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Although the National Science Foundation attempts internally to make papers published in *Antarctic Journal* error-free, papers generally are not refereed for scientific content or merit.

COVER: Mount Erebus (elevation, 3,794 meters; 77°32′S. 167°09′E.), Ross Island, as photographed from the road between McMurdo Station and New Zealand's Scott Base on 25 January 1977. For a description of Mount Erebus' recent volcanic activity, see pages 270-271 of the December 1976 *Antarctic Journal*

Photo by Vid Johnson

News and notes

SCAR/SCOR conference on living resources of the southern ocean

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In an earlier article (El-Sayed, 1976) we reviewed the living resources of the southern ocean and discussed the role played by the Scientific Committee on Antarctic Research (SCAR) and the Scientific Committee on Oceanic Research (SCOR), both of the International Council of Scientific Unions, in establishing a group of specialists on living resources of the southern ocean. At a 1975 meeting in Cambridge, England, the group welcomed an offer from the Polar Research Board of the U.S. National Academy of Sciences (NAS) to host an international scientific meeting on living resources of the southern ocean. A total of 59 scientists representing 14 nations were invited.

Conference objectives

The chief objective of the conference and meeting of the group of specialists was to review present knowledge of southern-ocean living resources and to develop a proposal for future cooperative studies in this area. Five background review papers and about 25 scientific reports and reviews of the marine living resources (especially krill, fishes, cephalopods, mammals, and birds) were available for discussion. Background papers included: "Physical oceanography of the southern ocean: key to understanding its biology," by T. Foster, United States; "The problems of harvesting and utilization of antarctic krill," by J. Scharfe, United Nations Food and Agriculture Organization (FAO); "The legal status of the Antarctic," by F. Sollie, Norway; "Remote sensing of antarctic living resources," by W. Hovis, United States; "Modeling of antarctic ecosystems," K. Green, United States.

Also, West-German and Polish scientists showed films on their respective antarctic expeditions in the 1975-1976 season carried out by their research vessels and commercial factory trawlers. Participants from France, Japan, Argentina, and the United States also reported on research activities of their countries during the 1975-1976 austral summer.

To provide the knowledge essential to determine the rational utilization and management of the southern ocean and its resources, participants agreed that a fully coordinated international effort is necessary. It was clear from the discussion at this meeting that little is known of the biomass and productivity of southern-ocean living resources other than marine mammals. Although investigations began shortly after the turn of the century, it was not until recently that studies of the biomasses of such resources as fish, crustaceans, and seaweeds were made.

Resource identification and assessment

Discussions on the various living resources were aimed at identification of those aspects of ecology that are of particular importance in assessing the magnitude of these resources. They also focused on the possible consequences of resource exploitation, which should be planned and managed using knowledge of the population dynamics of the resource itself and also of its ecological interaction with other parts of the ecosystem. Highlights of these discussions and a summary of the recent findings appear below.

Marine mammals. Participants discussed biological aspects of the present role of marine mammals in the antarctic ecosystem and the changes that have taken place since the depletion of whale stocks and the cessation of sealing. Abundance estimates of seals are fairly reliable, and their biology is relatively well-known except for rarer species (particularly the Ross seal). Crabeater seals are by far the most abundant seal in the Antarctic and probably in the world; their diet consists almost exclusively of *Euphausia superba* (krill). Most of the other species have a mixed diet consisting of krill, fish, and squid. Before exploitation began, large whales probably consumed about 165 million metric tons of krill, 11 million metric tons of squid, and 4 million metric tons of fish. Their numerical abundance is now reduced to about 38 percent of the initial population, their biomass more so, and they are estimated to consume substantially less than before. As a consequence of whaling, there are indications of increased body-growth rates, of earlier maturation, and of increased pregnancy rates in blue, fin, and sei whales as well as in crabeater seals.

Birds. For the first time, an attempt has been made to make a global assessment of the bird population of the antarctic ocean. Penguins comprise 99 percent of the biomass of antarctic avifauna. The total biomass of all birds in the southern ocean is estimated to be nearly 200 million individuals. However, there is considerable variation in accuracy of the census of the various populations. The estimated food consumption of the bird population is about 35 million metric tons of food per year, 54 percent of which is taken in the sub-antarctic region.

Fish. A dozen species of fish, mainly Nototheniids, are presently exploited or likely to become attractive for exploitation in the near future. All of them are demersal and live on the narrow shelves and banks of antarctic and sub-antarctic islands and on parts of the continental shelf. No reliable figures on abundance, stock density, and distribution are available for any of the antarctic fish. Among pelagic fishes, only Myctophids are relatively frequent in antarctic waters; however, nothing is known about their population dynamics.

Cephalopods. Squids are frequently found in the catches of pelagic trawls taken north of the Antarctic Convergence; they are extremely rare in the samples taken farther south. Without reliable data on squid abundance and on species composition and life history, no estimates are possible on the potential resource or on the role of squids as consumers of krill. The stocks of octopus in the Antarctic do not appear to be large.

Krill. Euphausia superba is by far the most important species of antarctic euphausiids. Other species play a major role only at the edge of the antarctic continent and in the area north of the Antarctic Convergence.

Despite extensive work on the distribution and life history of krill, carried out during and soon after the main 19th-Century whaling period, there are still major gaps in our knowledge. Areas, depth, and intensity of spawning are poorly known. There is still much dispute on the growth rate of krill: whether they reach an age of a little more than 2 years or almost 4 and whether each female spawns only once in her lifetime. Further, it is not yet known whether *E. superba* consists of one genetically uniform circumpolar stock or, more likely, a number of more or less self-sustaining units that differ genetically and in population parameters.

Estimates of food consumption by the virgin whale stocks are of the order of 180 million metric tons. While they are relatively reliable, the share taken by other predators such as small cetaceans, seals, birds, squids, and benthic invertebrates remains largely unknown.

Seaweeds. The littoral zones of the Antarctic Archipelago and the sub-antarctic islands are the habitat of large populations of macrophytes such as red algae, agarophytes, and particularly large brown kelp. For example, average figures of standing stock of 5 to 10 kilograms per square meter have been recorded for large beds of *Macrocystis* and *Durvillea* off Kerguelen Island. At the conference, the potential importance of algae as a resource for industrial, chemical, and pharmaceutical use was stressed, together with the ecological importance of seaweeds as a habitat, as a source of detritus, and as producers of dissolved organic substances.

Resource utilization

The conference also discussed the resource utilization of marine mammals, fish, large crustaceans, cephalopods, and krill. In addition to the harvesting of whales and seals, for which there are arrangements for conservation through international conventions (International Whaling Commission and the 1972 Convention for the Conservation of Antarctic Seals), substantial catch of fish in the Sub-antarctic has begun, and the large-scale harvesting of krill appears to be a reasonable possibility in the not-too-distant future. The conference advocated that arrangements should be made as soon as possible to ensure the conservation and rational utilization of these important resources.

Proposed BIOMASS investigation

The major part of the conference as well as the subsequent sessions of the group of specialists were devoted to discussions on the development of an international program for "Biological Investigations of Marine Antarctic Systems and Stocks (BIOMASS)." Principal BIOMASS objectives are:

(1) to provide data and information for the conservation and wise management of living resources of the southern ocean;

(2) to improve understanding of the complex ecosystem upon which the resources depend and to understand the flow of energy through the system.

To achieve these objectives, conference participants agreed to promote an in-depth study of the individual components of the marine ecosystem, as well as to study the entire system as an integrated whole. For reasons of resource management and of basic ecological science, attention was focused on those particular components that offer actual or potential opportunities for commercial harvest.

For each of these resources (krill, squid, fish, marine mammals, lobsters, birds, and seaweeds), the main objective will include studies of:

(1) standing stock and production;

(2) basic parameters important in the dynamics of the populations (growth, mortality, reproduction, etc.);

(3) trophic relationships (feeding and predation);

(4) general biological and ecological characteristics, especially those needed to elucidate the preceding points.

Besides studying the individual resources and collecting information on the characteristics of each resource that are particularly important in studying quantitative trophic relationships, BIOMASS aims to develop a general and theoretical understanding of the system as a whole. One element of this will be the construction of models describing the whole ecosystem or parts of it.

The group of specialists also discussed the implementation of BIOMASS as well as plans for international coordination and cooperation. The group noted that there is a number of international organizations that have expressed interest in the resources of the southern ocean; several of these have biological programs of one kind or another. The group realized that the success of BIOMASS will ultimately depend on effective planning and coordination. The group studied the current structure of international cooperation and drew up a number of recommendations to international bodies for the implementation of BIOMASS. A summary of these recommendations follows.

(1) That SCAR and SCOR approve the following amended terms of reference for the group of specialists on living resources of the southern ocean (SCOR working group 54):

(a) To encourage and stimulate investigations of the trophodynamics of the antarctic marine ecosystem and the ecology and population dynamics of organisms at different trophic levels

(b) To keep under review the current state of knowledge concerning the antarctic marine ecosystem from the viewpoint of structure, biomass of organisms, dynamic processes at different trophic levels, and prospects and consequences of exploitation of the marine living resources of the southern ocean

(c) To advise SCAR and SCOR, and through them other international organizations, on scientific matters related to the study of the ecosystem and living resources of the southern ocean, and in particular to respond to relevant recommendations of the Antarctic Treaty consultative meetings and the Intergovernmental Oceanographic Commission (IOC) of UNESCO

(d) To act as the international scientific planning group for BIOMASS

(e) To recommend standardized methods, techniques, and data research for biological investigations in the southern ocean.

(2) That IOC undertake the international coordination of BIOMASS.

(3) That IOC request countries carrying out research in the southern ocean to provide details of proposed cruise tracks and scheduled researches, which would be made available to the group of specialists.

(4) That SCAR request the national agencies operating supply ships to institute a circumantarctic program of underway observations of surface temperature, salinity, chlorophyll, and underway collection of records of expendable bathythermograph and biological echo traces.

(5) That SCAR collaborate with FAO in drawing the attention of all parties engaged in the exploration and exploitation of living resources of the southern ocean to the need of detailed catch and effort statistics to be submitted to FAO.

(6) That SCAR inform FAO of its approval of the proposed northward movement of the boundary lines between statistical areas in the Atlantic and Indian oceans, and that in the interim period before the new regions are formally approved by all interested parties, countries should be requested to distinguish separately, when reporting to FAO, the catches taken (a) in the South Atlantic in the area bounded by 50° to 60°S. in 20° to 50°W. and 55° to 60°S. in 50° to 60°W. and, (b) in the Indian Ocean between 40° and 50°S. in 30° to 80°E.

(7) That SCAR and SCOR should agree as soon as possible on the publication of selected documents submitted as working material for the Woods Hole meeting.

These recommendations were approved by SCOR at the XIII General Meeting of SCOR in Edinburgh, Scotland, in September 1976, and by SCAR at the XIV General Meeting of SCAR in Mendoza, Argentina, in October 1976. These recommendations, as well as the BIOMASS program, will be presented at the next IOC meeting in 1977. Background papers and a selected number of review papers and reports are being edited and will be published as a separate volume in mid-1977.

Reference

El-Sayed, S.Z. 1976. Living resources of the southern ocean. *Antarctic Journal of the U.S.*, XI(1): 8-12.

With the Soviets in Antarctica

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On 19 July 1974 I learned of the possibility of spending a year with the Soviets in Antarctica from Professor Werner Schwerdtfeger, an expert in polar meteorology and a colleague at the University of Wisconsin, Madison.

We had learned from the National Science Foundation that there was an opening in the antarctic scientist exchange program. As in 17 previous years, one U.S. scientist was to spend a year at the large Soviet station Molodezhnaya (figure 1). In exchange, a Soviet scientist would winter at McMurdo. Until that time, a U.S. meteorologist had not been at Molodezhnaya.

I submitted a proposal within a month to do research on cyclone energetics in an area of the most spectacular weather in the world. Also, I hoped to document my stay, as well as the scientific programs, photographically.

Soon after I learned that the Science Foundation and the Soviets had accepted my proposal, I was contacted by Ed Kerut of the National Oceanic and Atmospheric Administration. Ed wanted me to take to Molodezhnaya an automatic weather station in the form of a buoy. Signals from the buoy were to be transmitted to a soon-to-be-launched Nimbus F satellite and thence to Washington, D.C., in real-time. Successful deployment of such a buoy would have far-reaching implications for expanding weather observations of the southern ocean. I was delighted to be involved.

Preparing for the trip

I received physical and psychological examinations at the Great Lakes Naval Training Station, near Chicago, on 9 October 1974. I recall being impressed by the efficiency of the examination procedures. The

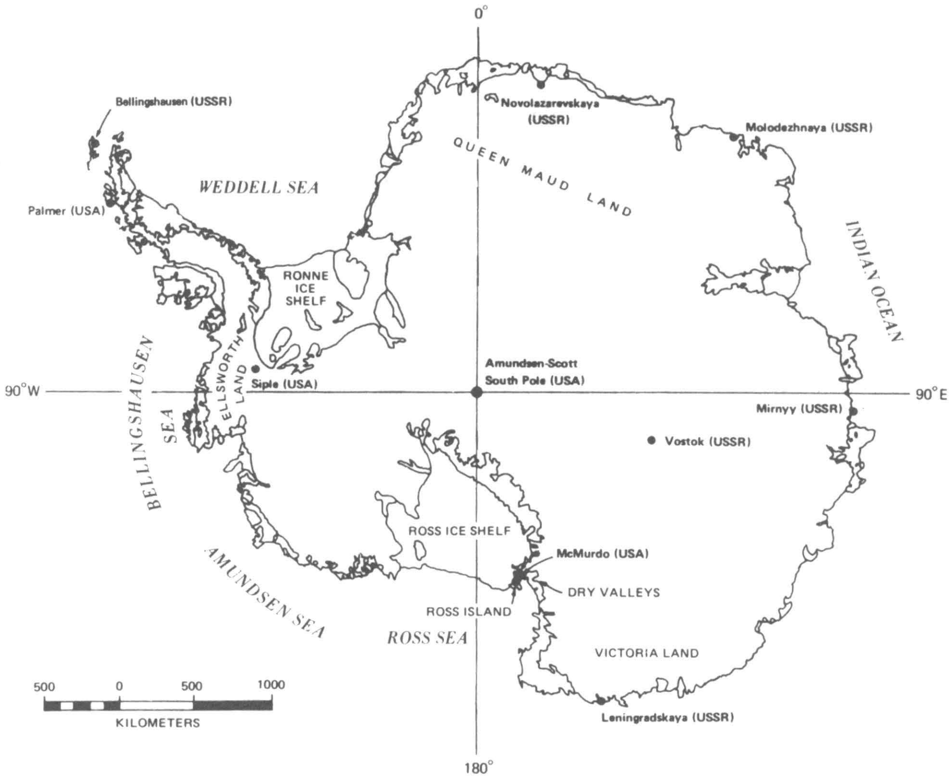

Figure 1. U.S. and U.S.S.R. antarctic stations.

only complications were repair of some teeth and tests to insure that kidney stones would not recur. The psychologist suggested that I keep a diary because little was known about exchange scientists in remote locations among foreigners.

At the outset we realized the need for a language refresher in Russian. Although I had studied Russian for 3 years in graduate school, I was hardly fluent. After considering several possible—and some impossible—alternatives, I enrolled in the Berlitz "Total Immersion" course in Milwaukee. This is a course of individualized, intensive instruction that meets for 9 hours a day, 5 days a week, for 3 weeks. The course began 14 October 1974.

When I left the course I was grateful to the staff for their competent and friendly assistance, but I knew that I was still unprepared for what lay ahead.

Holmes and Narver, Inc., the Foundation's antarctic support contractor, sent me a set of cold-weather clothing, which arrived on 20 October 1974, about 20 days before departure.

It is difficult to think about the trip preparation without giving credit to Edward S. Grew. Ed was at Molodezhnaya during a previous Soviet expedition as an exchange geologist (Grew, 1975). Thus I obtained considerable insight into life at Molodezhnaya. To make such a trip blindly would be difficult. Ed gave me the hints I needed on everything from the food to how many presents and *Playboy* magazines I should take.

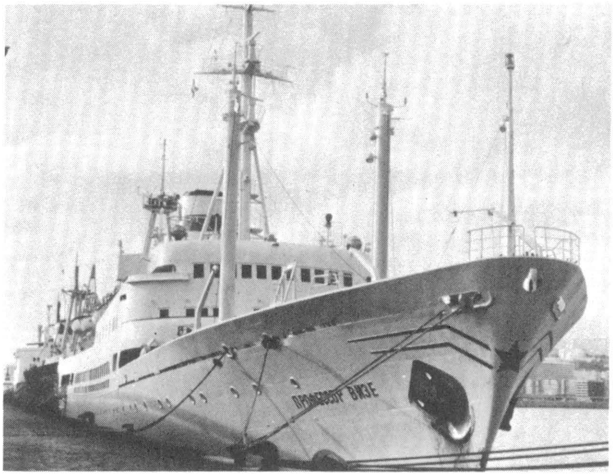

Figure 2. The Soviet oceanographic ship, *Professor Viese*.

Enroute to Antarctica

With farewells attended to, I departed for Washington, D.C., on 10 November 1974 for a final

Figure 3. Author and friend.

briefing at the National Science Foundation. On 12 November I flew from Washington to New York and left the States. I was to meet the Soviet oceanographic ship *Professor Viese* (figure 2) at Las Palmas in the Canary Islands around 15 November. If the ship was on schedule, I had little time to make sure that all my gear and the buoy would be at the dock ready for loading. As it turned out, the ship was delayed a week and my anxieties abated.

Professor Viese arrived on 20 November, and I made purchases of liquor and other novelties for use as gifts.

It was distressing for me, and evidently for the Soviets, to realize that my gear and the buoy had not yet arrived. Two days later a truck brought the gear to the *Viese*. This delay did not interfere with our scheduled departure, because Viese was loading supplies for the expedition.

On the *Viese* I had the good fortune of rooming with the ship's surgeon. He was amiable and spoke English reasonably well—a mixed blessing for me, as during the next month he learned more English than I learned Russian. I was warned of this, but I didn't know how to avoid it.

The *Viese* is one of several Soviet research ships that cruise annually to Antarctica between November and March. It carries food and some equipment for the antarctic stations and can handle up to 250 people—crew and expedition members. The ship is equipped with a rocket launcher (not now in use) and launched radiosondes routinely, twice a day. Also aboard are the usual meteorological and oceanographic facilities: facsimile machines and an automatic picture transmission (APT) unit for reception of satellite photographs. Synoptic weather observations are made by crew members as are bathythermography soundings, records of iceberg demensions by sonar, depth soundings, water samples, and related studies. A small computer is on board for data processing.

On 24 November, just 2 days out, we met a large Soviet fishing fleet. A tanker was refuelling the ships when we arrived. Our turn for refueling came the same day and, due to rough seas, took over 12 hours.

By this time, I had met several of the meteorologists who were to be at Molodezhnaya. V. Bilov was to head the aerological group. V. Efimov was the top scientist among the meteorological technicians. His project involved work on a 500-millibar numerical forecast model for the entire Southern Hemisphere.

Bilov and Efimov seemed very interested in the buoy and my computer requirements. I agreed to work in the synoptic office half-time (weekends included). Bilov assured me this work would guarantee his cooperation regarding deployment of the buoy.

Life on the *Viese* was relaxed and enjoyable. Sunbathing, volleyball, working out on the deck, and parties constituted the life-style of the expedition members. The ship's crew was, in my view, busy, hard-working, and efficient.

The highlight of the 1-month voyage was the Neptune party that marked our equatorial crossing on 29 November. A huge swimming tank was erected on the afterdeck, and everyone improvised costumes from untwisted line and signal flags. Burnt cork and all shades of grease paint were available. All the uninitiated, including the women, of whom there were about a dozen in the crew, were rounded up, summarily stamped on the butt with the ship's seal, and tossed into the swim tank. Then there was abundant food, drink, singing, and dancing.

On 7 December 1974 the clouds thickened, boots and parkas appeared, and the temperature dropped markedly. I saw my first iceberg on the 9th. Four days later we hit the ice pack.

At this point, we rendezvoused with the icebreaker *Ob*. The *Ob* (named after the Ob river) is a 20-year-old transport that has been hauling heavy expedition equipment to the Antarctic from the beginning of 20th-century Soviet involvement there. It was slow go-ing in the pack ice. Once both ships were stuck in the ice for 4 days. Time began to drag; we were eager to unload and test our survival skills on the great white continent.

Finally, on 19 December one of the small planes from the *Ob* was assembled on the ice and was put into use to reconnoiter the ice pack for signs of cracks. On the 20th, we stopped the ships at the edge of a large floe (about 2 meters thick) and began to unload men and equipment to clear a runway. I helped, of course, and made my first acquaintance with penguins. By this time, the day was 24 hours long, and the afternoon heat made working even in T-shirts sweaty (figure 3).

Then unloading got under way. Planes and helicopters took men, equipment, and supplies to the station at Molodezhnaya, some 80 kilometers away. The planes departed nearly every half-hour, a process that was to go on for nearly 2 weeks.

On 22 December 1974, I slept in, exercised on deck, ate a hearty meal, loaded my gear, and waited standing in the windy, cold snow for my last leg to the "big city"—Molodezhnaya.

Molodezhnaya

Grew (1975) gives an adequate description of the station layout at Molodezhnaya. I add the map (figure 4) to pinpoint relevant locations.

Traditionally, people live and work in the same building or in one nearby. For example, there is a geophysics building, a radiosonde building, air chemistry, etc. On arriving at the station I was assigned a single room in the geophysics building (point A, figure 4). The meteorology dormitory was crowded during the summer layover of the old expedition. I was assured that I would move into the meteorology building when the old expedition left, but I was glad to have a variety of people with whom to associate.

The room I had was bleak and austere, as they all were. But it was warm and comfortable.

I began working in the synoptic offices on the day before Christmas 1974. These offices were in the radio building (point B, figure 4) at the extreme southern end of the station. We had two rooms for our work. In one we plotted and analyzed maps or prepared

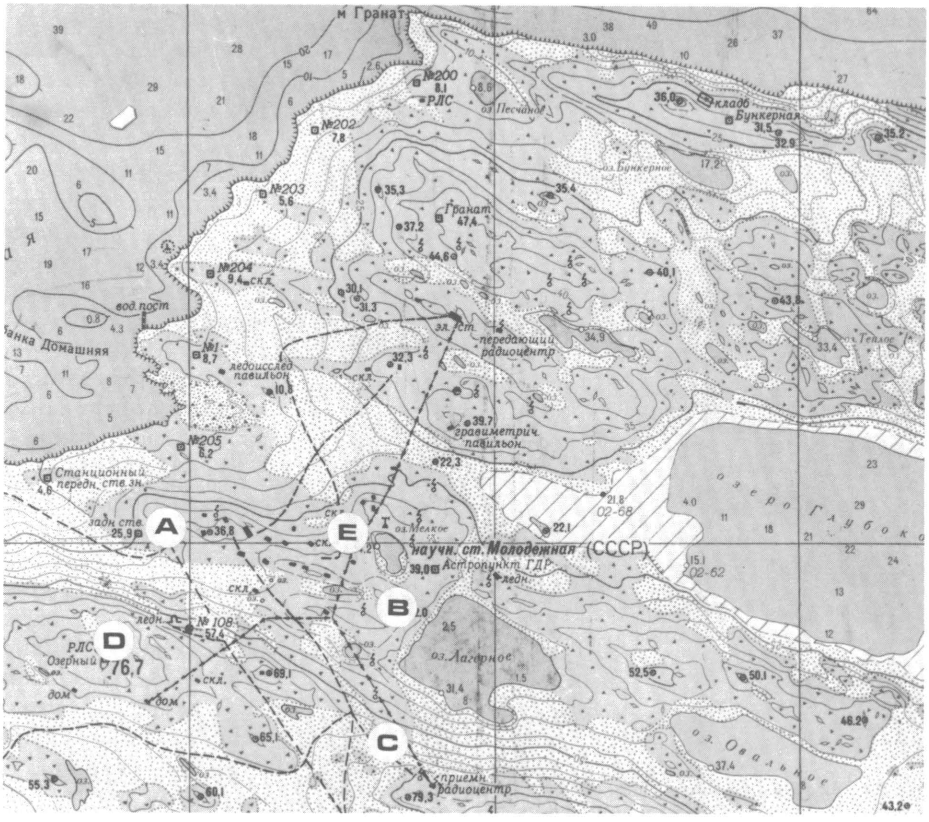

Figure 4. Map of Molodezhnaya: (a) geophysics building, (b) radio bureau, (c) satellite tracking building, (d) rocket launcher, (e) radiosonde building.

forecasts, and in the other facsimile maps were transmitted to the other Soviet stations or ships.

My job consisted of plotting and analyzing the entire Southern-Hemisphere 500-millibar chart twice a day. Portions of the charts were traced and sent via facsimile to other Soviet stations or to ships at sea. Usually two of us were on duty at any one time. The duty forecaster plotted and analyzed hemispheric surface charts and prepared his forecasts for local field programs, summer flights, or nearby ships. During the winter there was virtually no requirement for a forecast except the routine briefing (usually by phone) of the station chief and expedition leader.

In addition to the two synopticians there was a satellite meteorologist who operated the APT system on the hill west of the radio bureau (point C, figure 4). Depending on his tracking skills and the quality of the reception, he would construct a mosaic each day of the clouds over eastern Antarctica and adjacent water. People on ships were interested in limits of and shifts in the ice pack.

The other meteorological programs at Molodezhnaya were snynoptic and actinometric observations, air chemistry measurements, and radiosonde and rocket launches. Each of these groups was housed separately, and it was unusual and difficult to visit the various buildings. Occasionally, there were multiple rocket launchings, and sometimes there were many launches on consecutive days. The rocket launcher was located west of the station (point D, figure 4); and the radiosonde building, east (point E, figure 4).

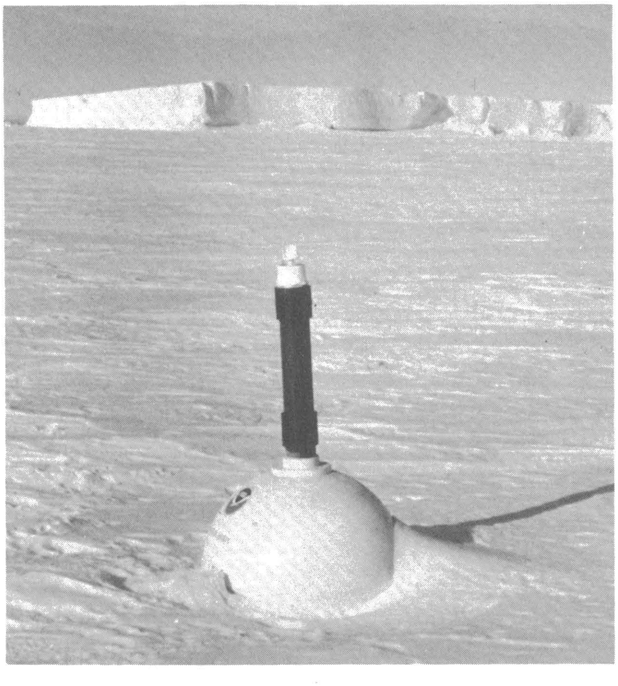

Figure 5. The National Oceanic and Atmospheric Administration data buoy.

Among the 100 people at the station in 1975 were four East Germans who participated in a medical program involving frequent monitoring of blood pressure, blood specimens, respiration rate, etc. These studies were aimed at learning the effects of the polar night on biorhythms.

The geophysics group monitored ionospheric activity and magnetic field variations. Occasionally, auroral displays created quite a stir, as all observers were to note fluctuations in their recordings. Auroral displays were among the most beautiful and spectacular I have seen.

Another active group was comprised of glaciologists, who frequently took core samples on the pack ice. Korneilov, the expedition chief, was among them. There was an instrument for monitoring ocean tides, and a good deal of surveying was done around the station.

The buoy (figure 5) was deployed on 3 July 1975, soon after I learned that the satellite was launched. It took about a half day for eight to ten of us to drag the buoy by tractor onto the ice about 2 kilometers north of the station, drill the holes by hand, and activate it. Unfortunately, the signal from the buoy was never received by the satellite. This was a source of great disappointment.

Life at Molodezhnaya had many comforts. If one could accept the absence of family and close friends to talk with, it would be possible even to enjoy the routine of work, rest, partying, and exercise. Of course, one can't forget the family and all the enjoyable things one can do at home. I often daydreamed of or had flashbacks to favorite walks, films, plays, and even window shopping. I did have some good music with me on tape that was a blessing.

My daily routine began with an early rising, a cold water shave, and an hour spent studying Russian. I then walked to the radio bureau (6 minutes if no wind, a half-hour if the katabatic wind was up), where I would sort the teletype data that had come in during the night and plot charts. I also plotted radiosonde soundings for my own research. After breakfast, I returned to the office to finish the 500-millibar analyses and transmitted them by facsimile.

After lunch, I usually took an hour's walk on the ice or around the station. Then, after some chores in the room and a nap, I studied a little more Russian and then headed back to the radio bureau to work on the afternoon charts and do my research. After dinner I usually read or prepared notes. It was popular to go to the movies after dinner, but I became discouraged with the age and quality of the films and was annoyed by frequent film breakages. I could entertain myself quite nicely in my room with books and music.

About halfway through the year, I decided it would be useful to work in the kitchen. I was invited to do so, and this experience buoyed my spirits. In addition to keeping busy helping with the bread baking and soup preparation, I learned some good Russian recipes and considerably improved my command of the language. It was the most sociable of my activities and generally pleasant, although my work schedule was leaving me exhausted by the end of the day. But this was good, too, because it insured a good night's sleep.

Parties and banquets were held on birthdays and holidays. For the birthdays, a small group would gather for a special dinner, usually steaks or chicken and fried potatoes plus vodka and "spirit"—mostly the latter. On holidays, at least once a month, the custom was to have a large banquet in the dining hall for all. Suit and tie were always worn at birthdays and holidays. They began with much talking and toasting and were invariably followed by singing and dancing.

I am reminded of the tragedy of the year in Molodezhnaya. One of the largest and most looked-forward-to banquets was the one on May Day. It was the first large banquet since New Year's Day, and all the expedition members seemed to party without reservation. Early the next morning, at work, I detected a somber atmosphere. Funeral music was played on the radio, and, finally, someone told me that one of the men in the rocket group had become ill during the night and died.

And so it was that Molodezhnaya had its second funeral in 20 years. I will never forget the bleakness of the 2 weeks when everyone's spirits were at their lowest. We all attended the funeral. The viewing was followed by a procession of men following a tractor-drawn sled with casket draped in red. The cemetery is about 6 kilometers east of the station on the stark and rocky coast. There the casket was covered by a large steel vault, and we each carried large rocks and piled them over and around the vault to secure it from those frightful, stormy Molodezhnayan winds (figure 7).

Research

Originally, my proposed research consisted of two parts: first, I wanted to study the energetics of antarctic cyclones, and, second, I wanted to document on film the activities at Molodezhnaya in order to show the daily routine of both life and work at the station. The first of these goals was quickly scrubbed when I realized that the data scarcity and computer facilities were limited. Antarctic data are scarce enough under the best of conditions, but when radio reception failed completely for 2 or 3 days, it was clear that my original program became infeasible. With regard to the use of the computer, it was unrealistic to make such a large demand on machine time and programmers in order to do cyclone energetics in isentropic coordinates.

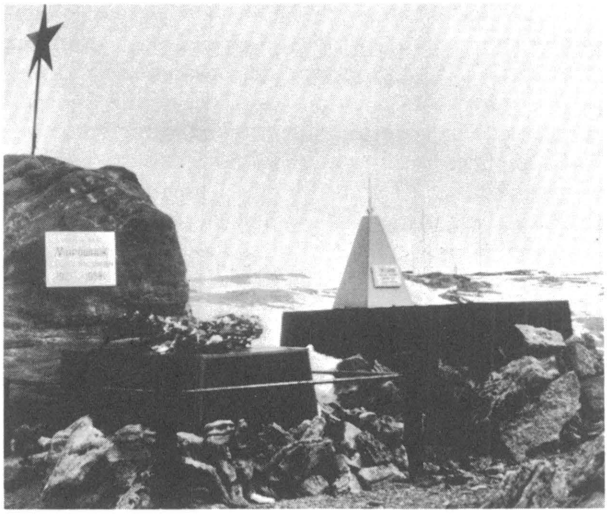

Figure 6. Molodezhnaya cemetery.

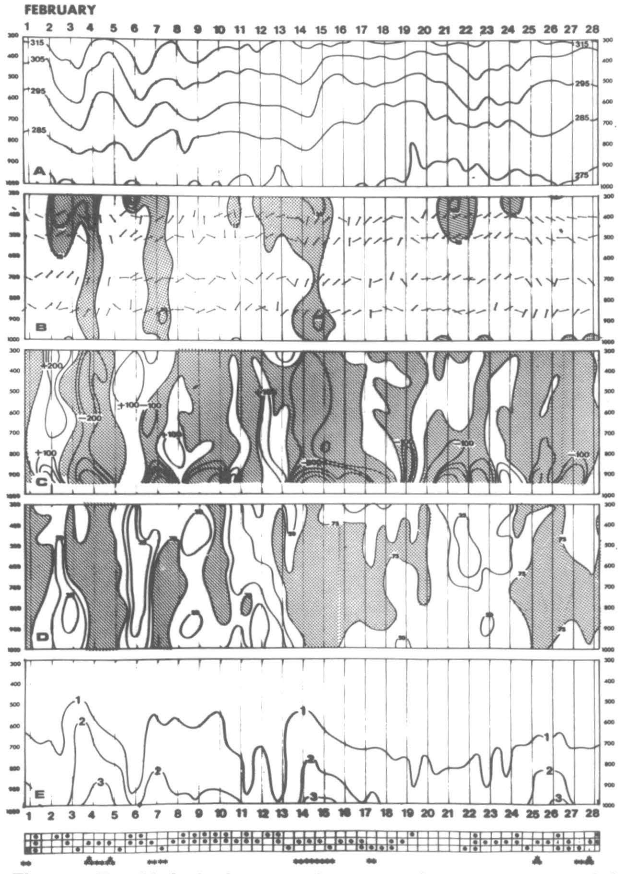

Figure 7. Molodezhnaya time section: (a) potential temperature (°K), (b) wind speed (meters per second) and direction, (c) vertical velocity (millibars per 12 hours), (d) mean relative humidity (per cent), (e) mixing ratio (grams per kilogram).

I concluded that it would be useful to prepare a continuous time section of the radiosonde data available at the station. This program had the virtue of allowing me to study the coupling or interaction between tropospheric jet cores and instances of strong katabatic flow. One becomes impressed with the katabatic winds in Molodezhnaya. I consider myself fortunate to have observed these often shallow but spectacularly strong downslope winds. In fact, while I was there on 25 May 1975, Molodezhnaya recorded its record high wind of 54 meters per second (122 miles per hour). I should remark, however, that this was not strictly katabatic. A strong storm was in the area.

In addition to allowing study of the interrelation between upper air jet cores and surface katabatic winds, the time section would allow study of moisture redistribution in the troposphere over Molodezhnaya. The twice daily (0000 GMT and 1200 GMT) plots of temperatures aloft were hand plotted and analyzed for potential temperature and mixing ratio.

The seven elements calculated twice each day from the Molodezhnaya radiosonde data were static stability, wind speed, wind direction, mean relative humidity, mixing ratio, vertical velocity, and temperature advection. Surface synoptic observations were recorded for comparison with the various parameters described above. It would be necessary to compare the vertical motions and moisture changes with the cloud cover and precipitation.

Figure 7 gives an example of the time section for the month of February 1975. Preliminary results suggest that katabatic winds are indeed enhanced by the presence of jet core vertical circulations, but they can and do exist independently of the cores aloft. Further studies are under way in an effort to correlate the various weather parameters. For example, it is important to learn if a model storm can be constructed to show how changes in wind direction affect the redistribution of moisture and the onset of cloudiness and precipitation.

In addition to the time section, I calculated weekly averages of meridional transport across the eastern coast of the continent. There are about eight stations distributed along the coast to ease such calculations (figure 1). This work is not yet completed.

Finally, I did achieve what I had hoped in terms of photo-documentation of life and work at Molodezhnaya. I have several time-lapse cloud films to study instances of strong vertical wind shear and to show the onset of cloudiness and clearing conditions. Moreover, I photographed virtually all of the major activities performed in both the radio and synoptic buildings. Rocket and radiosonde launches were filmed. Included in the more than 1,500 meters of film I took are scenes showing the holiday routine. These films show football games on the ice, weight lifting contests, people enjoying the ever-popular sauna, and dining in the mess hall (figure 8). One section of the mess hall was set aside as game rooms where pool, chess, and ping-pong were popular. None escaped my lens. The slides and films are being used in the preparation of what we hope will be two half-hour television tapes. These will be available at the National Science Foundation for preview by others making similar trips as exchange scientist.

Return

We learned, as early as October, when the ships would arrive with the 21st expedition. October and November were busy for me as I had to do all the necessary filming during that time. I also worked a good deal on my research, plotting and analyzing the time section. I embarked on an ambitious program of running and other exercise. I learned that getting in shape was good not only for body but for mind as well.

The ships arrived in early December, and I joyfully began packing and distributing the remaining gifts. The first helicopter made its appearance on 15 December, and the entire station turned out on the small airstrip to greet the new leaders. The station chef provided bread and salt to keep the ceremony traditional and official.

Then the endless unloading began. Helicopters flew back and forth to the ships every half-hour for nearly 2 weeks. New people were arriving, and everyone got mail and packages from home. Little serious work was done by the old expedition members during this time.

After bidding farewell, I left Molodezhnaya on 21 December 1975, the same date as my arrival a year earlier. That evening, I settled down once more on the *Viese* and shared a cabin, this time with a young oceanographer.

The days on board the *Viese* during the trip to

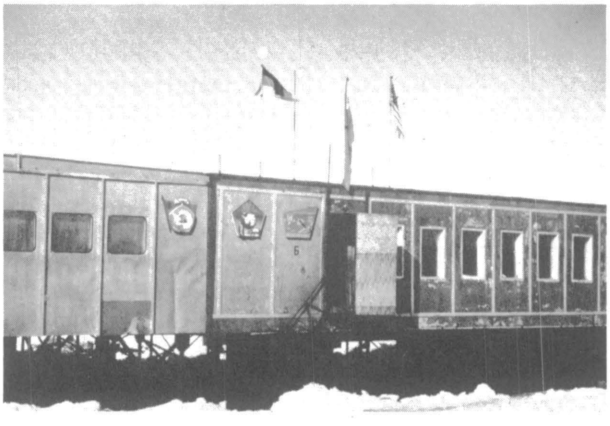

Figure 8. Molodezhnaya mess hall.

Montevideo went slowly but pleasantly as I kept busy during the mornings by writing reports and in the afternoons by running on the decks and exercising. The weather was stormy, but improved about 2 or 3 days out of Montevideo. Although away from home for the second consecutive Christmas, the sadness was somewhat dispersed by my East German friends who invited me to a small Christmas Eve party in their cabin. I missed the New Year's Eve party due to a stomach upset—the first and only illness experienced during the entire year.

We arrived in Montevideo on 6 January, and I was met by an agent contracted by the National Science Foundation and received mail from the Ambassador's representative. Both of these people were helpful and kind in getting my gear unloaded and shipped to the States. They took care of all the arrangements for my flight home and even sent flowers and liquor to the *Viese* as a gesture of gratitude to my Soviet friends who had taken such good care of me all through my antarctic adventure. I left Montevideo on 8 January 1976 and was at home with my family on the evening of the 9th. At that moment I was the happiest of the 20th expedition's polarniks.

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Glaciological studies with the U.S. Antarctic Research Program, 1974-1975 and 1975-1976

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The Antarctic Treaty provides for the exchange of scientists between the antarctic expeditions of treaty nations. This gave me the opportunity to participate in the U.S. Antarctic Research Program (USARP) during 1974-1975 and 1975-1976 as an exchange scientist from the 20th Soviet Antarctic Expedition (SAE).

I was stationed at McMurdo, where I spent almost 14 months from 2 December 1974 to 22 January 1976. This was my fourth trip to the Antarctic: I wintered at the Soviet Union's Mirnyy Station (66°33'S. 93°01'E.) in 1960 and at Vostok Station (78°28'S. 106°48'E.) in 1970, and I participated in the Chilean antarctic program on the Antarctic Peninsula in January and February 1973.

Glaciology is a major portion of the SAE program. Glaciological observations are being carried out at Vostok Station, during the Mirnyy-Vostok traverses, and in the vicinity of Novolazarevskaya Station (70°46'S. 11°50'E.) (Barkov, 1975a, 1975b; Barkov *et al.*, 1975).

My research in 1974-1975 and 1975-1976 included studies of the antarctic ice sheet structure. Knowledge of the vertical structure of the ice sheet based on field measurements would enhance understanding of the causes and mechanisms of past environment (mainly climatic) changes that primarily resulted in variations of the ice sheet dimensions. My work with the U.S. antarctic program enabled me to make observations in those antarctic areas that were less known to other Soviet scientists. I was able to travel to nearly any place of interest during these 14 months, and all necessary equipment was made available to me for both field and laboratory studies, including perfect laboratory facilities at McMurdo; for all of this help, I am sincerely grateful.

Structure of the snow layer. Together with French glaciologists C. Lorius, J. Sanak, and F. Gillet, I worked at Amundsen-Scott South Pole Station from 6 to 21 December 1974. We made a pit 5.2 meters deep at a distance of 5 kilometers from the station. Snow stratigraphy was studied with depth, snow density was determined at 5-centimeter intervals in the pit, and snow samples for oxygen-isotope analysis were taken. The French glaciologists also took snow samples for later chemical, oxygen-isotope, and hydrogen analyses (Sanak and Lorius, 1975).

From 31 December 1974 to 16 January 1975, together with Drs. Lorius and Gillet and other French glaciologists J. Campin and C. Chaufriasse (Lorius, 1975), I worked at dome C (74°30'S. 123°10'E., elevation 3,240 meters). We dug a pit down to 5.4 meters and then from its bottom several holes were drilled using a SIPRE corer down to 10 to 12 meters. Snow samples were thus obtained from depths of 15 to 17 meters. The program was similar to that at the geographic South Pole. It was our intention originally to continue this activity on a wider scale during the 1975-1976 season, but these plans were postponed due to the LC-130 airplane accidents at dome C.

Observations from the above work indicate that snow density at the South Pole increases with depth ranging from 0.34 gram per cubic centimeter in the 0- to 1-meter layer to 0.43 gram per cubic centimeter in the 4- to 5-meter layer. Deviations from the averages at different levels amount to ± 10 percent. Mean values for the whole 5-meter thickness were found to be 0.39 gram per cubic centimeter. Stratigraphic analysis revealed 27 annual accumulation layers within this depth (5 meters), corresponding to the period from 1948 to 1974. Average accumulation was calculated to be 7.5 grams per square centimeter per year. Snow density in the dome C area increases with depth from 0.33 gram per cubic centimeter at 4 to 5 meters, with deviations from average values at certain levels being ± 25 percent. Stratigraphic analysis in this area showed 38 annual layers, corresponding to the period from 1937 to 1974. The mean accumulation rate for the past 20 years (1955 to 1975) in the vicinity of the South Pole appears to be 8.2 grams per square centimeter per year, while at dome C it is 3.7 grams per square centimeter per year. The stratigraphic technique is known to have a large error, and this may explain the discrepancy in the obtained results.

Sea-ice growth. My sea-ice observations in McMurdo Sound began in May 1975. Observations were made twice monthly at 10 to 15 sites along a 16-kilometer-long linear profile running westward from McMurdo Station. In September the Navy began routine sea-ice observations for McMurdo Station's annual-ice aircraft runway operations. The profile was 3 kilometers long. Ice thicknesses were measured at 21 sites; from September to November measurements were made weekly, and in December they were made every 2 to 3 days. The observations were completed by early January 1976. Altogether, 30 series of observations were made since May 1975. They showed that during May to August the sea-ice accretion rate was an average of 1 centimeter per day. During the coldest period (late July to early August), when air temperatures ranged from -30° to -40°C, the average accretion rate increased to 1.5 centimeters per day with an average snow layer of 10 centimeters.

Sea-ice growth was observed until mid-December 1975, and during the last 3 months the growth rate was 0.5 centimeter per day. On 18 December the average ice thickness at the profile was 240 centimeters. In the following days ice thickness decreased at an average rate of 2 to 3.5 centimeters per day, which was mostly due to melting from the bottom. The apparent melting from the surface occurred only from the dirty surface (roads, runways, aircraft, and surface-vehicle depots).

Ice-sheet structure in the McMurdo Sound vicinity. The McMurdo Ice Shelf, Erebus Glacier, Koettlitz Glacier, Wright Lower Glacier, Garwood Glacier, Hobbs Glacier, and areas of so-called "dead ice" at the coast between Hobbs and Blue glaciers were the main objects of this study. In January 1975 a group of scientists, including myself, was transported by helicopter to the McMurdo Ice Shelf (not far from the tip of Ross Island's Hut Point Peninsula), to the Dailey Islands (77°53'S. 165°06'E.), and later to the lower part of Koettlitz Glacier (78°17'S. 164°00'E.). Robert B. Boyd, manager of McMurdo's Ecklund Biological Center, and two other support personnel from Holmes and Narver, Inc., were also in the group. Holes were made by a SIPRE drill to 6.5- and 7.5-meter depths, and ice samples were obtained as cores.

In August 1975 a traverse with two vehicles was organized to travel over the northeastern portion of the McMurdo Ice Shelf. The traverse team consisted of Jack R. Steinman (Holmes and Narver, Inc., engineer), two New Zealanders from Scott Base (J. Stevens, biologist, and Kenneth Parker, cook), and myself. Despite the rough surface of the ice shelf, which was crisscrossed by thaw holes and water channels formed in previous summers, some of which had steep walls 1.5 to 2 meters high, the drivers managed to reach the northernmost edge of the McMurdo Ice Shelf. Glaciological and morphological observations of the ablation relief forms were carried out along the traverse, two holes were drilled, and 6.6- and 5.9-meter-long ice cores obtained.

Major observations along the McMurdo Ice Shelf were completed in the period from October 1975 to January 1976. I express my gratitude to Douglas W. Hall and Daniel L. Osborne for helping me with this job. We were transported to the work site by helicopter, and after a day's work we were transported back to McMurdo Station. The work consisted of glaciomorphological observations, photography, collecting moraine material and rock samples, and hole drilling with ice core sampling down to 1 to 2 meters. To determine the sources of moraine material formation, a circular flight around McMurdo Ice Shelf was made with landings at six sites where ice samples and moraine and rock material were sampled. S.M. Miagkov, Moscow State University (U.S.S.R.), took part in this work (Miagkov *et al.*, 1976). During one of the last flights, most interesting sections of the ice shelf were photographed by a hand-held aerial camera (18 by 18 centimeters) from an elevation of 2,500 meters.

In September 1975, together with a team headed by Samuel B. Treves, University of Nebraska, Lincoln, we traveled over the sea ice to Erebus Glacier Tongue (77°42′S. 166°40′E.). We walked for some distance along its central part and retrieved an ice core from a hole 3.5 meters deep.

In December 1975, together with Dr. Miagkov and Noel Potter, Jr., we studied Wright Lower, Garwood, and Hobbs glaciers in the dry valleys of southern Victoria Land. Our tent camp was moved by helicopter from site to site. The studies included observations on the structure of glacier edges, their recent position changes, and moraine deposits that belong to earlier glaciation stages. A preliminary discussion of Dr. Miagkov's research during this period is in Miagkov (1976).

Along with field studies, my program called for some laboratory analysis of samples obtained in the field. For this purpose, a glaciology laboratory was equipped in a cold room of McMurdo's Ecklund Center. A special table was made for core studies, and the following devices were used: an instrument for thermal ice cutting by means of a heated wire and for taking pictures of thin-ice sections under polarized light using a Polaroid 108 camera. Thin sections were prepared using a special cutting device brought from Vostok Station in December 1974.

Orientation of the crystal optical axes was determined by means of a conventional universal stage and a specially made universal stage for large (10-by-10-centimeter) thin sections. With the aid of a thermal-regulating device, ambient air in the laboratory was maintained at -6°C; when air temperature outside exceeded 0°C, it became necessary to move to a new laboratory in the cold chamber of the Thiel Earth Sciences Laboratory.

Simultaneous to the above studies, ice samples were taken for oxygen-isotope analyses; also, total salt content was determined for the ice samples by measuring electric conductivity of the melt water using a Beckman conductivity meter, which measures electrolytes from 4×10^{-7} to 5 ohm^{-1} per centimeter with an accuracy of ± 1 percent.

Much data was obtained during these studies. Most interesting, in my opinion, were the observations carried out on McMurdo Ice Shelf and in the area of dead ice located in the lower portion of Brown Island (78°05′S. 165°25′E.) and over northwestern slopes of the coast in the McMurdo Sound vicinity. The present condition of these glacial forms appears to be quite different. The ice shelf (30 to 80 meters thick) is afloat, while the dead-ice fields are grounded at an elevation ranging from 0 to 400 meters; also, the dead ice may extend into the ocean where it may still be grounded and it may form peninsulas and islands. The dead ice is completely covered by moraine material that averages 0.2 to 0.3 meters in thickness and is a good protective cover to prevent ice evaporation and melting during the short antarctic summers. The melting occurs only in thermocarst holes. The moraine layer is rich in mineral salts, which show as salty patches on its surface or as dispersed white powder. Salt clusters may be seen as whitish layers 0.3 to 0.4 meters thick and sometimes with crystalline structure; the lens is lightly distributed through the moraine thickness with a diameter of up to several meters. Nobuyuki Nakai, Nagoya University (Japan), made a special analysis of the samples and reported (personal communication) that this salt seems to be mirabilite formed from sea water. Some parts of the McMurdo Ice Shelf also show common moraine material abundant in salt clusters and powder and in some places in whitish salt lenses. The moraine material of both sites is similar in its mineral composition. The presence of mirabilite in floating portions of the McMurdo Ice Shelf is easily attributed to salt transport to the surface through a process of surface melting and bottom growth of the ice.

The study of ice samples from the McMurdo Ice Shelf and from dead-ice areas has shown that their structure and level of mineralization are similar; however, they differ greatly from glaciers formed by atmospheric precipitation. The evidence indicates the genetic similarity of the discussed formations. The dead-ice fields seem to be the relics of an ancient, vast, floating glacier that might have been similar to the present McMurdo Ice Shelf. A relative decrease in sea level due to the tectonic rise of the coast, for instance, might have resulted in the grounding of the marginal portion of an ancient floating glacier. It seems improbable that the tectonic rise occurred faster than the glacier mass shrink, but there is no other plausible explanation.

During my stay at McMurdo Station I constantly felt that I was among friends. Monthly radio contacts were arranged for me with the Soviet Union's Molodezhnaya Station (67°40′S. 45°51′E.), so I kept in touch with home news. I was very pleased to teach a short Russian-language course for a group of willing students at McMurdo Station, and I was happy to tell my interested American listeners about my country in a lecture on the Soviet Union. I also enjoyed sports at McMurdo and won a prize for being the "best Russian bowler." I take this opportunity to thank all my colleagues with whom I spent the 1975 winter and the 1974-1975 and 1975-1976 summers at McMurdo for their assistance and friendship. Without their help it would have been impossible to carry out my research.

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Birds of the Palmer Station area

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The United States' Palmer Station (64°46'S. 64°03'W.) on Anvers Island, off the Antarctic Peninsula, is a center of activity for both terrestrial and marine biology. Scientists contemplating polar research find an unlimited potential for environmental studies in an unusual natural setting in addition to

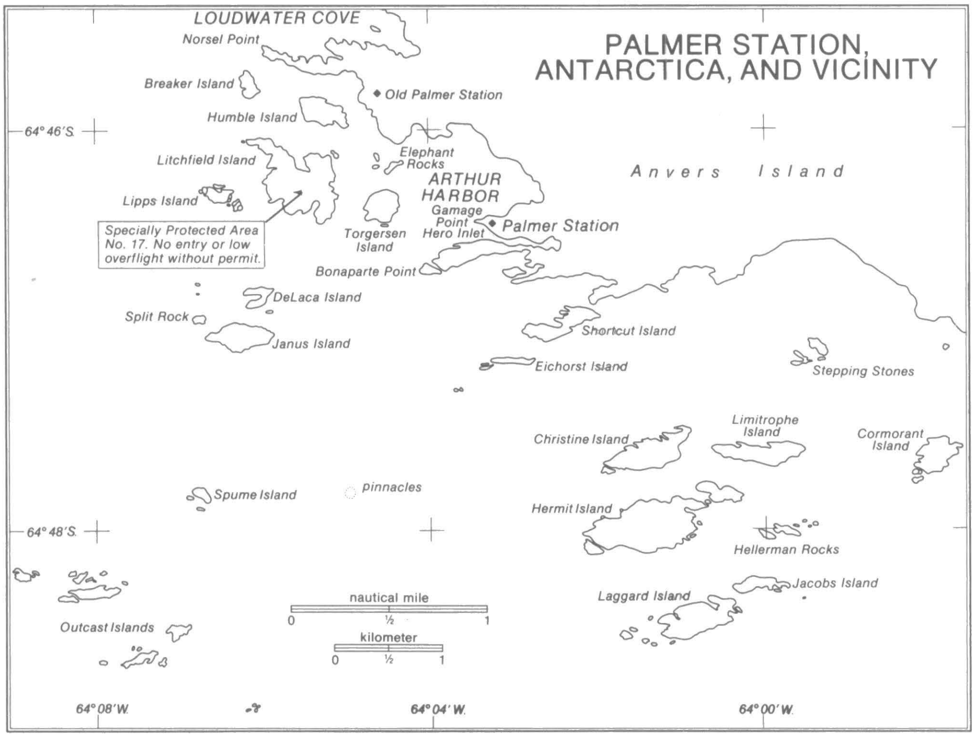

Figure 1. Palmer Station, Anvers Island, and vicinity. Parallels of latitude and longitude are based on the position of the upper (garage) building at Palmer Station: 64°46'30''S. 64°03'16''W. The U.S. Geological Survey established these coordinates using a geoceiver, which gives a precise ground position by measuring the doppler effect of signals from passing satellites.

well-equipped laboratories and station facilities. Numerous moss- and lichen-covered rocky peninsulas and islands (figure 1) of varying size and relief coupled with a sea extraordinarily rich in marine life provide a haven for birds and seals.

This paper provides scientists based at Palmer with basic data and also informs them of the kinds and relative abundance of birds in the region by updating an earlier report by Holdgate (1963) on observations made at the abandoned British station that was located about 2 kilometers west of the present station. However, since Palmer is a popular stopping place for various research and supply ships traveling up and down the Antarctic Peninsula and is becoming a visiting ground for an increasing number of tourists, there is a growing need to list flora and fauna of the Palmer area. We hope this paper will serve as a checklist of Palmer-area birds, especially when used in conjunction with George E. Watson's (1975) *Birds of the Antarctic and Sub-Antarctic.* Visitors to Palmer Station should report their sightings preferably in writing to the station science leader or manager.

Observations of all species of birds encountered by us were recorded, but our studies dealt principally with the charadriiform birds—the sheathbills, skuas, gulls, and terns—an important but mostly neglected south polar group. Our interests were in their ecology and behavior, and particularly in their adaptations to polar environments. Further, the interspecific interactions of these birds were noted, with special interest focused on the skuas since the ranges of two species (*Catharacta maccormicki* and *C. lonnbergi*) overlap at Palmer where some interbreeding takes place. To begin these studies, we banded and color-coded all charadriiform species. We also banded giant fulmars, storm petrels, and shags.

Little is known about the austral-winter movements and habits of polar birds in general. The Palmer area is favorably located for winter studies because of the persistence of open water much of the year, which not only provides a rich feeding ground for birds but also gives a certain amount of mobility to the investigator. The 1975 winter observations by Mr. Neilson already are changing some of our concepts about winter bird activity in the Antarctic. Mr. Fraser continued these studies in 1976, thus allowing for continuous, year-round observations that started at Palmer on 24 December 1974. Detailed results of the winter studies will be published separately.

Not all exposed land areas in the Palmer area have been explored yet, but by using small boats we covered fairly well an area extending from Cormorant Island (64°48'S. 63°58'W.), Biscoe Bay, in the east to Norsel Point (64°46'S. 64°06'W.) in the west. Trips also were made aboard R/V *Hero* and helicopters from the U.S. Coast Guard icebreaker *Glacier* to islands farther out at sea, including some of the Joubin archipelago (64°47'S. 64°27'W.)

For the following annotated list of birds we follow the taxonomic views of Watson (1975). Observations include those taken by us and others during the periods 22 November to 12 December 1973 and 24 December 1974 to 20 July 1976.

Annotated species list

Adélie penguin (*Pygoscelis adeliae*)

Common breeder and year-round resident; migratory habits poorly known for first-year and older, non-breeding birds. Adélie penguins are by far the most common pygoscelid penguins in the Palmer area, where breeding colonies range in size from less than 1,000 pairs each on Cormorant and Litchfield islands to about 3,000 pairs on Humble Island, 2,000 pairs on Christine Island, and over 8,000 pairs on Torgersen Island, according to our estimates and those of Müller-Schwarze and Müller-Schwarze (1975). The colony visited most often by station personnel and tourists is on Torgersen Island, a short distance from Palmer Station.

Nesting was so far advanced by the time we first visited a colony in 1974 that by 28 December many adults on Cormorant Island were attending small to fairly large young, although quite a few were still incubating eggs. The earliest egg date given by Holdgate (1963) is 12 November. The latest date we have for a live Adélie egg is 16 January (Joubin Islands).

Mr. Neilson's fall and winter observations are noteworthy. By 26 February 1975, he found the rookeries deserted of most adults and all young. With few exceptions, the young were not seen again; many adults, however, remained on the beaches nearby and formed scattered groups of five to 50 individuals, all of which evidently underwent body molt for approximately a month. By 18 April, the adults regrouped at the rookeries and entered a remarkable 3-week period of sexual activity that was characterized by courtship displays and nest-building but by no egg-laying.

In midwinter, Mr. Neilson often saw groups from two to upwards of a hundred or more individuals crossing the pack ice to open water leads. From late August to early October these birds were conspicuously absent. By mid-October their numbers had gradually increased, and from that time on they were often seen crossing the ice in the direction of the rookeries. Although ice conditions prevented us from reaching the rookeries at the very onset of egg-laying in 1975, quite a few adults had one or two eggs by 21 November despite the fact that many were also standing on nest sites still covered with snow.

Mr. Fraser witnessed irregular disappearances and reappearances of Adélies during the 1976 austral winter. Numbers began to decrease noticeably in early March, and by month's end only a few molting individuals remained. By 20 May, over 3,000 had returned to Torgersen Island, but whether they engaged in sexual activity at that time is uncertain. Their numbers dwindled to about 300 by 7 June and none were seen by 20 June. Scattered individuals and at least one large group appeared in July.

First-year birds are decidedly scarce in the Palmer area. We have noted only a few: one on 26 December 1974, and one each on 3 and 15 June and on 25 October 1975.

According to Holdgate (1963), large colonies of Adélie nest in the

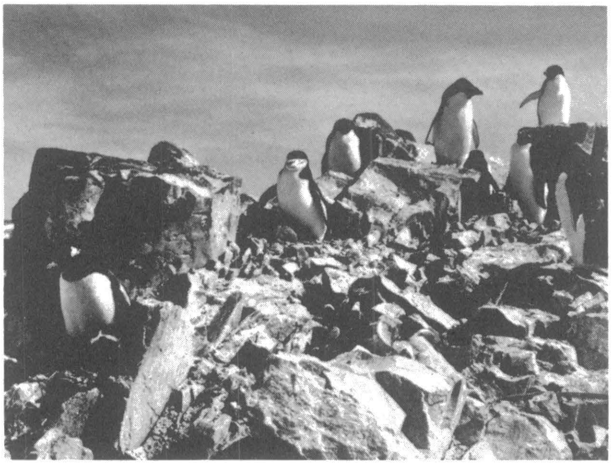

Figure 2. Three species of pygoscelid penguins nesting side-by-side on one of the Joubin Islands. Foreground: gentoo penguins (*Pygoscelis papua*) and chicks. Center: chinstrap penguin (*P. antarctica*) and chicks. Background: Adélie penguins (*P. adeliae*) and chicks. Photographed on 16 January 1975.

Joubin archipelago where, on 16 January 1975, we observed only small numbers breeding close to nesting chinstrap and gentoo penguins on one of the smaller islands. Although a precise nest count of the chinstraps and gentoos was made, time permitted only a rough estimate of the number of Adélies. There were at least 90 pairs or about the combined total of the other two species on the island.

The three species of pygoscelid penguins tended toward segregation, as there were several isolated groups of nesting birds of each kind; still, individuals of all three species nested side-by-side (figure 2). Close associations between two species of pygoscelid penguins are not uncommon, but most certainly are uncommon among all three species. Müller-Schwarze and Müller-Schwarze (1975) reported a similar colony on King George Island (62°00'S. 58°15'W.).

Chinstrap penguin (*Pygoscelis antarctica*)

Uncommon summer resident; small numbers breed on Dream Island (64°44'S. 64°W.) and on Joubin Islands; status uncertain at other times of year. During November, December, and January, these penguins are seen fairly frequently but only in small numbers in Arthur Harbor and Biscoe Bay, where they associate with Adélie penguins away from the rookeries. There is a single record of an isolated nesting for Arthur Harbor, according to Müller-Schwarze and Müller-Schwarze (1975), and the birds breed at least sparingly on Dream Island according to Holdgate (1963) and our one-time observation of 1 February 1975.

On 16 January 1975 we counted 35 breeding pairs in company with nesting Adélie and gentoo penguins on a small island in the Joubin archipelago where the species was not known to breed. Three nests held two eggs; nine held one young; 22 held two young; one held three young. Two of the six eggs were spoiled. All 56 young appeared healthy. The species likely remains in the region beyond the summer, although Messrs. Neilson and Fraser saw none in the Arthur Harbor area during the 1975 and 1976 winters.

Gentoo penguin (*Pygoscelis papua*)

Uncommon year-round resident; small numbers breed on Joubin Islands. Previously, gentoo penguins were not known to breed anywhere in the Palmer area, although the species has been seen there during every month of the year according to our records and to those of Holdgate (1963). In the Joubin Islands, on 16 January 1975 we counted 54 breeding pairs among the Adélie and chinstrap penguins mentioned above. Of the 54 gentoo nests, three held one egg and one young; 14 held one young; 37 held two young; all three eggs and 91 young appeared healthy.

During the 1975 winter, Mr. Neilson observed small numbers of gentoos at Arthur Harbor from March through July but none from August to mid-September. More than 500 appeared on 19 September. Thereafter, several hundred could be seen regularly until 24 October, after which their numbers dropped dramatically.

Macaroni penguin (*Eudyptes chrysolophus*)

Status uncertain; probably accidental visitor. The vague record (Holdgate, 1963) of a single macaroni penguin on Humble Island on 6 January 1956 remains hypothetical.

Black-browed albatross (*Diomedea melanophris*)

Rare transient, not often seen near land. In 1975 we saw one flying at sea near the Joubin Islands on 23 January, and on 27 February we saw three flying near Litchfield Island. Mr. Fraser noted a few in the Arthur Harbor vicinity as late as 19 April in 1976.

Gray-headed albatross (*Diomedea chrysostoma*)

Rare transient, not often seen near land. In 1975 we saw one flying at sea near the Joubin Islands on 23 January, and at least two flying near Litchfield Island on 27 February. In 1976 Fraser noted a few in the vicinity of Arthur Harbor as late as 19 April.

Southern fulmar (*Macronectes giganteus*)

Common breeder and year-round resident; first-year birds migrate from area but status poorly known for older, non-breeding individuals. Scattered pairs and small colonies of giant fulmars breed commonly in the Palmer area where the birds are conspicuous year-round. The greatest concentration of nesting birds noted by us occurred on Stepping Stones islands, but at least a few pairs were seen on most islands visited, including several of the Joubin group.

Our earliest egg date in 1975 was 2 November, although most eggs that year were laid during the middle of the month. Egg laying by a few pairs continued until 26 November. Incubation periods (from laying to hatching) ranged from 59 to 64 days (mean of 61 days).

Our earliest sighting of a newly hatched chick in 1975 was on 8 January—the same early date given by Holdgate (1963) for a first chick sighting. The mean age at which chicks left nests in 1976 was 107 days. These chicks were flightless and swam or walked near the shore or on ice until they flew some days later at an undetermined age. Our earliest date for a strong flying young was 1 May (1975).

Young giant fulmars appear to leave the breeding grounds soon after they achieve flight and fly long distances (Warham, 1962;

Sladen *et al.*, 1968), as our banding records also clearly indicate (table 1). After reaching maturity some years later, young may return to the Palmer breeding ground. Two flightless chicks banded at Palmer in 1965 were found by us sitting on nests 10 years later on Bonaparte Point and on Shortcut Island, respectively.

Mr. Neilson and later Mr. Fraser often noted adults near or sitting on nests (no eggs) during the winter, a phenomenon reported for Palmer earlier by Holdgate (1963) and for a different region by Warham (1962).

Gray-plumaged birds are common in the Palmer area. Perhaps one in 15 or 20 birds is white-phased. Very dark birds are exceedingly rare.

Northern giant fulmar (*Macronectes halli*)

Rare, probably accidental visitor. Mr. Fraser observed a single bird near Palmer Station for the first time on 6 January 1976. Evidently the bird had joined a Chilean vessel some 600 kilometers north of Anvers Island and had followed the vessel all the way to Arthur Harbor. It did not leave with the ship but remained for 10 days in the station vicinity, where it attempted to catch gull chicks—a predatory behavior not known to occur among the many southern giant fulmars residing in the area. So far as is known, the bird failed to catch a single chick.

Southern fulmar (*Fulmarus glacialoides*)

Uncommon to common transient in fall; status uncertain at other times. Holdgate (1963) recorded the species once in the Palmer area (one bird, 20 March 1956). Although we failed to note any during the 1975 austral summer, Mr. Neilson later observed the following: thousands flying at sea off Bonaparte Point on 8 May, but their numbers were greatly reduced there from 9 May to 18 May; a single individual was seen flying near Humble Island on 28 September. In 1976, Mr. Fraser first noted small numbers on 5 April, hundreds by 12 April, and thousands by 18 April when numbers probably peaked; their numbers dropped off steadily until 21 May, when he last saw the birds.

Antarctic petrel (*Thalassoica antarctica*)

Transient species, rare in summer, uncommon to common at other times. Holdgate (1963) recorded only small numbers (14 to 19 September). Our only summer record is of a single bird flying near Litchfield Island on 27 February 1975. That year Mr. Neilson noted the species occasionally during April, May, and June, but from 15 to 22 September he witnessed a mass migration of thousands of birds flying northwesterly on strong winds. Individuals and small flocks were noted occasionally thereafter until 30 October. During the 1976 fall and winter, Mr. Fraser occasionally observed from one to five birds; no large numbers were seen, however, up to 20 July.

Cape pigeon (*Daption capense*)

Transient species, rare in summer, uncommon to common at other times. Holdgate (1963) recorded the species only once during the summer, and only periodically and in small numbers at other times. We also noted the species only once in the summer: several scattered individuals near Litchfield Island on 27 February 1975. That year Mr. Neilson saw thousands of cape pigeons at sea far off Bonaparte Point from 26 April to 18 May, noticeably fewer of them during June, and only scattered individuals during July and August. In 1976 Mr. Fraser noted small groups at sea on 19 April, followed by thousands of birds on 23 April when numbers probably peaked. The birds declined rapidly thereafter, until by 20 July only a few individuals and small groups remained. Although Watson *et al.* (1971) did not include Palmer in their winter distribution for the species, the area conceivably is an important winter feeding ground for migrating cape pigeons.

Snow petrel (*Pagodroma nivea*)

Transient species, uncommon in summer, uncommon to common at other times. Snow petrels occasionally fly over Arthur Harbor in the summer, although Holdgate (1963) failed to record them anywhere in the area in the summer. He stated that there were fairly frequent records of individuals and groups between 27 March and 5

Table 1. Recovery sites of southern giant fulmar (*Macronectes giganteus*) young banded at nests in the vicinity of Palmer Station, Anvers Island, Antarctica.

Chick number	Banding date	Banding site	Recovery date	Recovery site
658-67539	25 March 1975	Stepping Stones	27 July 1975	Yanchep Beach, Australia 31°3'S. 115°3'E.
658-67555	25 March 1975	Stepping Stones	8 July 1975	Pt. Sir Issacc, Australia 34°2'S. 135°1'E.
658-67562	3 April 1975	Shortcut I.	24 Aug 1975	3 S Bald Head, Australia 35°1'S. 118°0'E.
658-67590	9 April 1975	Shortcut I.	11 Oct 1975	6 NW Rainbow Beach, Australia 27°2'S. 153°2'E.
658-67593	18 April 1975	Humble I.	20 July 1975	Jandakot, Australia 32°0'S. 115°5'E.
658-67648	19 March 1976	Humble I.	14 July 1976	Titahi Bay, New Zealand 41°1'S. 174°5'E.

November. Mr. Neilson and later Mr. Fraser noted that their numbers fluctuated during this period when peak observations in 1975 occurred on 24 April (hundreds) and several times during late May and June (thousands); in 1976, on 12 April (hundreds) and on 18 April (thousands).

Thousands of snow petrels moved through the Palmer area during 30 to 31 October 1975, when a steady stream of individuals and small flocks flew northwesterly low over the glacier immediately behind Palmer Station. Specimens taken from the flock were in breeding condition (gonads greatly enlarged), and probably the birds were migrating to breeding spots not yet described. Vague reports of possible breeding sites on or near Mount Francais (64°38′S. 63°27′W.) on Anvers Island to the east of Palmer Station need to be substantiated.

Wilson's storm petrel (*Oceanites oceanicus*)

Common summer and fall resident. Probably breeds abundantly throughout the Palmer area, although nesting records exist only for Bonaparte Point and for Cormorant, Humble, Litchfield, and Shortcut islands. A few were noted at sea near the Joubin Islands, where the species likely breeds. Dates of first arrival given by Holdgate (1963) range from 16 to 25 November; his latest departure dates range from 16 April to 8 May.

In 1973 we saw a few Wilson's storm petrels flying about Bonaparte Point as early as 22 November. By 27 November, scores were flying there especially when the sun was low. At least a dozen nests were found that year in rock crevices, but none had an egg before we left Palmer on 12 December. Many of these same sites had fresh or nearly fresh eggs when next seen the following year on 26 December.

In 1975 we first saw a newly hatched chick on 25 January. Young were last seen in their nest crevices that year by Mr. Neilson on 9 April. Tracks in fresh snow revealed nests still in use after that date, although no adults or young were seen again until 13 November when one landed briefly on Bonaparte Point. Scores were there by 15 November.

An adult banded at the nest in 1975 returned to the same nest the following season. Its chick hatched on 26 January and left the nest crevice 67 days later on 2 April. No Wilson's storm petrels of any age were seen that year by Mr. Fraser after 23 April.

Black-bellied storm petrel (*Fregetta tropica*)

Status uncertain; probably rare but may be overlooked generally in the Palmer area. Mr. Fraser saw one at sea near the Joubin Islands on 1 February 1975, and Mr. Neilson banded one that had been caught by hand at Palmer Station on 19 March the same year.

Blue-eyed shag (*Phalacrocorax atriceps*)

Common breeder and year-round resident. Shags nest regularly on Cormorant Island where we observed at least 100 occupied nests on 25 November 1973. Although a few pairs incubated complete clutches on that date, the majority of nests had incomplete clutches or were empty except for fresh linings; this was also the case in 1975 when we visited the colony on 20 November.

Neither Holdgate (1963) nor we obtained much information on hatching or fledging dates for the Palmer area. Mr. Neilson noted many fledged young on Cormorant Island on 25 March 1975, when only a few well-feathered young remained in nests. Our records show that the species is resident throughout the winter, although the birds at that time frequently make short migrations presumably to open-water feeding areas depending on ice conditions in Biscoe Bay and in Arthur Harbor. Mr. Neilson's observations on roosting and sexual activities at the Cormorant Island rookery during the winter and the early spring will be published separately.

The colony on Cormorant Island suffers high mortality of eggs and young in some years. In visiting the colony for the first time in 1974 on 28 December, we found fewer than 40 pairs, most of which stood by empty nests. Only four nests held young (total of eight), which were fairly large and clearly indicated early egg laying. A few pairs evidently had a second nesting and were attending one or two eggs that were fresh or nearly so despite the late date.

A colony in the Joubin archipelago fared better that year. On 16 January 1975 we climbed to the top of a sea cliff and counted 94 adults. Seven nests held one young, 23 held two young, 15 held three young, and one held two eggs. Another colony atop a sea cliff a short distance away had at least 21 active nests (not observed closely). No other colonies are known for the Palmer area, although the species breeds 25 kilometers to the east in Neumayer Channel.

Yellow-billed pintail (*Anas georgica*)

Rare, probably accidental visitor. On 18 January 1975, on Breaker Island, we flushed a single yellow-billed pintail from a melt pool in a rocky depression. The bird flew out to sea and was not seen by us again. It may have been from either the South Georgia or South American populations. According to Watson *et al.* (1971), there are *A. g. spinicauda* records for the South Orkney and the South Shetland islands. Our sighting at Palmer evidently is the southernmost record for the species to date.

Red phalarope (*Phalaropus fulicarius*)

Rare, probably accidental visitor. A single bird was obtained by Robert Risebrough on Humble Island on 12 January 1970 (Risebrough *et al.*, 1976). The specimen, which now is in the Smithsonian Institution, is a male (enlarged testes) in alternate or breeding plumage.

American sheathbill (*Chionis alba*)

Resident and transient species, uncommon breeder. Sheathbills are conspicuous at Palmer Station during the winter, but only a few, seemingly unattached individuals occur there and on nearby Bonaparte Point in the summer. They are not reported as breeding anywhere in the Palmer area by Holdgate (1963), but we have observed them nesting on Cormorant Island and the Joubin archipelago.

In 1973 we first suspected breeding when a pair was noted at the shag colony on Cormorant Island. Much later, on 28 December 1974, we again found a pair, this one with a nesting hole first seen by N. Temnikow. This nest cavity, in shag guano beneath large rocks, was at least 2 meters long. Although the nest could not be reached, we were able to catch both adults; one had a British band. As a younger adult, the bird had been banded on Galindez Island (65°15′ S. 64°15′W.), Argentine Islands, on 29 August 1967. We rebanded the bird, color-banded it, and also banded and color-banded its mate on 17 January 1975.

On 16 January 1975 we found two pairs of sheathbills among nesting shags in the Joubin archipelago, an area evidently visited much earlier by Dr. Watson (personal communication) when two pairs of sheathbills were also noted. Since the shags were situated near the tops of two precipitous cliffs, nearly separated their entire lengths by a narrow inlet, each of the split colony had its own pair of sheathbills. Although we were able to reach only one pair, we soon found its nest in a meter-long hole that had been formed in shag guano beneath large rocks. One of several small downies (number uncertain) was collected. Shag nests were all around the nesting hole (figure 3).

Evidence thus far indicates that breeding pairs in the Palmer area utilize shag colonies rather than penguin rookeries, but not all local islands with penguins have been checked. It seems likely that more pairs of nesting sheathbills will be discovered.

Holdgate (1963) first reported on winter activities of sheathbills at the abandoned British station. These records and more recent ones from Palmer Station indicate a small winter population of fewer than a dozen birds. Mr. Neilson, however, banded 114 sheathbills at Palmer in 1975 and certainly did not catch every bird. His largest single count was 29 (16 July). Some of the banded birds remained in the area most of the winter, but others were transients. One banded earlier at the Cormorant Island nest was seen at Palmer Station and on Cormorant Island at various times from 9 August to 14 October. Mr. Fraser saw fewer birds at Palmer during the 1976 winter when station food scraps were no longer available to the birds.

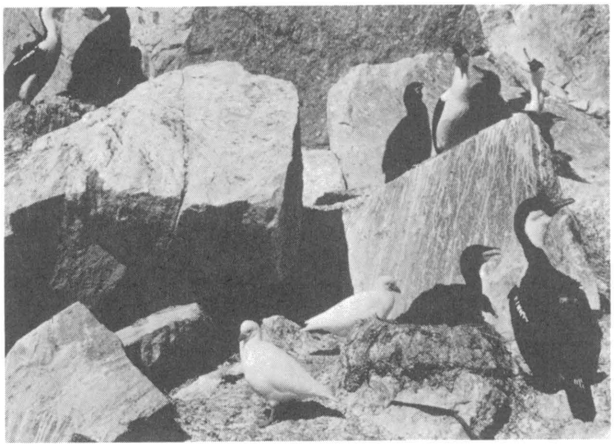

Figure 3. Pair of American sheathbills (*Chionis alba*) near entrance to nesting hole, surrounded by nesting blue-eyed shags (*Phalacrocorax atriceps*) on one of the Joubin Islands. Photographed on 16 January 1975.

South polar skua (*Catharacta maccormicki*)

Common breeding species; migrates from area for the winter. South polar skuas are abundant and conspicuous throughout the Palmer area, including the Joubin Islands where the birds definitely breed. Nesting pairs were found at all land areas visited, with the following exceptions: Torgersen Island, where one pair of brown skuas (*Catharacta lonnbergi*) bred; one of the islands of the Stepping Stones, where giant fulmars and antarctic terns bred; the peninsula occupied by the present Palmer Station, where skuas of both species congregated but did not breed. In 1974-1975, nesting birds were most concentrated on Bonaparte Point (24 pairs) and on Litchfield Island (at least 45 pairs). Some of these pairs were so concentrated that it was not uncommon to find nests only 15 to 20 meters apart.

In 1973, a few pairs had eggs by 23 November, while others were laying as late as 6 December; to our knowledge, however, none had young before 12 December; the date of our departure. At least one nest had a newly hatched chick upon our return to the area on 25 December 1974. But some nests still had live eggs as late as 24 January 1975, clearly indicating a wide spread or asynchrony in nesting time. Flying young were seen for the first time that year on 12 February. According to Mr. Neilson, the last banded young to fledge did so on 12 March.

Skuas were last seen in the Palmer area by Mr. Neilson on 25 May 1975 (one bird, Bonaparte Point). The first one sighted by him the following spring was at Palmer Station on 20 October. From that day their numbers increased gradually until mid-November, when the species was again common throughout the Palmer area. The first egg found that year was recorded by us on 28 November (Bonaparte Point). In 1976, Mr. Fraser saw no young in nesting territories after 4 April. He saw no birds of any age after 6 May. Since Holdgate (1963) made no attempt to separate the skuas at Palmer, his data with respect to arrival times, egg laying, etc., are not pertinent.

Table 2. Locations and numbers of south polar skua (*Catharacta maccormicki*) x brown skua (*C. lonnbergi*) pairs in the vicinity of Palmer Station, and the numbers of hybrid young fledged for the 1974-1975 and 1975-1976 austral summers.

	1974-1975		1975-1976	
	Hybridizing pairs	Hybrid chicks fledged	Hybridizing pairs	Hybrid chicks fledged
Bonaparte Pt.	1	2	1	0
Cormorant I.	1	2	1	2
Hermit I.	1	2	1	2
Humble I.	1	1	2	4
Shortcut I.	1	2	2	1*
Total	5	9	7	9

*Fledging at second nest not determined.

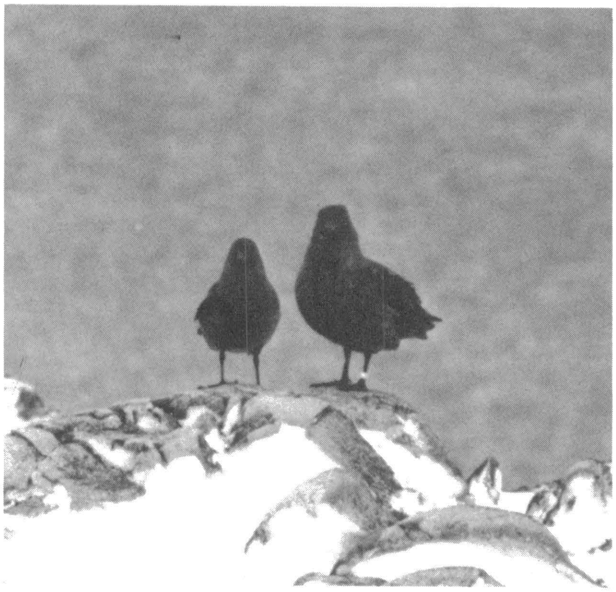

Figure 4. Hybridizing pair of skuas. The much smaller south polar skua (*Catharacta maccormicki*), believed to be a male, was paired with the banded brown skua (*C. lonnbergi*) when photographed on Shortcut Island on 20 November 1975. The pair produced one F₁ hybrid, which fledged on 8 March 1976.

In the Palmer area, and probably elsewhere along the Antarctic Peninsula, south polar skuas hybridize with the much scarcer brown skuas, resulting in many hybrids of intermediate size. In 1974-1975, five hybridizing pairs (figure 4) produced nine F_1 hybrids, all of which fledged. Members of these pairs returned to the old nesting territories in the 1975 spring and paired with former mates. A few more mixed pairs were also recorded. A summary of these nestings is given in table 2. Detailed information on all these matings will be published separately.

More than 500 breeding adult and young south polar skuas have been banded and color-coded by us in the Palmer area since December 1974. As a result, much information is being gathered on their ecology and behavior within the study area. To date, we have two long-distance banding returns that are noteworthy: a nestling banded on Litchfield Island by Mr. Neilson on 16 January 1975 and last seen by him on that date was recovered in Baja California, Mexico, on 14 September 1975; another nestling banded on Shortcut Island by him on 20 January 1975 and last seen by him on 20 February was recovered on 31 July 1975 at Godthabsf Jordan, Greenland. These recoveries indicate that *C. maccormicki* regularly crosses the Drake Passage and flies northward across the Equator into the North Pacific and the North Atlantic. If it does so in fair numbers, and this now seems likely, all skua sightings off the South and North American coasts should be carefully identified because of the possibility of confusing *C. maccormicki* with other kinds of skuas, including the breeding skua (*C. skua*) of the North Atlantic.

South polar skuas at Palmer range in color from very dark brown to pale buffy brown. Downy young show the same variation.

Brown skua (*Catharacta lonnbergi*)

Uncommon breeding species; migrates from area for the winter. Although brown skuas are at times conspicuous, they are not nearly so abundant as south polar skuas and probably account for less than an eighth of the total skua population. It is difficult to accurately assess the population because of the hybridization between it and *C. maccormicki*. During the 1974-1975 and 1975-1976 seasons, pairs thought to be typical examples of *C. lonnbergi*, based primarily on plumage plus bill and tarsal measurements, were recorded on the following: Cormorant Island (one pair both seasons); Humble Island (one pair both seasons); Litchfield Island (seven pairs both seasons); Torgersen Island (one pair in 1974-1975); Eichorst Island (one pair in 1974-1975).

Brown skuas were also noted near a penguin colony at the Joubin Islands on 23 January 1975, and it seems likely that at least a few pairs breed on those islands. Brown skuas comprised 8 percent of the breeding and non-breeding skuas that commonly flocked at melt ponds behind old Palmer Station on Norsel Point. Larger flocks or clubs of non-breeding skuas also congregated on Eichorst Island and far out on the Joubin Islands.

From our data so far it appears that brown skuas are no more synchronized in egg-laying than south polar skuas. We have no evidence that brown skuas generally breed earlier than the other species, a factor that no doubt contributes to the formation of mixed pairs. Our earliest hatching date for a newly hatched chick in 1974 was 28 December. Our earliest date in 1975 for a flying young was 15 February, and the last observed fledging occurred on 16 March. The last sighting of brown skua of any age by Mr. Neilson that year occurred on 2 May; our first sighting the following spring was 25 October.

Southern black-backed gull (*Larus dominicanus*)

Common year-round resident and breeding species; first-year birds leave the area. Southern black-backed gulls, also called dominican and kelp gulls, breed commonly in the Palmer area and are seen daily on the station grounds throughout the summer. The greatest concentrations of breeding birds occur on Bonaparte and Norsel points, and on Hermit and Stepping Stones islands, with lesser numbers on Shortcut, Litchfield, and Elephant Seal Rocks islands (figure 1). We also noted a few breeding pairs on two islands of the Joubin group, where a large downy young was found near abandoned nests on 16 January 1975. Holdgate (1963) reported breeding also on Dream Island.

The gulls began nesting early, with the first eggs occurring probably by 12 November in 1973, and definitely on 18 November in 1975. Egg-laying continued until the last of the month and exceptionally as late as 18 December. Some clutches lost to predators were replaced. Clutch size was 2 to 3 eggs (average of 2.6). The incubation period (laying to hatching of last egg) was 26 to 30 days (average of 28 days). The average period of fledging (hatching to first strong flight) of 19 chicks under close observation by Mr. Fraser was 43 days.

Hatching and fledging success was exceedingly high in 1975, and higher still in 1976. According to Mr. Fraser nearly all these many young had migrated from the area by 12 May in 1976, although one was seen as late as 19 July. To date, we have one long-distance recovery of a banded young: a large chick banded by Mr. Fraser on Bonaparte Point on 13 January 1975 was caught in a fox trap in Tierra del Fuego, Chile, on 29 August 1975. Evidently the young gulls, like the young south polar skuas, migrate across the perilous Drake Passage to South American wintering grounds.

First-year birds are uncommon in the Palmer area during the spring and summer, but at least a few return to the home ground at that time. The earliest date we have for a returning first-year bird is 14 November (Bonaparte Point, 1975). Older subadults of uncertain age are fairly common nearly any time. Banded adults are observed every month of the year. They frequently return to their breeding spots even during the winter. Their numbers around Palmer Station during the winter appear to be correlated with the extent of open water.

Antarctic tern (*Sterna vittata*)

Common year-round resident and breeding species. Parmelee and Maxson (1974) reported on the breeding biology of a colony on Bonaparte Point in 1973 and, later, Parmelee (in press) presented additional information on the results of that study. During 1974-1975, observations were continued on the Bonaparte Point colony and were extended to include colonies on Breaker, Cormorant, Humble, Limitrophe, Shortcut, and Stepping Stones islands. A colony was also found that season on one of the Joubin Islands.

Banding and color-banding of adult and young terns during 1974-1975 disclosed certain kinds of information not evident in the initial study. We found that pairs quickly abandoned a colony following loss of their eggs to skuas, the principal predator, but we did not determine whether the pairs renested. More recent observations showed that the terns not only have replacement clutches, but that they also move to another colony on a different island to renest. Judging by the lateness of nestings, it is probable that some pairs repeat several times each season.

Antarctic terns are among the first of the Palmer birds to lay eggs. Some pairs probably had eggs as early as 11 November in 1973, and definitely by 13 November in 1975. In defending sites early, especially in the presence of gulls, they are able to maintain choice nesting grounds in an austere environment where competition for such places is very high. The 1974-1975 study indicated that there are other kinds of advantages to early nesting since predation of tern eggs and chicks increases noticeably following the hatching of skua young. Skua hatchings generally occur late in the season at times when some young terns from early nestings are already flying strongly. It would appear that tern chicks from early hatchings have a distinct advantage over those that hatch late.

Tern eggs occurred on the breeding grounds in 1975 as late as 2 February. Flightless chicks were last observed that year by Mr. Neilson on 20 March, and two adults defended a recently fledged young as late as 25 March.

Mr. Neilson and later Mr. Fraser observed and collected adult and young terns throughout the fall, winter, and early spring. Their findings, especially on the species' winter ecology, will be published separately.

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Marine biology at Palmer Station, 1975 austral winter

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Investigations of the shallow-water marine benthos were continued for the fourth year by the University of California, Davis, at Palmer Station (64°46'S. 64°03'W.), Anvers Island. Subtidal marine communities were examined and collections were made by scuba diving in the Arthur Harbor vicinity. Additional collections were made during the 1975-1976 austral summer from aboard R/V *Hero* at the Melchior Islands, Paradise Harbor, Port Lockroy, the Argentine Islands, Brabant Island, Neumayer Channel, and the Gerlache Strait.

Mr. Laine studied the fast-ice community in Arthur Harbor. The community was observed *in situ*, and ice samples were collected from May to October by divers scraping the under surface of the fast ice. Ice blocks were removed with a chain saw or an ax to collect epontic diatoms and meiofauna. Plankton tows were made in the same area, ice conditions permitting, to compare the seasonal variation and abundance of diatoms and foraminifera in sea ice to the water column. The plankton samples mark the end of 4 years of sampling begun by W.M. Krebs in the 1972 austral winter (Krebs, 1974).

In 1975, fast ice first formed in Arthur Harbor in July. The fast ice was interrupted by long periods of brash ice whose density depended on prevailing wind directions. Water visibility before and during the freeze was 36 meters. Platelet ice was observed forming to 33 meters. Rocks and algae from the intertidal zone to 5 meters were observed to be coated with ice. No large formations of anchor ice were observed, but large fronds of the algae *Desmarestia mensiesii* and *D. anceps* were observed buoyed up to the under surface of the ice by platelet ice frozen in the fronds (figure 1).

The relationships among the communities associated with the ice were investigated. Such relationships have been investigated in the Davis Sea off

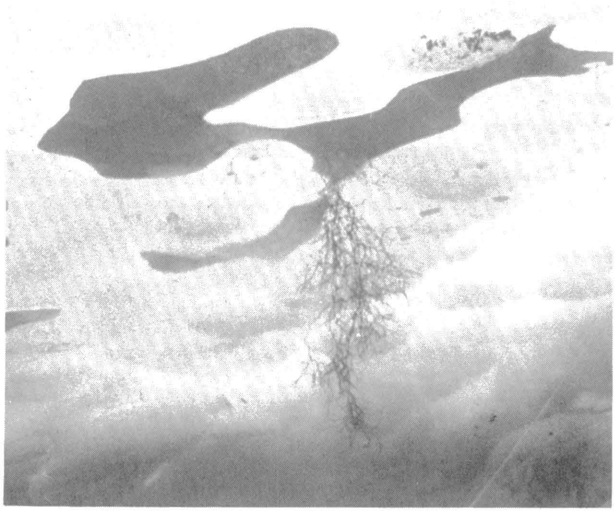

Figure 1. *Desmaristia anceps* buoyed up to the underside of the fast ice. The frond is approximately 1 meter. Amphipods can be seen in the upper right corner.

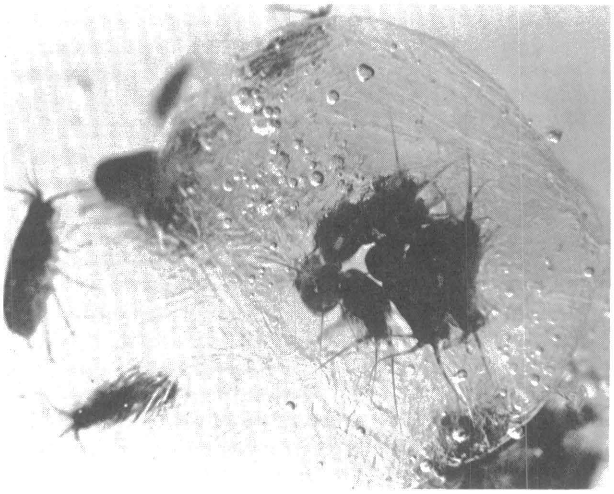

Figure 2. The amphipod *Nototropis* sp. in the platelet ice under the fast ice. Amphipods aggregated around cracks and irregularities under the ice surface.

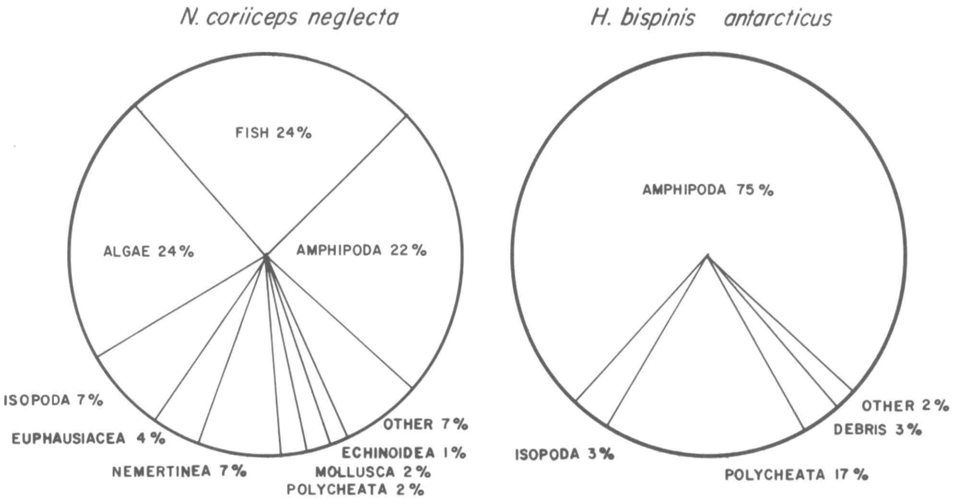

Figure 3. Stomach contents by percent point volume of *N. coriiceps neglecta* and *H. bispinis antarcticus* from the Antarctic Peninsula, 1975.

East Antarctica (Andriashev, 1968; Gruzov, in press), and components of the communities at Palmer have been described (Lipps and Krebs, 1974; Meguro, 1962). At Palmer, the amphipod *Nototropis* sp. was found in the loose flocculent platelet ice that accummulates under the fast ice (figure 2). Cydippid and beroid ctenophores, chaetognaths, and the fish *Pleuragramma antarcticum*, juvenile *Tematomus bernacchii*, and *Pagetopsis macropterus* were associated with the cryopelagic community. When the initial freeze broke up in August, dominican gulls were observed feeding on the exposed cryopelagic community when blocks of ice overturned. Most ice blocks formed brash ice and drifted out to sea. Brash ice continued to freeze and break up until late November.

Mr. Daniels investigated the trophic relationships of several species of fish to determine the degree of specialization in feeding. Two species of fish, *Notothenia coriiceps neglecta* and *Harpagifer bispinis antarcticus*, were collected monthly in Arthur Harbor. Otter and Issacs-Kidd trawls from *Hero* were used to collect representatives of 26 other species from 26 sites along the Antarctic Peninsula in February, March, and December 1975.

All specimens were preserved in 10-percent buffered formalin. Larger individuals also were injected with the preservative. Later, the fishes were dissected and their stomach contents examined. Food items were separated, counted, and either assigned a point volume, using the method discussed by Hynes (1950), or dried and weighed. The stomach contents of about 100 individuals of *H. b. antarcticus* were measured by both point volume and dry weights for comparison.

Ten species of fish were sufficiently represented in the samples to compare food-item dominance. Of these species, four had specialized diets. *H. b. antarcticus* and *N. c. neglecta* represent the two feeding types (figure 3). Both are ambush feeders and are relatively abundant in the rubble bottom areas of Arthur Harbor. *N. c. neglecta* has a generalized diet and is capable of switching its food seasonally. This

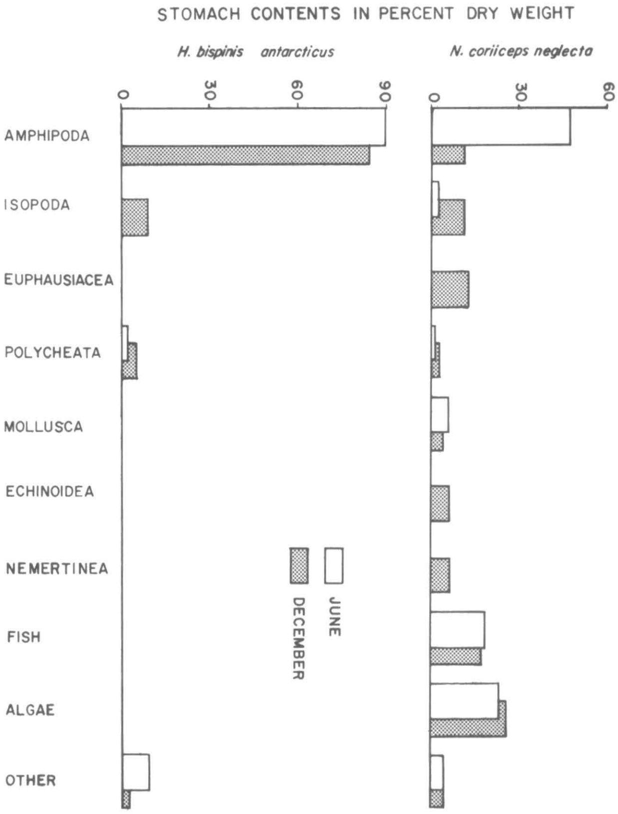

Figure 4. Stomach contents by percent point volume of *N. coriiceps neglecta* and *H. bispinis antarcticus* from Arthur Harbor — June and December 1975.

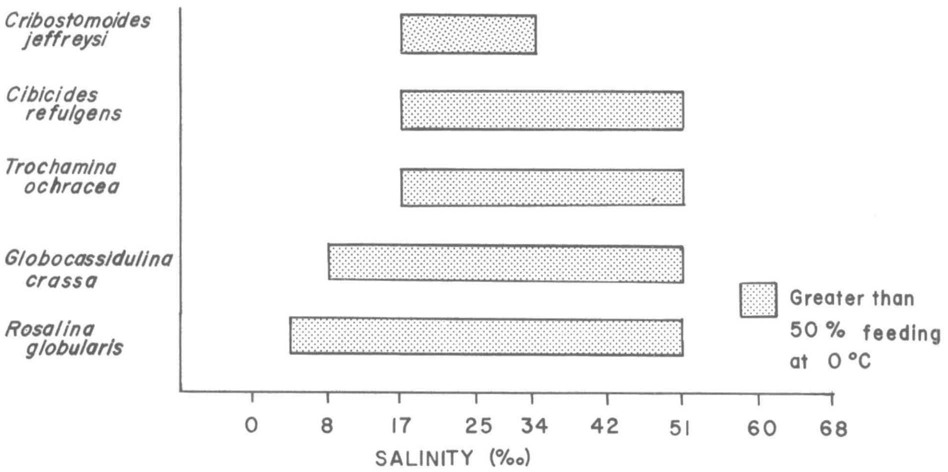

Figure 5. Feeding tolerances of five species of foraminifera found abundantly in the Palmer area. *R. globularis* has the widest salinity range of the species investigated.

behavior was not observed in the specialized feeder *H. b. antarcticus* (figure 4).

Like many other bottom dwellers, *H. b. antarcticus* prepares a nest and broods eggs. Mr. Daniels observed nesting behavior in marked nests in the field and in nests in the laboratory. Unlike other species, the female performs most parental activities, and a complex social system exists between the nest fish and other members of the population.

Mr. Showers investigated the life history and ecology of benthic foraminifera. Laboratory cultures were maintained to determine growth rates, reproduction processes and periodicities, and physiological tolerances to temperature and salinity. Samples of mud and algae were taken monthly at specific underwater sites, allowing comparison between laboratory data and field observations following the technique of Myers (1942). Reproductive cycles of *Rosalina globularis* in the laboratory produced an alternation of dimorphic generations; gamont prolocular diameter was 45 to 50 microns, while agamont prolocular diameter was approximately 25 microns. Growth rates were higher for both generations to the 10-chamber stage than in individuals that had more than 10 chambers. Gamonts grew faster than agamonts. Laboratory growth was sporadic in some individuals; inactive periods lasted up to 4 months. Reproduction occurred around the 20-chamber stage of *R. globularis*, but plastogamy was observed in individuals with as few as 16 chambers. Laboratory growth rates indicate reproductive periodicities of 90 to 120 days. Field populations appear to reproduce in 3-month cycles, but show no prolocular dimorphism in the winter months (March to October), indicating repeated asexual reproduction.

Feeding tolerances to salinity variation were determined for five species of foraminifera. Cultures of 20 to 50 individuals were placed in various concentrations of seawater, and feeding activity was observed. Feeding tolerance limits were set when less than 50 percent of the individuals did not feed in the culture for 3 days. All individuals were actively feeding prior to the media dilution or concentration (figure 5). The effect of elevated temperature on feeding was investigated using a thermal gradient temperature block designed after Bradshaw (1961). The same criteria for tolerance limits of more than 50-percent feeding were used for the temperature experiments. *R. globularis* fed in normal seawater from 0° to 12°C, and *Globocassidulina crassa* fed from 0° to 11°C (figure 6).

In Arthur Harbor and adjacent to the collecting sites, seawater chemistry was monitored for 12 months. Salinity varied from 33.56 to 32.23 parts per thousand, and seawater temperature varied from

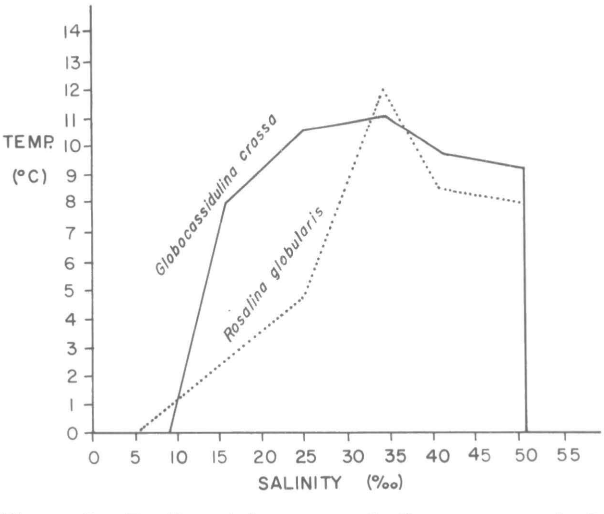

Figure 6. Feeding tolerances of *G. crassa* and *R. globularis* at elevated temperatures. The area under the curves represents feeding activity of 50 percent or greater.

1.06° to -1.94°C in 1976. Atkinson (1969) found *R. globularis*, living in Cardigan Bay, Wales, with salinity fluctuations of 30.2 to 34.6 parts per thousand and temperatures ranging from 5.5° to 8.5°C. Murray (1973) documents the wide geographic distribution of *R. globularis*, suggesting that it is a very tolerant species. Geographic distribution reflects reproductive as well as feeding tolerances, but this investigation of an antarctic population of *R. globularis* indicates that it has greater tolerance ranges than the other species investigated. This conclusion agrees with the general distribution data for the species.

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Penguin census by aerial photographic analysis at Cape Crozier, Ross Island

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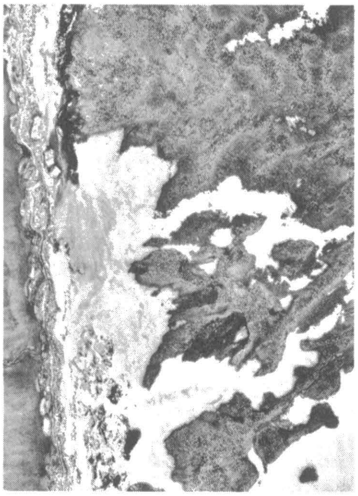
Accurate estimates of world numbers of most antarctic and subantarctic penguin species are currently impossible due to scarce and unreliable data on breeding populations. Although a large number of rookeries have been located, research has been conducted in only a small percentage of these. Each new survey reports previously unknown information regarding species composition and size of populations inhabiting individual rookeries (for example, see Müller-Schwarze and Müller-Schwarze, 1975). This is especially true of the pygoscelid penguins. The problem is compounded by the fact that even in extensively studied rookeries the resident populations have often not been accurately assessed. This has resulted in difficulties with the interpretation of data on predation pressure, mortality, etc. We suggest that this problem may be rectified through the proper application of aerial photographic analysis. Aerial photography was first used for penguin censuses by Bauer (1967) on the Crozet and Kerguelen Islands. The species studied were king penguins (*Aptenodytes patagonica*) and macaroni penguins (*Eudyptes chrysolophus*). Such analysis has also been used for censuses of the Adélie penguin rookeries at Cape Bird, Beaufort, Franklin, and Inexpressible islands (Stonehouse, 1965, 1969). Using this method, a more accurate census was obtained for a large rookery of Adélie penguins (*Pygoscelis adeliae*) at Cape Crozier (77°31′S. 169°23′E.) on Ross Island, Antarctica.

The U.S. Navy, in conjunction with the U.S. Geological Survey, has taken aerial photographs of the Cape Crozier rookery every season since 1961 (figure). Photos (9 × 9 inches) from the Crozier mission flown on 16 November 1966 were selected for a direct count of all penguins in the main rookery and in the smaller, adjacent east rookery. Exposures 5, 6, 7, 24, 38, and 41 (TMA 2004), taken at an altitude of 2,250 feet, were used in this study. Counts were conducted with a


U.S. Navy

Example of an aerial photograph of a small portion of the Cape Crozier rookery taken on 16 November 1963 at an altitude of 2,000 feet. Black dots are individual penguins against background of guano-stained substrate. Black areas are rock or gravel not occupied by Adélies, and white areas are snow fields. Landing beach (ice-bound) is at left.
TMA 1251.

binocular microscope (American Optical Corporation) and a hand counter.

The main rookery at Cape Crozier has previously been estimated to contain 300,000 Adélies and east rookery 50,000 (Penney and Lowry, 1967; Emison, 1968; LeResche and Sladen, 1970). However, it is difficult to extract from the literature the exact dates and methods used to arrive at these estimates. Penney and Lowry (1967) conducted counts of sample areas of aerial photographs, interpreted each penguin as a nesting bird, and estimated 147,039 nests (approximately 300,000 birds) in the main rookery. The validity of this method is questionable, largely due to their interpretation of every penguin as a nesting bird and their use of estimations rather than total counts of the Adélies present on the aerial photos. Our own direct counts from the 1966 photographs revealed far fewer penguins at Cape Crozier than had been reported previously. The main rookery contained 130,926 Adélies and the east rookery held 19,993. However, this information alone does not constitute a direct assessment of the Crozier Adélie breeding population because it is usually impossible to determine from the photos in mid-November which birds are occupying nests and which are either mates accompanying nesting birds or are unmated, nonnesting penguins. Using data obtained from periodic consenses of 12 Adélie colonies (approximately 1,210 successful nests) conducted by our research group at Crozier during the 1974-1975 field season, it was estimated that 25.3 percent of the total birds present during the period 18 to 20 November were not nesting. This leaves 92,278 breeding birds in mid-November. In 1974-1975, the total number of birds decreased by 29.1 percent from 18 to 20 November until 5 to 11 December. Using this value for the 1966 aerial census data, there were 92,827 birds on 5 to 11 December. Again using the 1974-1975 ground-count data, 91.5 percent of the birds present then occupied successful nests (that is, nests containing eggs or chicks). For 1966, this would be 84,934 nests, or the same number of breeding pairs.

Oelke (1975) censused the Crozier population during the period 4 to 10 December 1970 and estimated between 80,000 and 85,000 breeding pairs in the main rookery. Out estimate of 84,934 breeding pairs in the main rookery for December 1966 is in close agreement with Oelke's 1970 counts. Our Crozier censuses also indicated that approximately 4.4 percent of the total birds present from 5 to 11 December occupied unsuccessful nests. These penguins probably represented late breeders, reoccupation pairs, mated pairs that had recently lost eggs or chicks, or unmated juveniles or adults. Taking these birds into account, it is possible to conservatively estimate the Adélies in the main rookery at 178,040 and the east rookery at 27,188. This yields a total population estimate of approximately 205,000 Adélies at Cape Crozier in 1966 as compared to previous estimates of 350,000. Hence, claims that the Adélie population at Crozier has "sharply decreased" (Oelke, 1975) seem unsubstantiated, at least for the period between 1966 and 1970.

Although the photographic analysis technique has definite merit, it is also necessary to point out several of its inherent weaknesses. First, poor-quality photos that are incomplete, blurred, distorted because of topography, or taken at extreme altitudes or angles make population estimates difficult or unreliable. Stonehouse (1965, 1969) found that best photographs were obtained with fine-grain film and hand-held press cameras in strong but hazy sunshine, and at altitudes of 150 to 200 meters. Sladen and LeResche (1970) consider this altitude too low and helicopters too noisy. They recommend fixed-wing airplanes, such as the Twin Otter, flying at 610 to 760 meters with a 305-millimeter lens. Another major problem is developing an accurate population estimate from direct counts of photographs taken on a given date. It is essential to be able to determine during which state of the breeding cycle the photos have been taken in order to resolve what proportion of the birds photographed are actually nesting. Sladen and LeResche (1970) recommend aerial photography at the peak time of egg laying, when almost all nests are tended by only one bird of a pair and when few eggs have been lost. Weather and sea-ice conditions can influence the arrival of penguins at a particular rookery and can result in minor shifts in the timing of the breeding cycle from year to year. Nest losses in early December can vary from 0.4 percent per day in a "good" year to 2 percent per day in an unfavorable season (Stonehouse, 1969). These problems might be overcome by photographing a given rookery several times over the course of the breeding season. Finally, population estimates derived from aerial photos will probably be somewhat conservative as juveniles and mated pairs that have been unsuccessful and have returned to sea will not be accounted for. Of the three different census figures (total number of birds present, number of breeding pairs, and number of successful breeding pairs), only the first can be obtained from aerial photographs alone. The others require ground studies. It will depend on the questions asked which of the three figures is needed.

Despite its drawbacks, we think that with further refinement aerial photographic analysis will provide a superior and relatively inexpensive method for tracking population trends in various speniscid species. Research in progress by our group involves conducting analyses of several years' aerial photographs (1963 to 1976) to quantify any population trends at the Cape Crozier Adélie rookery. Also, we plan to survey photographs of the antarctic coast, the Antarctic Peninsula, and surrrounding islands to locate and estimate the size of additional penguin rookeries in order to facilitate estimates of total numbers of antarctic penguins.

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ARA *Islas Orcadas* cruise 8

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ARA *Islas Orcadas* cruise 8 began at Buenos Aires on 2 February 1976 and ended there on 13 March 1976. It had three objectives: (1) collection of zooplankton and phytoplankton samples in correlation with physical and chemical seawater data, (2) contribution to understanding of taxonomic, zoogeographical, and trophic relations of the benthic fauna, and (3) capture of krill longer than 40 millimeters for biochemical and microbiological study.

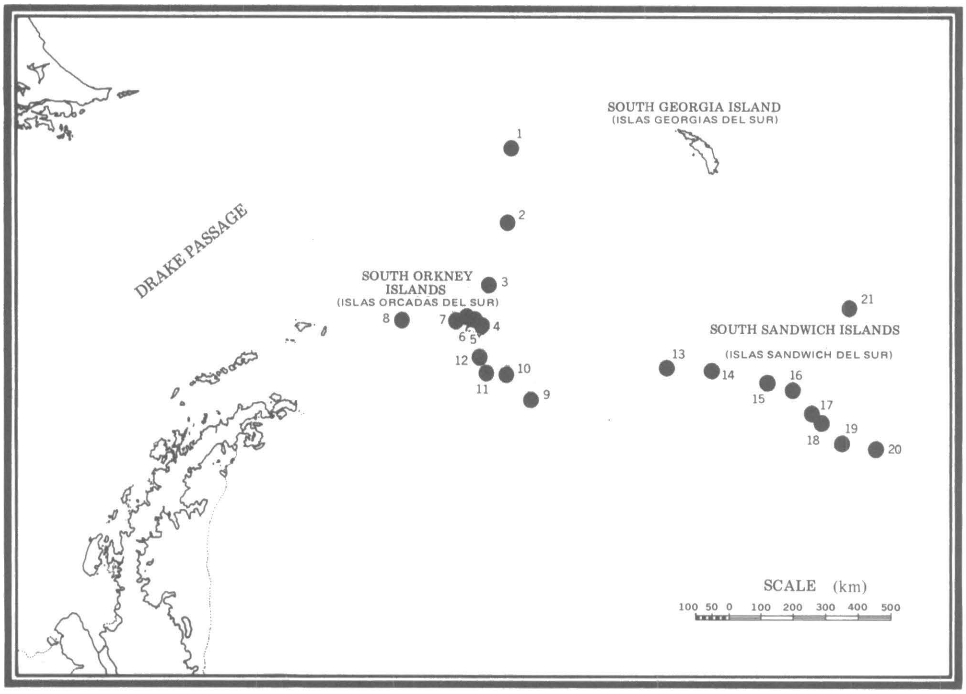
Results were as follows:

Seawater samples were collected from the bottom, the surface, and intermediate depths at 21 stations (figure and table). Proximity to bottom was determined by sonar. The samples were collected using a Hensen net (200-micron mesh) with a strangulation closing system.

Nansen and Niskin sampling bottles were used to collect water samples for determinations of salinity, temperature, dissolved oxygen, alkalinity, and pH.

Water samples were filtered for subsequent determination of nutrients and chlorophyll.

The samples were kept in formaline (5 percent) for qualitative and quantitative phytoplankton studies.



Location map for the 21 stations occupied during ARA *Islas Orcadas* cruise 8 (February and March 1976).

Trawls provided a great quantity of fishes and invertebrates. In waters shallower than 200 meters, most fishes belonged to these families: Nototheniidae; Chamnichthyidae; Bathydraconidae; Harpagiferidae; below 200 meters most fishes belonged to Macrouridae, Zoarcidae, Muraenolepidae, and Liparidae families. Some Myctophidae were captured, though some specimens of *Notothenia gibberifrons* were collected from depths exceeding 200 meters. The larger collections came from the lesser depths. In some areas the sea-bottom topography prevented the casting of nets.

Sampling performed during *Islas Orcadas* cruise 8.

	Plankton tows		Trawls	
Station	Clarke-Bumps	Hensen	Isaacs-Kidd	Blake
1	4	3	-	-
2	4	3	2	-
3	2	3	-	1
4	-	5	-	1
5	-	7	-	1
6	-	4	1	2
7	2	6	-	1
8	2	5	-	1
9	2	6	-	1
10	-	-	-	2
11	-	5	-	2
12	-	-	-	1
13	1	4	-	-
14	1	7	2	2
15	2	6	-	-
16	2	6	2	2
17	2	5	-	-
18	2	5	-	-
19	-	3	-	-
20	-	7	-	-
21	2	5	2	-

In the Islas Sandwich del Sur (South Sandwich Islands) area, captures consisted mainly of ophiuroids, but also of sea stars, crinoids, ascidiae, asteroids, polychaets, and some molluscans. Invertebrates will be classified and a systematic list made to enable identification of those found in stomachs of fishes.

The Islas Orcadas (South Orkney Islands) area was rich in benthic fauna; Nothotheniidae and Chamnichthyidae families were well represented. South of these islands some specimens of the Harpagiferidae family, *Pogonophryne* genus, were captured. Between stations 22 and 23 a great quantity of large sponges was collected.

For trawls at depths of 100 to 75, 75 to 50, 50 to 25, and 25 to 0 meters, an Issacs-Kidd net of 500-micron mesh and a 2-centimeter net were used for collection of pelagic and bathypelagic fishes.

Krill samples for biochemical and microbiological study were collected with an Issacs-Kidd net of 500-micron-mesh. Four samples were collected; the total weight was about 17 kilograms.

One sample contained between 2 and 5 percent *Parathemisto* sp. which was removed before analyses; a second sample was 3 percent phytoplankton, which was washed out before analysis. On board, the following operations took place: (1) recounting of aerobic bacteria under different conditions and using different methods, (2) observation of the deterioration of whole-krill samples at -30°, 2°, and 4°C., (3) registration of organoleptic characteristics of fresh material at different periods to correlate them with microbiological and biochemical characteristics, and (4) determination of water content (percent H_2O) in recently captured krill. Other chemical determinations included total nitrogen (milligrams nitrogen per gram wet krill), pH, and percentage of ash.

Throughout the cruise we recorded sightings of birds and mammals, noting date and time, position of the ship, sea conditions, weather (wind intensity and direction, cloudiness, temperature) swimming or flying characteristics, and behavior. Sixty-four birds and 10 cetaceans were recorded. After processing and analysis, these data will be published by the Argentine Antarctic Institute in its *Series Contribuciones Científicas*.

We thank the Argentine navy officers and crew of *Islas Orcadas* for their dedicated support.

Solar radiation in the South Atlantic Ocean

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Through cooperative arrangements between Argentina and the United States aboard ARA *Islas Orcadas* (formerly USNS *Eltanin*), the large gap in our knowledge of the solar radiation environment over the southern South Atlantic Ocean is gradually being filled. Since solar radiation is the primary source of energy for physical, chemical, and biological processes, such increased understanding is indeed welcome. To date, data have been obtained for the western sector of the South Atlantic (i.e., Drake Passage and the western area of the Scotia Sea). Total and photosynthetically active radiation (PAR) were determined from measurements that were made during the 1974-1975 austral summer during cruises 3 and 4.

Measurement program

Incident global solar radiation was measured with Eppley precision spectral pyranometers. Four intercalibrated sensors were used to obtain the spectral flux over four broad wavebands between 285 and 2,800 nanometers. Continuous daytime measurements, which were digitized and recorded at 2-minute intervals, formed the basis of flux determination.

Unfortunately, biological experiments of primary production were curtailed due to operational priorities during cruise 3, and these were not scheduled for cruise 4. Nevertheless, these cruises offered the needed opportunity to extend our knowledge of the solar radiation milieu over waters around Antarctica.

Results

General. Since photosynthetically active radiation is associated with wavelengths from 285 to 700 nanometers (i.e., the visible part of the spectrum), only the data for this broad waveband and the total insolation are presented in this interim diagnostic report. Based on half-hour averages, summations were determined for the pre- and post-noon (a.m. and p.m.) periods of the local apparent solar day. Results, in terms of daily arithmetic averages and extrema for 5°-latitude zones, were obtained from these. The period of cruise 3, 14 to 26 December 1974, was centered on the time of the austral-summer solstice (22 December), when the fluxes of solar energy were maximum. The period of cruise 4, 12 January to 24 February 1975, was centered in early February, more than a month after the solstice, when solar fluxes were appreciably diminished. Results are presented in tables 1 and 2. The extrema in the tables, viz., the maximum and minimum fluxes of total as well as PAR, correspond respectively to days with minimum and maximum cloudiness.

Latitudinal variations and anomalies. In tables 1 and 2, the average value of the total flux, as well as PAR, is seen to decrease with the southward increase of latitude south of 45°S. for both cruises. This is especially noticeable in the west Scotia Sea at 55°W. and is also apparent in the maximum values (i.e., those associated with minimum amounts of cloudiness). An exception to this anticipated variation is the anomalously low value during both cruises in the 55°S. zone as a result of increased cloudiness. This latitude zone presumably marks the storm track during these periods.

Interdiurnal ranges. In addition to masking the latitudinal variation, a dominant role played by cloudiness is seen in the large day-to-day differences and in the ranges between maximum and minimum values. In the Drake Passage and the western area of the Scotia Sea, the largest ranges are found in the 55°S. zone, the belt of anomalously low values of incident flux. Such large variability is associated with the succession of migratory storms and their attendant cloud systems that repeatedly move eastward at these latitudes. The smallest interdiurnal ranges, associated with a lesser variability in cloud amounts, are seen on either side of this zone. This is especially well-marked in the cruise-3 data (table 1) at 60°S.

These interdiurnal ranges of PAR may be taken as a measure of the reduction of incident flux as a consequence of excessive cloud amounts. A comparison of minimum and maximum values shows that during cruise 3 (table 1) reduction by clouds varied between 5 and 67 percent; during cruise 4 (table 2), between 5 and 78 percent. Awareness of such a major control is necessary for any consideration of energetics, both physical and biological.

Coastal anomaly. Another exception to the latitudinal decrease is the anomalous increase that is apparent in the maximum values during cruise 3 (table 1) at 65°S. This zone is adjacent to the islands and coastal regions of the Antarctic Peninsula. The interplay of reflection by snow-covered topographic features, as well as the lesser amounts of cloudiness in the coastal regions, are considered responsible for the observed enhancement.

Diurnal asymmetry. Since estimates of primary productivity are often based on experimental, *in situ* incubation periods during half-day intervals, it is necessary to determine if the incident solar flux is symmetrical about local apparent noon (LAN). In tables 1 and 2, values are given for the percent of the daily PAR that was realized during the p.m. period. Apparently there was a cloud-induced, unequal partitioning with respect to LAN. Hence, in addition to causing large reductions that are manifest in latitudinal and coastal anomalies, and large interdiurnal ranges, cloudiness variations also produce a diurnal asymmetry. During cruise 3, the extreme values of percentage-in-p.m. of

Table 1. Daily average and extrema of incident solar radiation, total and photosynthetically active (PAR), for 5°-latitude zones during ARA *Islas Orcadas* cruise 3 (December 1974) in the southwest South Atlantic Ocean.

Lat(°S.)/Long(°W.) Date		Total	Photosynthetically active radiation		
		(Cal/cm^{2}day)	(Cal/cm^{2}day)	(% in p.m.)	(% of total)
45/62 14	Avg	700	323	48	46
50/65 15,16	Avg	564	264	56	47
	Max	663	307	51	46
	Min	465	220	64	48
55/66 18,26	Avg	279	146	51	52
	Max	428	213	44	50
	Min	129	78	70	60
60/62 19,24,25	Avg	412	208	57	51
	Max	427	213	66	50
	Min	384	202	47	53
65/63 20,21,22	Avg	270	147	51	55
	Max	451	232	54	51
	Min	123	76	63	62

PAR were 44 to 70 percent, while for average zonal values they were 51 to 57 percent. Corresponding values for cruise 4 were: 36 to 63 percent for extremes; 40 to 57 percent for zonal averages. Consequently, long-term estimates of organic production based on half-day experiments should take this diurnal asymmetry into account.

PAR as a percent of total. One major requirement of primary productivity efforts is a quantitative estimate of the amount of PAR that is made available to the biomass. Since measurements and estimates of the incident solar radiation (i.e, the flux here referred to as total) are often available in climatological atlases, it would be very useful if PAR were known as a percentage of the total. The variation of this parameter of PAR (namely, percentage of total) is shown in the tables. For both cruises, the smaller values are associated with the maximum fluxes, while the larger values are associated with the minimum fluxes (i.e., a larger fraction of the total is photosynthetically active under cloudy skies than under clear to partly cloudy skies). Again the influence of cloudiness also extends to modification of the quality of incident solar radiation. In table 1, the values range from 46 to 51 percent during days with lesser cloud amounts, to 48 to 62 percent with greater cloudiness. Corresponding values from table 2 are 46 to 53 percent with minimum cloudiness, and 50 to 67 percent with maximum cloudiness.

Comparison with other studies

Results presented here were compared with those of studies of the southeast South Indian Ocean (*Eltanin* cruise 46), southwest South Pacific Ocean (*Eltanin* cruise 51) (Franceschini, 1971, 1972, 1973), and with a study of the influence of clouds on insolation at sea (Franceschini, 1968). There is excellent agreement between these findings, as well as those presented in a summary account by Holm-Hansen *et al.* (in press). Specifically, remarkable consistency is found in all features with regard to: latitudinal variations and anomalies; coastal enhancement; and the dominant role of cloudiness on PAR, its variability, its interdiurnal range, and its diurnal asymmetry. Apparently, these are fundamental characteristics of solar radiation in the regions studied.

Results to date are valuable and encouraging. However, an urgent need exists for evaluating solar energy as a function of depth within the water mass.

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Table 2. Daily average and extrema of incident solar radiation, total and photosynthetically active (PAR), for 5°-latitude zones during ARA *Islas Orcadas* cruise 4 (January and February 1975) in the southwest South Atlantic Ocean.

Lat(°S.)/Long(°W.) Date		Total	Photosynthetically active radiation		
		(Cal/cm²day)	(Cal/cm²day)	(% in p.m.)	(% of total)
40/55 12-13 Jan	Avg	455	220	51	49
	Max	493	225	51	46
	Min	416	215	51	50
45/58 14-15 Jan	Avg	513	268	40	52
	Max	577	300	39	52
	Min	448	235	41	53
50/62 16-17 Jan	Avg	438	219	50	50
	Max	497	245	48	49
	Min	378	192	51	51
55/61 18-19 Jan 7-24 Feb	Avg	275	148	50	54
	Max	463	255	36	53
	Min	90	55	45	61
60/66 20 Jan-1 Feb	Avg	289	164	55	56
	Max	387	189	50	49
	Min	182	122	56	67
60/55 12-13 Feb	Avg	243	125	57	51
	Max	303	150	53	49
	Min	182	99	63	55

to P. Dudley-Hart and A. Abregu for their valuable field assistance.

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International Antarctic Glaciological Project: past and future

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Nearly 10 years have passed since the initial discussions that led to the creation of the International Antarctic Glaciological Project (IAGP) in 1969. Since, the original three participating nations have been joined by two others, there have been six meetings of the IAGP coordinating council, and six field seasons have come and gone—more than half of the tentative 10-year duration originally planned for the project. It therefore seems timely to raise such questions as: What concrete results have been obtained? How have the original plans been fulfilled? What remains to be done? What lessons have been learned?

Results to date

Before the inception of IAGP, its study area, between longitudes 60°E. and 160°E. and between the coast and the 80th parallel, had been explored by Australian, French, U.S., and U.S.S.R. traverses (figure 1). Initially, IAGP set up standards on techniques, measurements, and accuracies to be sought. Later field seasons saw the work summarized in figure 2. There have been new traverses from Casey (66°17'S. 110°32'E.) and Dumont d'Urville (66°40'S. 140°01'E.) toward the summits of the ice sheet and several complete crossings from Mirnyy (66°33'S. 93°01'E.) to Vostok (78°28'S. 106°48'E.) and back. Holes cored into the ice sheet include two to 950-meter-depths at Vostok, a 450-meter hole at Vostok 1, and two holes to 350-meter-depths near Casey and one near Dumont d'Urville. Numerous shorter and surface-layer cores have clarified regional details of firn chemistry and the concentrations of both stable and radioactive isotopes in the ice. Airborne radio-echo sounding has defined the detailed topography and thickness of the ice sheet over the eastern half of the IAGP area along a line between Mirnyy-Vostok-Pole of Inaccessibility-Amery Basin-Mirnyy, and around the Amery Basin (figure 3).

Concurrent with these field studies, computer modeling of the thermodynamics and dynamics of the East Antarctic Ice Sheet has achieved the first reconstructions of its changes over periods of the order of hundreds of thousands of years, with predictions of

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The International Antarctic Glaciological Project is a cooperative venture linking Australia, France, the Soviet Union, the United Kingdom, and the United States in a study of a large part of the East Antarctic Ice Sheet.

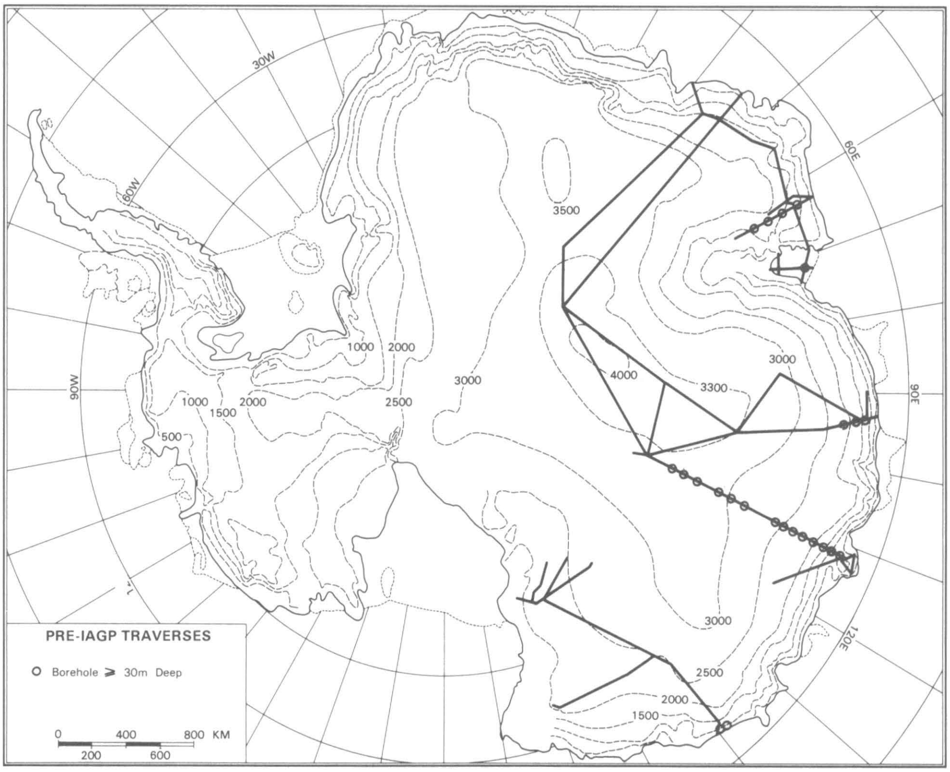

Figure 1. Pre-International Antarctic Glaciological Project (IAGP) traverses. 0 = boreholes ≥ 30 meters deep.

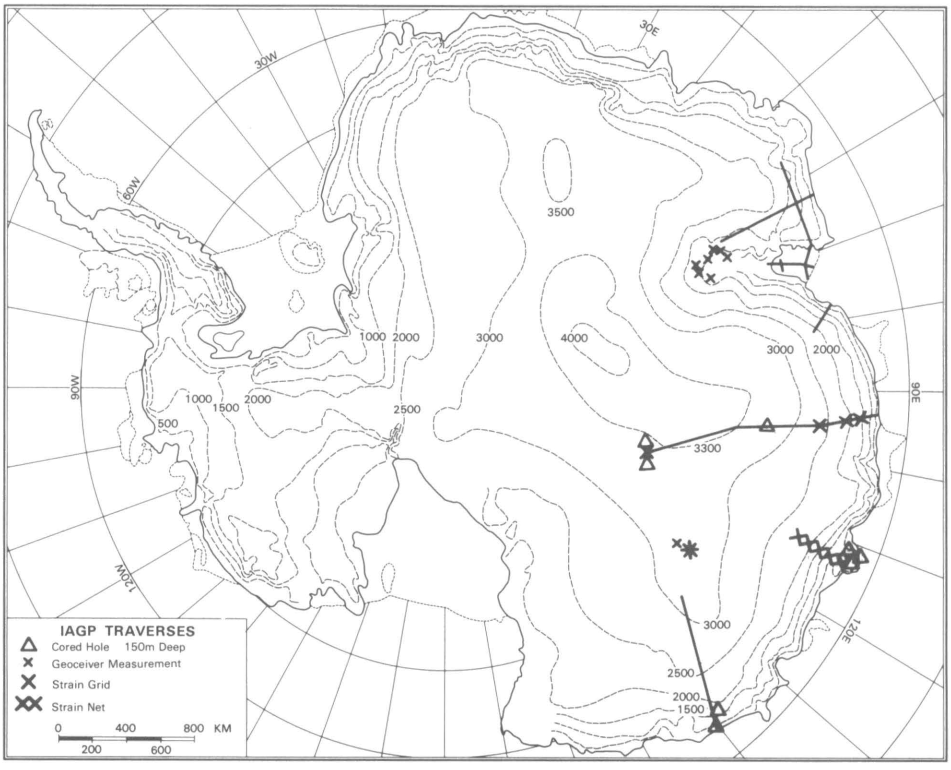

Figure 2. IAGP traverses. △ = cored holes ≥ 150 meters deep. $\overline{x}$ = geoceiver measurements. X = strain grids. $\overline{X}$ = strain nets.

current ice temperature and isotope profiles, ice flow velocities and strain rates, etc., which can be checked by observations. An especially significant modeling result is that the normal behavior of the ice sheet appears to feature the periodic surges that have been postulated by A.T. Wilson to explain the onset of major glaciations. Finally, a start has been made with the close reconnaissance of a possible site for the coring of the first of the deep holes needed to reach the oldest ice, ice presumably below one of the domes of the East Antarctic Ice Sheet.

The general progress of IAGP has been recorded in newsletters in *Antarctic Journal*. More than 100 reports and papers in English, French, and Russian have already resulted from IAGP and form part of a progressive bibliography following this paper. A symposium review of IAGP achievements is planned under the auspices of the International Commission on Snow and Ice just before the next general assembly of the International Union of Geodesy and Geophysics in 1979.

Plan fulfillment

The original plans for IAGP, as published in the *Polar Record* [1971, 15(98): 829-833], were scrutinized and made more definite by a meeting of theoretical specialists in 1971. By and large, the specialists' recommendations have been followed at least to the extent permitted by changing logistics support capabilities. However, some significant modifications have been brought about by technical advances. One major advance has been a field technique for precise location by means of geodetic satellites. This has permitted the toughest of all questions, the determination of ice flow rates at points remote from nunataks, to be answered sooner and far more conveniently than seemed possible at the time of the specialists' discussions. The first of these directly measured ice flow velocities now extends 350 kilometers from the coast along the Casey-Vostok line.

This gain is somewhat offset by slower-than-expected progress toward the production of further cores extending right through the ice sheet. Although an operational wireline system for ice coring has been developed and tested, the major breakthrough to a deep hole penetrating the very cold ice of East Antarctica into bedrock is still in the future. Its crucial importance has not diminished; on the contrary, the advances in ice-sheet modeling (for which it is possible to claim a significance comparable to that of the satellite

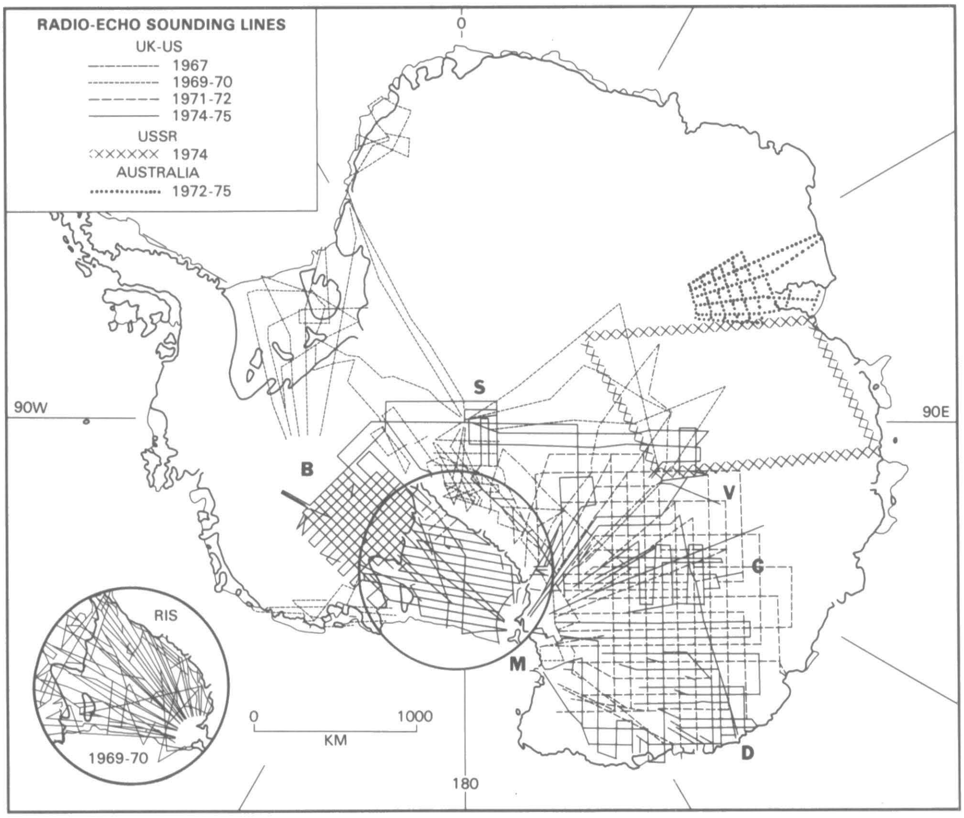

Figure 3. Radio-echo sounding lines.

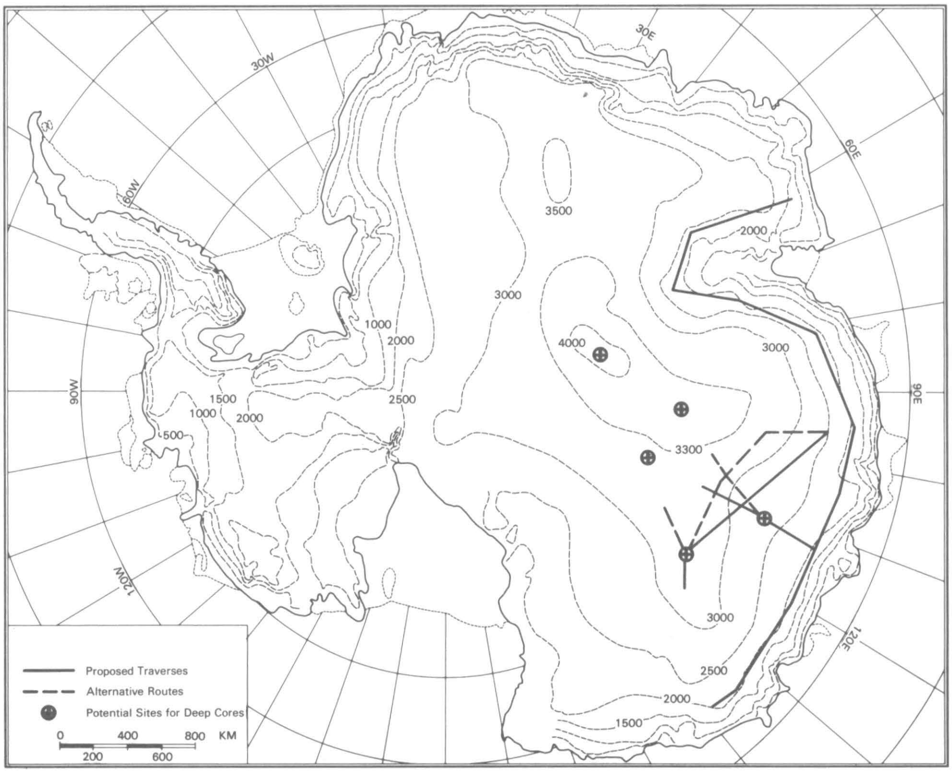

Figure 4. IAGP proposed traverses (solid lines), alternative routes (broken lines), and potential sites for deep cores (⊕).

location technique) underline the need for not just one hole, but two or more on the same flowline, as prerequisites for unambiguous modeling and interpretation of core features.

Remaining work

Much remains to be done if IAGP is to provide a complete picture of the East Antarctic Ice Sheet, its past and its future. The proper placing of the deep holes will be crucial for this. Assuming the first of them is somewhere in the dome C vicinity (74°30′S. 123°10′E.) (figure 4), a good location for the second would be on the Casey-Vostok line, where some of the deepest ice of the region is found and even the oldest ice should have retained a reasonable spread along the vertical. However, there is some suggestion that the lowest ice may be considerably "disoriented" by flowing around obstacles rather than along flow lines defined by the ice-sheet surface slope.

In addition to the deep cores, many more intermediate and shallow cores are needed to further define mesoscale details of present and past accumulation rates, temperatures, and surface heights at the time of deposition; also, further radio-echo soundings are needed to establish the surface and base-rock topographies over the rest of the IAGP area and to define them more closely in regions of special interest (potential drilling sites, subglacial lakes, etc.). Particular attention is needed for subsurface echo layers that are not yet fully understood but may approximate age isochrons of the ice.

The study of contours around the entire IAGP area is possible through the use of geoceivers and has moved close to top priority, since it promises to clarify the relative importance of sheet and stream flows and give the total mass balance of the region, especially when supplemented by satellite monitoring of the ice edge. Plans have already been announced by the Soviet Union for a geomagnetic traverse along the route Mirnyy-Pionerskaya-dome C-Dumont d'Urville, and by Australia for traverses from the Casey-Vostok line toward both Mirnyy and Dumont d'Urville along the 2,000-meter contour. These operations will provide some of IAGP's most promising opportunities for such collaborative studies as geoceiver measurements of ice-flow velocities and comprehensive chemical sampling. Together with further radio-echo soundings and chemical studies along the radial lines from Dumont d'Urville toward dome C and Vostok, from Casey toward Vostok or dome B, and along the Mirnyy-Vostok profile, these studies will come close to achieving the aims set for IAGP, albeit over a period longer than that originally planned for the project.

Lessons learned

In addition to its scientific results, IAGP has led to a new style of international collaboration in which national programs and expeditions preserve their full independence. Furthermore, the project developed as a logical sequence of work from model predictions through field work (giving checks and new facts) to further model development and field work. Both the form of collaboration and the approach centered on modeling deserve close attention from other antarctic projects, and from the point of view of deciding priorities for antarctic glaciological exploration.

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New antarctic place names

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This listing makes available the antarctic name decisions of the U.S. Board on Geographic Names, concurred in by the Secretary of the Interior, since the publication of *Gazetteer No. 14: Antarctica, Third Edition, Official Name Decisions of the United States Board on Geographic Names* (Geographic Names Division, U.S. Army Topographic Command, Washington, D.C. 20315, June 1969). The names are those approved through December 1976.

The list includes approximately 1,600 new names, together with a small number of amended names, and should be used as a supplement to the *Gazetteer*. The names are arranged alphabetically, with the specific element first. Their geographic positions have been taken from the most reliable sources available. Those marked with a dagger (†) are listed in *Gazetteer No. 14*; only their positions or descriptions have been amended. Those marked with an asterisk (*) are amended forms of names previously listed as approved, the former name following in parentheses. Names that have been dropped are listed in *italics* followed by the word VACATED.

All of the decisions by the Board on Geographic Names on these antarctic names have been approved upon the recommendation of its Advisory Committee on Antarctic Names. The present members of the advisory committee are Walter R. Seelig, chairman (National Science Foundation), Alison Wilson (National Archives), William R. MacDonald (U.S. Geological Survey), Cdr. Jerome R. Pilon (U.S. Navy), and Richard R. Randall (*ex officio*, Board on Geographic Names). The members serve as individuals with special knowledge, not as representatives of agencies. Others who have served on the committee since June 1969 are Kenneth J. Bertrand (Catholic University of America), Meredith F. Burrill (*ex officio*, Board on Geographic Names), Albert P. Crary (National Science Foundation), Henry M. Dater (U.S. Naval Support Force, Antarctica), Herman R. Friis (National Archives), Cdr. Kelsey B. Goodman (U.S. Navy), and Morton J. Rubin (U.S. Weather Bureau). Fred G. Alberts and Thomas J. Strenger (Defense Mapping Agency Topographic Center) provide secretarial and staff support to the committee.

Research for the advisory committee as well as preparation of the antarctic names list was conducted in the Geographic Names Division, Department of Technical Services, Defense Mapping Agency Topographic Center, Washington, D.C. 20315. This research was supported by National Science Foundation grant DPP 75-23430.

Abendroth Peak	71 05 S	62 00 W
Abolin Rock	71 50 S	11 16 E
Acarospora Peak	86 21 S	148 28 W
Acorn Rock	54 00 S	38 14 W
Acrid Point	56 17 S	27 36 W
Acton, Mount	70 58 S	63 42 W
Adams Fjord	66 50 S	50 30 E
Adams Nunatak	71 44 S	68 34 W
Adams Rocks	76 14 S	145 39 W
Aerodromnaya Hill	70 47 S	11 38 E
Akkuratnaya Cove	70 45 S	11 48 E
Albatross Crest	54 30 S	37 02 W
Alberich Glacier	77 36 S	161 36 E
Aldebaran Rock	70 50 S	66 41 W
Aldridge Peak	72 27 S	167 24 E
Alekseyev, Mount	67 28 S	50 40 E
*Alexander Nunataks (*not* Alexander Nunatak)	66 30 S	110 39 E
Alford, Mount	71 55 S	161 37 E
Algal Lake	77 38 S	166 25 E
Almond, The	78 19 S	163 27 E
Alpheratz, Mount	70 59 S	66 58 W
Altar, The	71 39 S	11 22 E
Altarduken Glacier	71 39 S	11 26 E
Ambrose Rocks	65 16 S	64 22 W
Amos Lake	60 42 S	45 39 W
Amphitheatre, The	78 18 S	163 03 E
Anckorn Nunataks	70 14 S	63 12 W
Anderson Peninsula	69 48 S	160 13 E
Anders Peak	71 45 S	9 01 E
Andrews Peaks	77 08 S	144 03 W
Andrews Ridge	77 39 S	162 50 E
Andreyev, Cape	68 55 S	155 12 E
Andreyev, Mount	71 46 S	10 13 E
Andromeda, Mount	57 05 S	26 39 W
Angle Peak	71 45 S	62 03 W
Antenna Island	69 00 S	39 35 E
Anuchin Glacier	71 17 S	13 31 E
Aogōri Bay	69 13 S	39 44 E
Apollo Island	70 15 S	1 55 W
Appleby, Point	67 25 S	59 36 E
Ares Cliff	71 49 S	68 15 W
*Arkhangel'skiy Nunataks (*not* Archangel Nunataks)	69 28 S	156 30 E
Arkticheskiy Institut Rocks	71 18 S	11 27 E
Armitage Saddle	78 09 S	163 15 E
Armlenet Ridge	71 59 S	2 52 E
Armstrong Glacier	71 31 S	67 30 W
Armstrong Platform	70 32 S	160 10 E
Arnold Cove	77 25 S	163 46 E
Arsen'yev Rocks	71 51 S	11 12 E
Ashen Hills	57 48 S	26 43 W
Asher Peak	75 44 S	129 11 W
Asimutbreen Glacier	71 23 S	13 42 E
Astarte Horn	71 40 S	68 52 W
Astor Rocks	71 48 S	12 44 E
Astraea Nunatak	71 59 S	70 25 W
Atoll Nunataks	71 21 S	68 47 W
Augen Bluffs	83 30 S	157 40 E
Aurdalen Valley	71 42 S	12 22 E
Aurdalsegga Ridge	71 44 S	12 23 E
Auriga Nunataks	70 42 S	66 38 W
Aurkjosen Cirque	71 21 S	13 33 E
Aurkvævane Cirques	71 52 S	14 26 E

Austbanen Moraine	71 32 S	12 21 E
Auster Islands	67 25 S	63 50 E
Austranten Rock	71 24 S	14 02 E
Axthelm Ridge	69 35 S	159 02 E
Back, Mount	54 29 S	36 07 W
Baggott Ridge	70 19 S	64 19 E
Baillie Peak	83 22 S	161 00 E
Bain Crags	70 30 S	71 45 E
Bainmedart Cove	70 51 S	68 03 E
Bain Nunatak	71 06 S	71 35 E
Baker Glacier	72 46 S	169 15 E
Bakewell Island	74 50 S	18 55 W
Bakker, Mount	70 19 S	64 36 E
Balchunas Pass	75 46 S	128 45 W
Baldwin Bluff	72 06 S	169 27 E
Baldwin Nunatak	70 19 S	64 24 E
Baleen, Mount	65 36 S	62 12 W
Balham Lake	77 26 S	160 57 E
Bandy Island	75 04 S	137 49 W
Bardell Rock	65 20 S	65 23 W
Bardsdell Nunatak	70 16 S	63 54 W
Bareback Ridge	54 29 S	37 05 W
Barela Rock	77 01 S	148 52 W
Barkell Platform	72 40 S	68 16 E
Barkov Glacier	71 46 S	10 27 E
Barter Bluff	75 10 S	114 00 W
Bartlett Bench	86 24 S	152 18 W
Basilisk Peak	59 25 S	27 05 W
Basso Island	62 30 S	59 44 W
Bastei, Mount	71 22 S	13 32 E
Battle Point	67 10 S	64 45 W
Beacon Dome	86 08 S	146 25 W
Beaglehole Glacier	66 33 S	64 07 W
Beaumont Skerries	64 46 S	64 19 W
Beck, Cape	78 18 S	166 16 E
Beck, Mount	71 02 S	67 01 E
Beetle Spur	84 10 S	172 00 E
Behr Glacier	72 55 S	168 05 E
Bell Rock	71 35 S	66 26 W
Bennett Escarpment	70 36 S	64 19 E
Bensley, Mount	70 19 S	64 15 E
Benson Hills	70 28 S	62 17 W
Bergel Rock	65 10 S	64 58 W
Berlin Crater	76 03 S	135 52 W
Berlin Crevasse Field	76 03 S	136 30 W
Berry Glacier	75 00 S	134 00 W
Berry Massif	70 27 S	62 30 W
Bertalan Peak	72 04 S	167 08 E
Betekhtin Range	71 54 S	11 32 E
Bielecki Island	64 46 S	64 29 W
Bigler Nunataks	70 45 S	159 55 E
*Billey Bluff (*not* Landry Peak)	75 32 S	140 02 W
Binary Peaks	54 29 S	36 05 W
Bird Bluff	76 30 S	144 36 W
Birdwell Point	74 18 S	128 10 W
Biscuit Step	72 22 S	168 30 E
Bitgood, Mount	76 29 S	144 55 W
Bjerke, Mount	71 58 S	9 43 E
Bjornert Cliffs	74 58 S	135 09 W
Blackface Point	67 57 S	65 24 W
Blacksand Beach	77 33 S	166 08 E
Blackstone Plain	57 45 S	26 28 W
Blackwall Glacier	86 10 S	159 40 W
Blades Glacier	77 38 S	153 00 W
Blair, Mount	72 32 S	160 49 E
Blanchard Nunataks	72 00 S	64 50 W
Blaskimen Island	70 25 S	3 00 W
Blessing Bluff	77 19 S	163 03 E
Bloor Reef	54 00 S	37 41 W
Blundell Peak	69 24 S	76 06 E
Blustery Cliffs	71 25 S	67 53 E
Boeger Peak	75 49 S	116 06 W
Boennighausen, Mount	75 47 S	132 18 W
Boggs Valley	71 55 S	161 30 E
Bōhyō Heights	68 08 S	42 44 E
Bolle, Mount	71 54 S	6 50 E
Bond Ridge	70 16 S	65 13 E
Bonert Rock	62 27 S	59 43 W
Bool, Mount	70 11 S	64 57 E
Booth Spur	75 37 S	142 01 W
Borceguí Island	61 03 S	55 09 W
Bosse Nunatak	72 08 S	65 22 E
Botnfjellet Mountain	71 45 S	11 25 E
Boulding Ridge	68 02 S	66 55 W
Bourgeois Nunataks	69 54 S	158 22 E
Bøving Island	66 17 S	110 31 E
Bower, Mount	72 37 S	160 30 E
Bowler Rocks	62 21 S	59 50 W
Bowsprit Point	56 40 S	28 08 W
Boyd Head	75 17 S	110 01 W
Boyd Nunatak	69 50 S	74 44 E
Boyer Spur	71 51 S	62 48 W
*Braces Point (*not* Low Point)	57 06 S	26 46 W
Braddock Nunataks	70 48 S	65 55 W
Bradley Rock	65 00 S	64 42 W
Bramble Peak	72 22 S	166 59 E
Brand Peak	70 01 S	63 55 W
Brandt, Mount	72 10 S	1 07 E
Bransfield Rocks: VACATED	61 46 S	56 51 W
Brattebotnen Cirque	71 45 S	10 15 E
Brattstrand Bluffs	69 13 S	77 00 E
Braunsteffer Lake	68 32 S	78 22 E
Breakbones Plateau	57 04 S	26 41 W
Brearley, Mount	77 48 S	161 45 E
Breeding Nunatak	77 04 S	142 28 W
Brekilen Bay	70 08 S	25 48 E
Bremotet Moraine	71 41 S	12 05 E
Brennan Point	76 05 S	146 31 W
Bresnahan, Mount	71 48 S	161 28 E
Brewer Peak	71 34 S	168 28 E
Bridger, Mount	72 17 S	167 35 E
Britt Peak	76 03 S	135 07 W
Brocoum, Mount	70 12 S	63 45 W
Brookman Point	74 19 S	131 51 W
Brooks Point	66 45 S	108 25 E
Brounov, Mount	71 58 S	14 20 E
Brown Bay	66 17 S	110 33 E
Brown-Cooper, Mount	70 42 S	64 12 E
Brownworth, Lake	77 26 S	162 45 E
Bruner Hill	75 39 S	142 25 W
Brunhilde Peak	77 38 S	161 27 E
Bruns Nunataks	72 05 S	1 10 E
Brunt Icefalls	75 55 S	25 00 W
Brusilov Nunataks	66 42 S	51 24 E
Buchanan Passage	66 48 S	67 42 W
Bucher Peak	75 20 S	110 52 W
Bucher Rim	76 19 S	112 09 W
Buddenbrock Range	71 52 S	5 24 E
Buddha, Lake	78 03 S	163 45 E
Budnick Hill	66 17 S	110 32 E
Buell Peninsula	70 36 S	164 24 E
Buennagel Peak	77 30 S	146 46 W
Buettner Peak	75 17 S	110 55 W
Bulkington Pass	65 49 S	62 43 W
Bull, Lake	77 32 S	161 42 E
Bullseye Lake	77 25 S	161 15 E
Bundermann Range	72 01 S	2 42 E
Burley, Mount	54 29 S	36 09 W
Burns Bluff	70 22 S	67 56 W
Burris Nunatak	71 47 S	160 27 E
Bursey Icefalls	75 59 S	132 48 W
Burton Cove	54 01 S	38 04 W
Burt Rocks	69 35 S	159 09 E
Bushell Bluff	71 28 S	67 36 W
Butcher Nunatak	76 32 S	146 30 W
Butler Nunataks	68 03 S	62 24 E
Butler Peaks	71 31 S	67 10 W
Buzfuz Rock	65 28 S	65 53 W
Byrd, Mount	77 10 S	144 38 W
Bystrov Rock	71 47 S	12 35 E
Cabrera Nunatak	75 46 S	128 12 W
Cachalot Peak	65 38 S	62 16 W
Cachalot Rock: VACATED	60 48 S	45 47 W
Cadenazzi Rock	76 18 S	112 39 W
Cadle Monolith	71 40 S	60 58 W
Cady Nunatak	77 13 S	142 51 W
Callisto Cliffs	71 03 S	68 20 W
Caloplaca Cove	60 43 S	45 35 W
Campbell Ridges	70 23 S	67 35 W
Canham, Mount	70 29 S	64 35 E
Canis Heights	70 26 S	66 19 W
Cannonball Cliffs	71 47 S	68 15 W
Canopus, Lake	77 33 S	161 31 E
Canopus Crags	71 10 S	66 38 W
Capella Rocks	70 39 S	66 32 W
Capling Peak	72 26 S	167 08 E
Carbon Point	57 06 S	26 42 W
Carina Heights	71 09 S	66 08 W
Carlota Cove	62 22 S	59 42 W
Carlson Inlet	78 00 S	78 30 W
Carnes, Mount	77 39 S	161 21 E
Carpenter Nunatak	73 37 S	61 15 E
Carter Peak	70 19 S	64 12 E
Carter Ridge	72 37 S	168 37 E
Cartledge, Mount	70 17 S	65 43 E
Cartographers Range	72 21 S	167 50 E
Casey Bay	67 30 S	48 00 E
Castillo Point	75 30 S	141 18 W
Castor and Pollux: VACATED	57 05 S	26 46 W
Castor Rock	57 07 S	26 47 W
Catcher Icefall	54 09 S	37 40 W
Cat Ridge	71 10 S	61 50 W
Cauldron Pool	57 04 S	26 43 W
Cemetery Bay	60 42 S	45 37 W
Centennial Peak	84 57 S	174 00 W
Ceres Nunataks	72 03 S	70 25 W
Cetus Hill	70 56 S	66 10 W
Chadwick, Mount	72 30 S	160 26 E
Chancellor Lakes	78 13 S	163 18 E
Chandler Island	77 21 S	153 10 W
Changing Lake	60 42 S	45 37 W
Chan Rocks	72 45 S	160 30 E
Chaos Reef	62 22 S	59 46 W
Chapman Hump	70 13 S	67 30 W
Chernushka Nunatak	71 35 S	12 01 E

Chervov Peak	71 50 S	10 33 E
Cheshire Rock	62 22 S	59 45 W
Chider, Mount	72 06 S	169 10 E
Chimaera Flats	57 04 S	26 40 W
Chinstrap Cove	61 14 S	54 11 W
*Chinstrap Point (*not* Rocky Point)	57 07 S	26 46 W
*Choyce Point (*not* Choyce, Cape)	67 42 S	65 23 W
Christie Peaks	71 15 S	67 25 W
Christine Island	64 48 S	64 02 W
Cirque Peak	72 11 S	165 58 E
Citadel Bastion	72 00 S	68 32 W
Citadel Peak	85 57 S	154 27 W
Clapmatch Point	57 06 S	26 39 W
Clapp Ridge	72 54 S	167 54 E
Clarke Bluff	69 38 S	159 13 E
Clark Hills	70 43 S	63 25 W
Clark Knoll	76 53 S	146 59 W
Clausen Glacier	76 10 S	112 03 W
Clayton Glacier	54 04 S	37 26 W
Cleft Island	69 21 S	75 38 E
Cline Glacier	71 40 S	62 00 W
Clinker Gulch	57 03 S	26 42 W
Colbert Hills	84 12 S	162 35 E
Coleman Bluffs	72 28 S	160 37 E
Coleman Glacier	75 47 S	132 33 W
Cole Point	74 39 S	127 30 W
Collerson Lake	68 35 S	78 11 E
Collinson Ridge	85 13 S	175 21 W
Collins Peak	72 58 S	167 49 E
Colosseum Cliff	77 36 S	161 27 E
Coloured Peak	85 30 S	156 20 W
Columbia Mountains	70 14 S	63 51 W
Conard Peak	72 22 S	167 26 E
Conchie Glacier	71 36 S	67 15 W
Condor Peninsula	71 46 S	61 30 W
*Confusion Island (*not* Confusion Point)	60 44 S	45 38 W
Conical Hill	77 39 S	168 34 E
Conrad, Mount	69 26 S	158 46 E
Conroy Point	60 44 S	45 41 W
Cook Nunataks	67 05 S	55 50 E
Coor Crags	74 29 S	136 36 W
Cope Hill	75 07 S	114 47 W
Coppermine Peninsula	62 22 S	59 43 W
Copper Nunataks	74 22 S	64 55 W
Corbató, Mount	85 04 S	165 42 W
Cordini Glacier	70 01 S	62 30 W
Cornet, The	61 07 S	54 47 W
Corry Massif	70 27 S	64 36 E
Corry Rocks	70 20 S	71 41 E
Coulston Glacier	72 25 S	167 58 E
Coulter Heights	75 21 S	138 15 W
Cousins Rock	75 16 S	133 31 W
Cowan, Lake	68 32 S	78 25 E
Cowell Island	69 16 S	76 43 E
Cowie Dome	86 25 S	152 00 W
Cox Point	74 56 S	136 43 W
Crabtree, Mount	77 00 S	144 58 W
Crack Bluff	86 33 S	158 38 W
Crandall Peak	71 27 S	168 41 E
Crary Ice Rise	82 56 S	172 30 W
Creehan Cliff	75 47 S	115 26 W
Creswick Gap	70 23 S	67 44 W
Crooker, Mount	71 03 S	67 15 W
Croom Glacier	70 18 S	62 25 W
Crosson Ice Shelf	75 05 S	109 25 W
Crume Glacier	71 33 S	169 21 E
Crummey Nunatak	76 47 S	143 36 W
Cumbie Glacier	77 13 S	154 12 W
Cumpston Glacier	66 59 S	65 02 W
Cumpston Massif	73 33 S	66 53 E
Curl, Mount	70 48 S	63 07 W
Curry, Mount	56 18 S	27 34 W
Cutcliffe Peak	70 32 S	65 17 E
Cyclops Peak	68 00 S	55 40 E
Dakers Island	64 46 S	64 23 W
Dalton, Cape	66 53 S	56 44 E
Dalziel Ridge	70 15 S	63 55 W
Dana Glacier	70 55 S	62 23 W
Daniels Hill	70 34 S	64 36 W
Dart, Mount	70 12 S	65 07 E
Dart Moraine	70 54 S	68 00 E
Dater, Mount	67 08 S	64 49 W
Davern Nunatak	70 54 S	69 20 E
Davis Ice Piedmont	70 38 S	166 16 E
Davis Ridge	71 24 S	63 00 W
Dawson Head	70 43 S	61 57 W
Daykovaya Peak	71 28 S	12 11 E
Dean Nunataks	74 31 S	98 48 W
De Camp Nunatak	72 16 S	160 22 E
Decennial Peak	84 22 S	166 02 E
Decker Glacier	77 28 S	162 47 E
Dee Nunatak	74 28 S	136 31 W
De Goes Cliff	71 44 S	161 54 E
Deildedalen Valley	71 24 S	12 43 E
Deildegasten Ridge	71 29 S	12 42 E
Deildenapen, Mount	71 24 S	12 46 E
Dekefjellet Mountain	71 58 S	13 25 E
DeLaca Island	64 47 S	64 07 W
Delta Peak	86 35 S	147 30 W
Demas Bluff	76 34 S	144 50 W
Demas Range	75 00 S	133 45 W
Deming Glacier	72 00 S	168 30 E
*Demon Point (*not* Spit Point)	57 03 S	26 40 W
Denfeld Mountains	76 55 S	144 45 W
Derbyshire Peak	72 31 S	161 06 E
DeRemer Nunataks	69 45 S	158 09 E
Dergach, Mount	70 36 S	163 01 E
Deryugin, Mount	71 51 S	11 20 E
DeWald Glacier	72 19 S	167 00 E
Dickinson Rocks	77 33 S	147 55 W
Dike Cirque	83 14 S	157 57 E
Dismal Ridge	78 17 S	162 48 E
Diver Point	54 00 S	38 03 W
Dlinnoye Lake	70 44 S	11 39 E
Dobrynin, Mount	71 42 S	11 46 E
Dodd Island	69 42 S	75 38 E
Dodd Nunatak	71 50 S	160 24 E
Dodson Rocks	69 55 S	68 25 E
Doe Nunatak	72 21 S	160 47 E
Doescher Nunatak	72 23 S	160 59 E
Dohle Nunatak	71 17 S	66 06 E
Dolber, Mount	77 07 S	145 31 W
Domashnyaya Bank	67 39 S	45 50 E
Donner Valley	77 37 S	161 27 E
Downs Cone	75 50 S	116 16 W
Dow Nunatak	75 01 S	136 14 W
Dublitskiy Bay	70 05 S	7 45 E
DuBridge Range	71 30 S	168 53 E
Durrance Inlet	73 50 S	16 30 W
Dykes Peak	77 13 S	161 01 E
Dzhalil', Mount	72 01 S	14 36 E
Dziura Nunatak	71 44 S	161 15 E
Early Islands	73 40 S	101 40 W
East Groin	77 39 S	160 57 E
Eckhörner Peaks	71 32 S	11 27 E
*Edisto Rocks (*not* Edisto Rock)	68 13 S	67 08 W
Edwards, Mount	76 51 S	144 07 W
Edwards Glacier	71 35 S	160 30 E
Edwards Nunatak	70 46 S	65 42 E
Edwards Pillar	73 05 S	66 20 E
Edwards Spur	75 59 S	135 18 W
Ehrenspeck, Mount	84 46 S	175 35 W
Eichorst Island	64 47 S	64 04 W
Eidsgavlen Cliff	71 41 S	11 42 E
Eidshaugane Peaks	71 40 S	11 46 E
Eisberg Head	75 12 S	110 27 W
Eissinger, Mount	70 02 S	67 44 W
Ekesteinen Rock	71 46 S	10 46 E
Ekho Mountain	71 28 S	15 26 E
Ekspress Nunatak	71 48 S	2 53 E
Ekstrom Ice Shelf	71 00 S	8 00 W
Elder, Mount	61 13 S	55 12 W
Elder Bluff	70 31 S	61 44 W
Eldred Point	75 30 S	141 58 W
Elephant Rocks	64 46 S	64 05 W
Elliott Hills	71 25 S	65 25 W
Ellis Cone	75 49 S	116 23 W
Ellyard Nunatak	70 19 S	64 54 E
El-Sayed Glacier	75 40 S	141 52 W
Else Nunataks	67 21 S	55 40 E
Else Platform	70 22 S	68 48 E
Ely Nunatak	72 08 S	66 30 E
Emerald Lake	60 43 S	45 39 W
Emerson, Mount	71 35 S	168 44 E
Enceladus Nunataks	71 43 S	69 27 W
Endurance Glacier	61 10 S	55 08 W
Endurance Reef	68 18 S	67 32 W
English Rock	76 49 S	118 00 W
Entuziasmy Glacier	70 30 S	14 30 E
Erebus Glacier	77 41 S	167 00 E
Erickson Bluffs	75 02 S	136 30 W
Eroica Peninsula	71 12 S	72 05 W
Escarpada Point	61 17 S	54 14 W
Eubanks, Mount	70 02 S	67 15 W
Europa Cliffs	70 52 S	68 45 W
Evans Ice Stream	76 00 S	78 00 W
Everson Ridge	60 43 S	45 39 W
Explorers Cove	77 34 S	163 35 E
Factory Bluffs	60 43S	45 36 W
Fagan, Mount	54 30 S	36 08 W
Faget, Mount	71 44 S	168 26 E
Fan Lake	54 30 S	37 03 W
Farbo Glacier	75 50 S	141 45 W
Faure Passage	68 14 S	68 55 W
Favela Rocks	76 12 S	145 21 W
Feeney Col	85 37 S	155 45 W
Feeney Ridge	69 40 S	159 06 E
Fenrir Valley	77 37 S	161 56 E
Fernette Peak	85 35 S	176 58 W
Ferrer Point	62 30 S	59 42 W
Ferri Ridge	75 01 S	113 41 W
Fielding Col	68 52 S	67 02 W
Field Rock	67 36 S	62 54 E
Fields Peak	75 59 S	135 56 W
Fikkan Peak	71 31 S	159 50 E
Filer Haven	60 44 S	45 35 W
Finback Massif	65 41 S	62 25 W
Finch, Mount	72 34 S	167 23 E
First Crater	77 50 S	166 39 E

Fischer Ridge	71 58 S	169 00 E
Fisher Spur	71 09 S	159 50 E
Fitzsimmons Nunataks	72 08 S	161 42 E
Flånuten, Mount	71 47 S	11 17 E
Flat Spur	77 36 S	161 30 E
Fleece Glacier	65 54 S	63 10 W
Fleet Point	67 37 S	65 24 W
Fletcher Ice Rise	78 20 S	81 00 W
Flint Ridge	77 31 S	163 02 E
Flory Cirque	77 39 S	160 52 E
Foale Nunatak	70 16 S	65 20 E
Foca Cove	60 42 S	45 39 W
Fog Bay	77 40 S	168 10 E
Fokker Rocks	78 04 S	155 10 W
Fomalhaut Nunatak	70 58 S	66 40 W
Fonda, Mount	76 59 S	145 15 W
Forecast, Mount	70 40 S	64 18 E
Forsythe Bluff	71 16 S	159 50 E
Fortress, The	77 18 S	160 55 E
Fortress Rocks	77 51 S	166 41 E
Fossil Wood Point	70 50 S	68 02 E
Foster Nunatak	71 06 S	71 40 E
Foster Peninsula	71 18 S	61 10 W
Fowler Ice Rise	77 30 S	78 00 W
Fox Ridge	70 47 S	67 53 E
Frame Ridge	78 05 S	165 26 E
Freeman, Mount	72 43 S	168 21 E
*Freezland Rock (*not* Freezeland Rock)	59 03 S	26 44 W
Friedmann Nunataks	70 55 S	65 30 W
Friis Hills	77 45 S	161 25 E
Frosch, Mount	72 46 S	167 55 E
Frost Cliff	75 13 S	135 43 W
Frostman Glacier	75 08 S	137 57 W
Frost Rocks	65 15 S	64 20 W
Frustration Dome	68 00 S	64 33 E
Fry Peak	71 03 S	63 40 W
Fucík, Mount	71 52 S	14 26 E
*Fuente Rock (*not* Fuente Island)	62 30 S	59 41 W
Fukuro Cove	69 12 S	39 39 E
Fuller Rock	68 10 S	68 54 W
Fulton, Mount	76 53 S	144 54 W
Fume Point	56 20 S	27 33 W
Furdesanden Moraine	71 48 S	9 37 E
Futago, Mount	69 12 S	39 44 E
Gabriel Peak	65 36 S	62 39 W
Gagarin Mountains	71 57 S	9 23 E
Gain Glacier	71 01 S	61 25 W
Galileo Cliffs	70 46 S	68 45 W
Gallen Nunatak	75 48 S	128 36 W
Galyshev Nunatak	71 36 S	12 28 E
Gamage Point	64 46 S	64 04 W
Gamaleya Rock	71 44 S	10 43 E
Gamburtsev Subglacial Mountains	80 30 S	76 00 E
Ganymede Heights	70 52 S	68 26 W
Gardiner Ridge	75 39 S	132 26 W
Gardner Island	68 35 S	77 52 E
Garfield Glacier	74 57 S	136 35 W
Gaston, Mount	70 25 S	65 47 E
Gateway Pass	71 40 S	68 47 W
Gatlin Peak	70 47 S	63 18 W
Gawne Nunatak	76 03 S	135 24 W
Gealy Spur	84 38 S	165 13 E
*Gedges Rocks (*not* Gedges Reef)	65 20 S	64 32 W
Geier, Mount	71 34 S	62 25 W
Geoffrey Bay	66 17 S	110 32 E
George VI Ice Shelf	71 45 S	68 00 W
Georgian Cliff	71 15 S	68 15 W
Gerry Glacier	77 21 S	152 08 W
Gester, Mount	75 01 S	134 48 W
Getz, Mount	76 33 S	145 13 W
Giannini Peak	71 00 S	62 50 W
Gibbous Rocks	61 03 S	54 59 W
Giddings Peak	70 12 S	64 44 E
Gilbert Bluff	74 58 S	136 37 W
Gillett Ice Shelf	69 35 S	159 42 E
Gillett Nunataks	75 48 S	114 43 W
Gillick Rock	75 36 S	129 12 W
Gilruth, Mount	71 44 S	168 48 E
Gipps Ice Rise	68 46 S	60 52 W
Gjertsen Promontory	86 38 S	148 32 W
Glee Glacier	78 16 S	163 00 E
Glimpse Glacier	78 16 S	162 46 E
Glossopteris Gully	70 51 S	68 06 E
Glubokoye, Lake	67 40 S	45 52 E
Gneiskopf Peak	71 56 S	12 07 E
Gneysovaya Peak	71 33 S	12 10 E
Gockel Ridge	72 42 S	0 12 E
Goettel Escarpment	70 14 S	66 55 W
Golubaya Bay	69 58 S	9 50 E
González, Mount	77 11 S	144 33 W
Goodman Hills	69 27 S	158 43 E
Gorgon Pool	57 04 S	26 41 W
Gorki Ridge	71 37 S	11 37 E
Gorman, Mount	70 29 S	64 28 E
Gornyye Inzhenery Rocks	71 32 S	12 44 E
Gould Island	77 08 S	148 05 W
*Gould Nunataks (*not* Gould Nunatak)	66 30 S	51 42 E
Graben Horn	71 48 S	12 01 E
*Grace Rocks (*not* Grace, Cape)	66 25 S	100 33 E
Graham Spur	70 06 S	62 30 W
Gråhorna Peaks	71 36 S	12 16 E
Grainger Valley	70 45 S	67 52 E
Grakammen Ridge	71 41 S	12 20 E
Granat, Cape	67 39 S	45 51 E
Granitnaya Mountain	72 08 S	11 38 E
Grautskala Cirque	71 37 S	11 22 E
Grayson Nunatak	76 47 S	143 48 W
Greegor Peak	76 53 S	145 14 W
Greer Peak	76 47 S	144 25 W
Gregory Rock	77 40 S	147 46 W
Grew Peak	75 18 S	110 37 W
Grikurov Ridge	71 17 S	69 00 W
Grinder Island	77 34 S	149 20 W
Gromov Nunataks	67 45 S	50 40 E
Groux Rock	76 13 S	144 47 W
Gruendler Glacier	72 38 S	167 28 E
Guard Glacier	71 01 S	62 10 W
Guenter Bluff	70 40 S	159 44 E
Guesalaga Peninsula	62 29 S	59 40 W
Gunner, Mount	83 32 S	169 38 E
Gurling Glacier	70 34 S	62 20 W
†Gutenko Mountains	71 40 S	64 45 W
Guthridge Nunataks	71 48 S	64 33 W
*Haag Nunataks (not Haag, Mount)	77 00 S	78 18 W
Haderich, Mount	71 57 S	6 12 E
Hagey Ridge	74 57 S	134 56 W
Haigh Nunatak	71 15 S	71 13 E
Haley Glacier	71 33 S	61 50 W
Hall Cliff	71 59 S	68 37 W
Hall Ridge	70 42 S	63 12 W
Hall Rock	76 51 S	159 20 E
Halvfarryggen Ridge	71 10 S	6 40 W
Hamilton Bluff	69 44 S	73 56 E
Hammer Hill	61 04 S	55 21 W
Hamm Peak	69 43 S	74 08 E
Hamna Icefall	69 17 S	39 43 E
Hand Glacier	72 58 S	168 05 E
Handler Ridge	72 30 S	167 00 E
Handsley, Mount	77 56 S	161 33 E
Hanessian Foreland	74 42 S	135 15 W
Hannah Island	76 39 S	148 48 W
Hansen, Mount	71 28 S	12 09 E
Hansen Rocks	67 30 S	62 54 E
Harcourt Island	54 29 S	35 58 W
Harrison Peak	72 24 S	166 39 E
Harriss Ridge	70 08 S	65 08 E
Hart, Mount	72 05 S	169 05 E
Hartshorne Island	64 47 S	64 23 W
Harvey Ridge	70 59 S	65 18 E
Harvey Shoals	68 11 S	67 09 W
Haselton Icefall	77 21 S	160 46 E
Havfruen Peak	59 02 S	26 32 W
Hayes Glacier	76 16 S	27 48 W
Hayne, Mount	70 16 S	65 02 E
Hazlett, Mount	72 06 S	167 35 E
Heaphy Spur	77 14 S	161 15 E
Heaps Rock	76 00 S	132 46 W
Heart Lake	77 34 S	166 14 E
Hedden, Mount	72 05 S	1 25 E
Hedley Glacier	77 49 S	162 07 E
Heg, Mount	72 57 S	166 45 E
Heimdall Glacier	77 35 S	161 50 E
Heintz Peak	70 56 S	63 42 W
Heitō, Mount	69 16 S	39 49 E
Heitō Glacier	69 16 S	39 48 E
Helfferich Glacier	70 35 S	160 12 E
Hellerman Rocks	64 48 S	64 01 W
Helman Glacier	72 12 S	168 28 E
Hemmen Ice Rise	76 40 S	49 15 W
Henry Ice Rise	80 35 S	62 00 W
Henry Moraine	71 57 S	9 38 E
Herbst Glacier	75 40 S	132 07 W
Hero Inlet	64 46 S	64 04 W
Herschel Heights	71 53 S	69 38 W
Hesperus Nunatak	71 31 S	69 21 W
Hess Mesa	77 38 S	160 47 E
Heth Ridge	69 58 S	159 45 E
Heuser Nunatak	72 02 S	160 38 E
Heverley Nunataks	75 33 S	128 34 W
Heywood Lake	60 41 S	45 37 W
Hidden Col	85 32 S	156 00 W
Hidden Valley	78 10 S	163 52 E
Hillier Moss	60 43 S	45 36 W
Hind Turret	77 38 S	161 37 E
Hinode Peak	68 10 S	42 35 E
Hiroe, Mount	69 21 S	39 46 E
Hiroe Point	69 22 S	39 44 E
Hiyoko Island	69 00 S	39 33 E
Hoare, Lake	77 38 S	162 52 E
Hockey Cirque	83 17 S	156 30 E
Hodges Point	67 21 S	65 03 W

Hogg Islands	67 31 S	61 37 E
Holcomb Glacier	75 35 S	142 48 W
Holder Peak	69 45 S	74 31 E
Holdgate, Mount	59 28 S	27 11 W
Holiday Peak	78 06 S	163 36 E
Holladay Nunataks	69 31 S	159 19 E
*Holtedahl Peaks (*not* Holtedahl Mountains)	71 47 S	8 58 E
Honores Rock	62 30 S	59 43 W
Hoopers Shoulder	77 32 S	166 53 E
Horne Nunataks	71 42 S	66 46 W
Horrocks Block	71 35 S	68 22 W
Horror Rock	54 31 S	37 11 W
Horseshoe Nunatak	81 52 S	158 25 E
Horteflaket Névé	71 56 S	12 45 E
*Houlder Bluff (*not* Houlder, Mount)	61 06 S	54 51 W
Hourglass Lake	77 21 S	161 04 E
House, Lake	77 42 S	161 24 E
Houston Glacier	70 34 S	62 03 W
*Hovde Glacier (*not* Hovde Ice Tongue)	69 15 S	76 55 E
Hovdeskar Gap	71 47 S	11 39 E
Howard Heights	77 27 S	151 40 W
Howard Island	64 47 S	64 23 W
Howell Peak	70 58 S	160 00 E
Hoyt Head	74 59 S	134 36 W
Hudson Nunatak	70 54 S	65 17 E
Hueca Point	58 26 S	26 26 W
Hughes Ice Piedmont	70 12 S	62 15 W
Humble Point	61 11 S	54 08 W
Hunt Nunataks	70 11 S	64 53 E
*Husky Massif (*not* Husky Dome)	71 00 S	65 09 E
Hussey, Mount	72 46 S	167 31 E
Hutt Peak	76 01 S	132 39 W
Hydrodist Rocks	63 44 S	60 55 W
Iapetus Nunatak	71 36 S	70 15 W
Ibar Rocks	62 27 S	59 43 W
Idun Peak	77 38 S	161 26 E
Imshaug Peninsula	70 53 S	61 35 W
Inferno Peak	72 07 S	165 59 E
Institut Geologii Arktiki Rocks	70 56 S	11 30 E
Intrusion Lake	54 29 S	37 04 W
Iquique Cove	62 29 S	59 40 W
Irving, Mount	61 17 S	54 08 W
Isacke Passage	66 54 S	67 15 W
Isdalen Valley	71 44 S	12 30 E
Isdalsegga Ridge	71 45 S	12 33 E
Isocline Hill	83 31 S	157 36 E
*Ivanoff Head (*not* Brooks Island)	66 53 S	109 07 E
Jabs, Lake	68 33 S	78 15 E
Jackson Glacier	74 47 S	135 45 W
Jacobs Island	64 48 S	64 01 W
Jacoby Glacier	75 48 S	132 06 W
Jagar Islands	66 35 S	57 20 E
Jane Col	60 42 S	45 38 W
Jaques Nunatak	67 53 S	66 12 E
Jennings Peak	71 32 S	168 07 E
Jeroboam Glacier	65 38 S	62 40 W
J.J. Thomson, Mount	77 41 S	162 15 E
Joern, Mount	72 35 S	160 24 E
Johannessen Nunataks	72 52 S	161 11 E
Johnson Peaks	71 21 S	12 26 E
Johnstone Glacier	71 52 S	163 53 E
Johnston Heights	85 29 S	172 47 E
Jones Escarpment	70 00 S	64 21 E
Jones Nunatak	69 47 S	159 04 E
Jordan Nunatak	72 09 S	101 16 W
Jorge Island	62 23 S	59 46 W
Joubert Rock	68 12 S	67 41 W
Jukkola, Mount	71 51 S	64 38 W
Junction Knob	77 36 S	161 39 E
Juno Peaks	71 58 S	69 47 W
Kado Point	69 39 S	39 22 E
Kalafut Nunatak	77 46 S	145 36 W
Kal'vets Rock	71 47 S	11 09 E
Kamelen Island	67 31 S	61 37 E
Kamenev Bight	69 55 S	9 30 E
Kamenev Nunatak	71 41 S	63 00 W
Kammuri, Mount	69 13 S	39 45 E
Kamskaya Peak	71 57 S	13 25 E
Kaname Island	69 21 S	37 36 E
Karaali Rocks	75 23 S	137 55 W
Karamete Point	69 09 S	35 26 E
Kåre Bench	71 29 S	12 10 E
Karelin Bay	66 30 S	85 00 E
Karpinskiy, Mount	72 12 S	18 25 E
Kartografov Island	69 12 S	157 43 E
Kauffman Glacier	71 15 S	61 18 W
Kaye Crest	72 06 S	4 24 E
Kay Peak	75 14 S	110 57 W
Kazanskaya Mountain	71 58 S	13 15 E
Kealey Ice Rise	77 15 S	82 00 W
Kelley Massif	70 39 S	63 35 W
Kellogg Glacier	71 51 S	62 41 W
Kelly Nunataks	77 17 S	141 44 W
Kempe Glacier	78 18 S	162 54 E
Kennel Peak	75 01 S	133 44 W
Kenneth Ridge	70 57 S	71 30 E
Kennett, Mount	67 03 S	65 10 W
Kerr, Mount	70 26 S	65 38 E
Kershaw Ice Rumples	78 45 S	75 40 W
Keyhole, Lake	78 08 S	163 41 E
Keyhole, The	78 07 S	163 41 E
Keyser Nunatak	77 36 S	145 55 W
Keyser Ridge	73 57 S	63 28 E
Khmara Bay	67 20 S	49 00 E
*Khmara Island (*not* Khmary Island)	66 33 S	93 00 E
Khmyznikov, Mount	71 52 S	11 39 E
Kibal'chich, Mount	71 56 S	14 19 E
Kikko Terrace	68 08 S	42 40 E
Kiletangen Ice Tongue	69 57 S	26 25 E
Kilfoyle Nunataks	70 43 S	65 51 E
King Cliffs	72 14 S	96 10 W
Kirk Glacier	72 02 S	169 09 E
Kirkpatrick Glacier	75 09 S	136 00 W
Kita-karamete Rock	69 04 S	35 23 E
Kitano-seto Strait	69 00 S	39 35 E
Kitching Ridge	85 12 S	177 06 W
Kitney Island	67 31 S	63 04 E
Kizahashi Beach	69 28 S	39 35 E
Kizaki, Mount	70 45 S	65 46 E
Knezevich Rock	76 10 S	112 00 W
Knight Nunatak	69 23 S	158 52 E
Knob Lake	60 42 S	45 37 W
Knut Rocks	71 24 S	13 02 E
Koehler Nunatak	74 52 S	98 08 W
Koenig Valley	77 36 S	160 47 E
Kohler, Mount	77 17 S	145 35 W
Kohler Dome	76 02 S	134 17 W
Kohnen, Mount	75 00 S	134 47 W
Koke Strand	69 13 S	39 44 E
Kolich Point	77 21 S	163 33 E
Kolodkin, Mount	71 45 S	12 37 E
Kolven Island	67 33 S	61 29 E
Komandnaya Nunatak	72 12 S	14 31 E
Komatsu Nunatak	71 54 S	161 11 E
Komsomol'skiy Peak	75 45 S	63 25 E
Konter Cliffs	75 06 S	137 48 W
Koons, Mount	72 43 S	160 22 E
Korff Ice Rise	79 00 S	69 30 W
Kosky Peak	70 57 S	63 28 W
Koslov Nunataks	66 37 S	51 07 E
Kotterer Peaks	70 11 S	64 26 E
Koyubi, Cape	69 14 S	39 38 E
Kraken Cove	57 03 S	26 41 W
Krakken Mountain	71 32 S	12 09 E
Kramer Island	77 14 S	147 10 W
Krasheninnikov Peak	71 41 S	12 40 E
Krasin Nunataks	68 18 S	50 05 E
Krasinskiy, Cape	69 50 S	8 30 E
Krasnaya Nunatak	68 18 S	49 42 E
Krasnov Rocks	71 48 S	10 20 E
Kraut Rocks	76 04 S	136 11 W
Krebs Ridge	70 33 S	62 25 W
Krigsvold Nunataks	75 38 S	137 55 W
Kropotkin, Mount	71 54 S	6 35 E
Kroshka Island	70 40 S	2 05 E
Kruber Rock	71 45 S	11 05 E
Kuberry Rocks	75 17 S	138 31 W
Kubitza Glacier	70 24 S	63 11 W
Kuiper Scarp	71 26 S	68 27 W
Kurchatov, Mount	71 39 S	11 14 E
†Kurze Mountains	71 53 S	8 55 E
Kvævefjellet Mountain	71 52 S	14 27 E
Kvævenutane Peaks	71 57 S	14 18 E
Kvamsgavlen Cliff	71 46 S	11 50 E
Kvinge Peninsula	71 10 S	61 10 W
Kyle, Mount	71 57 S	168 35 E
Kyle Cone	77 31 S	169 16 E
Lachal Bluffs	67 30 S	61 09 E
Lagernoye, Lake	67 40 S	45 51 E
Laine Hills	70 46 S	64 28 W
Laizure Glacier	69 15 S	158 07 E
Lama, Mount	78 04 S	163 42 E
Lamykin Dome	67 27 S	46 40 E
Landing Cove	60 44 S	45 41 W
Landmark Point	67 31 S	63 56 E
Lands End Nunataks	83 43 S	172 37 E
Langway, Mount	75 29 S	139 47 W
Lanyon Peak	77 15 S	161 41 E
Laputa Nunataks	66 08 S	62 58 W
Larson Glacier	77 28 S	154 00 W
Latino Peak	72 09 S	167 33 E
Law Dome	66 44 S	112 52 E
Lawson Aiguilles	67 50 S	66 15 E
Lawson Nunatak	67 56 S	62 51 E
Lawson Nunataks	70 47 S	159 45 E

Lawther Knoll	54 29 S	37 03 W
Lazarev Ice Shelf	69 37 S	14 45 E
Leach Nunatak	77 36 S	146 25 W
Leafvein Gulch	57 06 S	26 46 W
Leah Ridge	70 13 S	65 00 E
Lee Lake	77 02 S	162 08 E
Lee Nunatak	71 01 S	159 58 E
Leeson Point	58 24 S	26 14 W
Leland, Mount	77 16 S	161 18 E
LeMasurier, Mount	75 27 S	139 39 W
Lenfant Bluff	70 22 S	160 03 E
Lenie Passage	64 44 S	64 23 W
Leningradskiy Bay	70 00 S	12 30 E
Leningradskiy Island	70 08 S	12 50 E
Lepus, Mount	70 40 S	67 10 W
Lewis Rocks	76 18 S	145 21 W
Lewis Snowfield	71 25 S	71 20 W
*Lewis Sound (*not* Lewis Passage)	66 20 S	67 00 W
Liebknecht Range	71 48 S	11 22 E
Lie Cliff	76 42 S	117 37 W
Light Lake	60 42 S	45 39 W
Lilliput Nunataks	66 08 S	62 40 W
Limestone Valley	60 42 S	45 37 W
Limitrophe Island	64 48 S	64 01 W
Lind Ridge	75 48 S	132 33 W
Line Glacier	72 59 S	167 50 E
Line Islands	67 56 S	67 14 W
Linsley Peninsula	72 03 S	98 11 W
Linton-Smith Nunataks	70 17 S	72 45 E
Lira, Mount	67 52 S	48 53 E
Lipps Island	64 46 S	64 07 W
Liston Nunatak	70 54 S	63 45 W
Litke Nunatak	67 37 S	51 40 E
Little, Mount	70 30 S	65 16 E
Little, Mount	77 00 S	143 51 W
Littleblack Nunataks	81 35 S	156 20 E
Livdebotnen Cirque	71 45 S	11 21 E
Locke, Mount	71 24 S	169 06 E
Loewe Massif	70 34 S	68 00 E
Loke, Mount	77 29 S	162 33 E
Lokey Peak	71 50 S	64 06 W
Lomonosov Mountains	71 31 S	15 20 E
Lonely One Nunatak	71 12 S	161 18 E
Longton Point	59 28 S	27 09 W
Lopatin, Mount	72 51 S	168 04 E
López Nunatak	62 29 S	59 39 W
Lowman, Mount	70 39 S	160 03 E
Loze Mountain	71 37 S	11 17 E
Lozen, Mount	72 07 S	168 24 E
Lucifer Hill	57 04 S	26 42 W
Luff Nunatak	71 06 S	71 28 E
Lugg, Mount	71 13 S	64 43 E
Lugg Island	68 32 S	77 57 E
Luhrsen Nunatak	71 59 S	161 40 E
*Lumus Rock (*not* Lumus Reef)	65 13 S	65 18 W
Luna-Devyat' Mountain	71 40 S	11 50 E
Lurker Rock	68 03 S	68 44 W
†Luz Range	72 03 S	4 49 E
Lyddan Island	74 25 S	20 45 W
Mackey Rock	76 36 S	146 22 W
Madden Island	77 27 S	149 03 W
Maglione, Mount	77 18 S	141 47 W
Magoke Point	69 40 S	39 29 E
Maigetter Peak	76 27 S	146 29 W
Maigo Peak	68 08 S	42 42 E
Main Bay	54 01 S	38 03 W
Malva Bluff	71 55 S	62 21 W
Malysh Mountain	72 09 S	11 24 E
Malyutki Nunataks	72 04 S	10 46 E
*Mamelon Point (*not* Mamelon Island)	67 19 S	64 49 W
Manfull Ridge	75 05 S	114 39 W
Manger, Mount	77 29 S	153 15 W
Manning Massif	70 42 S	67 50 E
Marble Knolls	60 42 S	45 37 W
Marble Peak	85 29 S	156 28 W
Marble Rock	67 36 S	62 50 E
Marcoux Nunatak	69 55 S	159 04 E
Markab, Mount	70 56 S	67 02 W
Markov, Cape	66 46 S	50 15 E
Marshall Archipelago	77 00 S	148 30 W
Marsh Spur	65 53 S	62 38 W
Marzolf, Mount	70 28 S	159 41 E
Masquerade Ridge	83 04 S	164 40 E
Massey Glacier	71 53 S	168 24 E
Mathias Point	58 28 S	26 14 W
Mathis Nunataks	77 08 S	143 27 W
Mattox Bastion	77 38 S	160 56 E
Matusevich Glacier Tongue	69 05 S	157 15 E
Maud Subglacial Basin	81 00 S	15 00 E
Mautino Peak	77 21 S	162 03 E
Mayewski Peak	77 18 S	162 14 E
Mayhew, Mount	65 35 S	62 26 W
*Mayr Ridge (*not* Mayr Range)	72 11 S	2 22 E
Mazzeo Island	65 09 S	65 00 W
McArthur Glacier	71 20 S	67 29 W
McCain Bluff	70 19 S	160 05 E
McCarthy Island	67 16 S	59 25 E
McCarthy Nunatak	69 07 S	64 45 E
McCrory, Mount	75 29 S	139 26 W
McCuddin Mountains	75 47 S	128 42 W
McElroy Ridge	72 37 S	168 03 E
McGaw Peak	75 52 S	140 59 W
McGee Rock	75 54 S	142 59 W
McGrath, Mount	70 53 S	65 28 E
McGrath Nunatak	68 03 S	63 01 E
McGuire Island	64 46 S	64 24 W
McKenzie Peak	70 18 S	65 38 E
McKinnis Peak	69 34 S	159 21 E
McKinnon Glacier	70 38 S	67 45 E
McLaughlin Cliffs	71 35 S	67 32 W
McLean Buttress	77 19 S	160 58 E
McLeod Glacier	69 21 S	158 27 E
McLeod Massif	70 46 S	68 00 E
McMurdo Ice Shelf	78 00 S	166 30 E
McPherson Crags	54 29 S	37 04 W
McSaveney Spur	77 17 S	160 35 E
McWhinnie Peak	77 16 S	162 14 E
Mechnikov Peak	71 37 S	11 28 E
Medusa Pool	57 04 S	26 42 W
Medvecky Peaks	70 34 S	67 38 E
Mefford Knoll	76 01 S	136 16 W
Meier Peak	71 51 S	168 40 E
Meknattane Nunataks	69 48 S	75 12 E
Melbert Rocks	78 02 S	155 07 W
Mel Moraine	71 53 S	9 18 E
Melville Point	74 35 S	135 31 W
Mendeleyev Glacier	71 55 S	14 33 E
Mendori Island	69 00 S	39 32 E
Mercer, Mount	70 13 S	65 39 E
Merrem Peak	76 03 S	136 03 W
Midkiff Rock	77 28 S	145 06 W
Migmatitovaya Rock	71 47 S	10 38 E
Mikus Hill	70 27 S	63 50 W
Milan Rock	76 01 S	140 41 W
Miller Bluffs	77 35 S	85 45 W
Miller Butte	72 42 S	160 15 E
Miller Nunataks	67 02 S	55 11 E
Miller Spur	75 07 S	137 29 W
Milles Nunatak	70 55 S	160 06 E
Mime Glacier	77 37 S	161 45 E
Minami-heitō, Mount	69 17 S	39 48 E
Minami-karamete Rock	69 13 S	35 26 E
Minamo Island	69 39 S	39 27 E
Minstrel Point	61 04 S	55 25 W
Miranda Peaks	71 28 S	68 36 W
Mirazh Mountain	71 18 S	13 25 E
Mirotvortsev, Mount	71 50 S	12 17 E
Misnomer Point	62 22 S	59 42 W
Mitchell Nunatak	70 58 S	71 30 E
Mitterling Glacier	66 50 S	64 18 W
Mittlere Petermann Range	71 30 S	12 28 E
Mizuho Plateau	71 30 S	39 00 E
Mizukuguri Cove	69 11 S	39 38 E
Mjollkvaevane Cirques	71 53 S	14 27 E
Moe Point	70 19 S	62 23 W
Molchaniya Rock	72 09 S	14 08 E
Möll Spur	76 23 S	112 09 W
Molly Hill	54 01 S	38 04 W
Mom Peak	85 27 S	173 00 E
Monakov, Cape	67 09 S	48 21 E
Monica Rock	62 20 S	59 44 W
Monson, Mount	77 31 S	143 31 W
Montecchi Glacier	72 04 S	167 35 E
Monteverdi Peninsula	72 30 S	72 00 W
Moonie, Mount	70 13 S	65 07 E
Moraine Ridge	72 18 S	168 03 E
Moran Bluff	74 23 S	132 37 W
Morgan Ridge	70 29 S	64 41 E
Mørkenatten Peak	71 52 S	10 34 E
Morrell Point	59 26 S	27 25 W
Morrison Rocks	76 51 S	117 39 W
Morris Point	54 01 S	38 04 W
Morriss Peak	76 50 S	144 29 W
Moss Lake	60 42 S	45 37 W
Moulton Icefalls	76 00 S	134 35 W
Mousinho Island	70 38 S	71 58 E
Moutonnée Lake	70 52 S	68 20 W
Muckle Bluff	61 09 S	54 52 W
Mudrey Cirque	77 39 S	160 44 E
Mukai Rocks	69 03 S	39 42 E
Mumford, Mount	71 33 S	65 09 W
Munizaga Peak	85 32 S	177 37 W
Murmanskiy Cape	69 40 S	13 20 E
Murphy Rocks	77 35 S	144 55 W
Murrish Glacier	71 02 S	61 45 W
Musketov Glacier	71 20 S	14 55 E
Musson Nunatak	71 31 S	63 27 W
Mutel Peak	76 31 S	146 03 W
Muus Glacier	71 26 S	61 36 W

Nachtigal Glacier	54 29 S	36 09 W
Nadezhdy Island	70 44 S	11 40 E
Nakayubi, Cape	69 14 S	39 39 E
Nash Glacier	71 15 S	168 10 E
Navarrette Peak	75 55 S	128 45 W
Neighbour Peak	54 31 S	36 06 W
Neilson Peak	70 57 S	62 13 W
Nella Rock	67 31 S	62 51 E
*Nelson Cliff (*not* Nelson Cliffs)	71 14 S	168 42 E
Nelson Nunatak	72 56 S	167 54 E
Neptune Nunataks	76 37 S	145 18 W
Nereide Patch: VACATED	61 57 S	56 44 W
Nero, Mount	71 12 S	159 50 E
Neshyba Peak	71 14 S	62 45 W
Neupokoyev Bight	70 05 S	4 45 E
Neustruyev, Mount	71 51 S	12 14 E
Nevskiye Nunataks	71 40 S	8 05 E
Newman Shoal	68 35 S	77 54 E
New Year Nunatak	71 02 S	71 12 E
Nibelungen Valley	77 37 S	161 20 E
Nicholson Island	66 17 S	110 32 E
Nicholson Rock	75 50 S	114 56 W
Nichols Rock	75 23 S	139 13 W
Nickell Peak	77 19 S	161 28 E
Niels Peak	71 57 S	9 23 E
Nikolayev, Mount	71 44 S	12 26 E
Nikolayev Range	71 54 S	6 02 E
Nimrod Passage	64 59 S	63 58 W
Nims Peak	72 34 S	160 58 E
Noll Glacier	69 42 S	159 15 E
Nordhill, Mount	70 55 S	63 27 W
Nordwestliche Insel Mountains	71 27 S	11 33 E
Norman Glacier	71 25 S	67 30 W
Norsel Iceport	71 01 S	11 00 W
North Fork	77 32 S	161 15 E
Northrup Head	69 52 S	160 09 E
Novyy Island	70 50 S	2 50 W
Noxious Bluff	56 19 S	27 34 W
Ober-See, Lake	71 17 S	13 39 E
Oblachnaya Nunatak	67 41 S	51 16 E
Oceanite, Mount	58 29 S	26 15 W
Odin Glacier	77 35 S	161 36 E
Odinokaya Nunatak	71 32 S	6 10 E
Odin Valley	77 36 S	161 43 E
Oehlenschlager Bluff	75 03 S	136 42 W
Oeschger Bluff	76 24 S	111 48 W
Office Girls, The	72 20 S	160 01 E
Offset Ridge	71 41 S	68 32 W
Ōgi Beach	69 08 S	39 26 E
O'Keefe Hill	70 20 S	64 24 E
Okskaya Nunatak	71 58 S	13 47 E
Oliver Peak	77 37 S	161 03 E
Ollivant Point	57 46 S	26 31 W
Olson Glacier	72 49 S	166 41 E
Olson Island	77 14 S	153 17 W
Omega Peak	72 09 S	166 03 E
Ondori Island	69 00 S	39 32 E
Onezhskiye Nunataks	71 35 S	7 03 E
Oona Cliff	72 27 S	160 09 E
Opornyy Point	69 48 S	13 00 E
Orestes Valley	77 28 S	161 55 E
Orion Massif	70 23 S	66 47 W
Orr Island	77 38 S	149 36 W
Osechka Peak	71 31 S	15 26 E
Oshiage Beach	69 38 S	39 27 E
Oskeladden Rock	71 18 S	11 27 E
Östliche Petermann Range	71 26 S	12 44 E
Ostryy Point	69 55 S	12 00 E
Osuga Glacier	72 34 S	166 55 E
Otis, Mount	75 05 S	136 13 W
Otome Point	68 08 S	42 36 E
Ouellette Island	64 47 S	64 25 W
Outback Nunataks	72 30 S	160 30 E
Outlook Peak	85 59 S	150 50 W
Outrider Nunatak	69 28 S	156 23 E
Owen Ridge	79 50 S	84 50 W
Oyayubi Island	69 14 S	39 40 E
Oyayubi Point	69 15 S	39 39 E
Ozhidaniya Cove	70 44 S	11 39 E
Pagoda Ridge	71 53 S	68 33 W
Pagodroma Gorge	70 50 S	68 08 E
Paine Ridge	71 50 S	162 00 E
Palets Rock	70 46 S	11 36 E
Pallas Peak	72 06 S	69 43 W
Pallid Peak	84 37 S	178 49 W
Palmer Point	69 43 S	74 02 E
Palombo, Mount	77 29 S	143 12 W
Pål Rock	71 18 S	11 26 E
Pålsson, Mount	67 20 S	65 32 W
Panorama Peak	77 37 S	161 24 E
Papanin Nunataks	68 13 S	50 15 E
Paradise Ridge	85 27 S	157 10 W
Pardoe Peak	73 29 S	61 38 E
Pardo Ridge	61 07 S	54 51 W
Parizhskaya Kommuna Glacier	71 38 S	12 04 E
Parker Hill	68 31 S	78 26 E
Parker Mesa	77 15 S	160 55 E
Parker Pass	75 53 S	142 48 W
Parmelee Massif	70 58 S	62 10 W
Partizan Island	68 31 S	78 10 E
Partridge Nunatak	75 42 S	140 20 W
Paschal Glacier	75 54 S	140 40 W
Passel Pond	76 53 S	145 05 W
Paternoster Valley	60 41 S	45 37 W
Paternostro Glacier	69 24 S	158 37 E
Paterson Islands	67 32 S	63 10 E
Payne Creek	54 00 W	38 04 W
Peacock Peak	75 11 S	134 30 W
Pearigen, Mount	72 01 S	168 50 E
Peden Cliffs	74 57 S	136 28 W
Pegasus Mountains	71 00 S	67 12 W
Pegmatite Peak	85 39 S	154 39 W
Pemmican Step	72 00 S	167 33 E
Penance Pass	78 04 S	163 51 E
Pendragon, Mount	61 15 S	55 14 W
Peneplain Peak	83 51 S	167 02 E
Penguin Heights	68 08 S	42 38 E
Perkins Glacier	74 54 S	136 37 W
Per Rock	71 17 S	11 26 E
Perry Range	75 00 S	134 12 W
Perseus, Mount	57 04 S	26 40 W
Perseus Crags	70 36 S	66 11 W
Per Spur	71 19 S	12 36 E
Pervomayskaya Peak	71 47 S	11 40 E
*Petermann Ranges (*not* Petermann Range)	71 40 S	12 20 E
Peter Nunatak	75 55 S	128 33 W
Peters Bastion	70 27 S	62 54 W
Peters Glacier	54 08 S	37 33 W
Peterson Ridge	84 34 S	163 56 E
Petrides, Mount	75 05 S	136 30 W
Pettersen Ridge	71 47 S	9 42 E
Pettigrew Scarp	54 30 S	37 04 W
Pew, Mount	72 19 S	169 11 E
Phoebe, Mount	71 47 S	68 47 W
Pickering Nunataks	71 49 S	68 57 W
Pieck Range	71 45 S	12 06 E
Pilot Glacier	73 23 S	165 03 E
Pinder Gully	60 43 S	45 35 W
Pinegin Peak	71 44 S	12 33 E
Pinther Ridge	70 22 S	64 20 W
Pionerskiy Dome	73 59 S	73 08 E
Piore Ridge	72 40 S	168 55 E
Pipecleaner Glacier	78 14 S	162 51 E
Pippin Peaks	65 39 S	62 28 W
*Pirner Peak (*not* Pirner, Mount)	54 31 S	36 04 W
Pitzman Glacier	70 41 S	160 10 E
Plane Table	77 36 S	161 27 E
Podprudnoye Lake	70 45 S	11 37 E
Poisson Hill	62 29 S	59 39 W
Pollard, Mount	70 28 S	64 37 E
Pollux Rock	57 07 S	26 47 W
Pomornaya Hill	70 45 S	11 47 E
Poorman Peak	69 57 S	159 15 E
Pope Mountain	69 44 S	158 50 E
Porkchop, Lake	78 16 S	163 08 E
Post Ridge	76 56 S	143 38 W
Pothole Gulch	57 07 S	26 46 W
Potmess Rocks	62 19 S	59 45 W
Potter Nunataks	72 02 S	161 10 E
Potts Glacier	72 58 S	166 50 E
Poulton Peak	68 02 S	63 02 E
Powell Channel	68 08 S	67 08 W
Prahl Crags	76 04 S	134 43 W
President Beaches	62 39 S	61 09 W
Preuschoff Range	72 04 S	4 03 E
Prilednikovoye Lake	70 45 S	11 35 E
Prince Creek	54 01 S	38 04 W
Procyon Peaks	70 29 S	66 30 W
Proschchaniya Bay	70 10 S	4 20 E
Prospect Mesa	77 30 S	161 52 E
Pryamougol'naya Bay	70 10 S	5 30 E
Publications Ice Shelf	69 38 S	75 20 E
Pumphouse Lake	60 42 S	45 37 W
Pungent Point	56 18 S	27 31 W
Puppis Pikes	71 16 S	66 24 W
Purvis Peak	72 38 S	169 09 E
Putzke Peak	75 49 S	128 32 W
Pyxis Ridge	71 16 S	66 48 W
Quadrangle, The	71 35 S	68 36 W
Quadrant Peak	57 06 S	26 47 W
Quar Ice Shelf	71 20 S	11 00 W
Quartermain Glacier	67 01 S	65 09 W
Quensel Glacier	54 46 S	35 50 W
Rabben, Mount	66 27 S	54 07 E
Rachel Glacier	65 37 S	62 10 W
Ragle Glacier	76 28 S	145 32 W
Rainbow Ridge	78 06 S	165 24 E
Ramenskiy, Mount	71 46 S	12 33 E
*Ramp Rocks (*not* Ramp Rock)	53 59 S	38 18 W
Randall Ridge	71 44 S	64 38 W

Rankin Glacier	71 41 S	62 15 W
Ranney Nunatak	76 53 S	143 55 W
Rathbone Hills	71 39 S	64 48 W
Ravelin Ridge	61 11 S	54 05 W
Razlom Point	70 00 S	12 52 E
Razumovskiy, Mount	71 29 S	12 43 E
Rea Rocks	77 05 S	145 10 W
Rebholz Nunatak	74 05 S	100 13 W
Recess Nunatak	76 31 S	144 17 W
Reddick Nunatak	76 17 S	144 01 W
Redfearn Island	68 37 S	77 53 E
Reek Point	56 16 S	27 32 W
Reeves Peninsula	77 24 S	152 20 W
*Reference Islands (*not* Reference Island)	68 12 S	67 10 W
Regula Range	72 05 S	3 20 W
Reilly Rocks	75 09 S	114 59 W
Renaud Glacier	67 43 S	65 35 W
Renner Peak	70 21 S	67 50 W
Reyes Spit	62 29 S	59 41 W
Reynolds Bench	70 35 S	63 40 W
Reynolds Glacier	77 38 S	145 55 W
Reynolds Strait	74 15 S	132 10 W
Rhea Corner	71 53 S	68 48 W
Rhodes Icefall	74 58 S	136 25 W
Richardson Glacier	70 28 S	63 42 W
Richmond Peak	75 48 S	115 49 W
Richter Glacier	77 10 S	155 25 W
Rigel, Mount	70 24 S	66 52 W
Riiser-Larsen Ice Shelf	72 40 S	16 00 W
Rinehart Peak	70 38 S	160 01 E
Ristkalvane Nunataks	71 41 S	10 36 E
Roaring Ridge	86 14 S	146 45 W
Roaring Valley	78 16 S	163 06 E
Robbins Island	64 47 S	64 27 W
Roberts Cirque	75 45 S	115 49 W
Robertson Nunatak	71 54 S	69 37 E
Robertson Ridge	77 24 S	162 12 E
Robilliard Glacier	70 13 S	159 56 E
Rock Haven	60 44 S	45 35 W
Rockney Ridge	75 02 S	133 45 W
Rodman Cove	61 07 S	55 28 W
Rokhlin Nunataks	72 12 S	14 28 E
Roos Glacier	75 17 S	110 57 W
Rorqual, Mount	65 39 S	62 20 W
Rosenberg Glacier	75 44 S	132 33 W
Rose Point	74 45 S	136 45 W
*Rossa Point (*not* Rassa Point)	65 57 S	65 14 W
Rowley Corridor	71 25 S	67 15 W
Rowley Massif	71 35 S	61 55 W
Rubeli Bluff	70 26 S	72 27 E
Rubey Glacier	75 11 S	137 07 W
Rubin de la Borbolla, Mount	75 02 S	135 03 W
Rücker Ridge	78 12 S	162 50 E
Rudder Point	56 40 S	28 08 W
Rude Spur	77 27 S	160 49 E
Ruhnke, Mount	72 05 S	3 38 E
Rukhin, Mount	71 35 S	15 07 E
Runyon Rock	76 56 S	116 33 W
Rusanov, Mount	71 32 S	19 38 E
Russkiye Mountains	72 10 S	18 00 E
Rust Bluff	82 56 S	157 42 E
*Rutford Ice Stream (*not* Rutford Glacier)	78 50 S	82 30 W
Sakazuki Rock	68 43 S	40 28 E
Salamander Point	59 25 S	27 05 W
Samoylovich Nunatak	71 48 S	4 55 E
Samsel, Mount	70 24 S	63 15 W
Sandau Nunatak	71 42 S	67 12 W
Sandbakken Moraine	71 34 S	12 08 E
Sandbotnen Cirque	71 44 S	12 01 E
Sandegga Ridge	71 54 S	9 43 E
Sandeggtind Peak	71 52 S	9 45 E
Sandeidet Moraine	71 39 S	12 15 E
Sandhøhallet Glacier	71 52 S	9 50 E
Sandhø Heights	71 50 S	9 47 E
Sandhøkalvane Nunataks	71 46 S	9 55 E
Sandneset Point	71 39 S	9 33 E
Sandneskalven Nunatak	71 40 S	9 53 E
Sandnesstaven Peak	71 41 S	9 39 E
Sandseten Mountain	71 33 S	12 09 E
Sarcophagus Point	57 04 S	26 43 W
Sarkofagen Mountain	72 10 S	16 45 E
Sarnoff Mountains	77 10 S	145 00 W
Satellite Snowfield	71 28 S	69 45 W
Saunders Bluff	72 45 S	160 44 E
Sbrosovoye Lake	70 45 S	11 35 E
Schaefer Islands	73 40 S	103 24 W
Schicht, Mount	71 26 S	13 08 E
Schimansky, Mount	70 50 S	63 49 W
Schirmacher Massif	71 37 S	62 20 W
Schlatter Glacier	77 41 S	161 27 E
Schloredt Nunatak	75 03 S	134 15 W
Schmehl Peak	69 34 S	158 45 E
Schmidt Nunataks	69 53 S	158 56 E
Schroeder Spur	71 38 S	160 30 E
Schultz Glacier	77 19 S	162 20 E
Schüssel Cirque	71 34 S	11 33 E
Schüssel Moraine	71 34 S	11 32 E
Schutz, Mount	69 46 S	159 16 E
Schwob Peak	75 53 S	128 39 W
Scorpio Peaks	70 31 S	67 26 W
Scudder Mountain	86 07 S	149 36 W
Sealers Passage	61 02 S	55 23 W
Seavers Nunataks	73 10 S	61 58 E
Sechrist Peak	75 23 S	111 02 W
Secluded Rocks	67 32 S	59 20 E
Second Crater	77 49 S	166 40 E
Secret Lake	71 50 S	68 21 W
Sedov, Cape	69 22 S	14 05 E
Seekopf, Mount	71 17 S	13 42 E
Send, Mount	70 02 S	159 49 E
Serba Peak	69 37 S	159 03 E
Serlin Spur	75 04 S	134 42 W
Serrat Glacier	70 24 S	161 04 E
Severtsev, Mount	71 43 S	12 37 E
Shabica Glacier	70 21 S	62 45 W
Shamrock Hill	56 42 S	27 05 W
Shangri-la	78 03 S	163 42 E
Shark Peak	68 03 S	62 41 E
Sharman Rock: VACATED	62 06 S	58 28 W
Shatskiy Hill	72 02 S	13 21 E
Shcherbakov Range	71 51 S	10 32 E
Sheathbill Bay	53 59 S	37 26 W
Ship Nunatak	71 04 S	159 50 E
Shirshov, Mount	66 51 S	51 37 E
Shmidt Subglacial Basin	72 00 S	106 00 E
Shoemake Nunatak	75 33 S	140 05 W
Shortcut Island	64 47 S	64 03 W
Shostakovich Peninsula	72 11 S	71 20 W
Showers, Mount	71 45 S	61 28 W
Sibiryakov, Mount	67 56 S	49 35 E
Siegfried Peak	77 34 S	161 46 E
Siegmund Peak	77 35 S	161 46 E
Sierra Island	62 24 S	59 48 W
Simmons Glacier	75 00 S	113 36 W
Simpson Glacier	71 17 S	168 38 E
Simpson Ridge	68 06 S	62 23 E
*Single Island (*not* Single Promontory)	69 48 S	68 36 E
Singleton Nunatak	71 15 S	61 36 W
Sinha, Mount	75 04 S	136 09 W
Siniff Bay	74 40 S	135 50 W
Sirius Cliffs	70 33 S	66 53 W
Sjøbotnen Cirque	71 22 S	13 25 E
Sjøneset Spur	71 17 S	13 35 E
Skaar Ridge	84 49 S	163 15 E
Skarsbrotet Glacier	71 50 S	11 45 E
Skarshaugane Peaks	71 49 S	11 37 E
Skarshovden, Mount	71 47 S	11 38 E
Skarskvervet Glacier	71 45 S	11 30 E
Skavlrimen Ridge	71 58 S	13 32 E
Skeidshornet Peak	71 50 S	12 01 E
Skeidskar Gap	71 46 S	11 33 E
Skeidskneet, Mount	71 53 S	11 57 E
Skeidsnutane Peaks	71 53 S	11 35 E
Skilift Col	86 11 S	148 36 W
Skinner Glacier	70 14 S	68 00 W
Skorvehallet Slope	71 59 S	9 12 E
Skuggekammen Ridge	71 23 S	13 40 E
Slabotnen Cirque	71 46 S	10 27 E
Slagle Ridge	71 55 S	169 50 E
Slater Rocks	75 05 S	113 53 W
*Slava Ice Shelf (*not* Slava Bay)	68 49 S	154 44 E
Sledging Col	85 51 S	154 48 W
Smalegga Spur	71 55 S	10 37 E
Small, Mount	70 30 S	64 42 E
Smirnov Peak	71 43 S	10 38 E
Smith Nunatak	70 13 S	64 35 E
Smith Ridge	70 02 S	72 50 E
Smolenskaya Mountain	71 52 S	12 21 E
Smoot Rock	75 15 S	135 24 W
Smørstabben Nunatak	71 30 S	10 52 E
Sneddon Nunataks	77 17 S	153 46 W
Snøskalkegga Ridge	71 59 S	13 13 E
*Snow Hills (*not* Snow Hill)	60 42 S	45 38 W
Snyder Peninsula	71 25 S	61 26 W
Soldat Island	68 31 S	78 10 E
Solem Ridge	71 12 S	63 15 W
Solhøgdene Heights	71 22 S	13 42 E
Solitary Nunatak	67 28 S	58 46 E
Solitary Peak	83 14 S	161 40 E
Solov'yev, Mount	74 41 S	12 19 E
Sombre Lake	60 41 S	45 37 W
Sombre Point	57 45 S	26 25 W
Soond, Mount	75 00 S	134 13 W
Sooty Cove	54 01 S	38 02 W
*Sooty Rock (*not* Black Reef)	65 14 S	65 09 W
Søråsen Ridge	71 25 S	10 00 W
Soto Glacier	71 31 S	61 46 W
Sourabaya, Mount	59 03 S	26 36 W

South Fork	77 34 S	161 15 E
Southwind Passage	65 18 S	65 20 W
Spartan Glacier	71 03 S	68 20 W
Spatz, Mount	72 41 S	160 33 E
Spaulding Rocks	77 00 S	143 16 W
Spaull Point	60 44 S	45 41 W
Specimen Nunatak	67 59 S	66 46 W
Spencer Island	77 09 S	148 04 W
Sphinxkopf Peak	71 25 S	11 57 E
Sphinx Mountain	71 27 S	11 58 E
Spilite Arch	54 30 S	37 02 W
Spindrift Col	60 41 S	45 37 W
Spirtle Rock	65 13 S	64 20 W
Splinter Crag	57 05 S	26 48 W
Split Rock	64 47 S	64 08 W
Sponskaftet Spur	71 39 S	11 12 E
Spraglegga Ridge	71 55 S	14 45 E
Stadium, The	61 07 S	54 42 W
Stamper Peak	71 41 S	169 19 E
Stancomb-Wills Glacier	75 18 S	19 00 W
Stancomb-Wills Glacier Tongue	75 00 S	22 00 W
Stanford Nunatak	76 51 S	143 18 W
Starbuck Crater	76 01 S	133 11 W
Starr Lake	77 50 S	166 40 E
Stauffer Bluff	76 10 S	111 46 W
Stedet Island	67 33 S	61 27 E
Steele, Mount	69 50 S	159 40 E
Steel Peak	70 54 S	63 27 W
Steeple Peaks	71 38 S	67 03 W
Steeple Point	71 43 S	67 19 W
Steinbotnen Cirque	71 18 S	13 21 E
Stein Islands	69 39 S	75 47 E
Steinmulen Shoulder	71 18 S	13 25 E
Steinnes	69 22 S	76 34 E
*Stench Point (*not* West Bluff)	56 18 S	27 36 W
Stenka Mountain	71 55 S	14 46 E
Stepping Stones	64 47 S	64 00 W
Steuri Glacier	76 23 S	112 24 W
Stevenson Bluff	69 51 S	159 28 E
Stevenson Peak	72 25 S	168 17 E
Stewart Glacier	77 29 S	151 25 W
Stillwell Hills	67 26 S	59 28 E
Stinker Point	61 13 S	55 23 W
Stockton Peak	71 08 S	62 10 W
Stoker Island	62 24 S	59 51 W
Storeidet Col	71 41 S	11 31 E
Store Svarthorn Peak	71 35 S	12 33 E
Storkvammen Cirque	71 44 S	11 44 E
Stornes Peninsula	69 26 S	76 05 E
Storsåtklubben Ridge	71 25 S	12 25 E
Strauss Glacier	77 20 S	139 40 W
Stravinsky Inlet	72 20 S	71 30 W
Strawberry Cirque	83 20 S	157 36 E
Strawn Pass	75 06 S	135 16 W
Striated Nunatak	67 21 S	56 13 E
Strider Rock	78 02 S	155 26 W
Strømme Ridge	71 27 S	61 42 W
Strong, Mount	70 35 S	62 45 W
Strover Peak	69 43 S	74 07 E
Stubbs Pass	68 11 S	65 12 W
Südliche Petermann Range	71 46 S	12 20 E
Sullivan Nunataks	70 52 S	65 33 E
Sultan Glacier	61 08 S	55 21 W
Sultans Head Rock	77 43 S	167 12 E
Summers Glacier	72 13 S	167 28 E
Surge Rocks	64 47 S	64 04 W
Suribachi, Mount	69 29 S	39 38 E
Surprise Spur	86 34 S	147 50 W
Sutherland Peak	77 38 S	161 03 E
Svarthausane Crags	71 40 S	12 40 E
Svarthausen Nunatak	69 49 S	74 30 E
Svarthorna Peaks	71 35 S	12 37 E
Svarthornbotnen Cirque	71 35 S	12 36 E
Svarthornkammen Ridge	71 31 S	12 31 E
Svarttindane Peaks	71 39 S	12 30 E
Svendsen Glacier	70 21 S	160 00 E
Svensson Ridge	70 11 S	64 29 E
Sverre Peak	71 43 S	9 39 E
Swadener, Mount	77 16 S	153 45 W
Swanson Glacier	71 30 S	160 24 E
Swarm Peak	76 29 S	146 20 W
Swarsen Nunatak	71 25 S	63 39 W
Swift Peak	66 19 S	63 08 W
Swinburne Ice Shelf	77 10 S	153 55 W
Swinford, Mount	77 16 S	161 54 E
Swope Glacier	77 20 S	145 50 W
Sykes Glacier	77 35 S	161 32 E
Syrstad Rock	75 58 S	133 02 W

Table Bay	61 09 S	55 24 W
Taborovskiy Peak	71 48 S	11 35 E
Tachimachi Point	69 00 S	39 37 E
Talutis Inlet	77 15 S	81 10 W
Tambovskaya Peak	71 41 S	12 20 E
Tangekilen Bay	69 58 S	26 20 E
Tange Promontory	67 27 S	46 45 E
Tapsell Foreland	70 52 S	167 20 E
Tarbuck Crag	68 35 S	78 12 E
Tarr, Mount	70 25 S	65 46 E
Tasch Peak	76 40 S	118 03 W
Taurus Nunataks	70 52 S	66 23 W
Taylor Buttresses	70 08 S	67 23 W
Taynaya Bay	68 27 S	78 16 E
Teardrop Pond	76 54 S	145 18 W
Temnikow Nunataks	70 37 S	64 10 W
Tempyō, Mount	69 31 S	39 43 E
Tenorio Rock	62 28 S	59 44 W
Terletskiy Peak	71 49 S	10 31 E
Terningskarvet Mountain	72 11 S	2 46 E
Terra Nova Islands	68 53 S	157 57 E
Terror Point	77 41 S	168 13 E
Tester Nunatak	70 58 S	71 29 E
Thälmann Mountains	72 00 S	4 45 E
Theaker, Mount	70 18 S	159 38 E
Themis Nunatak	71 37 S	69 06 W
Thode Island	77 02 S	148 03 W
Thomas, Lake	77 24 S	162 15 E
Thomas Nunataks	70 32 S	65 11 E
Thomas Peak	72 46 S	166 43 E
Thompson Point	70 18 S	161 04 E
Thompson Ridge	76 27 S	146 05 W
Thompson Spur	71 32 S	160 23 E
Thomson Rock	71 27 S	66 56 W
Thorarinsson, Mount	67 15 S	64 59 W
Three Sisters Cones	77 34 S	166 58 E
Threshold Nunatak	83 46 S	166 06 E
Thrinaxodon Col	85 12 S	174 19 W
Thundergut, Mount	77 39 S	161 24 E
Tiger Rocks	53 59 S	38 16 W
Tilbrook Point	59 26 S	27 15 W
Tindal Bluff	67 04 S	64 52 W
Tingey Rocks	69 57 S	67 52 E
Tiw Valley	77 36 S	161 47 E
Tocci Glacier	72 10 S	168 18 E
Todt Ridge	71 22 S	13 57 E
Tomandl Nunatak	76 49 S	144 57 W
*Tomblin Rock (*not* Black Rock)	57 04 S	26 39 W
Tombstone Hill	72 27 S	169 42 E
Toogood, Mount	71 37 S	160 14 E
Topografov Island	68 30 S	78 11 E
Topping Cone	77 29 S	169 16 E
Torinosu Cove	69 29 S	39 34 E
Trabucco Cliff	76 37 S	118 01 W
Trail Glacier	73 34 S	61 35 E
Trajer Ridge	68 34 S	78 30 E
Treadwell, Mount	77 01 S	144 51 W
Trenholm Point	75 26 S	142 23 W
Trubyatchinskiy Nunatak	68 20 S	49 38 E
*Trulla Bluff (*not* Glacier Bluff)	59 02 S	26 31 W
Trundy Island	64 47 S	64 28 W
Tsentral'naya Hill	70 45 S	11 40 E
Tsiolkovskiy Island	70 30 S	3 00 E
Tuff Bluff	78 02 S	165 27 E
Tukey Island	64 46 S	64 26 W
Turbulence Bluffs	67 09 S	56 29 E
Turmoil Point	59 02 S	26 40 W
Turmoil Rock	62 21 S	59 47 W
Turnbull, Mount	70 21 S	64 02 E
Tussock Island	54 29 S	37 07 W
Tvireita Moraine	71 55 S	14 37 E
Twilight Bay	68 32 S	69 48 E
Twisted Lake	60 43 S	45 40 W
Twomey, Mount	71 30 S	161 41 E
Tyuleniy Point	70 44 S	11 36 E

Ufsebotnen Cirque	71 24 S	13 09 E
Ufsebrotet Bluff	71 23 S	13 17 E
Ufsekammen Ridge	71 24 S	13 14 E
Ulla, Mount	77 32 S	162 24 E
Unicorn, Mount	71 16 S	67 07 W
Unneruskollen Island	70 30 S	6 10 W
Unter-See, Lake	71 20 S	13 27 E
Uragannyy Point	69 57 S	12 50 E
Urvantsev Rocks	72 06 S	5 37 E
Usnea Plug	62 38 S	61 05 W
Utrista Rock	71 35 S	10 32 E

Valhalla, Mount	77 35 S	161 56 E
Valhalla Glacier	77 34 S	161 58 E
Valikhanov, Mount	71 49 S	12 15 E
Valkyrie, Mount	77 33 S	162 19 E
Van Buren, Mount	71 18 S	63 30 W
Vane Glacier	75 16 S	110 19 W
Vangengeym Glacier	71 17 S	13 48 E
Van Hulssen Islands	67 33 S	62 43 E
Van Loon Glacier	71 01 S	163 24 E
Van Veen, Mount	71 35 S	161 54 E
Vashka Crag	77 19 S	161 03 E
Vavilov Hill	72 02 S	13 11 E
Vee Cliffs	77 38 S	167 45 E
Vela Bluff	71 10 S	66 56 W

Veli Peak	77 39 S	161 28 E
Vennum, Mount	71 33 S	61 53 W
Venture Dome	68 36 S	62 13 E
Venzke Glacier	75 00 S	134 24 W
Verblyud Island	70 00 S	15 55 E
Vereteno, Lake	68 31 S	78 25 E
Verleger Point	74 42 S	136 15 W
Vertigo Bluff	83 35 S	167 00 E
Vesëlaya Mountain	71 38 S	12 32 E
Vestbanen Moraine	71 35 S	11 59 E
Vestkapp, Cape	72 40 S	19 00 W
Vestknatten Nunatak	69 48 S	75 03 E
Veststraumen Glacier	74 15 S	15 00 W
Vestvika Bay	69 10 S	33 00 E
Veterok Rock	71 54 S	14 43 E
Victoria Upper Lake	77 19 S	161 35 E
Vidal Rock	62 30 S	59 43 W
Vindegga Spur	71 51 S	11 19 E
Vindegghallet Glacier	71 49 S	11 15 E
Vishniac Peak	77 14 S	160 31 E
Vitnesteinen Rock	71 25 S	12 36 E
Vivian Nunatak	77 32 S	143 34 W
Von Braun, Mount	71 59 S	169 34 E
Vortex Col	77 34 S	160 25 E
Vos'moy Mart Rocks	72 02 S	14 40 E
Vrana Dome	69 53 S	73 28 E
Vrana Peak	70 22 S	63 59 E
Vulcan Nunatak	76 35 S	144 37 W
Vyatskaya Peak	71 57 S	13 32 E
Vysotskiy Peak	71 34 S	11 40 E
Vystrel Mountain	71 37 S	15 04 E
Wagner Spur	70 09 S	159 36 E
Waitt Peaks	71 29 S	62 34 W
Wakadori Island	69 00 S	39 32 E
Walcott Peak	71 49 S	64 22 W
Wales Stream	77 35 S	163 30 E
Walgreen Peak	77 03 S	145 43 W
Walker Ridge	72 34 S	168 22 E
Walker Valley	70 41 S	67 33 E
Wallace Rock	75 55 S	128 27 W
Wallis Nunataks	66 52 S	55 39 E
Walsh Glacier	69 33 S	158 45 E
Walsh Spur	72 40 S	169 22 E
Walton, Mount	72 29 S	160 18 E
Walts Cliff	76 01 S	135 42 W
Wanderer Valley	54 00 S	38 03 W
†Ward, Mount	71 36 S	66 57 W
Ware, Mount	70 27 S	65 36 E
Warriner Island	68 37 S	77 54 E
Wasp Point	59 28 S	27 22 W
Waterhouse Spur	86 37 S	147 25 W
Watson Nunatak	67 58 S	62 45 E
Watson Ridge	67 00 S	55 46 E
Webber Island	77 17 S	153 05 W
Webb Icefall	77 16 S	160 29 E
Webb Lake	77 20 S	160 52 E
Webster Peaks	70 28 S	65 25 E
Wedemeyer Rocks	76 06 S	135 56 W
Wegert Bluff	69 42 S	159 20 E
Weikman Nunataks	76 30 S	143 59 W
Welch Mountains	70 57 S	63 30 W
Weldon Glacier	77 05 S	31 30 W
Wells Saddle	76 03 S	135 35 W
Wendland, Mount	84 42 S	175 18 W
Werenskiold Bastion	67 26 S	65 32 W
West, Mount	77 25 S	145 30 W
West Dailey Island	77 53 S	164 54 E
West Groin	77 39 S	160 48 E
Westliche Petermann Range	71 35 S	12 10 E
West Reef	61 05 S	55 36 W
Whale Rock: VACATED	60 48 S	45 39 W
Whale Valley	54 30 S	36 05 W
Whelan Nunatak	70 09 S	64 17 E
Whewell Glacier	72 04 S	169 47 E
White Company, The	61 06 S	55 09 W
Whited Inlet	69 50 S	160 08 E
White Glacier	75 45 S	140 50 W
White Islands	77 17 S	153 10 W
White Spur	71 19 S	160 16 E
White Valley	76 39 S	117 57 W
Whitewhale Bastion	65 37 S	62 30 W
Whiting, Mount	71 40 S	62 37 W
Whiting Rocks	65 15 S	64 20 W
Wignall Nunataks	70 10 S	64 23 E
Wilhelm Glacier	72 46 S	166 37 E
Willey Glacier	70 25 S	67 50 W
Williamson Bluff	68 05 S	65 42 W
Williamson Ridge	75 47 S	116 45 W
Wiltshire Rocks	67 30 S	63 07 E
Wise, Mount	78 08 S	165 23 E
Wishbone Ridge	84 56 S	166 56 W
Witt Bluff	71 16 S	68 27 W
Wolak Peak	77 39 S	161 08 E
Wollesen Islands	67 31 S	62 41 E
Womochel Peaks	72 40 S	161 04 E
Worley Point	74 24 S	132 47 W
Wu Nunatak	72 29 S	161 08 E
Wylie Ridge	71 51 S	168 27 E
Yakovlev, Mount	71 59 S	16 38 E
Yanovskiy Rocks	71 56 S	11 40 E
Yates Glacier	70 49 S	62 12 W
Yelcho, Cape	61 03 S	55 22 W
Yeliseyev Rocks	72 05 S	14 30 E
Yellowstone Crags	57 45 S	26 27 W
Yesenin, Mount	72 03 S	14 26 E
Yoder Glacier	75 07 S	114 24 W
Youngman, Mount	77 15 S	154 21 W
Young Peak	69 45 S	74 31 E
Zanuck East Peak	85 57 S	150 53 W
Zapadnoye Lake	70 44 S	11 28 E
Zebra Peak	69 41 S	64 56 E
Zeigler, Mount	77 13 S	143 03 W
Zhelannaya Mountain	72 04 S	18 28 E
Zhil'naya Mountain	71 40 S	12 38 E
Zubchatyy Ice Shelf	67 13 S	49 05 E
Zub Lake	70 45 S	11 44 E
Zuckerhut, Mount	71 25 S	13 27 E
Zuncich Hill	75 50 S	142 51 W
Zurn Peak	75 44 S	115 40 W
Zvezda, Lake	68 32 S	78 27 E
Zwiesel Mountain	71 43 S	12 08 E

News and notes

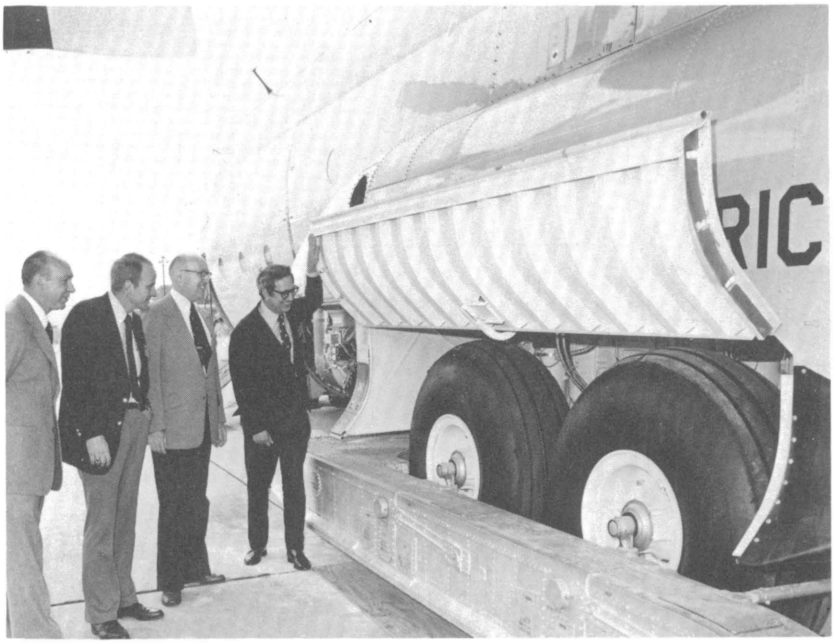
U.S. Antarctic Program science and support personnel, winter 1977

During the 1977 austral winter, 22 scientists—including one Soviet exchange scientist and two N.Z. meteorologists—and 89 support personnel are wintering at four U.S. antarctic stations. Also, one U.S. researcher is at the Soviet Union's Vostok Station (78°28'S. 106°48'E.) with the 22nd Soviet Antarctic Expedition.

Participants in the 1977 winter U.S. Antarctic Program are listed below and on the next page. Support units of the U.S. Naval Support Force, Antarctica, and Holmes and Narver, Inc., are abbreviated NSFA and H&N.

Amundsen-Scott South Pole Station

Anderson, Lloyd J., *meteorology*, N.Z. Meteorological Service
Barker, Kenneth, *doppler research*, U.S. Geological Survey
Boucher, Denis R., H&N
Fletcher, James B., *doppler research*, U.S. Geological Survey
Gastil, Jerry E., H&N
Gibson, Kenneth A., H&N
Halter, Bradley C., *meteorology*, National Oceanic and Atmospheric Administration
Harris, Stewart E., *upper atmosphere*, Bartol Research Foundation
Heg, John M., H&N
Koerner, Frederick C., M.D., H&N
Koleto, William F., Jr., H&N
Nelson, Alan D., H&N
Norman, Simon F., *meteorology*, N.Z. Meteorological Service
Rosenberger, Gary L., *meteorology*, National Oceanic and Atmospheric Administration
Soares, Marshall A.,



Lockheed-Georgia

This new LC-130R, fresh off the production line at the Lockheed-Georgia Company, Marietta, Georgia, and another new LC-130R this spring joined the nation's five other ski-equipped Hercules used in Antarctica. Viewing the unique ski/wheel landing gear at the Georgia plant are (left to right): Harold J. Hart of the Naval Air Systems Command and Robert H. Rutford, division director, Division of Polar Programs, Edward P. Todd, acting assistant director for astronomical, atmospheric, earth, and ocean sciences, and William S. Kosar, Jr. (U.S. Navy), Division of Polar Programs, of the National Science Foundation. The Navy's Antarctic Development Squadron Six (VXE-6) will operate the airplanes.

meteorology, University of California, Davis
Spindler, William J., *station manager*, H&N
Sundblad, Lee R., H&N
Thelander, David R., H&N
Whan, Craig S., *meteorology*, University of California, Davis
*Yogi, Tadashi, *geophysics*, University of California, Davis
Zaitsev, A.N., *geophysics and upper atmosphere*, Institute of Terrestrial Magnetism and Ionosphere and Radio-Wave Propagation (U.S.S.R.)

McMurdo Station

Bailey, David K., NSFA
Bailey, James C., NSFA
Barker, James D., NSFA
Barlow, Cleamon, NSFA
Barnes, John, *officer in charge*, NSFA
Barrett, Kenneth D., NSFA
Bassett, William E., NSFA
Bautista, Antonio M., NSFA
Blair, J.L., NSFA
Boyle, Avery J., NSFA
Bujanovsky, Edward R., NSFA
Cole, Gale M., NSFA
Davis, Billy E., NSFA
Duncan, John R., NSFA
Eckert, Kim H., *geodesy and upper atmosphere*, University of Texas, Austin
Erickson, John J., NSFA
Gibby, George A., NSFA
Grant, David A., NSFA
Grinde, Elling J., NSFA
Grover, Bruce T., NSFA
Hadley, Richard C., NSFA
Haney, Earl L., NSFA
Hull, Richard L., NSFA
Iosa, Peter A., NSFA
Kaelin, James M., NSFA
Kalk, Thomas M., H&N
Kearns, Robert, NSFA
Kehl, Frederick M., *upper atmosphere*, Bartol Research Foundation
Lawther, William A., NSFA
Lewis, Robert, NSFA
Lockhart, Robert B., Jr., NSFA
Loft, Charles A., NSFA
Majeske, William E., NSFA
Maley, Richard J., NSFA
Marshall, Ralph G., NSFA
Mathis, Roosevelt, NSFA
McMahan, John F., NSFA
Meyer, Eugene A., NSFA
Miller, Robert C., NSFA
Miranda, Martin A., NSFA
Moss, Max A., NSFA
Murawski, L.A.J., NSFA
Niehaus, Dale A., NSFA
Nixon, William W., NSFA
Norman, Robert L., NSFA
Oliver, Donna M., *biology*, University of California, San Diego
*Oliver, John S., *biology*, University of California, San Diego
Olszta, Chester R., NSFA
Palmer, Glenn J., NSFA
Phillips, Richard C., NSFA
Potter, William E., NSFA
Preston, Burton C., NSFA
Ransdell, Gary W., NSFA
Reed, David H., NSFA
Reiners, Jerald L., NSFA
Richards, David W., NSFA
Rodriguez, Alfonso, NSFA
Rohde, Leslie E., *geodesy and upper atmosphere*, University of Texas, Austin
Saxman, Kenneth E., NSFA
Schmidt, Dennis R., NSFA
Scott, Ward M., NSFA
Shaffer, Barry, NSFA
Sheets, James R., NSFA
Shelton, Lyle, NSFA
Slattery, Peter N., *biology*, University of California, San Diego
Spargur, William L., NSFA
Spence, Thomas, M.D., NSFA
Stewart, Joseph M., NSFA
Thomas, John R., NSFA
Thompson, Otis H., NSFA
Umpleby, Dale W., NSFA
Van Reeth, Mark M., H&N
Volman, Brian E., NSFA
Watson, Daniel J., H&N
Webb, Gwin E., NSFA
Whitney, Lester F., NSFA
Wilkinson, Charles E., NSFA
Wooldridge, Jack D., NSFA

Palmer Station

Cullen, Gary M., *station manager*, H&N
Dorffeld, Frederick J., H&N
*Glass, Brian M., *biology*, University of Minnesota
Laine, Daren L., H&N
Moriarty, Patrick T., H&N
Schwalenberg, Edward C., *meteorology*, University of Nevada System
Tendick, John P., Jr., H&N

Siple Station

Armstrong, William C., *upper atmosphere*, Stanford University
*Doolittle, John H., *upper atmosphere*, Stanford University
Harding, Peter X., *station manager*, H&N
Logan, James W., H&N
Marsh, Ronald M., H&N

Vostok (Soviet Union)

Fancher, Michael F., *upper atmosphere*, Stanford University

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*Station science leader.

U.S. ratifies seal convention

On 28 December 1976 President Gerald R. Ford signed the instrument of U.S. ratification of the Convention for the Conservation of Antarctic Seals. The convention (see May/June 1972 *Antarctic Journal*, pages 45-49) was concluded in London in 1972 among the 12 nations party to the Antarctic Treaty, which itself provides no protection for seals; the effect of this convention will be to rectify that situation.

Although commercial sealing is not taking place in the Antarctic, the seals there have been vulnerable to the possible onset at any time of uncontrolled exploitation. The convention is a preventive measure intended to create an effective management system for the seals well before their survival might become seriously threatened.

The convention has as basic objectives the preservation, conservation, scientific study, and rational use of the seals, taking into account the effects on the ecological system. It provides complete protection for the Ross seal, the southern elephant seal, and the fur seal. Also, it sets very low catch limits for the other three of the six known antarctic seal species—crabeater, leopard, and Weddell seals—all of which are more plentiful. Responsibility for monitoring the convention is assigned to the Scientific Committee on Antarctic Research of the International Council of Scientific Unions. Provision is made for adoption of additional controls beyond those instituted by this agreement. Should commercial sealing get under way in the Antarctic, each of the parties may adopt more stringent controls for itself than are provided for in the convention, as the United States has already done in the Marine Mammal Protection Act of 1972.

Signatories to the convention include all 12 of the original Antarctic Treaty parties: Argentina, Australia, Belgium, Chile, France, Japan, New Zealand, Norway, South Africa, the Soviet Union, the United Kingdom, and the United States. Four of these—France, South Africa, Norway, and the United Kingdom—have ratified the convention; upon deposit of its ratification, the United States will be the fifth nation to have done so. Ratification by seven of the 12 signatory nations is necessary for the convention to enter into force.

Symposia set on ice masses, glacier beds

The International Glaciological Society will hold a symposium on the dynamics of large ice masses at Ottawa, Ontario, Canada, 21-25 August 1978. The symposium will concern the dynamics of ice sheets past and present, ice caps, large valley glaciers, and floating ice.

A papers committee will consider any paper that provides new information on these topics. For information write: Secretary, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, England.

Also at Ottawa, and during the previous week, the National Research Council of Canada, Subcommittee on Glaciers, will hold a symposium on "glacier beds: the ice-rock interface." Write: C.S.L. Ommanney, Glaciology Division, Environment Canada, Ottawa, Ontario, Canada K1A OE7.

Proceedings of both symposia will be published in special issues of the *Journal of Glaciology*.

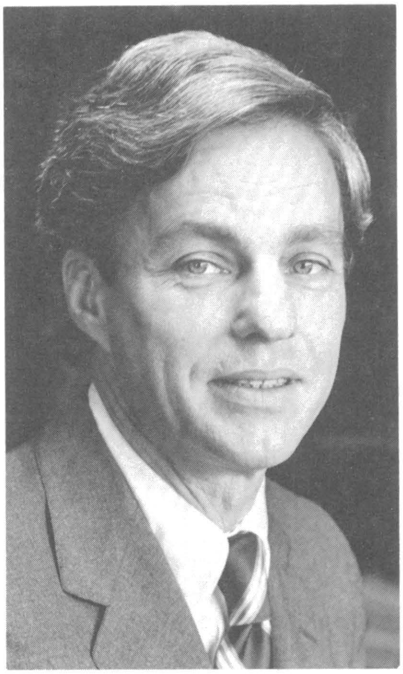
Cold breaks records at South Pole

Three low-temperature records at the United States' Amundsen-Scott South Pole Station were broken in 1976, the 20th year of year-round weather observations at the geographic South Pole: it was the coldest year and the coldest winter half-year, and it had the coldest month so far since 1957.

The average daily temperature at the South Pole in 1976 was -50.0°C. The previous yearly lows of -49.7°C were set in 1959 and 1964. The 1976 cold months (April through September) averaged -60.7°C, versus the -59.9°C of 1968. And August 1976 had an average daily temperature of -65.1°C, which broke the previous monthly low of -64.4°C in July 1969.

Contrary to any notion that the South Pole is getting colder, the first 10-year average temperature record exactly matches the second: -49.3°C. And although 8 August 1976 was the coldest day (-76.0°C) last year at the South Pole, it left intact the record lowest daily South Pole temperature of -80.6°C on 22 July 1965.

The world's lowest natural temperature was recorded on 24 August 1960 at the Soviet Union's Vostok Station (78°28'S. 106° 48'E.), Antarctica, about 1,240 kilometers from the South Pole: -88.3°C.



NSF

Richard C. Atkinson was confirmed by the U.S. Senate on 5 May 1977 as director of the National Science Foundation. He had been acting director since August 1976 and deputy director since June 1975. President Jimmy Carter nominated him for the position of director in April 1977. Dr. Atkinson came to the Foundation from Stanford University. He is an experimental psychologist and an applied mathematician whose research has been concerned with analyses of memory and cognition. He holds a Ph.B. from the University of Chicago and the Ph.D. from Indiana University.

Soviet volume translated, published

Volume 42 of *Problems of the Arctic and the Antarctic* (A.F. Treshnikov, editor in chief) has been translated from Russian and printed for the National Science Foundation.

The 128-page hardcover translation has 16 articles on meteorology, glaciology, geology, sociology, and upper-atmosphere physics. It originally was published by the Hydrometeorological Service, Leningrad, in 1973.

Microfiche ($3) and hard ($6) copies are available from the Nationag Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161. Cite number TT 75-52018.

U.S. Navy

Present and former U.S.-U.S.S.R. antarctic exchange scientists at the Soviet Union's Vostok Station (78°28'S. 106°48'E.) on 28 December 1976, the day that Michael F. Fancher (second from left), Stanford University, arrived to winter there with the 22nd Soviet Antarctic Expedition. The group was flown to Vostok aboard a U.S. LC-130 Hercules (background) from the United States' McMurdo Station, about 1,260 kilometers distant. Others (left to right): Ralph N. Johnson, U.S. Geological Survey (wintered at Vostok in 1976); Robert B. Flint, Jr., Stanford University (wintered at Vostok in 1974); A.N. Zaitzev, Institute of Terrestrial Magnetism and Ionosphere and Radio-Wave Propagation (wintering at the United States' Amundsen-Scott South Pole Station in 1977); Edward P. Lysakov, Arctic and Antarctic Research Institute (wintered at McMurdo in 1976). The Soviet Union and the United States have exchanged scientists in the Antarctic yearly since the 1957-1958 International Geophysical Year.

AAAS national meeting includes polar symposium

"Polar research: to the present, and the future" was the title of a day-long symposium held as part of the 143rd annual meeting of the American Association for the Advancement of Science (AAAS) in Denver, Colorado, on 20-25 February 1977.

Mary Alice McWhinnie, De Paul University, arranged the session. The 11 papers given discussed the emergence of Antarctica (Laurence M. Gould, University of Arizona), polar research—a synthesis (George A. Llano, National Science Foundation), Antarctica and Gondwanaland (Campbell Craddock, University of Wisconsin), glaciology and glacial history (Richard L. Cameron, National Science Foundation, and George H. Denton, University of Maine), the polar role in global climate change (Joseph O. Fletcher and John J. Kelley, National Oceanic and Atmospheric Administration), oceanography (Theodore D. Foster, University of California), southern-ocean productivity (Sayed Z. El-Sayed, Texas A&M University), marine mammals (Donald B. Siniff, University of Minnesota, Ian G. Stirling, Canadian Wildlife Service, and L. Lee Eberhardt, Pacific North-West Laboratories), physiology and biochemistry of marine ectotherms (Arthur L. DeVries, University of Illinois), terrestrial adaptations (Bruce C. Parker, Virginia Polytechnic Institute and State University), and conservation, resources, and international perspectives (Robert H. Rutford, National Science Foundation).

AAAS will publish a proceedings of the session in late 1977.

Museum wing opens in New Zealand

The N.Z. city that has been the main staging base for U.S. expeditions to Antarctica since 1955 opened a new antarctic museum on 4 March 1977.

The Canterbury Museum's 100th Anniversary Wing and Antarctic Center, in Christchurch, was dedicated by the Duke of Edinburgh. Attendees included the U.S. Ambassador, ambassadors from other Antarctic Treaty nations, and leaders of former British expeditions to Antarctica.

The National Science Foundation's public understanding of science program granted $72,000 toward construction of the $1.1-million structure in recognition of the cooperative roles of the United States and New Zealand in antarctic research.

Old South Pole Station sealed

Surface access passages to the original Amundsen-Scott South Pole Station were permanently exposed to drifting snow in early 1977 as a means of sealing off the abandoned facility from further visits.

Built in 1955-1956 for the International Geophysical Year, the old station operated year-round through early January 1975. A replacement facility nearby was dedicated on 9 January 1975 (see March/April 1975 *Antarctic Journal*, pages 37-44).

The original U.S. station at the geographic South Pole became buried over the years under about 15 meters of snow and ice, the crushing weight of which eventually led to the decision to build the new station. After the new station opened, however, the old station was still visited from time to time to collect miscellaneous, small items that might be useful at the new station. Most salvageable items had been removed from the old station at the time of its closing in early January 1975.

Occasional visitors to the old station reported hearing loud cracks, presumably caused by the weight of the snow and ice. Fearing that the strained buildings and tunnels might collapse, National Science Foundation officials declared the old station unsafe and ordered it sealed.

George J. Dufek, 1903-1977

U.S. Navy

George J. Dufek

Retired U.S. Navy Rear Admiral George J. Dufek, the first American to set foot at the geographic South Pole and central to the establishment of the year-round U.S. Antarctic Program in the years surrounding the 1957-1958 International Geophysical year (IGY), died at the Bethesda, Maryland, Naval Medical Center on 10 February 1977. It was his 74th birthday.

Born in Rockford, Illinois, Admiral Dufek assumed command of the Naval Support Force, Antarctica, at the time of its creation in February 1955, having been a veteran of previous polar expeditions and involved in planning for the IGY. He commanded the Support Force and Task Force 43 during *Operation Deep Freezes* I through IV (1955-1959), during which seven year-round U.S. research stations were built and manned in the Antarctic.

By the IGY era, Admiral Dufek had already achieved a distinguished record as a Navy officer and a polar explorer. He graduated from the U.S. Naval Academy in 1925. He served first as a submarine commander. Later he volunteered to participate with Rear Admiral Richard E. Byrd in the 1939-1941 U.S. Antarctic Service Expedition as a navigator aboard USS *Bear*.

Following meritorious service in several areas during World War II, he went to the Arctic in 1946 to help establish weather bases near the North Pole. He returned to the Antarctic with Admiral Byrd for the 1946-1947 Navy Antarctic Developments Project (*Operation Highjump*). He again went to the Arctic in 1948 to establish more weather stations.

On 31 October 1956 Admiral Dufek flew to the geographic South Pole aboard the Navy R4D *Que Será Será* and became the first U.S. citizen—and the first person since Roald Amundsen and Robert F. Scott in 1911 and 1912—to set foot at 90°S. Thereafter the original U.S. station at the South Pole was built by those under his command and, as modified over the years, operated continuously until a replacement facility was opened in January 1975. He wrote the book *Operation Deepfreeze* (1957), which chronicles his IGY-era experiences.

Foundation awards of funds for antarctic projects

1 October 1976 to 31 March 1977

Below are listed National Science Foundation antarctic awards made in the first half of fiscal 1977 (1 October 1976 to 31 March 1977). Each item lists principal investigator or project manager, investigator's or manager's institution, shortened title of award, award number, duration, and amount. A few investigators received joint awards from more than one Foundation program, and the full amounts of their awards are shown in parentheses. International Southern Ocean Studies awards were made by the Division of Ocean Sciences; all others, by the Division of Polar Programs.

Biology and medicine

Ainley, David G. Point Reyes Bird Observatory. Seabirds in antarctic marine ecosystems. DPP 76-15358. 12 months. $20,000.

Dewitt, Hugh H. University of Maine, Orono. Abundance, diversity, and trophic dynamics of benthic fishes and invertebrates. DPP 76-23043. 12 months. $63,300.

Devries, Arthur L. University of Illinois, Urbana. Glycoproteins as biological antifreeze agents in fishes inhabiting ice-laden sea water. DPP 76-82366. 12 months. $15,000.

Dick, Elliot C. University of Wisconsin, Madison. Cataloging of data on viral samples. DPP 77-06064. 6 months. $10,000.

El-Sayed, Sayed Z. Texas A&M University. Productivity of the Weddell Sea, the waters of West Antarctica, and the Indian sector of the southern ocean. DPP 76-80738. 12 months. $74,000.

Holm-Hansen, Osmund. University of California, San Diego. Biological activity in the water column, Ross Ice Shelf Project. DPP 76-22134. 12 months. $39,700.

Jehl, Joseph R. San Diego Natural History Museum. Comparative studies of oceanic birds in the austral winter. DPP 76-23438. 12 months. $15,000.

Kooyman, Gerald L. University of California, San Diego. Comparative aquatic biology of endotherms. DPP 76-23424. 24 months. $74,700.

Landrum, Betty J. Smithsonian Institution. Cooperative systematics and analyses of polar biological materials. DPP 76-23979. 12 months. $20,000 ($200,000).

Lipps, Jere H. University of California, Davis. Benthic marine communities below the Ross Ice Shelf. DPP 76-17231. 12 months. $50,000.

McWhinnie, Mary A. DePaul University. Biological investigation of krill (*Euphausia superba*). DPP 76-23437. 12 months. $56,000.

Müller-Schwarze D. State University of New York, Syracuse. Behavioral adaptations of penguins. DPP 75-15506. 12 months. $36,000.

Parmelee, David F. University of Minnesota. Ecological and behavioral adaptations to environments. DPP 76-15350. 12 months. $47,000.

Paterson, Robert A., and Bruce C. Parker. Virginia Polytechnic Institute and State University. Ecosystem comparisons of oasis lakes and soils. DPP 76-23996. 12 months. $70,100.

Siniff, Donald B. University of Minnesota. Biota of pack ice. DPP 76-23111. 12 months. $50,000.

Siniff, Donald B. University of Minnesota. Colony behavior of marine mammals. DPP 73-09316. 12 months. $48,000.

Strandtmann, Russell W. Texas Tech University. Terrestrial arthropods of Marie Byrd Land. DPP 76-20056. 12 months. $1,400.

Geology and geophysics

Borns, Harold W. University of Maine, Orono. Ross Sea glaciations: events in Wright and Victoria Valleys. DPP 76-23460. 20 months. $24,000.

Cartwright, Keros. University of Illinois, Urbana. Ground water and hydrology in McMurdo dry valley region. DPP 76-23045. 12 months. $17,600.

Cassidy, William A. University of Pennsylvania. Field search for meteorites, McMurdo ice-free area. DPP 76-10800. 12 months. $12,900.

Colbert, Edwin H. Museum of Northern Arizona. Triassic vertebrates. DPP 75-23126. 12 months. $16,100.

Collinson, James W. Ohio State University. Stratigraphy and sedimentary petrology of the Fremouw Formation of the Cumulus Hills. DPP 76-23431. 18 months. $32,700.

Cosgriff, John W. Wayne State University. Triassic vertebrates from the Fremouw Formation of the Cumulus Hills. DPP 76-23435. 18 months. $46,500.

Dalziel, Ian W. Columbia University. Structure and tectonic history of the Scotia Arc and the Antarctic Peninsula. DPP 74-21415. 19 months. $99,300.

Denton, George H. University of Maine, Orono. Late Cenozoic glacial history. DPP 74-20991. 12 months. $83,200.

Ernst, Wallace G. University of California, Los Angeles. Petrology of granulite facies metamorphic rocks of Enderby Land. DPP 76-80957. 12 months. $24,600.

Faure, Gunter. Ohio State University. Isotopic and geochemical studies in the Transantarctic Mountains. DPP 76-11871. 12 months. $15,900.

Ford, Arthur B. U.S. Geological Survey, Virginia. Geological investigations in the Pensacola Mountains and the Shackleton Range. DPP 75-17682. 12 months. $6,400.

Kyle, Philip R. Ohio State University. McMurdo volcanic province: surveillance of Mt. Erebus and geological mapping of Mt. Morning. DPP 76-23440. 22 months. $38,800.

Schopf, James M. Ohio State University. Palynology and palynostratigraphic zonation of the Beacon Supergroup, Transantarctic Mountains. DPP 76-83030. 12 months. $16,000.

Slichter, Louis B. University of California, Los Angeles. Search at South Pole for the pendulum mode of the Earth's inner core. DPP 76-17234. 12 months. $100,000.

Stump, Edmund. Arizona State University. Investigations in the Leverett and Scott glaciers area. DPP 76-82040. 12 months. $43,400.

Zeller, Edward J. University of Kansas. Resource and radioactivity survey by airborne gamma-ray spectrometry. DPP 76-23441. 12 months. $71,800.

Glaciology

Clough, John W. University of Nebraska, Lincoln. Coordination of ice core drilling. DPP 77-17722. 12 months. ($241,300).

Gudmandsen, Preben E. Technical University of Denmark. Design and construction of antennas for airborne radio-echo sounding. DPP 76-82431. 7 months. $39,600.

Oeschger, Hans. University of Bern, Switzerland. Radioactive isotope dating and other geochemical and isotope studies as part of polar ice-drilling projects. DPP 76-81496. 12 months. $31,600 ($63,100).

Whillans, Ian M. Ohio State University, Ohio. Analysis of data from the Byrd Station strain network. DPP 76-82032. 12 months. $22,800.

Meteorology

Carroll, John J., and Kinsell L. Coulson. University of California, Davis. Atmospheric processes and energy transfers at the South Pole. DPP 76-22260. 13 months. $94,000.

Cobb, William E. National Oceanic and Atmospheric Administration. Atmospheric electric 5-year measurement program for Amundsen-Scott South Pole Station. DPP 76-22261. 12 months. $4,800.

Hanson, Kirby J. National Oceanic and Atmospheric Administration. Geophysical monitoring for climatic change. DPP 76-22944. 40 months. $1.

Hofmann, David J., and James M. Rosen. University of Wyoming. Fluorocarbons, nitrous oxide, and aerosols in the stratosphere. DPP 76-17777. 9 months. $35,800.

Hogan, Austin W. State University of New York, Albany. Aerosols. DPP 76-23110. 21 months. $76,700.

Kuhn, Michael. Ohio State University. Micrometeorology at the South Pole. DPP 75-23048. 12 months. $30,000.

Ohtake, Takeshi. University of Alaska. Ice crystal precipitation in the atmosphere. DPP 76-23114. 12 months. $54,800.

Ostlund, H. Gote., and Allen S. Mason. University of Miami, Florida. Tritium. DPP 76-23433. 12 months. $37,100.

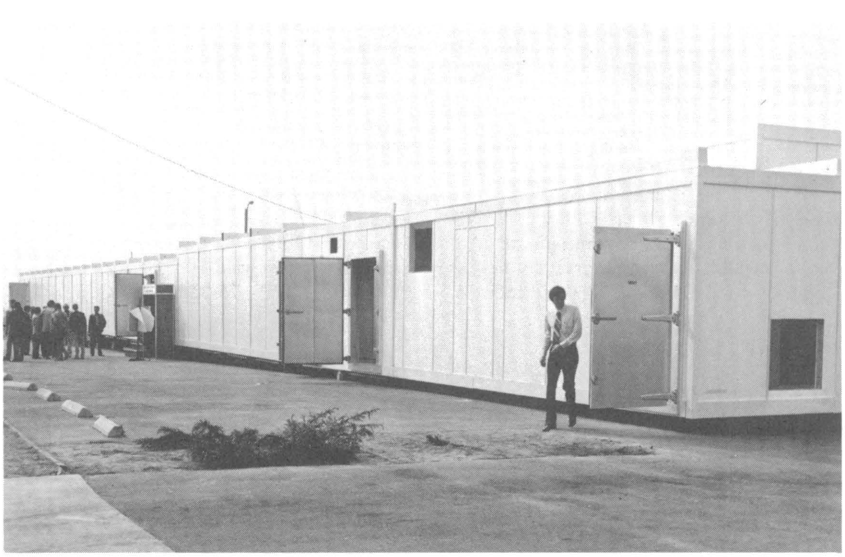
Rasmussen, Reinhold A., and Elmer Robinson. Washington State University. Halocarbons. DPP 76-00437. 15 months. $59,500.

Renard, Robert J. U.S. Naval Postgraduate School, California. Mesoscale atmospheric events. DPP 76-80165. 36 months. $48,600.

Shaw, Glenn E. University of Alaska. Atmospheric radiation field. DPP 76-20629. 12 months. $30,500.

Warburton, Joseph A. Desert Research Institute, Nevada. X-band radar at Palmer Station for studies of atmosphere-ocean interactions. DPP 76-17501. 6 months. $77,100.

Zoller, William H. University of Maryland. Sources and distribution of trace elements in the atmosphere. DPP 76-23423. 12 months. $64,800.



Holmes and Narver

Twenty-four modules will replace the original Siple Station (75°56'S. 84°15'W.), first occupied year-round in 1973. They arrived disassembled at McMurdo Station by ship in January 1977 and will be flown the 1,750 kilometers to Siple next austral summer. The modules will be installed under a metal arch 13 meters across and 75 meters long. Occupancy of the new eight-person station, expected to last 10 years or more, is scheduled for January 1979. Holmes and Narver, Inc., designed and Pepsico Building Systems built the the modules for the National Science Foundation. The structions were erected for inspection (above) at Cucamonga, California, on 21 October 1976.

Ocean sciences

Foster, Theodore D. University of California, San Diego. International Weddell Sea Oceanographic Expedition. DPP 75-14936. 12 months. $190,000.

Foster, Theodore D. University of California, San Diego. Weddell Gyre workshop. DPP 77-05310. 12 months. $14,000.

Franceschini, Guy A. Texas A&M University. Solar radiation over water. DPP 76-01121. 12 months. $37,700.

Jacobs, Stanley S. Columbia University. Physical oceanography of the Ross Sea—II. DPP 76-11872. 12 months. $40,000.

International Southern Ocean Ftudies

Baker, James D. University of Washington. Administration and coordination of ISOS. OCE 74-13735. 12 months. $24,800.

Baker, James D. University of Washington. Transport measurements of the circumantarctic current and analysis of tidal and meteorological data. OCE 76-83904. 12 months. $146,000.

Emery, William J. Texas A&M University. Thermal structure south of Australia. OCE 76-81371. 15 months. $55,600.

Gordon, Arnold L. Columbia University. Oceanographic atlas. OCE 76-80065. 12 months. $35,900.

Gordon, Louis I. Oregon State University. Chemical observations and interrelationships. OCE 76-00592. 12 months. $49,800.

Joyce, Terrence M. Woods Hole Oceanographic Institution. Dynamical observations at the polar front. OCE 76-82036. 12 months. $66,800.

McCartney, Michael S. Woods Hole Oceanographic Institution. Theoretical modeling of current/bottom topography interactions. OCE 76-00390. 12 months. $27,200.

Neal, Victor T. Oregon State University. International coordination of ISOS. OCE 76-24598. 24 months. $50,600.

Nowlin, Worth D. Texas A&M University. Central administrative coordination and planning. OCE 74-12032. 12 months. $94,000.

Nowlin, Worth D. Texas A&M University. Chemical and physical oceanography of the circumantarctic current and frontal zones in Drake Passage. OCE 76-80410. 13 months. $171,400.

Pillsbury, R.D. Oregon State University. Long-term variability of the circumantarctic current in Drake Passage. OCE

76-80066. 12 months. $317,200.

Upper atmosphere physics

Akasofu, Syun-Ichi. University of Alaska. Midday auroras at South Pole Station. DPP 75-22592. 12 months. $35,000.

Balsley, B.B., and Warner L. Ecklund. National Oceanic and Atmospheric Administration. Radar auroral studies at Siple Station. DPP 76-23750. 18 months. $18,800.

Cahill, Laurence J. University of Minnesota. Detectors at Siple Station and Roberval, Quebec, and interpretation of observations. DPP 76-23749. 14 months. $10,000 ($65,000).

Chivers, Hugh J. University of California, San Diego. High latitude ionospheric absorption. DPP 76-80556. 15 months. $9,800 ($49,800).

Heacock, Richard R. University of Alaska. Magnetometer studies of plasma waves at Vostok. DPP 76-82038. 12 months. $17,800.

Helliwell, Robert A. Stanford University. Active and passive probing of the magnetosphere using VLF techniques at Siple Station. DPP 74-04093. 12 months. $48,400.

Helliwell, Robert A. Stanford University. Very-low-frequency probing of the magnetosphere from Palmer Station. DPP 76-82042. 12 months. $55,000.

Matthews, David L. University of Maryland. Rocket investigation of electron precipitation triggered by VLF emissions. DPP 75-03516. 12 months. $27,450 ($54,900).

Monthly climate summary

	November 1976			December 1976			January 1977		
Feature	McMurdo (date)	Palmer* (date)	South Pole (date)	McMurdo (date)	Palmer* (date)	South Pole (date)	McMurdo (date)	Palmer* (date)	South Pole (date)
Average temperature (°C)	-11.8	0	-37.1	-3.0	1	-25.8	-1.4	2	-25.0
Temperature maximum (°C)	-1.1 (11/9)	6 (11/7)	-12.3 (11/16)	5.0 (12/31)	4 (12/23)	-19.8 (12/25)	4.4 (1/12)	7 (1/15)	-19.7 (1/14)
Temperature minimum (°C)	-22.2 (11/1)	-10 (11/1)	-50.5 (11/2)	-11.7 (12/18)	-3 (12/22)	-26.9 (12/27)	-8.9 (1/27)	-4 (1/12)	-35.0 (1/31)
Average station pressure (mb)	989.5		687.3	1003.1		699.0	995.9		696.6
Pressure maximum (mb)	1013.9 (11/30)		708.0 (11/30)	1016.3 (12/16)		704.8 (12/1)	1007.5 (1/15)		705.6 (1/19)
Pressure minimum (mb)	959.0 (11/14)		661.7 (11/9)	994.2 (12/9)		693.4 (12/11)	982.4 (1/11)		684.1 (1/30)
Snowfall (mm)	429.3		Trace	Trace		Trace	331.5		Trace
Prevailing wind direction	90°		40°	90°		70°	90°		30°
Average wind speed (m/sec)	5.2		5.3	4.1		4.7	4.5		5.3
Fastest wind speed (m/sec)	40 180° (11/5)		15 350° (11/12)	21 180° (12/24)		14 310° (12/20)	26 180° (1/4)		14 340° (1/13)
Average sky cover	5.8/10		3.9/8	5.0/10		4.4/8	5.5/10		4.2/8
Number clear days	10		3	16		8	2		3
Number partly cloudy days	8		9	6		13	19		14
Number cloudy days	12		18	9		10	10		14
Number days with visibility less than 0.4 km	2		5	0		1	1		3

*Temperature data unverified.

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Mende, Stephen B. Lockheed Missiles & Space Company Inc. Auroral photometry. DPP 71-01668. 12 months. $67,500.

Pomerantz, Martin A. Franklin Institute. Cosmic ray intensity variations. DPP 76-23429. 12 months. $79,500.

Services and support

Bawden, John. British Antarctic Survey. Resupply of Palmer Station by RRS *Bransfield*. DPP 77-00455. 6 months. $51,029.

Bretherton, Francis P. National Center for Atmospheric Research. Technical support for scientific configuration of LC-130R airplane. DPP 76-82858. 6 months. $26,700.

Davis, Allan S. Department of the Navy. Rations for United States Antarctic Research Program personnel. DPP 76-82902. 12 months. $90,000.

Johnson, James R. Holmes and Narver Inc. Station operation and other support. DPP 73-07187. 12 months. $4,000,000.

Johnson, James R. Holmes and Narver Inc. Operation of Palmer Station and research ship *Hero*. DPP 74-03237. 12 months. $1,592,648.

Landrum, Betty J. Smithsonian Institution. Curation of biological specimens. DPP 74-13988. 12 months. $44,000 ($70,157).

Langway, Chester C. State University of New York, Buffalo. Operation of a central ice core storage facility and data bank. DPP 75-08512. 12 months. $36,000 ($49,000).

75-08512. 12 months. $36,000 ($49,000).

Nordhill, Claude H. Department of Defense (U.S. Navy). Logistics and support. DPP 76-10886. 12 months. $20,490,000.

Shabad, Theodore. Scripta Technica Inc. Publication of *Polar Geography* (startup costs). DPP 76-81106. 12 months. $14,000.

Vicente, Calixto E. Government of the Argentine Republic. Operation and use of the research shiv *Islas Orcadas*. DPP 74-12163. 6 months. $375,000.

Correction

On the inside back cover of the December 1976 issue, the correct duration of award DPP 76-80592 to Bernhard Lettau, State University of New York, Albany, is 24 months.

Feature	February 1977			March 1977			April 1977		
	McMurdo (date)	Palmer* (date)	South Pole (date)	McMurdo (date)	Palmer* (date)	South Pole (date)	McMurdo (date)	Palmer* (date)	South Pole (date)
Average temperature (°C)	-11.4	1	-41.9	-19.1	1	-54.1	-21.8	-1	-58.0
Temperature maximum (°C)	0.0 (2/1)	6 12/23)	-30.4 (2/3)	-4.4 (3/30)	5 (3/10)	-38.7 (3/3)	-9.0 (4/3)	6 (4/11)	-43.9 (4/8)
Temperature minimum (°C)	-22.8 (2/28)	-5 (2/15)	-55.0 (2/28)	-33.9 (3/24)	-4 (3/27)	-69.4 (3/26)	-35.0 (4/30)	-9 (4/30)	-68.9 (4/19)
Average station pressure (mb)	988.2		684.0	989.5		681.8	991.5		682.4
Pressure maximum (mb)	1001.4 (2/7)		692.0 (2/7)	1001.7 (3/10)		698.0 (3/13)	1013.2 (4/26)		690.2 (4/22)
Pressure minimum (mb)	978.3 (2/13)		674.4 (2/26)	976.6 (3/18)		666.0 (3/22)	970.9 (4/3)		667.0 (4/20)
Snowfall (mm)	226.1		Trace	119.4		Trace	297.2		Trace
Prevailing wind direction	90°		40°	115°		30°	90°		60°
Average wind speed (m/sec)	11.2		4.6	6.1		5.8	4.9		3.8
Fastest wind speed (m/sec)	15 115° (2/25)		13 20° (2/20)	43 135° (3/30)		17 10° (3/2)	21 90° (4/23)		12 360° (4/3)
Average sky cover	7.4/10		3.7/8	5.7/10		4.3/8	5.1/10		3.4/8
Number clear days	0		2	5		5	6		5
Number partly cloudy days	15		14	20		8	19		14
Number cloudy days	13		12	6		18	5		11
Number days with visibility less than 0.4 km	0		2	0		9	1		2

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