ISLANDS IN THE MIDNIGHT SUN

Energy, Mines and Resources Canada
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COVER PHOTO
Field camp of the Polar Continental Shelf Project in the midnight sun.

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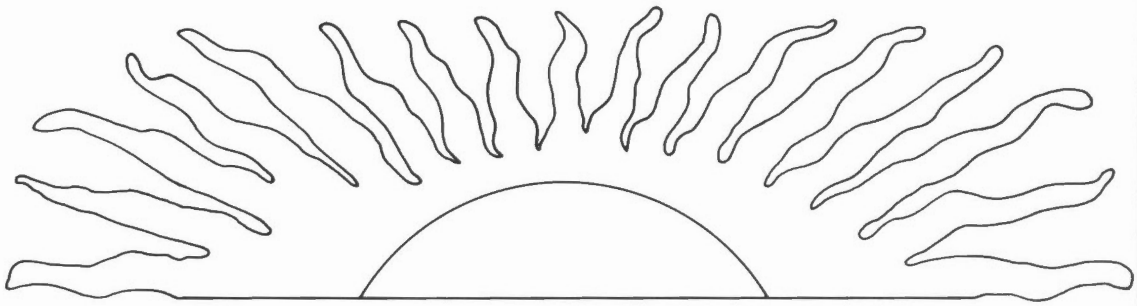

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The story of the Polar Continental Shelf Project

"Camp 200 was established in the third week of March 1967, when the temperature hovered about −50° . . . The unusually low temperatures encountered during April, coupled with several unfortunate accidents, prevented our placing a recording station any further than 220 km (from the nearest land) . . . The movement of the ice pack increased considerably during the survey, with the ice camp moving a total of 25 km to the NE along a 'random-walk' path during the 26-day period."

The above is a series of excerpts from a scientific paper published by two seismologists in the Department of Energy, Mines and Resources. What makes it noteworthy is that such type of small talk is not a standard feature of modern scientific reports, whose authors rigorously eschew anything but the matter at hand. And the authors of the paper just quoted felt moved to explain: "The authors appreciate that it is not normal practice to burden the reader with the difficulties of field practice but rather to concentrate exclusively on the results. However, the rigors of an arctic experiment and the uncommon problems encountered may be of interest to any other scientists contemplating a similar endeavor."

Such explanations may well be necessary for the ordinary "other scientists," but there is one scientific fraternity for whom the rigors of the high Arctic are an obvious and readily appreciated fact of life — the men and women who have shared in the field work of Canada's Polar Continental Shelf Project.

(For readers whose curiosity may have been aroused by that cryptic reference to "several unfortunate accidents": One accident was the burning of a shed at the main camp holding aircraft supplies; another, consequent on the former, was the marooning of a four-man helicopter party on the ice pack for four very uncomfortable days.)

It must be said at the start that this name — Polar Continental Shelf Project or PCSP for short — is a misnomer. It errs on the side of modesty, a peculiarity it has in common with many of its protagonists. The continental shelf in the Arctic — i.e., the submerged portion of the continental landmass that extends under the relatively shallow water tens or hundreds of kilometres into the ocean — is no longer the sole object of interest. Research and surveys under the auspices of the PCSP now cover all of the Arctic Islands, and sometimes parts of the mainland as well.

The inception of the PCSP dates from 1958, when a government committee, responding to the urgings of a number of concerned scientists and politicians, rang down the curtain on the expeditionary "hit-and-run" approach to arctic research and recommended a sustained, long-term, integrated effort.

It was in the 1950's that the vast resource potential of the world's continental shelves came into the official limelight. Not only were the shallow waters above the shelves rich in fish, the sea bottom itself was a promising hunting ground for oil and gas and possibly other minerals. Also, the shallowness of the ocean over the shelf — generally defined as a depth not exceeding 200 metres — has certain obvious military implications, as for submarine warfare.

Surveyor on top of ice ridge operates tellurometer. The introduction of electronic distance-measurement devices has greatly accelerated accurate mapping of the Canadian Arctic.

It was therefore not surprising that governments of coastal nations all over the world began laying claim to "their" continental shelves. Canada followed suit. And it was with some considerable embarrassment that Canadian geopoliticians, when they turned their attention to the Arctic, found that the only maps outlining the shelf in that area had been produced in the United States and the Soviet Union. Here was a genuine case where Canada's sovereignty had to be asserted. The scientists and technicians who flocked north in the first field season of 1959 packed not only seismographs, tellurometers, echo sounders, and core drills, but Canadian Red Ensigns as well.

The Red Ensign has since been replaced by the Maple Leaf, and it flies securely over the islands and the seas of the high Arctic.

A listing of the scientists and types of surveys supported by the PCSP would take up pages. Even a listing by general fields looks impressive: surveying, mapping and charting of many kinds; geophysical and geological surveys probing deep into the crust of the earth; ice studies on land and on the ocean; terrain studies; studies of arctic fauna and flora; oceanography; anthropology and archeology; historical research.

The man who was responsible for initiating the Polar Continental Shelf Project was W.E. ("Van") van Steenburgh, who in the late 1950's held the post of Director General of Scientific Services in the Department of Mines and Technical Surveys (now EMR). He was aware that successful and efficient arctic exploration, on a continuous scale, depended on two technological factors: safe, reliable air transport and a reliable position-finding system. Piloting small planes in the rugged north had long been a Canadian specialty, but planes alone would not do, as scientists and surveyors would want to land in many places where no flat stretches of land or ice existed. In 1955, the Geological Survey of Canada had carried out a far-flung reconnaissance survey of the Arctic with the extensive use of helicopters, the so-called Operation Franklin. And it was this experience that contributed largely to the use of the chopper as one of the workhorses of the PCSP. The other requirement, that of accurate, reliable position-finding on the monotonous pack-ice and the then still poorly mapped islands was taken care of with the installation of a DECCA chain — an electronic system that covers a given area with an invisible grid of signals and enables survey teams to read off their position from a figure on a "black box."

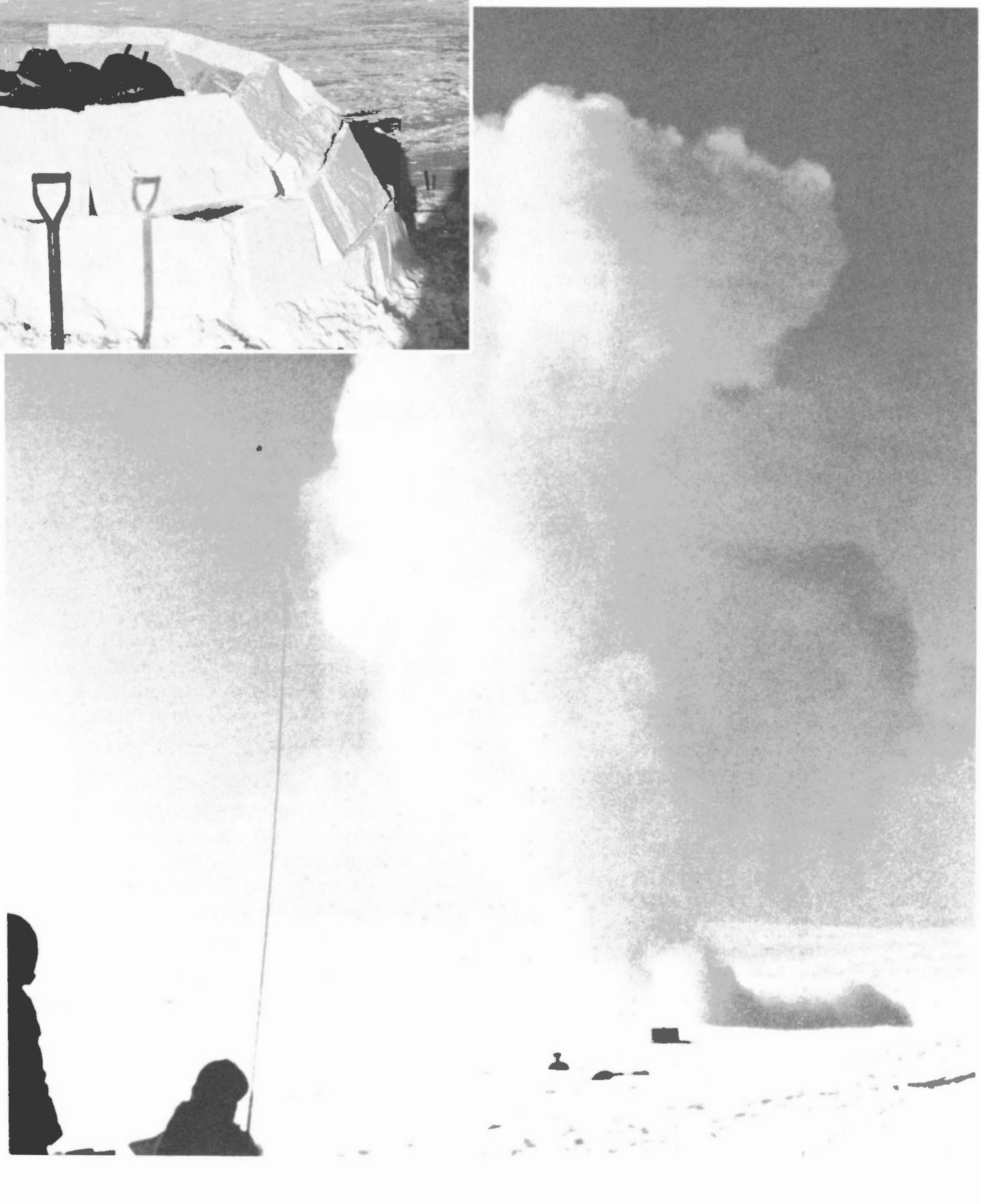
Thus equipped, the sustained exploration of the Canadian high Arctic began. The first summer — the field work takes place mainly in the 24-hour daylight of the arctic summer — PCSP teams were guests of Canada-U.S. weather stations, but later they set up their own base camp or camps. There are now two of these, one serving the eastern Arctic from Resolute on Cornwallis Island, and the other serving the western Arctic from Tuktoyaktuk ("Tuk") on the mainland coast, just east of the Mackenzie River delta.

The men involved in arctic research are conscious of making history. Men are still active in field work who were the first human beings to set foot on some of the Arctic Islands, hitherto known to geographers only from air photographs. The first landing of a Canadian plane on or near the North Pole took place in June 1967. It was a twin-engine Bristol, and it carried a small team of gravity experts — men who take precise measurements of variations in gravity with a view to determining the composition of the earth's crust. The plane was a larger aircraft than had been planned, which meant that it would need a fairly long, solid, flat ice surface to set down on — a minimum of 900 metres, to be exact. The pilot found a promising ice pan a few kilometres from the Pole, and after some close passes he ever so cautiously eased the plane onto it, touching the pan at the very edge. Afraid to come to a complete rest, the pilot kept taxiing, while a couple of men jumped out and frantically began to drill the ice, to determine if it was thick enough. It was; and all went well from then on. (When they measured the length of the "runway" they found it was only slightly over 700 metres.)

Members of oceanographic field party lower diver through hole in ice.

Emergency shelter:
PCSP-supported scientists fall back on ancient Eskimo technology to construct shelter for the night.

Seismic explosion.



Tuktoyaktuk base of the Polar Continental Shelf Project at Tuktoyaktuk.

6 That plane is now on display at the edge of the Yellowknife airport, resting on a tall concrete base, a ghostly silhouette looming above the ragged black spruce.

Air transport is needed to and in the Arctic not only because of the roadless terrain but also because of the vast distances that have to be covered rapidly. The distance from Ottawa to Alert, at the northern tip of Ellesmere Island, is greater than the distance from Ottawa to the Panama Canal.

The tremendous expense involved in living, working and travelling in the Arctic, the uncertainty of all plans because of changes in weather and equipment breakdown, the physical difficulties in making measurements and taking samples in the severe northern environment, even in summer, all have a deleterious effect on research. Observation is often less careful than in a more hospitable setting, and conclusions are sometimes drawn from a single observation, where they should have been verified by several. Researchers suffer psychologically from their total dependence on the decisions and services of those who manipulate their lifelines.

Only the largest and most affluent organizations can afford to by-pass the PCSP network. Most others, as well as scientists working on their own, arrange their schedules with the Director of the Project before the start of the field season and are assigned aircraft or helicopter time, along with other aids, a system that costs about $3 million a year. For example, in a recent field season, the Project chartered six helicopters and three fixed-wing aircraft for six months, and used additional aircraft when the need arose. The problems in providing even minimum air transportation in the Arctic were pointed out by a former PCSP Director: "The researcher cannot hire half a helicopter and so must charter a whole one. But in an isolated area it is not safe to operate one machine by itself, so he must hire two. Two helicopters cannot keep themselves supplied with fuel except at unreasonable cost and delay, so it is necessary to hire a fixed-wing aircraft to lay fuel caches. But one cannot have three aircraft operating in isolation without adequate communications, so a radio network is necessary. The net result is that in order to get a helicopter ride the research party finds itself running an airline."

Most scientists and surveyors are from the departments of Energy, Mines and Resources, and Fisheries and the Environment, but there have been others from many Canadian and also foreign research institutions. They are supported by the PCSP if their research promises to contribute to Canadian scientific objectives.

The first need of the PCSP in the field of surveys was accurate control of the DECCA chain along the northwest front of the Arctic Archipelago, and a link-up between that chain and the geodetic control network across Canada. This was accomplished through tellurometer and theodolite traverses from island to island, all the way from the Mackenzie delta to the northern tip of Ellesmere Island. Surveying on the ice pack called not only for some fancy footwork but also for intricate calculations accounting for ice drift. The work produced a few surprises: Meighen Island, for example, turned out to be a whole degree longitude from where existing maps had it.

Members of a Polar Continental Shelf Project field party inspect huts of "Fort Conger" near the northern end of Ellesmere Island, built by R. E. Peary during his attempts to reach the North Pole at the turn of the century.

8 Special topographic surveys were made of icecaps on some islands and in support of geomorphological, geophysical and hydrographic surveys. One interesting geodetic survey aims at determining whether there is any slow, long-term change in position between Canada and Greenland — a test of the theory of continental drift.

The most recent geodetic survey consists of a five-year program of establishing exact, primary control throughout the Arctic by means of electronic signals from orbiting satellites, an application of the so-called Doppler effect, the change in wavelength produced by a moving source.

Hydrographic charting, which traditionally has served the purposes of marine navigation, took on new roles in the Arctic: delineating the continental shelf, assisting marine geology in the study of sea-bottom morphology. Hydrographic charting has been carried out from a variety of vehicles: ships of the Canadian Hydrographic Service based at Dartmouth, Nova Scotia, and at Victoria, B.C., helicopters, and even Hovercraft.

The Canadian Geological Survey's reconnaissance mapping of the Arctic Islands antedates the PCSP, and the Survey, from its main establishment in Ottawa and its branches in Dartmouth, N.S., Calgary and on the West Coast, continues to call on the PCSP for assistance and support in its work in the northern Arctic.

Geological activities fall into several categories: bedrock mapping and the delineation and investigation of the sedimentary basins that may contain oil and gas deposits; terrain studies, which seek to ascertain the response of Arctic terrain, much of it in the permafrost zone, to exploration and construction; and marine geology, embracing both regional mapping and the study of the sea bottom, which has important implications for pipeline construction.

Geological studies are carried out with all available techniques: direct observation, collection of rock and fossil samples for analysis in the laboratory, drilling of shallow boreholes to study permafrost and ground ice, and geophysical studies of the earth's crust with seismic, gravity and electromagnetic methods.

Members of EMR's Earth Physics Branch are carrying out geophysical studies in a broader framework, embracing earthquake probabilities, monitoring of atomic explosions, the location of the Earth's magnetic pole, the theories of continental drift and plate tectonics, etc.

One of the most important fields of research under the auspices of the PCSP is ice studies. During the first half of the 1970's Canadian and American scientists carried out a series of experiments designed to gain a better understanding of the factors affecting the behavior of sea ice, and the effect of the vast masses of arctic ice on the world's climate. The project, called Arctic Ice Dynamics Joint Experiment (AIDJEX), relied heavily on expertise accumulated by PCSP personnel in the location of ice floes suitable for landing large aircraft and setting up camps and observation stations.

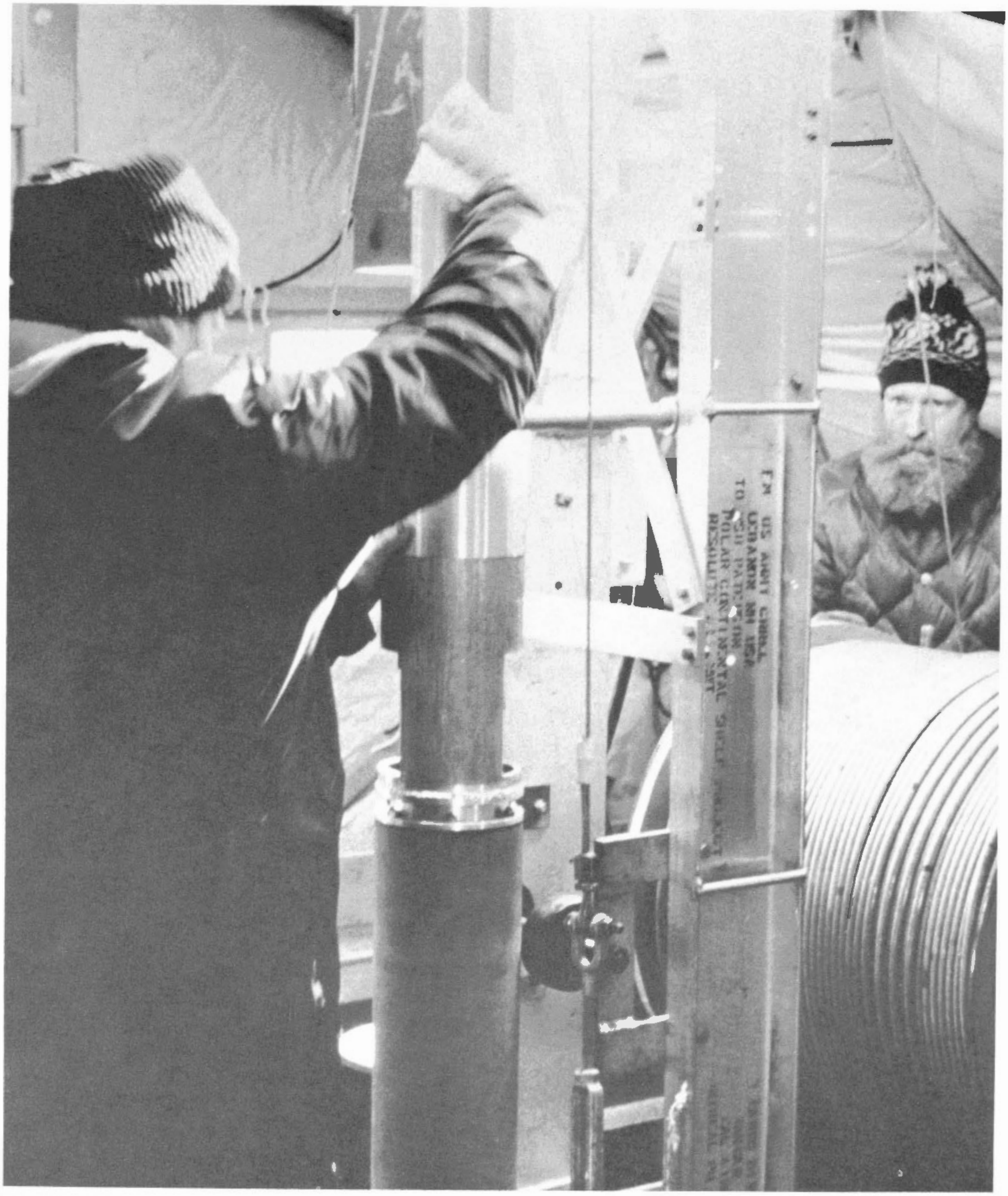
As a result of AIDJEX, it is now possible to make more reliable predictions concerning the formation and movement of sea ice, information that is important to mariners. For example, if it were possible to send ships through the Arctic Ocean, the shipping distance between Europe and Japan would be cut in half. New data on the interaction between the ice and the atmosphere may help climatologists to develop models of long-term climatic cycles. Knowledge of ice behavior gained by AIDJEX will be useful in the design and operation of drilling machinery for oil exploration, and the prevention or containment of oil spills.

Another important aspect of glaciology is the study of ice cores from arctic glaciers. As much of the ice is tens of thousands of years old, its composition and the organic matter contained in the ice can yield clues as to climatic cycles. This information can be used to forecast trends in the world's climate and therefore future needs for heating, a major component in energy demand. Present indications are that climatic cycles have a period of several hundred years.

Members of a seismic team are stringing together explosives for test.

Permafrost is continuous in most of the Arctic. It must be taken into account in construction and exploration, since any activity that causes the permafrost layer to melt tends to produce major ground disturbances. Geologists working under the auspices of the PCSP are studying the depth and ice content of the permafrost with seismic, electrical, and magnetic methods as well as test boreholes. They have found, for example, that permafrost is present even under the sea bottom of the continental shelf, where it presents hazards to drilling. Also, ice content in the ground is often so high that the ice can be considered one of the country rocks. It has been calculated that if all the ground ice in the Mackenzie River delta were to melt, much of the delta would subside below the level of the ocean.

All of this shows that the northern Arctic is an environment that is wholly different from that of southern Canada, requiring special scientific and technical methods, and even a special type of mental attitude. These methods and this attitude are among the most important products of the Polar Continental Shelf Project.



Glaciology: Scientists drill into Devon Island icecap to obtain cores.