FLOATING ISLANDS

By Maynard M. Miller

Reprinted without change in pagination from
NATURAL HISTORY MAGAZINE, Vol. LXV, No. 5, 1956, pp. 233-39, 274, 276.
American Museum of Natural History, New York, N.Y.

FLOATING ISLANDS

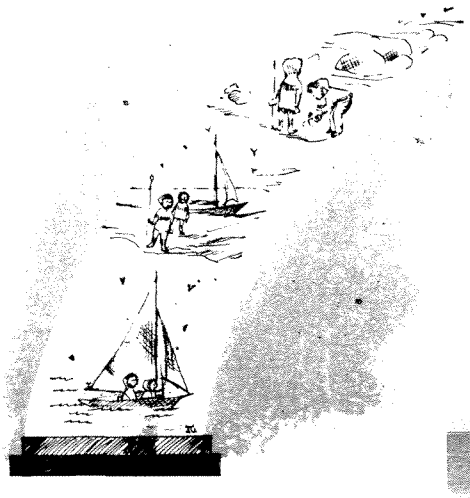
By Maynard M. Miller*

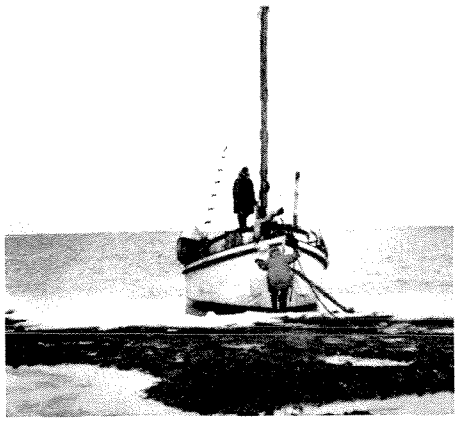
Recent aerial explorations in the high arctic provide clues to the centuries-old mystery of vanishing lands. Here is the story of a significant flight over the Pole and the illuminating conclusions that it yielded

TAKPUK was an Eskimo. Cruising one day in his sloop about 80 miles off the northern coast of Alaska, he saw what appeared to be an island. Takpuk was puzzled. He had never seen or heard of land in these waters. His chart showed nothing of the sort.

*MAYNARD M. MILLER has received many honors for his work in organizing and implementing the now-famous Juneau Icefield Project, and these include a citation from the Junior Chamber of Commerce "for outstanding leadership in the field of geologic science. . . ."

He is Research Associate of the Lamont Geological Observatory of Columbia University and Director of The Foundation for Glacier Research in Seattle, Wash. Mr. Miller has participated in 20 expeditions to the arctic and has recently completed a two-year Fulbright Fellowship in glaciology at Cambridge University, England. —ED.





➤ TAKPUK was puzzled. With the bow of his sloop on shore, the water at the stern was 120 feet deep.

Courtesy The American Geographical Society

He steered for the island and ran the bow of his boat onto the beach. To his surprise, the water was 120 feet deep at the stern with the bow touching bottom.

With a companion, he landed and explored the mysterious island. Its surface was gently undulating, with small ponds on it. Grass and moss were growing on the island. No driftwood was seen along the shore. There were a good many boulders scattered about, some of them perhaps larger than a man's head.

It never occurred to these men that this could be anything but an island. But when the noted explorer Stefansson heard the story and published an account of it, he mentioned the possibility that this might be drifting ice that had somehow picked up a load of debris.[1]

Twenty years later, on August 1, 1951, I was sitting in the nose of a B-29 flying over the area where Takpuk's island had been found. The day was sparkling clear, but I could see no land, only broken, shifting ice. Where had it gone?

Perhaps we could dismiss the Case of the Disappearing Island if numerous other similar ones had not been "discovered" in the Polar Sea and vanished. There were the Gunnbjorn Skerries and the Brendan Legends. The Sunken Land of Busse was sighted in 1578 off the coast of East Greenland by one of Frobisher's returning vessels and possibly later seen by other explorers—but in a different place. People thought its position had been wrongly figured, but in later centuries no one could find it at all.

In more recent times, there have been reports of Keenan Land, President's Land, Bradley Land, and Sannikov Land—not one of which could later be verified. Perhaps the most famous is Crocker Land, described by Peary in 1906 and duly noted on all maps. No trace of it could be found eight years later by Commander Donald B. MacMillan.

A U.S. Air Force weather flight to the North Pole on August 14, 1946, gave the first clue to the mystery. Visibility at the time was zero, and a young officer was making his observations by radar. He was startled to see "land" on the radar scope where no land was known to exist. The outline on the radar screen was clearly that of an island about 200 square miles in area. The officer informed the pilot, who verified the plane's position as 300 miles north of Point Barrow, Alaska.

When the crew returned to base, their discovery naturally excited a great deal of speculation. It was coded as "Target X," or T-1, and its existence was classified as a military secret.

It moves

It was not necessary to wait long for confirmation or denial of the island's existence, for daily weather flights were being made over the Polar Sea, and crews were alerted to watch for T-1. Darkness and clouds make naked-eye reconnaissance over this no-man's land virtually impossible for three-quarters of the year, but using radar as the primary detection, crews again spotted T-1. This time, it was several miles from its first position.

Succeeding flights often found difficulty in locating the island, but each time it was reported, it was a little farther east. The shape of the island on the radar screen remained the same.

One day, the mists cleared, and from a vantage point of 18,000 feet above the ice, the crew of a weather plane got a good look at it. Circling lower, the airmen could see that a coastline rose 20 to 40 feet above the surrounding sea ice, apparently impervious to the pressures of the pack. Bright blue lakes, grayish streams, and dark red rocks were clearly visible. The position was again carefully plotted, checked, and re-checked. Certainly it was moving, and it was about the size of Guam.

For the next three years, the ex-

[1] "An Eskimo Discovery of an Island North of Alaska," by Vilhjalmur Stefansson, in the *Geographical Review* for January, 1934.

istence of T-1 remained a military secret, and strategists dreamed of making a landing field on it. Apart from its possible military importance, valuable scientific work could be carried out on it if a base could be established there. By October 6, 1949, it had travelled more than 1500 miles from where it had originally been seen.

In the spring of 1950, air crews were advised to search for other island-like masses, and in July a second one even larger than the first was discovered. This was named T-2. A few days later, a third one, T-3, was sighted. Since then, dozens of smaller tabular "ice islands" have been located in the western arctic and have been spotted on aerial photographs taken by both the U.S. Air Force and the Royal Canadian Air Force.

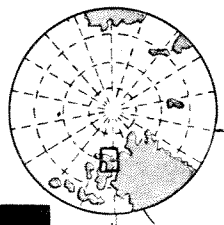
The first public announcement was made at the First Alaskan Science Conference, held in Washington, D.C., in November, 1950; and I remember my interest and excitement when Col. Joseph E. Fletcher, then in command of the Air Weather Squadron at Fairbanks, Alaska, read his descriptive paper. Afterwards, several of us sat up late into the night conjecturing about the origin, composition, and probable future of these paradoxical floating "lands." We were especially curious as to where they had come from.

The arctic is a great elongated basin filled by a frozen, land-locked sea, which is over 14,000 feet deep at the North Pole. In autumn, the first thin slush forms over the surface, and remnants of the ice from previous years become consolidated with the freezing of open water between. Gradually, the whole mass solidifies, producing a veneer of new ice over the green-blue sea. Winds break the fresh ice, crushing and tearing it so that open passages, or leads, form between the floes. Individual cakes become broken and scattered, and as the waves spill over them, the waters freeze and weld large sections together again. Sometimes one floe is thrust upon another. So the process goes on—an incessant breaking, churning, and rending of the ice to produce a boundless and incredibly jumbled mass.

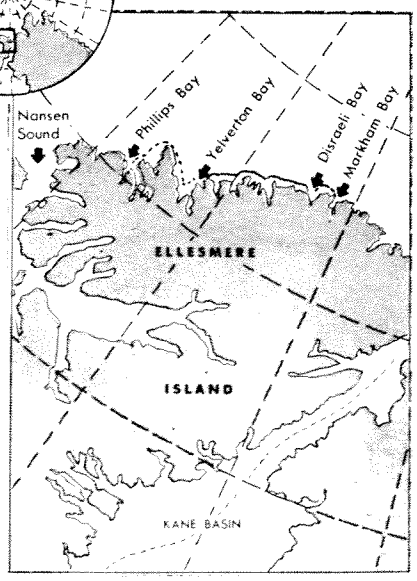
The Polar pack varies in thickness from a few inches to scores of feet and averages about thirteen feet in winter. As the long winter night descends, the ice thickens and increases in strength, so that there are fewer and fewer open leads. Great "pressure ridges" are forced up by the grinding action, and the

Maynard Miller

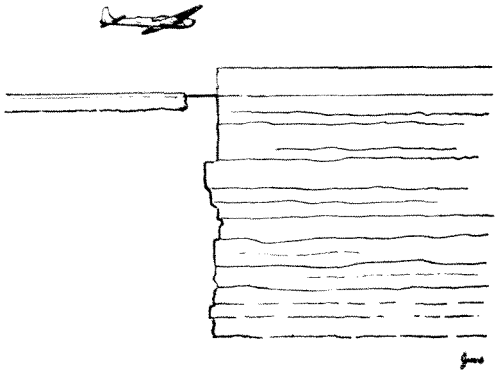
▲ The B-29 Superfortress undergoing a final check-up before starting on the 4100-mile flight to beyond the Pole and back.



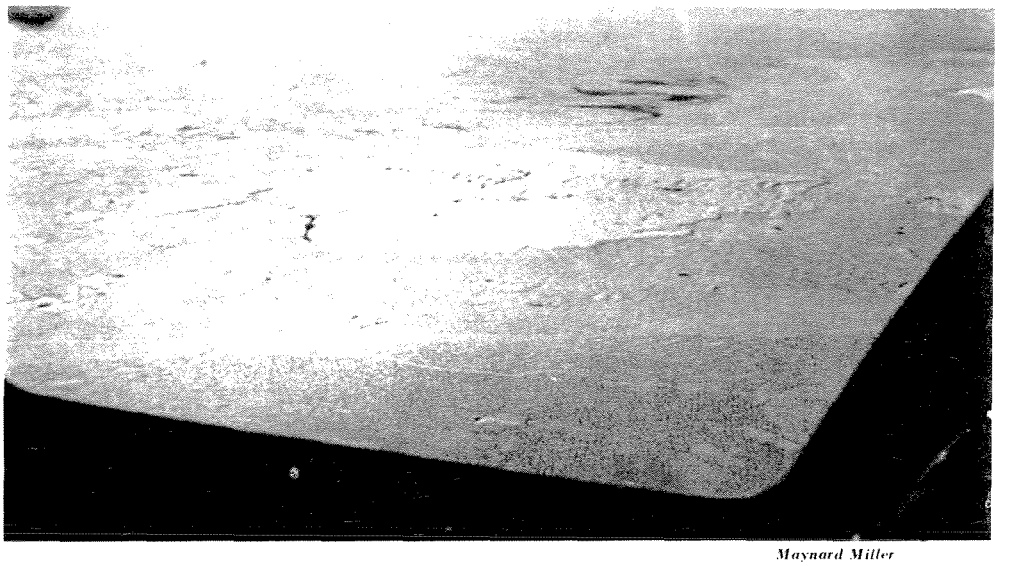
▼ A STRANGE "CLIFF" of non-glacial ice (red line) may produce ice islands.



▼ LOOKING SOUTHWARD over northeastern Axel Heiberg Island. Nansen Sound, at left, separates it from Ellesmere Island.



▲ ORDINARY ICE in the Arctic Sea averages 13 ft. thick, whereas the islands are 200 ft. thick or more.



Maynard Miller

▲ SMALL ICE ISLANDS near Disraeli Bay, which could have come from thick land-fast ice. This "shelf ice," strangely, is not fed by any glacier.

currents of the sea carry the mass in a clockwise rotation.

In spring, as the first tentative rays of the slanting sun cross the top of the globe, the sea ice slowly begins to melt. It cracks here and there, and pools of water form on its surface. Small chunks become separated and float apart, and the whole mass becomes thinner, until large sections of it dissolve once again. Broad spaces appear along the southern shores of the Polar basin, and the pack may recede 100 miles or more from the mainland.

But even at the height of the summer melt season, the pack never completely disappears. At the Pole of Relative Inaccessibility (sometimes called the "Ice Pole" because it is the geographical center of the polar ice) and at the geographic North Pole itself, the sea remains covered for the most part with fairly thick ice. Even here, however, leads and broader stretches of open water can occasionally be seen.

This, then, is the Polar Sea. Hemmed in on all sides and constantly churned by wind, tide, and current, the arctic pack resembles a vast jigsaw puzzle whose pieces are continually stirred by an unseen hand and continually changed in shape. Although building up to formidable thicknesses each winter, it is never quite able to withstand the terrible pressures induced by the rotation of the earth.

How then could these large floating islands of ice have come into being? How could they withstand the enormous pressures at work? Where could ice of such tremendous thickness be manufactured?

I thought of these riddles as I returned to Alaska in July of 1951 to continue my geological work on the Juneau icefield. Urgent duties soon pushed them to the back of my mind, but I kept hoping for a chance to get a firsthand look at these impossible islands.

My chance came while in Anchorage arranging air support for our Juneau project through General William D. Old, the Commanding Officer of the Alaskan Air Command. General Old had the keenest interest in arctic work and was an already well-proved friend of my Alaskan icefield expeditions. During our conference, I asked him if I might later go on one of the Air Force flights over the ice islands. Observations would be useful as a preliminary to landing on one of the islands for a detailed glaciological study.

General Old told me that a special flight had been made in March to check on the position of the islands and also to examine the shore of lands bordering the Arctic Sea in an attempt to find their source. The flight had been arranged by Col. Fletcher, with whom I had talked in Washington at the Science Conference, but severe headwinds and icing had unfortunately restricted the result. Also, it had proved difficult to interpret landscapes shrouded under winter snow. But enough had been seen to enliven interest.

"Here's an idea," said General Old. "Col. Fletcher will be arriving this afternoon from Fairbanks. Why don't you come to my office around four o'clock and talk with him. If he plans another survey flight, you may be able to go along."

It was a pleasure to meet Fletcher again. He was obviously still enthused about the "ice island" problem, and we were soon deep in discussion. Before I could suggest it, he turned to me and said: "We may try again to fly along the Canadian Arctic coast, if the weather ever clears up there. Could you come along and help us with some geological answers?"

This was just what I wanted. We left it that Fletcher would wire me when the plan could be carried out.

I did not hear from him again until I came out to Juneau at the end of July. Clouds hung over the city and great sheets of rain beat against the windows of our hotel. All local flying was suspended. There was nothing to do but sit and wait.

I was at my desk finishing some paper work when an attendant advised me of a telegram:

> CAN YOU BE AT EIELSON FIELD FOR PTARMIGAN SPECIAL FLIGHT AUGUST 1ST? PROMISE OF GOOD WEATHER.
>
> JOE FLETCHER.

I checked at once with the pilot of the plane that had been loaned to us for the Juneau icefield work by the Air Rescue Service.

"Not a chance of these skies clearing for at least three days," he told me. "Besides, a plane has just crashed in the mountains northwest of here, and we'll have to look for it."

This meant that the delivery of our equipment would have to be delayed for at least a week—just the time I needed to accompany Fletcher.

I travelled by local transport to the fair-weather side of the range at Whitehorse, Yukon Territory, and flew to Fairbanks just below the Arctic Circle.

Terris Moore, President of the University of Alaska, had happily been invited to join our flight and was at the airport when I arrived. In addition to the crew, there was Major Lawrence Koenig, ice reconnaissance officer for the 58th Strategic Reconnaissance Squadron, who had already contributed much to our knowledge of the ice islands.

A tone of suppressed exictement permeated our group as we assembled for the briefing. The first good weather report in more than eight weeks had been received from the high eastern arctic. To take advantage of it, we could not delay a day.

We took off from Eielson Field in a converted B-29 Superfortress in mid-morning on August 1, 1951 with Capt. Pat Bass as pilot and Capt. C. P. Bloom as navigator. Once over the Brooks Range, we headed out across the broken drift ice of the Beaufort Sea. The Arctic Ocean for 50 miles or so from the mainland was fairly free of floes. Between 71 and 72 degrees N. latitude, very open pack ice persisted. More water than floes was seen until we entered a more congested zone extending up to 74 degrees.

Flying at an altitude of about 10,000 feet instead of the usual 18,000, we were in and out of cloud banks until, about a hundred miles off Cape Prince Albert at the northwestern end of Banks Island, our vision below became completely obscured.

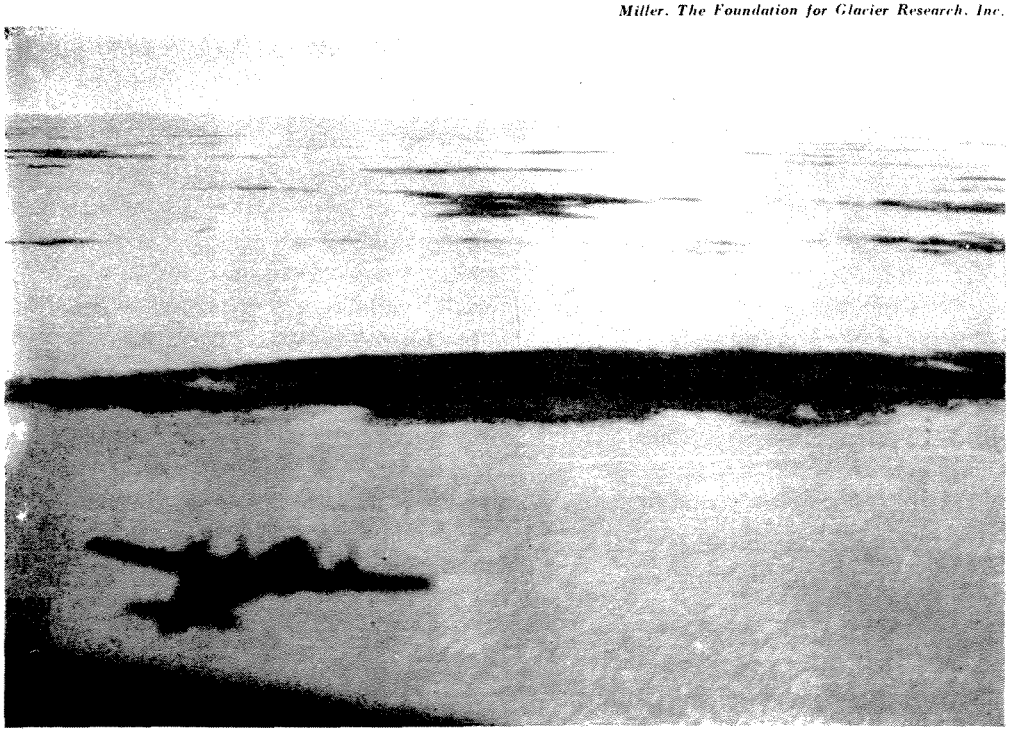
While crossing M'Clure Strait, the radar operator picked up land ahead. This proved to be a stretch of coast on Prince Patrick Island, the westernmost of the Canadian Arctic Archipelago. We were on course. We skirted the northern coast of Prince Patrick Island and Brock Island and then on across Borden Island to Cape Isachsen at the northwestern tip of Ellef Ringnes Island. Through a nearly solid undercast, we had an occasional glimpse of tight-laced pack and field ice pressed against the brown and desertlike shores.

We could make out the patterns on the ground produced by frost action and summer melting. It was disappointing not to have a completely clear view, since I was interested in aspects of the physiography of these seldom-seen islands. At least, we could see that they were low, relatively gentle masses of land, free of glaciers. We feared that the hoped-for view of Ellesmere Island off to the northeast would likewise be obscured. But a new set of weather reports still gave promise of clear weather.

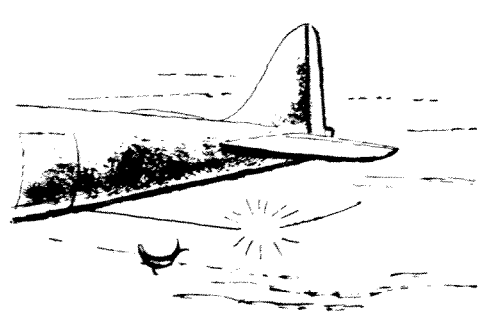
At 80 degrees N., Captain Bass swung his controls to a more northerly course, and we began to make out, under a vast stretch of blue sky, at a distance of at least 200 miles, a startling view of snow-crested highlands, glistening white with glaciers. These were the Challenger Mountains and other ranges of Ellesmere Island. Soon everything was under a magnificently cloudless sky.

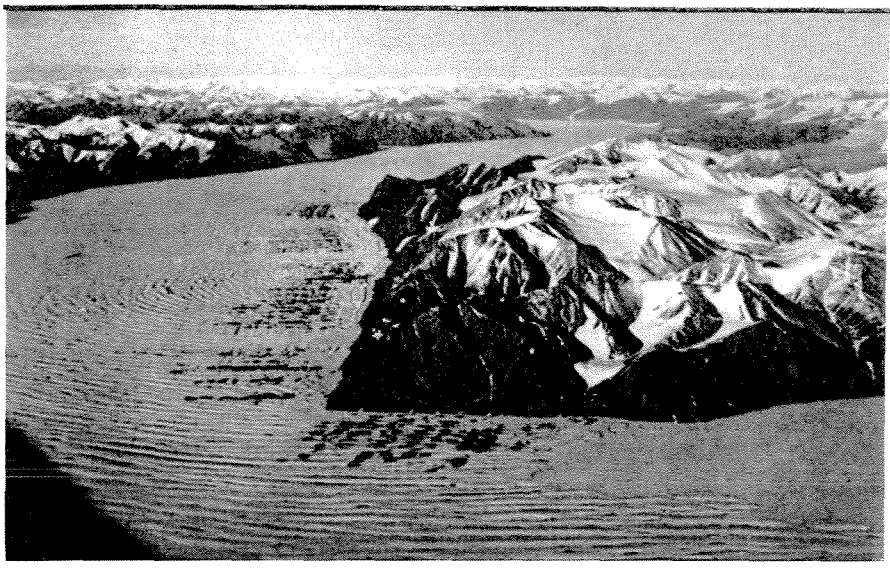
Below, the strangely arid ground of Axel Heiberg Island shimmered into view. With both my cameras working, I photographed in still and motion pictures a record of high arctic land ice. In depressions on the glacier's surfaces, I could see deep blue melt-water lakes and

Miller. The Foundation for Glacier Research, Inc.



▲ FLYING low over T-2. The dark streak is a patch of blue ice. It apparently formed in one of the troughs that mark the otherwise smooth surface.





Maynard Miller

◄ McCLINTOCK BAY, in Ellesmere's "shelf-ice" zone. Note ridges and furrows that suggest this as source of ice islands.

a sheer cliff of banded sedimentary rock bounding the south edge of ice-choked Nansen Sound.

For the next two hours, our aircraft traversed and circled the deeply cut re-entrants, narrow fjords, and twisting glaciers along this spectacular coast, glowing in pastel shades and peaceful shadows—a scene of lifeless solitude and frozen beauty.

Then between Phillips Bay and Markham Bay, we caught sight of a most unusual ice feature—a sheet of 50 or more miles of ice projecting out from the shore of the Polar Sea. At first, it was intermittent, but especially between Yelverton Bay and Disraeli Bay it was continuous. On the seaward side, a 20-foot cliff of ice delimited it from the pack. Had we been in the antarctic, this would not have been surprising, because "shelf-ice," presumably afloat and usually connected with glaciers on the mainland, is well known. But so far as I know, a true "ice shelf" had never before been reported in the arctic. And since shelf-ice of the antarctic sort was just what the ice islands seemed to call for, it was a temptation to jump to conclusions. But I could see important differences between this shelf-ice and that of the antarctic.

There were distinct furrows on it, making it look like a great plowed field, with clean snow on the ridges and blue ice and meltwater showing as long dark lines in the depressions. We estimated that the waves of ice were 100 to 300 yards apart and the individual rolls between 5 and 15 feet high. Of particular interest was the fact that this whole series of undulations ran across the surface of the ice in a manner strangely parallel to the general trend of the coastline.

This ice was much more severely melted than any of the antarctic types. But a more important difference was that it was moored to an almost glacier-free shore. In fact, at several places, I could see where land rivers had flowed from the rocky mainland right onto the ice, sometimes straight across the furrows to form extended river channels clear to the seaward edge. This proved that the surface of the shelf sloped gently down from the land to the sea and that it was essentially solid ice. It also indicated a surface draining pattern unheard of in the antarctic. Lt. Pelham Aldwich of the Nares Expedition in 1876 and later Peary in 1905, both of whom travelled along this coast, thought that the broad rim of shore ice was of land origin and had been formed by glaciers. In fact, Peary referred to it as the "ice foot" and the "glacial fringe." But from what I could see, the shelf had never moved down from the mainland. I was convinced that it was distinctly non-glacial in origin and had been built up more or less in its present position by processes not unlike those that form ordinary sea ice. I could only explain its considerable thickness, as compared with the fringing pack, by the fact that it had been held fast to the land over many years, thus preventing its annual breakup and allowing accretion to continue without interruption.[2]

Close to the seaward edge of the shelf, we passed over a tabular sheet of ice about a square mile in area. It had all the characteristics of the adjacent land-fast or grounded ice. Almost certainly it was a segment that had broken from the "shelf" to drift free in the pack—the very evidence we needed.

One of the big ones

Then, about 20 miles north of Disraeli Bay, we made a most startling discovery. There, within sight of land, floated a huge triangular chunk of flattish ice—about 17 by 20 miles!

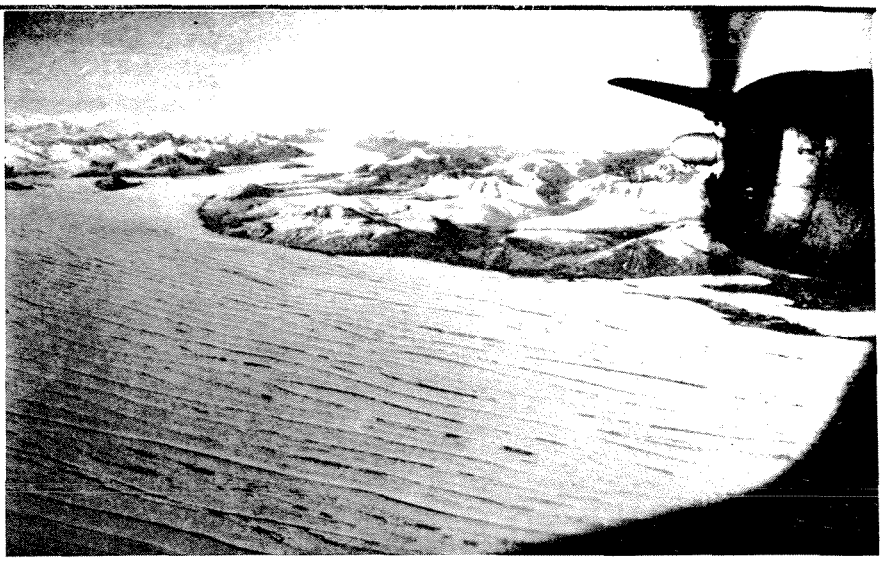
Major Koenig, shuffling photographs, exclaimed, "That's it! It's T-1, all right. What luck!" And then turning to Terry Moore, he explained his excitement: "It's been lost for two years."

My own excitement reached a climax as we made two low passes over it, which brought us down to less than 100 feet above the surface. Here, at close range, we could see again the strange corrugations we had viewed with such interest on the ice shelf of the near-by coast.

We made one final pass over the island at 4000 feet before heading out to sea on a northerly track.

We had been too busy to talk. Now the cabin buzzed wtih conver-

2 This is probably related to the type of heavy polar ice that early explorers termed "paleocrystic" ice, "floebergs," and so forth. Its excessive thickness is attributed by Stefansson to the combined effects of strong westerly winds and high "storm tides" along the shores of the Polar Sea (see his *Friendly Arctic*, pp. 223-224). The first person to photograph such ice and to detail its nature and probable origin was E. K. Leffingwell in his painstaking U. S. Geological Survey monograph "The Canning River District, 1919." This paper gives a useful summary of the early literature pertaining to this type of "old ice."



Maynard Miller

➤ GENERAL LACK of connection with glaciers makes this "shelf ice" in McClintock-Disraeli Bay area unlike antarctic's.

sation. Koenig and I were discussing how an "ice shelf" could possibly have persisted in this region where glaciers have been shrinking and snowfall is known to be scanty. I theorized that it might be a relic of the great Ice Age, or more likely of a lesser cold period in the more recent past. I suggested that in spite of the vast surface-melting in summer, it was being maintained by sea water freezing on the underside during the coldest winter months. This was along the lines first advanced by Professor Frank Debenham, of the Scott South Polar Expedition, in his controversial theory on the origin of the Great Ross Barrier in the antarctic.[3]

Koenig interrupted:

"Before you get too absorbed in technical thoughts, look at this,"—and out came the most tremendous club sandwich I had ever seen—chicken, lettuce, and fresh tomatoes, to be washed down with a jug of steaming coffee from the cabin thermos. With a nonchalance I scarcely felt, we settled back for lunch, as the plane drummed onward toward the Pole.

After lunch, I searched through my field notebook for a quotation which Major Donald Shaw, of the Air Force's Arctic Information Center, had brought to our attention. It was from Peary's *Nearest the Pole*, written in 1906, and described the very same coast over which we had flown:

"The new light snow made fine snowshoeing, but was very heavy for the dogs and sledges; and this heaviness was accentuated in the series of rolling swells which are a feature of this peculiar ice foot along here. These swells are on a large scale, and reminded me very strongly of portions of the icecap of Greenland. If they are not huge drifts, I do not know how to account for them. Off Ward Hunt Island and especially the western end, they are particularly marked and here they blend into drifts formed in the lee of the island. From the summit of the tumulus, I saw the ice ahead of us in the same condition: a gigantic potato field with a long blue lake or a rushing stream in every furrow."

"You know, Larry," I said, "it's just possible someone has been on T-1 or T-2. If this *is* their birthplace, as I feel sure it is, then men from the Nares' Expedition, Peary, and some of these other early explorers probably travelled right across them *before they were launched.*"

Pleased as we were with this part of our project, we were not fully satisfied, for we also hoped to relocate T-2, which had last been seen in June, fairly near the Pole.

Between latitudes 83 and 85 degrees, we passed over the tightest pack yet seen, with giant floes and much pressure ridging everywhere. Above latitude 85, there was another broad area of undercast, and we doubted we could find T-2. We had been airborne for eleven hours, and the plane would soon reach the outer safety limit of its fuel supply. At 87 degrees, less than 200 miles from the North Pole, the undercast gave way to a cold front, and the reflected light of the midnight sun gleamed from the endless pack.

And then came the expected announcement. Our fuel radius had been reached. The navigator's decision was final, for in polar flying, it is he who actually controls the plane. We headed back for Alaska.

One last look

I decided to strain through just one more tedious round of horizon-scanning with the binoculars before we became completely enveloped in mist again. Presently I picked up a faint unconformity on the horizon in the clear area off our starboard beam. I nudged Captain Bass and pointed. He veered slightly for a better look. When I saw it again, there was no question of what we had found. The nose of our plane swung through an arc of 120 degrees to close in on T-2.

What an exciting piece of luck! I had seen it almost at the limit of visibility. Had our flight taken us only a mile or two farther east, we should have missed it altogether.

At that moment, we were 150 miles beyond the North Pole on the other side of the world. As we swung down for a closer look, the navigator advised us that there was only enough fuel for one low pass. Captain Bass brought the Superfortress so low I almost thought we were coming in for a landing. This was not too discomforting a thought, for with the surface only 50 feet below, T-2 presented the most gigantic and unbelievably

continued on page 274

3 "The Problem of the Great Ross Barrier," by Frank Debenham, *The Geographical Journal*, Vol. CXII, Nos. 4-6, October-December, 1948, pp. 196-218.

 continued from page 239

smooth mass of floating ice I had ever seen. The level top of the island stood 30 feet or so higher than the surface of the pack ice. From this, we calculated that the island must be 200 feet thick.

Ahead was the shadow of our B-29, alarmingly close. On each side stretched an unrippled plain, looking very much like a vast skating rink. In the midst of the excitement, Captain Bloom reminded us: "Take a good look while you can. We won't have enough gas for another run."

Perhaps the extreme smoothness of T-2 can be attributed to meltwater becoming impounded in the "furrows" during the summer months and later re-freezing. Progressive melting and freezing might thus tend to level the surface. Further flattening might be produced by sand-blast action from driven snow. All this, of course, would take time. But it may mean that the smoother "ice islands" are those that have drifted around the Polar Basin for the greatest number of years.

Photographs of T-3 show it to be rougher and even more corrugated than T-2. Possibly, T-3 has come from a different sector of the Ellesmere shelf or from another source; or perhaps it is only of more recent vintage.

As we skimmed over the surface of T-2, I could see no water in even the deepest depressions. Its lack may be explained by the fact that this island is farther north than T-1, farther from the warming influence of land.

I was convinced that a wheels-down landing would not have been difficult, and in fact that a wheels-up emergency landing would have had an excellent chance of success. A smooth runway of any length could have been selected in almost any direction.

As I quipped, half-jokingly, "Let's drop the wheels and set her down," I may have influenced our pilot, because he brought the huge bomber in even lower. In fact, the rubber end of our trailing antenna struck the ice and ripped off, to provide proof of our visit and perplex any future party that comes to explore.

It took six and half minutes by stop-watch to pass over the middle of the island from side to side, making it 21 miles across and at least 300 square miles in area.

As we roared over the island's farther end, a large seal slithered off a fringing scarp and splashed into the water. Of course, my movie camera chose that moment to jam, but the sight served to remind us of Stefansson's contention in his book *The Friendly Arctic* that a good hunter need not perish in the far North. Although a slightly reassuring idea in case of an emergency at this high latitude, we hardly wanted to put it to a test.

We longed for a more studied view of our island, but the navigator's word this time was adamant: "We're heading home," he said. "I hope we make it; there's still 1900 miles to go." Then with octant in hand, he climbed up into the astrodome for another sunline to check our position.

Major Koenig leaned back in his seat in the nose of the Fortress, and we climbed to 10,000 feet. I also tried to find a more comfortable position. There is so little spare space in the control pit of a B-29 that I found it difficult without pressing against some important-looking instrument handle or other protruding mechanism. To give us more freedom, Dr. Moore crawled aft along the fusilage passageway to where he could stretch out full length in the roomier rear compartment. It was our first relaxation in more than 14 hours.

For the first two hours of our homeward flight, we were in sparkling sunshine. I sat in the nose, writing notes and scanning the ever-changing pattern of floating ice. Our four smoothly churning propellers made me think of the epoch-making flights of Eielson, Wilkins, and Byrd. How differently they must have felt with only one small engine to keep them aloft.

Soon we encountered increasing amounts of mists. Whenever the navigator needed a new fix, we would climb up into the sunlight. Then at 2 A.M., a solid wall of clouds closed around us, and for the next four hours the engines drummed a steady beat in a seeming vacuum of milky nothingness. It was not until 6 A.M. that we broke out of the murk. Captain Bloom advised that we were approaching the Alaskan coast but that there was not enough fuel to reach Fairbanks or even Point Barrow. In consequence, Captain Bass turned eastward for Barter Island, where there was a small emergency landing field only 4000 feet in length. Since this landing strip had always been considered too short for a B-29, the crew of the small Naval Radio Station there were mighty surprised to see us. They were even more surprised, however, when they learned where we had come from. Our 20-hour non-stop flight was the longest Ptarmigan mission in the squadron's history of more than 500 polar flights. A welcome breakfast of sizzling bacon and fresh eggs was spread out on a huge table. While we ate, gasoline was pumped from 55-gallon drums into the aircraft's hollow tanks.

A few hours later, we were coursing over the Brooks Range toward Fairbanks in brilliant sunshine. There had been no night on this flight, and I had been too excited to catch much sleep. When the letdown finally came two hours later at Eielson Field, all of us knew we were completely exhausted. Yet the pilots calmly landed the ship just as if they were coming in from a routine training flight instead of a memorable 4100-mile journey beyond the Pole.

Eight months later a dramatic phase in the scientific exploration of the Polar Basin took place. On

March 19, 1952, a ski-equipped, twin-engined aircraft flown from northwestern Greenland, made a bold landing on T-3, which by then had drifted to within a hundred miles of the Pole. On board was Colonel Fletcher, with General Old serving as co-pilot. Colonel Fletcher and two companions remained on the island for 13 days to assess the possibility of setting up a permanent camp. Additional personnel, supplies, and equipment were then flown in to establish a year-round station for weather and geophysical observations.

"Project Icicle," as this expedition was called, initiated detailed studies of this wedge-shaped island of ice and of the ocean floor over which it floats. The objectives embrace a broad range of field research, which will greatly increase our knowledge of arctic meteorology, oceanography, and glaciology. For stimulating this program, the greatest credit is due Colonel Fletcher and General Old, both of whom showed inspiration and vision in pushing forward the initial landing at a time when circumstances were much against the project's success.

Ground parties are now unravelling various problems concerning the development and nature of these strange ice bodies, and much information of interest has already been gathered. One question not yet answered is how long the islands have been drifting around.

We do know that climatic conditions have changed markedly in recent times. At the height of the glacial period, the pack was vastly more extensive than it is today. Heavy sea ice filled the ocean and extended well up into the fjords of all the bordering land. Several times since the last maximum advance of the Pleistocene glaciation about 10,000 years ago, the Arctic Ocean has been almost, if not completely, an open sea. The first such condition is suggested by the strong retreat of land glaciers in the warm era known as the "Climatic Optimum," which occurred some 5000 years ago. This was followed by another temperature fluctuation, culminating in a colder condition at the beginning of the Christian era. Further evidence suggests that in the fifth and seventh centuries, the seas in the summer months were clear again as far north as the Pole and that probably their peripheral waters remained relatively free of ice on up through the tenth century when Eric the Red and his son Leif were voyaging to the New World. The records of Norse settlers reaching Greenland for 300 years after 983 A.D. suggest that the climate was relatively milder up until the fourteenth century. Then, two to four centuries ago, there was a world-wide expansion of glaciers and a thickening of polar ice in a new "Little Ice Age." At that time, the shores of the arctic basin had much more land-fast ice than they do today, and ice must have been especially persistent along the coast of Ellesmere Island. But now, the pendulum is swinging back, and the glaciers and sea ice are again diminishing.

The present appearance of the Ellesmere ice-shelf suggests that its break-up has been hastened since the turn of this century and probably even since the time of Nares' distinguished voyage of eighty years ago. Recent European studies have shown that the pack may have thinned about 40 per cent since 1895. Meteorological records also show that a climatic change of world-wide significance has warmed the earth an average of 2 degrees F. since 1885, resulting in a rise in the winter temperature of more than 11 degrees F. at the latitude of northern Ellesmere Island. Considering these facts, it may be that the sea ice is no longer continuous enough for a sledge party to travel across it to or from the Pole as Peary did in that memorable spring of 1909.

With the ice islands to serve as bases for scientific parties, our knowledge of the arctic basin can grow apace. A lot of work can be carried out on them before they melt, unless I miss my guess.