VOLUME XCII NUMBER FOUR

THE NATIONAL GEOGRAPHIC MAGAZINE

OCTOBER, 1947

Map of Countries of the Caribbean

Including Mexico, Central America, and the West Indies

Our Navy Explores Antarctica

With 59 Illustrations and 3 Maps
11 Natural Color Photographs

REAR ADMIRAL RICHARD E. BYRD, USN. RET.

The Society's New Map of the Caribbean Area

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THE NATIONAL GEOGRAPHIC MAGAZINE

Our Navy Explores Antarctica

BY REAR ADMIRAL RICHARD E. BYRD, USN. RET.

With Illustrations from U. S. Navy Official Photographs

AT THE bottom of this planet lies an enchanted continent in the sky, like a pale sleeping princess.

Sinister and beautiful she lies in her frozen slumber, her billowy white robes of snow weirdly luminous with amethysts and emeralds of ice, her dreams iridescent ice halos around the sun and moon, her horizons painted with pastel shades of pink, gold, green, and blue.

Such is Antarctica, luring land of everlasting mystery. The ice-imprisoned continent covers almost 6,000,000 square miles of the earth's surface—nearly as much as South America. Most of the interior actually is less known than the sunlit side of the moon.

In the century since the land was discovered, fewer than 600 human beings have lived on its shores. Sirenlike, it challenges the restless, adventure-hungry postwar world.

Exploration a Navy Tradition

Last winter this challenge was accepted by the United States Navy, as part of its training and research activities, with the largest exploring expedition ever organized—thirteen ships manned by 4,000 men. It was the fifth, and by far the largest, polar expedition which I have led.*

Of the five, this was the first which was entirely naval, with the exception of a few Army and civilian observers and scientists.

Whatever I have been able to accomplish in the past as an explorer has been due largely to my training and experience as a naval officer, and to the Navy's spirit of fair play and justice that give importance and dignity to the individual.

Obviously, the technical education of any man who is to exercise command in this branch of our armed services must include most of the specialties of the professional geographer. He must be competent not only as a navigator but as a map maker, an astronomer, a sensitive and accurate observer of Nature.

Some of the foremost figures in the history of our naval service, both here and abroad, have been explorers—especially explorers of the polar regions. The American list is impressive and inspiring—Peary, Wilkes, Kane, De Long, and many others.

Among the outstanding names in the history of the Antarctic have been those of Capt. James Cook, Sir James Clark Ross, and Capt. Robert F. Scott. All were of the Royal Navy, and Sir Ernest Shackleton was of the Naval Reserve. Bellingshausen was a Russian naval officer, D'Urville a French naval captain. The story of polar exploration would fill a much smaller volume if the accomplishments of all these men were erased.

In the Navy, battles with storm, distance, cold, loneliness, and hunger stand nearly as high in the tradition of the service as battles with hostile fleets. The officer enters upon his career with this tradition as one of the impelling forces of his life.

* Admiral Byrd also was in command of the naval aviation unit of the MacMillan Arctic Expedition in 1925. See, in the NATIONAL GEOGRAPHIC MAGAZINE for November, 1925, "Flying Over the Arctic," by Lt. Comdr. Richard E. Byrd, and "MacMillan Arctic Expedition Returns," by Donald B. MacMillan. See also, by Admiral Byrd: "First Flight to the North Pole," September, 1926; "Conquest of Antarctica by Air," August, 1930; and "Exploring the Ice Age in Antarctica," October, 1935; and, by Capt. Ashley C. McKinley, "Mapping the Antarctic from the Air," October, 1932.

With Three of His Top Advisers, Admiral Byrd Plans an Exploring Flight

War against the grim powers of ice, snow, and wild Antarctic weather centered in this map-lined room. Behind the Admiral (left to right) are Capt. G. F. Kosco, expedition aerological officer in charge of scientific projects; and Comdr. C. M. Campbell, commander of the base group. In foreground is Capt. H. R. Horney, Admiral Byrd's chief of staff.

So I was glad and proud to see the naval service return on such an impressive scale to the field for which it is so pre-eminently adapted by training, equipment, and history.

The project was, moreover, a means of demonstrating strikingly to the American people that their Navy is not alone "war insurance." It pays its way in services between wars. The code and spirit of the Navy are the finest things I have known in life or literature, and I consider them to be a great asset to the Nation in peace as well as in war. With great sincerity and a lifelong conviction I should like to say that I wish the people of this country could know our Navy as I do.

This great undertaking, the 1946-1947 U. S. Navy Antarctic Expedition, officially designated Operation Highjump, was made possible by the vision and enterprise of Secretary of the Navy James Forrestal and Fleet Admiral Chester W. Nimitz, Chief of Naval Operations. Vice Adm. Forrest P. Sherman, Deputy Chief of Naval Operations, assisted by Rear Adm. Roscoe F. Good, showed extraordinary foresight and initiative in making the general over-all plans and in implementing those plans.

To Capt. Richard H. Cruzen, veteran of our 1939-41 Antarctic Expedition, fell the job of doing most of the detailed organizing—a tough assignment indeed. He was put in command of Task Force 68, as the expedition's ships were known collectively, upon my recommendation. Just before the departure of the expedition, Cruzen was promoted by the Selection Board to the grade of Rear Admiral.

This delighted me, as it was what I had hoped for. Further, it would make Cruzen's job and mine easier.

The Navy was considerably handicapped because of the short time that was available (this was unavoidable) for organizing and

Good Hunting! They'll Have "Sealburgers" and Seal Steak Tonight

While the ships of the Central Group were stalled in the Ross ice pack, a hunting party was organized and a crabeater seal killed. In the hunting party were (left to right): Dr. H. H. Howe, of the U. S. Coast and Geodetic Survey; Dr. H. H. Richardson, assistant staff medical officer; Jack E. Perkins, expedition biologist and representative of the U. S. Fish and Wildlife Service; and Dr. Paul A. Siple, senior representative of the War Department. Ordinarily, seal meat is used only for dog food.

readying the expedition. From these pages it can be seen how well the above-mentioned officers overcame this handicap.

I was designated Officer in Charge of Operation Highjump, and as such represented Fleet Admiral Nimitz during the preparation and while operating in the Antarctic.

Encirclement of Continent Planned

A major objective was to sail with two task groups, each with a seaplane tender, as far as possible around the 16,000-mile coast of the roughly circular continent (map, pp. 436-7).

Most of the coastline, as shown on present maps, is largely conjectural. It has little more relation to reality than had some of the grotesque 16th-century maps of America used by pioneer explorers who crossed the Atlantic.

From our seaplane tenders it was proposed to launch planes at various points to explore the coast itself and make flights inland.

Another major and very important objective was to have the main group of ships—the Central Group—establish a base for ski-equipped landplanes which would make long exploring and photo-reconnaissance journeys over the unmapped interior of the continent itself.

To sum up, the plan was to attack the continent on three fronts.

One group of three ships would move eastward from the 90th west meridian and proceed as far as possible toward the meridian of Greenwich (0°), which approximately bisects Queen Maud Land east of the Weddell Sea.

Another would start from the Balleny Islands, south of New Zealand, and proceed westward until it met the first group.

Each of these groups carried three PBM flying boats and three crews. The planes were to be launched from the open sea just north of the ice pack, photograph the coast, and fly inland as far as possible.

Between these two operated the Central Group, with a base on the ice near the Bay of Whales. Its ski-equipped planes were to operate over an arc of about 80 degrees of longitude in which lies the Ross Sea.

Thus there was a chance that a complete circle could be closed around the continent. It was hoped that in a few weeks more would be learned of the great unknown than had come from a century of previous exploration by land and sea (maps, pp. 436-7, 467, 495).

Success of our plan was dependent on a reasonable amount of good flying weather. Ordinarily, one expects a total of little more than a week a month of clear calm days during January and February, even with the unbroken daylight during which missions could be sent out at any time during the 24 hours.

War Gave Explorers New Weapons

From the war there was a heritage of powerful new weapons which could be adapted to exploration and turned from fighting men to overcoming the even more malevolent elements which guard the secrets of Antarctica.

Our aircraft were equipped with all the marvelous photo-reconnaissance tools developed during the war.

Of great significance was the war-developed science of trimetrogon photography with the interpretation, and translation into maps, of photographs taken from the air. Since 1939 its techniques had undergone remarkable advances to meet the needs of the Air Forces and of general military intelligence.

For the purposes of the map maker the method is no different in principle from the triangulation techniques of surveyors on the ground, but there is a thousandfold increase in speed. There is also the advantage of showing what the countryside looks like and of revealing even minute details which would not be grasped by the naked eye (page 506).

Before us was the job of photographing much of the face of a continent, of combining in an enormous composite picture the topographical features of several million square miles. We knew that our Air Forces had mapped in this way most of North Africa and western Europe in the face of hailstorms of flak and the opposition of enemy fighters.

Here, in place of an armed enemy, were bad visibility, fog, Antarctic blizzards, and trackless immensities of cloud which formed without warning.

For the first time, Antarctic explorers were equipped with that uncanny instrument, the air-borne magnetometer, by which it was possible to determine the nature of the rock under the great icecap which covers the bottom of the world and to learn something of its mineral composition (page 509).

Still another weapon which could be adapted for conquest of the Antarctic and which had undergone remarkable development during the war was the icebreaker, as exemplified by the 6,660-ton, 10,000-horsepower Coast Guard icebreaker *Northwind* and the Navy's brand-new *Burton Island*. Both these ships accompanied the expedition.

Either could smash, slash, and wrestle almost indefinitely through solid pack ice up to eight feet thick. Thus was greatly simplified the problem of getting through the frozen seas which girdle the continent. The difficulties made me wonder how we ever got through the ice pack before with our 200- to 600-horsepower tiny wooden ships.

A mighty asset was the modern aircraft carrier, from which we planned to fly planes direct to Antarctica.

In short, it was our job to fashion all these swords into plowshares for the peaceful but perilous work of exploration.

New Age of Exploration

Equally as important as immediate geographical discovery was the responsibility of learning to use these marvelous new instruments, to test them under extreme conditions, to ascertain and devise means of overcoming their defects. In this respect we were pioneers, trail blazers of exploration's new age.*

Accompanying the expedition and distributed among the various ships were distinguished Army, Navy, and civilian scientists directed by Capt. George F. Kosco, USN.

The chief War Department representative was Dr. Paul A. Siple, Lt. Col., U. S. Army Reserve, whom I regard as the foremost living Antarctic geographer and authority on Antarctic problems.

He first came south with me as a Boy Scout in 1928. Since then he has been with all my

*Rear Admiral Richard E. Byrd, the first man to fly over the North and South Poles and the only one to fly over both, has looked upon more square miles of unknown area than any human in all history. He served in aviation with distinction in both World Wars; in the last one he was overseas four times and was cited or decorated four times. He had charge of the navigational preparations for the first successful transatlantic flight in history, made by the Navy in 1919. He flew nonstop to France in 1927, several weeks after Charles Lindbergh made the flight. His naval record shows twelve mentions of bravery, which include two citations for extraordinary heroism. He has the Congressional Medal of Honor, the Congressional Lifesaving Medal, three specially voted Congressional Medals, and nearly every other medal within the power of the United States Government to bestow.—The Editor.

Strange Brood for a "Fighting Lady": Six Big Douglas Landplanes, Antarctic-bound, on the Deck of the Carrier *Philippine Sea* in the Panama Canal

A dramatic highlight of the Navy's Antarctic expedition was the take-off of these heavy transports for a flight over the ice pack to Little America (pages 434 and 443). Because of their extensive wing-spread and danger of running into the "island," right, only half of the deck was available for their historic take-off run.

Antarctica Next Stop! Six Heavy Landplanes Taking Off from the Aircraft Carrier *Philippine Sea* Made Aviation History

Plumes of smoke jet from the rocket-propulsion JATO bottles as they boost the R4D into the air with a deafening noise. All six planes, largest ever launched from a carrier, successfully made the 800-mile hop to Little America. Dual landing gear, consisting of skis with three inches of wheel protruding, enabled the planes to roll off the deck into the air and land on the big "barrel staves" on the snows of Antarctica (page 512).

expeditions, and his contribution to south polar science is in my opinion far greater than that of any man living or dead.

Siple has an intimate knowledge and broad grasp of everything associated with south polar regions. He is the only human being who refers to this land as "my own country." To Siple a return to Little America is "coming home." His advice and the assistance he gave the scientific group were invaluable.

For the last 25 years I have run across Army officers and men all over the world, and I have received from them personally the highest courtesy and hospitality and officially only the fullest cooperation.

This is especially true of World War II, in which I served under Army officers and over them when they were attached to my staff.

On this expedition, as always, it was a joy to work in the field with the Army. I recommend strongly that the next large polar expedition be made a joint Army-Navy project.

Central Group Battles Ross Ice Pack

The five ships of the Central Group of Task Force 68, with Rear Admiral Cruzen in direct command and Capt. Robert S. Quackenbush, Jr., always a tower of strength, as Chief of Staff, gathered on the last day of the year around a coal-black rock looming out of the ocean among hundreds of blue-and-white icebergs north of the Ross Sea. This is Scott Island, only land above water within a radius of more than 300 miles, and probably the best-

known landmark south of the Antarctic Circle.

Soundings by Drs. J. L. Hough and W. G. Metcalf of the Woods Hole Oceanographic Institution showed that the island is the flat-topped peak of one of a pair of submarine mountains, each nearly two miles high. The second peak, hitherto unknown, comes within about 200 feet of the surface. This was the first notable geographic discovery of the expedition.

For a century the Ross Sea has been recognized as the best approach to the interior of the Antarctic Continent. It is a large wedge-shaped shallow bay which, including its great ice shelf, cuts into the land for more than 1,000 miles. It starts near the 70th parallel, south latitude, and is roughly bisected by the 180th meridian, the international date line.

For about 700 miles there is usually, in summer, either open water or relatively loose pack ice. The pack, which varies in area from year to year, generally is concentrated near the northern boundary and must be traversed to reach the open water.

The sea ends abruptly at an ice wall from 40 to 80 feet high—the edge of the Ross Shelf Ice. This is a smooth, occasionally crevassed sheet, several hundred feet thick and about the size of California, stretching southward to the foot of the Queen Maud Range, which rims the great Polar Plateau.

An Epic of Navigation

The penetration of the Ross pack by the Central Group—the Coast Guard icebreaker *Northwind*, the command ship *Mount Olympus*, the freight carriers *Vancey* and *Merrick*, and, at the outset, the submarine *Sennet*—became an epic of navigation.

It started on New Year's Eve.

A seaplane reconnaissance had indicated to Admiral Cruzen that the ice was thin and soft, with numerous lanes of open water between the floes. It appeared that the thin-shelled ships with hulls only about a half-inch thick would be in little danger of being dented or punctured in the pack drift.

This soon proved a delusion. The dawn of 1947 found the vessels already south of the area of floating, slushy chunks. At midnight the seascape was solid white as far as eye could see in any direction, except for a very few widely scattered green pools. A wind change immediately after the air observations apparently had solidified the white desert.

For two full weeks the expedition wrestled and traded punches with angry, belligerent ice. Sometimes the ships went forward only two or three miles a day on their way to the Bay of Whales, 800 miles distant. At one time, for three days, the ice carried them backwards about six miles a day (Plates IV-V).

Worst Ice Conditions in Century

Within the next few days it became obvious that this was the worst pack encountered in the 106 years since Sir James Clark Ross first pushed through the sea which bears his name. His ships, the *Erebus* and *Terror*, in early January, 1841, had bucked only 195 miles of ice.

Captain Scott's *Terra Nova* in December, 1910, had to push through more than 425 miles of fairly solid ice—an ill omen for the expedition that was to end in the greatest tragedy of south polar explorations.

Lincoln Ellsworth's *Wyatt Earp* in 1933 encountered one of the worst packs up to now—525 miles of thick, crushing whiteness.*

A few weeks later I sailed through the pack in the vicinity of the 169th meridian in an unprotected ship without seeing any pack. In January, 1940, Cruzen and I sailed through in twenty hours.

I have been through the pack a number of times and am convinced that it follows some sort of pattern in its behavior from year to year, but this is so complicated and so many unknown factors are involved that at present it is unpredictable. This constitutes one of the many problems of the Antarctic that await solution through the patient accumulation and coordination of observations.

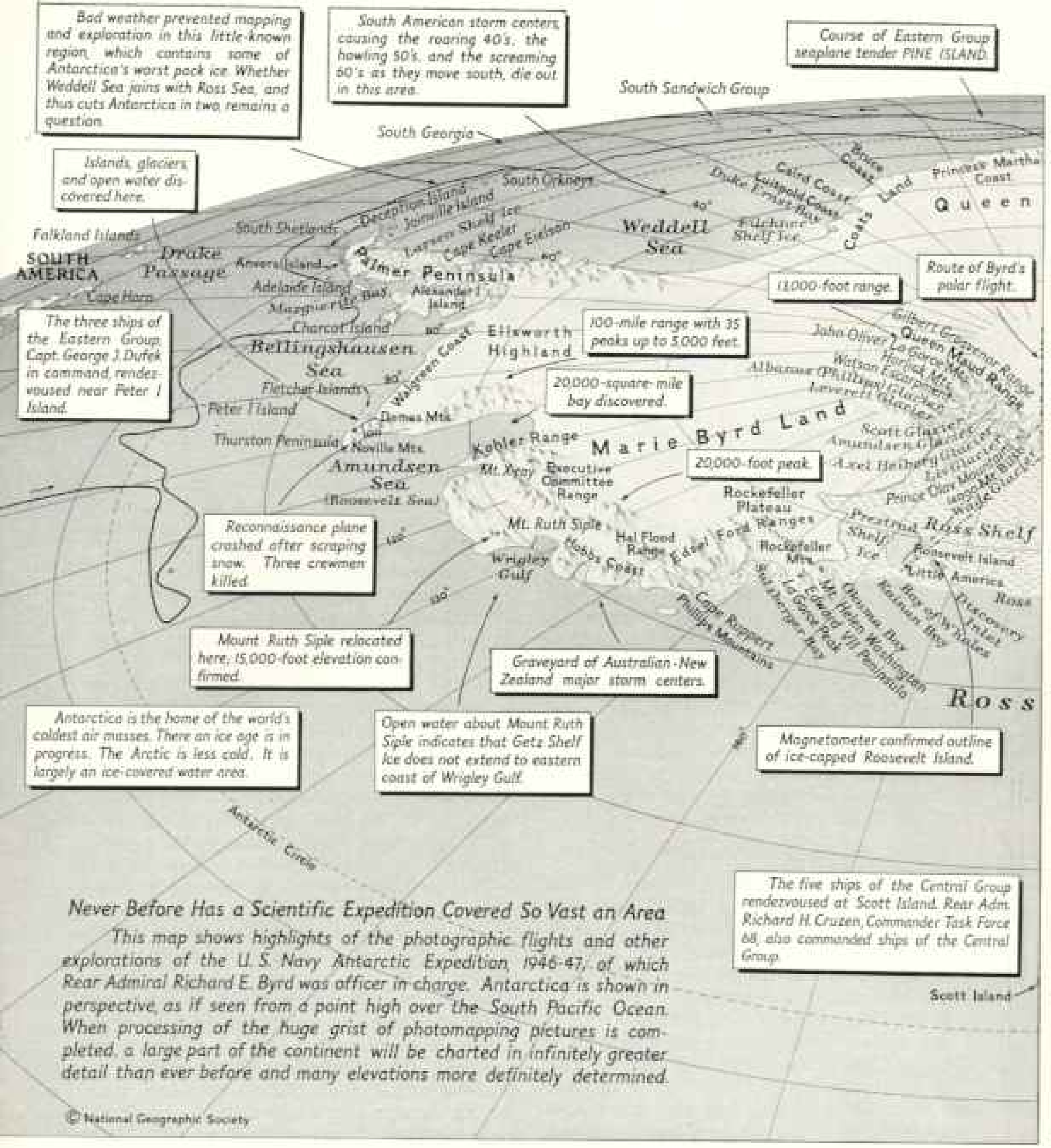
The ice has a general northwesterly drift. Every summer, it seems likely, there is a relatively open roadway somewhere which might be located by air observations. These would require time and a great deal of patience. Time, it must be remembered, is very precious when one can expect, at the best, only a few weeks of good weather.

Getting back through the pack is likely to prove a much more difficult problem than getting through it in the first place. It is hard to guess when the ice will reconsolidate into a thick, unbroken sheet which will be impassable for any ship.

Late in the season this may happen very quickly and without much warning. In 1930, for example, we barely escaped being trapped at Little America for another winter.

The eastern group of our 1941 expedition actually was trapped at Marguerite Bay by the suddenly re-formed pack, and it was necessary to evacuate them by air, an extremely perilous procedure.

* See, by Lincoln Ellsworth, in the National Geographic Magazine, "My Flight Across Antarctica," July, 1936, and "My Four Antarctic Expeditions," July, 1939.



Never Before Has a Scientific Expedition Covered So Vast an Area

This map shows highlights of the photographic flights and other explorations of the U. S. Navy Antarctic Expedition, 1946-47, of which Rear Admiral Richard E. Byrd was officer in charge. Antarctica is shown in perspective, as if seen from a point high over the South Pacific Ocean. When processing of the huge grist of photomapping pictures is completed, a large part of the continent will be charted in infinitely greater detail than ever before and many elevations more definitely determined.

Safe escape from the pack may be a matter of hours. This was to become a serious possibility before the Antarctic summer ended.

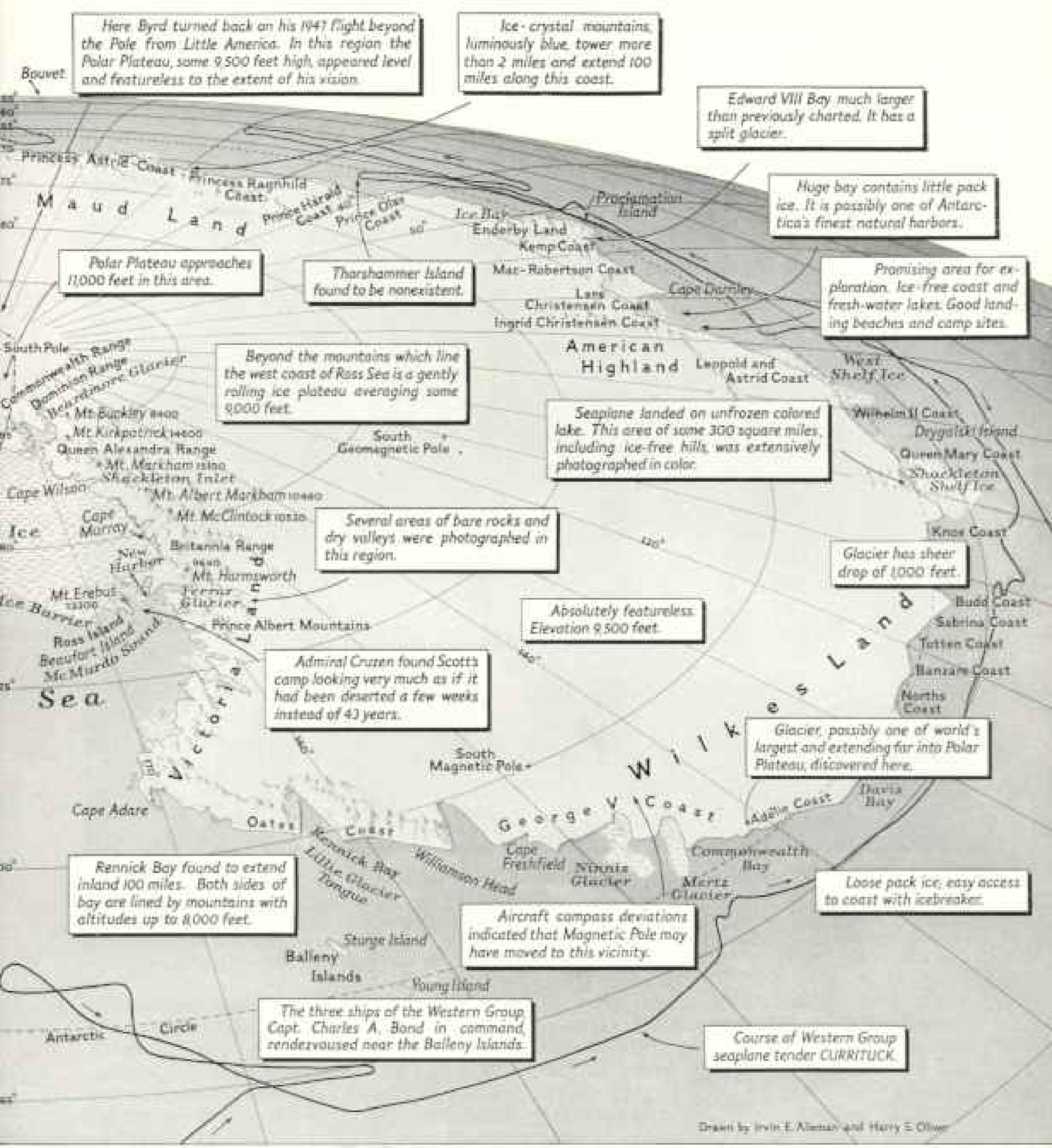
This year, on the trip south, Admiral Cruzen found an astounding contrast to what we had known before—approximately 600 miles from Scott Island to open water through ice from one to 30 feet thick.

Much of this was thin, not more than four feet thick, and "rotten." The solid structure of the frozen surface of the sea was undergoing rapid disintegration.

This, however, was crisscrossed by ribs of thick hard ice which had broken from the rim around the continent the summer before and floated northward to become integrated with the pack. Occasionally such ribs would be several miles wide. They were like steel walls in the path of the ships.

For the most part, this ice field was unbroken by leads or pools of open water. During the voyage only two large lakes were found in the desert, and these served as havens for days at a time.

"Desert" is a good descriptive word for the pack. The ice is covered with about a foot



of snow. This snow is dry, with the texture of fine sand.

Sturdy Icebreaker Runs Interference

The *Northwind*, commanded by Capt. Charles W. Thomas of the Coast Guard, one of the best ice sailors living, led the way.

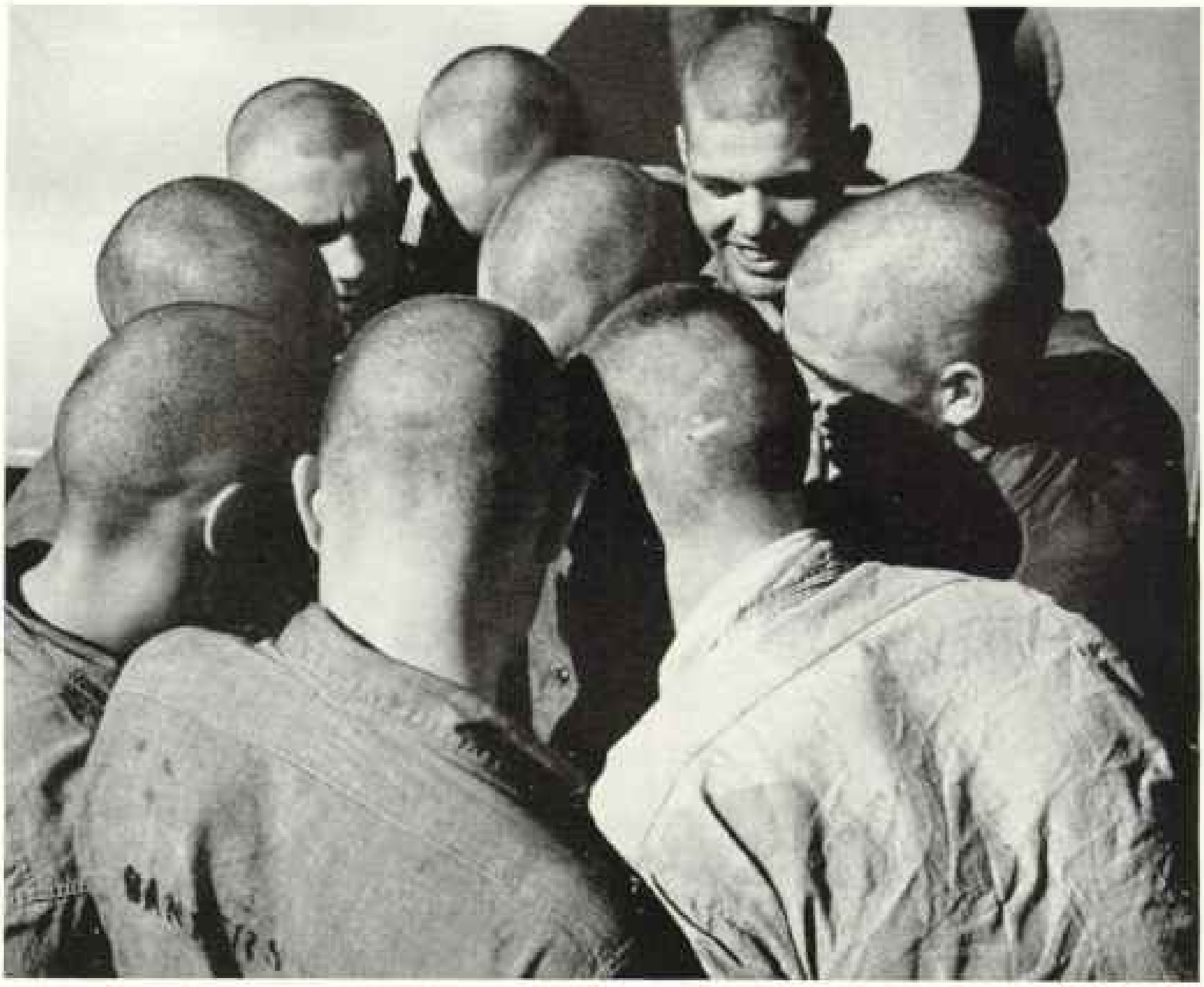
Before the 10,000-horsepower punches of this 6,660-ton icebreaker, one of the three or four toughest ships in existence, the pack offered little resistance.

Her slashing, crushing bow could push through ordinary three-foot ice smoothly at 10 knots, and one wall 30 feet thick was battered down in less than an hour. She could twist and turn in solid ice almost as easily as the other ships could maneuver in water.

The difficulty was that the unprotected ships could not follow the sharp-curved, narrow lanes she cut; loosened ice chunks piled in front of them, and the yawning jaws of ice pried open by the *Northwind* threatened to close on them relentlessly with pressures of many thousands of tons.

It soon became obvious that they might be in real danger of becoming crushed in the pack. All suffered dented hulls.

Before the end of the first week the peril



Fred Ramhe-Pix

"Don't Worry; There Aren't Any Women Where We're Going"

About as bare of adornment as nine doorknobs were the heads of the men in this huddle after King Neptune's "royal barber" had done his worst on their scalps. A part of the initiation ceremonies when crossing the Equator, Antarctica-bound, was to clip the heads of all "Polliwogs," men on their first trip across the Line. The hair will grow out—they hope—before they see anything more glamorous than a penguin.

was so great for the frail submarine that the icebreaker towed her back to open water at the entrance to the Ross Sea. She would have had little chance if the wind-driven ice had started to climb over her low deck (page 458).

Almost hourly helicopter surveys of the pack ahead for 20 to 30 miles brought back the same discouraging reports day after day—no open water in sight. Only after 400 miles was looser ice encountered, and, for 200 miles more, banks of solid ice 10 to 20 miles wide frequently blocked the way.

Only on the fifteenth day, when the expedition was in sight of the high, blue-veined walls of the Ross Ice Barrier, were the ships sailing in unobstructed open water, with many spouting killer whales.

Although the schedule of exploration and scientific observations was delayed by the slow progress, the unprecedented thickness of the pack was considered fortunate for one of the expedition's major objectives. It was intended to test the practicability of maneuvering ordinary Navy transports in polar waters, with the aid of icebreakers and air reconnaissance.

The test was so severe that it may be considered conclusive. Admiral Cruzen's recommendations are certain to constitute an important chapter in the new science of ice navigation now being formulated.

A Master of Ship Navigation

It would be difficult to exaggerate Admiral Cruzen's qualities, as the organizer of Task Force 68, as a consummate master of ship navigation under the most difficult possible circumstances, and as a leader and inspirer of men, which brought the ships safely through this grinding ice pack.

Few of those under his command, including the task groups to the east and west, ever had experienced ice before. They were keenly aware of the perils, with little knowledge of how to combat them. The dangers were

"Who Said an Explorer's Life Was Tough?"

Seaman William Collins eats turkey on Christmas Day as the *Mount Olympus* nears the Ross ice pack.

exaggerated in wild rumors which spread among the crews—rumors engendered by the long delays and the weird fantasies of fog and white darkness.

That he was a determined, fearless, and resourceful leader I fully appreciated from my long association with him on our previous expedition in these waters. That, plus my admiration and liking for him, is why I recommended to Admiral Nimitz that he be put in command of the ships. But the experience this year is one of the sagas of the Antarctic and assures Admiral Cruzen of an undisputed place among the great explorers of his time.

At last a narrow break was sighted in the ice wall. It was the entrance to the Bay of Whales, the best harbor in Antarctica, where ships can be anchored and planes based within flying distance of the South Pole.

The entrance was less than 300 yards wide. Seven years ago, when Admiral Cruzen had last sailed with us between these pillars of ice, they had been one and a half miles apart. A helicopter survey showed that the bay itself now was only about a mile wide and two-and-a-half miles deep.

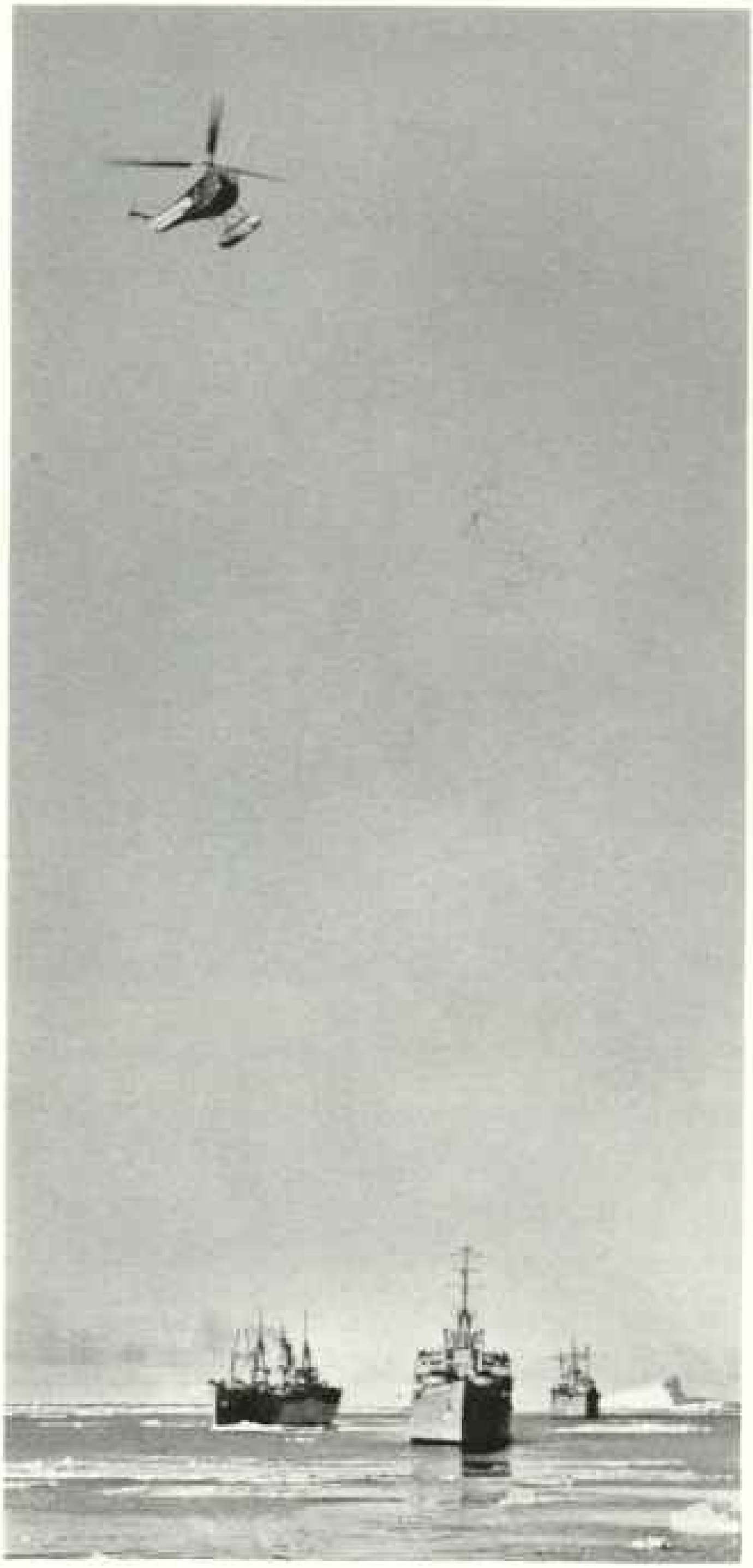
The Bay of Whales was frozen over five to eight feet thick and even up to 15 or 20 in places. This made it inaccessible to any ship except the *Northwind*. During the next three days the icebreaker accomplished the herculean task of smashing an estimated 15,000,000 tons of hard ice, thus making it possible for the other ships to enter and unload their cargoes of building materials for camp and airstrip (page 518).

Ice Masses Wage Titanic War

What had happened in the six years since our last expedition?

Through the ages this Bay of Whales has been the battlefield in a titanic elemental struggle between mighty moving ice masses.

The bay, it must be understood, is an indentation in a high, concavely curving wall of ice. It is the meeting place of two independent sections of this wall.



From a Pontoon-equipped Helicopter, Eyes in the Air Guide Ships on the Icy Sea

Present technique of getting through the ice pack is to send a helicopter ahead of an icebreaker to spot leads of open water or thin ice. The expedition demonstrated that the helicopter is a valuable new aid to Antarctic exploration. Its ability to rise vertically and to hover makes it especially suited to the task. Here the ships sail through loose pack such as was seldom encountered on this expedition (page 438).

One is the Ross Shelf. It is about 160,000 square miles in area, and according to seismic measurements it varies from 500 to more than 800 feet in thickness, counting, of course, the part that is under the water. It weighs several billion tons. It is moving northward about four feet each day.

The movement is due to the plastic nature of ice itself. Like any rock—and ice is only a somewhat aberrant variety of rock—it flows under the tremendous pressure of its own weight.

The other section is the so-called Prestrud Shelf, named for the Norwegian naval lieutenant who first crossed it. The northwest end, at the Bay of Whales, is moving westward, also about four feet a day.

Between these two the bay constantly grows narrower and narrower. At intervals of varying length—perhaps 50 years would be a fair average—the two ice sheets come together with a force slow but inexorable.

Bay Wiped Out, Then Reborn

At the time of such a collision the Bay of Whales becomes nonexistent. There is only an unbroken wall of ice from 40 to 70 or 80 feet high looming over the Ross Sea. Freshly broken faces may even exceed 100 feet in height in this area.

But this opportune break in the barrier cannot permanently disappear. Something must give way. Both shelves are being built up continually by the accumulation of snow and the ice flow from behind. The pressure of the incalculably enormous icecap that covers the Antarctic Continent is back of them.

Usually great chunks of both shelves are broken off and pushed into the open sea, where they float slowly northward as gigantic icebergs. It is possible that a single cake of ice as much as 800 square miles in area might be broken from the Ross Shelf. Icebergs more than 20 miles in length have been sighted in adjacent waters.

The sequence in this colliding of ice shelves never exactly duplicates itself. Sometimes the ice areas broken off are large, with the result that there is a big bay for many years. It was 10 miles wide and 10 miles deep when first charted by Amundsen in 1911. Each succeeding expedition to visit the area has found it smaller.

Calculations showed that a collision should have taken place last winter. There were dire predictions that there would be no indentation at all, or only a broad curve in the shelf that would afford little shelter.

What actually occurred, it is believed, is that the two masses came together on schedule, and a relatively small chunk was broken out of the shelf ice. This constituted the tiny sheltered area found by Admiral Cruzen. The two sides were on the move and another collision was due in about six months.

The four ships were unloaded on bay ice, a white plain level with the water's edge (pages 454, 464, 465).

Rear Admiral Cruzen Leaves His "Flying Crow's-nest"

On the way through the Ross Sea ice pack, Admiral Cruzen, task force commander, made frequent flights by helicopter to survey ice conditions ahead. Here he returns to the deck of the *Northwind*.

The "beach" had a fantastic hinterland—ice pressure ridges which took the form of luminous blue hills and villages which might have been copied from woodcuts in 18th-century fairy-tale books (Plate VI). There was a gentle slope up the face of the barrier over which the heavy building materials and other supplies were carried on large sledges drawn by weasel tractors (page 505).

Little America Moved 1½ Miles

About two miles away across rolling fields of lightly crusted snow, radio masts and ventilator shafts of the last Little America protruded above the ice.

The site, surveys indicated, had moved 8,361 feet, or roughly one-and-a-half miles, toward the northwest since it was abandoned in 1941. The buildings were imbedded completely in the Prestrud Shelf and took part in all its slow drift.

A strange spectacle met the eyes of members of the last expedition—Dr. Siple himself, Capt. Vernon D. Boyd, and Lt. Comdr. J. C. McCoy—after they had dug away four feet of snow to lower themselves through a skylight into the well-remembered old barracks building.

The men were in darkness and a temperature close to zero, although on the snow outside it was barely below freezing.

They found themselves in a crystal-walled palace throne room hung with glittering chan-

"I Checked with the Sun Compass All the Way to the Pole and Back"—Admiral Byrd

Lying across the fuselage gasoline tanks, the Admiral uses the device invented by the late Albert H. Bumstead, chief cartographer of the National Geographic Society. Its principle is the reverse of that of the sundial, in which the direction of north is known and the shadow of the sun gives the time. With the sun compass the time is known and the shadow indicates directions. Especially useful in polar regions, where magnetic compasses are unreliable, it has served Admiral Byrd over both Poles (pages 453, 463). Referring to his North Pole flight, he once said, "Without it we could not have reached the Pole."

deliers. Such was the transformation six winters had wrought (page 485).

Their flashlights showed the walls tapestried with mats of ice crystals in fantastic designs, such as flashing white stars, diamonds, and feathers. This crystal formation still was in progress. The walls had been bare when they left.

They soon found lanterns still filled with kerosene and proceeded to explore the buried settlement through tunnels between the buildings. Visible through a mat of crystals was a poster advertising the motion picture which had been most popular during the long winter night of 1940-41. The explorers found their own names scribbled with tributes to the actress.

At one spot they found themselves underneath a cathedral stained-glass window about two square yards in area, colored a shade of soft, luminous, unearthly purple such as human eyes have rarely seen—the coloration of sunlight passing through about eight feet of Antarctic snow.

The window was an open spot in a tunnel roof with snow arched above it. Presumably the strange color effect was due to light scatterings by the snow crystals, so that the green element of the solar spectrum was mostly eliminated.

Six-year-old Steak Still Edible

Beefsteak, bread, butter, and candy left behind were in excellent condition after six years, and the party ate a picnic lunch from the abandoned provisions.

The buildings imbedded in ice had proved the best possible natural refrigerator, tending to retain throughout the year the mean annual temperature of the ice shelf, although temperatures outside range from just above freezing to 70 or 75 below zero, Fahrenheit.

This was the third Little America. The first had been set up in January, 1929, at a point about 15 miles from the present northern edge of the Ross Ice Barrier. Then the Bay of Whales extended much farther into the barrier ice.

When we returned in 1934 we had seen only our old radio towers rising about 30 feet above the white desolation. They had been 60 feet high when we erected them. In 1947

Family Reunion in Panama: Her Nose Knows the Pups Are Hers

When the *Mount Olympus* left Norfolk, Virginia, some Husky puppies were left behind. Flown to Panama to overtake the expedition, they get a greeting from mother.

only about 18 feet of their height remained visible. During our absence ice and snow had accumulated around them at a rate of several feet a year.

The second Little America had been erected on the same site—on the ice directly above the first settlement. By sinking tunnels about eight feet it had been possible to make use of our old tunnels and some of our old buildings. We had had literally a two-layered city. Before the end of the year the second camp also had been completely buried.

One night, without any warning, the ice where our camp was located had broken loose from the barrier. We had felt ourselves lifted and lowered on some great sea swell. For a while it had looked as if Little America might float to sea on an iceberg. In the face of this emergency, a very cold spell had hit us and the barrier ice had consolidated again about as rapidly as it had split apart.

The third Little America, the one now visited by Siple, was about four miles from the water's edge and six miles north of the first one.

Hereabouts were many of the cinnamon-colored, stocky-bodied Antarctic skuas, the southernmost and among the most voracious birds on earth. These birds, with coal-black feet, curved claws, and hawklike bills, gathered about in large flocks, showing no fear of man and apparently anticipating a meal.

Just over the edge of the ice shelf a tent camp was set up with accommodations for 300 men. This was the fourth Little America, about two miles north of the third.

Its construction was a major engineering job, considering the difficulty of transferring all necessary supplies from the ships over a 60-foot-high crevassed rise which was the dividing point between the sea ice and the permanent shelf ice. Near by an airstrip for land-based planes was laid down (page 462).

Tense Take-off from the *Philippine Sea*

Now all was in readiness at Little America for one of the major jobs of the expedition—aerial exploration of the great unknown interior of the Polar Plateau and the walls of high mountains to the east, west, and south.

This was to be accomplished by six R4D planes, en route on a carrier in the Pacific. The R4D is the Navy version of the Douglas DC-3, the twin-motored transport which has been called "the air work horse of the war." Each carried a crew of five men, was equipped for take-offs and landings either on wheels or

on skis, and was loaded with photographic and other scientific equipment.

Such craft, it was calculated, could fly missions inland for as much as 850 miles with sufficient fuel for safe return. This would make possible flights from Little America to slightly beyond the South Pole.

The planes arrived in the vicinity of Scott Island, at the edge of the ice pack, on the *Philippine Sea* late in January.

When one considers the comparatively small, underpowered, overloaded ships that had been used on previous expeditions, one can appreciate what it meant to me to find myself flying my flag on the *Philippine Sea*, one of our great modern carriers, sailing the northern edge of the vast Ross Sea ice pack within plane distance of Little America.

Growlers, icebergs, and heavy pack are to a thin-skinned aircraft carrier as dangerous as rocks. The great Antarctic icebergs are somber, sinister-looking monsters, especially when dimly seen in thick weather.

One can therefore understand the initial anxiety of the commanding officer of the *Philippine Sea*, Capt. Delbert S. Cornwell. He was indeed in strange waters and thousands of miles off his beaten route. However, when he found that even in the thickest weather the icebergs would show up on the radar, he began to take things more casually. Cornwell was a very fine officer to work with.

The six large R4Ds on the *Philippine Sea* were a very pleasing sight indeed, but also a strange sight—ski planes on the deck of a carrier (page 433).

Biggest Ever Flown from a Carrier

It would be unthinkable to attempt to get the *Philippine Sea* through 600 miles of ice pack to Little America. Therefore, we would have to fly these large planes from the carrier. This project would constitute another important pioneering effort in aviation.

The great question was, Could we do it? Unfortunately, because of the little time we had in preparation, we had not been able to carry out a test hop from the carrier deck.

This would be the largest plane ever flown from a carrier.*

Because of the wingspread, we would have to take off forward of the "island," the superstructure which rises above the flight deck amidships on the starboard side and houses the main controls.

Thus we would have only half of the runway, or approximately 400 feet, for the take-off instead of the 840 feet that are the maximum available to the smaller carrier planes.

On top of that handicap, the wheels would protrude only about three inches under the skis, and the least swerve on the deck might cause the ski to strike the deck and throw the plane overboard.

The reason we could allow no more than three inches was the danger of capsizing on the snow at Little America if we allowed more of the wheel to show.

It was a situation where we had to figure carefully and compromise on the safety factors at each end of the flight.

Captain Cornwell naturally wanted six inches of the wheel to show, which would have given us a better chance to get off the carrier safely, but six inches at the other end would almost certainly have capsized the planes on landing (page 512).

Further, only a few of the pilots and co-pilots had ever flown from carriers before. Added to our problems was the fact that we would have to fly near the South Magnetic Pole, which would be on our starboard hand going south (map, pages 436-7).

Rocket-propulsion Tubes Aid Take-off

We had decided to assist our take-offs with JATO bottles, rocket-propulsion tubes, about the size of ordinary fire extinguishers, which are attached to the sides of the fuselage.

Theoretically, such launchings seemed entirely practicable—but until calculations have been checked by actual tests there always remains an element of doubt. Had every possible factor been considered? We were betting our lives on figures on a sheet of paper.

Some extra safety was provided by eliminating heavy equipment, such as oxygen bottles for high-altitude flights—and it must be remembered that almost any Antarctic flight is at high altitudes.

We would take off at a slight angle to the center line of the ship, so that if we should crash into the sea we would not be run over by our high-speed carrier.

We decided to fly to Little America in pairs. If the first pair should reach it all right and land safely, then there was a good chance that the other four planes could make it O.K. Just in case the ski-wheel arrangement should capsize us at Little America, we wanted to be certain not to crack up all six planes.

Success in the venture required sufficiently good visibility for the *Philippine Sea*, while making a 30-mile run at 30 knots, to avoid growlers, bergs, and ice floes. Also, we would not want too much of a sea running. We suffered a discouraging delay of a week, awaiting suitable weather.

* General Doolittle's B-25 bombers had a smaller wingspread than the R4Ds.

Amon color by Fred Sparks from Pix

Raised over Little America IV, the Flag Was Left Flying in the Face of Antarctic Blasts

The U. S. Navy Antarctic Expedition did not lower Old Glory at sunset, for sunlight prevailed 24 hours a day.

Amon color U. S. Navy, Official

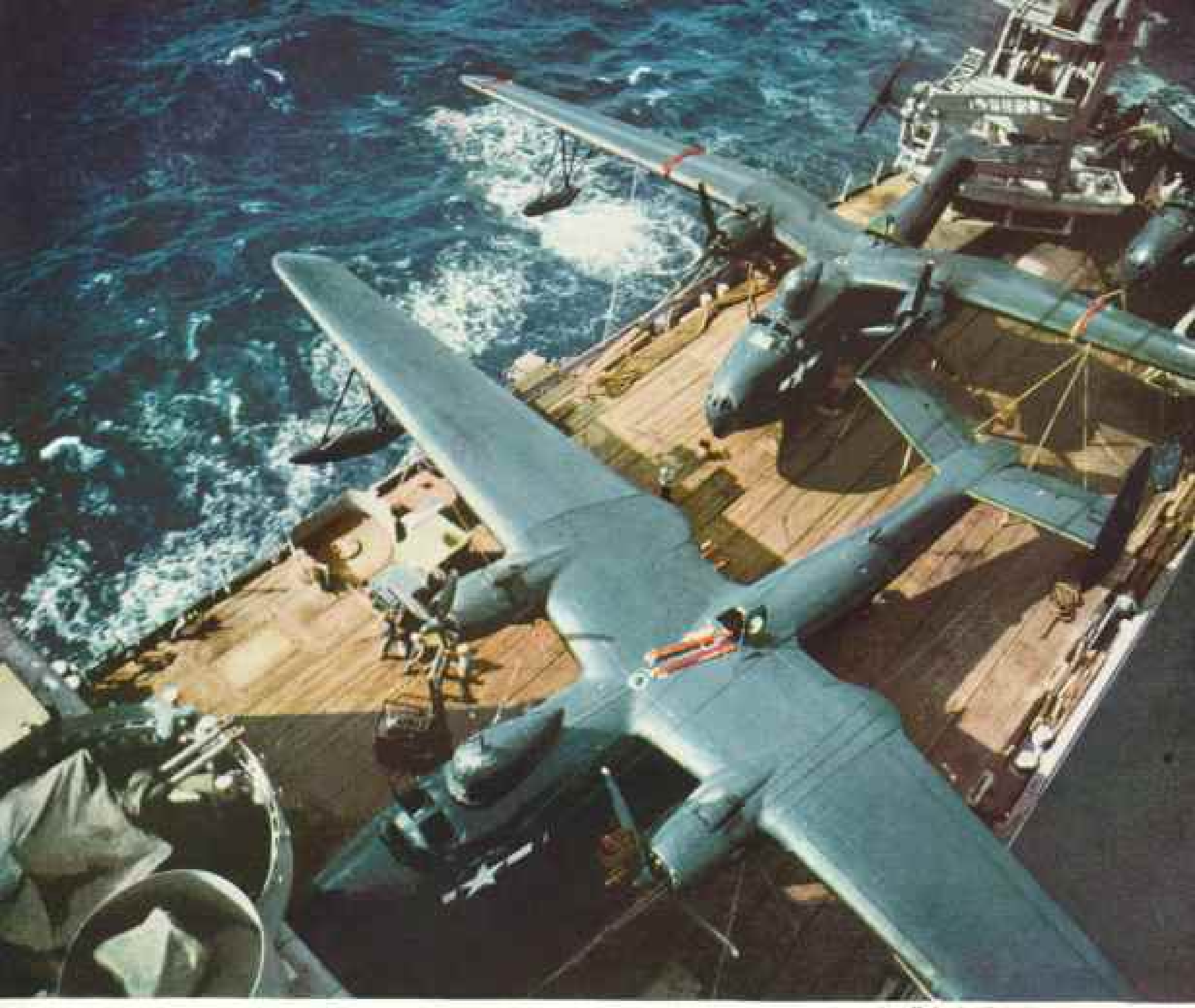
Such Ski-equipped "High Jumpers" Explored Thousands of Miles of Antarctica

Poised on the edge of the ice shelf with the expedition's tent city in the background, this Navy R4D—the Douglas Skytrain—awaits a break in the weather for a flight far inland over the continent's frozen immensity.

Navy Radiophoto U. S. Navy, Official

Serene but Menacing Appears the Antarctic's Icy-featured Face

Airborne explorers just off the Antarctic coast east of the Ross Sea photographed this gleaming scene showing three types of ice formation. The smooth area in the foreground is bay ice, essentially the frozen surface of the sea. Through it protrude the tops of black offshore rocks. The curiously fissured object in left center, which looks like the two-lobed brain of some primeval monster, is a large chunk of barrier ice which has broken off, been trapped in the bay ice, and become badly weathered. The irregular white surfaces above the bay ice are low icebergs, their zigzag edges etched in black by the shadows they cast. Beyond lies the edge of the shelf itself, here quite narrow and close to the ice-covered shore of the continent.



Aero Radiophoto U. S. Navy, official

PBM's—Martin Mariners—Roost on the *Pine Island;* They Mapped Immense Areas

© National Geographic Society

Radiotelemax U. S. Navy, official

With Needle and Knife Explorers Keep Busy as They Sail Ever South

Two inoculate one of the dogs which supplemented tractors and planes. Others split bamboo for marking trails.

Icy Outriders of Antarctica Greet the Expedition in the Ross Sea

For the first few hours after the Central Group entered the Ross Sea ice pack on New Year's Eve, the ships sailed through fairly open water filled with floating ice cakes, as in this view from the expedition flagship, U.S.S. *Mount Olympus*. The cloud formations on the southern horizon, however, are ominous. This is a typical "ice sky." There are no dark areas which promise open water ahead. Six hours after the picture was taken, the ships were in a white desert of ice which stretched as far as the eye could see in every direction, and progress was slowed from about ten to six knots.

Aero Radiolor U. S. Navy, Official

Some Ice Cakes Were So Big They Would Hold a Good-sized Town

This ice is merely the frozen surface of the sea, which forms every winter and breaks up, to some extent, every summer. The scene is only a few miles south of Scott Island, the mass of black rock which forms the northern sentinel of the Ross Sea. A little farther south the ships met thick ribs of ice of a quite different nature—ice which had broken loose from the edge of Antarctica's permanent "barrier" 700 miles to the south and, drifting slowly northward, had become incorporated in the pack. Ice conditions were the worst reported since Sir James Clark Ross first pushed through the sea named for him more than a century ago.

Kinfaffinnun U. S. Navy, Official

On Guard Against the Treachery of Shifting Bay Ice, the Cargo Ships *Yancey* and *Merrick* Are Ready to Cast Off at a Moment's Notice

The vessels are moored to "deadmen"—large timbers frozen securely into the bay ice at the foot of the Ross Shelf Ice. Big chunks of the shelf sometimes break loose. The weirdly piled ice in the foreground, formed by pressure between opposing ice masses, casts long shadows in the low sun of a bright Antarctic afternoon.

Through Heavy Pack They Plow Toward Little America, with the Coast Guard Icebreaker *Northwind* (Left) Slashing a Path

"Dog Town," Little America: Despite the Wide Use of Snow Tractors (Left), Dogs Are Still Useful in Rough, Crevassed Country

Arm Kinkaid U. S. Navy, Official

Bare Rocks and Vivid Lakes Appear—Strange Oasis in a Desert of White

THE most surprising discovery of the expedition was a so-called "oasis" just inside the Queen Mary Coast of Wilkes Land by a plane of the Western Group. Blue and green lakes of open water were scattered among brown, barren rock hills in an area of at least 300 square miles which was entirely free of ice.

One of these lakes was large enough to afford landing space for a seaplane. Its crew observed no sign of life except red, blue, and green algae, the microscopic plants which give the lakes their colors. Dipping their hands in the water, the explorers found its temperature "comfortable"—much warmer than Antarctic ocean water.

At the time the oasis was discovered there was considerable speculation as to whether it might not mean a gradual recession of the ice, which eventually would clear the greater part of the continent.

As yet there is no positive explanation. Some underground source of heat may exist, although no evidence of volcanic or hot spring activity was noted. On the other hand, the phenomenon may be due to prevailing winds which keep an area free of snow and thus prevent ice formation. The bare rocks absorb much heat during the summer of perpetual daylight, and the re-radiation of this heat may account for the relative warmth of the water.

The area is only a few miles from open water, and its discoverers say it might afford a good land camp site for a future Antarctic expedition. From this coast the slope is gradual to the great Polar Plateau.

A few days after this discovery was announced, a similar, but smaller, area was found by another exploring plane of the Western Group about 600 miles to the westward. Here, however, ice was beginning to form over the lakes at the start of the Antarctic autumn. Several other ice-free spots were located by the expedition's planes, but these were all much smaller.

Finally, on January 29, we got a break in the weather both at our position and at Little America, 800 miles away. The commanding officer of the R4D unit, Comdr. William M. Hawkes, and I, with Hawkes at the wheel, were to take off in the first plane with an additional crew of four. We climbed aboard the plane and stood by for Captain Cornwell to head the carrier into the wind.

From the vibration of our great carrier I knew when the Captain had got the ship up to about 30 knots and it was time to take off.

We seemed to creep along the deck at first, and it looked as if we could never make it with only 400 feet for a plane that usually required a 2,500-foot runway. But when our four JATO bottles went off along the sides of the plane with a terrific, deafening noise I could see the deck fall away (page 434). I knew that we had made it. We had crossed our first river.

Flying by Sun Compass

Luckily, the weather had remained sufficiently clear to use the sun compass (page 442) as we flew near the South Magnetic Pole. There was a lot of ice and I had an unparalleled opportunity to study the pack. I believe we saw more ice pack that day than earth-bound explorers would see in a lifetime.

Hours later, when we had left the ice pack behind and found the Ross Sea barrier opening up before us, I noted that the effect on my companions, who thought they had seen everything, was as if they had taken several drinks of strong wine. I felt exhilarated, though I had for long periods lived under the snows of this great natural wonder of the world.

The exhilaration vanished when we reached Little America and saw the rough condition of the snow landing field. A recent storm, I learned later, had thrown up bad sastrugi. We would have preferred making our first ski-wheel landing on a smoother field. We circled a long time and looked things over carefully before letting down. It was a tense moment. The landing was rough enough to capsize most planes, but the rugged R4D took it. Another river was crossed.

I knew that I had witnessed another landmark set along the road of aviation's amazing progress. Captain Cornwell and Commander Hawkes and the officers and men of his unit had done well.

I am convinced now that the take-offs from the carrier would have been possible without the jet tubes. With their help, and with a redesigned flight deck, it appears feasible to launch from a carrier even much larger planes with a range of 8,000 miles and capable of carrying a much heavier load.

There has been some discussion whether the carrier, which played such a dramatic and essential part in our Pacific war, may not have become essentially an obsolete weapon with the development of larger planes with much longer flight ranges. Our experience in the Antarctic should be an adequate answer.

Why, it may be asked, use a carrier for a bomber that can fly 8,000 miles? There would be few targets more than 4,000 miles away. But it always must be kept in mind that, as a general rule, the shorter the distance that must be flown the greater the load of destruction for the enemy.

These flights also demonstrated the complete practicability of taking off from the deck on wheels and landing on skis. The wheels should be retractable through slits in the big "barrel staves" after the planes are in the air.

The object lesson in all this should be obvious. The shortest distance between the New and Old Worlds is across the Arctic Ocean and the north polar regions. It is freely predicted that here will be one of the great battle areas of future wars.

Our long-range bombers—or those of another power—could be brought by carrier to the edge of the northern ice and sent across the top of the world.

Risks Carefully Calculated

Those six planes looked mighty fine lined up facing into the prevailing wind there at Little America IV, poised to fly into the unknown as soon as we could "ready" them.

Little America IV was rapidly being "shaken down" under the efficient leadership of Comdr. Clifford M. Campbell, an experienced aviator and one of the most cooperative officers I have ever come in contact with. Aside from the scientific projects under Captain Kosco and the engineering experiments of Comdr. Charles O. Reinhardt (who was also the expedition and camp engineer), activities of the camp revolved around our aviation mission.

The successful accomplishment of this mission would involve serious hazards. In fact, some of us were much concerned about the safety of the crews and passengers of the planes.

It had always been my policy on each previous expedition to risk the lives of my men only when it was a reasonable risk, and a necessary one to accomplish the mission of the expedition. Even though this rule is followed, there are many occasions when explorers have to take extremely hazardous chances to succeed. When such chances have to be taken, I believe in calculating the risk with the greatest of care.

Antarctic Beachhead: Unloading the Cargo Ships *Yancey* (foreground) and *Merrick* onto the Ice of the Bay of Whales

This expedition, generally speaking, was different from the former ones in that I could not, because of the chain of command setup and the numerous separated, far-flung units, have close personal contact with all the various projects. However, at Little America I was able to carry on as of old and had the opportunity to work closely with Campbell and Hawkes to do everything possible to achieve what we wanted most: namely, to accomplish the mission without losing any men.

I had already had close contact with the personnel of the R4D unit on the way south on the *Philippine Sea*. Commander Hawkes and his staff and my chief of staff, Capt. Harry R. Horney, and I had spent days on the carrier discussing the many problems ahead of us in the most minute detail. For hours on end, and often late into the night, we would assess the uncertainties and attempt to work out methods of meeting them (page 430).

Capacity for Taking Pains

Hawkes showed great capacity for taking pains, as did Captain Horney, an old-time experienced pilot; and now at Little America, Campbell, as base commander, checked with us on our conclusions and had valuable suggestions of his own.

Many factors handicapped us. In the first place, the maintenance and readying of the R4Ds for the long flights was a tough job in the cold without benefit of hangars.

Because of the ski-wheel arrangement and the shape of the R4D fuselage, we could not design the skis as large as we would have liked for the heavy loads we would have to carry on our long flights.

That raised the question of how these big planes would perform on skis when flying with very heavy loads from the névé. They had never been fairly tested, and, further, only Lieutenant Commander McCoy of the Navy pilots had had any real experience in ski flying.

In Antarctica the best flying season for safety and results is in November and December. The weather is best then, and there would be more time for rescue operations in case of a forced landing far from base. To carry on rescue operations after the long winter night descended would mean casualties.

But to explore in the early summer it is necessary to spend the winter night on the continent, because it is generally not possible for any ships but the new icebreakers to get through the ice of the Ross Sea until the Antarctic midsummer day is past.

There is thus a serious handicap for a summer season expedition expecting to achieve any notable results in discovery. We had, of course, planned carefully in Washington to overcome this handicap, but we actually had a far shorter flying season than the short one we had planned for.

It came about this way.

We had, as is seen, used up the good summer flying weather getting through the ice pack to Little America. On top of that, the early consolidation of the ice pack made it necessary to evacuate the vulnerable ships weeks ahead of our scheduled date lest they be forced to winter at Little America. This would have resulted in the loss of the ships.

Accordingly, Cruzen, on February 6 instead of the middle of March as planned, headed north with all the ships of the Central Group before we had made a single major flight. An icebreaker would return to Little America for us, but even this sturdy ship would have to depart weeks ahead of the scheduled date.

The loss of flying time was not the only handicap this imposed on us. Among other things, it meant that to all practical purposes we would have no radar to guide the flyers back to base, nor would we have at our disposal the wonderful facilities in material and personnel provided by the ships.

It may be thought that I have dwelt unduly on our predicament, but the fact is that I have understated the difficulties, which only a few on the expedition understood.

So great was the pessimism of those "in the know" that they felt that our R4D mission was doomed to failure.

Versatility and Leadership

But the doubters didn't count on the versatility of the Navy in general, and in particular the leadership of Campbell, the amazing coordinating ability of Horney, the super-loyalty and selflessness of the enlisted personnel, and the ingenuity and ability of Hawkes. He was a pilot of exceptional skill, an aviation engineer, and a fine leader and inspirer of men.

But Hawkes was more than that. From boyhood he had been an enthusiast about polar exploration. He was steeped in the lore of Arctic and Antarctic. Flying over these wastes of ice was for him fulfillment of a lifetime's dream.

I have mentioned one of the question marks: the take-off of the R4Ds. First, the pressure of such heavy planes would turn the Antarctic névé upon which they rested into ice which would stick to the skis. Would we be able to get the planes started?

Secondly, if we could get started, would this same pressure—which made a very heavy load per unit of area of the skis—give the

Past Icebergs Like Floating Cliffs of Dover, the Ships Approach Antarctica

Ahead of the flag-ship *Mount Olympus* steam the cargo ships *Yancey* and *Merrick* and the icebreaker *Northwind*.

landing gears too much of a beating as we took off on the rough terrain? Thirdly, would we be able to get up enough speed to rise into the air?

We soon settled these points. On February 9, three days after the ships left, we were ready for a flight of discovery with a heavy load of gas aboard and with the wheels removed from the landing gear. The slot in the skis where the wheels had been we filled in with duralumin.

Hawkes at the wheel pushed the throttle forward to full power (which we know is bad for the engines). We didn't budge. Men on the snow rocked the plane from the wing tips to loosen up the skis from the snow. The vibration was terrific and the whole plane took a beating, but still we hadn't moved an inch.

Then we used planks under the skis and finally got moving, very slowly at first until Hawkes set off the JATO bottles; they literally shot us off the rough snow (page 488).

Soon we ran into bad weather with zero visibility, and ten minutes later we suffered a gasoline leak from one of the midship tanks into the fuselage. The violent vibration had caused the leak.

Pleasanter things can happen. We had to turn back. That was disappointing, but we had shown that a large ski-equipped plane such as the R4D could be taken off the névé with a very heavy load. This was another river crossed.

Now all depended on the weather during February, with its rapidly sinking sun and deepening cold. There were no weather stations, as in the States, to help us with locating good weather at our targets and, what was even more important, to insure us against impossible landing conditions on our return.

By the old method of waiting at Little America for the weather, the chances were ten to one against achieving even a reasonable success. So it was up to us to develop a new technique—or else.

That technique was to send planes out to scout for the weather, and, further, while exploring, to take the weather where we could find it. We knew that would mean that we would seldom be able to follow a predetermined flight track.

This technique, of course, would not insure against bad weather back at the base. That chance would have to be taken.

In carrying out this plan we had splendid assistance from the meteorologists, Captain Kosco and Mr. B. C. Haynes, of the U. S. Weather Bureau. They deserve great credit.

Mapped Vast Area Never Before Seen

It had been calculated that our whole program could be accomplished by 25 missions—that is, 25 single plane flights—with good visibility for photography

Actually, when the flying was finished and the score was in, 29 operational flights had

Emerging from the Pack at Last, They Sail On Toward the Great Ice Barrier

This ring of open Ross Sea water adjoining the frozen continent is due to prevailing ocean currents.

been made by planes of the Central Group. Of these, 17 were successful and three partly successful. Nine accomplished very little, because of weather conditions or mechanical troubles. The planes spent 220 hours in the air on operational and mapping missions. They flew approximately 27,500 miles, exclusive of local and test flights (maps, pages 467 and 495).

In each plane were mounted trimetrogon aerial cameras. One pointed straight down. Two were pointed downward at angles of 30 degrees from the horizontal, thus sweeping from horizon to horizon.

A fourth camera photographed a clock and other recording devices in the plane itself.

A fifth camera formed part of the radio altimeter apparatus which, by means of radio pulse echoes, continuously recorded the altitude of the plane above the ground.

Four cameras were operated by an automatic device which clicked them simultaneously several times a minute, the number depending on the plane's speed and altitude.

A plane equipped with such a battery of cameras could photograph in rough fashion about 100,000 square miles—such as a strip 850 miles deep and 70 miles wide both going and coming—under ideal conditions.

Following is a résumé of the accomplishments of this group before considering the experiences on individual missions:

Several islands in the Ross Sea, which hitherto had escaped detection because they were buried under the Ross Shelf Ice, were discovered.

The exact location of the east coast of the Ross Sea always has been a mystery, because it rises so gradually in many parts that it is difficult to tell where the sea ends and the land begins under the unchanging white surface of the névé. This expedition found evidence for determination of several precise points on this shore line.

An important project was mapping the Bay of Whales area.

The 1947 front of the Ross Ice Barrier was photographed. This barrier changes every year, and maps from previous expeditions when compared with ours will provide valuable data on the movements of a great ice block 400 miles long and 400 miles wide.

In the course of this work several new bays, inlets, tension cracks, and crevasses in the barrier were discovered and mapped. The relative rates and directions of ice movements for the central and eastern sections of the shelf were investigated.

At least three major mountain ranges hitherto entirely unknown were discovered. Incidental to this was the discovery of at least one, and probably several, mountains of 16,000 to 20,000 feet elevation.

These rank easily among the highest mountains in the world. Precise elevations cannot be determined until photographs are studied.

Low-decked and Fragile, the Submarine *Sennet* Gets Help from the Burly *Northwind*

Soon after the Central Group entered the Ross Sea ice pack it became evident that submarines are not fitted for ice maneuvers and risk constant danger of disaster. Three times the *Sennet* was helped to safety of open water by the Coast Guard icebreaker, here about to take her in tow as a crew member heaves her a line. Towed back to open water around Scott Island, she served as a weather ship for the remainder of the expedition and contributed much valuable information.

We discovered literally hundreds of mountains and hundreds of mountain peaks never before seen by man. Some of these had elevations of at least 15,000 feet.

Numerous glaciers not on present-day maps were discovered. The number and location of these also depend on processing of the photographs in the Washington laboratories.

More than 200,000 square miles of the polar icecap were explored from an average elevation of approximately 10,000 feet, or twice the height of the Adirondacks. One of the more colorful discoveries was that of several fairly large areas of bare earth and rock surface among the mountain ranges which border the western shore of the Ross Sea.

All a Result of Two Weeks' Flying

All this was accomplished in only about two weeks of passable, and occasionally excellent, flying weather. It was essential that we remain constantly alert, that the planes and their crews be ready to take off at any time when there was a favorable break in the weather.

Statistics yield at best a colorless picture of exploration. They can give no intimation of the thrill of seeing something no eye ever has looked on before, of being in places where no human being has been since the earth began.

All this can be conveyed, although quite inadequately, only through accounts of the personal experiences and reactions of the men who made the flights from Little America into the trackless skies domed over this trackless land. Despite the hardships and perils, nearly all of them have expressed a desire to return. They have been caught, as have so many before them, by the enchantment of the Antarctic.

The two planes which crossed the South

From His Dizzy Perch He Films the Crunching Progress of an Icebreaker

A Navy motion-picture cameraman is swung out by crane to record the slashing onslaught of the Navy icebreaker *Burton Island* upon the Antarctic ice pack. Beyond, a helicopter hangs in the air. The *Burton Island*, on her maiden voyage, entered the ice pack in mid-February, 1947, and reached the Bay of Whales in time to evacuate the 200 men at Little America before a flash freeze could consolidate the pack and imprison the explorers for eight months.

Pole left Little America shortly after 11 p. m. on February 15.

Off to Explore Beyond the Pole

This flight into the area beyond the Pole had been set down in our plans as one of the major flight objectives.

About 9:30 a. m. Captain Kosco told me that the weather was O.K. to the southward and that if we didn't take advantage of it we probably would not get another chance in that direction. That settled it. We had two planes standing by to fly in whatever direction the weather would permit.

It was a tense take-off. The temperature was 18 below zero. Preheated JATO bottles, taken from the tent and attached to the plane for a jet-assisted start, were cooling rapidly. Commander Hawkes had information that they might explode prematurely at subzero temperatures.

The pressure gauge showed the oil pressure in one engine was too low to permit leaving the ground. But the more we "revved up" the engines to increase the pressure the colder the JATO bottles were getting.

It was essential that no time be lost. We took a chance on the possibility that only the leads in the gauge itself were frozen and that the oil pressure actually was sufficient. This proved to be the case.

Take-off a Calculated Risk

The decision to take off on the longest flight of the expedition was hard to make under such circumstances. But there probably would not be another such break in the weather, which would hold for only a few hours. If the flight was not made then, twelve hours would be required to return the JATO bottles to a safe operating temperature. It seemed to be a question of starting then for

the area beyond the Pole, or not at all. Little more good weather in that direction could be expected this season.

Pilots of the leading plane, in which I rode, were Lt. George H. Anderson and my old associate, Lieutenant Commander McCoy, veteran of Antarctic aviation.

McCoy had been with me on a previous expedition. He is, I believe, the most experienced living pilot in the peculiar conditions of the south polar regions—resourceful, level-headed, conservative, a splendid comrade and a gallant gentleman.

Anderson was new to the Antarctic, but the skill he displayed was of a high order. Lt. (jg) Robert P. Heekin was navigator.

Completing our crew were J. E. Valinski, aviation radioman, first-class, and K. C. Swain, photographer, first-class.

Immediately behind us was a plane in which Commander Campbell rode as senior, with Maj. Robert R. Weir as pilot, Capt. Eugene C. McIntyre as co-pilot, and Capt. Raymond J. Butters as navigator. The radioman was M/Sgt. A. V. Mincey and the photographer was Sgt. George E. Baldwin.

We were glad to have these fine Marine Corps officers and men with us.

The two planes were greatly overloaded. That is the sort of thing an explorer is always forced to contend with.

The maximum gross weight officially allowed was 25,000 pounds. This would have permitted us to take only about 1,000 gallons of gasoline—far from sufficient to reach the Pole. We carried 1,400 gallons, and the personnel and equipment raised the gross weight of each aircraft to over 32,000 pounds.

Ideal Day for Longest Flight

It was an ideal day for our longest flight mission. The sky ahead was cloudless. Visibility was nearly perfect. From the plane we could see nearly 150 miles in any direction.

Under the vault of the purple-blue sky we proceeded straight across the Ross Shelf Ice just west of the 100-mile-long, saddlebacked Roosevelt Island which rose like a hump in the ice. The surface below us, rippled and ridged by the wind, was a brilliant white, tinged with blue and gold.

We passed over the terribly crevassed area which lies in front of the Queen Maud Range and constitutes one of the formidable barriers to any land expedition seeking to enter the continent from this direction.

Far below us stretched the blue and purple chasms of the crevasses. They were many miles long and shaped like horseshoes with the ends pointing south. Some of the huge crevasses were wide enough to swallow destroyers.

We were flying into the strange sunset of the Antarctic's late-summer midnight. The sun was low, a great ball like a red wheel rolling along our horizon just a few feet above it. In another week it would dip below that horizon for the first time this year.

Heating System Paralyzed by Cold

The temperature dropped steadily. The heating system and automatic pilots refused to work, congealed by cold. Anderson's ears began to freeze. My own hands stuck to the metal of my sun compass (page 442).

Vibration loosened fittings on the extra hull tanks and gasoline fumes filled the plane aft of the cockpit. I had to tighten the fittings every few minutes.

We were approaching the Wade Glacier from the northeast across scattered low mountains of fantastic shapes, some with bare black crests and some snow-covered.

Here one of the engines stopped. Why, nobody knows. It started again when we switched to another gas tank, and we had no further trouble with it for the rest of the trip.

The windows began to fog badly inside the cockpit because of the failure of the heating system. I took my turn in the co-pilot's seat, and McCoy and I were kept busy scraping away the frost with our knives. It was a continuous operation and very uncomfortable, since the ice formed with amazing rapidity on the glass.

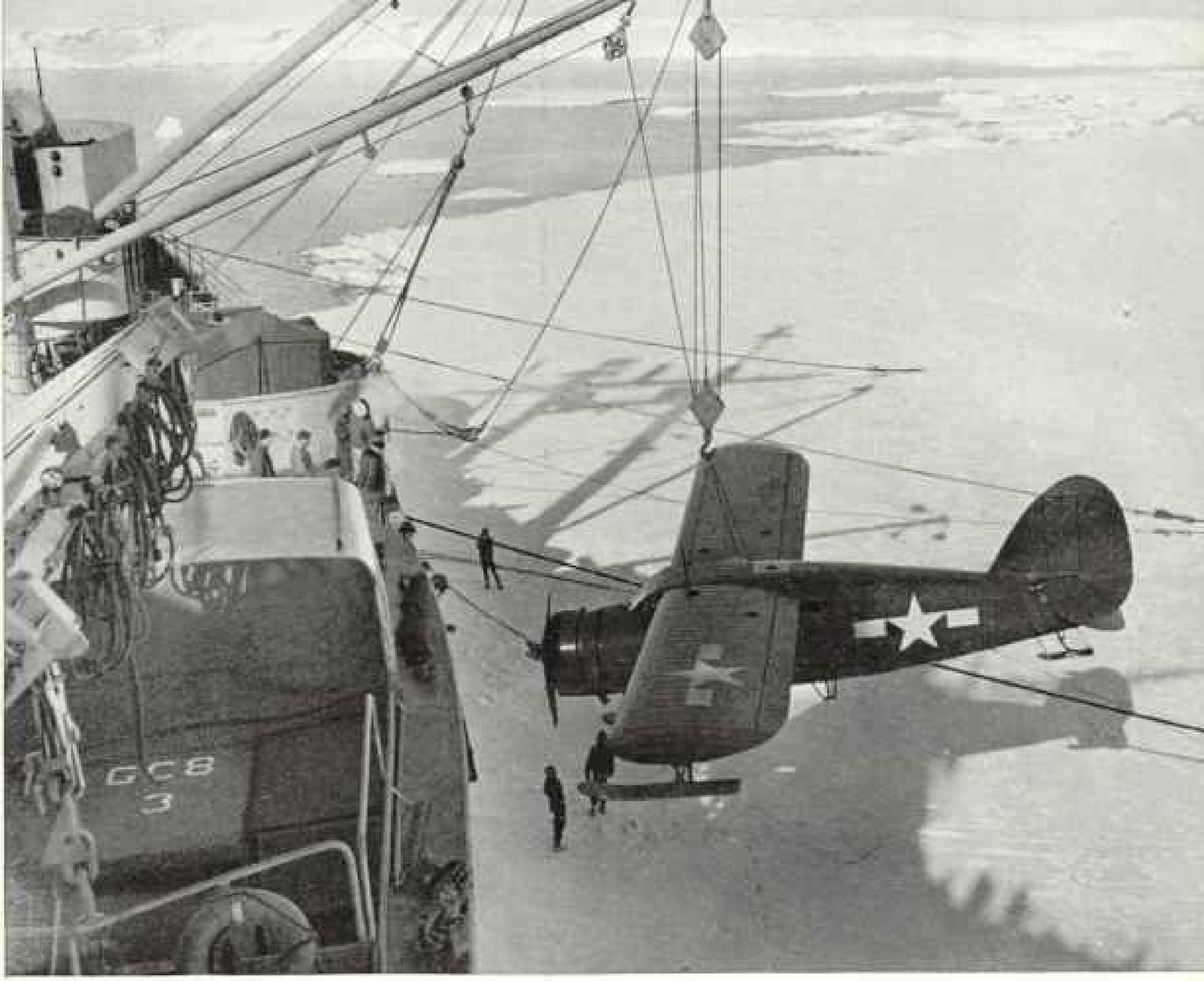
Then we turned into the glacier itself—a vast silver river about 14 miles wide flowing between high walls of ice (page 470). This appears to be one of the best gateways to the Polar Plateau, either by land or by air. It cuts through a great chaotic array of low-lying peaks which increase progressively in height to the southward.

Seemingly without end they stretched around us—a scene of grandeur such as hardly is duplicable on earth. The wheeling sun flooded the glacier.

Dominating the entire Wade Glacier area to our left, that great Beacon sandstone massif, Mount Rush, towered to an altitude of approximately 14,000 feet.

In the glacier below we noted one curious feature. Like a wriggling snake along the west bank of this enormous ice river was a sinuously curving brown strip about 300 feet wide and extending for approximately 35 miles. For many minutes it lay in sight below the plane. This appeared to be an ice-free strip, seemingly filled with chaotically piled brownish rocks.

McCoy and I gave much attention to this



Three-point Landing Without a Pilot: Lowering the Norseman Scouting Plane onto the Bay Ice from the Deck of the *Mount Olympus*

phenomenon. Any explanation of the strip at present must be conjectural. It is, presumably, a morainic deposit of some sort, since it occurs near where several subsidiary ice streams join the Wade. There was no fog rising from it, as would be expected if there were any subterranean source of heat.

Beeline for the Pole

When we emerged from the ice river the altitude of the Polar Plateau was about 9,500 feet, although some of the snow-covered ridges must have been higher.

A few miles beyond the top of the glacier we started straight south along the 180th meridian toward the Pole. The spectacle to the right and left and below was one of the most awesome I have ever seen. To the west lay the Dominion Range; to the east, what I believe to be the southernmost mountain range yet known on earth, the Gilbert Grosvenor Range.

This range I had discovered in 1929 and named for my long-time and valued friend, the President of the National Geographic Society.

Then I had entered the plateau by way of the Liv Glacier and had seen these mountains lying to the west.

We continued along the 180th meridian. All the way we flew at an elevation of approximately 11,500 to 14,000 feet above sea level. We averaged around 2,000 feet above the spotlessly white, undulating, essentially featureless surface of the great, looming interior of Antarctica. A fairly steady speed of approximately 130 miles an hour was maintained.

The cold was intense at this altitude, at one time reaching a minimum in our plane of −40°. The aerial photographer had to operate from the rear compartment and I was using the sun compass from back there. This compartment was unheated and the camera openings were causing a severe draft. We got a bit chilly.

Ice continued to form on the windshield of the pilot's cockpit. The glass was kept clear both by scraping with knives and by constant rubbing with alcohol.

We had no oxygen equipment. The effects

Like Ink Dots on a White Sheet Appear the Tents of Little America IV

Antarctic base of Operation Highjump, as the Navy called its exploration of the continent, was this tent city on the edge of the Ross Shelf Ice. The flagship *Mount Olympus* and the cargo ships *Yancey* and *Merrick* are moored in the Bay of Whales. In the lower left-hand corner is the galley and mess tent. In about the center of the picture is the air operations section, with an airstrip for ski-equipped planes.

of anoxia soon became apparent in the uncoordinated speech, staggering gait, and happy-go-lucky attitude of some members of the crew.

Probably the alcohol fumes the men were inhaling and the bitter cold accentuated the effects of flying for so long a period at such high altitudes without oxygen. The victims themselves appeared to be unaware of these symptoms.

Some of the things they said seemed funny at the time—at least they seemed so to me, but I would not want to vouch for myself.

At about latitude 88 there was a considerable rise in the altitude of the plateau to approximately 10,600 feet. After a few miles this altitude drops again to approximately 9,500 feet at the Pole itself. This increase in height was noted by both Scott and Amundsen on their land journeys.

There apparently is a hump for at least several hundred miles across the face of the plateau, with some evidence of an increasing altitude westward of our flight line. Probably it indicates a mountain range buried under the snow.

Sastrugi Indicate Wind Direction

All the way across the plateau I observed the sastrugi, the straight, almost parallel windrows of névé piled up by the winds, which are a feature of all Antarctic landscapes.

They are a sure guide to the prevailing winds of a region, giving information which meteorological observers on the surface would require months to accumulate.

I deduced from them that the prevailing winds on the Ross Sea side of the continent from the Pole are from the southeast.

All the time we continued flying as closely as possible along the 180th meridian. Even without wind drift, for which adequate corrections could be made, it is obvious that no navigator can fly along a mathematical line.

Consequently, since this is the international date line, we were zigzagging constantly from today into tomorrow and back again. But sticking as closely as possible to the meridian made easier the navigation, difficult at best, toward what is only a mathematical point on the earth's surface.

Air navigation in polar regions affords problems of peculiar difficulty.

Near the Magnetic Poles the ordinary compass as a guide to direction becomes so unreliable as to be practically useless. Much of the time the sun and the pale outline of the moon visible during the 24-hour-long Antarctic day are hidden behind clouds, leaving no celestial guides over the trackless wastes where eventually, at the South Pole, all directions merge into an all-encompassing North.

Navigation in other parts of the world today is largely by various types of electronic direction finders. There are of course no permanent installations of this sort south of the Antarctic Circle, and our young Navy pilots, at least in the Central (Little America) Group, had to learn to navigate without the benefit of electronic aids such as they had used during their flying career.

Twenty minutes away from the Pole I tapped Navigator Heekin on the shoulder. I had been keeping something up my sleeve.

"Know how to tell when we are over the Pole?" I asked. "It will be when the altitude of the sun and its declination are equal."

This was a rule-of-thumb equation which I had formulated for myself long before the days of the present ultra-refined methods of navigation.

Heekin nodded. Throughout the flight I had checked our course with the sun compass and I had observed that he was doing a fine job. I was confident that he would find the Pole unaided. Campbell's plane was following us.

Byrd's Second Visit to the South Pole

Heekin took observations every moment or so and at almost exactly 5 a. m. he gave the signal. We were crossing the mathematical bottom of the world. My hat is off to Heekin.*

For the fourth time in history human beings were at the South Pole. For the second time I was looking down upon it.

The South Pole simply is the geographical farthest south. It is physically indistinguishable from any other point on the plateau, and, except for the aerial photographic record, a flight over it from the Ross Sea side no longer adds anything of importance to our knowledge of the Antarctic regions.

The Pole has been a symbol of achievement, of the surmounting of Nature's greatest barriers by man's determination and ingenuity.

In the air age this symbol is no longer valid. Except for details, the nature and contour of the country from the rim of mountains around the Ross Sea to the bottom of the world can be rather accurately described either from direct observations or from almost unquestionably reliable deductions.

But all successful polar expeditions by land or air have been from this direction. In any other direction from the Pole the nature of the plateau is completely unknown.

Except from the neighborhood of the Ross Ice Barrier, the South Pole until recently has been considered well-nigh unattainable. In fact, a point somewhere in the neighborhood of 78 south latitude on the 70th east meridian has been designated as "the pole of inaccessibility," supposedly the most difficult spot left on earth for man to reach.

Into Mystery Land Beyond the Pole

It had been one of the major objectives of the Navy to penetrate beyond the Pole into this "area of inaccessibility," the vastest unknown which remains in the world.

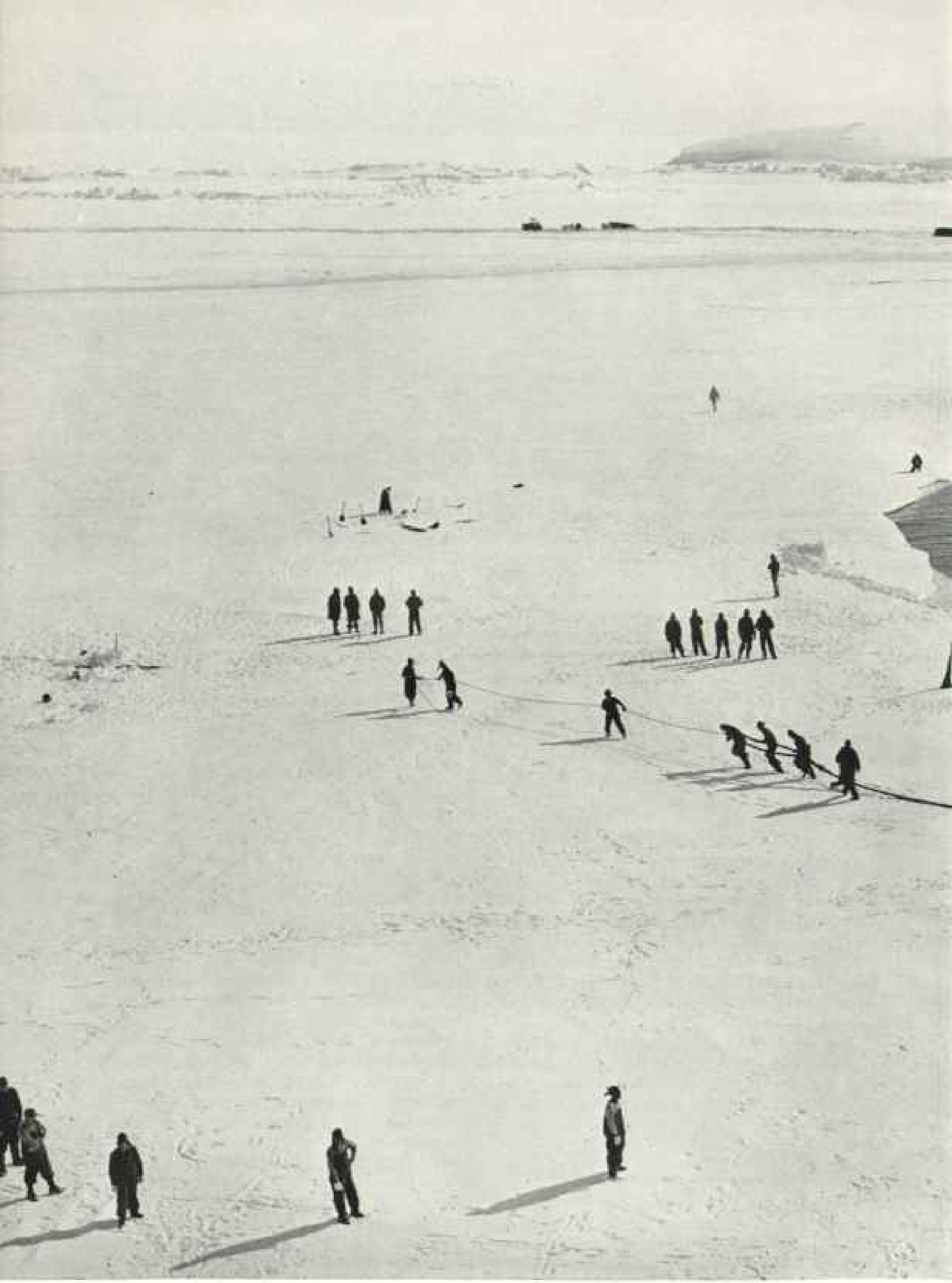
When one speaks of "beyond the South Pole" the language is not entirely figurative. The Pole is, of course, by definition the farthest south possible to reach, but it hardly is a midway point towards what now must be the goal of Antarctic exploration—the interior of those millions of square miles which no eye has seen.

When we were a few minutes beyond the Pole both planes turned to port and flew in a circle around it. This was, for me, the third nonstop flight around the world.

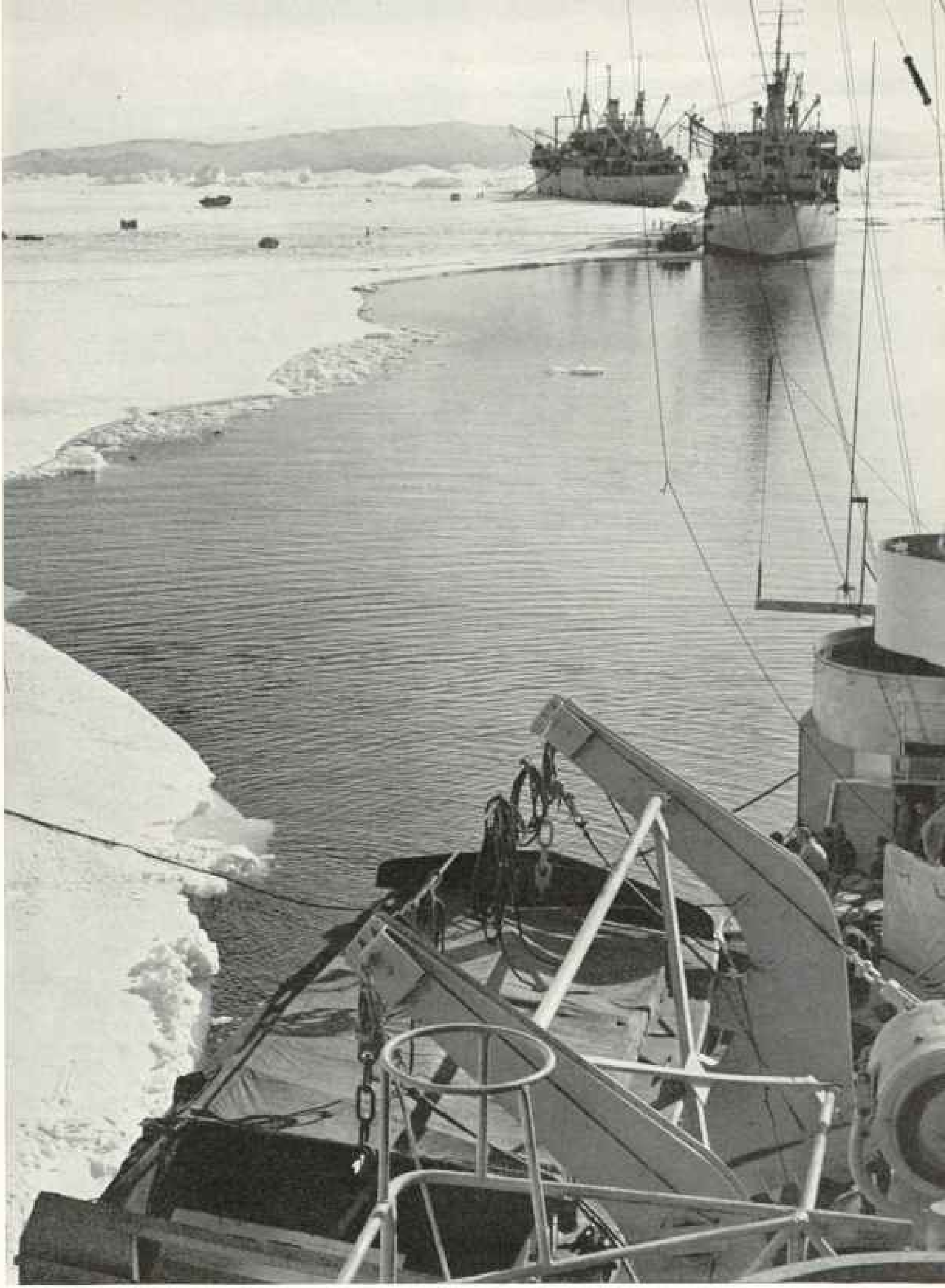
At the Pole it seemed—and this is an impression subject to correction—that the sastrugi were smaller and less well defined than elsewhere. They may indicate that the South Pole itself is not a place of high winds, so characteristic of much of Antarctica.

Below us the snow surface had a slight metallic sheen. Where the sun struck at angles it was tinged with gold. I dropped a cardboard box containing multicolored little flags of the United Nations. The symbolism

* Captain Butters in the other plane checked Heekin's position.



Charging Ashore with a Heavy Hawser, Seamen Moor the *Mount Olympus* to a Pier of Ice While Cargo Ships Unload



Expedition Members Haul the Flagship's Stern Line to a "Deadman" Sunk in the Ice of the Bay of Whales (Page 478)

should be obvious—the dedication of this goal of so much selfless heroism of the Norwegians and the British to the ideal of brotherhood among peoples.

Then, on the back of my navigation chart, I printed a personal message to Fleet Admiral Nimitz in Washington. My hands were so cold I had difficulty holding the pencil.

I wondered lately if this message could have been legible and examined the chart with a good deal of curiosity.

I wondered if there would be any evidence of the giddiness which comes from lack of oxygen and the fumes of the alcohol which we were using every few minutes to keep the cockpit window clear of frost.

What I wrote seems to have been entirely rational, although the message looks somewhat like the writing of a child who has just learned to print the alphabet. It read:

"It is 13.47 G. A. T. [Greenwich Apparent Time].

"As I write this, we are circling the South Pole. The temperature is 40 below zero.* Our altitude is 12,000 feet. The Pole is approximately 2,500 feet below us. On the other side of the Pole we are looking into that vast unknown area we have struggled so hard to reach. We are dropping on the Pole the flags of the United Nations.

"The young men with me join in sending to you and to the Secretary of the Navy our gratitude for giving us this opportunity for geographical discovery and great adventure. As this message is finished, we are heading into the unknown beyond the Pole. Warm regards from a cold place to you, Duke, and Forrest. There is no heat in the plane and it is chilly."

The reference to Duke and Forrest was to Adm. De Witt C. Ramsey, Vice Chief of Naval Operations, and Vice Admiral Sherman, who had done so much to make the expedition possible (page 430).

Only "Rolling White Desert" Seen

Both planes then continued on beyond the Pole. The instant we passed it some interesting things happened.

First, though we were following the same straight line, our true course changed from south to north and our 180th meridian changed to the zero meridian. Second, west had become east and east west.

In other words, one moment we were looking eastward out of the port window, and the next we had crossed the Pole and were looking westward out of the same window.

We flew to approximately latitude 88.30 south, an estimated 100 miles. Then we made approximately a right-angle turn eastward until we reached the 45th east meridian, when we turned again, this time on our way back to Little America.

Altogether, we had surveyed nearly 10,000 square miles of "the country beyond the Pole."

As was to be expected, although it is somewhat disappointing to report, there was no observable feature of any significance beyond the Pole. There was only the rolling white desert from horizon to horizon.

Visibility continued perfect, probably 150 miles. At one time, far to the northward in the direction of South America, I thought I discerned mountains, but this was little more than a passing impression. I am doubtful.

Our course was planned to take us over unknown areas practically all the way back to the Beardmore Glacier, toward which we now headed (page 471). Until this expedition discovered a glacier which is very probably larger (pages 473 and 478-9), the great Beardmore was supposed to be the earth's largest ice river.

Along this broad, crevassed white highway through towering mountains both Shackleton and Scott had made their land dashes toward the Pole. I hoped that it would be possible to set our course over the glacier itself.

A message received at this time from Little America, however, warned that weather was closing in there. This made a shorter route home advisable. But this turned out to be fortunate, because the flight was over hitherto unexplored country between the Beardmore and Wade Glaciers.

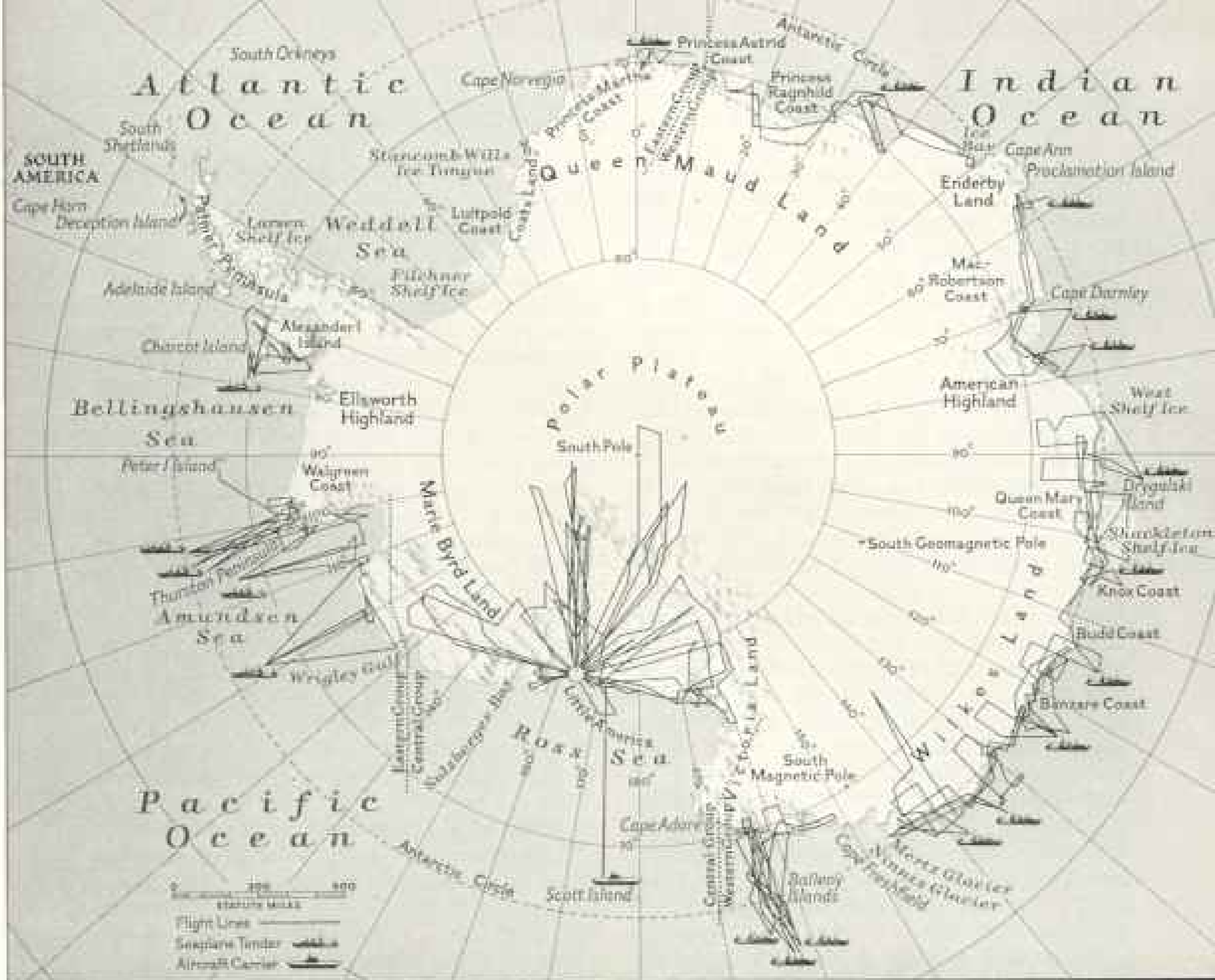
"Avenue of Frozen Rainbows"

Actually, I think, the way we traveled proved as breath-takingly beautiful a road through the skies as could be imagined. It might have been called the Avenue of Frozen Rainbows. The day remained cloudless. The sun, into which we had flown at midnight on our way south, now had moved around the heavens so that it faced us on our way north.

To east and west towered great mountains. Some were free of ice—coal-black and brick-red. Others were completely ice-covered. These looked like titanic waterfalls. Where the sun struck their peaks and slopes the light was reflected from them in an indescribable complex of colors. There were blends of blues, purples, and greens such as man seldom has seen before.

When we left the high plateau behind, it was a great relief to descend to a lower altitude. It is spending many hours at high altitudes in bitter temperatures that makes anoxia annoying.

* This was an approximation at the time.



Drawn by Harry B. Oliver

Flight Tracks of the Expedition's Exploring and Mapping Planes

Landplanes based at Little America made 29 photographic flights, and seaplanes from the tenders *Pine Island* and *Currituck* made 35 (pages 456-7 and 500).

We were back at our base shortly before noon, having covered more than 1,800 land miles in a little more than 12 hours. The pilot lowered the landing gear. Just as the tents of Little America, like ink dots on a white sheet, appeared ahead and we let down for a landing, the photographer rushed up to me and shouted, "Hold tight for a crash landing. The right ski is gone."

I looked out the window. The stabilizer holding the right ski horizontal had broken, possibly from crystallization of the metal from intense cold and vibration. But, very luckily, McCoy some days before had rigged a cable to keep the front end of the ski from dipping too far forward in just such an event.

"Fine ending for a good flight," I said to myself as Anderson made a perfect landing.

The "hump" in the plateau, the marked rise in altitude which reaches its maximum about 150 miles north of the Pole in the direction of the Ross Shelf and which was noted on our flight, also was pronounced in the altimeter readings from two other flights which entered the continent through the gateway of the Wade Glacier but turned southwestward instead of following a direct southerly course.

At approximately latitude 87 and 115 east longitude their instruments indicated that the white surface below was about 10,500 feet above sea level.

Here again the recorded rise had been gradual. No irregularity was observable in the surface of the névé. It would seem to be a great ridge miles broad, about 10,500 feet high, and at least 200 miles long.

Frozen Torrents Pour Through Passes

On these southwesterly flights also it was possible to make more detailed observations of the Wade Glacier, named for a distinguished explorer, my old friend and associate Dr. F. Alton Wade, senior scientist of our last expedition. It now appears to be a frozen river system with four or five large ice streams pouring into it through high mountain passes from

various points on the plateau (page 470).

Almost at the mouth there are two small tributaries, and about 20 miles "upstream" the Wade is joined by another frozen torrent which pours down through the Prince Olav Mountains to the east through sheer walls of ice and appears to ascend as far as the surface of the plateau.

From 40 to 50 miles from the mouth there are two other large tributary glaciers which also seem to come from the plateau through 10,000-foot-high mountains to the west. The manner in which these rivers of ice flow together and amalgamate like rivers of water into one gigantic stream will be a fascinating problem for future expeditions.

The mountains grow steadily higher from the low, black hills on either side of the Wade, where it flows into the ice shelf, to the dark gray, brown, and red peaks towering into the sky at the top. Most of the mountains are sharp-peaked and steep-sided. A few, however, have curiously flattened tops. Some mountains are completely bare. Others are dome-shaped and covered with snow and ice.

There appears to be no easy explanation for this. Sometimes an ice-free mountain looms a thousand feet or more above a lower crest a few miles away on which not a single patch of bare rock is discernible. Thus temperature and altitude appear not to be the deciding factors in the phenomenon.

"Like a Gigantic Coal Pile"

The blackness of some mountains impressed the observers. They stood like masses of onyx among titanic crystals. One was described as "like a gigantic coal pile composed of loose black chunks scooped up by some glacier over a million years and left behind when the ice retreated." Some of them might possibly be mountains of coal. But actually coal exposed to weather over long periods tends to be brownish rather than black.

Both historically and geographically, the western shore of the Ross Sea from Cape Adare to the Beardmore Glacier was, before the establishment of Little America, the best-known part of Antarctica.

This serrated coast, over which loom ice-covered mountain ranges through whose defiles wind blue and silver glaciers, first was skirted for 400 miles as far south as McMurdo Sound by Sir James Clark Ross with his two wooden ships, *Erebus* and *Terror*, in 1841.

Since then, McMurdo Sound has been the base of four British expeditions, two led by Capt. Robert Falcon Scott and two by Sir Ernest Shackleton. The coastline has been adequately mapped. British explorers have made long and perilous journeys up the great glaciers.

The British and Australians have done magnificent work.

They have located and named the more prominent divisions of the west coast mountains—such as the Commonwealth, Queen Alexandra, Britannia, and Prince Albert ranges. They have placed on the map many individual peaks, such as cloud-piercing Mount Kirkpatrick, with an elevation of nearly three miles above sea level; Mount Harmsworth, which reaches 9,640 feet; and Mount Albert Markham, towering to 10,460 feet.

But these mountains along the coast formed a wall beyond which men could not go in the days of sailing ships and dog sledges. Explorers had no means of knowing what lay beyond the first ramparts of this mountain barrier, other than by glimpses from sea and shore of great peaks in the saffron-skied distance. They knew only that somewhere west of the mountains was the high plateau which Ross, who had sailed along its northern shore for about 100 miles, had named Victoria Land, in honor of his then youthful queen.

The magnitude of the prospect was too great for its adequate grasping by earth-bound eyes of the explorers who had gone afoot up the Beardmore. Consequently, this expedition's air explorations brought a wealth of discoveries. They were, in fact, beyond our expectations. They are still more or less of a confusion in our minds until the trimetrogon photos can be analyzed.

Hitherto-unknown mountains are numbered in hundreds, glaciers in scores. For the first time, it can be stated confidently, one will be able to picture this complex of towering peaks as a whole, rather than in disconnected fragments.

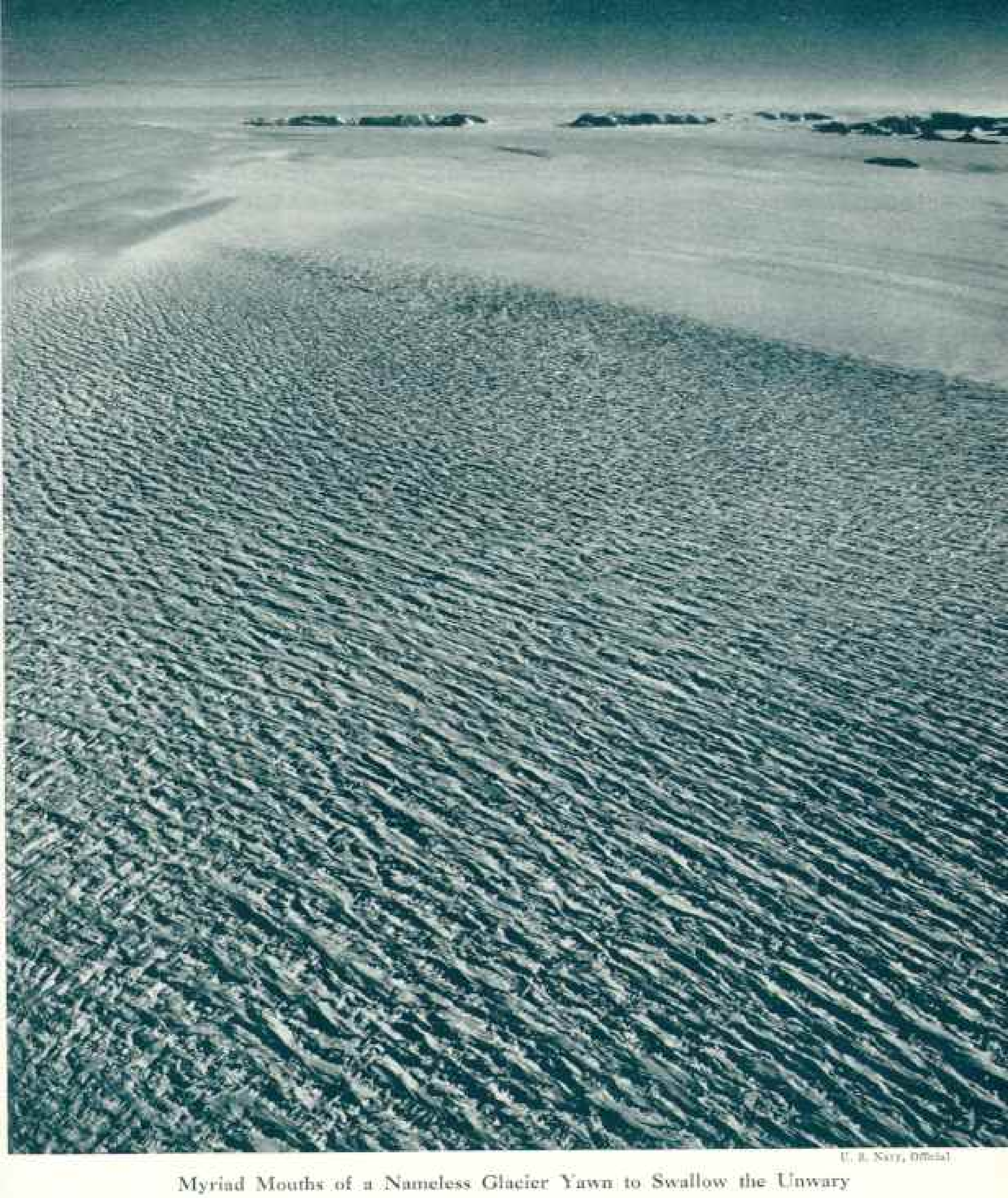
The discoveries were made in a series of flights from February 14 to February 20. One of the most notable flights was that of a plane commanded by Commander Hawkes on February 20. It set out from Little America shortly after midnight on a clear, bitterly cold morning with a bright sun low in the sky.

Pilots Too Warm Where Heroes Froze

On our way westward across the shelf it became uncomfortably warm in the plane's cockpit. The heater was working this time. Lt. George H. Anderson opened a window.

"George," commented Hawkes philosophically, "do you realize that this is almost exactly above the spot where a lot of good men froze to death?"

He had kept a careful log since leaving the base and noted that the plane had reached



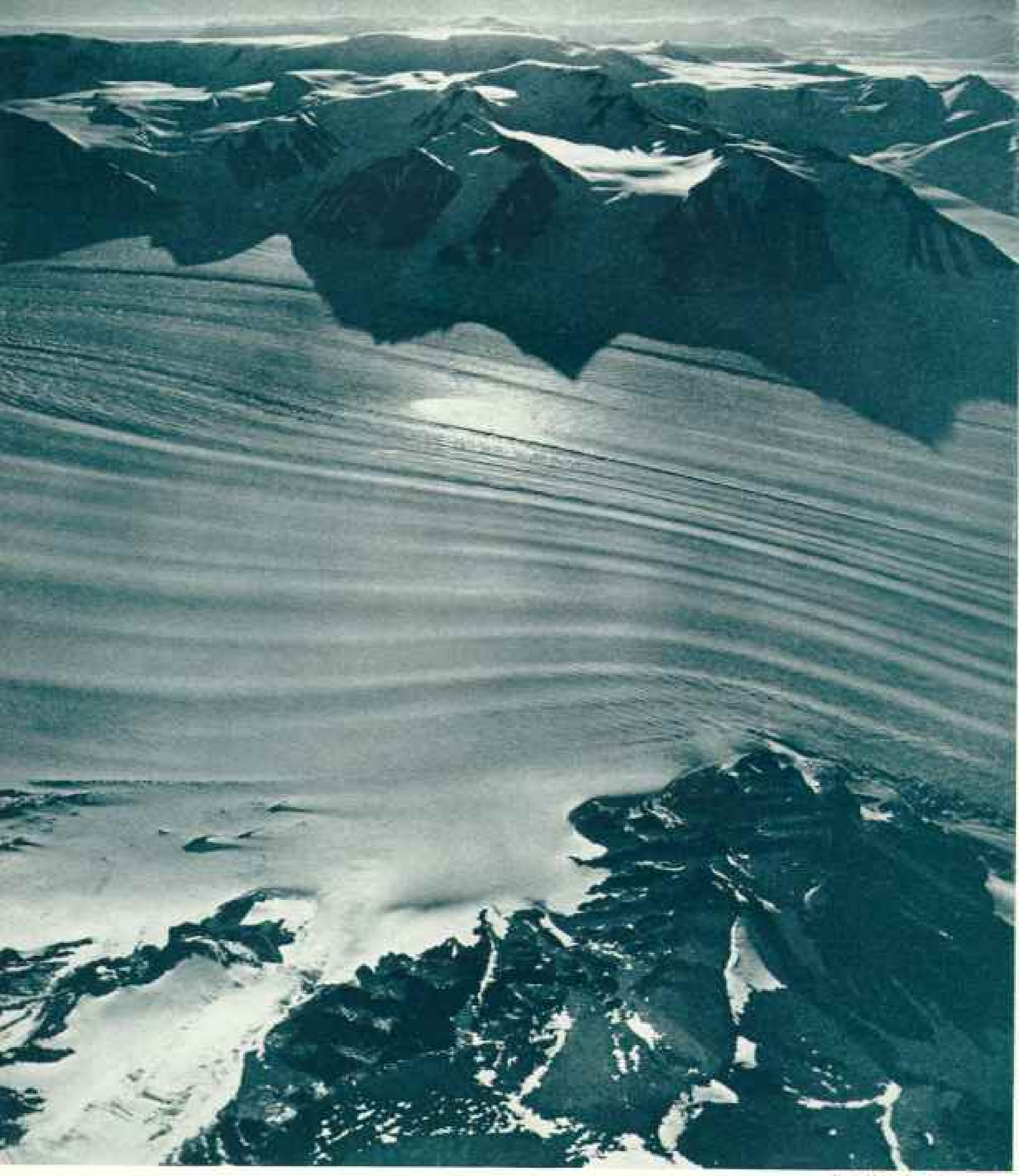
U. S. Navy Official

Myriad Mouths of a Nameless Glacier Yawn to Swallow the Unwary

WHAT appear to be ridges are enormous crevasses, many of them more than 100 feet wide. Some would hardly be apparent to an observer on the ground, since they would be covered with snow bridges. An experienced explorer, however, would note parallel ridges, which would warn him of his peril.

Such an area is impassable, even for dog teams or men on foot. Badly crevassed regions like this were heartbreaking to earlier explorers, such as Shackleton and Scott, who crept like ants across the trackless white. Admiral Byrd's trail parties, too, had to find a way around them.

This danger area is in an unnamed glacier which originates on the slopes of Mount McClintock, on the western shore of the Ross Shelf Ice. The glacier enters the shelf beyond the black rocks at the top of the photograph.



U. S. Navy, Official

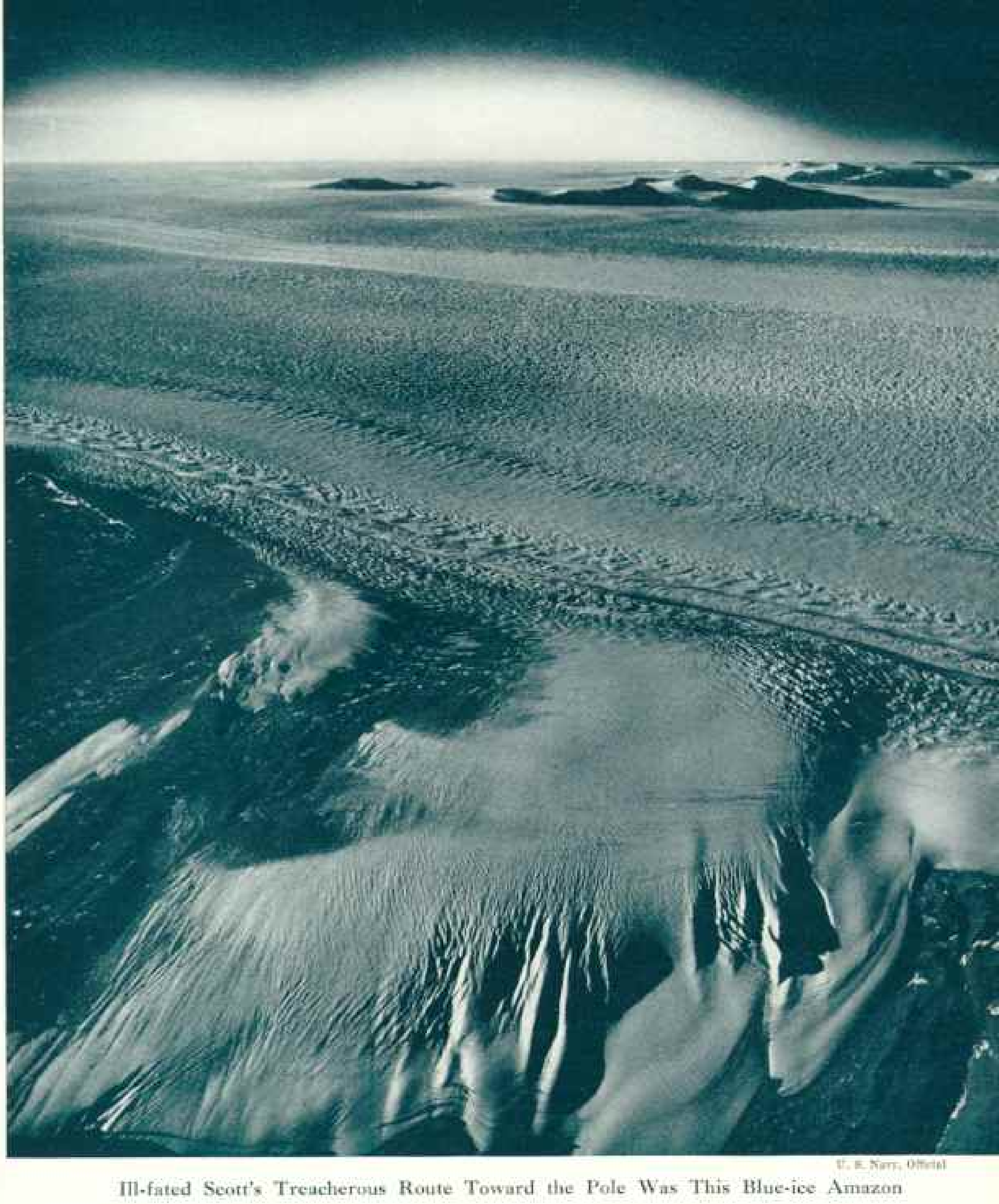
Through Shadowy Mountains of Desolation Runs a Great Silver Ribbon

ABOUT 14 miles wide, the mighty Wade Glacier, named for Admiral Byrd's friend and fellow explorer, Dr. F. Alton Wade, flows through a gap in the Queen Maud Range into the Ross Sea. It appears to constitute one of the best gateways to the vast interior plateau, either by land or by air, Admiral Byrd reports.

It was over the Wade that the Admiral flew on his epochal flight "beyond the Pole."

Near the Ross Sea coast the glacier cuts through a chaotic array of low-lying peaks. These become progressively higher as one continues southward.

"Seemingly without end they stretched around us —a scene of grandeur such as is hardly duplicable on earth," says Admiral Byrd. "Dominating the entire Wade Glacier area to our left, that great Beacon sandstone massif, Mount Bush, towered to an altitude of approximately 14,000 feet."



U. S. Navy, Official

Ill-fated Scott's Treacherous Route Toward the Pole Was This Blue-ice Amazon

BEARDMORE Glacier is one of the two or three largest ice rivers in the world and historically is the best known in the Antarctic.

It was up the Beardmore that both Shackleton and Scott made their heroic poleward treks. After returning down this glacier toward their base camp at McMurdo Sound, Scott and his companions perished within 11 miles of sorely needed supplies. They had reached the South Pole only to find that Roald Amundsen had been there before them.

Beardmore is a broad highway into the continent, but in places it is terribly crevassed. On both sides tower high mountain ranges which were explored and photographed from the air by the U. S. Navy Antarctic Expedition. For a few miles from its source, the air photos show, the Beardmore falls quite abruptly about 3,000 feet, after which the decline is gradual until the barrier ice is reached

U. S. Navy, Official

White Tongues Lick Out from Dark Mountains and One Hangs Suspended in Air

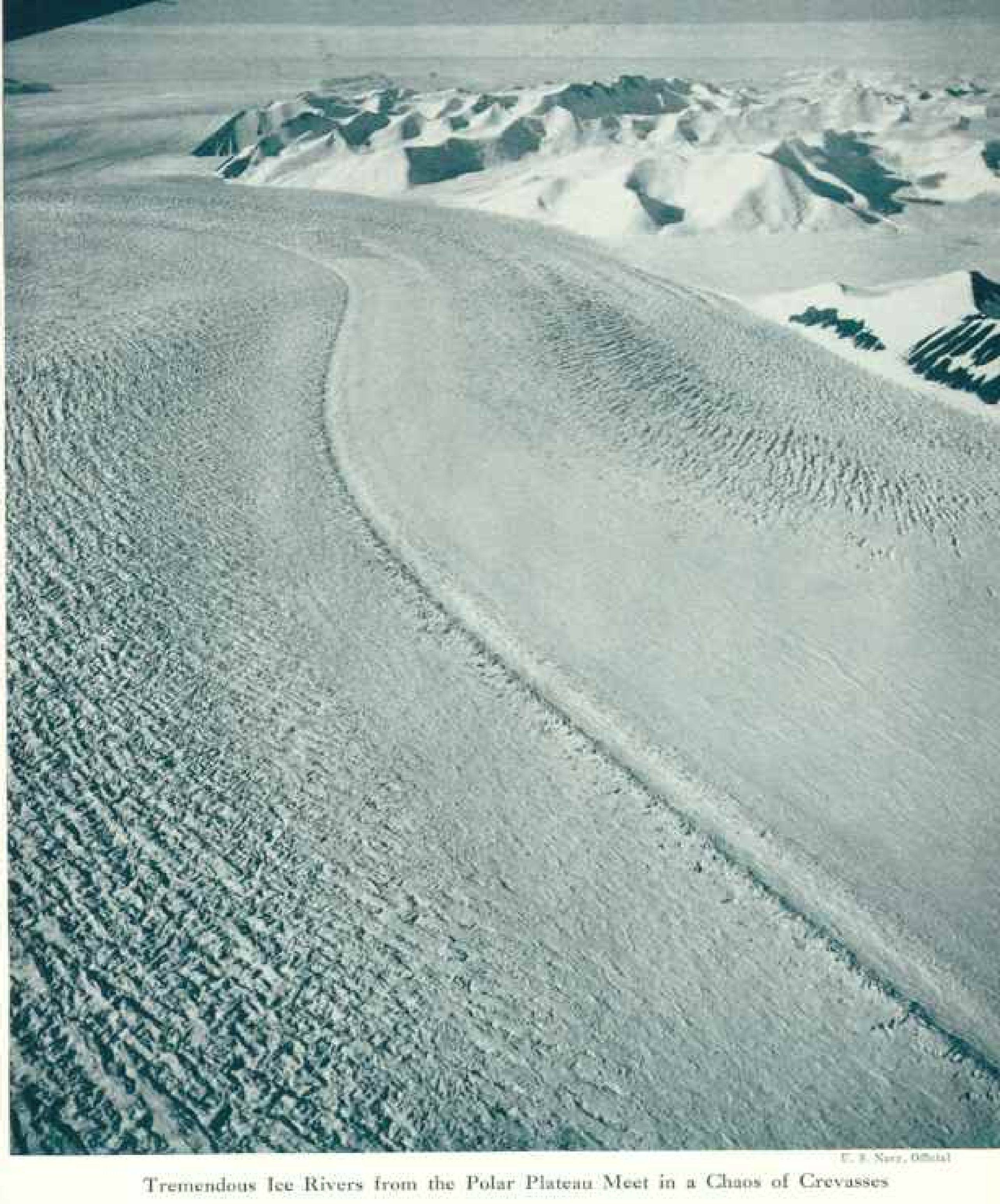
THIS small, unnamed glacier, its milky whiteness contrasting with the black peak in the foreground, is one of a series flowing down parallel valleys from the west coast mountains.

A few miles away is a similar narrow valley which is entirely free of ice. The glacier which once flowed through it has retreated, leaving only bare rocks. Why this should have occurred in one valley only is unexplained.

Note the tongue of white hanging over the black wall of the valley on the left, like a waterfall suddenly frozen in space. This is a typical icefall, of which hundreds were found in the area.

The glacier flows into the Ross Sea just west of Mount Erebus, which is visible in the background (page 476).

Beaufort Island appears as a patch of white like a small iceberg on the skyline.



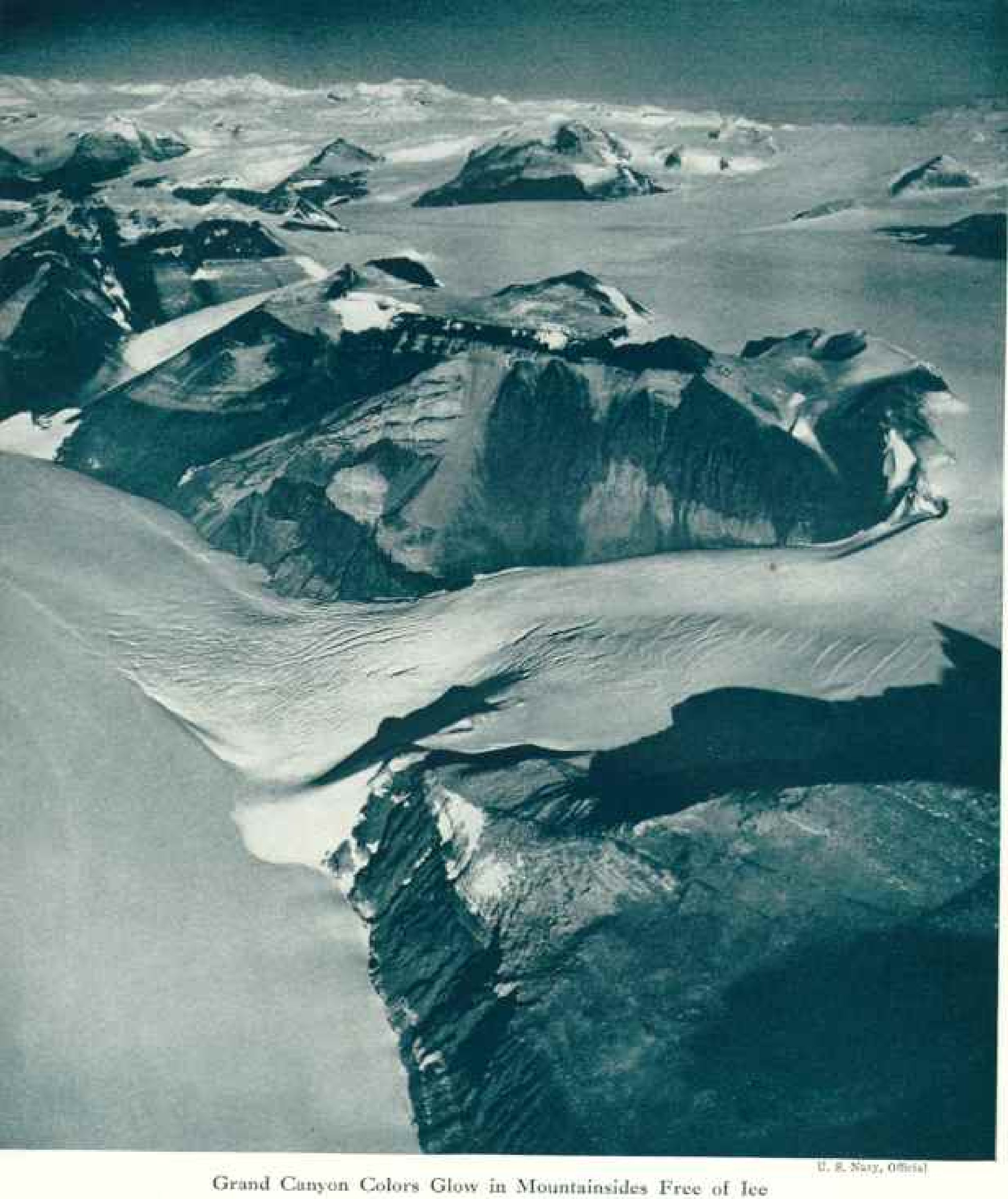
U. S. Navy Official

Tremendous Ice Rivers from the Polar Plateau Meet in a Chaos of Crevasses

HERE merge three great glaciers, only two of which are shown. The dynamic force responsible for the badly crevassed area is ice flowing down the slopes of 15,100-foot Mount Markham, one of the highest elevations in the west coast mountains.

These three ice streams unite to form a glacier which Admiral Byrd believes is the largest so far discovered. It probably empties into Shackleton Inlet on the west coast of the Ross Shelf and is thought to be identical with the glacier whose mouth was described by Sir Ernest Shackleton. Majestic mountains which he saw in the distance were photographed by the U. S. Navy flyers.

Ice near the top of the picture has a "roller-coaster" appearance where it curves around a black mountain peak. These billows are a series of great icefalls, comparable to frozen Niagaras



U. S. Navy, Official

Grand Canyon Colors Glow in Mountainsides Free of Ice

COMDR. William M. Hawkes, in command of the flight on which this photograph was taken, describes the area as one of the most scenic spots in Antarctica. It is strongly reminiscent of the Grand Canyon of the Colorado. The mountainsides, which here appear black, in reality show delicate shades of pink, red, and purple.

Other natural features discovered included the "Titans' Honeycomb," a series of large, regular hexagons on a flat mountaintop. Some peaks are ice-covered, while others are bare—a curious, unexplained Antarctic phenomenon.

Streams of ice form high, tight collars around these mountaintops. The region is the "headwaters" of an unnamed glacier which flows out of the mountains into New Harbor, near McMurdo Sound. It creeps down a valley parallel to the glacier shown on page 472.

U. S. Navy Official

Air Exploration Finds a Warm Spot in Icy-hearted Antarctica

CONFIRMING a sight that made airmen rub their eyes, this air photo shows part of the "oasis," or ice-free region of green lakes and brown hills, discovered at about sea level by a PBM plane of the Western Group.

Except for algae which tint the waters, the area is apparently lifeless. It may indicate a gradual retreat of the ice sheet in this part of the Antarctic, but there are several other possibilities and no explanation is entirely accepted (Color Plate VIII).

This oasis, one of two large ones discovered, is easily accessible by plane and appears to have a fairly temperate climate during the summer months.

"It is far more than a natural curiosity," says Admiral Byrd. "It might be looked upon as one of Nature's test tubes, where many processes of importance to the world we live in can be observed by scientists."

U. S. Navy, Official

Steam and Gases Pour from the Snowy Cone of Fiery Mount Erebus

AIRMEN flying over Antarctica's only known active volcano reported huge wind-blown clouds of vapor issuing from its crater. Volcanic ash atop the snow was noted on some of the slopes.

To obtain this and other photographs, Commander Hawkes flew as close to the crater's edge as the enormous, whirling clouds of steam and noxious gases would permit.

Mount Erebus, on Ross Island near McMurdo Sound, towers to an altitude of 13,200 feet and dominates the entire area. The summit rises as a broad dome which appears to have been built up in three stages of volcanic activity. The active crater is approximately a half mile in diameter and 900 feet deep.

McMurdo Sound, under the shadow of steaming Mount Erebus, is vibrant from associations with Scott, Shackleton, and other British explorers.

169.15 east and 79.38 south, where Scott's blizzard-delayed survivors returning from the Pole had come to the end of their tragic trail 35 years ago, almost within sight of a depot where they would have found food and shelter.

It was the most striking contrast imaginable between exploration of today and yesterday. It would have been difficult indeed for those despairing men to have imagined that within less than one man's lifetime an explorer would be uncomfortably hot where they had died of cold.

At this point, far in the distance loomed the peaks of the west coast mountains. The plane crossed the coastline at Cape Murray, about latitude 80, and also the coast range just south of the sharp-peaked Mount McClintock, which reaches 10,530 feet into the skies.

Weather had been threatening, but by rising above a low cloud cover it was possible to fly northward along the western ridge of the coast mountains.

Mile after mile they towered out of the white sea of clouds—an endless succession of mountain ranges seemingly suspended in the substratosphere. They were sheer pinnacles of ice and snow. They were cities of enchantment, steepled cathedrals, and glittering palaces of infinite cold where dwelt the monarchs of the dark vastnesses of space.

It was a scene out of space and time, as the mind knows these abstractions. Perhaps human eye never has looked upon a more awe-inspiring prospect than that which stretched below and beside Commander Hawkes and his crew.

These mountains constitute a belt from 50 to 75 miles wide extending westward from the Ross Sea coast. Beyond, as far as eye can see, is only the high, featureless desolation of the Victoria Land plateau.

Scores of Ice-free "Oases"

The wealth of new mountains discovered can only be catalogued for the present. Some striking features were noted by Commander Hawkes and his crew. There were, for example, a number of "oases"—valleys free of ice, in some of which are blue-green frozen lakes.

All are small compared with the ice-free region several hundred square miles in area which had been discovered a few days before by Capt. Charles A. Bond near the coast 1,500 miles to the west (pages 475, 498, and 516, and Plate VIII).

These dry valleys, at least three of which are nearly ten miles long, show clearly on the trimetrogon photographs. They slope downward out of the mountains to the coast of the Ross Shelf Ice.

Their walls are steep slopes of brown rock over which icefalls hang suspended. These look like 1,000-foot-high waterfalls suddenly frozen in space before reaching the "oases" floors. The bottoms of the valleys, viewed through holes in the clouds, appear covered with hillocks of glacier-deposited gravel.

A somewhat similar ice-free corridor descends out of the mountains to the Ross Sea at New Harbor. This valley was explored by members of one of Scott's expeditions. It is about two miles wide and 20 miles long and is known to have once been occupied by a glacier. There is no evidence of any underground thermal activity.

Promising Base for Exploration

Most of the valleys of this sort photographed by Commander Hawkes seemed entirely isolated among low mountains. One aroused special interest. In its center is a small lake, entirely frozen over in mid-February, upon which an airplane could be landed easily.

Protruding out of the ice is a small island, a black mass of rock. This would provide an excellent "ground" for a radio station.

Thus explorers, including geologists, could be set down in the middle of one of the most forbidding regions on earth and conduct short foot or dog-sled expeditions into the surrounding mountains. All the time they could keep in constant touch with the outside world.

The presumption is that these valleys originally were cleared by the retreat of small glaciers. They probably are kept clear by strong prevailing winds which sweep away the snow as fast as it falls. The low hills of black rock which surround them absorb a great deal of heat during the three summer months of perpetual daylight. This is reradiated slowly.

Such a hypothesis might explain tentatively the hanging waterfalls. The rate of melting due to the radiated heat presumably is such that they never can quite reach the valley floors. From them through the summer would flow many small brooks to form the lakes in the valleys.

It was all a region of new "wonders of the world." One striking feature, for example, was a series of isolated mountains whose sides were stratified with rocks of various colors. They had the appearance of the walls of the Grand Canyon of the Colorado, but on an even more impressive scale. The stratification showed clearly, since the mountain walls were free of ice and vegetation (page 474).

Another such phenomenon was the "Titans' Honeycomb." This mysterious natural feature appears on the film now being studied as a plain of almost mathematically regular

Mittened Hands Make Fast a Hawser to a "Deadman" in the Ice

Securely frozen in, the timber with the picturesque name is stiff as rigor mortis. Such timbers for mooring ships form an essential part of the equipment of an Antarctic expedition (page 463).

hexagons covering a large area of low, flat mountaintop.

One tentative explanation was that it probably was a large field of dried mud, the sides of the hexagons being formed by the cracks.

The picture taken from more than 1,000 feet in the air was not dissimilar to that of a vegetationless mud flat in midsummer. But it required a stretch of the imagination to think of an Antarctic mountaintop actually covered with mud at any time.

The final explanation must wait until someone visits the place on foot. Expedition geologists now believe, however, that the scene portrayed on the film is about what would be recorded from a plane flying at a considerable altitude above the Palisades along the Hudson River, if they were stripped of all cover, or the Giant's Causeway on the Ulster coast.

The apparent explanation is that these hexagons are the tops of dolerite sills. Dolerite is very hard lava rock which rises from the depths of the earth very slowly, instead of suddenly and violently as in a volcanic eruption, and cools below the surface. Then, through the years, the processes of erosion eat away the softer surface rocks overlying them.

In this case, the lines of the hexagons presumably represent the tops of the dolerite columns. They are seams filled with snow, so that they are distinguishable in photographs, probably more clearly than if one viewed them from the ground.

This, of course, is not presented as a final hypothesis. It seems to be the best explanation that can be reached for the time.

The major discovery on another flight by Commander Hawkes over the west coast was a glacier which can be termed one of the most spectacular on earth. It rivals both the

Beardmore and the Wade, and in some respects surpasses them in wild scenic beauty. I believe it is the largest glacier so far discovered (page 473).

This is a monster river of ice which flows at least 80 miles out of the 9,000-foot-high continental plateau of Victoria Land through gaps in the mountain ranges into the Ross Shelf. It left those who looked down upon it awestruck, and their impressions have been more than confirmed by the photographs.

Perhaps the most striking feature of this glacier is its "roller-coaster" appearance. There are considerable stretches of its surface with rolling drops of 100 feet or more within a few feet of horizontal distance. They are like the great ocean swells that precede a typhoon.

One can hardly imagine the picture, in untold years to come, when the icecap melts and this glacier presumably will be a river of water—mile after mile after mile of perpetually thundering waterfalls through 10,000-foot-high mountains. For breath-taking savage sublimity it should be one of Nature's masterpieces.

The precise point where the great ice river empties into the Ross Shelf remains to be calculated from study of the photographs taken from the air, together with photos made by members of Sir Ernest Shackleton's party of 39 years ago. A possible outlet appears to be Shackleton Inlet, which cuts into the land at about 82.22 south.

"Curiosity Not Unmingled with Awe"

Shackleton* had predicted that a small glacier of low gradient would be found emptying into this inlet. It is interesting to recall his own observations at this point, prophetic as they are of the discoveries made by Commander Hawkes and his crew. In his account of his first expedition he writes:

"Up the inlet lies a great chain of mountains, and far into the west appear more peaks . . .

"It falls to the lot of few men to view land not previously seen by human eyes, and it was with feelings of keen curiosity, not unmingled with awe, that we watched the new mountains rise from the great unknown that lay ahead of us. Mighty peaks they were, the eternal snows at their bases, and their rough-hewn forms rising high towards the sky. . . . As the days wore on, and mountain after mountain came into view, grimly majestic, the consciousness of our insignificance seemed to grow upon us."*

* From *The Heart of the Antarctic*, by E. H. Shackleton, published in 1909 by William Heinemann, Ltd., London.

Thus one of the greatest explorers of all time was impressed by the distant prospect of the wildness and majesty which Hawkes and his crew were the first of living men to see as a whole.

They looked directly down on hundreds of square miles of these glaciers, valleys, and mountains. For miles above the clouds they flew beside mighty mountain walls over which glaciers hung suspended like silver ribbons.

Throughout the flight over the mountains there was a succession of ice-covered green lakes in the valleys. They appeared through rifts in the foamlike ocean of clouds below the plane and looked like emeralds in the diamond setting of the glittering névé which covered the surrounding peaks.

Colors of these lakes ranged from the green of new grass in a northern springtime to a strange purplish green.

Most of the lakes were small; presumably they would be typical tarns in northern mountains. But one was nearly three miles long. They usually are found in broad valleys among relatively low hills through whose interstices sweep high winds.

These keep the valley floor clear of snow. There is no opportunity for the compacting of the névé year after year, the process which results elsewhere in the building of the great ice sheet which covers the continent.

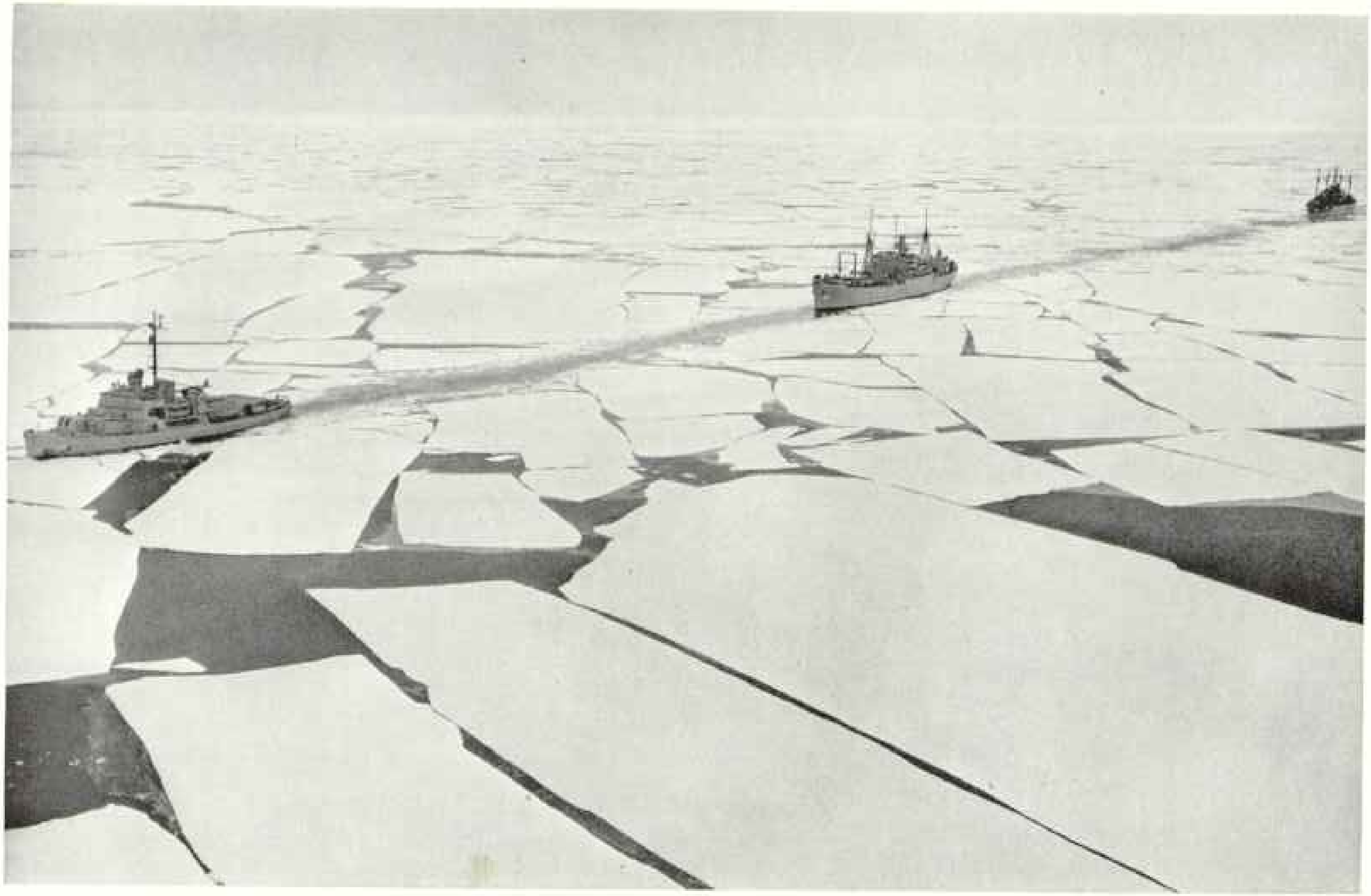
Slopes of many of the surrounding hills also are ice-free. Black and red rocks forming the northern walls of the valleys absorb and then reradiate the heat waves of the 24-hour-long sunshine of summer days.

Presumably small streams trickle into the valley floors where they form pools which freeze early in the Antarctic autumn. Thus are created the small lakes which are among the most striking features of Antarctic mountain scenery in the more northerly latitudes.

Fiery Mountain in Antarctic Ice

Just before returning to Little America from this mission, Commander Hawkes had planned to fly over the crater of Mount Erebus to photograph its interior. When he arrived, however, enormous volumes of vapor were pouring forth and being blown eastward and northward by a high wind. The great volcano apparently is approaching a period of increased activity.

It would have been highly perilous to carry out the plan—nobody knows what poisonous gases might be contained in this smoke from the earth's interior—and photographs would have revealed nothing. It was possible only to skirt close to the western edge of the 13,200-foot-high summit (page 476).



Beeline for Antarctica: Through Thin, "Rotten" Ice in the Ross Sea the Expedition's Ships Drive Straight for Their Goal

Breaking a path for the other ships of the Central Group is the Coast Guard icebreaker *Northwind* (left). In heavier pack the icebreaker usually broke a zigzag path which the other vessels found more difficult to follow.

Marines Test an Amphibious Tractor in the Bay of Whales

Normally used by the Marine Corps in landing operations, the vehicle can operate on land, ice, or water. Two such tractors made a 280-mile journey across the ice of Antarctica (pages 489 and 513).

Descending the *Merrick* Gangplank, Admiral Byrd Greets a Fur-coated Friend

Rickey, a Husky born at Little America on the 1933-34 expedition, is now a veteran of three Antarctic trips. Behind the Admiral (left to right) are Lt. Comdr. F. G. Dustin and A. H. Waite, Jr., both veterans of other expeditions, and Chief Boatswain's Mate Walter K. Toepfer, accompanying him on a visit to previous Little America sites.

The steaming mountain easily dominates the whole McMurdo Sound area.

Two planes, one piloted by Lt. George W. Warden, accompanied by Ensign Stanley J. Andrews, and the other by Lt. Robert J. McCarthy, came off the Polar Plateau down the Beardmore Glacier. They had flown inland for about 300 miles by way of the Wade.

The Beardmore extends about 100 miles through a 14-mile-wide corridor from the plateau at the 85th parallel, where the elevation is slightly above 7,000 feet, to the Ross Shelf, whose surface is slightly more than 200 feet above sea level.

This Amazon of ice was discovered and first ascended by Sir Ernest Shackleton during the polar summer of 1908 on his first attempt to reach the South Pole. Three years later it was the road chosen by Captain Scott for his epic and tragic polar venture. It is a series of rough torrents of blue ice (page 471).

On the west rise precipitously the ice-covered peaks of the Queen Alexandra Range, the highest of which, Mount Kirkpatrick, reaches an elevation determined by triangulation as approximately 14,600 feet.

The eastern wall is formed by the lower, but even more rugged, Commonwealth Range.

Flanking the glacier on the southeast, but apparently extending by no means so far east as is represented on existing maps, is the 10,000-foot-high Dominion Range.

A dozen or more tributary glaciers flow out of the mountains into the Beardmore. Between the icefalls are long stretches of crevasses which were crossed with extreme difficulty and peril by the British explorers.

Man Stunned by His Own Littleness

Both Shackleton and Scott were men of poetic imagination. Words failed them when they tried to describe the sublimity of this great highway of ice; words always will fail to convey to others the grandeur and the glory of the Beardmore. They traversed it slowly and perilously on foot, like white ants crawling through the long shadows of the gigantic mountains.

Perhaps nowhere else on earth is man so stunned at the realization of his own littleness before the majesty and the power of Nature. On the blue floor of the Beardmore, as nowhere else, comes the full realization of Mrs. Browning's lines:

> . . . God's greatness
> Flowed around our incompleteness—
> Round our restlessness, His rest.

Shackleton and Scott were mere men looking upward. They surveyed the mountain peaks as philosophical and scientifically minded ants might survey the towered buildings of Wall Street as they crawled along the curb. Lieutenant Warden and his crew surveyed them as might tiny wrens flying above. They got a more complete picture, but there was the same sense of human futility.

The glacier is formed by the merger of two large branches which flow in from the plateau, whose ice appears to be quite turbulent in this region. It apparently covers an extremely rough country, with numerous small peaks protruding above the great, flat whiteness.

At the southern end, approximately between these two streams, is a striking feature not hitherto reported—a relatively flat and almost completely ice-free area of about five square miles which protrudes about 2,000 feet above the névé.

It is dark red in color and absolutely barren—a red desert in the middle of a white desert. Its surface has an elevation of more than 9,000 feet above sea level and appears to be the top of an enormous mountain whose crest may have been planed down at some time. The surface is rough.

Ice Cataracts amid Red Peaks

Here again is a phenomenon for which there is no plausible explanation. The falling snow may be swept away constantly by prevailing winds, so that no ice can form, or there may be some subterranean heat source.

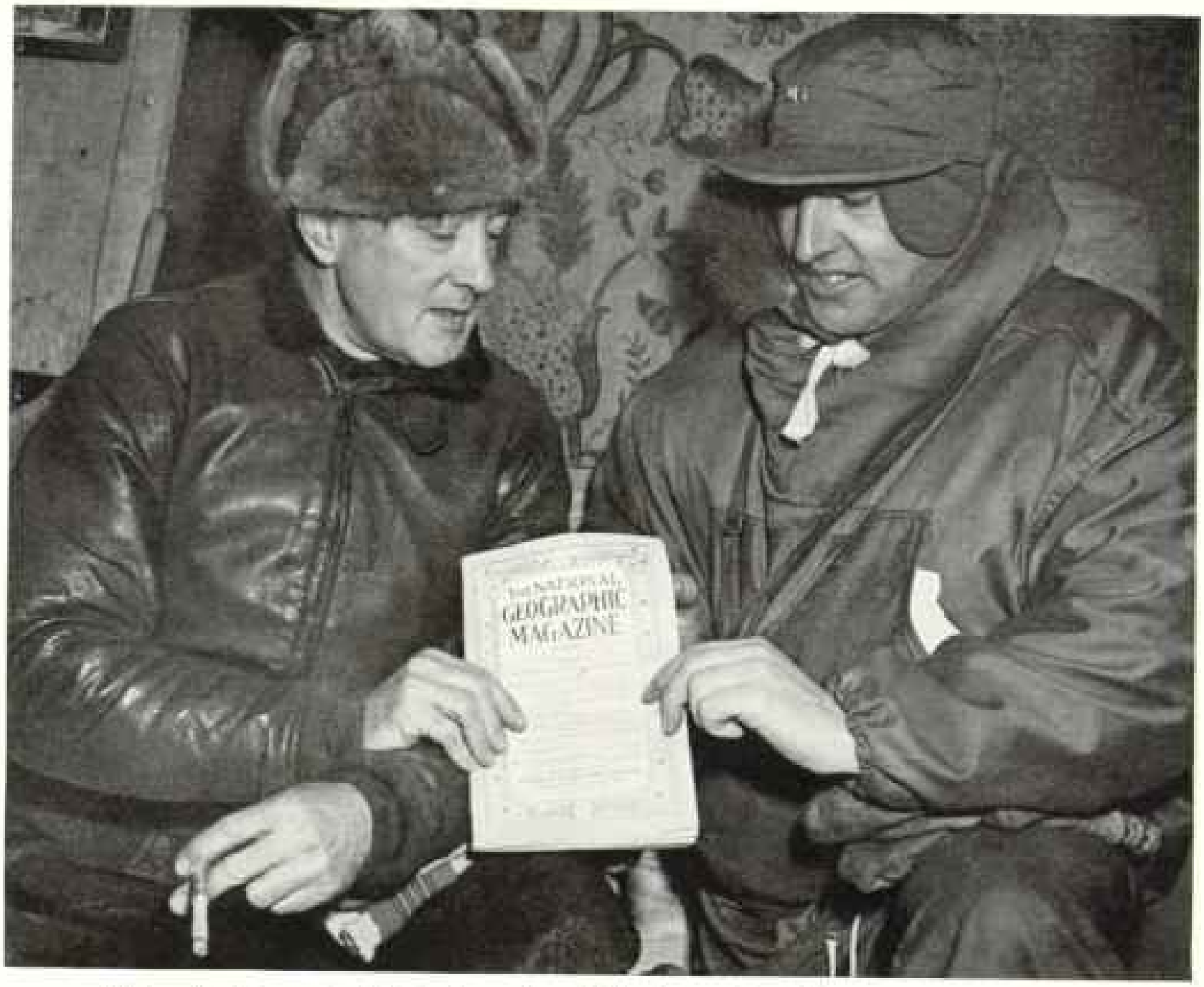
Frequently there is a depression over which ice spills from the glacier sides, forming lovely frozen cataracts. At one point is a small ice-covered lake.

The two planes flew down the glacier, one on the west and the other on the east, between 10 and 11 p. m., Little America time. Directly behind them, halfway up the southern horizon, was a bright sun which fell on the glittering mountain walls ahead.

A striking sight in the direct sunlight were the stratified rocks with alternating bands of dark maroon and rust red. The photos show several of the smaller glaciers flowing into the Beardmore, as well as ice Niagaras falling over the mountainsides. Near the source the crevasses are breath-taking. They grow smaller and smaller as one approaches the mouth, until the barrier ice is reached.

The great wall of the Queen Mauds stands between the southeastern extremity of the Ross Shelf Ice and the plateau.

At least ten glaciers flow through the high passes of this series of mountain ranges—mighty frozen rivers dropping at least 8,000 feet within 90 or 100 miles from the great ice-cap into the solid sea.



After 12 Years in Little America, This Magazine Was as Good as New

Admiral Byrd and Dr. Paul Siple, chief Army representative on the expedition, inspect a copy of the National Geographic Magazine for July, 1934, which was left at Little America II in the winter of 1934–35. The magazine was in perfect condition. It might have come off the press yesterday. Some issues dated from 1933. To Dr. Gilbert Grosvenor and Dr. John Oliver La Gorce, Editor and Associate Editor of The Magazine, Admiral Byrd radioed: "FOUND MY OLD CABIN AT LITTLE AMERICA BURIED DEEP UNDER THE SNOW. IN IT WERE SEVERAL COPIES OF NATIONAL GEOGRAPHIC MAGAZINES PLACED THERE IN 1933. WARMEST REGARDS. DICK BYRD. USS MOUNT OLYMPUS."

The mouths of these and other glaciers—the Liv, the Axel Heiberg, the Cooper, the Isaiah Bowman, the Amundsen, the Albanus (Phillips), the Scott, and the Leverett—are not more than 50 miles apart.

It intrigues the imagination to picture this coast released from its ice shackles, with the eternal thunder of these torrents pouring out of the mysterious red and purple mountains.

Because of their steep descent, these glaciers exert enormous pressures when they merge with the ice shelf. The result, as everywhere when this occurs, is an almost continuous series of terribly crevassed areas which are an effective barrier against land expeditions that try to penetrate the continent from this direction. Although the glaciers have been photographed and recorded on maps, most of them are unexplored.

One flight, with Major Weir, of the Marine Corps, as senior pilot, started from Little America at midnight and flew southeastward across the barrier headed for the unknown area just east of the known limits of the Queen Maud Range. We expected to cross the continuation of the Watson Escarpment to find out what was in the area on the South American side of the South Pole. It was our first flight into unknown areas.

"Hourglass Glacier" Discovered

After passing the 82d parallel of latitude we had unknown country under us until finally we sighted mountains ahead. Many of them were covered with clouds, and Major Weir and I found ourselves faced with the necessity of carrying out our policy of taking the weather where we could find it.

Gleaming Ice Crystals Adorn a Ceiling in Long-abandoned Little America

Six winters of Nature's handiwork transformed the old barracks into a glittering palace throne room (pages 441-2). This was the third Little America, left to the mercies of Antarctica since 1941.

The mountains were strung out as far as eye could see, ahead to right and left.

On the starboard bow we saw a great glacier which was free of clouds and appeared to be the best approach to the plateau. We decided to use that route. Scott Glacier should have been somewhere on the starboard bow, but if our position was correct this glacier seemed too close aboard to be the Scott.

We knew it was possible that we might be well off our course to the westward and that this glacier was the Scott.

We had with us some photographs of the mountains at the portals of the Scott Glacier and some foothills thereabouts. As we approached, we could not check any of the mountains with our photographs. We began to doubt then that this was the Scott Glacier. If not, then it was a great new one, in which case we probably had been off the course to the left instead of to the right.

We later found out that this glacier was approximately 60 miles east of the Scott, and it therefore constituted a major discovery.

At its mouth the glacier appeared to be about 15 miles wide (distances judged from an airplane, of course, must be approximate), but it narrowed rapidly to a width of only three or four miles about halfway up the glacier; then it broadened again as it approached the plateau until it once more had about a 15-mile width. The shape was strikingly like that of an hourglass.

New Mountains Every Few Minutes

This great glacier was one of the most interesting discoveries of the expedition. The plane approached it at an altitude of slightly more than 7,000 feet. We intended to remain about 2,000 feet above the surface. In order to do this, so steep was the slope of the great ice river, we had to rise to 11,200 feet.

Looming over the western side of the glacier all the way was lofty mountain after lofty mountain. Many of these peaks were more than 10,000 feet above sea level.

These mountains I believe to be a continuation of the Watson Escarpment, discovered on my 1933-35 expedition and named by me after my friend, the distinguished American, Thomas J. Watson. On the eastern side of the glacier the mountains were lower, not exceeding 4,000 to 5,000 feet.

Often we found ourselves flying alongside the western range, so that we saw the mountain walls directly in front of our eyes when we looked out the window. These often were close aboard.

The surface of this new glacier was like a silver washboard, but there were none of the great rises and drops noted along most of the other ice rivers.

Most striking of all was the fact that there appeared to be no very badly crevassed areas, either at the source or at the mouth. No tributary streams were noted. This may prove of considerable significance when some future expedition seeks a road for the tractor march to the South Pole.

Once through the glacier we found it advisable, because of clouds to the right and ahead, to turn eastward instead of flying south over the plateau.

At that point we made an interesting discovery. We could see high mountains ahead as far as the eye could reach. There were clouds here and there, but our range of visibility was considerable. Some of the mountains were very high.

This indicated that the great range of mountains we had to cross to get to the Pole continued on indefinitely to the eastward and did not dwindle down until they disappeared under the snow, as had been thought by many.

I suspected that some mountains I dimly saw to the southeastward might be a great new range.

This is the sort of situation out of which I get the greatest kick: flying over completely unknown areas with magnificent topographical features coming into view every few minutes of the flight.

Oil-pressure Drop Threatens Forced Landing

As we continued to the eastward, I saw mountains of all shapes and sizes on the port hand and ahead, many of them a long distance away. The temperature had dropped to about 35° below zero.

Since this was the kind of experience that more than anything else draws me again and again to the Antarctic, I was greatly disappointed when Major Weir told me that the oil pressure in the starboard engine was dropping rapidly. But my feeling was not only one of disappointment. A forced landing in that area would have been a bit unpleasant.

There was only one thing to do—get back down the glacier as soon as possible, hoping that the engine would hold out until we could reach lower and much warmer temperatures, and that when we did get there we would find that it had been the cold that had caused the pressure to drop and not some other trouble that would force us to crash-land.

Marines are notable for their courage, and these flyers with me had distinguished themselves in the war. But this situation was something entirely new to them. Since it was the R4D unit's first flight into the unknown, it was a sort of baptism.

These gallant officers, who felt at home fighting the Japs, in effect found themselves suddenly precipitated into a scene of infinite grandeur that can be observed only in an area in the clutches of a full-grown ice age.

Flyers Awed by Mountains' Immensity

For some reason I have never been able to understand, when gazing upon the great mountains that rim the Polar Plateau one gets the impression of such immensity that one feels like a tiny and infinitely insignificant speck in the vastness.

Perhaps it's the amazing visibility one gets down there where there is no dust. Possibly it's the grandeur of the terrain or some quality that is peculiar to an ice age.

At any rate, feeling like an infinitely insignificant speck in eternity does not add to any feeling of cockiness one may have.

A forced landing in an ordinary mountainous area was one thing, but this was another proposition altogether. I admit that, veteran though I was, I probably felt just as uncomfortable as they did. But I could not help but feel a friendly amusement at the awestruck faces of my companions.

I could almost hear their thoughts as they were undoubtedly asking themselves, "How in heaven's name did I ever get into this place?" And while the photographer was taking a photograph I heard him mutter to himself something that sounded like "Jeepers!"

Needless to say, we didn't lose any time getting down that glacier. Luckily, the engine held out, and as we descended into the less cold strata of air the oil pressure began to pick up again.

When we got down to the foot of the glacier, the co-pilot, without any orders, automatically started in the general direction of Little America. He didn't know exactly where it was, but he certainly had a wonderful homing instinct.

When we asked him where he was going, he said, "Back to Little America, of course. This area and this engine don't fit together, and I'm sorry the war is over."

However, in a little while the engine appeared to be O. K.; so we headed eastward, and again we were exploring virgin areas every mile of the way.

Beneath us was either the shelf ice or ice-covered lowlands. As we continued eastward, great block-shaped mountains that were quite isolated came into view. Some of them were very high, but were covered with clouds, and we could not estimate their altitude.

An Important Geographic Problem

The great mountain range continued on in a direction south of east, and after flying about 70 miles I had the impression that this range might continue for hundreds of miles.

If the area under us was shelf ice, it would not be impossible for it to continue until it connected with the Weddell Sea, which would mean there are two continents at the bottom of the world instead of one.

To determine whether or not this sea connection exists is one of the most important exploration problems left in the world to be solved. I made the solution of this problem, and not the flight beyond the Pole, the first objective of the expedition.

During our too-short stay at Little America we sent flight after flight out in that direction, and, though many major discoveries were made, we still have not got the answer.

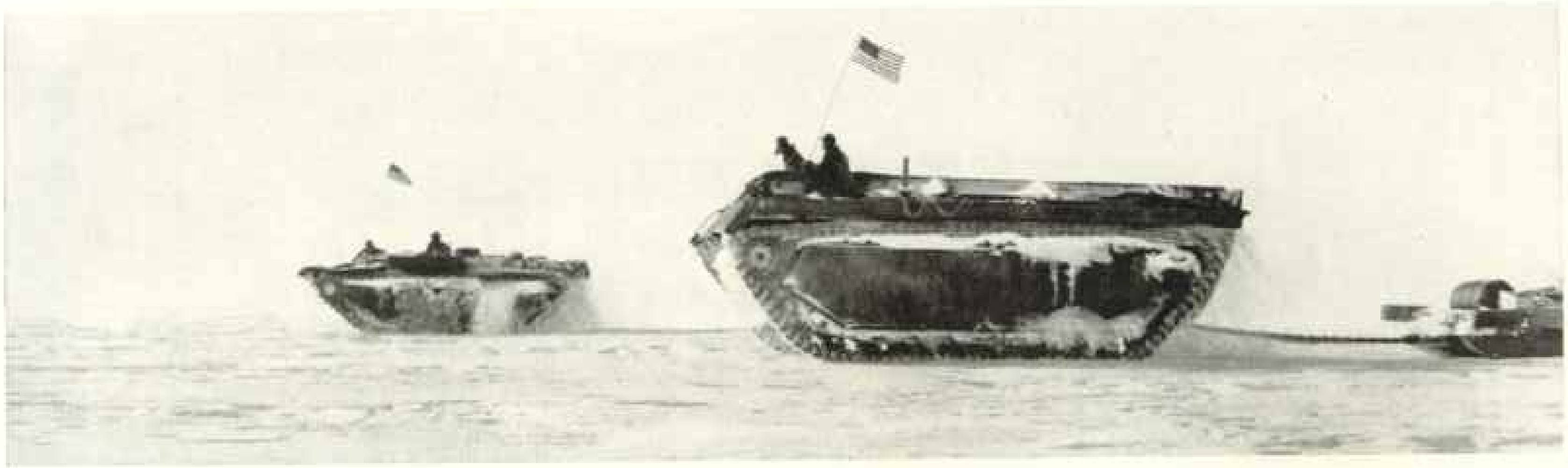
On my other expeditions we attempted again and again to solve this problem, only to be baffled by the thick weather that exists in that area. The great question is, Was there shelf ice under us, as it appeared to be, and did it extend on to the Weddell Sea? Or was low land under the snow?

Clinging Tightly, a Photographer Is Hauled Up from a 60-foot Crevasse

Depths of these natural mantraps vary, but some appear to be bottomless. First Lt. H. H. Anglin, Marine Corps photographer, descended with the aid of the knotted rope to take pictures deep in this typical crevasse. In such lairs live Weddell seals during the bitter cold Antarctic night. Their peculiar calls have been heard from far beneath the surface (pages 501 and 512).

JATO Bottles Boost a Plane into the Air from the Ice Strip at Little America

JATO (jet-assisted take-off) bottles were essential to get the heavily loaded R4D planes airborne. These powerful rocket-propulsion containers are attached on either side of the fuselage, just aft of the wing, and fired by the pilot with a button control. Soon after take-off the empty bottles are discarded.



Mechanized Attack on Antarctica: 16-ton Amphibious Tractors Carried the Flag Inland to the Rockefeller Mountains

Under command of Capt. Vernon D. Boyd, of the U. S. Marine Corps, veteran Antarctic explorer, the party established an emergency food and fuel cache at the foot of Mount Helen Washington (pages 481 and 513).

With Pierced Steel Planking and Snow, a Crevasse Is Bridged so the Plane Can Cross

Before the scouting plane from *Mount Olympus* could be towed over the bay ice to the airstrip, two wide crevasses opened in the ice. The gaps were quickly bridged.

We will keep at this problem until we get an answer. Perhaps the American expedition now in the Palmer Peninsula area, south of South America, may get an answer before it returns to the United States next winter.

Two missions went to within about 230 miles of the Pole. On one of these, commanded by Lieutenant Anderson, was discovered a very high mountain range which branches southeastward from the eastern end of the Queen Mauds. It appears to be a continuous series of ice-covered peaks extending for at least 200 miles. These may have been the mountains we saw clearly on the flight just described.

This flight passed through a saddle-shaped area between the Queen Mauds and the Horlick Mountains, which extend to the eastward. Below the airplane were round-topped hills with an average elevation between 9,000 and 10,000 feet above sea level.

Once through this depression, Lieutenant Anderson was forced to go higher and higher, and he never got out of the high mountain area before turning around for the return flight to Little America at a farthest south of latitude 86.40.

The plane flew at an altitude of about 13,500 feet above soft, feathery clouds. Through these protruded the crystal mountaintops. Several appeared to be about 15,000 feet high, towering far over the aircraft. There were many with elevations of at least 12,000 feet.

The largest of the peaks rose above the clouds with somewhat the appearance of a vanilla ice-cream cone. The sheer, red sides of the mountains seen below the clouds were ice-free.

"Seeing Pink" Is a Danger Sign

All the way from Little America the plane was pushed by a strong tail wind. Anderson turned back when crew members complained of "seeing pink," a warning symptom of the dreaded anoxia from the long-continued altitude of nearly three miles without oxygen equipment.

Over the mountains it had been necessary to keep well above the clouds, and it was never possible to get out of the mountains and over the level plateau country.

This flight indicated that there may be a break between the Queen Mauds and the Horlicks. They may even belong to entirely different mountain systems in spite of the connecting chain of low crests in the "saddle." It also suggests the hypothesis that the main chain of the Queen Maud ranges themselves turns rather abruptly across the continent. It will be interesting to determine whether or not they extend as far as the Weddell Sea on the South Atlantic side.

Our flight crews were the first human beings ever to look on the greater part of this chaotic region. They discovered several new mountain ranges.

The precise locations of these and their relationships to each other remain for geographers to determine after a study of the hundreds of photographs. Perhaps data from future expeditions will be necessary before there is a satisfactorily clear picture.

A mission piloted by Captain McIntyre, of the Marine Corps, came over the continent about 50 miles east of the "saddle" through which Lieutenant Anderson's plane had passed. It flew inland for 500 miles without seeing a single peak protruding from the low clouds over the névé surface.

At the end of this route black crests began to appear to the south and west, all so obscured by the clouds that the photographs obtained are very difficult to interpret. This mission turned westward and came back over the Horlicks.

Through a Canyon above the Clouds

Low cloud cover also hampered a mission piloted by Lt. Conrad S. Shinn which crossed the continental shore line still farther to the east. This flight, however, encountered mountains almost from the start, and it was at least an hour, flying at an altitude of 14,500 feet without oxygen on one of the coldest days in February, before the plane was over the level surface of the plateau with no mountains ahead.

When the clouds cleared temporarily, the crew saw below them one very large range. The colors of the barren peaks ranged from dark brown to dark red. Shinn describes them as having an "ashy look," and feels that they are of volcanic origin.

This flight encountered several striking natural features. For about 20 miles the plane flew through a "canyon above the clouds," with sheer, towering rock walls about eight miles apart on both sides. Just south of this it passed over a great strange valley whose floor was paved with black, rounded, ice-free hillocks from 15 to 30 feet high.

On a two-plane flight just south of the coastline of the Ross Shelf Ice, almost straight east from Little America, one plane passed over most of the country designated on maps as occupied by the Executive Committee Range.

The trend of this range, hitherto sighted only from a distance, was more south-southeast than had been assumed.

On this flight, with Dr. Siple in one of the planes, were photographed some of the highest mountains sighted by the expedition, including one near the southern extremity which may be as much as 20,000 feet high.

Over one of the highest was clearly visible an ascending white plume which probably was wind-blown snow but may have been vapor from an active volcano's crater.

Seaplanes Map a Phantom Coast

Meanwhile, the expedition's seaplanes were doing their share of exploring.

The Western Group, commanded by Capt. Charles A. Bond, consisted of the seaplane tender *Currituck*, the tanker *Cacapon*, and the destroyer *Henderson*. These ships rendezvoused shortly after Christmas north of the Balleny Islands in approximately 163 east longitude and well north of the Antarctic Circle.

Some 450 miles south across mostly impenetrable pack ice lay the continent and the phantom coast of Wilkes Land, the name tentatively assigned to a half-million square miles of white desolation extending from high ice ramparts against the sea toward the South Pole.

Parts of this coast were sighted almost simultaneously 107 years ago by Lt. Charles Wilkes of the American Navy and the French explorer Dumont D'Urville.* On January 16, 1840, all three of Wilkes's ships—the *Vincennes*, *Peacock*, and *Porpoise*—reported seeing in the distance snow-covered conical peaks connected by partially bare ridges, with lower portions of the peaks covered by fleecy clouds, in approximately longitude 157 east.

These observations, historians and geographers now generally recognize, constituted the discovery of the Antarctic Continent.

Ever since, this has been an elusive coast. Broken segments appear across the ice pack in green and smoky-yellow mirages and vanish in blizzard-driven snow and low cloud. At only rare intervals have the curtains lifted to allow brief real glimpses of the continent or landings upon it.

It is difficult to distinguish where sea ends and land starts. Only fragments of the coast for nearly 2,000 miles westward from the Balleny Islands had been charted tentatively on maps, and, as this year's explorations were

End of a History-making Flight from the Carrier *Philippine Sea*

Admiral Byrd arrives in Antarctica after an 800-mile flight across the Ross Sea ice pack in one of the expedition's R4D landplanes, largest ever to take off from a carrier deck (pages 434 and 444). Rear Adm. Richard H. Cruzen (left), who penetrated the pack by sea, boarded the plane to greet him.

* See "Wilkes' and D'Urville's Discoveries in Wilkes Land," by John E. Pillsbury, National Geographic Magazine, February, 1910.

In a Snowy World that Frowns on Wheels, Both Men and Planes Wore Skis

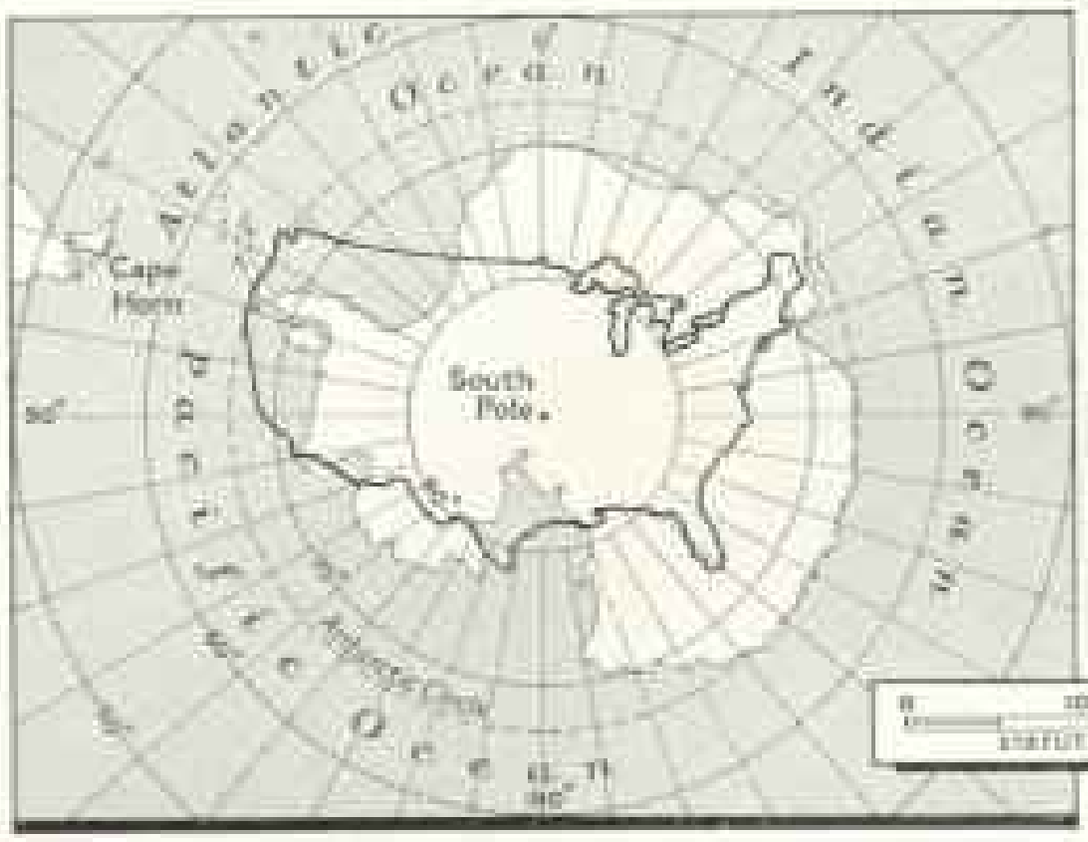
Without skis men tire fast when walking on the sandlike snow. At left is a combination sledge and toboggan which can be taken apart and compactly stowed in a plane for use with man-hauling harness in case of a forced landing. On hard snow the runners are used; on soft, the toboggan.

Human Seals Cavort in Icy Waters to Test Cold-resistant Swimming Suits

One of the expedition's experiments was a 20-minute swim by members of the underwater demolition team (page 404). The men holding the ropes were under orders to pull a swimmer in immediately if his head went under water even for an instant. Woolen underwear, socks, and headpiece help keep the wearer warm.

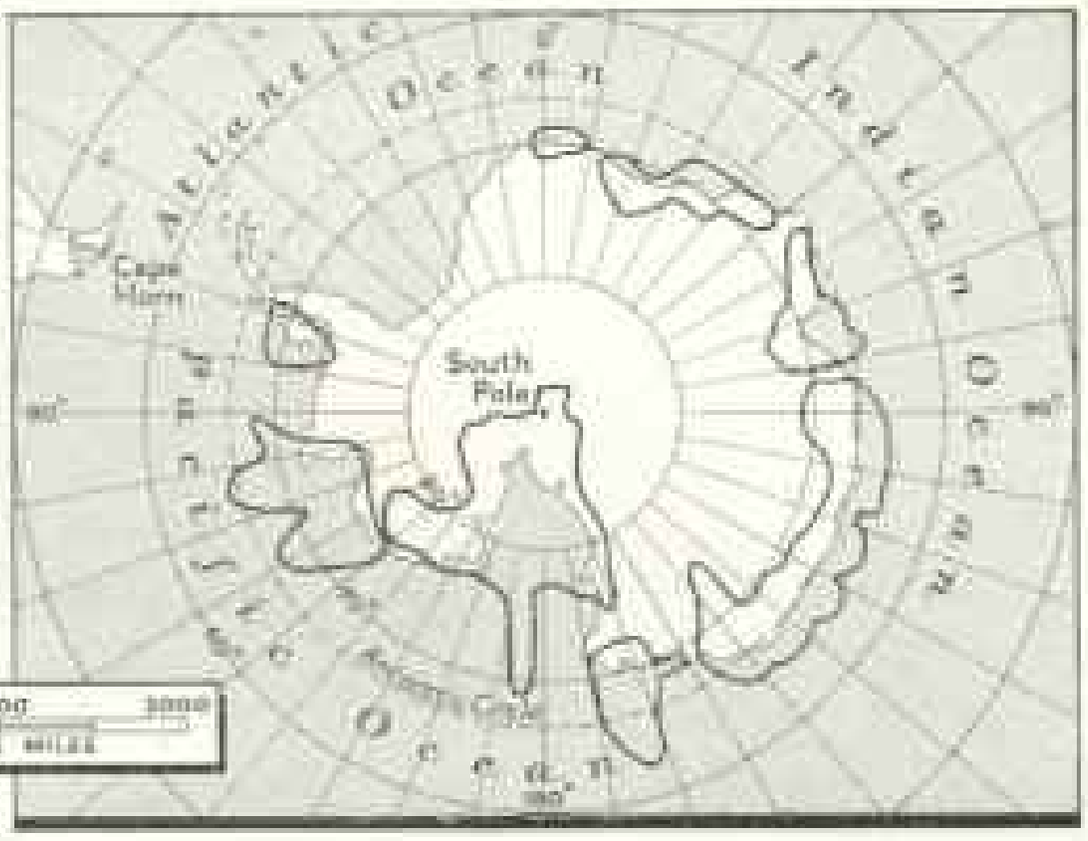
Hot Summer Day's Dream! Smiling, He Swims in Icy Antarctica

Lt. (jg) Halvor Iverson tests a rubberized fabric suit in ice-filled waters of the Bay of Whales. This suit had been devised especially for the projected invasion of Japan in the fall of 1945. To Antarctic swimmers the greatest danger was a possible attack by a killer whale or a sea leopard. The men suffered no ill effects (p. 493).



Antarctica Compared to the United States

Maps drawn on the same equal-area scale emphasize the extent of the southern continent. Here the South Pole about coincides with Tulsa, Oklahoma.



Areas Mapped by the Expedition's Planes

Mapping cameras covered most of the coastline and made deep dents in the largest unexplored area on earth, even penetrating beyond the Pole.

to demonstrate, these maps had little relation to reality. They had been patched from scattered observations, mostly from north of the ice pack, over the course of a century. Before Captain Bond and his pilots stretched a bleak, white unmapped immensity of blizzard-filled unknown.

Essentially the only systematic explorations here had been those of the Australian, Sir Douglas Mawson. But he did such magnificent work, not only in the field of geography but in other branches of science, that he easily qualifies as one of the greatest polar explorers of all time. His scientific data are probably superior to any that have come out of the Antarctic.

Winds Raise "Flying Rivers" of Snow

Commonwealth Bay, where Mawson once established a camp, is probably the windiest region on earth. It is the coast of "flying rivers," a phenomenon peculiar to Antarctica.

The air above the South Pole settles over the ice-capped high plateau and becomes cooled. This cold air flows down over the mountain passes and through the valleys, attaining hurricane velocities.

These winds raise huge whirlpools of snow to altitudes as high as 1,000 feet. These are blown northward at from 50 to 90 miles an hour. The result is a tumultuous "snow torrent in the sky" which finally descends over the pack ice and the ocean.

In this region, with their Martin Mariner flying boats (PBMs), the crews started transforming a panorama of mirages into a reality of solid ice and rock.

The first exploratory flights were along the Oates Coast, originally discovered by Lt. Harry L. L. Pennell, of the British Navy, who was a member of Scott's 1911 expedition. It bears the name of Capt. Lawrence E. G. ("Titus") Oates, one of those who perished with the commander on the return march from the Pole.

Because of the thick ice pack, Pennell was unable to approach the coast closer than 15 miles. Mist and clouds obscured the landscape ahead. This apparently is the usual condition. Only a thin fringe of coast is marked on maps.

The air photographs showed—as they were to show so frequently in the future—that the actual coastline had very little resemblance to that assumed by map makers.

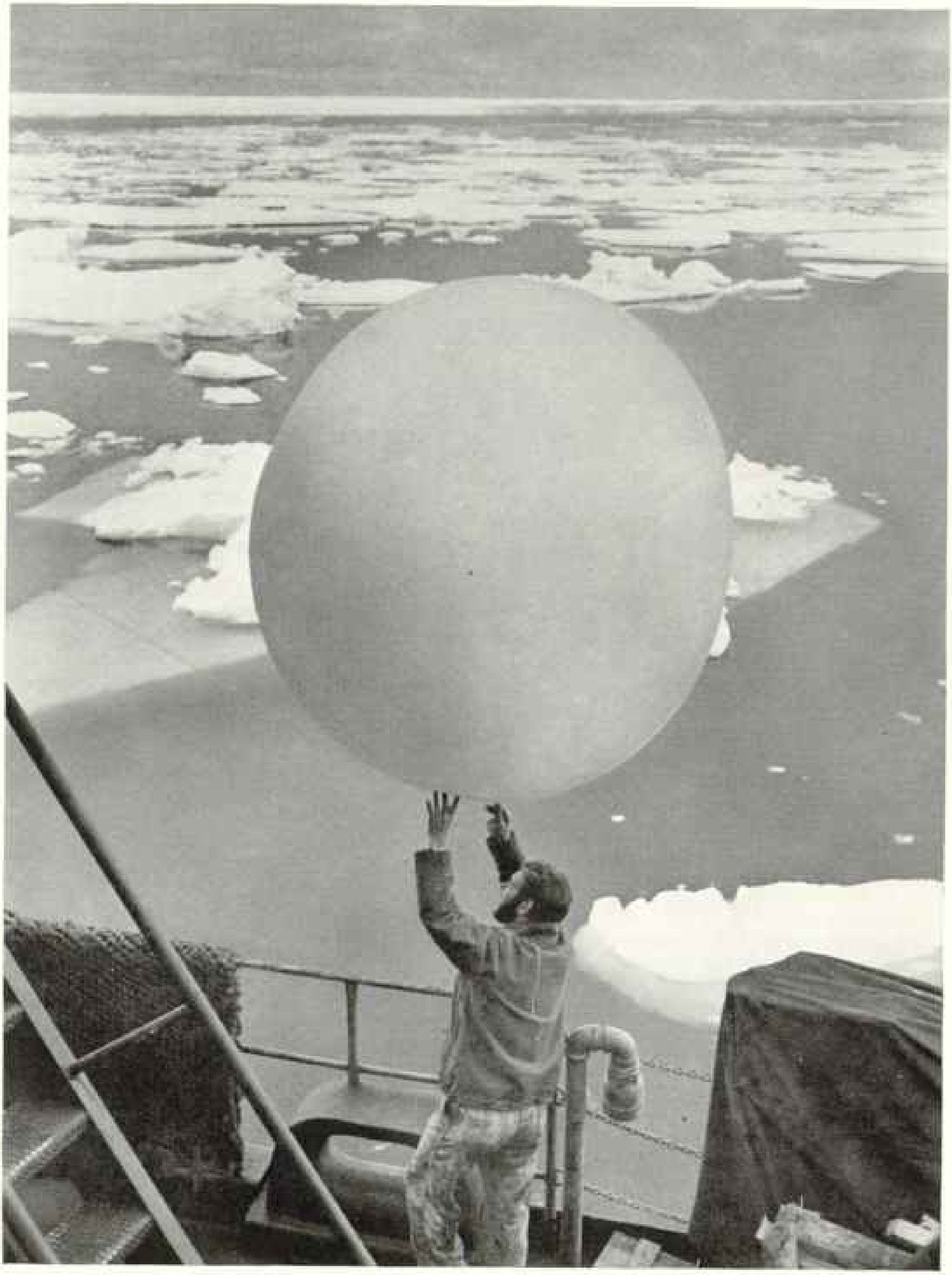
Rennick Bay became a deep triangle of ice-covered water extending about 100 miles into the land, with its western side constituting the hypotenuse. Both sides are bordered by mountains reaching altitudes of 8,000 feet above sea level.

The net result was that the feeble, wavering Oates Coast became almost in its entirety a mountain-enclosed bay. The whole region was fog-covered, and photographs do not show much detail.

Just outside and slightly to the west of Rennick Bay a new archipelago of small, rocky, ice-covered islands was discovered.

Then, between longitudes 150 and 145 east, comes a gap in the coast. Mapping of it was prevented by bad weather. At approximately longitude 145 an area of loose pack ice was found which easily could be negotiated by an icebreaker.

Here an overland flight passed within a few miles of the South Magnetic Pole. No mountains were observed. The continental icecap rises gradually to an altitude of 8,500 to 9,500 feet above sea level.



To Determine Wind Direction Aloft, Weather Men Released Balloons

During progress through the ice pack balloons were sent up daily. Their flight could be followed for miles in the exceptionally clear, dust-free Antarctic atmosphere. When clouds did prevent observation, meteorologists used balloons bearing radar tracking targets, like the one mistaken for a "flying saucer" last summer (page 511).

Pilots and observers described the landscape as featureless, except for a few sharp rises in the ice. Along the 141st meridian, however, they looked down on what appears to be one of the largest glaciers on earth. From the air it seems a terribly crevassed ice river extending far into the Polar Plateau.

Nearly 1,500 Miles of Coastline Mapped

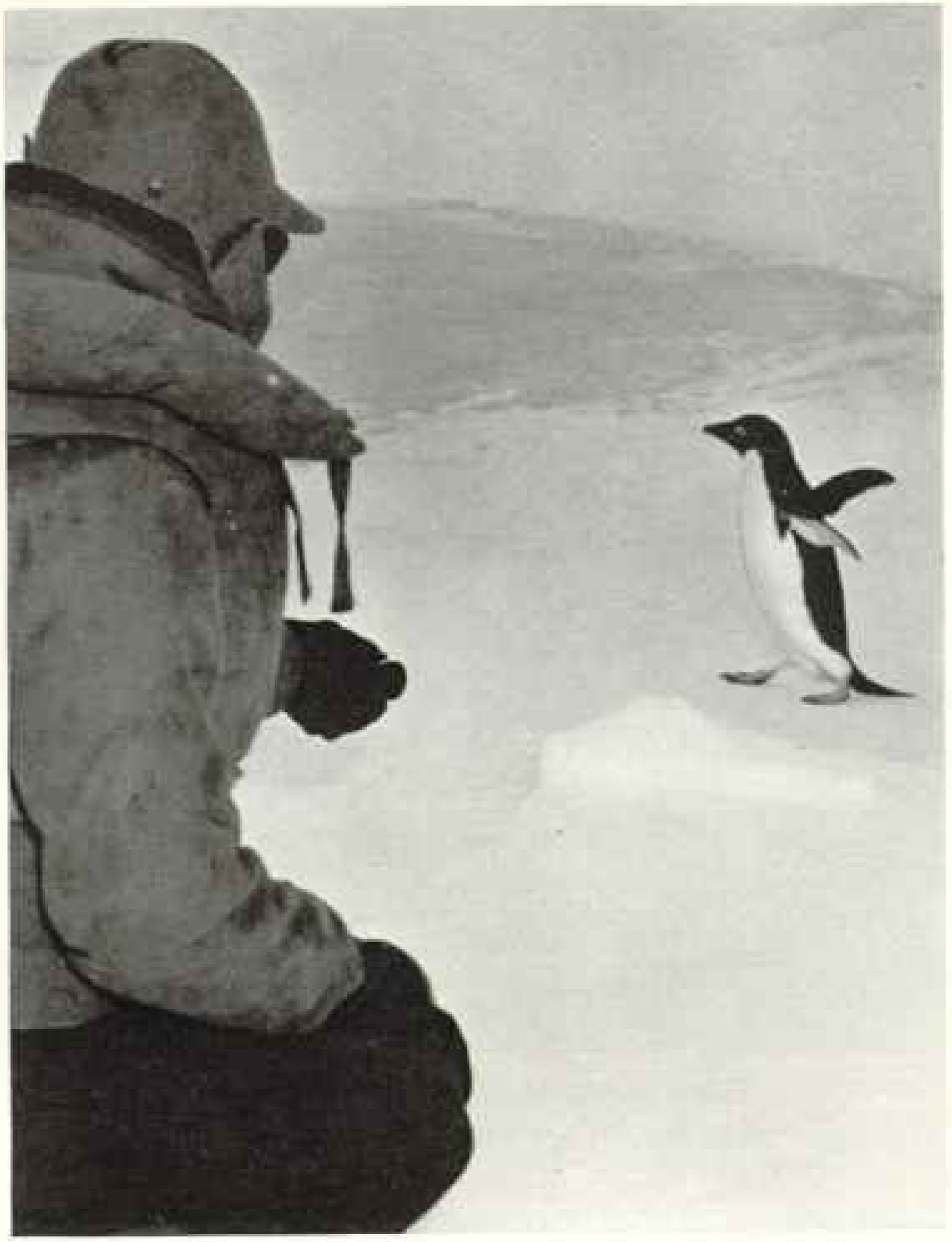
Between the 143d and 138th meridians also was found loose pack ice—presumably due to prevalent winds and ocean currents—through which an icebreaker could be navigated and where a boat landing on the continental shore might be possible.

Thence for about 300 miles the shore remained absolutely flat and almost indistinguishable. There were no mountains or glaciers. Between ice pack and shore is a stretch of open water about 15 miles wide. This presumably is due, as is the case elsewhere, to the constant high winds from the plateau which prevent the pack from forming against the coast.

At approximately longitude 115 the ice-capped plateau rises sharply to great heights. Here also there is an approach for ships through loose pack ice, and what appeared to be a good camp site was seen from the air.

Up to this point Captain Bond's crews seemed somewhat disappointed in their discoveries. The territory had been for the most part a monotonous, featureless desert of névé. There were few lofty mountains, no hidden seas. But for solid accomplishment in extending the boundaries of the known world their record had been very outstanding.

For the first time nearly 1,500 miles of coastline could be placed on maps with reasonable accuracy.



With Candy He Tries to Beguile a Native Flapper

A member of the expedition seeks to coax an Adélie penguin closer, but that big round eye is eloquent of distrust.

Of significance was the finding that in these longitudes the great South Polar Plateau, one of the major features of the globe, reached as far as the Antarctic coast without evidence of an enclosing rim of mountains.

Vivid Oasis in Land of Death

The Western Group, however, was destined for more exciting discoveries.

The broad picture of the Antarctic Continent is that of a lofty desert of ice out of which rise here and there high black or light-colored mountain peaks.

But, in nearly 6,000,000 square miles of lifeless white silence, are there possibilities of finding sheltered areas where remnants of the life of millenniums ago have survived and continued their evolution in a unique environ-

This Fiendish-looking Fellow Is a Harmless Navy Photographer

T. H. Malone operates a movie camera in full foul-weather clothing, including the effective face mask which makes him look like something out of a horror movie. The bulging eyes are snow glasses.

ment? This question excites the imagination. But, scientifically speaking, the answer is no.

Ice-free areas are known to exist in the much less inhospitable Arctic. On the Antarctic Continent such areas are probably less hospitable, with higher forms of life, especially vertebrates, nonexistent.

It remained for a Western Group PBM to discover and conduct a preliminary exploration of the most remarkable of these ice-free areas on the Queen Mary Coast, which fronts on the Shackleton Shelf Ice (map, pp. 436-7).

Early in February the crew of the flying boat commanded by Lt. Comdr. David E. Bunger, of Coronado, California, found themselves above a landscape which made them question their own eyes—a land of blue and green lakes and brown hills in an otherwise limitless expanse of ice.

This so-called "oasis" was by far the most important—so far as public interest was concerned—single geographical discovery of the expedition (Plate VIII and page 475).

A few days later the same plane landed on one of the large lakes for a superficial survey of one of the most remarkable regions on earth. An island suitable for life had been found in a universe of death (page 516).

The plane seemed to have dropped out of the 20th century into a landscape of thousands of years ago when land was just starting to emerge from one of the great ice ages.

The area of this ice-free region is somewhat more than 300 square miles. It contains three open-water lakes—each large enough to provide a smooth three-mile take-off for a flying boat—and about 20 smaller bodies of water.

These lakes are separated by jumbled masses of barren, reddish-brown rock. All is walled by ice with glittering white and amethyst ramparts rising as much as 400 feet.

From lake to lake, colors of the waters range from sky-blue to green. Occasional reddish streaks were seen. These color variations are due chiefly to the dominant life forms in each

lake. The waters contain countless billions of blue-green, green, red, and brown algae, single-celled plants which are among the most primitive living things on earth today.

No Life but Algae and Birds Seen

Both the green and the blue-green algae are the organisms which form the green scum on stagnant water everywhere. The brown and red, commonly known as rockweed, represent a long step upward in evolution.

These algae were the only life found in a hasty survey, but it is not certain that higher forms might not be revealed by a more extensive search. The observers saw no plant life on the rocks. A few birds of undetermined species were noted. Eventually these are likely to bring from the outside world seeds of higher plant life.

The lake region was described as approximately square. The ice banks rise very abruptly about 100 feet on the east and south. North and west there is a more gradual rise. One of the lakes has a gently sloping beach several hundred yards long, described as well suited for a camp site.

The water temperature was "comfortable." All the plane crew dragged their arms in the lake and testified it was much warmer than the approximately 30° temperature of Antarctic ocean water. Analysis shows that it contains about two-thirds as much salt as ordinary sea water. Floating about were a few small ice cakes broken from a large near-by glacier.

The rock hills were of various brown shades. It was first reported that they contained iron ore. But this is only the opinion of the flight crew, without means of verifying their speculations. A reddish color means the presence of iron oxide, but not necessarily concentrated as ore.

The area starts approximately five miles inland from what is assumed to be the coast. North of this coast is a band of open water about 20 miles wide, beyond which pack ice extends northward nearly 100 miles.

The northern edge of this pack appears to be the closest approach for ships, since the ice is thick and with no discernible open-water leads. The region would seem, however, to be easily accessible by air, with any one of the three large lakes affording a safe landing site.

The simplest explanation of the oasis is that this is an area left bare by a retreating glacier which once reached as far as the Shackleton Shelf Ice.

The reddish-brown rocks, once free of ice, would absorb considerable amounts of solar radiation during the perpetual daylight of the Antarctic summer. This heat then would be reradiated, thus constituting for the oasis Nature's own version of the new "radiant-heated" home.

The newly discovered lake region apparently differs from any of the other ice-free Antarctic areas in that it is surrounded by ice on all sides.

Whatever the origin of the oasis, it is disappointing that one of the most interesting areas, both scientifically and scenically, in Antarctica must be left for the present hardly more than a dot on the map.

Two weeks later another flying boat of this same group, flying along the almost uncharted coast of Queen Maud Land, came unexpectedly on one of the scenic wonders of the world. This was a range of ice-crystal mountains, luminously blue to the observers, more than two miles high and towering for many miles over an ice shelf (map, pages 436-7).

While over these ice mountains, the plane was gale-tossed in the fury of early winter.

Like a Landscape on Another Planet

This had been intended as a last flight from the *Curtiss*. Lts. W. R. Kreitzer and F. L. Reinbolt started on what was expected to be a routine photographic mission to map about 300 miles of coastline.

They soon found themselves flying over a hitherto unobserved ice shelf, one of the most extensive in Antarctica. The blue walls of this shelf towered above the sea along what previously has been charted as coast. Thus, as a result of this flight, the old coast disappears from the map.

Then the plane turned southward to the equally unanticipated mountains, which reached altitudes estimated at more than 12,000 feet. They were followed for nearly 100 miles and no break was found.

This chain is apparently a major link in a still vaster range which may prove one of the greatest in the world. Beyond these mountains lies the high plateau supposedly reaching to the South Pole.

The mountain range was interpreted as the actual coastline, constituting a seldom paralleled meeting of mountain and sea. There can be only a very narrow land shelf at the most in front of the gigantic, ice-covered precipices.

"It was like a landscape on another planet," said one of the pilots.

The last accomplishment of the group before early winter gales made further operations impossible was investigation of a previously known ice-free area covering more than 100 square miles.

Aretic or Antaretic, It's All the Same to a Husky

Snug in a hole in the snow, this sled dog slept through a mild blizzard. Only one of the dogs had had previous experience with Antarctic weather (page 482), but their ancestry stood them in good stead and apparently they suffered no discomforts from drifting snow and high winds. If dogs are brought inside, melting snow wets their skins and they become ill. All those taken on the expedition were brought back safely to civilization.

It consisted of a string of green lakes separated by brown and reddish hills of jumbled rocks. One of the lakes was estimated to be more than four miles long. The lakes were mostly blue-green, but a few were red-streaked and one was black. Some were dark green in the center but shaded to blue at the edges.

Evidence here suggests that this is an area cleared of ice by a retreating glacier and with some subterranean heat source. Straight black strips as wide as a two-lane highway were seen on the ice-free rocks. These were interpreted by the plane crew as the remains of old lava flows. They may, however, be strips of glacial deposits.

Near this oasis at the foot of the Vestfold Hills on the Ingrid Christensen Coast the explorers found a huge bay extending about 50 miles beyond what hitherto has been assumed to be the coastline. It apparently is one of the finest natural harbors in Antarctica.

During the two months of active operations, 33 flights took off from the Western Group. Of these, 25 were solely for the purpose of mapping. Eight were incidental to determine the condition of the pack ice and make weather observations. Captain Bond had accomplished one of the finest pieces of exploration in all history.

The Eastern Group consisted of the seaplane tender *Pine Island* with three planes and flight crews, the destroyer *Brownson*, and the tanker *Canisteo*. It was commanded by Capt. George J. Dufek, of Chevy Chase, Maryland.

This group rendezvoused around Peter I Island at 68.50 south latitude and 90.35 west longitude, under the shadow of 3,937-foot, ice-armored Lars Christensen Peak, a few days before New Year's.

Eastern Group Explores Forbidding Area

Captain Dufek's immediate task was to map the coastline east of the 120th meridian and to explore the continent beyond this coastline. This area extended for hundreds of miles and generally lay between Little America and the tip of South America.

For more than a century up to 1940, explorers had been attempting to get into this area, but had been turned back by impossible weather plus an impassable ice pack that guarded its secrets. No one had any idea where the Pacific Ocean ended and the continental land began.

Up Comes a Whiskered Weddell Seal for Air and a Look Around

In autumn, when such holes freeze over, the creatures cut through the ice with their teeth (page 512). Southernmost mammals in the world, they live all winter literally buried in the ice, presumably on ledges of crevasses. On the snow they travel with a swimming motion at a surprising pace.

In 1929 and also in 1934 we had tried again and again to penetrate this section with flights from Little America, but each time were blocked by storms or bad visibility. Here indeed was a challenge.

Finally, in 1940, I determined to try a new technique, which was to carry a small seaplane aboard my ship, the *Bear*, to proceed along the northern edge of the impenetrable ice pack, and to wait there patiently for the weather to break.

It turned out that the rule of patience, always a good one for conquering the Antarctic or steering clear of its vicious, snapping jaws, was the best one for this job.

Our patience at last was rewarded. We made three important flights by taking quick advantage of one good break in the weather, and found at last the elusive coastline that explorers had sought for so long.

I have brought this incident of a previous expedition into this story to provide a proper setting for an incredible human experience that fell to members of this expedition. Commanding officer of the *Bear* at that time was Lt. Comdr. (now Rear Admiral) Richard H. Cruzen, and the navigator of the *Bear* was Lt. (now Capt.) George Dufek. Thus Dufek was a veteran and also he was an old friend.

It was on two of these flights that I discovered the great Kohler Range, the Walgreen Coast, and the Fletcher Islands. There were indications of a peninsula, but it remained for Dufek, after a spectacular take-off, to fly over this peninsula and discover the Demas and Noville Mountains.

Dufek and I had found the ice pack very heavy, solid, and tough—impenetrable, in fact; and between it and the Walgreen Coast was a great body of open water, the Amundsen Sea (sometimes referred to as Roosevelt Sea).

Light Phenomenon Causes Tragedy

Somewhere on the land between Dufek's 1940 flight track and my flight track of a few hours later, which was east of his, there was a spot on the bleak and lonely snow where nine young Navy men, seven years later, would come for an instant face to face with eternity by a trick of fate so incredible that it seems it could not have happened.

And yet a sad proof that it *did* happen are three shallow graves in the snow where three young Americans lie.

With my binoculars I must have had a good view of that general area when we passed that fateful spot. Would that I could

Down the Ship's Gangway a Human Chain Passes Box after Box of Film

Supplies unloaded by a photographic working party are stowed in the "weasel" amphibious tractor alongside the *Mount Olympus*. With "Photo only" signs, the photographers staked their claim to exclusive use of the weasel, on which is mounted a motion picture camera tripod.

have had prescience to see what was implicit in the somber mystery of that desolate terrain!

Because these three flights in 1940 did not solve the mystery of this vast area, Dufek was back there seven years later with this expedition and orders to explore it. We had had only glimpses of the coastline, and we knew that we would have to come back again to get its trend accurately and to fill in the cartographic details.

Dufek now, as before, had to wait for the weather. Finally, on December 30, 1946, one of the big PBMs with nine men aboard lifted from the water and headed for the coast. Lt. (jg) Ralph Paul LeBlanc was senior pilot and Lt. (jg) William H. Kearns co-pilot. Capt. Henry Howard Caldwell, commanding officer of the *Pine Island*, an experienced pilot, rode with LeBlanc as observer.

I think I know what went through the minds of these experienced airmen as they passed over the rugged ice pack under a 400-foot ceiling. Soon the continent loomed up. The ceiling was now 1,000 feet, but the weather was still not good and they had dim views of ice and snow and the dark rock of mountains. But on they went to accomplish their mission.

After a while they reached an area where the clouds covered more of the sky, and they found themselves in a region of weird visibility. In all their years of flying they had come across nothing even remotely like it. They turned east and found themselves flying in what was like a great bowl of milk where there was no horizon. They did not know whether it was fog or mist or snow. There was no yardstick with which to judge distance.

They didn't like it. No flyer would like it. So they decided to return to the ship, and Kearns, who had relieved LeBlanc at the wheel, turned left just as the bottom of the ship scraped something that felt like hard sand. With split-second thinking he pushed

the throttles forward. The instant they reached full power there was a terrific explosion and oblivion for all hands.

The plane broke into four pieces, and the wreckage and the unconscious men skidded along the gently sloping snow surface, probably for many feet. It was hours later when survivors came out of their daze sufficiently to understand clearly what was going on.

But three of the crew never regained consciousness. They are lying near the wing tip of the plane with flags of the United States at their heads. They were the first human beings in the history of the world ever to reach that lonely coast and they will be the last ever to leave it. They are men of the Navy, and their names are Ensign Maxwell Albert Lopez, Frederick Warren Williams, aviation machinist's mate, first-class, and Wendell K. Hendersin, aviation radioman, first-class.*

Six Survivors Rescued

The heroism of Kearns and James H. Robbins, aviation radioman, second-class, who rescued LeBlanc, and LeBlanc's subsequent heroism as he lay grievously wounded, with his feet frozen, are already matters of record.

The courageous struggle of the six men for survival, with their final rescue through the efficiency of Dufek, has been told in detail. Of special note was Captain Caldwell's unselfishness, great stamina, and superb leadership. I shall not, therefore, write of those things here, except to add that Dufek's rescue of his men is in many ways unequaled in all the history of polar rescues.

But I should like to make one remark before passing on to other matters. These young men who crashed were not polar explorers. They had never seen the Antarctic Continent, and one can get little actual conception of it from hearsay.

One is generally introduced to Antarctica by degrees, and even then it is awe-inspiring. But these young men, after their plane exploded, came out of their daze—woke up, as it were—lying on the continent and in one of its most inhospitable spots. It was like dying and coming to life in another world.

This was the first time any lives had been lost on any expedition I have led within the Arctic or Antarctic Circles. Naturally, such a disaster disturbed me, although I was still in the United States preparing to head south on the aircraft carrier *Philippine Sea*.

I felt, nevertheless, that responsibility for the tragedy was mine. I had briefed and alerted the expedition on that strange phenomenon of multiple light reflection visibility, which I discuss later in this article (page 510), but that it did not get down through the chain of command to the pilot of that plane was my fault.

After the rescue, Dufek headed eastward to investigate the area south of the Bellingshausen Sea.

Weather conditions were exceptionally bad throughout January. Day after day missions were canceled. Late in the month Admiral Cruzen at my request ordered the entire group to move westward into the Amundsen Sea.

A considerable part of its coastline was unexplored. There was reason to believe that weather conditions would be more favorable in this area, and this proved to be true almost from the first.

Amundsen Sea lies roughly between meridians 100 and 125 west (map, pages 436-7).

Upon return of our previous expedition in 1941, I had requested that the coastline of the Amundsen Sea be placed on maps as a dotted line. Though we had discovered the continental land, we could not get a good idea of the coastline. That was why I was so anxious to have this area thoroughly explored.

Captain Dufek fulfilled our highest expectations. He confirmed, beyond all question, the existence of the Kohler Range, which turned out to be a larger and more extensive range than I had supposed.

It extends southward, towering over the western shore of an extension of the Amundsen Sea. One peak rises more than 15,000 feet above sea level, an altitude higher than any point in the United States.

Large Bay Discovered

One of the outstanding discoveries of the expedition was a bay that may be 20,000 square miles in area. It reaches more than 200 miles into the interior of the continent. This great indentation is doubtless one of the most important bodies of ice-covered water in Antarctic regions.

It extends about 150 miles from east to west, making its shape roughly that of an oblong. It ends in a high ice wall marking the Amundsen Sea's southern coast and lies within a double arc of high mountain ranges.

There were two other mountain ranges, hitherto unmapped, along the eastern shore. Five peaks were counted with altitudes of at least 6,000 feet and 35 which rose 2,500 to 5,000 feet. (All these altitudes, it must be understood, are taken from sea level, not from the high surface of the icecap.)

* The surviving members of the crew not mentioned in the text are William George Henry Warr, aviation machinist's mate, second-class, and Owen McCarty, chief photographer's mate.

Men Handy with a Hammer Put "Snowshoes" on a Tractor

With wooden extension pieces on the treads, the heavy D-6 snow tractor presented a larger surface to the snow and thus made easier progress across the vast wastes of sandlike névé.

After mapping this region, Captain Dufek's command again was sent eastward across the Bellingshausen Sea as far as the western shore of the Palmer Peninsula. It again was dogged by bad weather in one of the most dangerous areas in the world.

Few planes were able to get into the air along this coast of "hell holes." Great glaciers flow downward through high mountain passes and empty into bays which cut far into the land. Heavy cold air from the Polar Plateau falls over these glaciers, causing frequent winds of 50 to 80 miles an hour. They come through the bays like exhausts through pipes.

As a result, the mouths of these bays are almost impassable, although there may be a dead calm a few miles farther north. These exhaust valves of the tremendous energies stored up over the continent are scattered all along the coast.

Planes of this group, on the short flights they were able to make, passed over the region of "ice volcanoes," strange formations on the ice shelf west of the Palmer Peninsula. These are gigantic bowls of ice with floors as much as a mile in diameter, surrounded by circular walls 100 feet high. On the floors ice blocks are piled in gigantic heaps.

It may be that some sort of gas becomes entrapped in the ice when it forms, resulting finally in an explosion and the formation of a crater.

When efforts to land by boat on pear-shaped Charcot Island, 70 S., 75 W., where man never has stepped, were thwarted by ice conditions, the group abandoned this section of the Antarctic and proceeded immediately around the Palmer Peninsula to the Weddell Sea on the other side of the continent.

It was desired to send a few missions over

Antarctic Straphangers Ride to Work on a Tractor-drawn Train

Construction battalion men are hauled back up to the Ross Shelf Ice to work on the camp site of Little America IV after a midnight dinner aboard ship moored to the ice in the Bay of Whales. This was the customary method of transportation over the bay ice. Sometimes as many as ten sledges would be attached to one tractor.

this largely uncharted coast and into the unknown interior, and especially to solve, from the Weddell Sea side, the problem of the possible passage between the Weddell and Ross Seas (page 487). But the season already was too far advanced. Sea swells, high winds, fog, snowstorms, and formation of new ice in sheltered water prevented the launching of another successful flight.

Area Half Size of USA Covered

I know that if any man living could have made flights in this area, Dufek could have done it. He had performed superbly, fighting what was probably the worst flying weather any human has ever been up against.

During the flights of our three groups an area more than half as large as the United States was covered. Of this, at least 340,000 square miles never had been seen by man before (map, page 467).

It also was possible to explore about 75,000 square miles of ice-strewn ocean where no ship had ever sailed.*

More than 5,400 miles of coastline were discovered, relocated, or confirmed. Counting bays and indentations, the total would be considerably greater.

Ten new mountain ranges, among them some of the loftiest on earth, were discovered. New archipelagoes, peninsulas, islands, and seas were placed on the map. Some of the

* These figures are tentative, as given by the geographer on the basis of pilots' reports. Completion of the calculations made from photographs, a time-consuming task, will make necessary some revisions.

Thousands of Air Photographs Permit Study of Areas Never Before Seen by Man

Aboard *Mount Olympus*, Lt. Comdr. J. C. McCoy (right) and Lt. John H. Roscoe, expedition geographer, check trimetrogon photographs with the aid of stereoscopes. These were taken on a flight to Victoria Land and Ross Island (page 432).

world's largest glaciers were found and photographed. Great extensions were made in the known area of the enormous Antarctic plateau, approximately 8,000 to nearly 11,000 feet above sea level, and for the first time part of the vast plateau beyond the South Pole from the direction of the Ross Sea was explored.

There were unexpected discoveries, such as that of the large ice-free region of open-water lakes near the edge of the continent (Plate VIII and pages 475, 498, 516).

Out of the whole emerges a new and more accurate picture of the land, which is like a titanic upturned bowl just below the stratosphere with a badly cracked rim of mountain ranges.

The mere phrase, "literally hundreds of hitherto unknown mountains," borrowed from a routine official report, staggers the imagination when it is considered that for many years the discovery of a single new mountain has been a matter of geographic importance.

This expedition accomplished more in the way of increasing general geographic knowledge of the south polar regions than any other expedition. (This does not apply, of course, to detailed scientific research.) Together with the three previous expeditions I have led, more was accomplished in geographical discovery than by all other Antarctic expeditions combined.

Antarctica a Vast Laboratory

A major consideration in all Antarctic exploration is research in pure science. This comes second only to the essential geographical discovery, which is a requisite preliminary for other scientific departures.

Here has been set up by Nature herself a titanic physical, chemical, and biological laboratory where phenomena impossible of duplication elsewhere are in progress.

Here the story of the ice ages is repeated. Here is the extreme limit of the living world, where through thousands of generations the very small percentage of life that has survived has become adjusted to the most difficult possible conditions.

Thus the region is an unpredictably rich field for the physicist, the geologist, the biologist. It offers particular advantages to students of terrestrial magnetism, of cosmic radiation, and of the still unexplained radiation of showers of particles from the sun responsible for the indescribably weird auroral phenomena.

This expedition carried a staff of competent

scientists recruited both from the experimental laboratories of the military services and from such Government scientific bureaus as the Geological Survey, the Fish and Wildlife Service, and the Coast and Geodetic Survey.

Their activities unfortunately were limited by the brief periods during which it was possible for them to operate and by transportation difficulties. Nevertheless, their accomplishments were considerable.

For instance, our scientists made difficult and highly intricate studies of such subjects as the rapid pulsations in the earth's magnetic field, which required radio communication between Little America and what at that time was the Weather Bureau's farthest-north station at Thule, Greenland.

They measured variations in the speed of sound through various forms of ice and névé. They studied the spectrum of the eerie purple light which came through thick roofs of ice over their dugouts.

They made collections of those extraordinary microscopic living things, the pelagic plants and animals—plankton—which live and multiply in contact with ice itself and which, abounding in countless trillions in the cold seas, apparently constitute the base of the entire pyramid of Antarctic sea life.

Telescope of Time

Upon Antarctica lies, very approximately, some four quadrillion tons of ice.

This ice may be likened to rock. It has the characteristic crystalline structure of all rock.

The behavior of such a great shell of ice, covering nearly 6,000,000 square miles and possibly a mile thick in places, epitomizes in some ways the behavior of the rock shell of the entire planet over millions of years.

The Andes and Himalayas are only passing episodes of the earth's long history, but they are episodes of far greater duration than all the time of the existence of the human race. But here in one man's lifetime—on a miniature scale but resulting from almost exactly the same sequence of events—several "mountain ranges" 100 to 150 feet high may be erected out of the rock called "ice."

Antarctica thus becomes for the geologist a telescope through which he can look backward over the vast gulfs of time between the ages to study certain aspects of the folding of rock as the astronomer looks across the emptiness of space between the stars.

As many observations as were possible in the limited period allowed were made by Dr. Arthur D. Howard, of the U. S. Geological Survey. His chief service was in outlining the field for future research. Probably hundreds of future Ph. D. dissertations in geology will be based on observations of Antarctic phenomena.

Ice Mountains a Perilous Fairyland

For the mountain-building studies it was necessary to go only about three miles from the Bay of Whales to be in a fairyland reproduction of the Jura Mountains of Switzerland, which Dr. Howard had visited some years ago. Rolling ridges of luminous blue ice up to 150 feet in height form a narrow belt running southward about 20 miles to ice-covered Roosevelt Island.

The spectacle probably will last about five years more before the pressure of ice from behind pushes it into the sea.

The region where these studies were conducted is one of the most perilous in Antarctica. It can be entered with reasonable safety only by men roped together and walking single file. It is full of deep, hidden crevasses covered by light snow bridges which make necessary step-by-step progress and constant probing ahead with pikes.

In a pit dug and blasted into the Ross Shelf Ice by geologists of our last expedition, working in a constant temperature of several degrees below zero, Dr. Howard made direct observations of the evolution of ice under pressure. This pit was sunk first 23 feet below the snow surface at Little America about six years ago and left for future observers.

Since then some 18 feet of snow had accumulated over the surface, approximately three feet a year.

The result, as determined by Dr. Howard, is that the depth of the original pit has been reduced between five and six feet by the tremendous pressure of this accumulating weight. This apparently is the genesis of the steel-like glacier ice formed by compressing névé, the sandlike snow peculiar to an ice age.

Before they left, geologists of our last expedition bored auger holes in the wall of the pit. These were nearly perfect circles. Howard found them flattened into ellipses, but those near the top of the pit showed the greatest flattening.

Thus is epitomized the process which results in the birth of an ice age over thousands of years. Snow of one winter presses down on the snow of the preceding winter and compresses it into ice—a different type of ice from that which results from the quick freezing of the surface of a lake or the water in a rain barrel. This ice in turn compresses the ice underneath.

Before completing this study, Howard drove vertical rows of spikes into the walls of the

Admiral Byrd, Dr. Siple, and Lt. Richard E. Byrd, Jr., Visit Little America II

In the Admiral's 1933-35 shack, he found his old corncob pipe and some tobacco that seemed to have grown mellow with age and cold. His son (right) holds one of the Admiral's old books. Lieutenant Byrd, USNR, was attached to Captain Kosco's staff for scientific duties. This was his first Antarctic trip, though he had long been a Byrd expedition fan. "When he was eight years old," recalls his father, "he donated, with a very serious mien, to the first Antarctic expedition all of his savings of $4.83 and his only pocketknife." Food found here was unspoiled after 14 years under the snow and made a good meal (pages 442 and 484).

pit precisely one foot apart. When another expedition comes here in four or five years, the lessened distances between these spikes will show the precise amount of compression undergone by the ice under a measurable accumulation of snow. Howard also collected specimens from various heights of the pit wall for microscopic study of ice-crystal deformation under pressure.

Getting under Antarctica's Icy Skin

All this obviously is only scratching the surface of Antarctic geology. Many questions remain for the geologists of future expeditions. The fossil record of Antarctica, the handwriting of Time in hieroglyphics of death on tablets of rock, remains almost completely unknown.

Hitherto it has been possible to determine what lies underneath the ice only with artificial earthquake waves which move at different speeds through different materials.

This method, while accurate, was slow and laborious. At the best, only a few such measurements in a limited area could be conducted in any one season. It would have required centuries to obtain a picture of the land surface and some idea of the nature of its rocks.

On this expedition it was possible for the first time to obtain this information rapidly —that is, about as fast as a plane could fly— over a large area by means of the airborne magnetometer, perhaps the most revolutionary instrument ever introduced in the science of geophysics. Until a short while ago it was one of the Navy's most closely guarded military secrets.

This "secret weapon" was developed primarily by the Naval Ordnance Laboratory and used with considerable success during the war

to detect submerged submarines. It measures from the air minute variations in the intensity of the earth's magnetic field, such as would be caused by so large a mass of metal as a submarine.

As soon as the existence of the instrument became known to the U. S. Geological Survey, it was obvious that it might prove of enormous value for wide-scale geological explorations.

It had previously been determined that this magnetic intensity showed considerable variation with the major types of rock—igneous, sedimentary, and metamorphic—because of their different magnetic properties, and with the contours in which they were arranged.

It has been observed that "the magnetometer starts where radar ends." It might be described as an X-ray radar, by which one can see under Mother Earth's skin.

Land under the Icecap Probed

Surveys of more than 200,000 square miles in the United States and Alaska showed that the magnetometer fulfilled all its promise. It was of special value in locating geological structures which most frequently are associated with petroleum deposits.

For purposes of exploration, the instrument was improved so that an automatic, continuous record of magnetic intensity was correlated constantly with a plane's position in space, to obtain an uninterrupted recording of the geophysical structure of the country flown over.

Such an airborne magnetometer was operated on four flights from the Little America base by James R. Balsley, Jr., of the Geological Survey staff. The over-all result was to demonstrate that it was possible to record in this way what lay under the Antarctic icecap.

Near the eastern edge of the Ross Shelf Ice is Roosevelt Island. It is believed to constitute the fulcrum upon which two ice shelves, the Ross and Prestrud, turn to form the Bay of Whales a few miles to the north. But it is completely ice-covered to a depth of about 500 feet. It hardly protrudes from the rest of the shelf. Even its existence has been debatable. Balsley's magnetometer recordings showed unmistakably that it is a real body of land, composed chiefly of granite rock.

A somewhat smaller island, shown on maps at the entrance to the Prestrud Shelf, slightly to the southeast, was demonstrated either not to exist or to be composed of sedimentary rocks. The former conclusion is considered more probable.

Another flight was over the Edward VII Peninsula and the Rockefeller Mountains. In this area laborious geological studies have been made on the ground. It had been determined that the mountains are composed largely of granitelike rocks. The magnetometer, from a thousand feet above, gave precisely the same results.

On the other hand, the instrument showed that that magnificent landmark, La Gorce Peak, named for my old friend Dr. John Oliver La Gorce, was composed almost entirely of sedimentary rocks compressed from ocean-bottom muds through millions of years.

At one point the edge of the Ross Sea was found 20 miles east of the line designated on existing charts. A source of peculiar satisfaction was the finding of considerable magnetic intensity variation in the neighborhood of Kainan Bay. Dr. Siple had predicted, from the nature of crevasses there, that the point must represent a break of some sort in the earth's structure—probably an island. The magnetic readings verified this supposition.

The detector element of the magnetometer is housed in a streamlined, bomb-shaped case known as the "bird," which is towed behind and beneath the plane on a cable 100 feet long. This is to eliminate the magnetic effect of the metal in the aircraft itself. The measurements are so delicate that every possible contaminating factor must be removed to make valid conclusions.

Undoubtedly there are both valuable and precious minerals under Antarctica's ice. It is difficult to conceive of such a large part of the earth's surface without them.

The magnetometer can at least give a good indication of where to look. It cannot identify specific minerals, such as gold or uranium. It can detect, as has been demonstrated in the case of oil, the geophysical formations where they are most likely to be found.

South Magnetic Pole a Large Oval

Study of the earth's magnetism itself naturally has a notable part in the program of any polar expedition. This field of science was represented by Dr. H. Herbert Howe and Lt. C. A. Schoene, both of the Coast and Geodetic Survey.

Available evidence indicates that the South Magnetic "Pole" must be considered a roughly oval region, perhaps more than 1,000 square miles in area. At numerous points in this oval a compass needle on a horizontal axis would point straight downward, and these points would change position from day to day. The actual "pole" might be considered as the mathematical center of this region.

The North Magnetic Pole has shifted somewhat in the past few years. The South Magnetic Pole evidently has shifted also, but we haven't enough data to prove it.

That strange phenomenon which Dr. Siple calls the "antithesis of darkness," and which caused our aerial tragedy (page 502), constitutes one of the constant perils of the Antarctic, and must be understood before it can be conquered. It is especially important for airplane landings, which require fine judgments of the elevation and contour of the snow surface. It is a weird white light experienced chiefly on cloudy days when a woollike fleece covers most of the sky.

On such days there are no shadows. Nearby objects, especially men dressed in white, vanish and reappear without warning.

Sunburns, although no sun is visible, are likely to be severe, and the worst-burned areas may be the bottom of the chin and the palms of ungloved hands. Visibility is extremely bad. Elevations and depressions which ordinarily serve as landmarks are merged into an endless white flatness. Walking becomes a blind staggering because there is no way of judging the level of the snow surface.

Weird White Light a Danger Source

On such a day tractor and sledge parties away from base in unknown territory can proceed very slowly, if at all. The absence of shadows leaves the men with no means of detecting the parallel windrows of arched snow which indicate crevasses.

In the North a similar phenomenon, known as "Arctic white-out," has caused airplane accidents.

Dr. Siple's tentative hypothesis is that this "antithesis of darkness" can be explained as a phenomenon of multiple reflection of sunlight. Visible and short-wave invisible radiation is trapped between earth and sky.

Ordinary sunshine striking the earth is partly absorbed by the varicolored landscape and partly reflected back into space. Here there is only the unbroken whiteness of the névé. It is an almost perfect reflector.

The radiation rejected by the earth cannot get past this cloud screen into free space again. A certain amount of it is reflected back against the snow, to be re-reflected against the clouds.

Thus there is a constant building up of trapped light, which is added to that received each instant from the sun itself. Light is coming from above, from below, and from all sides where there are snow-covered slopes. The area within the Antarctic Circle is like a titanic hall of mirrors.

This trapped-light hypothesis obviously is only a tentative attempt to explain an eerie phenomenon of the polar regions. The explanation remains debatable.

Antarctica is swaddled in a warm blanket. This remarkable fact was established by daily soundings of the upper atmosphere by radiosondes, the astounding little robot observers which can be sent aloft by free balloon and which send back a continuous record of the conditions they encounter.

Here Stratosphere Is Closer to Earth

Over the Equator the temperature drops with altitude up to about 60,000 feet—the floor of the stratosphere there.* Thenceforth it remains constant or may even show slight increases.

Over Antarctica there is a different situation. Two thousand feet above the earth throughout the summer was found a layer of atmosphere about 300 feet thick in which the temperature generally was eight to ten degrees higher than at the ground. One recording was 14 degrees higher. Such inversions of temperature are known elsewhere.

Once this stratum is passed, the temperature declines steadily to about 60 below at 23,000 feet. In the next mile of altitude it increases about five degrees.

This means that Antarctica's summer stratosphere is only about two-fifths the height of that over the Equator and two-thirds as high as that over the United States. In winter it is about the same as in summer, or possibly a little lower.

Flasks were filled with South Pole wind—air which had moved northward at least a thousand miles over the continent at an altitude of more than 6,000 feet—for chemical analysis at the Bureau of Standards.

Breathing Antarctic atmosphere has a curiously exhilarating effect. It is one of the attractions which bring men back to these frozen wastes on expedition after expedition.

No Colds till New Men Arrived

While the winelike quality of winds over the ice mountains doubtless is partly psychological, there remains the fact that this air is a slightly different mixture of gases from that of air in middle latitudes. It contains, for example, less than a third as much water vapor as atmospheric samples collected at the Equator. Further studies with respect to the amounts of carbon dioxide, nitrogen, oxygen, and argon are still being made.

Antarctica is sterilized by millions of years

* See, in the National Geographic Magazine: "Exploring the Earth's Stratosphere," by Lt. John A. Macready, December, 1926; "Ballooning in the Stratosphere," by Auguste Piccard, March, 1933; and, all by Capt. Albert W. Stevens: "Exploring the Stratosphere," October, 1934; "Man's Farthest Aloft," January, 1936; and "Scientific Results of the World-Record Stratosphere Flight," May, 1936.

An Injured Arm Gets Expert Attention at the World's Southernmost Hospital

In the sick bay at Little America IV, Dr. H. H. Richardson, of Beaver, Pennsylvania, an Antarctic veteran, gives emergency treatment for a minor accident on the ice. An oil-burning stove keeps the tent warm.

of cold—a hypochondriac's dream land. Normally a person is safe here from such maladies as the common cold, influenza, and pneumonia.

Among the personnel of the expedition, respiratory diseases had disappeared and sick bays were empty except for accident cases until the arrival of new men late in January aboard planes from the aircraft carrier.

They brought with them varieties of the cold virus, which were transmitted rapidly in the warm ship wardrooms, and soon there was a mild epidemic of sneezing and coughing.

In the meteorological studies, balloons dragging targets which could be tracked by radar—a system developed for Air Force meteorologists during the war—were used to determine the velocity and direction of winds over the low cloud cover which overlies the entire region most of the time. The method functions up to about 30,000 feet (page 496).

Some curious meteorological phenomena were observed. One day at Little America, for example, there was a cloudless sky with perfect visibility for about eight hours. It was possible to follow with the naked eye an ordinary weather balloon up to 79,000 feet before it finally faded from sight in a deep-purple sky where shone the planet Venus. There was a grass-green horizon.

Sun Ringed with Rainbow Halo

The purple color of the heavens was especially striking and apparently has not been elsewhere recorded. The psychological impression was one of infinite coldness. There was no roof of blue between earth and the absolute zero of empty space between the stars.

The strange sky color presumably was due in part to the almost complete absence of dust particles in the Antarctic atmosphere.

There were rapid, radical temperature changes, such as a rise of 18 degrees in one hour without any variation in the wind direction.

Several "ice fogs" were observed. In appearance these do not differ notably from

Ski-wheel Landing Gear Enabled the R4Ds to Take Off from a Carrier and Land on Snow

Only three inches of wheel protruded through the ski, since more would have meant serious danger of a crack-up at the end of the flight from the *Philippine Sea* (page 444). It was the first time such a ski-wheel take-off had been attempted from a carrier. A ground crew member is jacking up the plane preparatory to removing the wheels for operation in Antarctica.

ordinary white fogs, but through them one sees rainbowlike halos around the sun. These are due to aggregations of billions of extremely minute ice crystals in the air close to the earth.

Two cradles of cyclones for Antarctic regions, which indirectly, it is probable, affect most of the world south of the Equator, were located. Cold air off the Polar Plateau sweeps northward from western Victoria Land near the South Magnetic Pole. It crashes into warm north winds somewhere near the Balleny Islands and "baby" cyclones are born.

These grow rapidly, sweeping eastward across the Ross Sea, and finally decay in the Rockefeller and Queen Maud mountains.

The other cradle is probably near Mount Ruth Siple, on the western edge of the Amundsen Sea. Here apparently the cold polar air sweeps through some wide gap in the mountains and encounters southward-blowing winds. Thus again cyclones are created which move eastward, gathering strength, and finally decay somewhere over the Palmer Peninsula.

This accounts for the origin of major storms in two of the four quadrants into which, for convenience, Antarctica ordinarily is divided.

Several minor areas of storm center activity also were found by the Eastern and Western Groups operating in the other quadrants. Location of all, with the establishment of adequate observing stations, would simplify Antarctic weather forecasting for future expeditions.

"Blue City" of Southernmost Mammals

A few miles from the base, hidden among blue ice grottoes, was a large colony of Weddell seals (page 501). These drowsy giants are the world's southernmost mammals, and this infernolike region of pressure ice in the Ross Shelf, always suffused by a strange blue light and traversed by deep, hidden crevasses, marks the southern limit on earth of warm-blooded mammals.

For the seals it is a permanent summer and winter home. Hundreds were counted by air surveys conducted from the base. They ordinarily live beside holes in the ice which give them access to deep Ross Sea waters for fish, their staple food. When these holes freeze over several inches thick in early autumn, the

creatures cut windows through the ice with their teeth.

Dr. Alton A. Lindsey, assistant biologist of my second expedition to the Antarctic, watched these seals at work. "Swinging the entire head from side to side," he reported, "with the mouth held open at an angle of 150°, they cut a double groove by use of the canines (and perhaps incisors also) of both jaws."

In winter these strange animals disappear, but they do not desert their "blue city." They apparently huddle on ledges on the sides of the crevasses all the winter night, with temperatures as low as 70 below outside. They supposedly have access to the sea at most times. On the snow they can outrace a man, but ordinarily show no fear.

The animals seem complete masters of their harsh environment. When fish are plentiful they store enormous amounts of blubber to sustain them in hard times. Females, for example, eat nothing for a week after pups are born, but, drawing on this blubber for food, are able to give enough milk for a single pup to gain as much as seven pounds a day.

There was some speculation as to whether the ice drift had not carried their home canyon among the crystal mountains too far away to allow them further access to the sea. In that case, they would be doomed to slow death from starvation.

This can be determined only by a later expedition. It seems improbable, however, that such naturally intelligent animals, with instincts built on countless generations of experience with ice, would have allowed themselves to be trapped in such a fashion. The "blue city," it is most likely, remains their home and not their prison.

Two Geographic Ghosts Are Laid

On the edge of the Antarctic sonic depth findings confirmed the nonexistence of two century-old phantom lands, in the positions previously reported for them.

First were the "Nimrod Islands," at latitude 56.30 south and longitude 158.30 west. They first were reported by Capt. Henry Eilbeck in the *Nimrod* in 1828 after his ship had been blown off course during a passage around Cape Horn. He described high mountain peaks, hosts of birds, and fields of marine vegetation in the water.

On our expedition the ships *Yancey* and *Merrick* made radar soundings over a 20-mile radius around the reported position. They found only ocean about two miles deep.

The second ghost laid was "Swain's Island," in latitude 59.30 south and longitude 100 west.

It apparently was the ice-born hallucination of the Nantucket whaler Jonathan Swain who in 1809 recorded the position of a large island surrounded for miles by fields of red water due to the presence of minute crustaceans known as "krill," which concentrate in colonies of countless trillions. They usually indicate that land is somewhere in the vicinity.

Here also the expedition's depth findings showed only water two miles deep.

Both Eilbeck and Swain may have seen exceptionally large icebergs drifting slowly northward, eventually to disintegrate in the warmer waters of the Pacific.

Sometimes these are enormous. In January, 1927, for example, the Norwegian whaler *Odd I* passed a tabular iceberg the area of which was estimated at 10,000 square miles, or approximately the size of Maryland.

Another explanation is that both ship captains were victims of mirages. They presumably were too far north to have observed much horizon "blink," the magnified reflection of ice formations against the sky, in whose fantastic configurations anybody is likely to see anything, from the skyline of New York City to an island in the mid-Pacific forested with fronded palms.

Certainly there was no suggestion of charlatanism about the "discoveries." They were reported merely as matters of routine before the day when scientific methods of observation were well established.

16-ton Tractors Make Six-day Journey

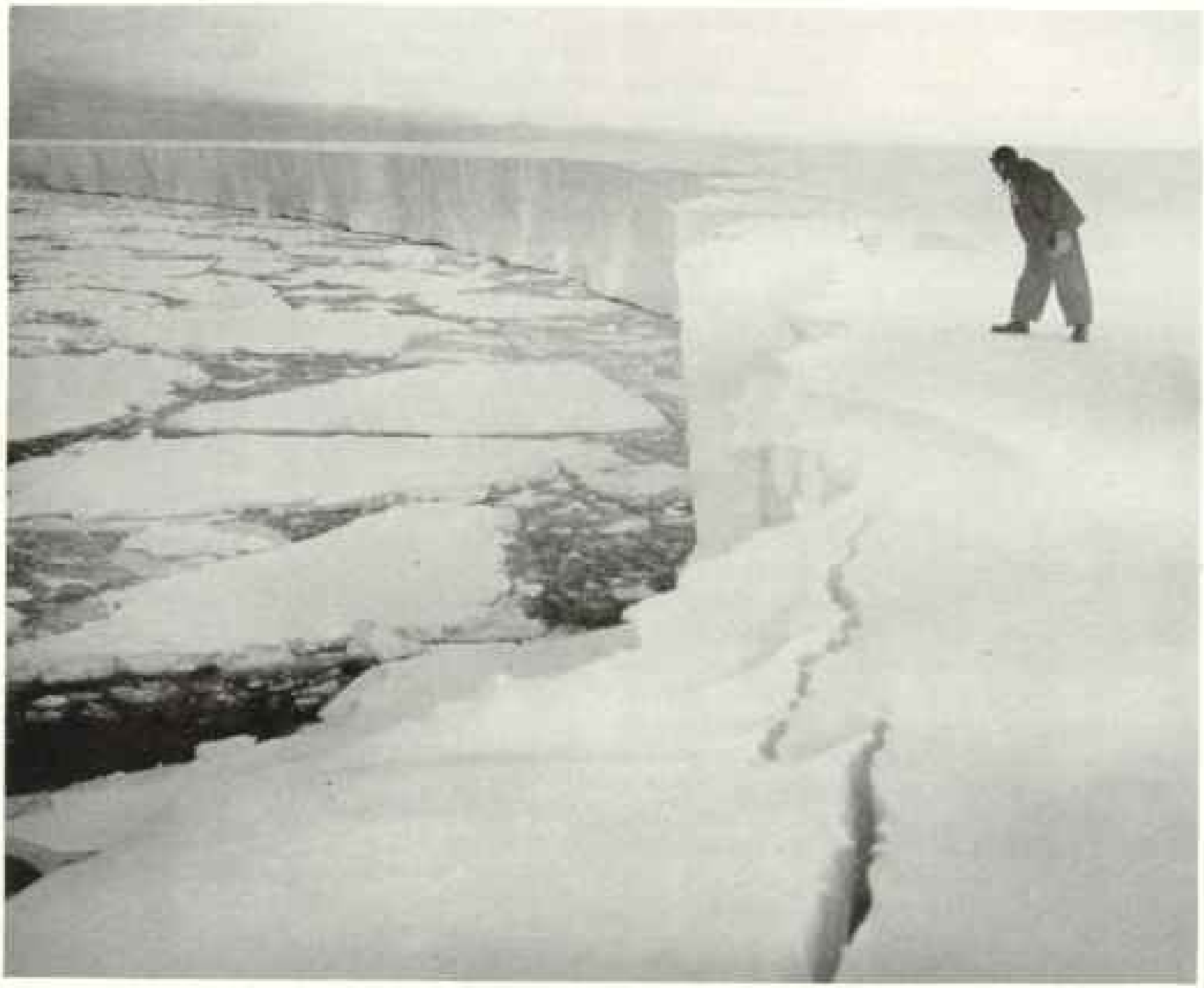
A six-day land journey into the Rockefeller Mountains and return, a total of 280 miles, with two 16-ton amphibian tractors was one of the most important experiments, as regards future exploration in polar regions, conducted by the expedition.

The party was led by Capt. Vernon D. Boyd of the U. S. Marine Corps, a veteran of Antarctic exploration (pages 481, 489).

The immediate objective was to establish a gasoline cache and weather station for the planes, but of significance also was the test of the possibility of using specially equipped heavy tracked vehicles for long overland journeys, such as a conceivable march from the Bay of Whales to the South Pole.

Such a journey would be beset by many unpredictable complications. Transportation has been the nemesis of south polar expeditions in the past, with dog teams generally recognized as the most reliable means for long incursions into the interior. But this is the gasoline age. Sooner or later some explorer will motor overland to the Pole.

Our previous expeditions have experimented



Tons of Ice Break from the Ross Ice Barrier Almost at the Photographers' Feet

Cracks in the foreground emphasize the danger of coming so close to the barrier's face, here about 80 feet above the water and broken ice of the Bay of Whales. O. F. Bowe, Chief Photographer's Mate, is ready to beat a quick retreat as he peers over the brink. The dark area at upper left indicates a "water sky" reflected from the Ross Sea.

with motorized transport across the endless wastes of thinly crusted and sandlike névé with indifferent success, but each failure where we recognize our mistakes can be regarded as a step forward.

Our heavy tractors exerted a pressure of about 12½ pounds per square inch, or more than three times the maximum permissible. The two carried seven men and their gear—a load of nearly 3,000 pounds—on the Rockefeller Mountains trek.

Gasoline, food, and equipment sufficient for three months in case the party became marooned were carried on heavy sleds. Two were dragged behind each tractor.

The vehicles averaged seven miles an hour, moving steadily a quarter of a mile apart. The party traveled almost directly eastward over the ice of the Ross Shelf.

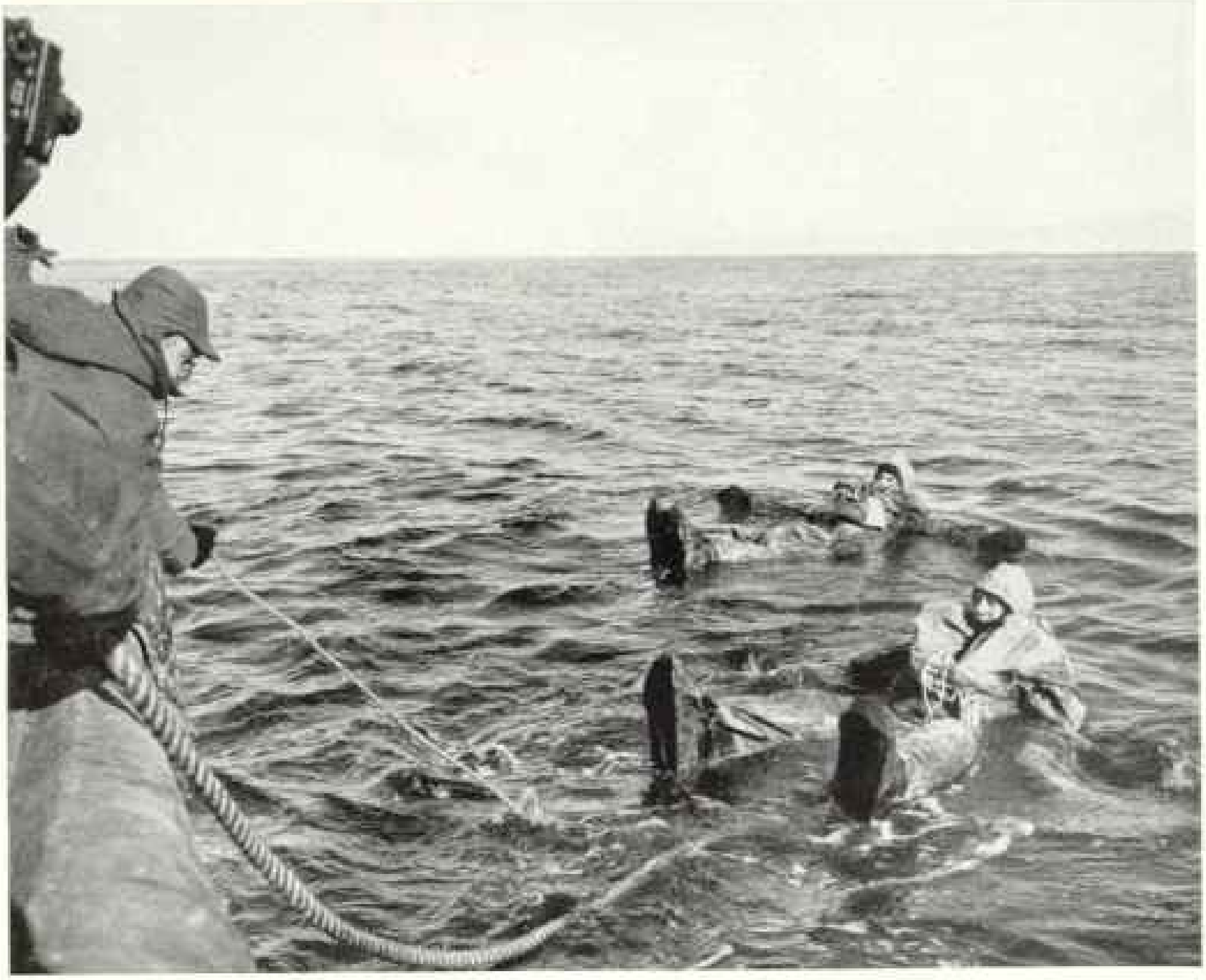
It was a region beset with death traps for heavy vehicles. These were wide crevassed areas where the great chasms in the ice were concealed by thin snow bridges.

Problems of visibility and navigation were important from the first. The sky was overcast nearly all the time. This resulted in a condition of shadowless low visibility in which it was impossible to detect the parallel ridges in the snow which indicate crevasses.

Nevertheless, only once did a tractor break through a snow bridge and then, fortunately, after it had straddled the chasm.

Mirages Paint Horizon with Illusion

Throughout the six days the sun was visible for only three hours; so Captain Boyd had to navigate entirely with the magnetic compass, which is highly unreliable in the Antarctic. The experience must be given due consideration in plans for any future tractor incursion deep into the continent. Boyd recommends some sort of gyrocompass.



Such Warm and Buoyant Suits Save Lives in Freezing Seas

Life-saving immersion suits are tested in water at a temperature of 29° Fahrenheit on Washington's Birthday. Quickly donned over ordinary clothes, they were used extensively during the war to save the lives of torpedoed merchant seamen.

Perhaps the most interesting feature of the trip was the continuous panorama of mirages. All one day great walls of cream-colored and dark-blue icebergs loomed ahead of the tractors. Sometimes they would merge into a solid blue wall. It seemed as if the party rapidly was approaching an iceberg-filled sea.

Actually this was a projection against the sky of Okuma Bay, which cuts into the Ross Shelf Ice about 60 miles to the north.

At the end of the route a party climbed Mount Helen Washington for geological specimens and a visit to the seismograph station set up by the last expedition. There they rescued two marble slabs used by Roy G. Fitzsimmons as a base for his instruments. Boyd brought them back with him as a possible base for a memorial to Fitzsimmons, who was killed in the war.

As a result of the trip, Captain Boyd was convinced that even the 16-ton tractors with certain improvements could be used for a much longer trek, even to the Pole itself. It would be necessary to provide heat for the space occupied by personnel, and some sort of living quarters.

With the vehicles in their present condition, Captain Boyd points out, the trip would have been impossible earlier in the season. The tractors' ground pressure was too great. By mid-February, however, the surface of the névé had hardened. Even so, the machines sank from eight to ten inches over soft areas and probably would have bogged down over any great distance.

Scott's Camp Perfectly Preserved

Antarctica is an ageless land where nothing, except the physiological system, grows old. This hardly could be better illustrated than by the camp of Scott's 1901-04 expedition on Ross Island, at McMurdo Sound, where Admiral Cruzen landed late in February from the icebreaker *Burton Island* to survey the

For the First Time in History, Men Land on a Lake in Antarctica

Furrowing the blue-green water is one of the wing floats of the Martin Mariner seaplane which alighted in the midst of the remarkable "oasis." Beyond rise icebergs and bare, brown hills where a superficial survey failed to disclose any visible sign of life (Plate VIII and pages 475 and 499).

possibilities of establishing an auxiliary base.

Scott's camp might have been abandoned only a few weeks ago. The prefabricated cabin which the explorer had brought from England still stood in perfect condition. The timbers looked as if freshly sawn. Printed directions for putting them together, which were found pasted on one wall, might just have come from the press.

A hitching rope which Scott had used for his ponies was so completely undeteriorated after 43 years that it was used without hesitation to secure the helicopter in which Admiral Cruzen had flown from ship to shore. A few sealskins scattered about looked new. Cartons of biscuits still were edible, although rather tasteless.

And there was the "latest news." A Russian army was invading the Pamirs, according to the headlines of a British news magazine found in the ice. Paper and print looked as if the publication had come from the press only a few days before. But this journal had been printed in 1892.

Scott's 1911 camp at Cape Evans, on the western shore of Ross Island, from which he set out on his ill-fated journey to the South Pole, was also visited by task force personnel. It appeared somewhat disorderly after the buffetings of 35 winters. Snow had drifted through cracks in the planks of the sealed cabin. Straw and debris were strewn over the nearly ice-free volcanic ash.

The frozen carcass of a dog stood on four legs as if it were alive. Seal carcasses from which fresh steaks might have been cut lay about. Scattered around the cabin were cartons of provisions, still good to eat. A box of matches ignited easily.

Just west of this camp the great Ferrar Glacier, one of the most impressive sights in the Antarctic, rises 7,500 feet through the mountains. Two graves on a hilltop are covered with beautifully colored volcanic ash. Steam came from the crater of three-tiered Mount Erebus on Ross Island (page 476).

Killer Whales, Seals, and Penguins

An unusual abundance of the dreaded orcas, or killer whales, was found in McMurdo Sound waters, and brown cliffs of the shore were covered with seals and penguins.

The season was so near its end that plans for an auxiliary base were abandoned. The area remains one of the best possible for an expedition headquarters.

This expedition was so large that I have had difficulty in condensing its story into a magazine article—even one as long as this. Thus there were many outstanding men and officers to whom it has been impossible to give the credit they so richly deserve. This has disturbed me, even though I realize that it would require several volumes to describe adequately a 4,000-man expedition. However, since I have covered the expedition by groups, I should be remiss not to mention two: the veterans of our former expeditions and the representatives of the press and radio.

11 Correspondents, 12 Antarctic Veterans

There were nine members of the press and two radio commentators. The three great press associations, several large newspapers, and the major broadcasting systems were represented.

I was not used to so many reporters. On each of my other expeditions I had had only one, and he carried on also as a member of the expedition. So I wondered how it was going to work out with 11 of them.

I soon found out. By the time we got settled at Little America I had seen enough of the men of the press to know that I could look upon them as true and loyal members of the expedition. They were thoughtful and considerate, and as square a group of men as I had ever in all my long career come in contact with in any walk of life.

At Little America I lost all desire to censor anything the correspondents wrote. Their judgment and craftsmanship were such that I didn't even check their stories for accuracy.

These 11 correspondents renewed my faith in our free press, and I am human enough to be very grateful to them.

Our personnel included 12 veterans of former expeditions. Since this was a naval expedition, it was not practicable to take more.

They supplied to the expedition such technical knowledge of Antarctica as the Navy lacked. Officially, their contribution was inestimable, and, personally, it was a joy to have them with us. They were all at Little America but Admiral Cruzen, who was taking the ships north, and Jack Perkins, biologist, who had broken his leg.

We used to meet at least once a day in what we called the veterans' tent. Of course we knew a lot about each other, and the razzing that went on there I am certain was a world's record.

They were all tried and true men or you may be sure they would not have been along. Many of them have been mentioned elsewhere in this article.

They were, in addition to Cruzen, Siple, and Perkins: Waite, Boyd, Dustin, McCoy, Lt. C. C. Shirley, USN., Richardson, A. J. L. Morency, chief warrant officer, US Army, Capt. M. W. Weiner, US Army, and R. R. Johnson, chief boatswain's mate.

We evacuated Little America on February 23, 1947, and the ships of all three groups left Antarctic waters early in March. The polar winter had started, making highly perilous and impractical any further air exploration.

The expedition had been on the whole highly successful.

The returns from an expedition sufficient to have financed the war for only a few moments had brought a notable advance in man's knowledge of the planet on which he lives, a contribution for all time to come.

Still, much of the continent remains unknown. There are many secrets behind the glittering ice ramparts and the painted white curtains of fog and gale-tossed snow. The final conquest of Antarctica remains perhaps for another generation of explorers.

What value has Antarctica to repay such effort and expense as was involved in this expedition? This so frequently is asked that it deserves a frank answer.

At the outset, it may be stated that, in terms of any financial return now or in the immediate future, it has no value whatsoever. Perhaps this will be a sufficient and conclusive reply to many of the questioners.

One day, it is quite possible, somebody will make money out of the bottom of the world. We know, for example, that there are huge reserves of coal there. The black mountains are full of it. It is impossible at the present stage of exploration even to make a wild guess as to the extent of these deposits.

But any mining operations, especially when we consider the difficulties of transport, would be fantastically impractical at this time. There may come a day, however, when the world will need this coal.

Almost certainly oil will be found under the ice. It is impossible to imagine a large continent without vast mineral wealth of many kinds buried in its rocks.

The Antarctic a Proving Ground

For the Navy's own purposes, much was learned about celestial navigation and ship operations in polar regions.

On this expedition the Navy equipment and personnel were subjected to the worst possible conditions. We operated deliberately late in the Antarctic season. It was an excellent opportunity to meet and learn how to overcome many situations which certainly will be en-

With an Icy Bone in Her Teeth, the *Northwind* Smashes Out a Basin in the Bay of Whales

The bay was found completely frozen over, and the Coast Guard icebreaker spent three days clearing room for the other three ships. High ice walls looming above the bay are the "cliffs" of the Ross Barrier.

Staff Photographer E. Anthony Stewart.

From the Bay of Whales to Washington, D. C.: Bluejackets and Marines Form an Honor Guard to Greet the Flagship *Mount Olympus* as a Yard Craft Nudges Her to the Pier at the Naval Gun Factory

countered if it ever becomes necessary to carry on actual warfare in polar regions.

It has been stated many times in the past year that, as the world continues to shrink with an ever-increasing acceleration, the North Polar Basin, the shortest route between the Eastern and Western Hemispheres, is bound to be an important strategic area and battleground in any future major conflict.

The United States owns no land areas sufficiently far north to utilize as an adequate proving ground for the most severe Arctic conditions. Even the northernmost point in Alaska is more than 1,200 miles south of the North Pole.

Our Army and Navy must be trained to cope with the severest conditions they may be subjected to in any possible emergency.

Any severe natural conditions ever likely to be met in the Arctic are more than duplicated in the Antarctic. Life is far more difficult here. The temperature averages about forty degrees colder the year round. The winds are the most violent and constant in the world. Much of the region is without landmarks of any sort.

Men who have sailed ships, flown planes, or carried out any sort of military operation south of the Antarctic Circle will find nothing to baffle them in the Far North.

Staff Photographer John E. Fletcher

When Being Introduced, Mr. Penguin Looks the Other Way

Rear Admiral Byrd shows Secretary of the Navy James Forrestal a macaroni penguin captured by the crew of the Coast Guard icebreaker *Northwind* on sub-Antarctic Campbell Island, south of New Zealand, and brought to Washington, D. C., on the *Mount Olympus* for the National Zoological Park. Several penguins escaped before they were taken off the ship and some started swimming down the Potomac River, presumably on their way back home. For a week they eluded all efforts at recapture.

Foods Could Be Stored Indefinitely

One reason weather conditions are so very much more severe in the Antarctic than in the Arctic is that there is a comprehensive ice age at the bottom of the world.

It has been suggested that the great bowl of the continental plateau some day may serve as a gigantic food refrigerator where surplus crops can be stored indefinitely—perhaps under a world trusteeship—until needed. There is little possibility of spoilage or insect depredations. This might prove a stabilizing influence in world affairs. Here again must be surmounted the physical obstacle of transportation.

I dislike to think of money in connection with Antarctica. It has higher values. This continent and these seas can be looked upon as Nature's most sublime work of art. They are poetry, music, painting, architecture, and philosophy all combined.

There are no paintings on earth such as those which the cosmic artists execute daily on canvases of green and purple sky with pink, white, and yellow cloud patches and mirages of fairy cities and glittering cathedrals raised out of the diamondlike ice.

There is no other music like the toneless music of millions of years of accumulated silence, through which come bars of unearthly colors. There is no need for ears to hear the fugues played on this ice organ.

Here Nature has set aside for man a domain of beauty and inspiration such as he cannot know elsewhere on this planet.

I have known few who have gone south of the Antarctic Circle who have not been raised out of themselves for a time into smoother realms of thought. Here is a door ajar through which one may escape a little way and for a short time out of our little world, from the noise and chaos of civilization into the silence and harmony of the cosmos, and for a moment be a part of it.

"Don't Take It So Hard, Old Man"

Jack Perkins, expedition biologist, stuffed frozen fish down the gullets of captive penguins for two weeks before they would eat voluntarily. Here he calms an emperor penguin's frayed nerves before starting the feeding operation.

But this chance to escape is not the greatest value of the immensity of lifeless whiteness over which the Southern Cross floats high in the sky. This greatest value is an intangible and certainly inexpressible spiritual value.

Antarctica a Sermon in Ice

The vastness, clearness, whiteness, silence, the purity, the elevation above the petty quarrels and ambitions of men and nations, combine to form a majestic symbol of what man should want most, peace on earth.

Antarctica is a sermon in ice. But there is also malevolence in the nature of things down there at the bottom of the world, just as cruel and sinister as its beauty is harmonious.

A summer visitor could not know much about this nor would he have the antithesis—the long winter night—to lend emphasis to the beauty of the Antarctic spring and summer.

But antithesis is not enough. The beauty of Antarctica cannot become entirely yours just for the seeing of it alongside its ugliness, any more than the harmony and peace are all yours just for the taking of them. There is no easy way. They have to be won. They have to be fought for. You have to go up against the elements of Antarctica to attain them fully.

And so we see that it is the great Nature-made contrast of good and evil there that enables you to see and value the good, but

Staff Photographer R. Anthony Stewart

Safely Home, Admirals Byrd and Cruzen (Right) Receive the Navy's "Well Done"

At Washington, D. C., Secretary James Forrestal gives Admiral Byrd a warm handclasp while Fleet Admiral Chester W. Nimitz, Chief of Naval Operations (left), awaits his turn. The greeting followed docking of *Mount Olympus* at the Naval Gun Factory on April 14, 1947 (page 519).

also that it is fighting the evil that enables you to possess the good, with its principal elements, harmony and peace, within yourself.

Antarctica's Eternal Challenge

When some of our men visited Scott's 1911 camp at Cape Evans, they found there among the wreckage wrought by the storms of 35 winters a corked copper cylinder. Inside was a single sheet of ruled school theme paper. Upon it was written:

"Sacred to the memory of ———, ———, ———." All three had been members of Sir Ernest Shackleton's 1914-17 expedition, part of which had wintered there. Two had disappeared during a blizzard on the ice pack; the other had perished on the trail. The names were followed by a few lines from Robert Browning:

> I was ever a fighter, so—one fight more,
> The best and the last.
> I would hate that death bandaged my eyes,
> and forbore,
> And bade me creep past.

There can be no more fitting expression of the guiding faith of the Antarctic explorer today and tomorrow. The great mystery of the South ever challenges to one fight more, and here death, dressed in storm, darkness, and cold, bandages no man's eyes.

The Society's New Map of the Caribbean Area

GREATLY increased geographic knowledge acquired by American airmen on wartime flights over the Caribbean area has enabled the National Geographic Society to map this important region in far more detail than ever before. The result is the 10-color map, "Countries of the Caribbean," which accompanies this issue of the NATIONAL GEOGRAPHIC MAGAZINE.*

Just 455 years ago this month, Christopher Columbus made his first discoveries here, groping among the islands off the slender waistline of the Western Hemisphere and thinking he was off the coast of Asia.

Since that time, many explorers, geographers, navigators, buccaneers, treasure hunters, and fishermen—even hurricanes and volcanic eruptions—have altered the geographic picture. But it remained for the modern aerial camera to give new distinctness and accuracy to coastlines, river courses, and mountains almost everywhere south of the Rio Grande.

The Cartographic Section of the National Geographic Society worked six months to epitomize the four-and-a-half-century accumulation of facts on this 41-by-25-inch map for The Society's 1,600,000 members.

Insets Show U. S. Possessions, Bases

Extending from Mexico's Tijuana to the mouths of the Orinoco in Venezuela, the new map area includes a slice of the southern United States as well as all of Mexico, Central America, and the West Indies—a winter vacation land of tropical greenery, deep-blue water, and glistening coral sand.

Of its 6,954 place names, few would be recognizable to Columbus. One would be San Salvador (Watling Island), in the Bahamas, where the discoverer and his men first landed in the New World, bearing the Admiral's Green Cross banner and the royal standard of Spain. Kneeling upon the shore, they gave thanks to God "and kissed the ground with tears of joy, for the great mercy received."

Where Columbus found only a few Indians and cruised along virgin verdant coasts, today are populous republics with millions of people—and not a single possession of Spain.

As a master mariner headed for the Orient, he would doubtless be most interested in the Panama Canal, "dividing the land and uniting the world." The Canal Zone inset on this map shows the projected third lock system intended to accommodate larger ships and make the vital artery less vulnerable to attack.

This large-scale inset is one of eleven which highlight areas of special interest. In one corner appear the Caribbean possessions of the United States—Puerto Rico, the Virgin Islands (two insets), and the Canal Zone. In another are insets of islands on which the United States has military bases—Cuba and the six islands on which the British granted us bases in 1940 in exchange for badly needed destroyers: Trinidad, Jamaica, Exuma, St. Lucia, Antigua, and Bermuda.

In the patrol which met the challenge of Axis submarine warfare, every square mile of the "American Mediterranean" was combed by air and sea again and again.

Most of the land area is now covered by United States Army Air Forces trimetrogon photographic surveys made in cooperation with the local governments. Results of these and of many new ground and sea surveys are incorporated in The Society's map.

Pilots will note much new information concerning altitudes of mountains. For example, two elevations of 8,202 and 10,301 feet are shown in the Dominican Republic, where earlier Caribbean maps show 5,543 feet as the highest definite peak.

In western Venezuela are peaks of 15,321 and 16,427 feet. Older maps show 13,864 feet as the maximum height of the Cordillera de Mérida.

A unique mountain is Mexico's amazing Paricutin, the young volcano which has sprung from a cornfield on a 7,500-foot plateau in the State of Michoacán to a height of 9,000 feet above sea level and is still growing.†

The map incorporates new census material from Mexico, Cuba, Jamaica, and the Bahama Islands. All four have increased sharply in population: Mexico, 1930—16,552,722; 1940—19,473,741; increase, 17.7 percent. Cuba, 1931—3,962,344; 1943—4,778,583; increase, 20.6 percent. Jamaica, 1921—858,118; 1943—1,237,063; increase, 44.2 percent. Bahamas, 1931—59,808; 1943—68,846; increase, 15.1 percent.

A new boundary, agreed upon after nearly 50 years of arbitration, divides Costa Rica from Panama. The treaty was concluded on May 1, 1941, and President Roosevelt sent both governments a message lauding the settle-

* Members may obtain additional copies of the new map, "Countries of the Caribbean, Including Mexico, Central America, and the West Indies" (and of all standard maps published by The Society), by writing to the National Geographic Society, Washington 6, D. C. Prices, in United States and Possessions, 50¢ each, on paper; $1 on linen; Index, 25¢. Outside United States and Possessions, 75¢ on paper; $1.25 on linen; Index 50¢. All remittances payable in U. S. funds. Postage prepaid.

† See "Paricutin, the Cornfield that Grew a Volcano," by James A. Green, NATIONAL GEOGRAPHIC MAGAZINE, February, 1944.

ment. The new boundary was actually demarcated on September 15, 1944.

For the first time accurate boundaries of the Senatorial Districts in Puerto Rico are marked. This boundary delineation is based on the work of a Puerto Rico planning commission using a map completed by the U. S. Geological Survey in 1943.

Projection Tuned to Air Age

For this map your Editor and The Society's cartographers chose the Transverse Mercator projection.

The ordinary Mercator projection may be considered as developed mathematically upon a cylinder tangent to the spherical earth around the Equator. For some 15 degrees on each side of the Equator, such a cylinder closely approximates the actual surface of the sphere, so that the scale change or stretch is at a minimum.

In using this projection in transverse, or oblique, form, as is done on the new National Geographic map, we may consider the cylinder as tilted on the sphere so that its line of tangency is no longer the Equator but some other great circle of the cartographer's choice.*

In this map the great circle which forms the axis of the projection has its vertex at 20 north latitude and 87 west longitude. From there it runs in a straight line across the map, passing just north of Mexico City and San Juan, Puerto Rico.

Like the Equator in the conventional Mercator projection, this is the line of zero deviation in scale. Since all parts of the map lie within 15 degrees of this line, the scale variation is slight, reaching a maximum of 3½ percent along the top and bottom borders of the map. Through the whole central area the scale change is negligible.

The National Geographic Magazine in 1921 pioneered in the use of the Transverse Mercator for mapping a long airplane flight, and today the projection is widely used for great-circle flight strip maps. It is admirably suited for general maps of certain areas and was used for The Society's Southeast Asia map (October, 1944).

Important to the navigator at sea or in the air is the fact that, in addition to reducing the scale variation to a minimum, this projection maintains strict conformality: that is, in any small area of the map the scale is the same in all directions and every place is in its true direction from every other place.

Roads, railways, and commercial airports are shown throughout the area. The entire Inter-American Highway, as the Mexican-Central American section of the Pan American Highway is called, is indicated by an emphasized red line, with uncompleted sections dashed.

There are now only two impassable stretches between Laredo, Texas, and the Canal Zone. One of these begins at Trinitaria, in southeastern Mexico, where a 150-mile section running into Guatemala is now under construction. The other impassable stretch of 120 miles lies in Costa Rica and Panama.

From the Canal Zone eastward there is no road beyond Chepo. The section through the Darien Peninsula has not been traversed or surveyed. From the Canal Zone the motorist must ferry across to Barranquilla or Buenaventura, Colombia, or La Guaira, Venezuela.

All of the Central American countries are carrying on highway construction projects, but rugged mountains and steaming jungle make roads hard to build and defend against encroaching Nature.

Ninety International Airports Now

Air transport in this region has increased remarkably. In 1939 there were about 50 airports in the Caribbean area with scheduled international service. Now this number has grown to 90.

Also, a number of local air services have been established in the area. Planes now haul horses, cattle, lambs, chickens, and many other creatures, from fish to chinchillas. Industrial equipment is flown to hitherto inaccessible areas and products are shipped out by plane. Frog legs from Cuba and many perishable tropical delicacies now are flown to United States markets.

One cargo of specially processed coke was flown from New Jersey to Cuba so big sugar mills could keep going in a fuel emergency.

The war caused a tremendous boom in Latin-American production of minerals and such products as rubber, abacá (Manila hemp), quinine, rotenone, tung oil, palm oils, cork, and kapok, ordinarily obtained from distant parts of the earth.

If the war tore much of the rest of the world to pieces, it emphasized the interdependence of the American republics; and that dependence upon one another comes to a focus in this area, which encompasses the Caribbean highway between the Americas and the approaches to the Panama Canal.

* For an illustrated description of this projection, see *The Round Earth on Flat Paper*, by Wellman Chamberlin, National Geographic Society cartographer. Copies of this work, an introduction to map projections, are obtainable from the Secretary, National Geographic Society, Washington 6, D. C., at 50¢ each in the United States and Possessions; elsewhere 60¢. Postage is prepaid.

Guatemala Revisited

By Luis Marden

ELEVEN years ago I went to Guatemala to make photographs for the National Geographic Magazine. At that time, equipment for making color pictures was cumbersome; we used big glass plates and a tripod camera. Exposures were slow; subjects had to "hold it" for one-tenth to one-half second. Nothing that moved very fast could be photographed.

Recently I went back. This time I could make color pictures in split fractions of a second, catching the fleeting smile or frown, and record the bustling life of crowded market places. Plates in the following pages show some of the photographs I made.

Guatemala begins at the Mexican border with a vast jungle area, where chicle tappers slash forest giants, but most of the Republic's people live in the *Altos*, or Highlands, in the shadow of sleeping volcanoes.

Highlands Little Changed; Capital Modern

The Highlands of Guatemala have changed little in four hundred years, but I found that the capital, Guatemala City, had expanded since my 1936 visit. Virtually surrounded by deep ravines, the city has stretched suburban tentacles out between the fissures. Old trough-shaped cobbled streets have given way to asphalted avenues, and splendid new buildings, such as the magnificent National Palace (pages 530, 559), rise from colonial foundations.

Sixth Avenue is the Fifth Avenue of Guatemala City. Here a race that was old when Cortés came to the New World presses its brown nose flat against plate-glass windows displaying products of the machine age. Brightly dressed Indians carrying loads of wood or vegetables trot unnoticed among smartly dressed Guatemaltecos.

Though pure-blooded Indians form more than half the population of the Republic, Guatemala City is the most metropolitan capital between Mexico and the South American mainland. High in a valley nearly 5,000 feet above sea level, the spotless city has a spring-like climate the year round.

Aromatic highland coffee forms the country's chief export, while among Indian small farmers corn remains a staple subsistence crop. Certain scholars think that the New World's pre-Columbian agriculture, which was based on corn, may have been born in Guatemala, for here grows *teosinte*, a wild grass allied to maize.

Realizing the importance of agriculture and animal husbandry to Guatemala, the United States sent as its Ambassador to the Republic Edwin J. Kyle, former Dean of the School of Agriculture of the Agricultural and Mechanical College of Texas.

Mr. Kyle has arranged visits between agricultural experts of both countries. Students come from Guatemala to the United States on scholarships to study farming and cattle breeding.

"You're My Half a Life"

In writing of Latin America, I have tried to record some of the graphic phrases and turns of speech in each country. I found Guatemala no less imaginative in the use of metaphor than its neighbors.

For example, if your Guatemalan girl friend says you are "half a life," she is complimenting you, not ridiculing your lack of vitality.

A Guatemalan monologue might go like this:

"Miguel over there is a long one, but as he has a lot of neck, he never puts himself in a shirt eleven yards long. At lunch today he was with 80,000 devils because the chicken we ate defended itself so well. But that wool is for the tiger now, though his cronies still think he is half a life."

This means: "Miguel over there is a sharp customer, but as he has a lot of pull, he manages to keep out of tight spots. At lunch today he was furious, because the chicken we ate was so tough. But that rascal is all washed up now, though his cronies still think he is wonderful."

José Milla, an author of the last century who lived in La Antigua, created the character of Juan Chapín, Guatemala's common man, and through him explains many of the colloquialisms of the language. Milla also wrote historical novels of colonial times, and Guatemalans revere him as the official recorder of national tradition and history.

When Guatemala was the seat of government of all of Spain's Central American provinces, the old capital, now called La Antigua, became a rich, cultured center of the church, arts, and letters. Twice destroyed by earthquake and flood, the "Very Noble and Very Loyal City of St. James of the Gentlemen of Guatemala" was demolished for a third time by earthquake in 1773. Three years later the capital moved to its present site.

Higher and colder than the new city, La Antigua has a savor that is hard to put on paper (pages 531, 549, 550).

People still live serenely in the old town that half sleeps in the bright sunshine of the

Kodachrome by Luis Marden

To Make Halos, Santiago Women Wrap Ten-yard Wool Ribbons Around Their Heads

Kodachrome by Luis Marden

When Boys Meet Girls in Santiago Atitlán, Few Turn to Look

Men and women tend to form separate groups during Indian celebrations, as on this day of St. James, Atitlán's patron. Men usually wear white shirts; youth on left wears colored shirt from neighboring San Pedro. Atitlán women often knot small purchases in ends of scarf. Black volcanic rock furnished material for the yard fence (left).

Valley of Panchoy. Wild flowers grow in cracks opened by earth tremors in the massive walls of convents and churches. Half-fallen arches frame the peaks of the volcanoes Agua (Water) and Fuego (Fire).

Earth Restive in a Serene City

Periodically the earth shudders to remind residents why their ancestors left the city. When I was in Antigua, Fuego Volcano, always steaming, began to thunder and spill incandescent lava from its yellow-stained mouth. Violent explosions blew away part of the crater wall. From Alotenango, a village just under the bulk of the 12,854-foot-high mountain, spectators at night watched the devil's dance of glowing lava streams as blood-red and fiery orange fingers of lava snaked slowly down the flanks of the volcano and low-lying clouds of steam reflected a dancing glare (page 528).

Old bells are the voice of Antigua. Belfries of sixty-odd ruined churches speak in cracked, thin voices, or deep, booming tones.

Antigua speaks more softly with flowing water. When Government excavators uncovered terra-cotta pipes which conducted mountain water to supply fountains and household needs, water was turned on, and old houses live again as the icy mountain water runs through their veins.

Nearly everywhere you hear moving, murmuring water; it falls into deep basins with distinct notes as musical as glass bells and rushes through open conduits with a susurrus as of wind in the pines above the city.

Town Characters

Into a fountain in the tree-shaded Plaza de Armas at the town's center, effigies of women discharge streams of water from their breasts

© National Geographic Society

Kodachrome by Luis Marden

Yellow Sulphur Streaks the Sides of Restless Fuego (Fire) Volcano

Southwest of Guatemala City, the active vent is the lower of twin peaks. The higher, 12,989-foot Acatenango, has a cold, filled-up crater. Shortly after this photograph was made, a violent eruption blew away part of the sharp-edged crater walls at left. Solid sulphur condenses as yellow patches beneath steam jets.

into a catch basin. As I sat on a bench near the fountain one day, a friend pointed out town characters to me.

Indicating a man who walked with a limp, rising and falling at each step, my companion said, "There goes the Can Opener."

When I commented on the good looks of a passing girl, he shook his head. "Yes, she's good-looking, but that's all; lacks appeal. We call her 'Cafiaspirina' [a popular brand of aspirin], because she 'does not affect the heart.'"

But a dark-eyed girl who sat opposite us with a girl friend had plenty of spirit and character. To a bell-bottomed-trousered dandy who spoke and leered at her as he passed, she snapped, "Honey was not made for a buzzard's beak."

Close to the Plaza stands the iron-barred yellow house of Bernal Díaz del Castillo. A soldier with Cortés on the conquest of Mexico in 1519, Bernal Díaz fifty years later wrote down all he remembered (which was practically everything) of that saga of Spanish arms. By then he was an old man, living in Guatemala on land allotted him as one of the original conquerors of New Spain.

The bulky manuscript, in the old soldier's hand, is carefully preserved in Guatemala City's City Hall. When I first turned the yellowed pages of the account ten years before, it made me want to see for myself the route followed by Cortés.*

While I read the tablet in the wall of Bernal's house, a man standing in the door said, "Would you like to come in?"

Showing me a niche in the wall he had discovered when remodeling the house, the present owner said, "Perhaps the old man kept his writing materials here."

He told me of Antigua's history, and when I commented on his knowledge he said, "Of course, but I have many other interests. I am," he drew himself up, "a tailor, farmer, beekeeper, and philharmonic musician."

Tilemakers of Spain brought their art to Antigua. They covered walls, fountains, and

* See "On the Cortés Trail," by Luis Marden, National Geographic Magazine, September, 1940.

Kodachrome by Helen B. Williams

"Business as Usual" During Baby's Lunchtime in Sololá Market

In most villages, Indian mothers nurse their children through one wide sleeve. The turkey (right) was already domesticated in the America that Spain conquered. Introduced into Europe, domesticated turkeys returned to North America with English settlers.

benches with tiles in gray, blue, and yellow. Today an Antigua potter carries on in the old tradition.

I copied some of the mottoes painted on square tiles and water jars and pitchers: "I am Yours, Pretty One." "Do not Tempt Me." "Heavenly Face." "Dreaming of Love." "I Die for You." "I Dreamed that You Loved Me," and, an anticlimax in tile, "To Love You Is a Pleasure."

From the patio of a house that an old friend, Mildred Palmer, rebuilt in its colonial splendor, I could see the green cone of Agua, driving its verdant wedge into the sky above the carved stonework of the fountain.

Indians Weave Fine Textiles

Guatemalan naturals, as the Indians call themselves, excel in the weaving of textiles. The Palmer collection of native costumes and fabrics includes examples from nearly all of the 250-odd villages.

Before the coming of Europeans to the New World, indigenes worked only in cotton. Spaniards brought sheep, and now Indians weave blankets, rugs, and some garments of wool (pages 535, 555, 563).

In most villages, women have showier costumes than the men. The woman wears the *huipil* (a loose blouse), a wrap-around sarong-like skirt, and some sort of shawl and headdress. Colors run through the spectrum from deepest reds through saffron yellow to blue and violet (page 534).

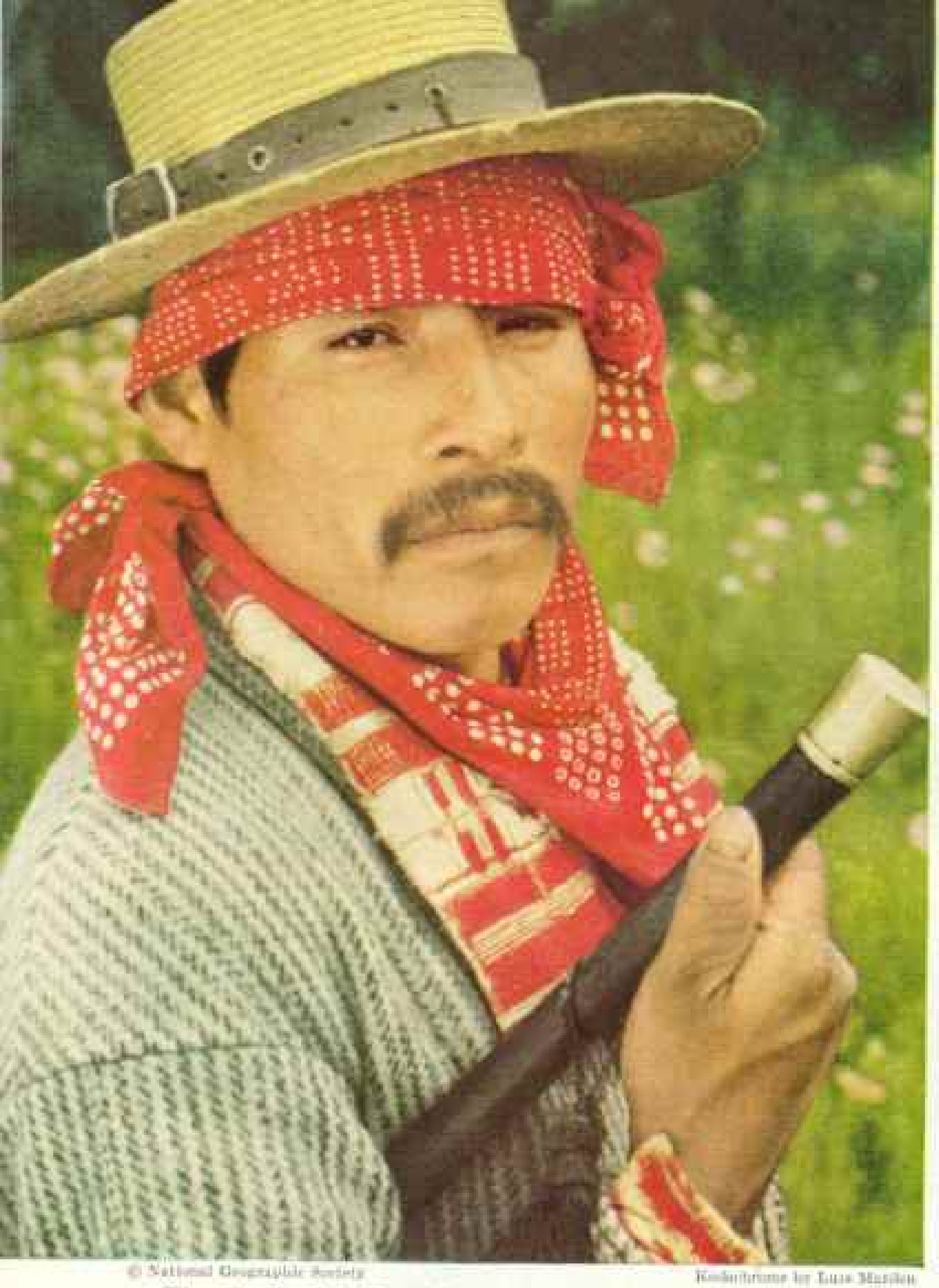
From Antigua you may begin your climb into the Highlands in earnest. Though most mountain roads in Guatemala are not paved, they have an all-weather surface, and you may go over them even in the months from May to November, when daily showers scour the hillsides.

To climb the heights—one road tops a pass at nearly 11,000 feet—roads twist in hairpin turns up hills and down into innumerable ravines. Dark pines and lichen-covered oaks clothe the hillsides, and wet gray mist swirls up from the valleys. The cold upland forest gives off a smell of resin and of charcoal fires.

Shade Trees of Guatemala City's Parque Central Were Cut to Provide Vistas for the New Palace and 165-year-old Cathedral

Kodachrome by Luis Marden

Architects Know the Palace of the Captains General at Antigua as One of America's Finest Examples of Spanish Colonial Architecture



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The Staff of Office Marks the Todos Santos Policeman

Unlike village religious elders, this man wields temporal, not spiritual, power. Called *alguacil*, he forms part of the Indian government of Todos Santos Cuchumatán, in western Guatemala, which is headed by the mayor. Guatemalan villages usually have two governments: the Indians' and that of the *ladinos*—people of mixed Indian and European blood.

Along these roads that seem to tilt up into the sky trot Indians with heavy loads of pottery, pigs, fruit, corn, vegetables, and textiles.

They carry their wares on and in a four-legged wooden net-covered frame that hangs from a tumpline around their heads. With a metal-tipped staff to help them set down the load and to rise again, and a rolled-up palm-leaf raincape, rush sleeping mat, tin lamp, and battered coffeepot hanging to the outside, the merchants dogtrot tirelessly along, stopping wherever night overtakes them (p. 542).

Merchants' loads may sometimes exceed a hundred pounds, and they walk 20, 30, even 50 miles to market. For the Guatemalan Indian is first and foremost a trader. He will walk for days with his produce or his wife's handicraft on his back to some famed market such as those of San Francisco El Alto or Santo Tomás Chichicastenango (pages 556, 563).

Though shy, Indians one meets on the roads usually are friendly. They answer questions in the peculiar singsong cadence and intonation of the Indian version of Spanish. Talking rapidly, in a high pitch, they do things to gender, verb tenses, and pronunciation that would make the cold perspiration break out on the brow of a grammarian.

Naturals have a great sense of personal dignity. I met one bowed under a tremendous load of bulbous clay pots, who, pointing to the thick-soled leather sandals he wore, said, "Señor, you see these *caites?* Well, in the pictures, God and all the saints wear the same things. That proves Indians are the children of God."

But most important to the Guatemalan Indian is religion. His whole life revolves around the religious calendar, with its feast and saints' days. Indians speak to their God in familiar terms. Their praying resembles conversation carried on with a friend.

In a low-voiced monologue they talk to God, telling Him of poor crops, of illness in the family, and other troubles. Supplicants gesticulate, sometimes fiercely, as they say in effect: "God, you make everything come out all right—or else!"

Deep-blue Lake Atitlán

Beyond Antigua, 5,000 feet up in the mountains, lies deep-blue Lake Atitlán. As you round the shoulder of a mountain at a lookout point called Godínez, suddenly the lake appears, almost unbelievable in the intensity of its "Kodachrome blue" (pages 536, 537).

I stood one morning beside the stone idols

In Wild Cosmos Stand Villagers of Todos Santos. Men Wear Breechclouts over Striped Trousers

Kodachrome by Luis Marden

San Antonio Women Weave and Wear an Intricate *Huipil*

San Antonio Aguas Calientes, near La Antigua, is one of the few villages that use rayon and silk in weaving. Blouses vary in detail, but over-all geometric effect is similar. *Huipiles* are simply made of two strips, like one this woman weaves, sewn together. The unsewn middle of the seam becomes the head opening.

that look mutely down from Godinez. The three volcanoes on the far side of the lake were invisible in the white fog. Through gaps in the mist I glimpsed the red roofs of San Antonio Palopó, nearly 2,000 feet below.

Formed originally by volcanic action, 13-mile-long Atitlán is 1,500 feet deep in places. Because there is little shallow water, the lake has comparatively few kinds of fish. One, the *mojarra*, grows to the size of a man's hand; villagers catch it on hook and line for food.

Surprisingly, small fresh-water crabs abound in the lake. Near the village of San Pedro La Laguna I watched fishermen set long trot-lines, baited with bits of stale fish, for crabs in the transparent waters close to shore. In the gin-clear lake water boats seem suspended in air over depths that shade from yellow brown of undulant underwater plants through jade green to deepest blue (page 539).

The fishermen tie the crabs' pincers with pliant green rushes, then string the crabs on a long stalk. In this way the crustaceans live for three days or more on the way to markets across the lake.

With amazement I watched a mojarra fisherman tie a stone on his line as a *float*. My eyes bulged as it bobbed high on the water. Laughing at my surprise, the fisherman tossed me an elliptical pebble from a pile on the beach. It was as light as foam; on examining it, I found it was pumice, a type of volcanic glass blown so full of air cavities by expanding gases that it floats on water.

Indians cross the lake to each others' markets, or come to Panajachel, the big town on the main road to the capital, in curious dugouts of hollowed logs, which have crudely hewn planks for gunwales. Still more curious is their manner of paddling; most stand up, but natives of Santa Cruz and San Juan squat in the thwartless dugouts, and men of Santa Catarina and San Antonio paddle sitting down. Indians remain individualists to the end.

Legend says there are twelve villages on Atitlán, each named for an Apostle. Actually,

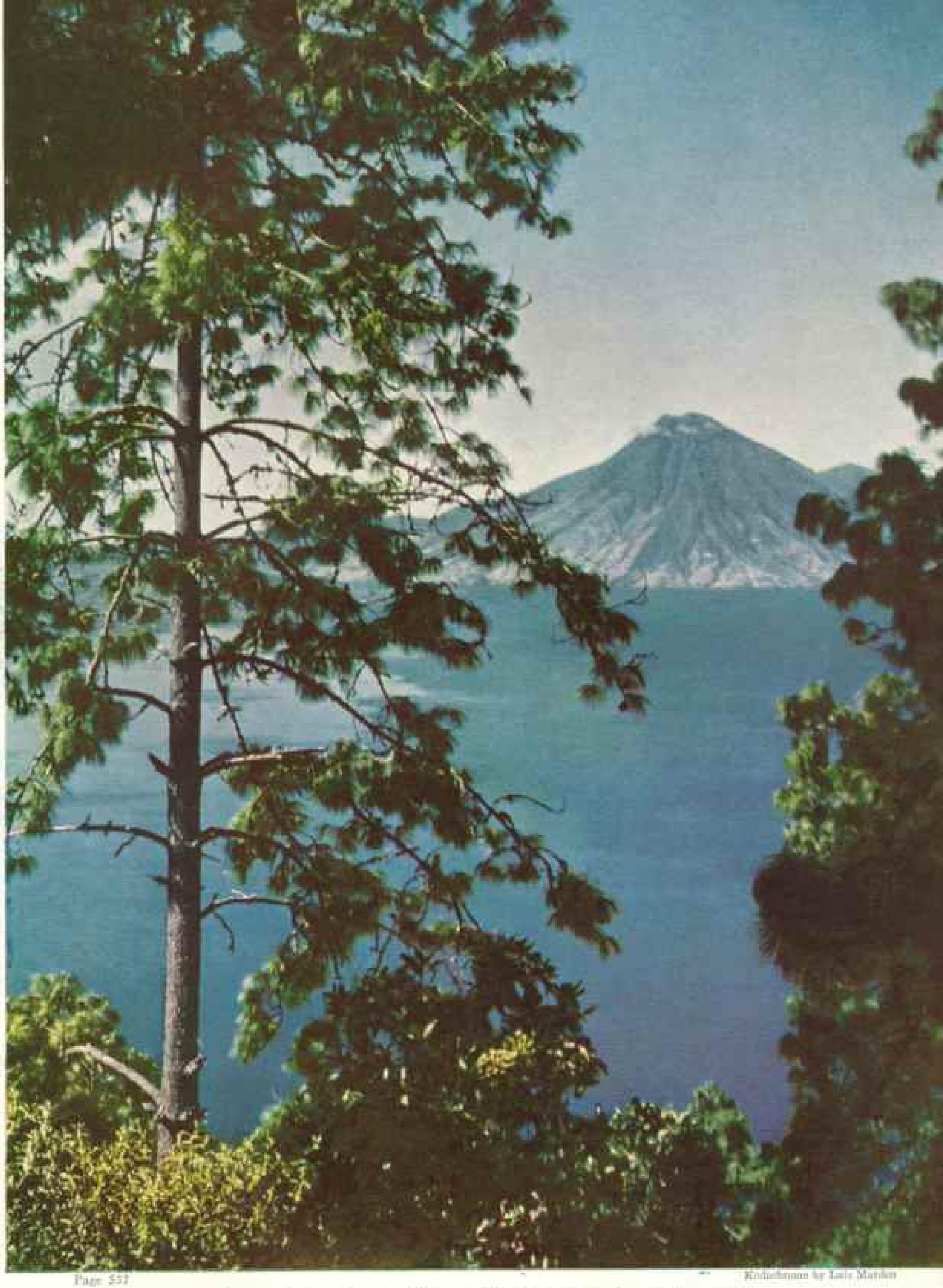
Kodachrome by Luis Marden

After a Saturday-night Bath, Wool Blankets Dry in the Sunday-morning Sun

Buyers from towns and the capital come to Momostenango's blanket market. The night before, weavers pound the blankets in sulphurous waters of hot springs. The chemically charged waters do not dim the vegetable dyes.

Three Extinct Volcanoes Overlook Deep-blue Waters of Lake Atitlán

In early morning, peaks of Toliman and Atitlán (left) and San Pedro (right) are clearly defined; later they become cloud-capped or totally obscured. Conflicting winds, called *chocomil*, can cause 12-foot waves.



Kodachrome by Lois Marden

More than a Dozen Villages Ring the Volcano-formed Lake

Legend says there are twelve villages, one for each of the Apostles. Of more than a dozen, only four are named for the original Disciples. Lake shores sheer precipitously off into 1,500-foot depths.

© National Geographic Society

Kodachrome by Luis Marden

***Cofrades* of San Antonio Palopó Pose with Their Patron Saint's Ikon**

These members of a religious brotherhood (page 540) appear against the backdrop of early-morning Lake Atitlán. The hill behind head of the man at left is the Cerro de Oro; beyond rises San Pedro Volcano.

there are more than twelve, if you count those which are near though not on the lake. Only four bear names of the original Twelve, but it is still a good story.

One day I talked with Padre Antonio Farfán, a priest from Sololá, just north of the lake, who makes the round of lake villages regularly in a motor launch.

He said: "Don't let the smooth look of the lake deceive you. I have seen waves twelve feet high when opposing winds meet to form the *chocomil* wind on the lake." For this reason, natives usually cross the lake in early morning or late afternoon.

Indians' Two-way Religion

I asked about the Indians' religious beliefs.

"It is true," said Padre Antonio, "that our Indians secretly pay homage to their idols, burning copal incense and pouring libations of ardent water. They pray to their supreme native deity, Nim Ajau, God World. He is all-pervading, everywhere, and he brings good crops and keeps a man from evil."

"But the Indians nominally are Christians, and observe Catholic feast days, don't they?"

"Yes," smiled the padre. "They want to be on good terms with God, and on not-too-bad terms with the Devil.

"Every village has its witch doctor who preys on the superstition of his people," the padre continued. "He pretends to deliver them from the evil designs of Ajau Juyú, the Lord of the Forest."

Near the lake I saw caves where smoke-blackened idols and wooden crosses showed that worshipers took no chances with their prayers.

Some time later I met Padre Antonio in Guatemala City and took him for his first airplane ride. At 6,000 feet I looked back to see how he was taking it. He was staring at the clouds through the cabin window, and I saw his lips form the words, "Hello, Peter!"

In a motor launch we visited some lake villages. At Santiago Atitlán I saw again the brilliant red wrap-around skirts and long ribbon headdresses that make up my favorite Guatemalan woman's costume. In Santiago live the Tzutuhiles, the tribe that resisted most fiercely the Spanish conquerors (pages 526, 527, 542-545).

Pugnacious Fresh-water Crabs of Transparent Lake Atitlán Make Delicious Soup

This fisherman of San Pedro La Laguna baits his trotline with stale fish. Here he hauls in his line and cautiously grasps a crab before it lets go the bait. Two others cling to the line beneath the surface.

© National Geographic Society — Kodachrome by Luis Marden

Twin Villages near the Capital Wear Almost Identical Costumes

Principally background color distinguishes blouses of women from San Pedro Sacatepéquez (left) and San Juan Sacatepéquez (right). Extra *huipiles* serve as shawls (page 534). Two-headed eagle of the Hapsburgs, suggestive of Charles V's arms, appears in the design of huipil at left.

On July 25—the day of St. James—in Santiago I watched the ceremonial dance of the Conquista. In this dance, woolen-masked figures dance out the history of Guatemala's conquest by Pedro de Alvarado in 1524.

About 20 dancers, in costumes of bright cotton and velvet, dance and declaim speaking parts that run to more than 40 typewritten pages. The color of hair, beard, and mustachios carved into the masks distinguishes the dancers; Spaniards have yellow hair and beards, Indians black.

High singsong voices issue from expressionless wooden faces as performers shake rattles and move to the music of drum and *chirimia*, a nasal, musettelike instrument (page 541).

The climax of the dance comes when Pedro de Alvarado lances to death Tecún Umán, war chief of the Quichés.

In a Guatemalan Indian religious festival, everything revolves around the *cofradía*, a sort of brotherhood that has care of a particular saint. For a year the image of the saint rests in the house of the chief *cofrade* (page 538).

During a festival, while cofrades gather to perform rituals before the saint, women in adjoining rooms prepare pungent hot *atol*, a thin gruel of ground corn and cacao spiced with chili peppers, anise, and other condiments. Cofrades ceremoniously drink the hot atol from a special gourd.

Marimbas for Saints

Then they carry saints' images to the courtyard and dance and play marimbas for them.

The marimba in its simplest form resembles the African instrument: rectangular wooden keys strung in a frame hang over dried gourds acting as resonators.

Don Mario Bolaños, noted composer of Guatemalan music, told me of the marimba's construction.

"The crude Indian marimbas have a range of little more than an octave; they have no halftones, or keys corresponding to the black keys on the piano. Big 'city' marimbas are usually divided into two instruments that between them encompass nearly ten octaves."

A "marimba" in the cities means the whole group of musicians: seven playing the two actual marimbas, plus a bass viol and drums.

The official Government marimba band, called *Maderas de Mi Tierra* (Woods of My Native Land), uses practically no metal in its instruments. Keys are made of *hormigo*, frames of mahogany, and the resonators of Spanish cedar. Players use mallets of quincewood, tipped with balls of crude rubber.

In the hot coast lands near Retalhuleu, I later saw the tall *hormigo* tree, from the reddish wood of which marimba keys are cut. Indians call the tree the "wood that sings."

Guatemalan marimbas, particularly in the bass notes, resonate with a peculiar rattling sound. The makers achieve this effect by stretching a piece of pig intestine over a hole near the bottom of each resonator. Rings of tacky black beeswax hold the membrane stretched tightly over each hole.

"Marimba players in small villages have to keep an eye on the gobs of wax on the resonators," said Don Mario. "Small boys like to steal the wax and chew it."

Marimbas in the big towns play everything from serious music to jazz, but village marimbas usually play only the *son*, the national dance rhythm of Guatemala.

From the lake the road climbs higher into the mountains; through Sololá, where Indians gather on Friday in the market place that overlooks the blue lake far below (pages 529, 564), and on to Santo Tomás Chichicastenango, center of the Quiché tribe, and a town well known to visitors to Guatemala (pages 553-556).

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Father and Son Furnish Music for Ceremonial Dances in Sololá

Thin, reedy music of the *chirimía* (musette), punctuated by off-beat booming of the drum, makes discordant music to the foreign ear. Like bagpipe music, the notes all sound alike at first, but with time some ears can distinguish different tunes.

Here Indians pray on the steps of their classic white church, swinging censers as they slowly work their way up to the church entrance.

Ribbon Weavers and Costume Makers

West of Chichicastenango, through Totonicapán, town of the ribbon weavers and Conquista-dance costume makers, past San Francisco El Alto of the great Friday market, lies 7,650-foot-high Quezaltenango, second city of the Republic.

Set amid yellow wheat fields, it has the barred windows, cobblestoned streets, and other-century quiet that the capital has lost.

In Quezaltenango I saw carved jadeite rings and pendants from ancient ruins (the capital of the Quichés was near here), and in bookshops I examined vellum-bound volumes three centuries old.

I visited Quezaltenango in September, time of the annual fair (page 561). In a mock Indian town representatives of a dozen outlying villages set up displays in thatched huts. While I looked at prize fruits and vegetables, a delegate from one village, asking if I was an American, handed me two enormous potatoes, saying, "Please give these to the President of your country. Tell him the Indians of Quezaltenango are well and hope he is the same."

Kodachromes by Luis Marden and Helen E. Williams

Babies Dress Like Mother—Shy Village Girls Cover Their Faces from the Camera's Staring Eye

The Atitlán mother stands beside two corn-filled wooden back packs, *cacaxtes*. A folded sleeping mat rests on top of one; to the back is tied a rolled-up palm-leaf raincape. Once a week, unmarried girls of Santiago Atitlán water and sweep out the church. Indian women go barefoot; most men wear sandals.

Long, Tight Wrap-around Skirts Cause Santiago Atitlán Women to Walk with Short, Shuffling Steps

Animals Parade Around Halo Headdresses as in a Film Strip of Noah's Ark

Because of a shortage of dyes and threads, ribbons for Atitlán's headdresses are shorter and plainer than before the war. Traditionally, the outer part of orange ribbon displays stylized green figures of rabbits and other animals.

Kodachrome by Luis Marden

"Is He Still Up?" Women Crane Their Necks to Watch Men Ride Wild Bulls

Nearly every Guatemalan festival features a rodeo. Of three principal tribes, fierce Tzutuhiles of Atitlán gave conquering Spaniards most trouble. Different dress and features distinguish the two Sololá women (left center).

Thick Hide of This Vegetarian Sea Cow Turned Rifle Bullets Like Armor Plate

White patches between the manatee's eyes show where shots glanced harmlessly off the inch-thick skin. Harpooned by a hunter on Lake Izabal, this large mammal will furnish welcome meat for villagers (page 552).

Imitative brethren, seeing what he had done, immediately pressed forward and, each shouting his name and village, pressed on me corn, apples, squash, sweet potatoes, blocks of sulphur, bottles of mineral-charged waters (the area is rich in hot springs), cabbages, carrots, cauliflowers—all for the President of the United States.

On my return to the capital I turned over the more durable items to Ambassador Kyle, who wrote a letter of thanks in the name of the President to each municipality.

To the northeast, on the road that some day will reach the Department of Petén, Cobán, almost in the geographical center of the Republic, grows premium coffee.

Many Germans owned coffee plantations in this area, and Cobán Indian women, noted for their cleanliness and good looks, often show an admixture of blond blood. Cobaneras wear a lacy white huipil (or similar ones of silk or satin) decorated with brilliant garlands of flowers or a conventional design around the neck called "little boxes and snails."

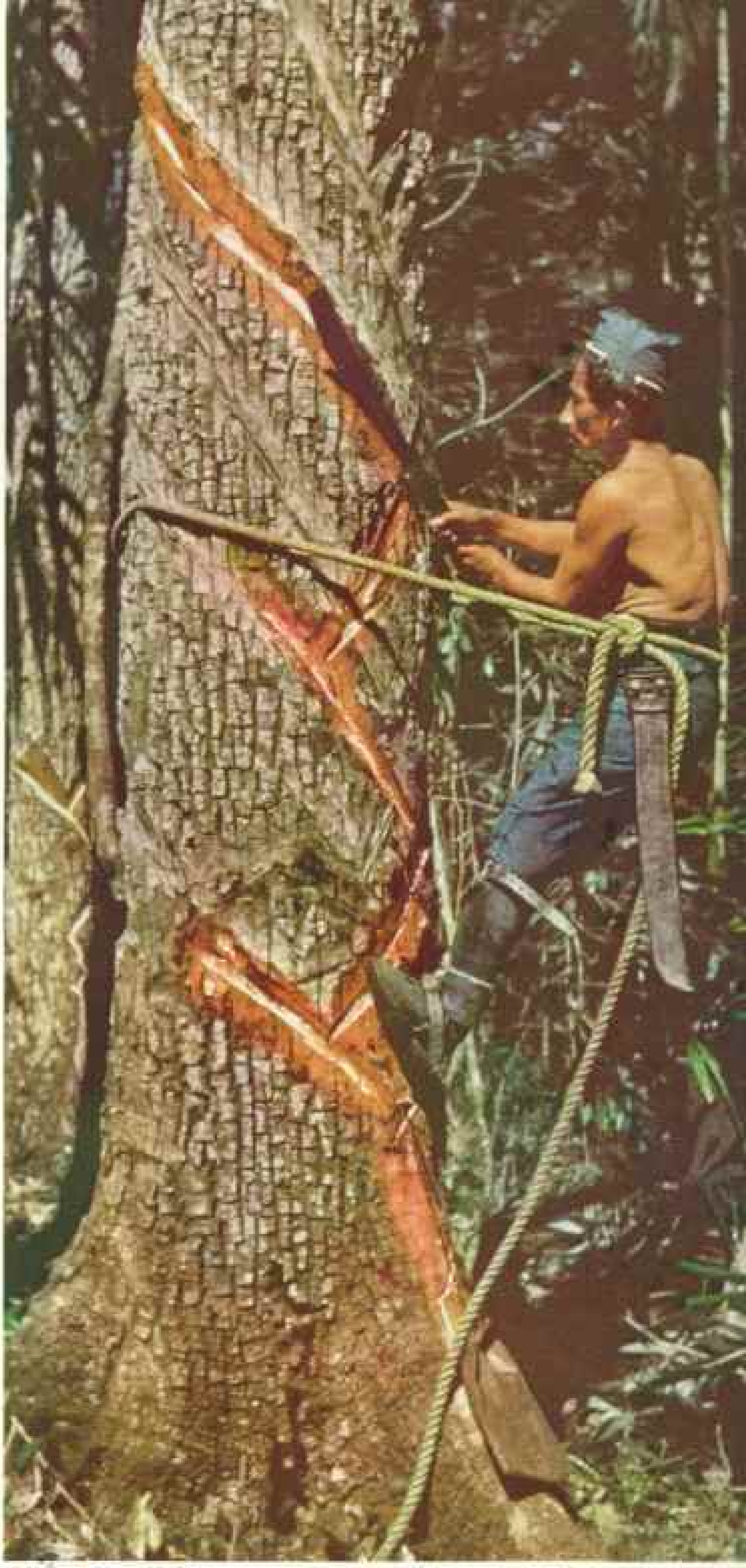
I flew to Petén in a U. S. military airplane with C. W. ("Buster") Smith, of the Chicle Development Company.

The Department of Petén consists of a great forest-covered limestone plain that stretches to the Mexican border. Averaging 400 feet above sea level, this dense jungle of 12,000 square miles is the home of jaguars, monkeys, macaws, turkeys, curassows, peccaries, deer, and snakes.

The Land of Mayas and Chicle

In this hot luxuriance flourished Mayas of the Old Empire. Beginning their vast building in central Petén, the Mayas trekked northward through the centuries, abandoning their stone cities. No one knows for certain why; some think farmlands about each city became exhausted. Finally they emerged in a new burst of building and artistic splendor in the New Empire cities of Yucatán.

Today, chicle tappers follow trails in the green twilight, seeking the scattered sapote trees that exude the latex from which chewing gum is made.



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Chicle for Chewing Gum Flows in the Petén Jungle

The latex comes from sapote trees which must be searched out individually. The heavy red wood was used in Maya construction, but cutting is prohibited today. Chicle gatherers tap each tree once every four or five years (page 548). Looking for new trees, they have discovered Maya ruins.

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A Quiriguá Stela Wears a Bird-nest Beard

Ten centuries have not changed the stolidity of the Buddha-like face on the largest stela. Tall monuments, monstrous-shaped "zoömorphs," and ruined buildings mark this Maya site, near the railway line between Puerto Barrios and Guatemala City.

As we flew north, the blue mountains of central Guatemala diminished and leveled into the flat green carpet of Petén. Smith pointed out clumps of higher trees that pushed above the forest level. "Sapotes and mahoganies are the tallest trees in the forest. Sometimes sapotes reach a height of 125 feet and a thickness of a yard.

"Most of the world's supply of first-grade chicle comes from Petén and southern Mexico," Buster continued. "And about a third of it comes from right here," pointing straight down.

During the war many *chicleros* took to rubber cutting and labor was scarce.

A sheet of water, Lake Petén Itzá, appeared on the horizon. As we approached we could see Flores, the town on an island in the lake, with houses so crowded they seemed about to spill off into the water.

Beyond this ancient capital of the Itzás, the ruins of Tikal thrust their bony fingers into the air. Verdure-covered mounds swell up from the jungle floor, and above them white limestone towers rise to a total of more than 200 feet above the ground.

In all, about 25 ruined cities and towns have been named and partly explored in Petén. How many more there are no one knows.*

Years before, I had flown low over the jungle, looking for ruins. From the air it was easy to make out the outlines of ancient streets and plazas, appearing as fainter lines against the dense green of the vegetation.

The Birth of Chewing Gum

Landing at Carmelita, north of Lake Petén Itzá, we struck off into the jungle, following a spongy wet trail between the liana-hung boles of giant trees. Close to a clear little stream we watched a tapper at work on the trunk of a tall sapote (*Achras zapota*).

The chiclero reminded me of rubber cutters I had seen in the forests of

* See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Foremost Intellectual Achievement of Ancient America," February, 1922; "Unearthing America's Ancient History," July, 1931; "Yucatán, Home of the Gifted Maya," November, 1936; "Chichen Itzá, an Ancient American Mecca," January, 1925; and "Excavations at Quirigua, Guatemala," March, 1913, all by S. G. Morley; and "Preserving Ancient America's Finest Sculptures," by J. Alden Mason, November, 1933.

With a Façade Like Cake Icing, La Merced Remains Best-preserved of Antigua's Churches

Rampant Stone Lions Guard the Intricately Carved Entrance to an 18th-century Antigua House

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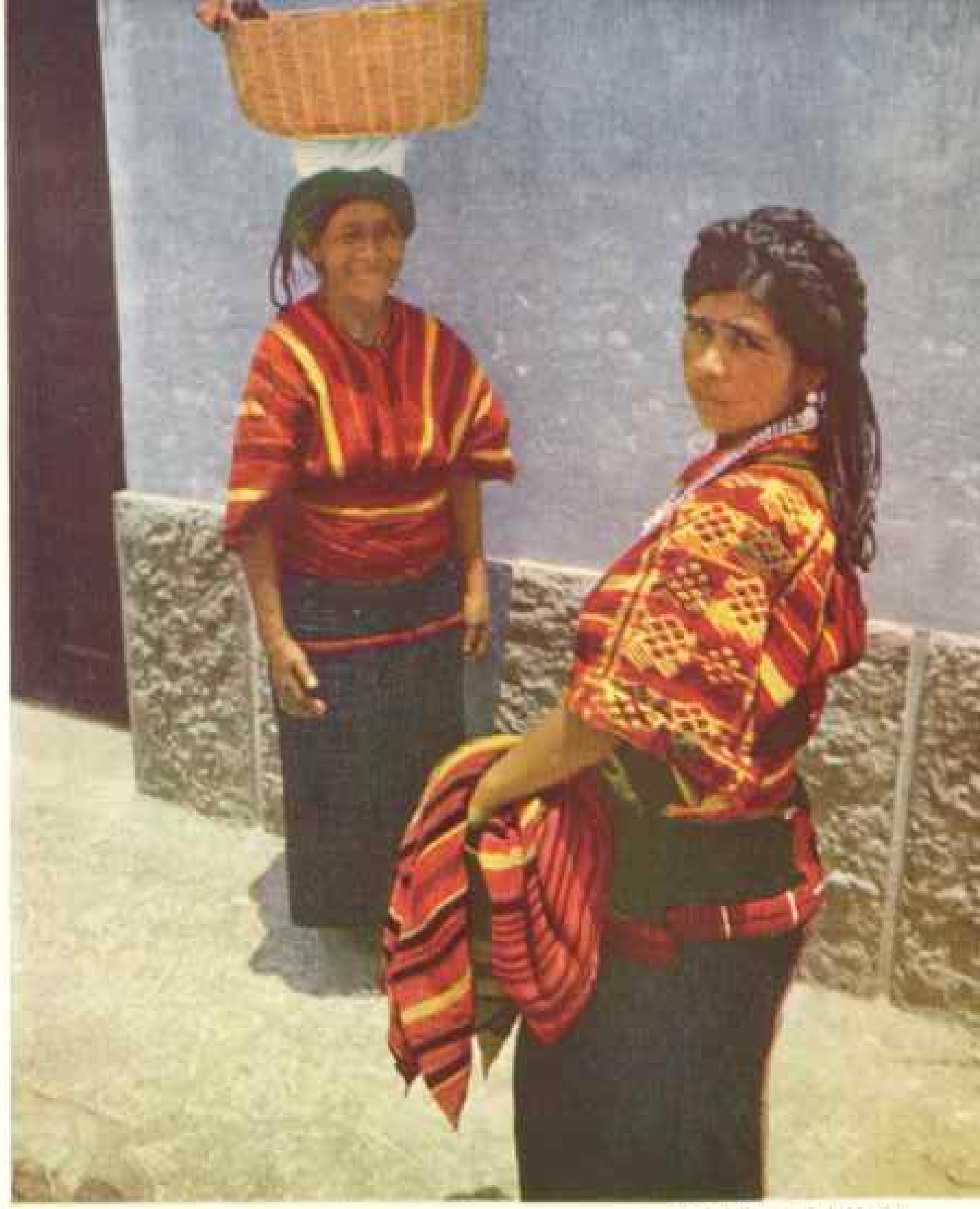
In Momostenango She Prays with Incense



Kodachromes by Luis Marden

Workaday Garb Meets Festive Dress in San Juan Sacatepéquez

Nicaragua, with his stiffened trousers and cap, thick with the drippings of countless chicle bleedings.

First, he lifted a splinter of bark near the base of the tree; under this he inserted a canvas bag. From the bag he hacked with his machete a series of cuts up to the first branches high overhead (page 547).

"Unlike rubber trees, which may be tapped regularly," said Buster, "sapotes should be tapped only every four or five years. That's why cutters have to wander far afield from a base camp to look for more trees, since sapotes never grow in a solid stand. A cutter can tap six to eight trees a day.

"But," Buster smiled, "he won't run out of material, as there are about 30 million trees in Petén. Approximately three-quarters of these have already been tapped at one time or another."

Dense red sapote wood was used by the old Mayas in building. In Yucatán I have seen sapote lintels a thousand years old still soundly supporting their burdens of stone. But today the Guatemalan Government fines anyone who cuts down a sapote tree $50. They are worth much more standing.

Chicleros boil chicle in big three-legged iron pots—the kind cannibals in cartoons boil missionaries in—then pour the hot liquid into molds. Hardened blocks go by air to Guatemala City or to Puerto Barrios. Guatemala's export of chicle has been worth from two to three million dollars annually in recent years.

If you fly from Petén down to Puerto Barrios, on the Caribbean, you may pass over another lowland lake: Izabal, close to the port of Livingston.

Travelers making the circuit from Cobán to the coast go by auto road through places with names like bird sounds in the night: Tamahú and Tucurú, then by road and rail to Panzós, on the Polochic River. From here a launch will take you to Lake Izabal.

A Hunt for Manatees

I was curious to see if manatees (*Trichechus manatus*) still existed in the lake. An American colonel in Guatemala City had told me how, years before, he had seen sea cows sitting in the shallows of the lake and munching weeds, like hillbillies gnawing turnips.

Manatees are big herbivorous mammals with a snout flattened at the end and a round spatulate tail.

Supposedly the sea cow gave rise to the mermaid legend in the days of sailing ships. One may wonder how anything so ugly (page 546) could pass for a woman. After a sailing voyage lasting many months, an old-time sailor might not have been too critical, particularly of animals whose females sit upright and nurse their calves by holding them against their breast with one flipper, in a curiously human fashion.

At El Estor on the northern shore of the lake I asked for a manatee hunter. A little man stepped forward. "My name is Tranquilino García," he said. The name seems to go with hunters of water animals; in El Salvador another Tranquilino had shown me how to capture four-eyed fish.*

"I am the last of the manatee hunters," said Tranquilino. "In my youth I used to go out with my grandfather, father, and brothers, but now I am alone."

Tranquilino puffed on a bulldog pipe. Waving an arm, he said: "The beasts live across the lake. They feed on grass on the lake bottom, but have to come up regularly for air. I'll go ahead in one canoe; you follow with the cameras in another."

Across the lake we disembarked at a village that looked like something in the South Seas. Before straw huts on the beach sat women from 12 to 60, cracking nuts of the coyol palm (*Acrocomia*), from the kernel of which oil would be extracted.

The women wore only a blue wrap-around skirt and a necklace of red beads. With brown breasts rising and falling to the rhythm of the pounding, they nodded their heads and told us, "Plenty manatee in the bay."

Taking his seat in a dugout canoe barely big enough for one man, Tranquilino wrapped his arm about a paddle, clamped his pipe between his teeth, and glided out over the smooth water. We followed in a larger dugout.

Harpooning a Sea Cow

Paddling silently over the 15-foot-deep glassy water, Tranquilino suddenly held up his hand. Ten yards ahead the shiny skin of the surface broke to the roll of a glistening gray-brown back; then a flat, round tail tipped up and disappeared. Across the water came a sighing "ah chuff" of exhaled breath.

Silently (the slightest sound frightens a sea cow) Tranquilino changed direction. He seemed to know where the animal would surface next. When it breached again, this time close to the boat, Tranquilino was ready. Without relinquishing his grip on the pipe, he lifted and hurled the harpoon with one movement. It struck home, and the sea cow sounded with a resounding whack of its broad tail.

* See "Coffee Is King in El Salvador," by Luis Marden, NATIONAL GEOGRAPHIC MAGAZINE, November, 1944.

Firecrackers Pop and Sizzle as St. James Rides a Tightrope on All Saints' Day

On feast days, celebrants haul the horseman up and down from the belfry of Santo Tomás Chichicastenango. The effigy wears a necklace of 300-year-old pieces of eight; firecrackers explode in a basket under the horse.

In Staccato Quiché Language, a Religious Leader Harangues His Assistants Before All Saints' Day Ceremonies—Chichicastenango

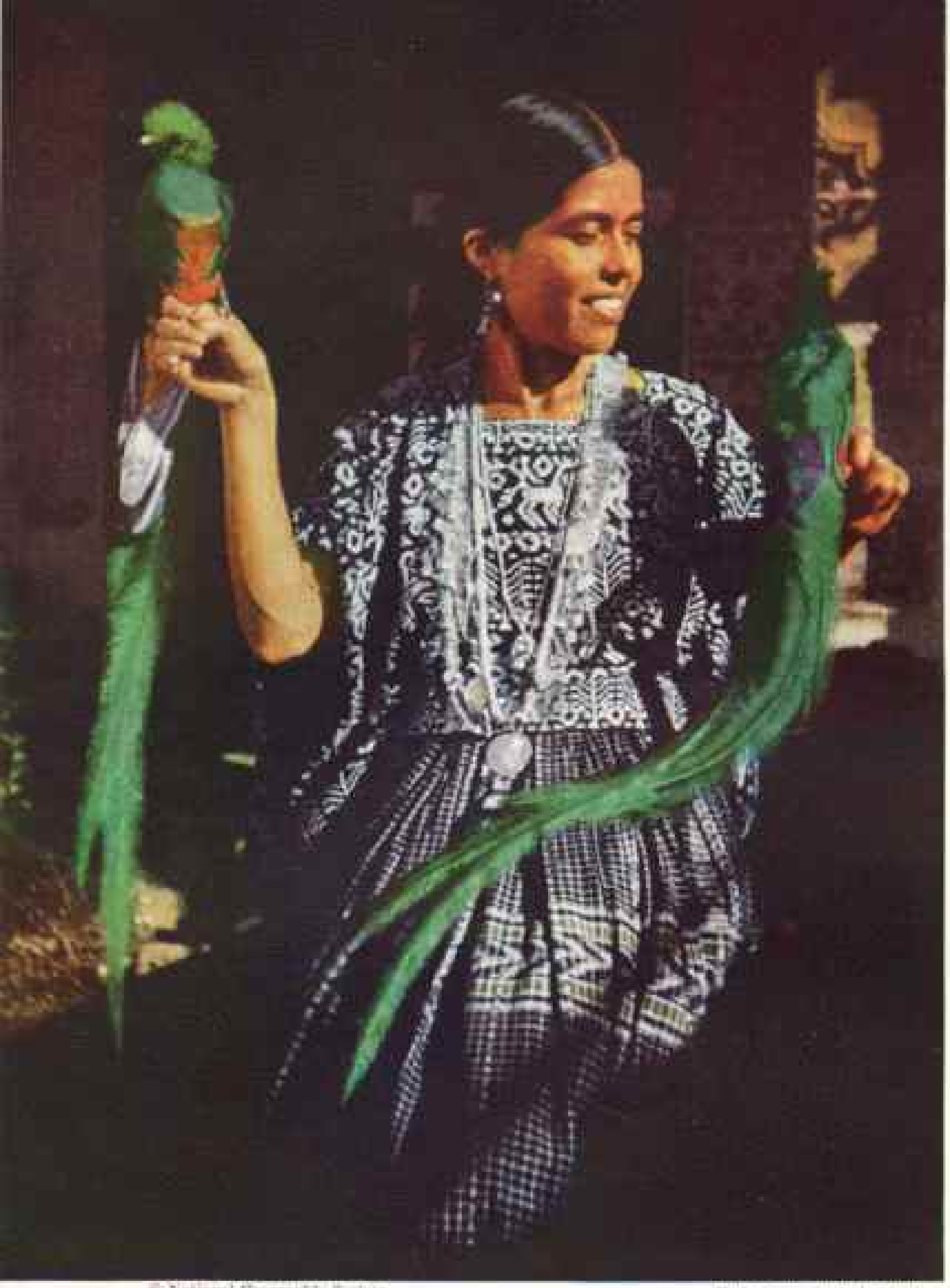
Reproduction by Luis Marden

A Chichicastenango Weaver Counts Colored Threads to Work Design and Owner's Initials into a Shawl

This Little Pig Went to Market and Came Back Again with a New Owner—Along the Highroad near Chichicastenango

Antonio Proudly Directs Religious Rites. Homeward-bound Women Walk in "Indian File"—San Juan Sacatepéquez

Babies ride on mother's back; market purchases fill baskets. Rarely do Guatemalan Indians walk abreast. Perhaps the habit comes from climbing mountain trails.



© National Geographic Society Kodachrome by Luis Marden

Long-tailed, Red-breasted Quetzals Symbolize Liberty and the Republic

A Cakchi woman holds mounted specimens of the national bird of Guatemala. Selected as the country's emblem because it usually languishes in captivity, the quetzal (*Pharomacrus mocino*) appears on the national coat of arms, coins, and stamps. Design for one Guatemalan postage stamp was taken from a color plate in the October, 1936, NATIONAL GEOGRAPHIC.

The shaft came away from the barbed harpoon and bobbed to the surface. The bobbin with its yards of line lay spinning rapidly in a wreath of bubbles.

Tranquilino picked up the bobbin, made fast the line, and blew a triumphant blast on a conch shell. The bellow, as of a wounded bull, brought his companion in a big canoe.

A second harpoon was thrown into the animal, the hunter transferred to the large canoe, and the manatee towed the dugout at a fast pace over the smooth waters of the bay.

Laboriously bringing in the line a foot at a time, the hunters struck repeatedly at the sea cow with a club. For nine hours they were towed up and down the bay, under a grueling sun, until finally they dispatched the animal close to the shore, and beached it with the help of enthusiastic villagers.

Fresh meat is scarce on Lake Izabal, and the manatee would furnish "three kinds of meat," said Tranquilino, "some like beef, some like veal, and some like turtle meat."

Rafts of Red Mahogany

We did not stay to taste roast manatee, but took with us some of the thick hide.

Sailing down the length of Lake Izabal, we descended the Rio Dulce, whose banks, luxuriantly covered with thick forest growth, seem nearly to meet overhead in places. We passed rafts of red mahogany logs floating down to Livingston on the Caribbean.

At Livingston we saw whips and riding crops made of translucent amber manatee rawhide. The flexible crops are so brutal a weapon that police regulations forbid their carrying in Guatemala City.

Livingston people assured me solemnly that "anyone struck with a manatee crop, however lightly, will shrivel up and die. Just touch someone with it in anger, and soon he is a husk, just like a mummy."

We saw many Caribs in Livingston. Though black, they are not Negroes, having a different cast of features and straight hair. They speak and write a special jargon of English, similar to that of British Honduras and West Indies Negroes who live along the coast.

Just before I left Guatemala I went up to Momostenango, high in the Altos, 65 miles northwest of the capital. Nearly 7,300 feet above sea level, Momostenango glistens in its high perch. The clear air burns in the nostrils like menthol.

This is Guatemala's blanket center. Every Sunday buyers from the neighboring towns

Slanting Rays of the Setting Sun Gild Guatemala City's Cathedral in Central Park

The guard stands at the entrance to the imposing new National Palace, built in 1943 (page 530). Fountains in its patios fall into blue-and-yellow-tiled basins. Bronze quetzals surmount chandeliers in the state reception room.

Before Partaking of a Ceremonial Meal, Women of a Religious Group Relax in Quiet Meditation

© National Geographic Society

Drums, Musettes Make Devil's Din at Quezaltenango Fair

Kodachromes by Luis Marden

Bell and Lolling Tongue Are Bull Dancers' Standard Props

Kodachrome by Luis Marden

Market Vendors Tuck Their Feet Under for a Comfortable Seat

Monuments show Maya ancestors of these women of San Antonio Aguas Calientes squatting in exactly the same position. In the market place of La Antigua, the old capital, they sell cabbages and other giant vegetables grown in the rich volcanic soil of the region. Hot springs gave their town its name.

and from the capital climb the road to Momostenango's open-air blanket market to finger and purchase. Blankets of every color and design lie in the sun to dry (pages 535, 563).

When I asked if vegetable dyes were still used, I was told, "Yes, particularly since the Indians were unable to get aniline dyes during the war."

I was shown pieces of orange, dark brown, and yellow wood, which, boiled with the wool, impart color.

"We get a purple dye from Brazilwood," said my informant. "*Palo amarillo*—yellowwood, gives a yellow color; from campeche wood we get a blue or black. The best blue, of course, comes from the indigo plant."

"How do you get the other shades?" I asked.

"Well, now it gets complicated. For green, we mix chips of campeche and yellowwood; red is either good aniline dye, or, in the case of very high-priced blankets, cochineal."

On Saturday night, weavers take their blankets to the river, deep in a ravine below the town, and pound and wash them in the warm sulphurous waters. If the colors stand the hot chemically charged water, they will stand anything.

Men, women, and children strip to the buff to beat the blankets; then, work finished, they bathe in bubbling pools. Huddled close together, their glistening bodies flickeringly lighted in orange and yellow by smoking torches, the Indians form part of a scene like a Doré illustration for Dante's *Inferno*.

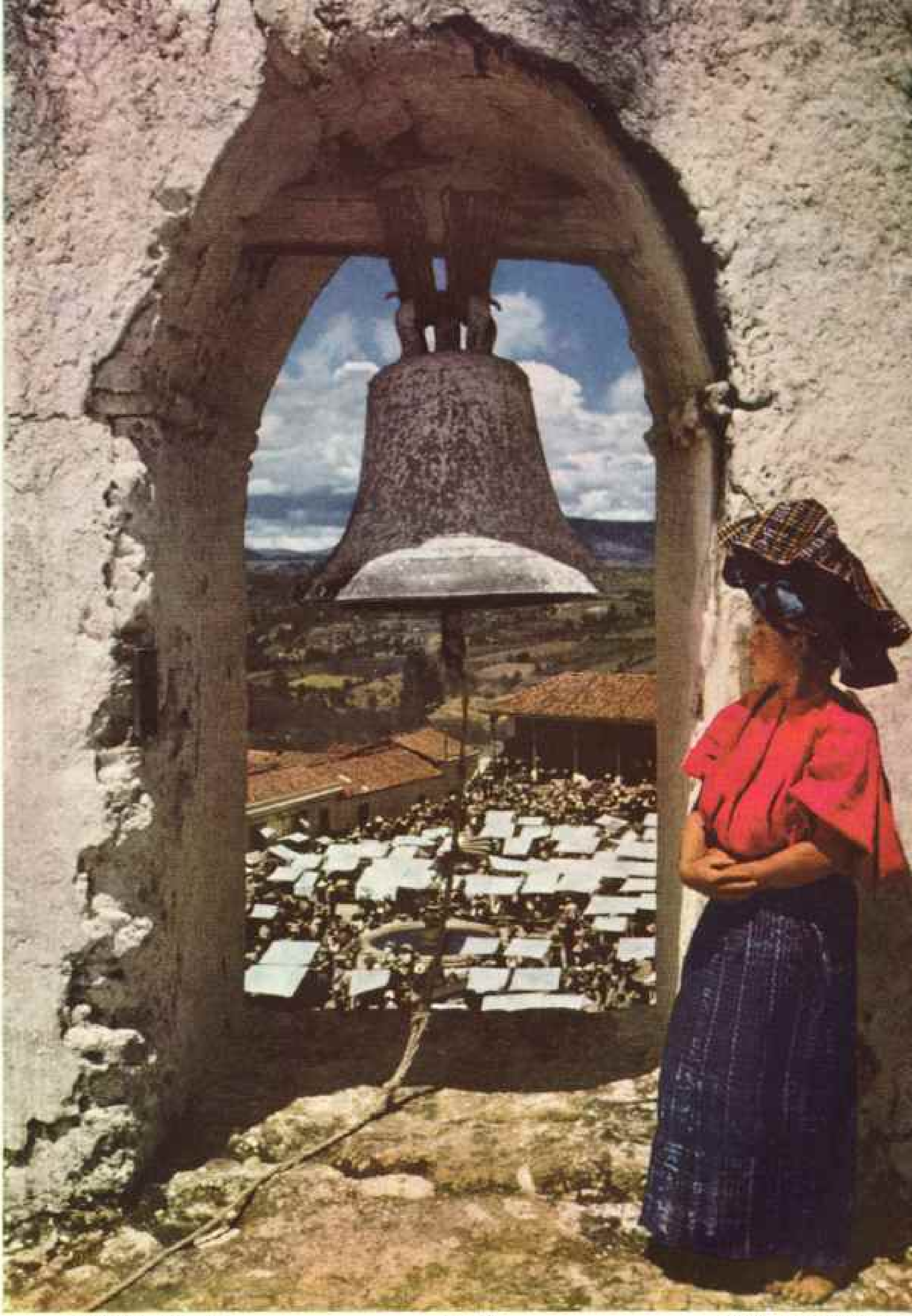
When I made pictures of blankets drying in the sun until long past lunch on Sunday, my Indian interpreter reminded me, "*Patrón*, the stomach is asking for tortillas."

The Lord of the Burning Place

High on a hill above the town rise mounds of broken potsherds. These are the *quemaderos*, the burning places of Momostenango, the altars of God World. Here worshipers light candles and pray on holy days of the *tzolkin*, the 260-day Maya calendar.

Though heads of families may make their own invocations, they usually employ a *chuchcajau*, or Lord of the Burning Place, who for cigarettes, bread, chocolate, or 25 cents, will intercede with the deity on their behalf.

Most important day of the year in the Momostenango region is Guajxaquip Bâts—the day of Eight Thread, sometimes translated Eight Monkey. It comes around once every eight months and fifteen days of our calendar, at which time some 15,000 Indians come down from the hills to pray at the burning places.



Kodachrome by Luis Marden

To San Francisco El Alto Market, Maria Brought Her Momostenango Blankets (p. 535)

Kodachrome by Luis Marden

Black Hats and Somber Clothes Denote Chief Men on Corpus Christi Day

Ordinary citizens wear costume at left. Checked wrap-around knee-length skirts over wide trousers add a curiously feminine note. Heavy wool jackets at center display stylized hat symbols. To keep vampire bats from lapping blood of cattle, Sololá villagers hang spined prickly-pear pads in stalls. Despite their voice "radar," bats occasionally impale themselves in the dark.

I was there on another holy day, the day of One Corn. As we climbed the hill to the altars, the ground glittered as if strewn with diamonds: tiny quartz crystals caught the light like miniature mirrors.

At the top my companion grasped my arm and whispered, "We are in luck," pointing to an old man with a patriarchal beard and a high conical straw hat. "That's the chief medicine man." Raising his voice, he asked, "May we join you, Señor Poronel?"

The old man courteously lifted his pointed hat and nodded. We walked after him between the mounds of smoke-blackened pottery fragments to the biggest altar, called Big Broom. Little hollows in the jagged piles held stubs of yellow candles, dead marigolds, and ashes of incense.

The old man climbed to the topmost burning place of the mound, while his wife and son waited below. Unwrapping the corn husks from a package of copal wafers, he lighted a disk of the resin and began to pray.

As the blue smoke spiraled upward, I became aware of a droning and muttering around me. Through the clouds of incense smoke I could see figures of men and women kneeling before flickering fires.

The medicine man prayed in his sibilant, staccato tongue, occasionally lapsing into Spanish. The smoke grew thicker.

Opening a little knitted bag, the old man strewed bright red beans and shining quartz crystals on the black ashes. He muttered and waved a hand in our direction.

When he had finished I asked, "Señor Poronel, what were you praying for?"

"Señor," answered the old man, "I asked God World to grant you and your friends a safe journey back to the capital and to your faraway country. But," he added, his kind brown face creasing into a thousand fine wrinkles as he smiled, "you will return. I have seen it in the crystals."

I said, in the Spanish phrase, "May God hear you." *

* See also, in the National Geographic Magazine: "To Market in Guatemala," by Luis Marden, July, 1945; "Guatemala Interlude," by E. John Long, October, 1936; and "Guatemala: Land of Volcanoes and Progress," by Thomas F. Lee, November, 1916.

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In addition to the editorial and photographic surveys constantly being made, The Society has sponsored more than ten scientific expeditions, some of which required years of field work to achieve their objectives.

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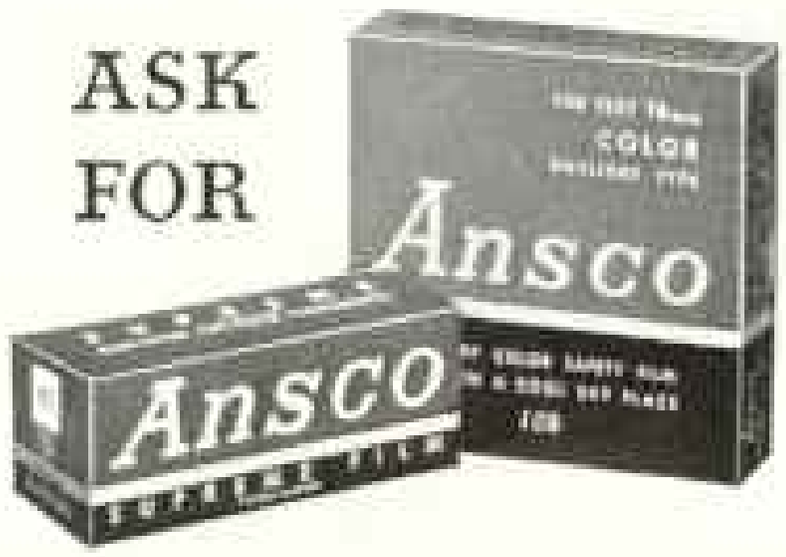

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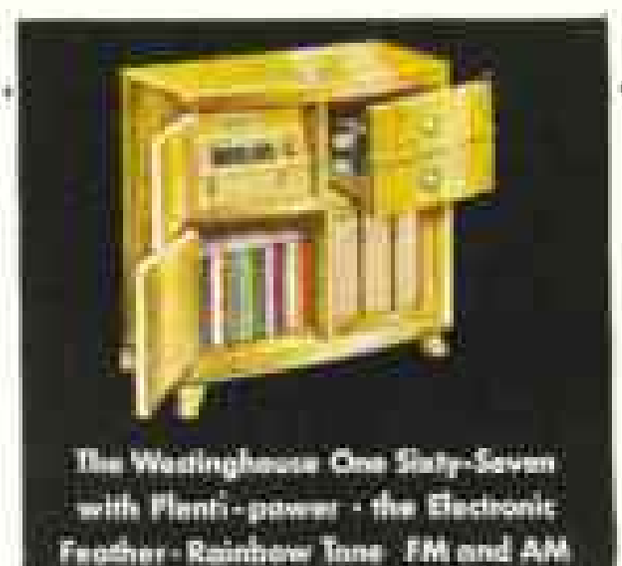

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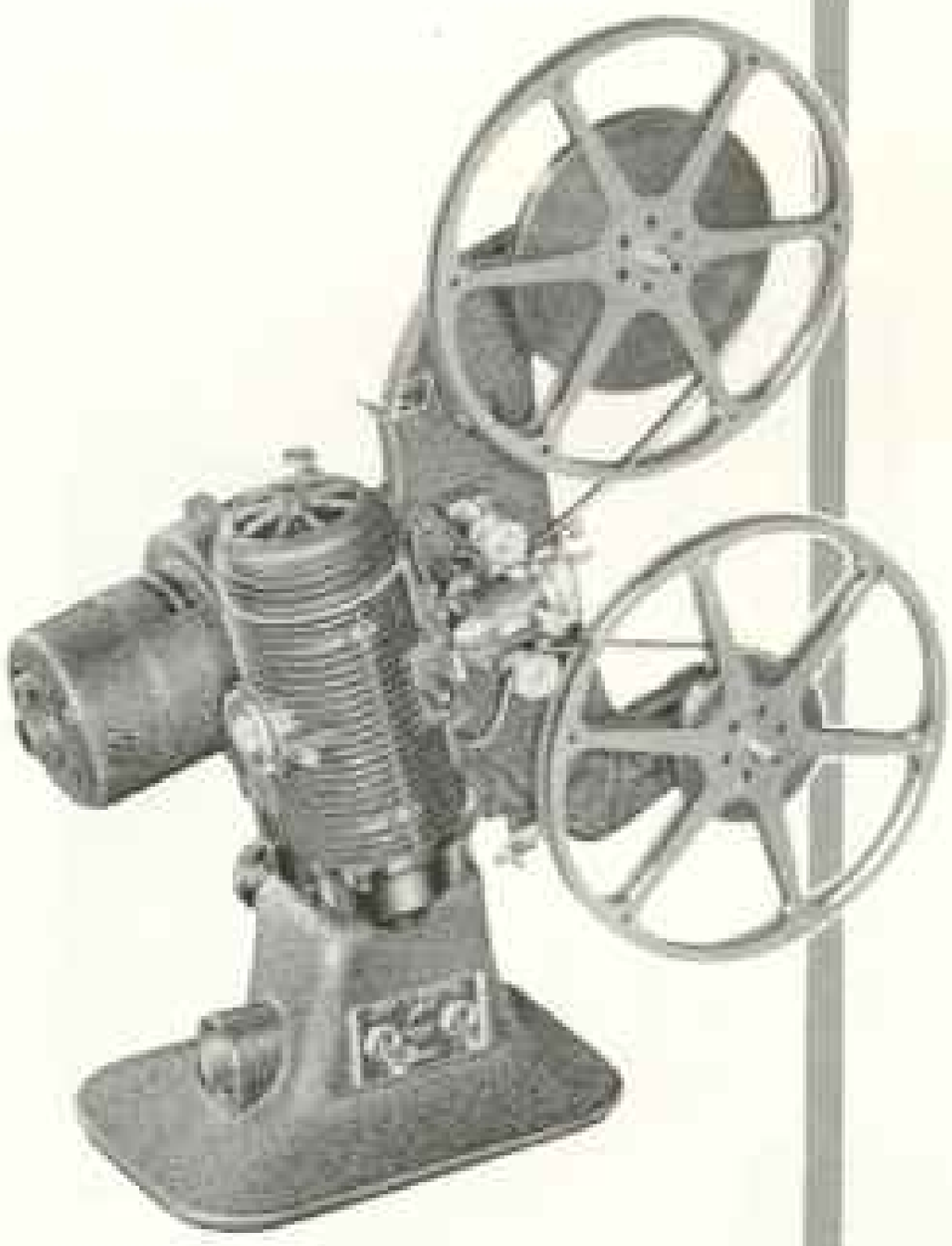

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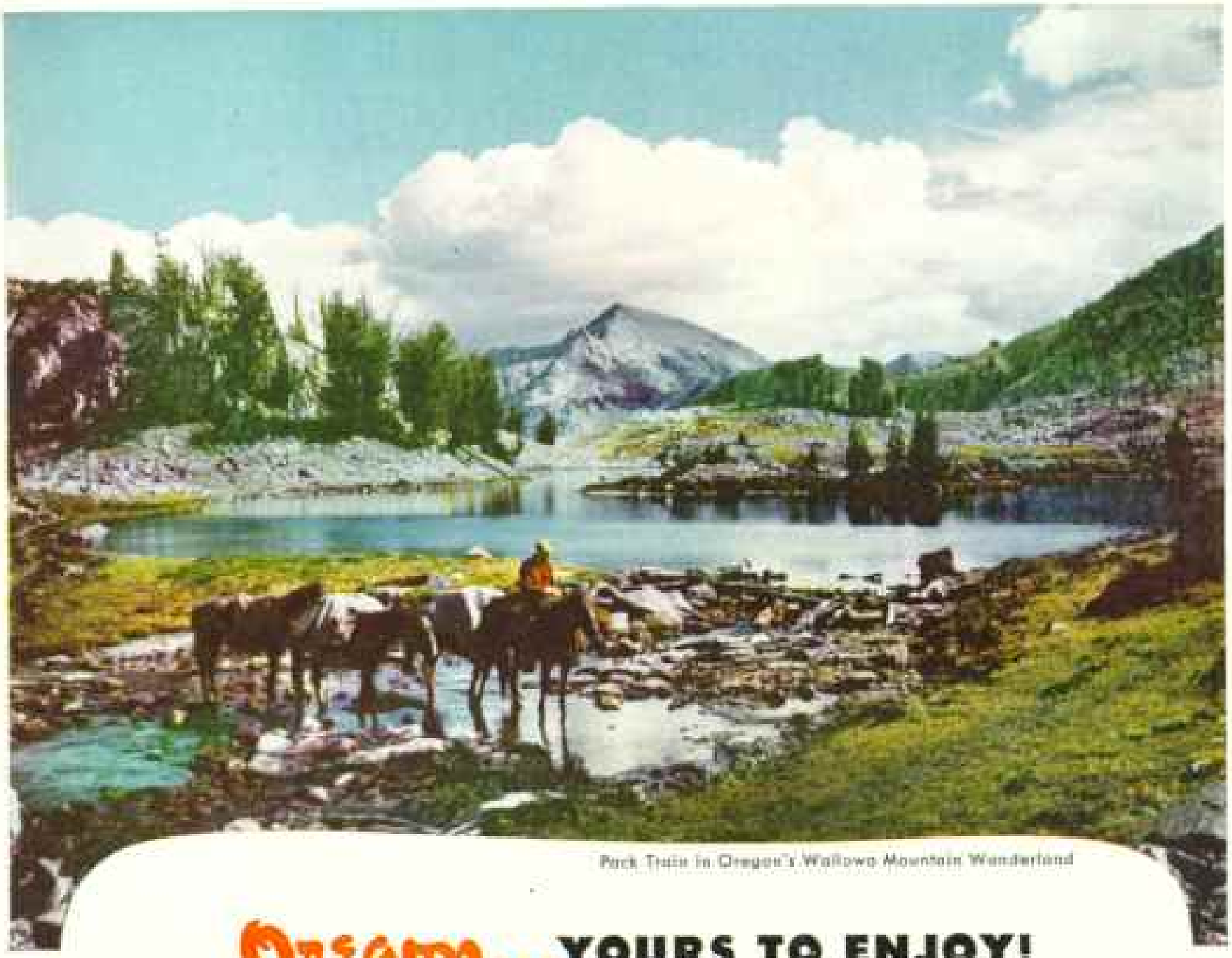

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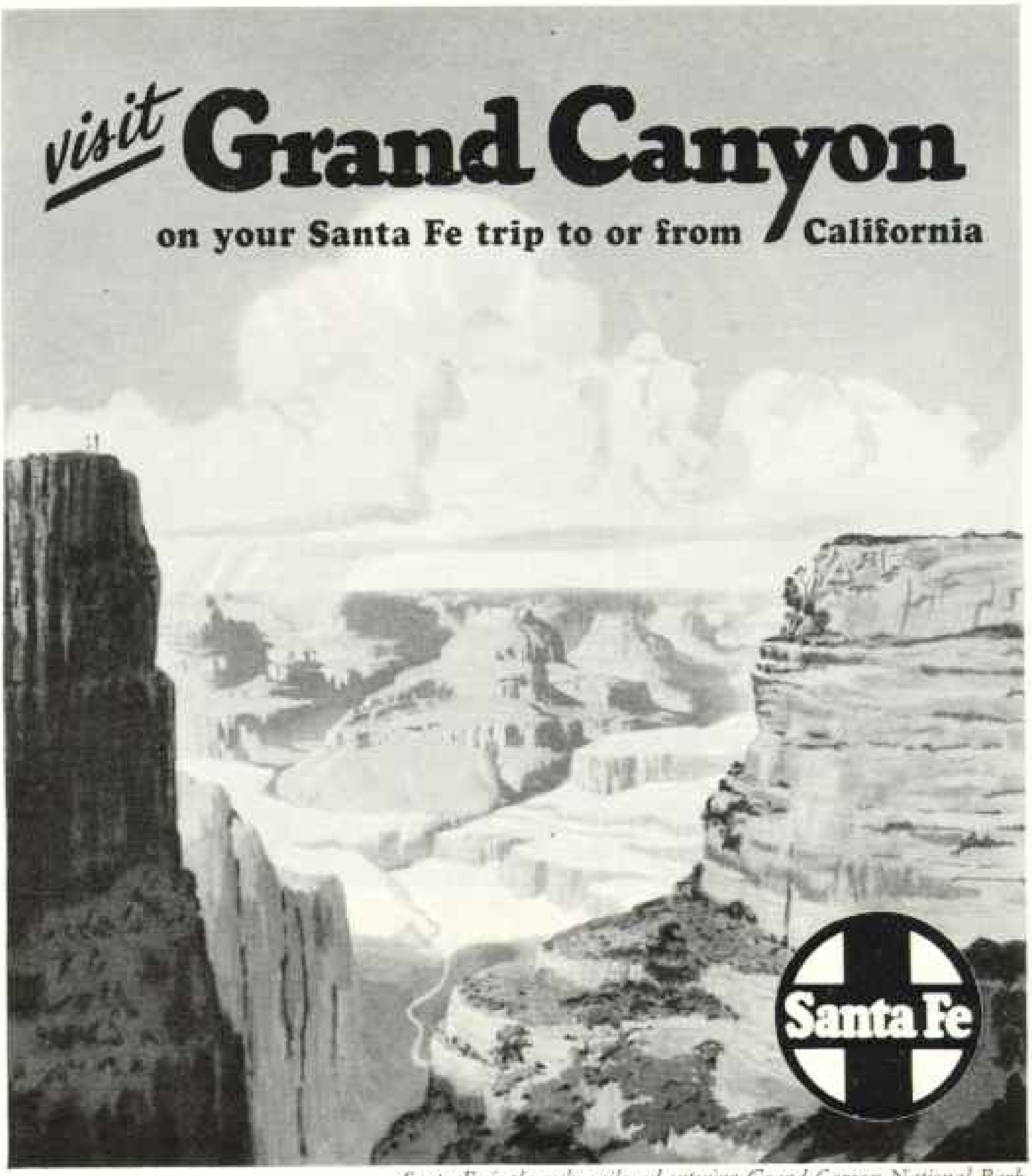

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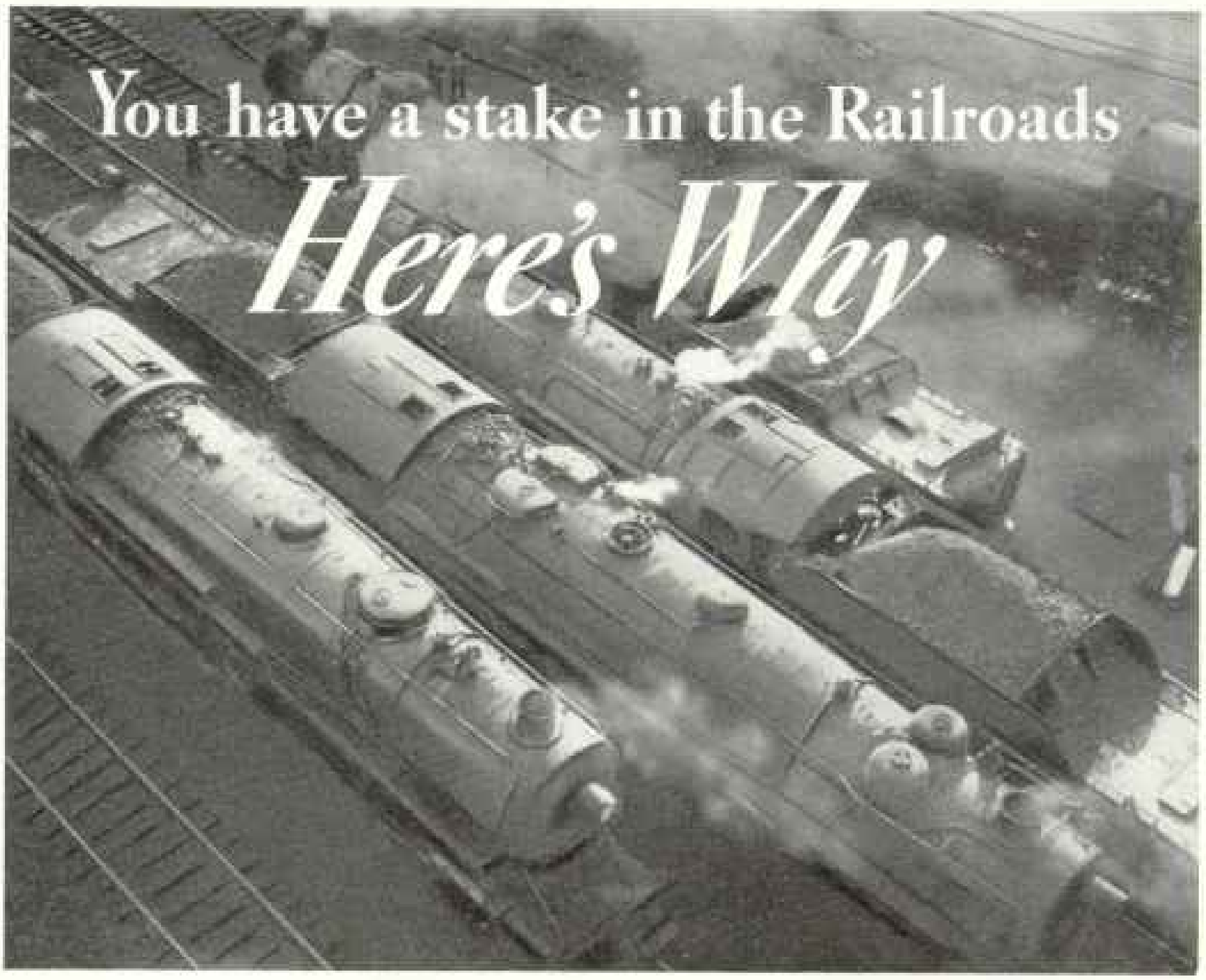

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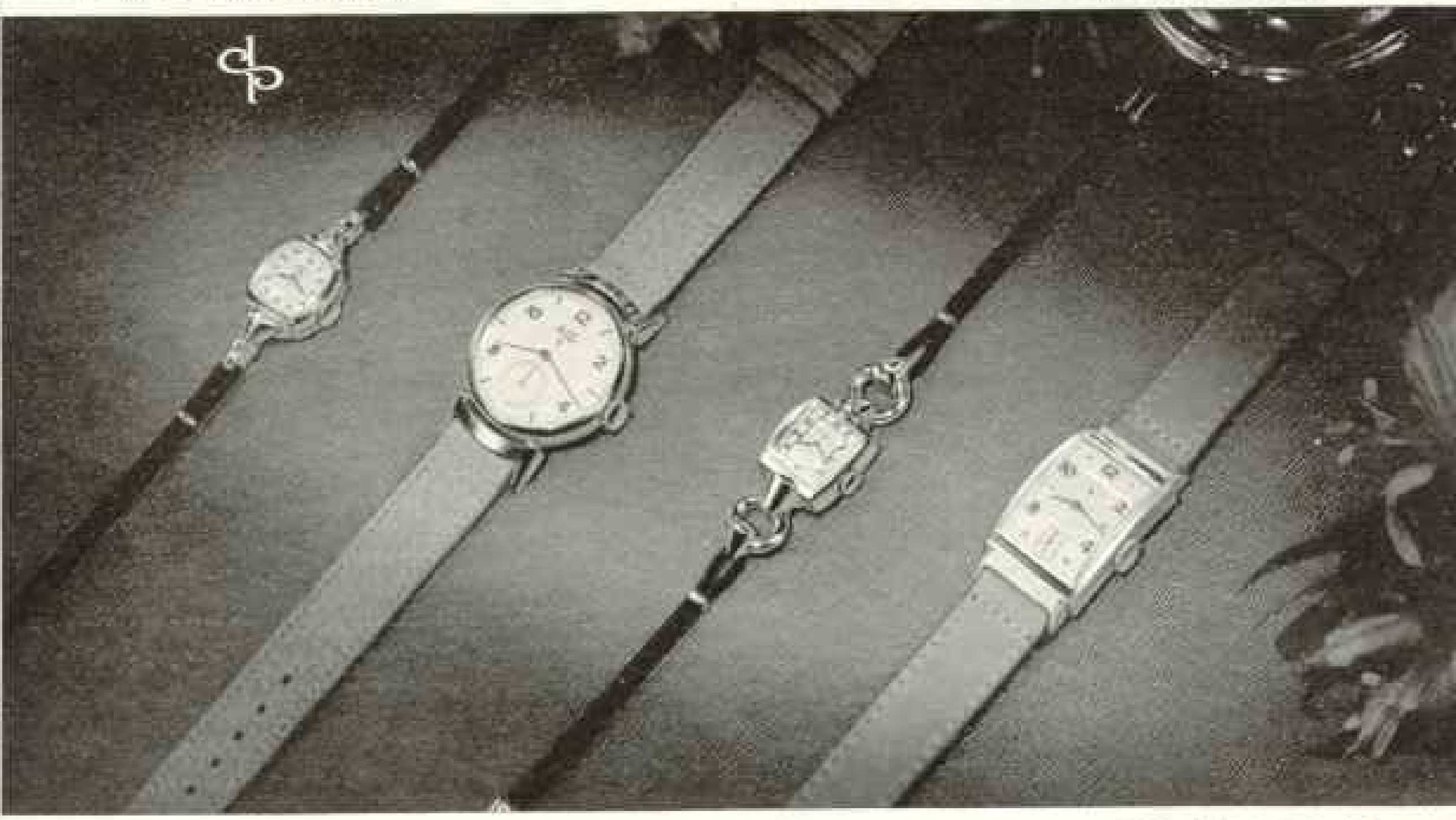

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The Smiths, of Roslyn, N.Y., cheer for General Electric's

AUTOMATIC SLEEPING COMFORT

"Cozy, restful sleep all night," say the Smiths. And more than *half a million* users of the General Electric Automatic Blankets agree!

One G-E Blanket (about 5 pounds) takes the place of three ordinary blankets (about 15 pounds). Saves storage space, saves buying winter night clothes. Cuts laundry bills. Certified washable by American Institute of Laundries. General Electric Company, Bridgeport 2, Conn.

Made to rigid G-E safety standards, and approved by Underwriters' Laboratories, Inc.

Automatic Blankets

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All sizes! One- or Two-Control, 72x86 inches (three-quarter or double beds), $39.95 and $49.95, plus tax. New, exclusive twin-bed size, 66x86 inches, $37.95, plus tax. Rose, cedar, green, blue. At department, furniture stores, electric service companies, G-E retailers'.

GENERAL ELECTRIC

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The added height (and better physical development) of most American-born children over their foreign-born parents is a story of better living conditions, better medical care and *better food.*

It's a story of more food and more kinds of food. Of an ever-increasing tendency to trade old notions about food for new facts. And especially of a widespread knowledge that fruit, vegetables, milk, cheese and butter, as well as bread, meat and potatoes, help build sound bodies and alert minds.

We're glad we've had a hand in helping develop the nation's important food resources. The meals a lot of people eat today will be better meals because National Dairy research staffs have discovered new and tasty ways to use milk and its many products.

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Q. Why see a doctor when you're well?

A. Health is more than an absence of disease. A medical examination permits your physician to determine whether you are as healthy as you can be, *and should be*, to live and work at your best. Or if you are below par, the doctor can often catch and correct trouble *before* a breakdown occurs. Most people should have such examinations once a year. In certain cases, and for people over 65, more frequent checkups may be desirable.

Q. Are "Fifth Column" diseases threatening you?

A. Diseases such as high blood pressure, cancer, tuberculosis, heart ailments, and diabetes may develop without any warning symptoms. But they can be detected by your physician, helped, when necessary, by blood tests, urinalysis, X-ray, fluoroscope, electrocardiograph, or other diagnostic aids. Annual examinations will usually lead to the discovery of "fifth column" diseases *in their early stages*, when modern medical science can do most to control or cure them.

Q. What about your daily living habits?

A. As part of your physical examination, the physician will probably check your daily living habits. He may ask about the amount and kinds of food you eat, whether you are getting sufficient rest and exercise, or how you use your leisure time. Knowing your daily habits may enable him to guide you to better mental and physical health. By following his instructions you may help assure yourself a longer, happier life.

To help you protect your health by observing sensible habits and simple precautions, Metropolitan has prepared a leaflet on selecting foods and one on general health habits as related to age. Write for free leaflets 107-N.

The Musaphonic shown above is the Stockton *Dress by Ceil Chapman*

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The Musaphonic Stockton is fashioned by master craftsmen in authentic Sheraton design of beautifully grained mahogany, patterned with marquetry of lustrous satinwood. All Musaphonic cabinets, classic and modern, lend new beauty to any room. If you've waited—even a bit impatiently—for your Musaphonic, you'll be glad. For now, at your Musaphonic dealer's, you can secure immediate delivery of one of the great musical instruments of all time. General Electric Company, Electronics Park, Syracuse, New York.

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Prophecy 1641

Prophecy 1641 - Fact 1947

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In 1946 automobiles killed 33,500 Americans. In 1947 careless driving *continues* on our streets and highways.

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1. Follow the line of traffic; don't be a "traffic weaver."
2. Keep your position on hill or curve. If you want to pass a car, do it on the level straightaway.
3. Let approaching car go by before passing car ahead.
4. Slow down for the car that wants to pass you.
5. When you have to stop, pull entirely off the pavement.
6. Be watchful for children.
7. Stop for a standing school bus.
8. Wait for the signal to "go," don't "jump" the lights.
9. "Stop, Look & Listen" at railroad crossings.

"If you drink, don't drive; if you drive, don't drink"

For safety on the highways, for safety in insurance—Look to Lumbermens! Automobile, Boiler, Compensation, Group, Liability, Hospital Insurance and Bonds, through local agents, nation-wide and in Canada.

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10-47

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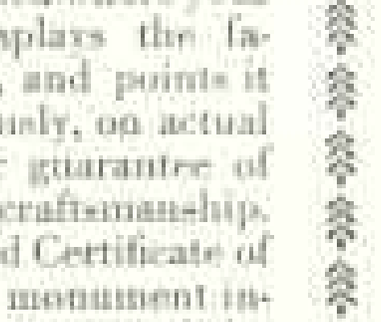

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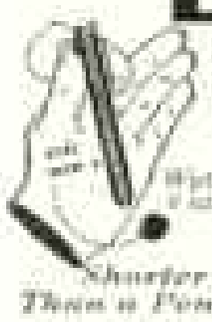

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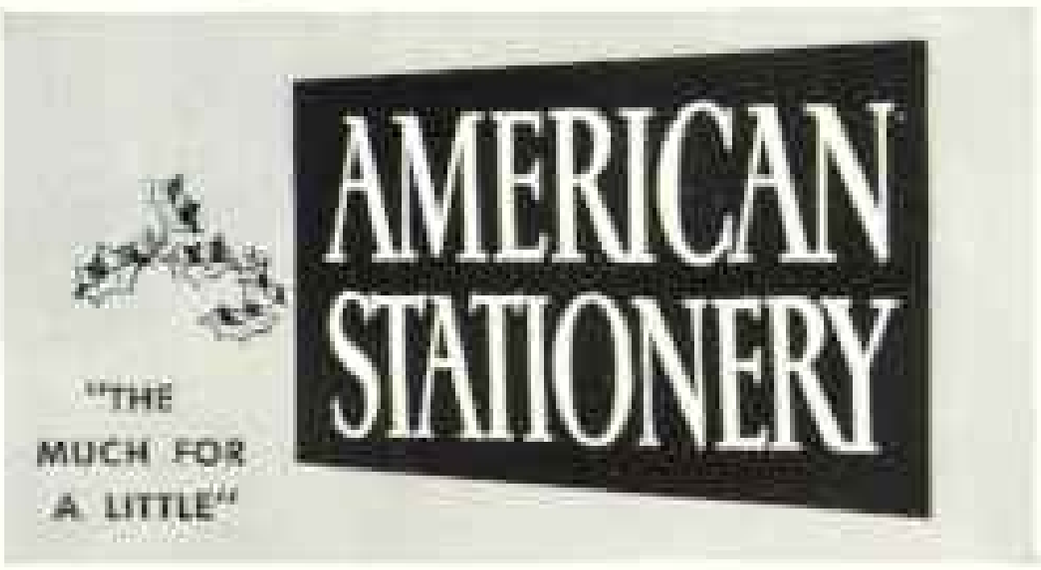

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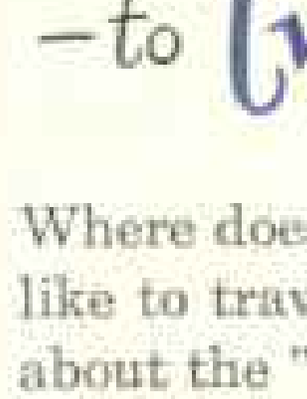

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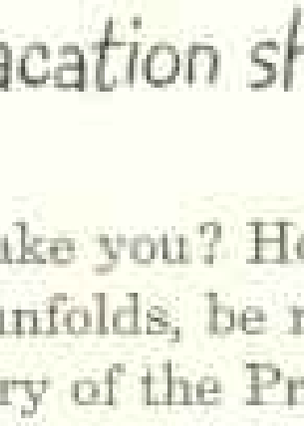

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