Vladivostok reported.

The reporter said the icebreaker and the research ship, the Mikhail Somov, crossed the 71st parallel, which roughly marks the edge of Antarctica's permanent sea of ice, and were making slow progress through patchy ice toward open waters 620 miles to the north.

"Although the weather continues to be bad, it now determines not the very movement of the ships, but only their speed," Tass said.

Both ships are expected to reach New Zealand to refuel in late August and then make for Vladivostok, the Soviet Far East port the icebreaker sailed from in June on a mission to rescue the Mikhail Somov and its crew.

naturalists

The British Antarctic Territories will commemorate early naturalists on a set of stamps to be released Nov. 4.

key to seals' deep diving

Boston (AP) — Scientists working on the antarctic ice believe they have solved the puzzle of how deep-diving seals can plunge 1,500 feet to the ocean floor and then swim rapidly back to the surface without suffering the excruciating bends.

The seals' secret: They collapse their lungs and store potentially harmful nitrogen throughout their bodies.

The international team of scientists attached computerized pumps to Weddell seals, then drew blood samples as the mammals dived below the ice of McMurdo Sound. The half-ton seals can stay down for more than an hour as the fish for cod.

"People had reasoned how a sea manages to avoid the bends, and they got it pretty much right," said Dr. Roger D. Hill of Massachusetts General Hospital. But the latest research "is the first definitive evidence."

A report on the experiments, conducted with researchers from West Germany, Denmark, Australia, New Zealand and Canada, was published in the latest issue of the journal *Science*.

The bends, or decompression sickness, is a painful condition that results when human divers return too quickly from the depths. It can lead to stroke or even death.

This photograph shows a Weddell seal with the 8-bit microcomputer used by Dr. Zapol's research team to monitor changes in the seals body during deep dives.



NSF photo courtesy of Warren Zapol.

When people go on long dives, they typically wear scuba tanks so they can breathe. The water pressure on their lungs increases as they go down, so the air pressure in their tanks automatically increases to keep their lungs from collapsing.

The increased pressure means their blood absorbs higher-than-usual amounts of oxygen and nitrogen, the primary components of air. The body burns the oxygen, but nitrogen levels build up in the blood.

As long as the diver stays down, this nitrogen will remain dissolved in the blood. But once he starts to come up, the pressure on his body decreases, and the nitrogen may start to form bubbles. These bubbles cause the bends.

To avoid this, a diver must stop periodically as he swims up so his lungs have time to remove the excess nitrogen from his blood.

The antarctic study found that the nitrogen level in a seal's blood reaches a peak when the animal gets about 100 feet or so below the surface. Then it actually drops a bit as the animal goes deeper.

The scientists found that the seals accomplish this through several biological tricks.

Instead of taking a big gulp of air, as

a human diver would, the seal exhales as it ducks into the water.

While the animal dives, a little nitrogen is dissolved in its blood while the water pressure builds. This nitrogen has a calming effect.

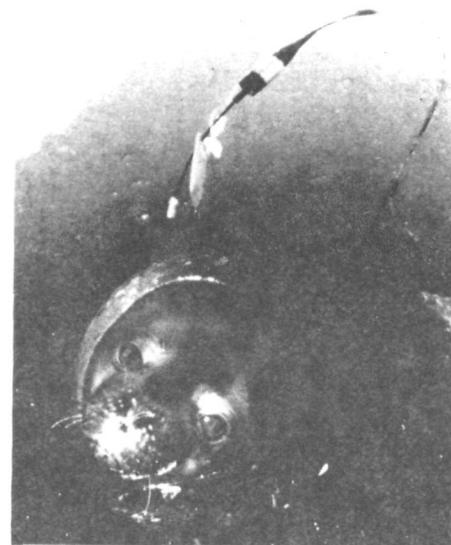
"That allows him a little bit of anesthesia and not too much to give him rapture of the depths," a drunk feeling that results from too much of the gas, said Dr. Warren M. Zapol, a Massachusetts General anesthesiologist who was in charge of the project.

By the time the seal reaches a depth of 100 feet, all the air is squeezed out of the air sacs in its lungs. Since there's no more air in its lungs, there's no nitrogen to be dissolved into its blood stream.

The air that is squashed out of the air sacs is stored in the seal's reinforced windpipe where it cannot be picked up by the blood. As it swims, some of the nitrogen already in its blood is redistributed into its blubber and muscles.

On its way back to the surface, the seal partially reinflates its lungs by allowing the gas in its windpipes to expand its air sacs.

"When he finally gets to the surface and breathes, he doesn't have very much nitrogen, so he doesn't get the bends," said Zapol.



NSF photo courtesy of Warren Zapol.

A Weddell seal comes up for air at one of the isolated breathing holes drilled for this experiment. The electrocardiogram lead with the computer backpack in the background are visible in this photograph.

An Explorer at the Bottom of the World

Call it one of the world's most unusual vacations. Call it a trip—literally—to the ends of the Earth. Call it the ultimate adventure in Exploring. Call it the continuation of one of Scouting's oldest and proudest traditions.

For 20-year-old Doug Barnhart of Post 95 in Pittsburgh, Pa., it was all these things and much, much, more. In late 1984 Doug boarded a U.S. Coast Guard icebreaker for a 29,000-mile odyssey to Antarctica and the South Pole that lasted for nearly six months.

Before it was over, Doug had seen some of the more incredible sights on Earth, taken part in several important scientific research projects, and enjoyed the distinction of being the sole representative of Exploring and Scouting on an entire continent.

To win the right to become only the fourth Scout in BSA history to follow the steps of Admiral Richard E. Byrd to the "bottom of the world," Doug had to meet a set of rigorous qualifications and beat out 250 other applicants, all of them Eagle Scouts.

After his selection, Doug had six months to get ready for his departure from Los Angeles aboard the 400-foot USCGC *Polar Star*, this country's largest icebreaker.

Doug took his turn standing watch and working the same long shipboard days as regular members of the 140-member crew, as the *Polar Star* headed south. Although it was mid-winter in the States, the brief Antarctic summer was at its peak when Doug arrived at McMurdo, the only "town" as such on the frozen continent, on Jan. 15, 1985.

Then, on Jan. 21, came the climactic moment that Doug had waited for and dreamed about so long. He and Dr. Eric Chiang of the National Science Foundation boarded a ski-equipped LC-130 cargo plane for the three-hour flight from McMurdo to the South Pole.



Doug stands beside a statue of Antarctic explorer Adm. Richard Byrd.

After a landing that Doug found surprisingly smooth, he was welcomed to the domed Amundsen-Scott South Pole Station (named for Norwegian explorer Roald Amundsen, who discovered the South Pole in 1911, and Robert Falcon Scott, the British explorer who died trying to reach the pole in 1912) by Station Manager Ed Duplek.

"All the vital parts of the station are under the dome, including the power plant, infirmaries, mess hall, laboratories, and most of the living quarters," Doug explains. "These are all in separate buildings, which are covered by the dome to keep the snow from drifting over the station."

Following a three-week oceanographic cruise and a stopover in New Zealand on the trip back to the United States, Doug returned to his home in the Pittsburgh suburb of McMurry, Pa., to his premed studies at Johns Hopkins, and to a routine much like those of the rest of us.

FACTS ABOUT THE UNITED STATES ANTARCTIC RESEARCH PROGRAM

More than 1,000 Americans work in and around Antarctica each year in the United States Antarctic Research Program. This National program involves the operation of ships, aircraft, stations, and camps, and it draws upon the resources and scientists of numerous U.S. universities, a number of Federal agencies, and several commercial firms.

Physical description of Antarctica

An ice sheet covers nearly all of Antarctica. At its thickest point the ice sheet is 15,670 feet deep—almost 3 miles. It averages 7,000 to 8,000 feet thick, making Antarctica the highest continent. This ice is 90 percent of all the world's ice, and it is 70 percent of all the world's fresh water.

The Transantarctic Mountains cross the continent, dividing the ice sheet into two parts. The larger, eastern part rests on land that is mostly above sea level. It has been there at least 14 million years. The smaller, western part is on land that is mostly below sea level.

Other mountain ranges are the Prince Charles Mountains and smaller groups near the coasts. The Antarctic Peninsula has many mountains. The Ellsworth Mountains are Antarctica's tallest; the Vinson Massif is 16,066 feet above sea level.

About 2 percent of Antarctica is ice-free. These areas, generally near the coast, include the dry valleys of southern Victoria Land, the Bungee Oasis in Wilkes Land, and isolated spits of land.

Surrounding Antarctica are the southern parts of the Pacific, the Atlantic, and the Indian Oceans. The Antarctic Convergence, which encircles Antarctica roughly a thousand miles off the coast, divides the cold southern water masses and warmer northern waters. An ocean current, the world's largest, moves eastward around the continent at an average speed of about half a knot. Sea ice up to 10 feet thick forms outward from the continent every winter, making a belt 300 to 1,000 miles wide. Even in summer the sea ice belt is 100 to 500 miles wide in most places.

Some 200 million years ago Antarctica was joined to South America, Africa, India, and Australia in a single large continent called Gondwanaland. There was no ice sheet, and trees and large animals flourished. Today, only geological formations, coal beds, and fossils remain as clues to Antarctica's warm past.

Antarctica is the coldest continent. The world's record low temperature of -128.6°F was recorded there. The mean annual temperature of the interior is -70°F . The coast is warmer. Monthly means at McMurdo Station range from -18°F in August to 27°F in January. Along the Antarctic Peninsula, temperatures as high as 59°F have been recorded. Some coasts of Antarctica are the windiest places in the world. Winds on the Adelie Coast in the winter of 1912-1913 averaged 40 miles an hour 64 percent of the time, and gusts have been recorded at nearly 200 miles an hour.

The interior of Antarctica is one of the world's major deserts, with the precipitation (if it were melted) averaging 1 to 2 inches of water a year.

Currently active year-round U.S. stations

McMurdo ($77^{\circ}51'S$ $166^{\circ}40'E$). America's largest antarctic station, McMurdo is built on the bare volcanic rock of Hut Point Peninsula on Ross Island, the farthest south solid ground that is accessible by ship. It is the logistics hub of the United States Antarctic Research Program, with a harbor, landing strips on sea ice and shelf ice, and a helicopter pad. Its 130 buildings range in size from a small radio shack to large, three-story structures. Science laboratories, repair facilities, dormitories, administrative buildings, a firehouse, power plant, water distillation plant, wharf, stores, clubs, and warehouses are linked by above-ground water, sewer, telephone, and power lines. The station was established in December 1955.

Little America. There were five Little Americas, all on the Ross Ice Shelf adjacent to the Bay of Whales or Kainan Bay. Numbers I and II supported Richard E. Byrd's expeditions in 1928-1930 and 1933-1935. III was operated in 1939-1941 as part of the United States Antarctic Service and was also called West Base. IV was used by Operation Highjump, 1946-1947. V was an International Geophysical Year station, operating from 1955 to 1959. All these stations have gone to sea as a result of calving of the Ross Ice Shelf.

Research objectives

Scientific investigation of Antarctica began on the present scale with the 1957-1958 International Geophysical Year, and, since then, continuous research by many nations has come close to completing a reconnaissance of the continent and its surrounding oceans. The goal of the United States Antarctic Research Program is to foster research on worldwide and regional problems of current scientific importance and to expand fundamental knowledge of the region. Research projects in the United States Antarctic Research Program are performed by investigators from universities and, to a lesser extent, from federal agencies and other organizations, and are supported by the National Science Foundation. Investigators may perform research and analysis individually, in small teams, or in large interdisciplinary groups.

In meteorology, Antarctica is Earth's largest heat sink, with its ice sheet containing about 90 percent of the world's glacial ice. As such, it is believed to play an important role in the planet's weather and climate. Research objectives are to improve understanding of the physical processes characteristic of the atmosphere over Antarctica, to determine the relationship between the antarctic atmosphere and global circulation and to determine Antarctica's role in past and present global climate. Much of the research in meteorology and atmospheric chemistry is performed at South Pole Station, but some is done at the other stations and aboard the LC-130 airplane specially equipped for meteorology and air chemistry. Automatic weather stations are used to

collect data at several remote locations. At South Pole Station, a clean-air sampling facility enables studies of atmospheric aerosols and trace gases and monitoring of changes in climate and in background levels of world atmospheric constituents including pollutants.

Ocean Sciences. Because of large-scale heat losses at high latitudes, the southern ocean is a major source of cooler intermediate and deep water masses that circulate throughout the world oceans. Nutrient-rich waters support high biological activity. Large annual variations in temperature and the extent of sea ice profoundly influence energy transfer processes. The sea floor around Antarctica presents fundamental problems in marine geology and geophysics. A major objective is to support physical, geological, and geophysical studies and to investigate the relationship between oceanic and atmospheric circulation systems and the physical basis for the biological productivity of antarctic waters. A circumantarctic survey from 1962 to 1979, in which the ice strengthened ship *Eltanin* made 66 cruises covering 521,000 nautical miles, provided much basic information and a framework for the current continuing program of problem-oriented ship-based research.

Glaciology. The world's largest ice sheet covers 98 percent of the antarctic continent in thicknesses up to 4.8 kilometers. It is a vast storehouse of information about climate and atmospheric constituents and their variation over time. Research activities have been predominantly descriptive with emphasis on the extent of the ice sheet and its surface characteristics, such as temperature and snow accumulation. Some deformation measurements have been made. There is much to be learned through study of the internal characteristics of the ice sheet using, for example, radio-echo sounding, ice coring, and thermal probes. Ice cores have been drilled to bedrock and to shallower depths. Oxygen-isotope studies, use of radioactive isotopes for dating, analysis of fabrics, and chemical measurements can be pursued to extract paleoclimatic data. Surging glaciers are of keen interest to glaciologists. Although there are no known surging glaciers in Antarctica, a better understanding of the range of physical conditions that cause surging and how close or how far the antarctic ice streams are from these conditions may be crucial to understanding the past and present dynamics of the ice cover of Antarctica, especially the west antarctic ice sheet. The present west antarctic ice sheet may be as young as 125,000 years old, while the east antarctic ice sheet could well be 25 million years old.

Amundsen-Scott South Pole (90°S). Americans have occupied the geographic South Pole continuously since November 1956; the station was rebuilt in 1975 as a geodesic dome 50 meters wide and 16 meters high that, with 14-by-24-meter (46 by 80 foot) steel archways, covers modular buildings, fuel bladders, and equipment. Two detached buildings house instruments for monitoring the upper and lower atmosphere. There is an emergency camp. Some 17 scientists and support personnel winter at the station, and 50 or more people work there during the summer.

An ongoing *Antarctic Bibliography* prepared by the Library of Congress abstracts and indexes the world antarctic literature published between 1951 and the present.

International cooperation

A. *Antarctic Treaty.* The Antarctic Treaty, signed at Washington, D.C., in 1959 and entered into force in 1961, establishes a legal framework for the area south of 60oS, which includes all of Antarctica. There are two types of Antarctic Treaty parties. Consultative nations, are empowered to meet periodically and to influence operation of the treaty. Accessing nations agree to abide by the treaty, but, not being among the original signatories and not having substantial programs in Antarctica, do not participate in the consultative process. Appendix 1 contains the Antarctic Treaty and a list of participating nations.

The treaty provides that Antarctica shall be used for peaceful purposes only: it prohibits military operations except in support of peaceful activities. It provides that freedom of scientific investigation and cooperation shall continue coordination of scientific activity in Antarctica, with a view to framing a scientific program of circumpolar scope and significance." Membership consists of a representative from each country engaged in antarctic research, representatives of other ICSU organizations as appropriate, and the World Meteorological Organization. Other international organizations may designate observers to attend meetings of SCAR. For the United States, the national committee adhering to SCAR is the Polar Research Board of the National Academy of Sciences.

SCAR meets every 2 years in a SCAR country to consider various scientific and logistics objectives and accomplishments. It also sponsors or associates with major symposia on antarctic subjects. Sometimes SCAR establishes working groups to develop information or reports in response to Antarctic Treaty recommendations. An example is a 1979 report on possible environmental effects of mineral exploration and exploitation, developed in response to a recommendation made at the 1975 Antarctic Treaty consultative meeting.

Bilateral and multilateral cooperation. Within the context of the Antarctic Treaty, extensive international cooperation takes place in Antarctica to more effectively accomplish both science projects and logistics. Some examples are exchanges of personnel among stations, cooperative planning and execution of large-scale science projects such as deep rock core drilling and glaciological exploration, and the exchange or shared use of logistics assets such as ships and aircraft. The United States has pursued cooperative projects with every Antarctic Treaty nation.

The United States Antarctic Research Program is the nation's program for research and presence in Antarctica. It is funded and managed by the federal government, with agency responsibilities as follows.

A. *Antarctic Policy Group* serves as the policy guidance body for the totality of U.S. activities under the Antarctic Treaty (described below). Its membership consists of the Secretary of State (chairman), the Director of the National Science Foundation, the Secretary of Defense, or their designees, and representatives of other agencies as appropriate.

B. *National Science Foundation* has overall funding and management responsibility for the U.S. activities in Antarctica.

Past U.S. antarctic expeditions

A. Before International Geophysical Year

United States expeditions to Antarctica have occurred almost since the beginning of the nation. Among the notable ones, in 1820 Nathaniel Palmer, a Connecticut sealer, saw the Antarctic Peninsula from his 14-meter sloop *Hero*. John Davis made the first known landing on Antarctica, at Hughes Bay, in 1821. James Eights, a scientist, provided remarkably advanced natural history reports after accompanying sealers to the South Shetlands in 1829-1831. Charles Wilkes headed a Navy expedition that in 1839-1840 explored and mapped the coast of Wilkes Land and established that Antarctica is a continent. Carl B. Eielson piloted the first airplane flown in Antarctica, in 1928. Richard E. Byrd introduced largescale mechanization of antarctic exploration in two expeditions, in 1928-1930 and 1933-1935, that included extensive exploration by airplane and the first flight over the South Pole. Lincoln Ellsworth flew across Antarctica in 1935 and discovered the American Highland in 1938-1939. The government established two antarctic stations in 1939-1941 that were intended to begin a continuing antarctic service (World War II ended this plan). In 1946-1947 the Navy's Operation Highjump, the largest expedition ever made to Antarctica, used 13 ships, several helicopters and airplanes, and 4,700 men; it performed extensive aerial photography for mapping. A smaller Navy expedition, Operation Windmill, followed in 1947-1948. Finn Ronne's expedition

in 1948 established a wintering station and explored and mapped at the base of the Antarctic Peninsula.

B. International Geophysical Year, 1957-1958

The International Geophysical Year, 1 July 1957 to 31 December 1958, was a great cooperative endeavor by the world's scientists to improve their understanding of the earth and its environment. Much of the field activity took place in Antarctica, where 12 nations established some 60 research stations.

The United States established six research stations—Little America, Hallett, South Pole, and Byrd (described in section III), plus Wilkes (on the coast of Wilkes Land, East Antarctica) and Ellsworth (on the Filchner Ice Shelf). Naval Air Facility, McMurdo Sound (now McMurdo Station), was set up as a logistics base from which to supply South Pole. Studies were directed toward geophysics and upper atmosphere physics and included simultaneous observations at all parts of the globe. In addition, long scientific traverses were made to collect data in glaciology, seismology, gravimetry, and meteorology. Geological and biological samples were collected, although these disciplines were not formally part of the IGY.

At the close of the IGY, it was recognized that many scientific problems merited continued attention, and most of the IGY antarctic nations decided to continue their research. The United States established its United States Antarctic Research Program, which has operated continuously to this day.

During survival training two participants walk through a crevassed area on Ross Island.

NSF photo by Ann Hawthorne.



NSF photo by Russ Kinne.

Research assistants Scott O'Grady and Wayne Van Voorhies stand on an ice outcrop at the Dailey Islands. They are preparing to set out stakes to measure ice ablation as part of a University of Illinois biology project.

The Age of Discovery

Men's minds were haunted by the idea of a great southern continent for many centuries before Antarctica was discovered. The Polynesians, including the Maoris of New Zealand, had legends about a white land to the south of them—their big canoes apparently had sailed south until stopped by ice. Earlier, the ancient Greeks believed that a great southern continent must exist. It was needed, they thought, to balance the land masses of the Northern Hemisphere. Although none of them ever saw it, they gave the region its name: in Greek, Antarctic means "the opposite of the Arctic."

Preludes to Discovery

Many famous voyages were made to find the fabled southern continent, for men imagined it to be populated and to contain great riches. The earlier of these explorers instead discovered Australia and many South Pacific islands. It is possible that a number of ships blown off course by the great storms around Cape Horn may have glimpsed some of the antarctic islands, but the first documented discovery of land within the Antarctic Convergence was not made until the 18th century: on January 1, 1739, a French expedition under Bouvet de Lozier sighted a snow-covered, fog-shrouded island in the South Atlantic, now called Bouvet Island. On February 12, 1772, another Frenchman, Yves de Kerguelen-Tremarec, discovered the Kerguelen Islands in the southern Indian Ocean. In between came another discovery. A passenger on a Spanish merchant ship reported sailing around a large island east of Cape Horn in 1756. It was given the name of San Pedro, but it now appears on the map as South Georgia.

Both Bouvet and Kerguelen thought that their discoveries might be part of the great southern continent. Kerguelen was later to revisit the area and determine for himself that he had actually seen islands. Before he did, however, Captain James Cook of the British Navy, one of the most illustrious navigators of all time, brought to an end the dream of an inhabited southern continent. Between 1772 and 1775, he sailed completely around Antarctica. Although he never sighted it, he did penetrate farther south than any man before him, and on January 17, 1773, he became the first man to cross the Antarctic Circle. He encountered great expanses of pack ice and many huge icebergs. This, and the presence of numerous seabirds, led him to believe that an ice-defended land lay to the south.

Even if Cook did not see Antarctica, he did sight the South Sandwich Islands and rediscovered South Georgia. On the beaches of the latter he spied fur seals. This news was of great interest to hundreds of adventurous American and British seal hunters. The demand for sealskins was very great in those days, and as the number of seals on known beaches decreased, the hunters sailed further southward looking for new beaches and more seals. Cook's report was like a magnet drawing them onward.

Discovery of a Continent

It seems probable that these sealers were the first people to see Antarctica. The sealers, however, frequently tried to keep their discoveries secret to prevent others from knowing of new seal colonies. Also, they did not keep very good records—and many of

those they did keep have been lost.

We are fairly certain, however, that on November 17, 1820, Captain Nathaniel B. Palmer, of Stonington, Connecticut, sighted the continent near the tip of the Antarctic Peninsula. The first known landing on the continent was made a few months later. On February 7, 1821, Captain John Davis, of New Haven, Connecticut, sent a boatload of men to look for seals on the shore of what is now called Hughes Bay. Captain Davis' logbook was found only a few years ago.

After Wilkes, d'Urville, and Ross returned to their homelands, men lost interest in antarctic exploration. For 50 years, only occasional efforts were made to learn more about the mysterious white continent, although sealers and whalers from the United States based their operations on islands within the Antarctic Convergence until about 1880.

The Heroic Era

Shortly after 1890, interest in the Antarctic revived, to continue ever since. There seem to be two principal reasons for this: first, scientists were convinced that more must be known about the south polar region if we are to understand the world and the universe better; second, new methods of whaling made it possible to catch and use antarctic whales.

During the winter of 1898, a Belgian exploring expedition under Lieutenant Adrien de Gerlache found its ship frozen fast. All winter long, the *Belgica* drifted with the ice until another summer freed her. Just about the time the ice loosened its grip on the Belgian ship, a British expedition, led by C. E. Borchgrevink, landed at Cape Adare. This landmark is at the western entrance of the Ross Sea. Here, Borchgrevink and his party built a hut. Their ship sailed away to New Zealand and returned to pick them up the following summer.

These two expeditions began what has been called the heroic era of antarctic exploration. Before de Gerlache, no scientific party had spent a winter in the Antarctic. Before Borchgrevink, none had attempted to live on the continent. Previously, men had been limited to what they could see during the summer—and then they had gone ashore only very briefly, if at all. Now it was proved that a base could be set up during the summer and journeys into the interior begun early the following spring. This has remained a principal procedure of antarctic exploration.

During the heroic period, men penetrated the continent and reached the South Pole itself. They faced dangers about which they knew little, with equipment that was frequently inadequate to the task. How to survive was learned by surviving. Above all, these early explorers had courage. From their failures and their successes were learned the techniques of antarctic exploration.

In 1901, German, Swedish, and British expeditions took to the field. All had their exciting times. The Germans' ship, *Gauss*, was frozen in the ice within sight of their goal and drifted with the pack for a year. The Swedes, on the other hand, made shore, but their relief ship, *Antarctic*, was crushed, leaving both the wintering-over party and the ship's company to make out as best they could. Their experiences proved that men could live from what they could find in the Antarctic.

Australian Antarctic Territory will release the second set of stamps in its Antarctic Scenes definitive series Aug. 7.

The designs reproduce photographs taken by expeditioners.

Garry Emery of Melbourne prepared the designs which show Prince Charles Mountains (15¢); Iceberg Alley (33¢); brash ice (45¢); pancake ice (90¢); and emperor penguins (\$1).

A tumble of collapsed ice on the edge of a glacier appears on the 15¢ stamp. The photograph was taken in the Prince Charles Mountains which lie about 100 miles from the ANARE Mawson Station.

Iceberg Alley (33¢) is the name given to a channel used by supply ships approaching Mawson Station. Towering icebergs grounded on either side of the channel account for the name.

The 45¢ shows floating fragments of splintered sea ice and disintegrating icebergs. In this form, it is known as brash ice.

At the onset of winter, fine ice crystals form in the Antarctic seas and float to the surface. The soupy layer coagulates into pancake ice like that shown on the 90¢ stamp.

Eventually the pieces of pancake ice freeze together to form a solid cover of sea ice.

The only birds to breed on the Antarctic continent in winter are the emperor penguins. The Auster rookery, near Mawson Station, is pictured on the \$1 value. Emperor penguins are the largest of penguin species.

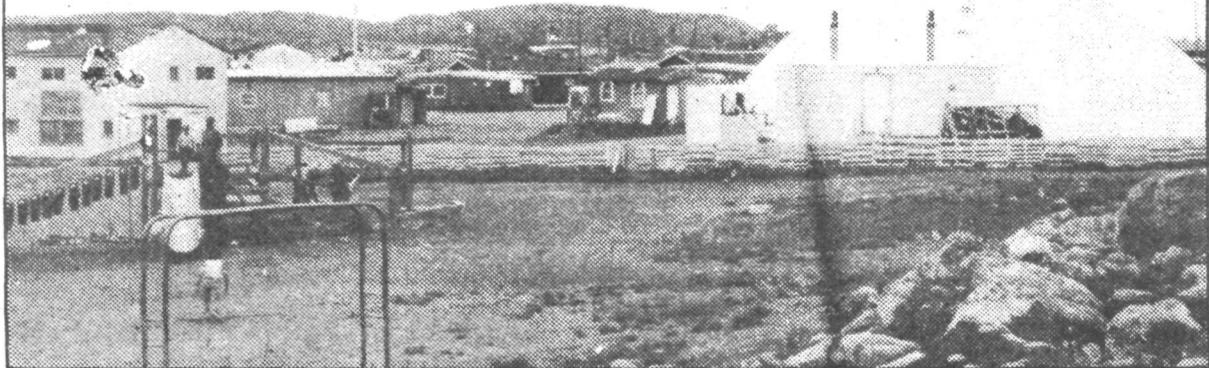
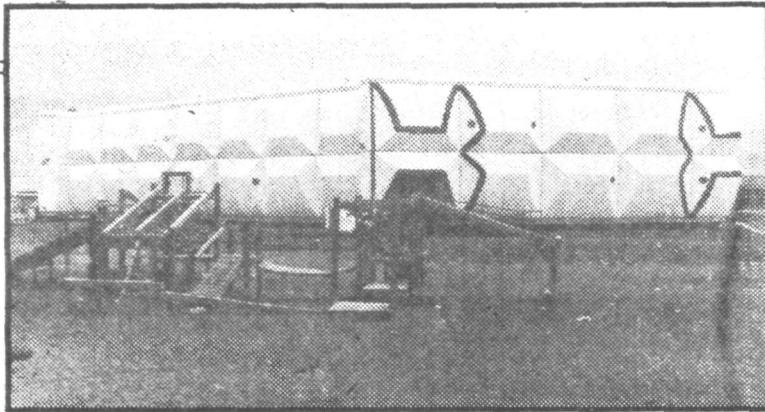
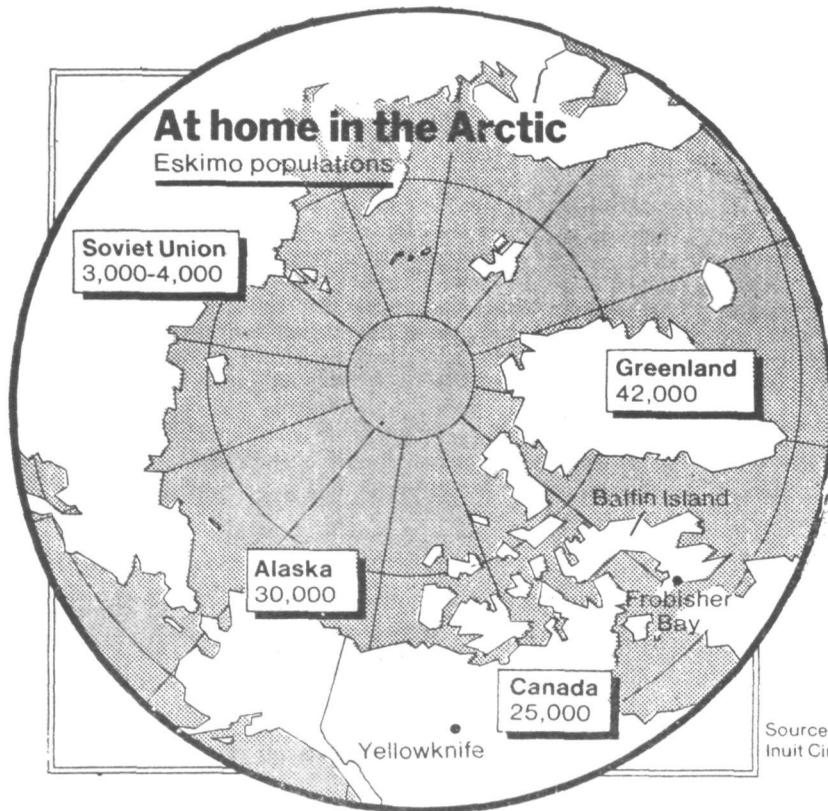
Antarctic Treaty issue

It is perfectly natural for the Chileans who have for many years administered a slice of the Antarctic cake, to remind us of the 25th anniversary of the Antarctic Treaty which becomes due for renewal in five years.

The Antarctic subcontinent is extremely rich in natural resources, oil and coal, fish, krill, and other basics are to be found in abundance.

Hence the interest in what would otherwise be one of the least hospitable spots on earth.

To this day the Antarctic is inhabited only by selected groups of hardy scientists,



The New York Times/Christopher S. Wren

The Anglican cathedral, built of wood to resemble an igloo, in Frobisher Bay, Northwest Territories, 200 miles south of the Arctic Circle. Inset, a fibreglass prefabricated school in the community.