

as far into the pack as seemed

practicable, and when she was

stopped to renew the assault by air.

These tactics proved extremely suc-

The initial operations were auspi-

cious. Laying a course to fetch us

up at the intersection of the Antarc-

tic Circle and the 150th meridian.

we were gratified to break 136

miles past Cook's record, something

in these latitudes which had not

been surpassed in a century and a

half. The ship ultimately at-

tained Lat. 66.45 S., Long. 150.10 W.

It would have been imprudent to

risk driving her deeper into the ice;

so we withdrew her for fourteen

miles to a lovely open lake in the

pack, and there let aviation carry

The first flight carried us within

sight of the 70th parallel, close to

350 miles beyond the deepest pene-

tration in this region and within

300 miles of the coast of Marie

Byrd Land. To the limit of vision

along our track the sea was littered

Enticed by the likelihood that no

land lay nearer than the coastal

front we had discovered in 1929, I

decided then to run east to the

120th meridian, where Dr. Charcot

had made a deep penetration, and

try to gain the coast along that

meridian. Those many miles of

easting no man aboard the iron

vessel is likely to forget; it was

impressively instructive as to why

this area has so long resisted inva-

sion. We entered the heart of the

greatest ice-producing region in the

world, which we called the Devil's

Graveyard. For days we never saw

The ship felt her way past innu-

merable bergs in dense fog. On a

bright day Dr. Poulter, senior sci-

entist, estimated we saw 8,000 bergs

in twenty-four hours. On one day,

in fog and in a gale, we lay help-

less for an hour and a half in the

midst of them with our engines

Still we persevered, sometimes

sailing into unexplored waters. At

the 120th meridian the way south

was barred by heavy pack; so we

worked to the 116th meridian. The

ice here was none too favorable,

but time was getting short. On

Dec. 31 we reached the pack for

the second time, forcing the ship

forty miles south to Lat. 70.05 S.

From this point we withdrew five

miles, to take advantage of open

water for a take-off, and on Jan.

3. 1934. made our second flight, this

time to Lat. 72.30 S., Long. 116.35 W.

Altogether it was a dramatic

the burden of the penetration.

Littered With Pack.

with pack.

the sun.

stopped.

Flying in Fog.

cessful, risky as they were.

The second Byrd Expedition to **Antarctica** has completed its task and will soon leave Little America for the long voyage back to civilization. In the following article Admiral Byrd sums up the results of the expedition—the explorations at the flights into Marie Byrd which uncovered new territory and determined that Antarctica is one continent; the geological and geographical discoveries of the trail parties, and the contributions made **by the scientific** staff.

By RICHARD E. BYRD, Rear Admiral U. S. N., Retired. By Mackay Radio to THE NEW YORK TIMES. LITTLE AMERICA, Antartica.

NDLESSLY this question is asked about polar exploration: "What is the use of it?" In a certain sense science supplies the answer. Geographical discovery, the brightest weapon in an explorer's armory, is only an elementary tool for getting at something deeper. Exploration nowadays reaches dignity only when penetrating past the superficial concerns of latitude and longitude. It brings the modern apparatus of science to bear upon the unknown for a truer understanding of the known and half known. In the twenty-two-point program of this expedition, geographical discovery was only a single point.

Among the subjects studied by this expedition during its field operations are astronomy, meteorology, physical oceanography, biology, oceanography, vertebrate and invertebrate zoology, mammalogy, physiology, glaciology, stratigraphy, petrography, paleontology, tectonic and economic geology, geophysics, physical geography, cartography, physical and terrestrial magnetism, bacteriology and botany.

The expedition has had the distinction of carrying cosmic ray research into the highest Southern latitudes thus far attained in the adventuresome pursuit of this most fascinating of newly discovered phenomena; of initiating the first meteor-observation program in Antarctica, with spectacular results; of introducing up-to-date technique in polar meteorology; and of gathering the first authentic data as to the thickness of the South Polar ice cap, thanks to the seismic sounding apparatus, the preliminary hints of which may radically change our conceptions of Antarc-

The most casual survey of these subjects shows they are not esoteric and peculiar to remote places. Many of them are of every-day sigmificance in civilization.

ON THE WAY.

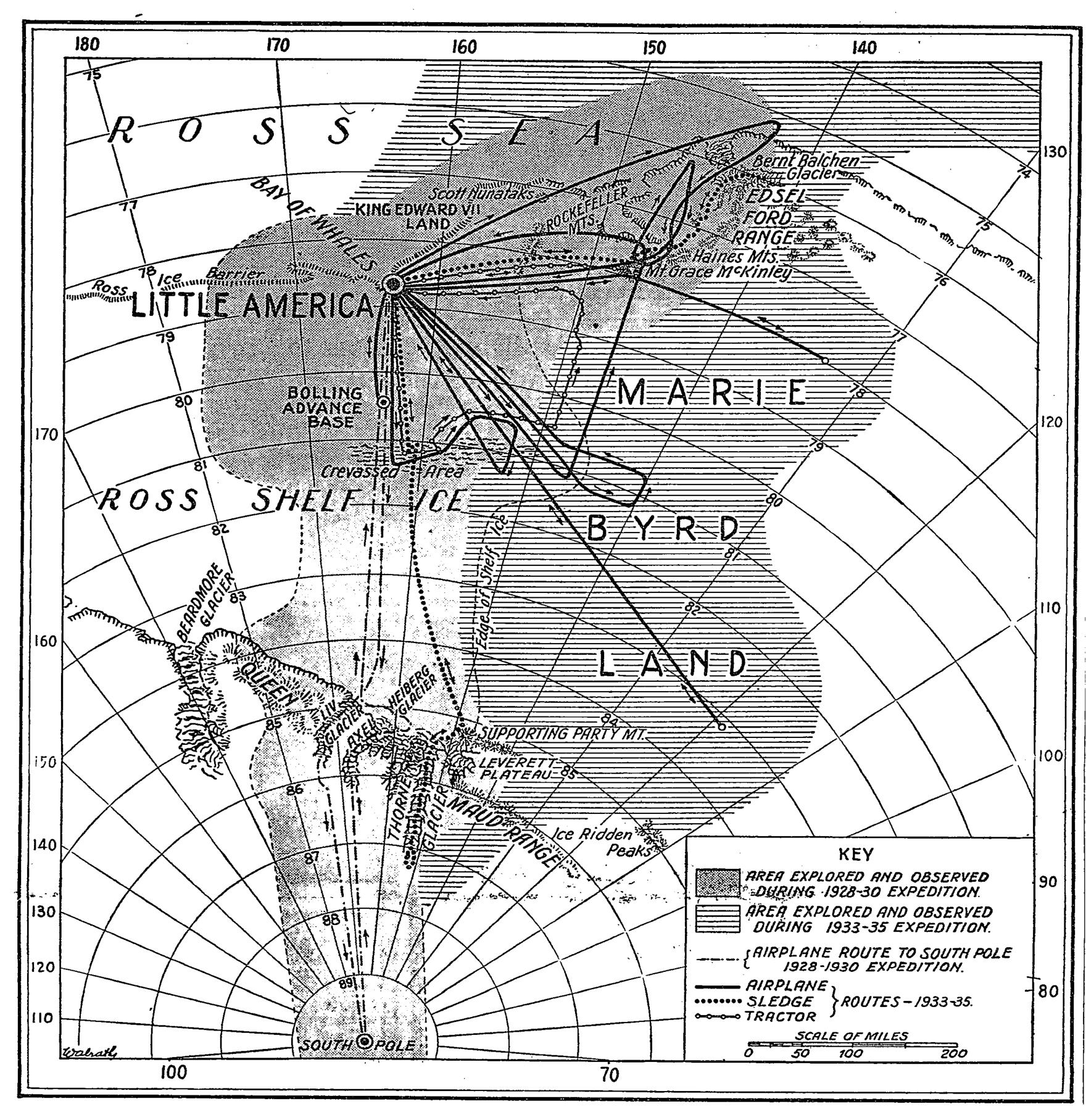
In certain respects my first expedition was a preparation for the Great problems still remained, and it seemed logical to try to close with them while we the advantage of an awakened public interest, the momentum of one successful effort. and while we still had available the nucleus of a well-trained personnel.

The intrusion of the depression made the task of building a second expedition formidable, but not insuperable. It was done finally, one way and another, and when we squared away for our job on Oct. 22, 1933, we numbered six score men. mostly volunteers, aboard two ships, the iron Jacob Ruppert, resurrected from the government graveyard, and the 60-year-old barkentine Bear of Oakland. We had aboard four airplanes, a fleet of six tractors, 150 dogs and the best tools of our trade that we could beg, borrow or buy. Strange Bulge of White.

For many years my curiosity had been attracted by that strange bulge of white, unexplored space jutting into the Pacific Ocean in the Pacific Quadrant between the 170th and 120th meridians West. Somewhere behind it lay the most extensive stretch of undiscovered coastline on the face of the earth. Since the time of Cook, innumerable explorers had tried in vain to make a break through, only to find the way barred, as he had, by mountains of ice and a pack of impenetrable thickness. After leaving New Zealand, instead of laying a course direct for Little America, I resolved to try to cut away some of this unknown.

An unprotected iron ship like the Ruppert was a poor weapon with which to engage the worst pack ice in the polar seas, but we fortunately had another string to our bow. Cocked on a special tiered pedestal on the after deck was our twinengined Condor biplane, William Horlick; in New Zealand it had been equipped with floats. It was our intention to press the vessel

First Complete Account of the 1933-35 Expedition, Which Added New Areas to the Map and Cast New Light on Scientific Problems



BYRD'S RECORD OF EXPLORATION IN ANTARCTICA: A BLANK AREA OF THE MAP FILLED IN.

flight. Fog closed in, and on the return flight to the skip we had to fly blind part of the way. The air speed indicator froze and the plane was on the verge of icing up. Flying quite low, we twice burst over huge bergs with barely fifty feet of clearance. Haines, the meteorologist, said when we came aboard the ship, "Well, you fellows certainly stole one that time." As before, the pack ran to the

limit of vision. Having already overstayed the

time allotted for these eastern operations, and still facing the tremendous job of re-establishing the Winter base of Little America, we had no choice but to start the long voyage to the west. We withdrew from the pack and commenced to run along the front of it. Fortunately the wind and current had carried much of the pack out of our path, and, edging southward from the 67th to the 69th parallel, the ship again broke into unknown waters. On Jan. 10, when

she stopped to let aviation resume the assault, she had reached Lat. 69.50, Long. 152.21. Here we had our third aerial thrust into the unknown, flying to Lat. 71.45 along the 152d meridian.

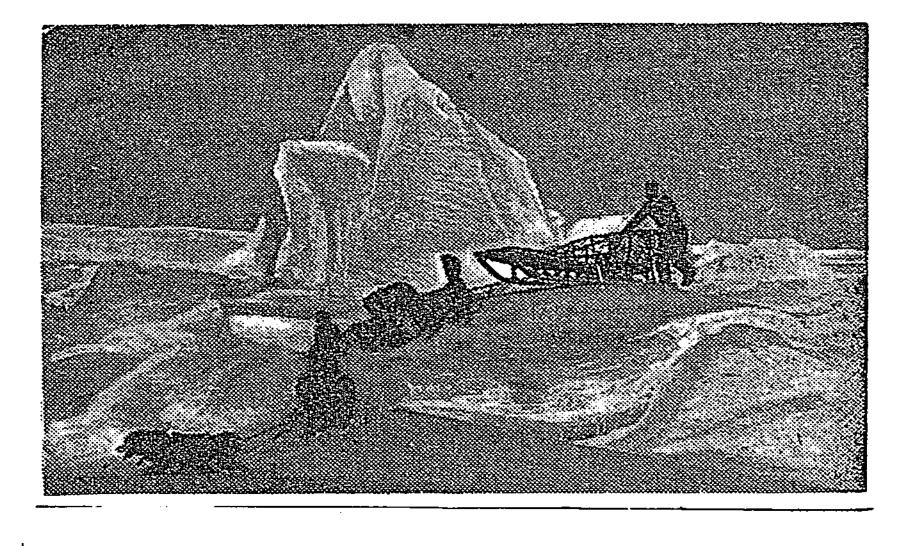
This flight closed the vessel's operations in the eastern sector. She was then steered directly for Little America. But in February. after the ships were unloaded. I was tempted to strike at the heart of the matter with a different weapon and from a new quarter.

exploration. Before the worst sea ice I have ever seen stopped the plucky old ship, we had worked our way northeast to Lat. 73.05 S., Long. 149.30 W., and thence westward to the 159th meridian, so that for all practical purposes the gap between the flight tracks and the known coast was closed.

With Captain English I took the

Bear of Oakland on a voyage of

The significant result of these operations, together with our subsequent explorations in the eastern



sector, was to identify a vast area of unknown as Pacific Ocean and extinguish the hypothesis of an archipelago reaching into it.

THE TASK BEGINS.

The bitterest task, in facing a wintering problem, is the establishment of the base camp. Luckily for us, the old buildings were available, though the roofs of several had been crushed by the snow; but new buildings had to be built for the larger personnel and a vast amount of stores had to be unloaded from the ships and transported to Little America. A direct approach was barred by impassable pressure ridges. A circuitous trail more than six miles long was cut through the ridges and at one point a ten-foot gap of open water was bridged with telephone poles.

Every ounce of stores-more than 500 tons in all-had to be hauled over that road. Night and day, for three weeks, tractors and dog teams shuttled between the caches. One plane made twenty-six flights to expedite the movement of vital equipment. The period was a white nightmare. Men worked until they dropped. The surging out-rushes of the bay ice menaced the ship, then the stores cached on the ice, and finally even Little America itself. Varied Preparations.

Still, in spite of these difficulties, on March 1 we were able to free Captain Innes Taylor and a southern party of six men and five dog teams for the vital mission of running a chain of food depots to Lat. 79.56 W. in preparation for the major journeys of the Spring and to dispatch Chief Pilot June and Demas southward with a fleet of four tractors carrying the equipment and stores necessary for the advanced meteorological base we proposed to establish somewhere on the Ross Ice Barrier and for its occupancy throughout the Winter

Meanwhile, under the direction of Lieutenant Commander Noville, executive officer of the expedition, a new city was built around old Little America, and, all things considered, it was really a first-class city. It could boast electric light and power, telephones, a wellequipped science laboratory, a first-class weather observation station, a radio station and a broadcasting plant, medical facilities, a machine shop, a tailoring establishment, a carpenter shop, a dairy housing three cows and a bull, and a transportation system geared to the varying gaits of dog teams, tractors and aircraft.

Little America was unique among

the cities of the world in the diversification of talents enlisted among a company of forty-six men and in its fortifications against the contingencies latent in isolation. When the recession of ice from the Bay of Whales made it seem possible that even Little America might breal: out, we built an emergency base called Retreat Camp on the high barrier about three-quarters of a mile to the south-southeast and stocked it with the bare essentials for survival.

Except for the crash and destruction of the Fokker airplane on a test flight and the dramatic appendectomy performed on Pelter, hard upon the alarums and excursions excited by a fire that threatened to destroy the surgical cache, the Fall operations closed uneventfully.

On to the Advance Base.

On March 22 I flew to the advance base to occupy the world's southernmost meteorological station, the occupation of which was important to our meteorological and auroral program. Till then most of the data on which our knowledge of the meteorology of Antarctica is founded were collected at stations on the coast or by ships exploring coastal waters. These stations naturally fell within the moderating influence of the ocean. No fixed station had ever been established in the interior, where conditions more truly characteristic of continental meteorology would be expected to prevail.

The advance base was a shack 123 miles by trail south of Little America. It was originally my hope to be able to advance the shack nearer the foot of the Queen Maud Range, 400 miles south, but the delay in discharging the ships, caused by the unusual ice conditions, together with the difficulties in re-establishing Little America, made necessary a change in this plan. Nevertheless, we determined to advance the shack as far south as the tractors could make it before the onset of Winter jeopardized the crews.

[At the advance post Admiral Byrd spent four and one-half months in solitude, undergoing severe hardships. His experiences during this period of isolation are described in the article on this page by Dr. Poulter, who reached him with a relief party in August.]

Continuous Weather Record.

The advance base was equipped with up-to-date apparatus for maintaining a continuous record of wind, temperature and pressure from the day the base was occupied through the Winter night and until it was shut down, on Oct. 12. These elements, together with observations of auroral activity, were continuously recorded after my arrival at the base. Dr. Poulter made a valuable series of simultaneous meteor and auroral observations

with observers at Little America. On my return to Little America I found a smoothly running exploring machine ready to prosecute the missions we had outlined for it. Siple's party was about to leave for the first scientific penetration into Marie Byrd Land, with special interest in its geological and biological features. Blackburn's geological party was topping off preparations for a long thrust into the Queen Maud Range on a biological reconnoissance into the unexplored western margin of Marie Byrd Land.

Dr. Bramhall and Morgan were making the plateau party ready for a dash onto the polar plateau, the former with the object of gathering magnetic data in a region where such data are extremely inadequate, the latter to delve into the secrets hidden by glaciation with an apparatus never before tried in the polar regions—a seismio sounding device.

A Notable Thrust.

June, in Tractor 1, was already coming home after a splendid thrust to the southwestern angle of the Edsel Ford Range, having made the surprising discovery of a high plateau rising on the coast just east of the Rockefeller Mountains and flowing unbrokenly through King Edward VII, Scott and Marie Byrd Lands.

Demas was grooming two tractors assigned to support the geological and plateau parties, and Captain Innes Taylor, in charge of trail operations, was everywhere helpful. Pilot William Bowlin and the men of the aviation unit were working with perseverance to make the planes ready for the Spring flights. The Marie Byrd Land party got

Continued on Page &

BYRD'S STORY OF ANTARCTIC DISCOVERIES

Continued From Page One.

parties left in company two days later, and the tractors, following in the wake of the latter units, cleared lettle America on Nov. 25. We were free then to launch our aerial enterprises.

Antarctic problems more or less interrelated were immediately accassible to approach by aircraft. The first was the problem of the so-called transcontinental strait. For many years it had been supposed that an ice-clad sea-level trough divided the continent. This theory was postulated upon the identical indentations cut in the face of the continent by the Ross and Weddell Seas, and upon other persuasive evidence. Until the existence or non-existence of this strait was affirmed, no one studying Antarctica could say with certainty whether he had to deal with one continent or two.

A Mountain Mystery.

The second problem grew more or less out of our operations in 1929. On a flight to the northeast on Dec. 5 of that year we discovered east of the 150th meridian the new land which we named Marie Byrd Land. It is a rugged and mountainous land, heavily glaciated. Behind the western front range we saw innumerable peaks. On the journey in Tractor 1 June and his companions reached Mount Grace McKinley, the southwestern peak in the Edsel Ford Range. They confirmed the massing of peaks in the northeastern quadrant and found that the plateau rolled to the east.

The Marie Byrd Land problem opened up fascinating possibilities: How far eastward did these mountains trend? Did they form a tectonic link in the Andean fold chain which had been traced to Graham Land across the continent? Did this plateau fold southward to the Queen Maud Range, to merge with the high polar plateau, or did it die out somewhere, say on the northern margin of the transcontinental strait? These problems we hoped to solve by a series of flights calculated to strike at strategic points.

IN THE AIR

Seizing upon the first break in the weather, we launched the first flight on Nov. 15. The course we flew followed the structure of a scalene triangle. The base rested on Little America and the southwestern tip of Edsel Ford Range. The apex rested in the unknown at Lat. 81.05 S., Long. 146.30 W., approximately half-way between the coast of Marie Byrd Land and the Queen Maud Range.

The course recommended itself for these reasons: It would strike at the heart of the white space holding the fate of the supposed strait and search out half the front through which it might cut; it would determine the trend of the newly discovered plateau; it would indicate whether or not Marie Byrd Land were an archipelago or a distinct epicontinental mass separated from the mainland by ice straits or an integral reach of the continent: and, finally, it would bring the base line of this flight track in coincidence with the limit of vision of that of Dec. 5, 1929.

The flight crew comprised the chief pilot, the co-pilot, Bowlin, Navigator Rawson, Chief Radio Operator Bailey and myself. Leaving Little America we first ran down the southeastern leg of the triangle to the apex. Then we ran northward into the Edsel Ford Range at Long. 146.27 W., Lat. 77.30 S., which put us about twenty-two miles east and a trifle north of

Mount Grace McKinley.

Then, rising some 11,000 feet above the Edsel Ford Range, we were struck by the massing of peaks to the northeast. It was as if a giant hand had strewn them there like so many pebbles. They streamed eastward and it seemed possible that these mountains skirted the continental front to form a link in the Andean chain.

A Low Depression.

Most fascinating of all, at the apex of our triangle, at a point where the belt of crevasses traversing the 81st parallel slithered off to form a curiously arrested white whirlpool at what appeared to be the foot of the plateau, we found a definite depression. We sounded the elevation with the plane's altimeter-a trick we later used to excellent advantage—and found it to be only 400 feet, nearly 4,000 feet below the highest known elevation of the plateau. From what we had seen there was strong reason to believe that if the transcontinental strait did exist it must lie there.

That was only the beginning of the matter. Next day, the weather holding good, I dispatched June, Bowlin, Rawson, Aerial Mapping Cameraman Pelter and Bailey on a reconnoissance flight to assist the tractors which were dangerously bogged in crevasses at Lat. 81.05 S., Long. 157.30 W. Besides seeking a safe passage for the tractors, they were instructed to make a brief southing and find out, if they could, what lay south of the depression. Clouds and gales drove them back at Lat. 81.20 S., Long. 151 W., before they had an opportunity to make extensive explorations. The point at which they turned was approximately fortythree miles west and fifteen miles south of the apex of the triangle. The surface there seemed to be

Because the weather is least favorable in that quarter, at the next fair spell we shifted our attack to the east in order to close our operations in that critical area before the rise of the fogs and clouds of

rising.

First Complete Account of the 1933-35 Expedition, Which Added New Areas to the Map and Cast New Light on Scientific Problems



The Machine in the Antarctic-A "Snowmobile" Used by Byrd.

Times Wide World.

Summer. On Nov. 19 June, Bowlin, Rawson, Pelter and Cameraman Petersen were dispatched on a 390-nautical mile penetration into Marie Byrd Land. The purpose was to feel out within the range of the plane the trend of the new mountains we had raised behind the western front of the Edsel Ford Range, to map them with the camera in their proper relationships and, if possible, to find the coast. The course lay along the 78th parallel.

Clouds massing ahead forced the crew to turn at Lat. 77.55 S., Long. 133 W., but important results accrued. For the last 165 miles of the flight the mountains of Marie Byrd Land, so densely packed behind the western front range, were found to thin out, withdrawing into a range running to the east at the turning point. The crew had before them a massive, broken block which June thought might be an extinct volcano, a not improbable surmise in view of the fact that the Marie Byrd Land party later came upon the remnant of a volcano cone in the Edsel Ford Range.

The plateau, flat as the plains of Kansas, rolled its white gleaming roof in all directions to the horizon, and a sounding by altimeter, corrected later to true barometric pressure, put its elevation at 4,300 feet. The coast was nowhere in sight, but throughout the last stage of the flight the crew marked on their port hand a very decided water sky, and, in view of what we know, it is quite likely that the coast of Marie Byrd Land will be found to follow the trend of the mountains which lie between the 76th and 77th parallels.

A Hint by Radio.

On Nov. 19 Blackburn's geological party, penetrating unknown areas 375 nautical miles south-southeast of Little America, flashed us an important hint by radio—the sighting of what appeared to be high land to the east of them. Weather held up flight operations for a while, but on the 22d, June, Smith, Rawson, Pelter and Bailey took off on the longest flight of all, a 960-nautical-mile journey which carried them ultimately to Lat. 83.05 S., Long. 119 W.

This flight resulted in important discoveries. As they turned they saw i the vicinity of Lat. 85 between the 110th and 115th meridians a cluster of ice-ridden peaks, presumably eastern prolongations of the Queen Maud Range, approximately 170 nautical miles east of the latitude of the last known peaks of that range. Commencing just a few miles southwest of the depression we had observed on the flight of the 15th they found a plateau rising and rolling unbrokenly to the feet of these new peaks.

Like every effort directed at the solution of unknown matters, the flight did not so much settle familiar problems as to raise new ones. Was this depression only a bight or bay in the Ross shelf ice on the western margin of the plateau? Would deepest penetration prove that these plateaus were one? At all events the fate of the transcontinental strait now lay in a sixty-mile gap between the 81st and 82d parallels east of the 147th meridian, and could be settled one way or the other.

A Problem Solved.

On Nov. 23 with June, Bowlin, Rawson and Petersen, I took off in the William Horlick to close the gap. Just a little bit south of the apex of the triangular course of the flight of Nov. 15, where we had found the depression, we headed east, sounding the elevation of the ice by altimeter as we went. When we turned at Long. 140 W., Lat. 81.10 S., we found that the surface under us had risen to 1,325 feet. On the return we sounded the northern border of the area and found that the elevation was uniformly 1,000 feet or higher.

The results were conclusive. The long-sought strait was non-existent. The plateau of Marie Byrd land rolled unbrokenly from the South Pacific Ocean to the Queen Maud Range. The eastern margin of the Ross shelf ice was at last defined by the coast of that plateau. The structural integrity of Antarctica was verified and a troublesome ghost of doubt was laid. Antarctica is one continent.

ON THE TRAIL.

Now the trail parties, pressing through cold, fog and blizzards to gain distant objectives, came into their own. Blackburn's party,

made up of himself, Russell and Paine, with three dog teams, pushed up the untraveled slope of Thorne Glacier to run a geological cross section of this area of the Queen Maud Range. When they paused they had risen 100 miles up the blue ice of the glacier, and, with twenty miles still to go to the shining dome of the polar plateau, the peaks above them had diminished to mere nunataks. There, 180 miles from the South Pole, in the vestiges of a sedimentary strata, they came upon numerous beds of coal and plant fossils.

Geographically, their discoveries were equally impressive. The high plateau escarpment fronted by two high granitic ranges and numerous foothills west of Thorne Glacier dwindled East of it into numerous glacial ampitheatres enclosed by mountains of igneous rocks. The stream of ice debouching into Thorne Glacier from the east, which Dr. Gould of the first expedition had called Leverett Glacier, was found to be a sub-plateau.

Eastward the mountains dwindled in size, becoming increasingly engulfed by the ice pouring from the Polar Plateau which, at the head of Thorne Glacier, had dipped to an elevation of only 7,000 feet. The important point was that through the terraced structure of the subplateau of Leverett the plateau of Marie Byrd Land rose to merge with the Polar Plateau and that further east if the sinking of the Polar Plateau persisted the two plateaus undoubtedly met at a common level.

In a New Found Land.

Behind the coastal front of Marie Byrd Land, Siple's party, comprising himself, Wade, Corey and Stancliffe and three dog teams, traveled with excellent fortune. A sledging party, they had the unique experience of penetrating on a scientific mission into a land first discovered by aircraft five years before. Siple's biological finds were superb. The peaks of this new land, fully a hundred miles from the coast, bore a flourishing life. The pink and gray granites and the steel gray schist were painted with patches of green moss, white lichens and a spectacular red lichen.

Wade, the first geologist on the spot, found evidence which may verify what he had surmised after the flight of Nov. 15—that tectonically the mountains of Marie Byrd Land seem to form a massive link

in the Andean fold chain between New Zealand and the Antarctic Archipelago, but that the petrographic dissimilarities make the connection less real than apparent. In a three-inch quartz vein slanting down the face of a mountain in the Donald Woodward group he found in situ a deposit of galena and elsewhere deposits of molybdenite and chalcopyrite from which lead, molybdenum and copper may be extracted.

The party brought back a rich harvest of geological and biological specimens. Siple gathered no less than two dozen different species of lichens and mosses, an excellent haul considering the fact that up to then scarcely a hundred different species had been found in the Antarctic, and most of these on sub-Antarctic islands. He also returned with samples of ice and water teeming with microscopic life.

The plateau party converted a misfortune into an accomplishment. The inability of the tractors to break past the crevasses along the eighty-first parallel in spite of gallant efforts forced Morgan and Dr. Bramhall, whose work was dependent upon instruments too heavy to be transported by dog teams, to throw their lot in with the tractors which were then directed on a long curving course that ultimately carried them into Marie Byrd Land south of the Edsel Ford Range and back through Scott Land.

Seismic Soundings.

In this unexplored area Morgan made a valuable series of seismic soundings which will give us an inkling of the depth of the ice sheet and the character of the underlying land on the same track. Dr. Bramhall, using a dip circle and an askania balance, obtained a valuable record of the distribution of magnetic elements in these regions.

Although the results have only been partly analyzed, certain conclusions are already evident. Bramhall had reported that existing isogonic charts for the south polar regions, based as they are on very meager data, conform in general to the present state of the earth's magnetic field. His observations, however, indicate that a more or less uniform shifting of the lines as much as two or three degrees will be necessary.

December and January are always a critical period in the life of an expedition, for then the field parties are at the greatest distance from

the home base and aviation must stand by night and day to seize the rarely occurring opportunities to break through the eternal mists and clouds of midsummer. Nevertheless we made three more attempts to break deeper into Marie Byrd Land. On Dec. 8 a flight crew was recalled sixty-five miles out when fog closed in tight over Little America; on the 15th a crew which had reached Lat. 75.10 S., Long. 14.30 W., on a flight to trace the coast of Marie Byrd Land, was turned back at the very edge of discovery by an ocean of clouds, and on New Year's Eve an attempt by Bowlin to penetrate to the Edsel Ford Range was blocked by the same conditions.

THE RESULTS.

Summing up, we can say that the results of the expedition are nearly all that we could rightfully hope for. Thanks to flight operations and the three sledging parties striking at strategic points along the front of Marie Byrd Land, we now have a better conception of the area which, in 1930, we lifted above the horizon. We know something of its geology and biology, of the thickness of the ice capping it, and by means of the mapping camera we shall be able to construct a map of its features.

This newest of American discoveries is a magnificent sweep of territory running from the Pacific Ocean to the South Pole, and encompassing more than 200,000 square miles of territory. Superb mountains lift gleaming peaks through the glacial seas covering it, and a grand plateau marches over all but the tallest peaks.

It must be clear to any one that such reviews as this can only outline the high spots and the general story. For the daily routine observations and efforts, each of which in its own field possesses great merit, there can only be passing mention. Prominent among these is meteorology. Haines, assisted by Grimminger, has extended the excellent observations on polar meteorology he began with the first expedition. In addition to routine surface observations he has made a continuous series of upperair soundings with pilot balloons—a total of nearly a thousand over both expeditions.

Weather Studies.

Our particular interest in this direction is to study the circulation of air over the polar regions and to test the theory of the glacial anticyclone. It is a common mistake to think that polar weather is of concern only to the polar regions. The world's meteorolgy cannot be divided into airtight compartments. The poles exercise a great influence upon world weather, and a knowledge of the conditions prevailing in Antarctica has a vital bearing on long-range forecasting not only for the Southern Hemisphere but for the world.

In the same sort of category is the study of terrestrial magnetism, one of the strongest departments not only on this but on the first expedition. With better apparatus over a longer period of time Dr. Bramhall, assisted by Zuhn, has made a continuous registration of magnetic elements at the base station. Such data are of indispensable importance to a full knowledge of the permanent magnetic field of the earth.

The biologists, Siple, Dr. Perkins, Lindsey and Sterrett, have worked with the same quiet effectiveness. From the day we landed here they have studied life—the variety of birds, seals and penguins and the microscopic plankton that inhabit the ocean depths within their reach. Even in the dead of the Winter night Dr. Perkins and Sterrett could be found in the Bay of Whales, with the temperature 60 below, lowering a plankton net for specimens until every crack in the

bay ice was closed. Testing the Ice Sheet.

Now a number of these so-called routine observational activities, especially where they have been able to benefit by improved technique, will, I trust, provide several of the brightest chapters in the scientific report. Earlier in this article I mentioned several innovations this expedition has introduced. Of these the seismic soundings have yielded the most spectacular data.

This instrument, which measures the velocity and track of a sound wave beneath the surface, has at last provided us with long-sought means to tap the ice sheet, determine its thickness and get a hint of what lies buried beneath. While Morgan was running his series of seismic soundings along the tractor track. Dr. Poulter made a series of soundings in the vicinity of Little America, the preliminary results of which threaten to force science to recast its present conception of the Ross Shelf ice as being largely water-borne.

He found that the ice is supported by an anchor on numerous submarine reefs and peaks. In many places where we had thought there was water these instruments showed land above sea level. Scarcely fifteen miles south of Little America a great hill rising in the barrier snow has been identified as an island, the summit of which is 1,000 feet above sea level and capped by 400 feet of ice.

Another excellent merit of the apparatus is that with its data we will be able for the first time to limit the probable volume of Antarctica ice to a reasonable figure.

A New Technique.

At first Poulter relied upon a dog team to carry his apparatus. Then he tried a tractor. Lately he has used the Condor plane William Horlick. Once he was flown to seven strategic points on a twenty-five-mile radius of Little America, at each of which he landed and made soundings. Returning to the main base, he developed his data that night.

It has been one of the firm negatives of my policies, never to land a plane away from base, if it could be avoided, on account of the possible disastrous consequences of a crack-up; but in this case I was tempted by the high promise of the research. Certainly here was exploration with a new twist—tracking down the unknown past a 600-foot armor of ice, with sound waves returning to whisper their discoveries to sensitive apparatus on the surface.

The cosmic-ray research is another innovation which has had highly creditable results. It was begun aboard the Ruppert by Dr. Poulter, Dr. Bramhall and Mr. Zuhn, carried across the Pacific. extended into new regions during the eastern cruise and made an integral part of the routine program at Little America. Recently, in order to determine whether or not the significant variations in cosmicray activity noted at high altitudes and lower latitudes occur at high altitude in high latitudes, we sent the apparatus to an altitude of 12,-500 feet in one of the planes.

Cosmic-Ray Data.

The data, which have been only partly analyzed, have confirmed Dr. Compton's theory of cosmic rays as consisting in their major part of electrically charged particles of great penetrating power originating in remote space, which rain in a continuous bombardment through the earth's atmosphere. A variation of intensity of cosmic-ray radiation with geomagnetic latitude has been determined. Of equal and perhaps greater interest, the observations at Little America show an unexpectedly high absolute value and a slow increase in intensity which may presage some period variation.

Polar meteorology was likewise given a boost upward. In September, with the temperature still between 50 and 60 degrees below zero, Haines initiated a series of highaltitude aerological soundings, the first of the kind ever undertaken in the South Polar regions. The autogyro was equipped with a barograph for making a continuous registration of temperature, barometmic pressure and humidity at different altitudes. Through September until the gyro crashed, McCormick made such flights on every clear day. Now that the major flights are safely past and a stand-by plane is not required for emergency purposes we have been able to resume these flights. The data, Haines believes, are of great value in understanding the general circulation of the air in these latitudes.

Considering how recent is the use of aircraft in polar explorations, we were able to put our planes to excellent use in many directions. Certain flights served as many as four purposes simultaneously: discovery, mapping, aerological soundings and altimeter soundings of surface elevations. On different occasions aviation was effectively employed to reconnoitre dangerous terrain for field parties.

Hazards Present.

The hazards, to be sure, remained. The keenest sort of cooperation was required between the meteorologist and pilots. Practically all our later flights were barely squeezed in between periods of unfavorable weather; but the main program was successfully executed.

Radio, too, as a polar tool made important advances. Every field party was equipped with radio and reported at fixed intervals. As many as five parties have reported to the main base on a single day. When important flights were pending these field parties filed weather reports from their widely scattered positions. The planes were in continuous communication with the main base and have on occasion communicated with field parties in the area of their flight, passing on important information about crevasses and other hazards in their path.

With such communication facilities, the credit for which belongs to Chief Radio Operator Bailey, Engineers Dyer and Hutchison and Operator Waite, I possessed directive influence over scattered units that no other leader of a polar expedition ever possessed. Any important discovery, any crisis, any situation requiring quick action, extraneous assistance or further investigation could be at once communicated to Little America.