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DEPARTMENT OF EXTERNAL AFFAIRS

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VOLUME I

NARRATIVE

THE EXPLORATION OF OATES LAND, ANTARCTICA

by

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(71)

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THE EXPLORATION OF OATES LAND, ANTARCTICA

by

PHILLIP LAW

Oates Land, extending from about 155° E. to 160° E. long., was discovered in February, 1911, by Lieutenant H. L. L. Pennell, R.N., and named after Captain N. E. G. Oates, who died with Scott on the return from the South Pole in 1913. It has remained one of the last unexplored coastal regions in Antarctica because its coast is protected by consistently heavy pack-ice and its weather is notoriously abominable.

It is highly mountainous and the coast is rugged and inhospitable, with sheer rock bluffs or ice cliffs rising from the frozen sea. The heavy pack-ice generally prevents an approach by ship until late February, then at the beginning of March the sea begins to freeze over again. Opportunities for investigating the region from the air are rare because of the prevalence of fog, snow storms and blizzards.

1840

The history of the region between Cape Adare and Cape Freshfield (or between Victoria Land and George V Land) begins in 1840, when Lieutenant Charles Wilkes with ships of the United States Exploring Expedition plotted the appearance of land in about latitude 67° S. between longitudes 150° E. and 149° E.⁽¹⁾ As the land is now known to lie at least 100 miles further south than this, there is still argument as to what Wilkes really saw.*

1841

In late February, 1841, Captain James Clark Ross⁽²⁾ with the ships *Erebus* and *Terror*, rounded Cape Adare (See Map 1) and sailed westwards along the coast of North Victoria Land. On 21 February, Ross wrote:

We therefore steered to the north-west, keeping as close to the shore as the pack and heavy streams that lay off it would permit. Smith Inlet, Cape Oakley and Cape Dayman were named after three mates of the *Erebus*: Cape Scott and Cape Moore after those of the *Terror*; Cape Davis and Yule Bay after the second masters; and Cape Hooker and Lyall Islets after the assistant surgeons. Beyond Cape Davis the northern extreme of land appeared; it was called Cape North. A low point, with three projecting knobs like the tops of mountains, was observed at a great distance beyond Cape North, whence the land trends considerably to the southwards of west; but a dense body of ice interposed between us and prevented our following the coast any further.

* A discussion of this question is given in a paper, "New Map of the Coastline of Oates Land and E. King George V Land", by B. P. Lambert and P. G. Law, included in Papers of the Antarctic Symposium of Buenos Aires, 1959. (In press).

Early next morning (22 February) we moved round and stood towards the land, in order to examine more narrowly whether any way might be made along the coast to the westward between it and the pack . . . But here, as on the eastern coast of Victoria Land, as far as we had traced it, we found the indentations of the coast completely filled with solid ice of many hundred feet in thickness. Smith Inlet and Yule Bay appeared two more promising places until we got close to them, when we found them equally impracticable as all the other places we had examined. The line of coast here presented perpendicular icy cliffs varying from two to five hundred feet high

At noon we were in lat. $70^{\circ}27'$ S and long. $167^{\circ}32'$ E, and about this time the snow cleared off for two hours, so as to give us a view of a fine range of mountains whose summits we had not before seen; the loftiest of the ranges I called Mt. Elliot

The uncertain state of the weather, the light and variable winds, and thick falling snow defeated my intentions of examination, and compelled us to keep off to the eastward the whole day, although we occasionally got glimpses of the land between the snow showers.

(Feb. 24) . . . at 4 p.m., when preparing to run to leeward of what we considered to be a monstrous iceberg, it became evident to us that it formed a part of a body of ice which we could distinctly trace as a continuous mass descending from near the tops of the mountains several miles into the sea, and terminated by stupendous cliffs; a deep bay was formed in these extraordinary cliffs into which we were standing, and which we could perceive was bounded by cliffs of a similar character; but it came on to blow a gale of wind by the time we had got within a mile of the south-east Cape of the Bay

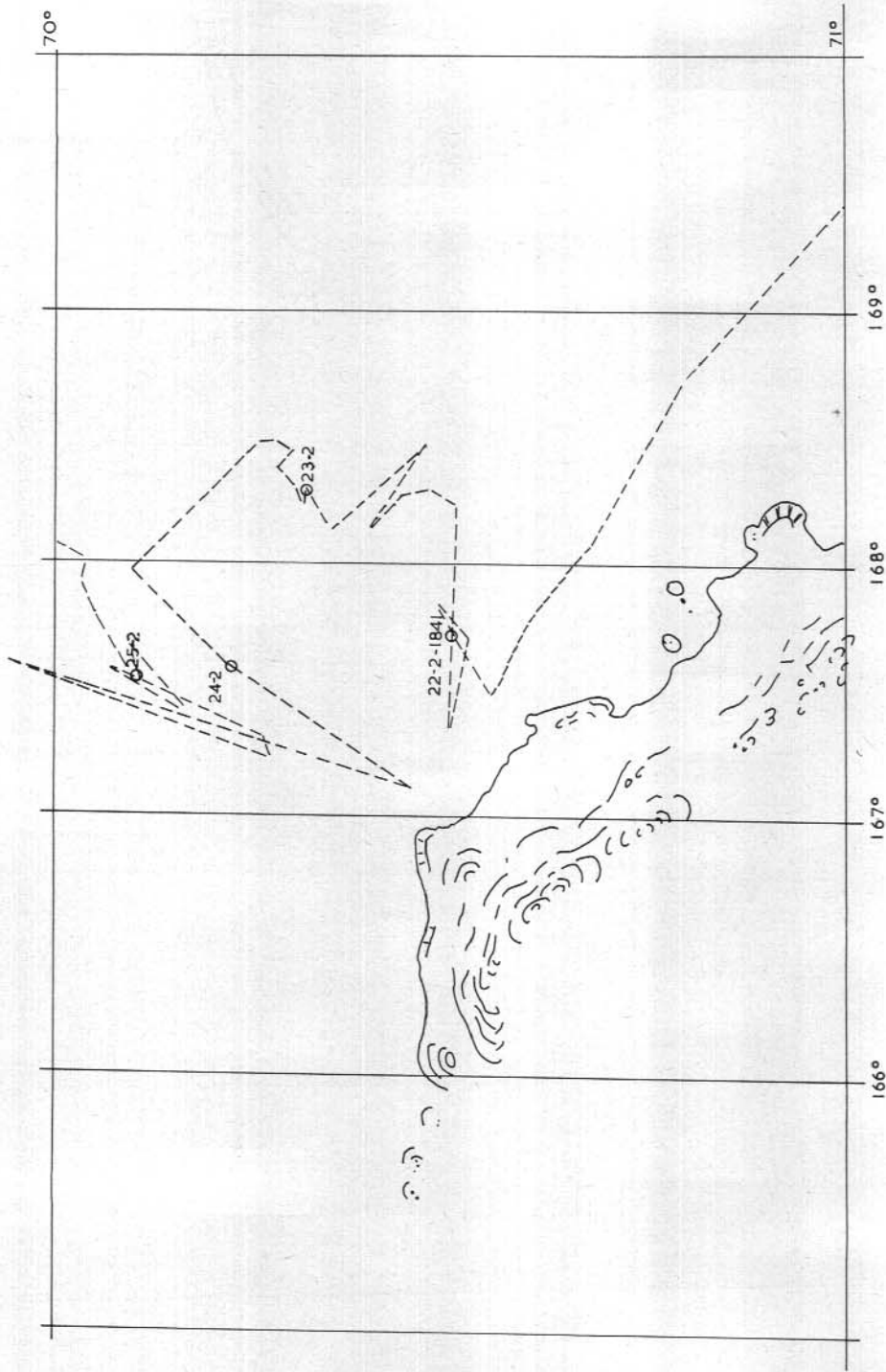
We had a very good view of Cape North whilst close in with the icy cliffs, and observed that a high wall of ice, of a similar character to that which extends from Cape Crozier forming the great barrier of $78\frac{1}{4}^{\circ}$ S, and which prevented our further progress to the southward, stretched away to the westward from the Cape, as far as we could see from the mast-head, and probably formed a coastline of considerable extent; a close, compact, impenetrable body of ice occupied the whole space to the northward and westward.

(Feb. 25) Still blowing hard from the westward. We woke before daylight and stood towards the ice, to continue the examination of it; in a few hours we got close up to the pack edge, which filled the whole space between us and the wall of ice projecting to the westward from Cape North, and without the appearance of any water amongst it, so firmly was it packed together; from this position several small islands appeared to the right of Cape North, which will probably prove to be the tops of mountains connected with it, but from their great distance we could not ascertain their continuity nor could we get any nearer to them owing to the solid intervening pack.

We had in the afternoon a good view of the coast. The whole of the land being perfectly free from cloud or haze, the lofty range of mountains appeared projected upon the clear sky beyond them beautifully defined; and although of a spotless white, without the smallest patch of exposed rock throughout its whole extent to relieve it, yet the irregularities of the surface, the numerous conical protruberances and inferior eminences, and the deeply marked valleys, occasioned many varieties of light and shade that destroyed the monotonous glare of a perfectly white surface, but to which it is so very difficult to give expression either by a pencil or by description.

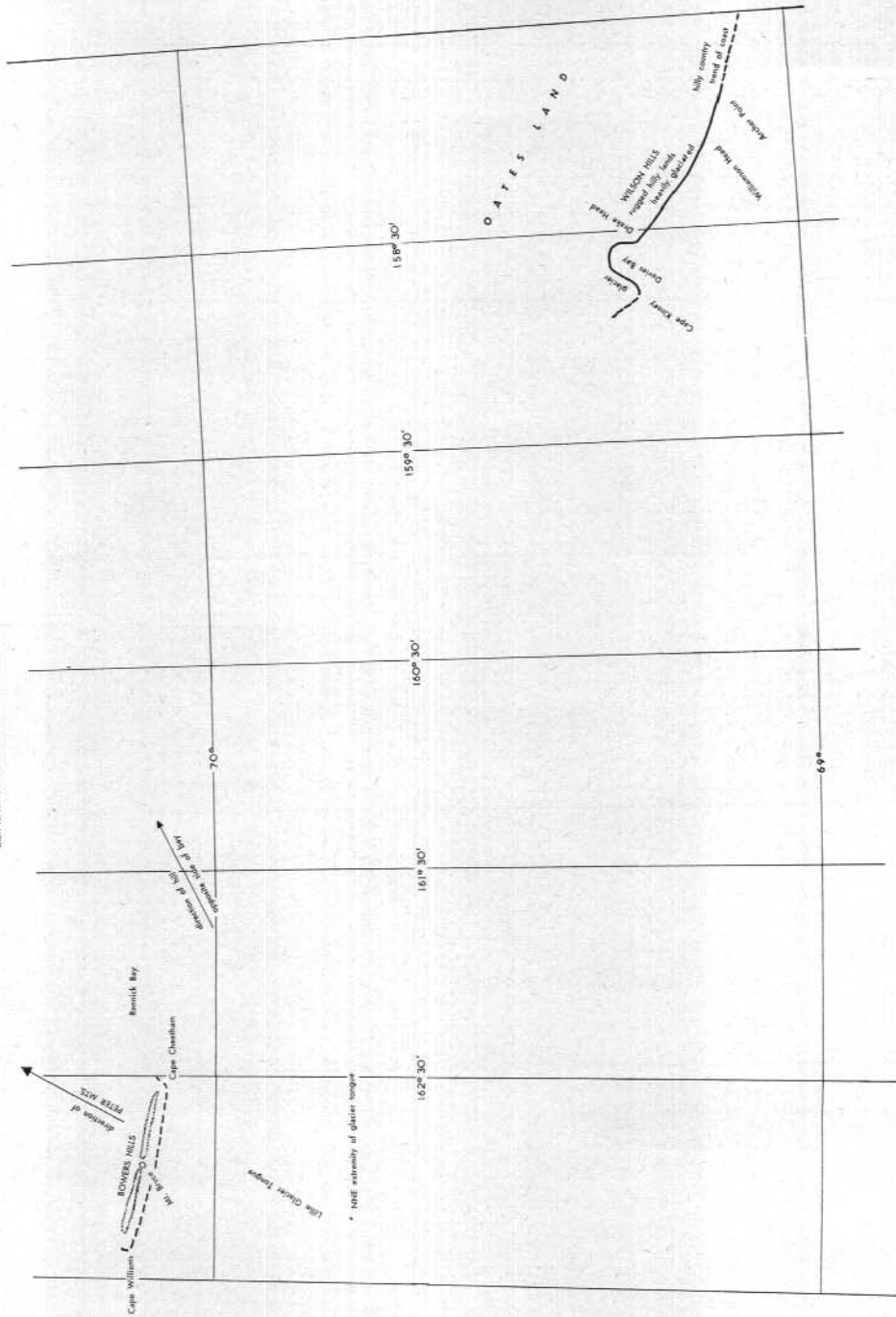
1911

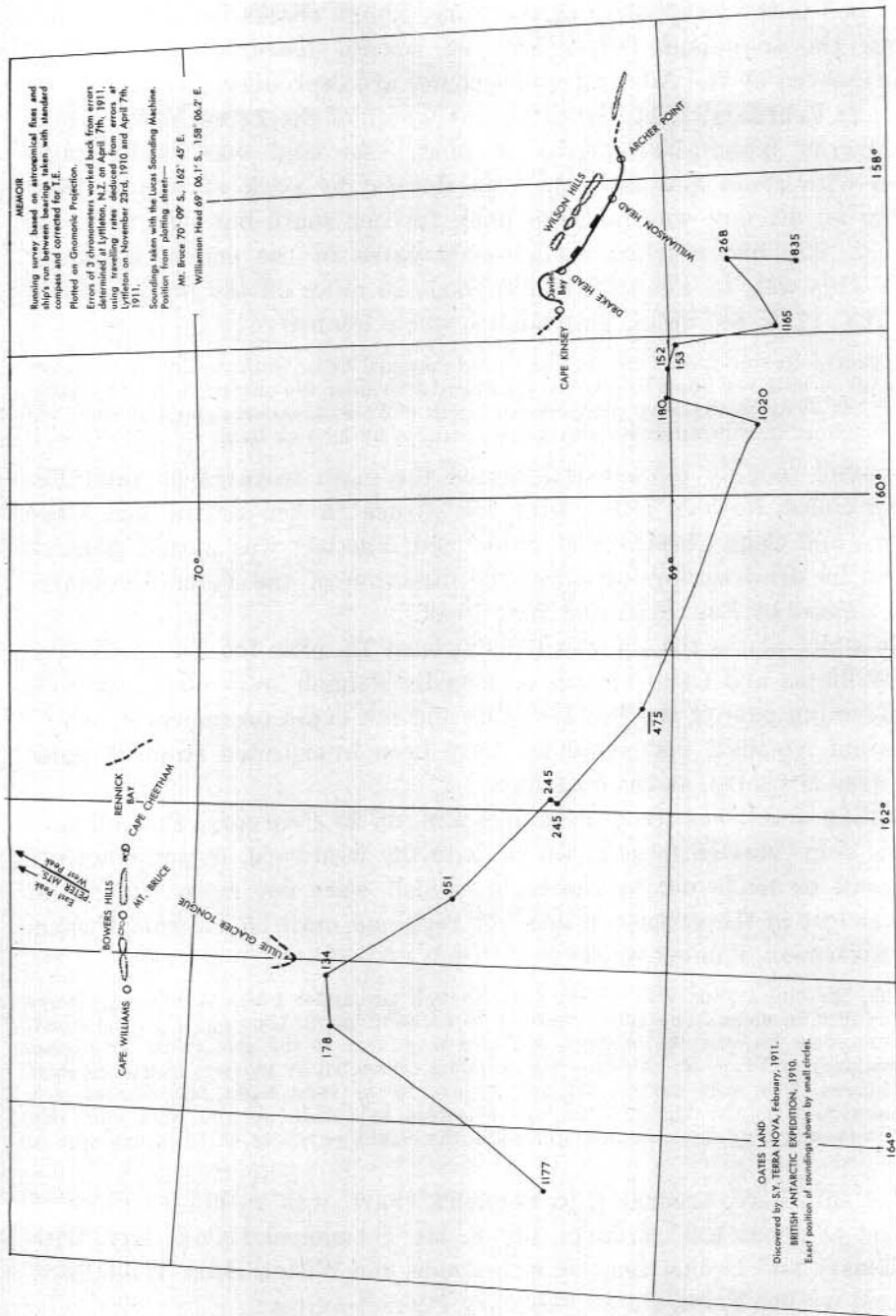
The next report of work along this coast comes from Lieutenant H. L. L. Pennell, R.N., Captain of the ship *Terra Nova*.⁽³⁾ Returning from McMurdo Sound in February, 1911, after landing the British Antarctic Expedition, he sailed westwards along the coasts of northern Victoria Land and Oates Land. He sighted the coast between longitudes $163\frac{1}{2}^{\circ}$ E. and $161\frac{1}{2}^{\circ}$ E, and again between 159° E. and $157\frac{1}{2}^{\circ}$ E., giving the name



MAP 1
Portion of a chart of North Victoria Land copied from the original chart prepared by Captain Sir James Clark Ross as a result of his voyage in February, 1841. Reproduced with the permission of the Hydrographer of the Royal Navy.

OATES LAND. Discovered by S.V. Terra Nova, February, 1911.
 First points from compass bearings from ship.
 Most from aneroid altitudes, aneroid barometer and
 aneroid altitudes. Longitude 162° 24' E., 51' 49" E.
 Most from variation in 69° 43' S., 163° 24' E., 51' 49" E.





MAP 2a 2b

A copy of an original chart of Lieutenant H. L. L. Pennell prepared as a result of the voyage of the *Terra Nova* in 1911. Reproduced with the permission of the Hydrographer of the Royal Navy.

Oates Land to the latter strip of territory. Rough charts made by Pennell showing the soundings taken and the coastal features sighted have been preserved by the Admiralty and copies are reproduced in Map 2.

On 22 February, 1911, the afternoon watch of the *Terra Nova* sighted snow-covered mountains and lower land. The land was tantalizingly covered with cloud and the ship was stopped by pack at 9 p.m. Next morning an attempt was made to push further south but was given up after the ship had reached within 8000 yards of the end of a glacier tongue. This was, by Pennell's chart, about 25 miles off the main coast at about $163^{\circ} 17' E$, $69^{\circ} 43' S$. This tongue, wrote Pennell:

appeared to run down from snow-covered rounded hills, while behind it a rugged range of hills ran down to a point, apparently forming the eastern point of a large bay, as away to the west could be seen high cliffs with outcroppings of rock, but everything in that direction was much obscured by mist or haze.

Pennell roughly plotted and named the main features he saw. The hills he called Bowers Hills, with Mt. Bruce in the centre and Cape Williams and Cape Cheetham at either end. The bay was named Rennick Bay and he drew arrows showing the direction of the Peter Mountains inland, limited by East Peak and West Peak.

This plot places the Bowers Hills at least 15 miles too far north. The Cape Williams and Cape Cheetham seen by Pennell were obviously rock bluffs forming part of the Bowers Hills and not capes on the coast, which here is flat ice shelf that could not have been interpreted from 25 miles away, even if visible, as the coastline.

Sailing north-west from here at 8 a.m. on 23 February, Pennell says that the ship "started to skirt the pack to the westward, noting what details could be made out of the coast, which were not many." Sight of land was lost in the afternoon and not regained until 25 February when, in the afternoon, Pennell writes:

. . . we had a good view of the land, though the upper parts of it were always shrouded in cloud. The ship appeared to be off a point (or angle) in the coast, apparently forming the western end of a large bay to the east of us. The coast was steep and rugged, half-bare rocky points separated by glaciers being the chief features. The hills behind did not appear to be very high, but this is only guesswork, as the higher land was obscured in clouds all the time and only occasionally a glimpse could be got when the clouds partially lifted in one spot or another.

The ship here, according to Pennell's chart, was within 14 miles of the coast at about $159^{\circ} E$ long., $69^{\circ} S$ lat. He named Davies Bay, with Cape Kinsey and Drake Head on either side, the Wilson Hills, Williamson Head and Archer Point. On 26 February Pennell writes:

After taking bearings and making sketches from the edge of the pack we ran to the northward and northwestward, with pack on the port hand and the coast beyond the pack till 2 p.m. when *the coast* made a sharp bend to the westward, though the edge of the pack still continued to trend northward. This was the last we saw of the land.

1915

In May, 1915, the ship *Aurora*, under Lieutenant J. R. Stenhouse, after landing Shackleton's Ross Sea Party, became beset and drifted for 9 months. For part of this time the ship was in the vicinity of the Oates Land coast. On 23 November, when in latitude $66^{\circ} 76' S.$, long. $154^{\circ} 50' E.$, land was seen at 8 a.m. bearing S. $60^{\circ} W.$ in the form of a high, bold headland, with low undulating land stretching away to the SSE. and to the westward of it. Stenhouse thought the land was Cape Hudson, looming up through the mists in about the same position as Wilkes had seen it. However, next day, in clear conditions, no land could be seen, so Stenhouse called the sighting "Cape Flyaway".

1947

A number of years elapsed before human eyes again sighted Oates Land. Then, in the summer of 1946-47, airmen of the United States "Operation Highjump" flew over the region.⁽⁴⁾

The Western Group of the expedition, consisting of a seaplane tender, a tanker and a destroyer, rendezvoused in late December, 1946, north of the Balleny Islands, about 450 miles north of the coast.

Seaplanes flew in to the coast and obtained trimetrogon photographs of the region between Smith Inlet and George V Land. Eight photographic runs were made and, although some were partly spoiled by cloud, a number of fine aerial photographs of this unknown region was obtained.

However, no ground control was obtained by the expedition to fix the positions of these flights and so little use could be made of them until landings by Soviet and Australian expeditions more than a decade later provided this vital information.

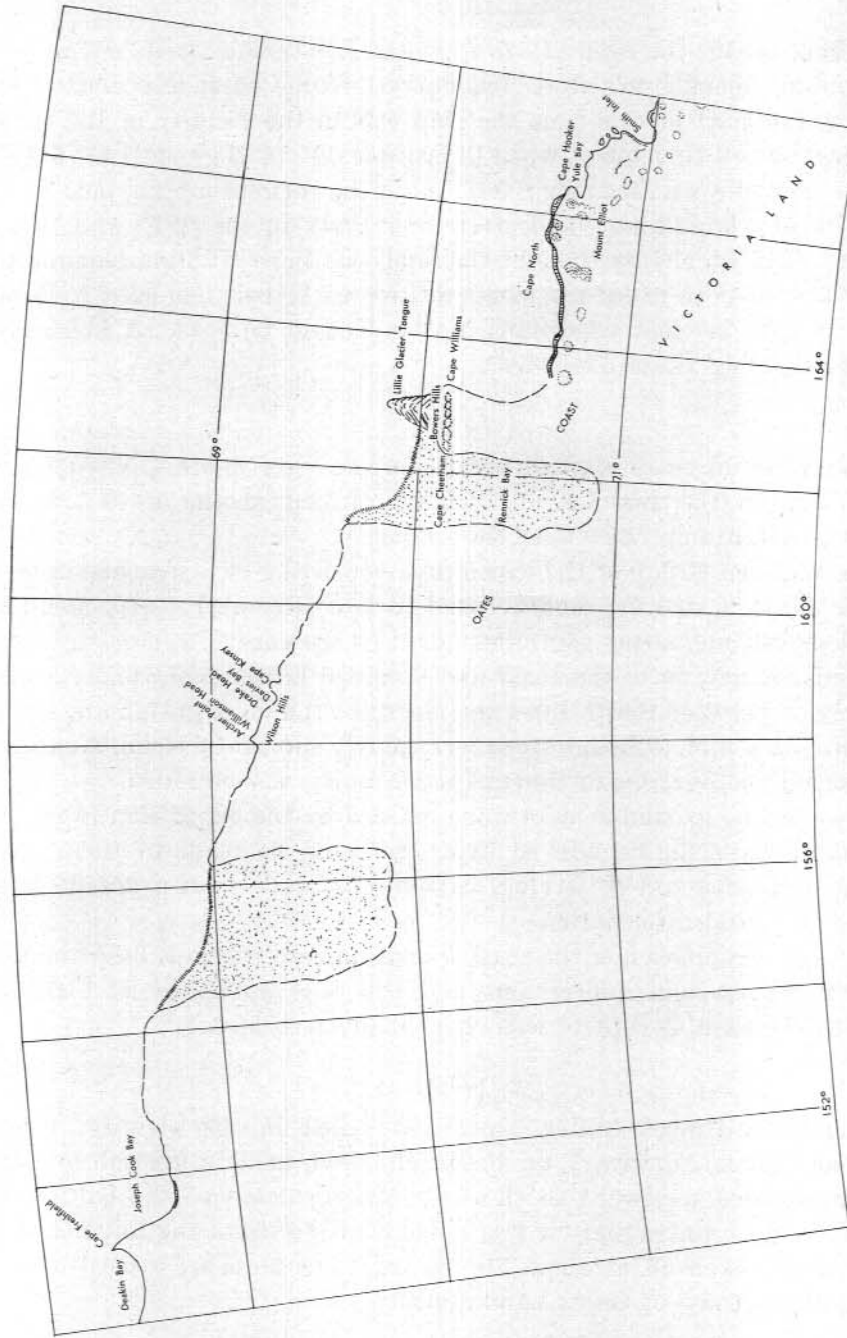
A rough compilation of the coast was made, nevertheless, based mainly on pilot's reports and impressions and this was published as U.S.H.O. Chart 6645 in 1956. A copy of this chart is given in Map 3.

1956

In 1956 a United States expedition sailed in the vicinity. U.S.S. *Glacier* left Little America V on 10 March, 1956, made a landfall at Cape Adare, and sailed westward south of the Balleny Islands. The Ice Report of Deep Freeze 1 states that "it was noted that the tip of the Lillie Glacier Tongue had broken off at about $70^{\circ} S. lat.$," but no other record of any sighting of the coast of Oates Land appears.

1958

Early in 1958 a Russian Antarctic Expedition in the ship *Ob* sailed eastwards along the coast of Antarctica.⁽⁵⁾ The expedition was equipped with



MAP 3
A copy of portion of U.S. Navy Hydrographic Office Chart No. 6645, 1956.

two AN-2 aircraft, fitted with ski landing gear, and a small Yak-12 aeroplane. No helicopter was carried. The ship was used as the base for the coastal surveys. It would be moored to the fast ice or a large ice floe strong enough to support the ski-mounted aircraft which, slung over on to the ice, could taxi away and take off quite close to the ship. Radio geodetic stations (one on the ship and one in the aircraft) provided control for the plotting of the aircraft's flight, while astronomical determinations of the ship's position and of selected points on the coast where surveyors were landed provided the necessary ground control of the aerial photographs taken.

Between 31 January and 10 February, 1958, work was carried out between $142\frac{1}{2}^{\circ}$ E. longitude and $166\frac{1}{2}^{\circ}$ E. longitude. The ship's closest approach to the coast was in the Rennick Bay—Ob Bay region, about 25 nautical miles off-shore.

Landings in the region under discussion were made from aircraft at Mt. Obruchev in the Scar Bluffs, Berg Mountains, Wilson Hills (just east of the Pennell Glacier), Mt. Kavrayskiy, Znamenskiy Island, Sputnik Islands, Cape Koposov and at a point near the Zykov Glacier.

The following charts were compiled:

Scale 1: 2,500,000—No. 5996 (1958) (See Map 4).

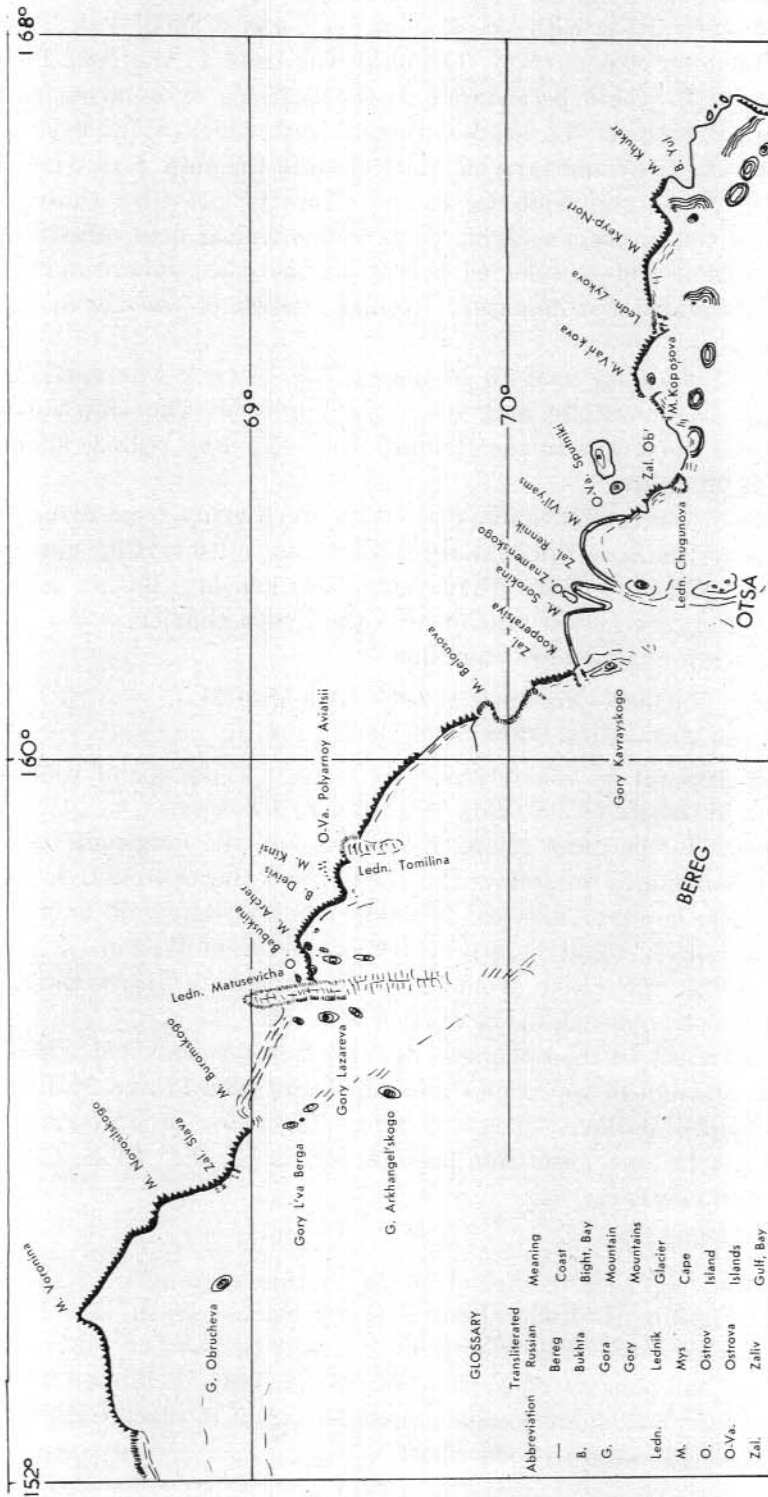
Scale 1: 500,000—Nos. 5403, 5404, 5405 (1961).

The first attempt by the ANARE⁽⁶⁾ to reach Oates Land was early in 1958 when, in the ship *Thala Dan* (Captain K. Hindberg), we attempted to push through to the coast of George V Land in the longitude of Cape Freshfield. I had hoped to follow the coast from there around to Oates Land. Heavy ice, however, blocked the ship when 80 miles off shore and, apart from a Beaver flight by Flying Officer William Wilson, R.A.A.F., and myself along the coast from Cape Freshfield to Horn Bluff (16 January), no close approach to the coast was made.

Returning north to the open sea, the ship headed eastward where we made a direct attempt to approach Oates Land. Between 17 and 20 January the ship struggled without success against heavy ice in uniformly bad weather and reached no closer than position $65^{\circ} 45' S.$, $154^{\circ} 12' E.$ (at 1500 hours on 18 January).

1959

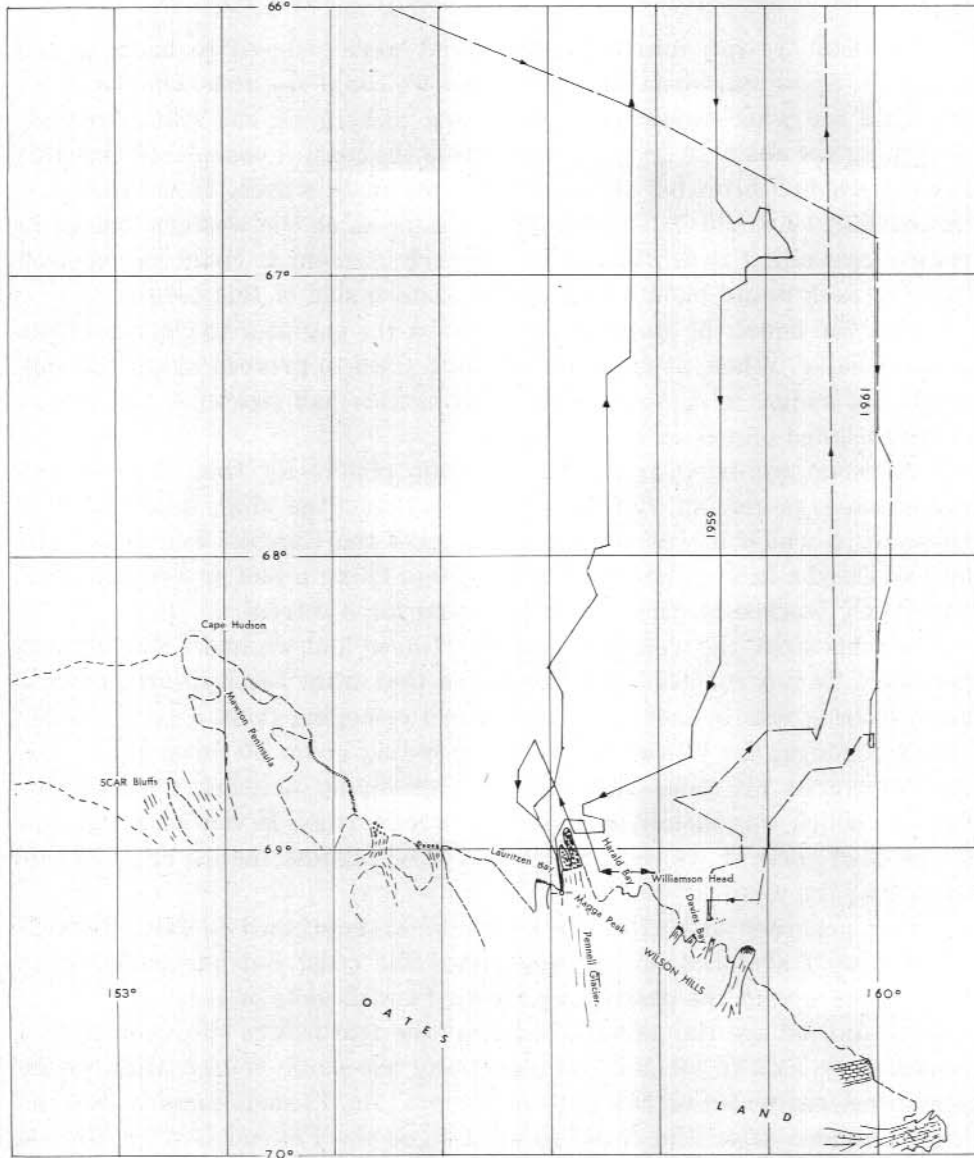
In 1959 the ANARE returned again to this region.⁽⁷⁾ In the ship *Magga Dan* (Captain H. Moller Pedersen) we headed south (see Map 5) and entered the pack-ice on 12 February at about position $65^{\circ} 48' S.$, $150^{\circ} 00' E.$ When we had penetrated to about $67^{\circ} 02' S.$, $148^{\circ} 57' E.$, bad weather and heavy ice forced us again to abandon any attempt to reach Cape Freshfield and we headed north to open water.



MAP 4

A copy of portion of Chart No. 5996 published by the Administration of the Chief of the Naval Hydrographic Service, Moscow, 1958.

I decided, as before, to try again further east to reach Oates Land and this time had more luck. On 17 February we turned south near longitude 160° and in the afternoon ran into ice. In spite of fog and heavy pack we made progress throughout the next day and at 2135 hours stopped for the night only 18 miles (by radar) off the Wilson Hills with what appeared to be impenetrable pack to the south.



MAP 5

A chart showing the tracks of ANARE ship *Magga Dan* in 1959 and 1961.

B

On 19 February we moved again at 0315 hours through snow showers into 8/8ths pack. Fortunately, it was one-season's ice and the easterly wind was light, so we could proceed at one or two knots. At 0430 the showers cleared and we could see the coast for the first time about 16 miles away. It appeared to comprise rocky, snow-drifted bluffs rising sheer from the sea to a height of more than 2,000 feet. Very grim and forbidding it looked. A growing mood of excitement gripped all on board as our hopes rose.

At 0530 we ran into heavy floes and were reduced to backing and charging. Snow started falling again and we could see little. On the radar we could see what appeared to be a long iceberg on our starboard side stretching for about 10 or 15 miles towards the coast. I considered that this obstruction had probably stiffened the pack in this area. If we had seen this earlier we would have attempted to come in on the western side of it. With a prevailing east wind and a westerly current it could be expected that the pack would pile up against the eastern side of this berg.

At 0730 hours the ship stopped to allow the engineer to clear ice from a water valve. When, at 0830, the Captain tried to proceed again the ship would not budge. It appeared that a falling tide had tightened up the ice, so we resigned ourselves to waiting.

At noon we tried again, but without result. By then the ice had hummocked, producing "tombstones" all around the ship, indicating the pressure to which it was subjected. At 1430 the Captain found that the ice had eased a little so he began backing and filling a foot or two at a time, and slowly worked to turn the ship around for a retreat.

At this stage the weather suddenly cleared and we had a fine view of the coast. To our consternation, we found that what had appeared to be a large iceberg was in fact a glacier tongue emerging from a broad valley glacier amongst the Wilson Hills and extending about 20 miles out to sea. We discovered by radar that we were gradually drifting towards this feature, which was then little more than a mile away. It was essential that we proceed north if we were not to be forced against the ice cliffs of this barrier by the westerly drift.

Our progress was painfully slow and we continued to drift towards the tongue. I sketched and photographed the coast but had difficulty in reconciling it with the description which Pennell gave of it in 1911. I felt sure he did not see the glacier tongue or the features to the west of it. I therefore decided to recommend restricting the name Wilson Hills to the mountains eastward of the glacier tongue. As Pennell himself had no feature named after him, I called the tongue the Pennell Glacier Tongue and the glacier giving rise to it the Pennell Glacier.

Gradually, as the ship cleared more space and could make a longer



ANAREE photo 68/0090

PLATE 1

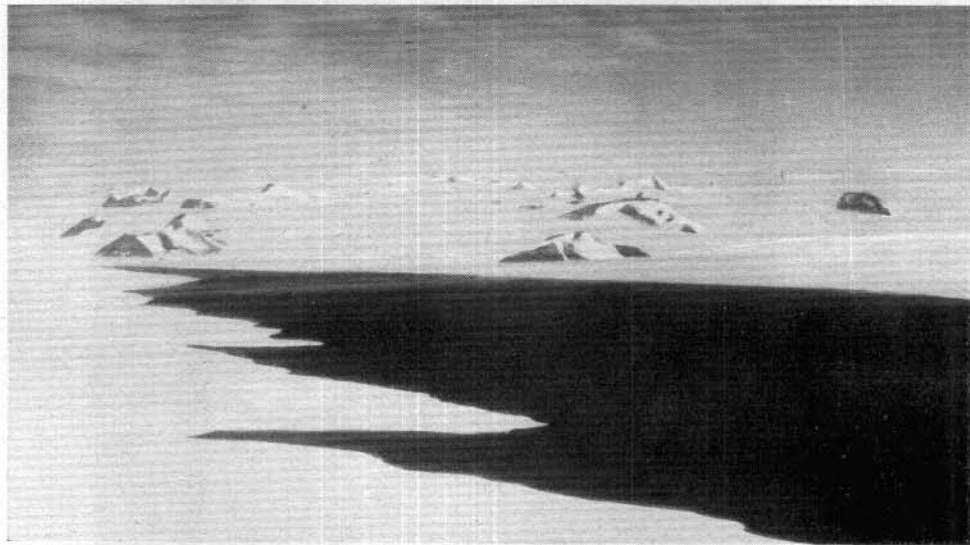
Berg Mountains photographed from Auster aircraft, 20 February, 1959.

Phillip Law

charge, we improved our progress, making about half a ship's length each charge. By 1700 hours, by working the ship hard, the Captain was able to clear the tip of the tongue, which by this time was little more than a quarter of a mile to port. It was a great relief to be free. At 1800 things improved as we moved out of the tombstone ice and by 1900 we were able to proceed slowly without stopping. At 2000 we could see an open pool about $1\frac{1}{2}$ miles ahead. The strong westward set of the current was apparent, for to proceed north we had to steer about 025° true.

I anticipated that there would be open water, or at least loose pack, in the lee to the west of the glacier tongue. Beyond the tongue we could see the coast swinging west-north-west with two mountain outcrops not far inland. It was apparent that there was much valuable work to be done if we could have some luck with ice and a few days of fine weather. At 2200 hours we stopped for the night in ice which had thickened up again, about one mile short of the pool.

Friday, February 20, dawned grey and overcast with a south-west wind and the barometer steady at 974 millibars. The ship started at 0430 hours and, whether because of the tide or the different direction of the wind, found the ice easier to handle. By 0500 we were in fairly open water and headed westwards. At 0645 we reached an extensive pool and I decided to carry out a flight. We appeared to be about 30 miles from the coast and visibility was good. If our luck turned bad we might not have another chance to photograph the land.

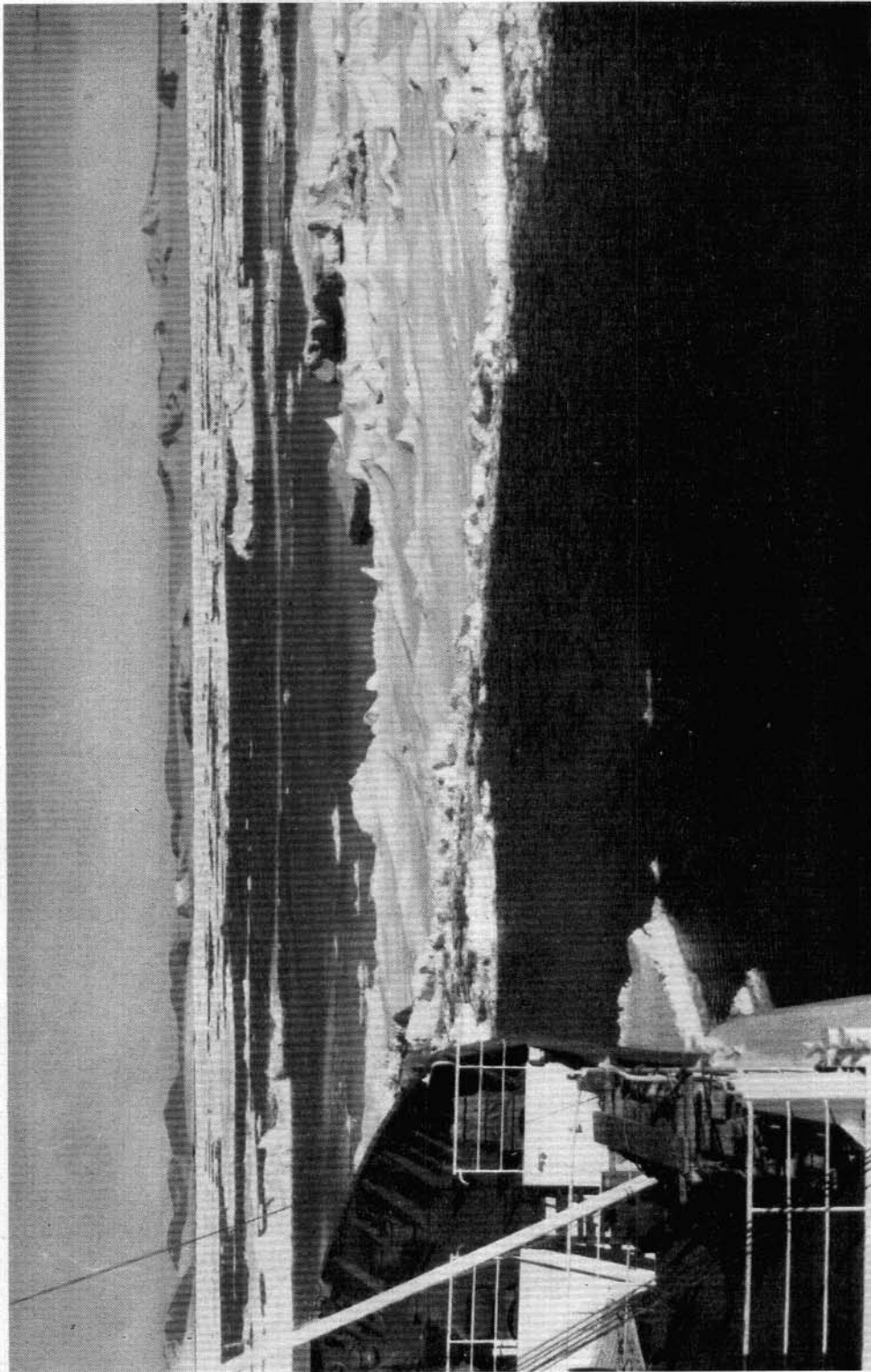


ANARE photo 68/0061

PLATE 2

Phillip Law

Pennell Glacier Tongue and Lazarev Mountains photographed from Auster aircraft, 20 February, 1959.



Phillip Law

PLATE 3

Approaching Oates Land in *Magga Dan*, 20 February, 1959.

ANARE photo 68/0013

Doug Leckie took me up in the Auster at 0845 hours and our take-off was not good. We were 360 pounds overweight and barely managed to scramble off the water and limp into the air before reaching brash ice at the end of our pool. We then set off on a course of 210° for the most westerly of the mountains, which we later found the Russians had called Gory L'va Berga. West of this mountain was a low area (a bay filled with ice shelf or bay ice) out of which rose a steeply domed ice island. Beyond this the coast swung away to the north-west. Between the Berg Mountains (Gory L'va Berga) and the sea the ice was low and broken up, giving the appearance of ice shelf or very thick bay ice, and this extended eastwards past several nunataks. Beyond these to the east were mountains, then the Pennell Glacier and tongue, then the rugged rock bluffs of the Wilson Hills. Fast ice adhered to the coast as far east as the nunataks, but a polynya extended from there to the glacier tongue.

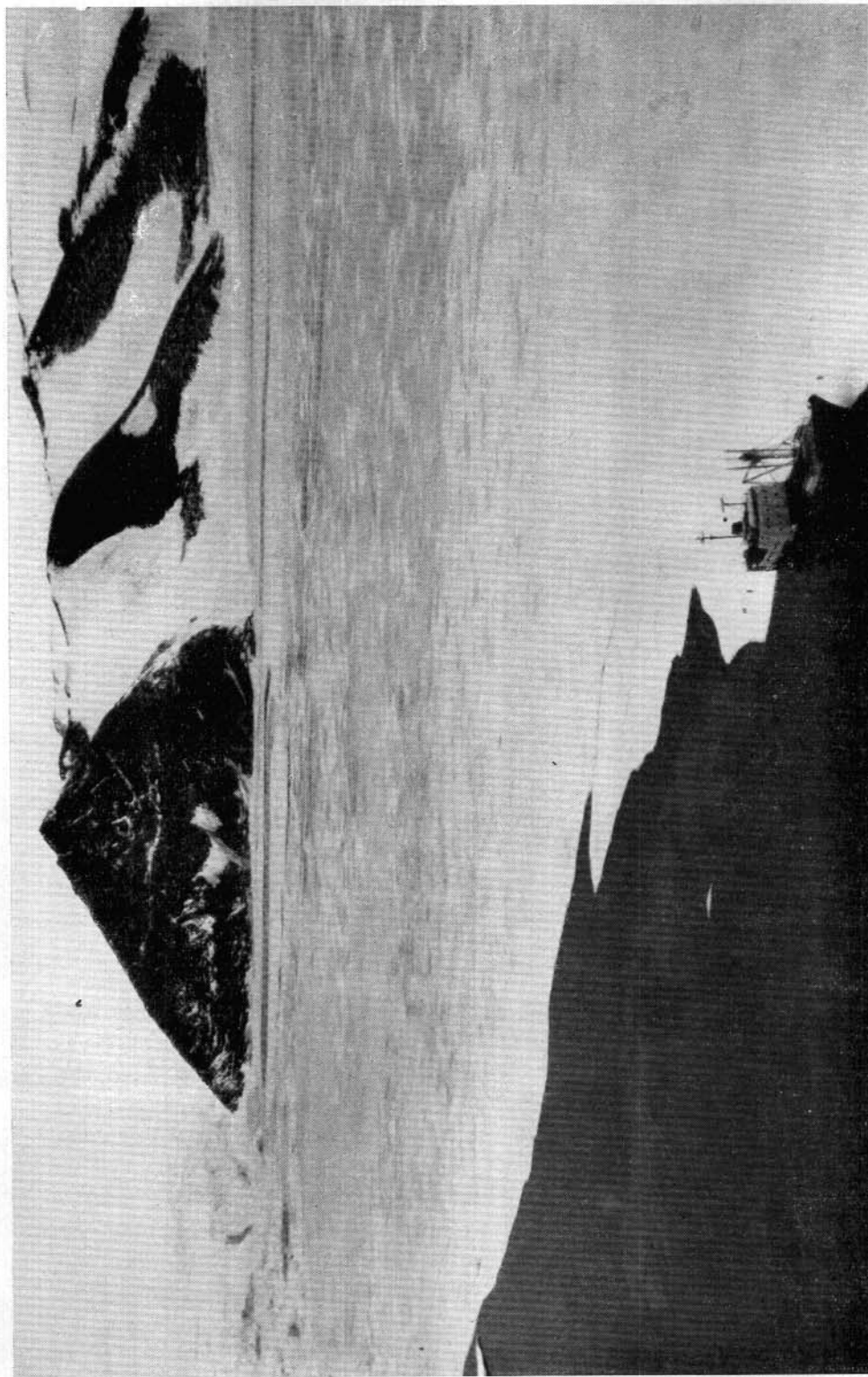
From Berg Mountains we flew on course 115° true at 2,000 ft. I carried an F.24 aerial camera and took a series of hand-held over-lapping oblique photographs, one about every 20 seconds, until we had crossed the glacier tongue and reached the Wilson Hills.

It was an uncomfortable flight. My feet were cold and I was very cramped carrying the heavy camera. I had to hold it half out of the small window of the plane and the hand triggering the shutter became frozen. Just off Williamson Head, Leckie said fuel would not permit us to proceed further, so we turned for the ship—or for where we thought the ship should be. Our return made the third side of an equilateral triangle.

We had left the *Magga Dan* lying in an extensive pool surrounded by pack-ice and icebergs. With the large camera on my lap I had been unable at the beginning of the flight to peer around as I usually do in such circumstances and commit to memory the appearances of the surrounding icebergs. The pool must have closed over, for when we returned we could not find it. There was only a vast mosaic of confetti-like floes, each of the same order of magnitude as the *Magga*. Our radio compass would not give any indication but we were in radio communication with the ship.

Finally, I asked my lieutenant on the ship to send men on to the bridge with every pair of binoculars available and to scan the sky in search of us. One man picked us up as a speck 10 miles away and the ship directed us back by radio. We landed in the restricted space of the tiny area which remained of our pool with only 5 minutes of fuel left.

I spoke to Captain Pedersen and explained about the open polynya in the lee of the glacier tongue. After our troubles the previous day he was not eager to approach the coast again but was very co-operative and, agreeing that there would be little danger from ice on the westward side of the tongue, he headed south at once.



Phillip Law

PLATE 4

Magga Dan moored to fast ice off Magga Peak, 21 February, 1959.
To the left of the peak is the Pennell Glacier.

ANARE photo 8282

The ice was very heavy and, after an hour, the Captain and I were just beginning to feel despondent and considering abandoning the attempt when conditions improved. The further we went the easier it became and soon we could see the polynya along the edge of the tongue. There was then no longer any doubt that we could reach the coast and our spirits soared.

We entered open water at 1600 hours and followed the western edge of the iceberg tongue down to where it ran into the fast ice.

Here, the broad Pennell Glacier, about 10 miles wide, separated the Wilson Hills to the east from a line of peaks (named Gory Lazareva by the Russians) to the west. The peak nearest the sea on the western side of the tongue presented some 800 feet of sheer rock in "flat-iron" shape and from its base a strip of fast ice one mile wide stretched along the coast.

At 1730 hours, we tied up to the edge of this fast ice opposite the peak, which I named Magga Peak in honour of the first ship to reach this coast. The weather had steadily improved and by then was calm and sunny. After dinner we held a meeting and arranged the tasks to be carried out. They included astronomical observations to fix the position of Magga Peak, measurements of magnetic declination, geological collecting, a flight by the Auster aircraft, observations of lichens and penguins, and the building of a cairn on the summit of the peak. After that, we went ashore.

We raised the Australian flag and walked to Magga Peak. Numbers of emperor penguins suggested that in winter there is probably a rookery on the fast ice somewhere in this locality. A glorious sunset illuminated flaming, smoky clouds with delicate tints of green and rose and dramatically floodlit an iceberg behind the ship.

At the junction of land and ice a tide crack wheezed and sighed, while jumbled ice blocks rose and fell 18 inches. In the still evening, the creaking noises had an eerie quality, while we stepped warily to avoid being wedged in crevices which opened and clamped tightly together again in this tormented ice.

A number of men climbed the peak, while the hydrographer, Lieutenant Commander Ian Burnside, set up his theodolite at the base and prepared to take star observations. He managed to complete his observations early in the night, before cloud obscured the stars, and fixed the position of Magga Peak as $69^{\circ} 09.3' S.$, $157^{\circ} 08.7' E.$ The three parallel rock ridges, of which this peak is the most northerly, I called Burnside Ridges in his honour.

Next morning, February 21, we rose at 0330 hours and I sent a man to place a pickle jar, containing an Australian flag and a note describing our landing, beneath the summit cairn. The Captain moved the ship along the ice edge to where the fast ice was stronger and the Auster, converted



ANARE photo 8314

PLATE 5

A. Campbell-Drury

Raising the Australian flag near Magga Peak, 21 February, 1959. The men are (from left to right) Robert Dalton, Bruce Coombes, George Smith and Phillip Law.

overnight from floats to skis, was hoisted out. Leckie went off to lay out markers for his air strip and arranged to take off with me at about 0600.

It was 0640 hours when we departed, the Auster rising smoothly off the excellent surface. The day was calm and overcast and we could not fly higher than 2000 feet because of cloud. We started on course 295° true at 60 knots but 15 minutes later changed to 310° . From a nunatak just west of the ship a jumble of bay ice and ice shelf ran into a broad bay which swept westward in front of several nunataks. The ice shelf continued on, extending halfway "inland" towards the Berg Mountains. In front of these the ice was riven by a series of giant cracks—crevasses as wide as boulevards—which, nearest the mountain, lay at about 20° to the direction of the coast and which swung to lie at about 40° - 50° to the coast as they reached it. There, the long parallel fingers of ice between the cracks protruded out into the sea, forming a glacier tongue which exhibited longitudinal valleys and ridges on its surface similar to those on the giant iceberg we had seen at Virik Bank. The acute angle at which this tongue projected into the sea was unusual. A number of the fingers began breaking up into block iceberg form about half-way between the mountain and the coast.

To the west of the Berg Mountains, the ice shelf continued and its southern limit passed behind a high, domed ice island about 15 miles long which rose from the shelf, and in front of a small, almost snow-obscured, ridge-shaped nunatak about 15 miles in from the coast. This was the last visible rock outcrop. The snow slopes of the mainland then seemed to swing north again to where a long iceberg tongue jutted into the sea. The coast was cluttered with a fantastic jumble of icebergs, bay ice and tumbled pack, and ran in about direction 305° true.

At 0710 hours we passed by the tip of the ridged iceberg tongue and flew over a comparatively small bay choked with bergs and heavy bay ice. The bergs debouched from a great mass of seracs and crevassed ice on the plateau—a wicked looking graveyard of giant tombstones.

At 0720 the coast swung still further northwards and we followed it on a true course of 335° . We had now passed beyond radio range of the ship and the plateau and bay offered no possible landing areas. Miles out to sea the convulsed masses of heavy ice petered out into fast ice which extended a further 40-60 miles to the north.

We reached what looked like the end of the northward trending coast at 0745 but found beyond it a shallow bay and a further point, bearing 325° , and we changed course to follow it. I was most anxious to reach this point and see what lay beyond. At 0750 Leckie pointed under our port wing and to my surprise I saw on the horizon some long, low, flat-topped bluffs of black rock which bore a singular resemblance to Horn Bluff.

(Horn Bluff, lying to the west of Cape Freshfield, in George V Land, I had flown over the previous year.) I could not believe we were close enough to Horn Bluff for it to be visible from our altitude. Under the starboard wing, and much closer, was another set of nunataks which appeared to lie on the far side of the northward trending promontory we had been following. I asked Leckie to point the aircraft at each of these two major features in turn and found that the Horn Bluff features lay on bearing 245° and the nunataks on bearing 275° . I took kodachrome photographs from the window. (The features resembling Horn Bluff are those which we later named Scar Bluffs).

I had noticed Leckie becoming uneasy and had attributed this to the desperate nature of the terrain over which we were flying and the fact that we were out of radio range of the ship; but I particularly wanted now to turn the corner of the promontory and see what relation the nunataks bore to it. However, Leckie turned to me and said, "The engine sounds funny. We had better turn back". So here, 76 statute miles from the ship, at 0752 hours, we turned about.

Leckie varied the carburettor heating and other controls and was very worried. Suspecting carburettor icing he dropped down first to 1200 feet and then to 800 feet. With our ears straining to the rough noise of the engine and our eyes searching the terrain below for a suitable area for a forced landing, we skimmed over the horrible bay of cluttered icebergs, over stretches of crevassed plateau ice and jumbled bay and pack ice. Meanwhile, a new anxiety was added to our minds—the weather began to close in from the east. Low dark clouds hung in the sky and a pall of mist was slowly enveloping the mountains around the Wilson Hills.

Leckie twiddled again with various controls and the engine smoothed out. We found out later that a petrol pump was faulty. Thinking it was carburettor icing, Leckie had increased the carburettor heating. At about the same time we had changed to another tank, as the other was running low in fuel. This change automatically brought another fuel pump into action, thus removing the original source of trouble, but the extra carburettor heating continued to cause the engine to run rough until, having decided that icing was not the trouble, he restored the carburettor heat to the normal level and the engine thereafter ran satisfactorily. We, however, were not to know all this and continued to worry all the way back.

We arrived over the ship at 0845 and, as the ceiling had not closed in completely, I asked Leckie to fly on over the Pennell Glacier Tongue to look at the condition of the pack-ice on its eastern side.

We found that open water extended all around the tongue, although the bay on the other side was partly covered with medium pack extending right to the foot of the coastal mountains.

The Pennell Glacier Tongue, like the giant iceberg at Virik Bank, exhibited longitudinal valleys separated by domed ridges, like long fingers laid side by side. Several of the fingers were beginning to separate at the northern end, with sea filling the valleys between, and the ends of some of the western fingers had broken off.

This form of glacier tongue is so unusual that I could not help wondering whether the giant berg at the Virik Bank had originally formed part of this glacier tongue or the one further west which lies in front of the Berg Mountains.

We landed at 0900 hours on the fast ice and went on board for a hearty breakfast. On top of Magga Peak a cairn had been built and the Australian flag was flying.

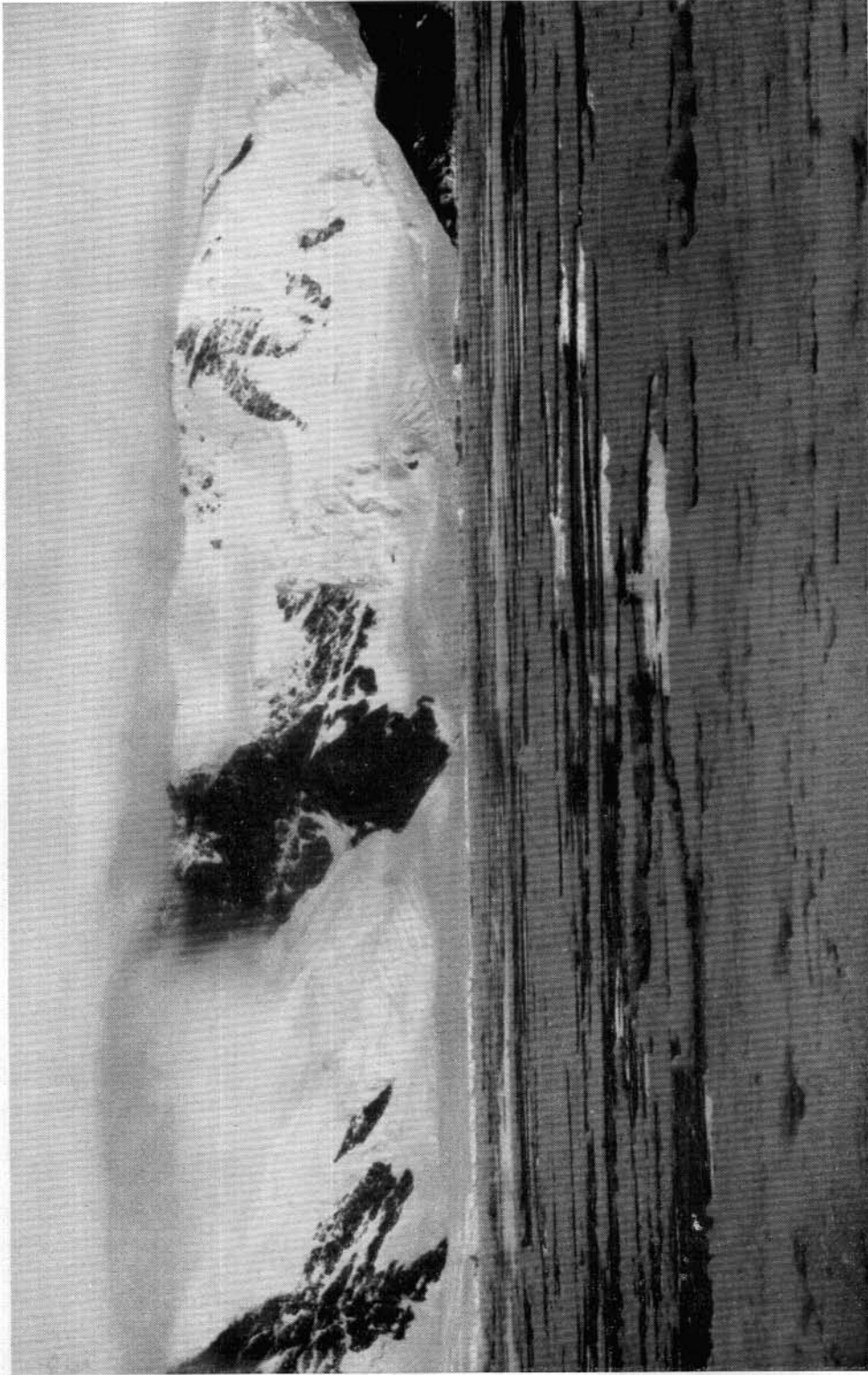
After breakfast I described the condition of the sea ice on the eastern side of the glacier tongue and asked Captain Pedersen would he risk sailing around there. I suggested that, if he were worried about pressure similar to that we had experienced previously, we could return before nightfall to our present anchorage. He agreed.

We sailed at 1215 hours in calm conditions and plotted a nice run of soundings from the Magga Peak fix, around the end of the tongue and down to within a mile of the Wilson Hills. We kept very close to the tongue, where we found a narrow lane of water, and measured the projection to be 15 miles long on its western side and 19 miles on its eastern side. Its tip was only a quarter of a mile wide and the depth of water there was 300 fathoms. There was no ice foot at the bottom of the ice cliffs, which were mainly low (8-30 feet high). The centre of the top of the tongue we estimated roughly as being 200-300 feet high and it appeared to be afloat.

I had intended landing on the slopes of the Wilson Hills, but the rock rose very steeply from the water and the last quarter mile of pack was very dense. Rather than waste a lot of valuable time on such an attempt I decided, instead, to keep the ship moving and to carry out a running survey, with soundings, of the coast to the east of the tongue.

At 1510 we started the run and at 1600 we were forced to stop because of heavy pack. It was not possible for the ship to maintain a perfectly straight course after the first mile because of large floes. I took a series of overlapping photographs while other men worked in collaboration with the ship's officers in plotting courses, radar observations and soundings.

The day was grey and, photographically, could have been better. Nevertheless, the scenery was most impressive, with white peaked mountains fanged with black ridges, and narrow steep glaciers and ice falls plunging into the sea. The rock slopes in most places swept straight into the sea at a sharp angle and the geology seemed to be similar to that near



Phillip Law

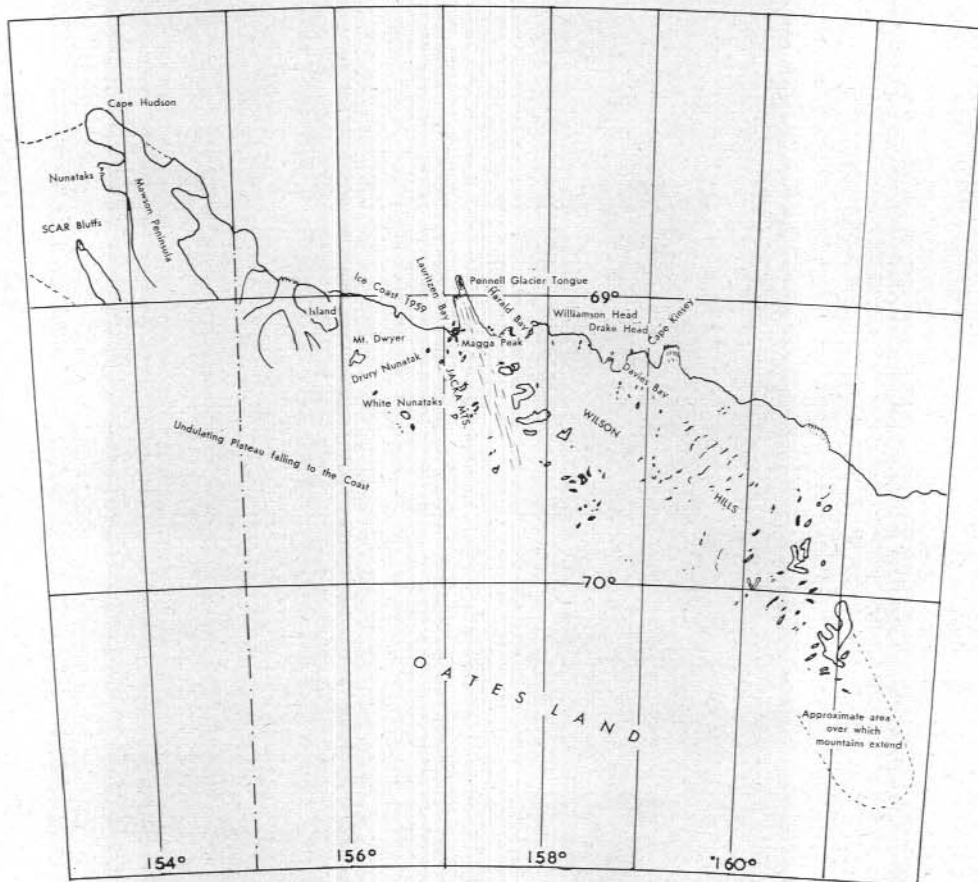
PLATE 6
Harald Bay from *Magga Dan*, 21 February, 1959.

ANARE photo 8268

Magga Peak, namely fine-grained gneiss with iron staining, some quartz, and some basaltic dykes dipping at about 30° . The coastal faces of rock were carved with picturesque cirques, some drifted with snow and others covered with scree. The bay between Williamson Head and Archer Point I named Harald Bay in honour of Captain Harald Pedersen.

A south-east wind was rising and pack-ice was beginning to drift across to the tongue, so at 1615 we set out to return. We had to push some ice on the way out but had an uninterrupted run down the western side, arriving at Magga Peak at 2000 hours. We found that large areas of the fast ice had broken out from our mooring place during our absence, so the Captain did not make fast to the ice edge but merely kept the ship's bows pressed to the ice with slow-running engines.

Next day was dull and overcast, with low clouds spoiling visibility, a



MAP 6

A copy of portion of a map drawn by the Division of National Mapping of the Commonwealth Department of National Development, Canberra, from data obtained by ANARE (1959) and U.S. Navy Operation Highjump (1946-47).

20-knot south-east wind and a falling barometer. At 0700 hours I decided that we could not expect the weather to improve sufficiently for further flights or useful work, so at 0705 we sailed for Macquarie Island. We ran into medium pack at the end of the tongue and pushed through fairly heavy pack all night. At 0730 hours on Monday, February 23, we reached open water, having passed over the edge of the Continental Shelf at 0130 hours in the approximate position $67^{\circ} 32' \text{ S.}, 158^{\circ} 01' \text{ E.}$

Captain Harald Pedersen had proved a courageous and determined master and our success had depended greatly upon his enthusiastic co-operation. Acknowledgements are due also to his officers and crew, to my lieutenant for the voyage, Group Captain Robert Dalton, to the R.A.A.F. Antarctic Flight led by Squadron Leader Douglas Leckie and to the hydrographer, Lieutenant Commander Ian Burnside, as well as to the other ANARE men who assisted with special watchkeeping and the handling of the aircraft.

The 1959 voyage had stimulated our interest in Oates Land so I made provision in the itinerary of the ship *Thala Dan* in 1960 for a further voyage of exploration along that coast. However, this was frustrated when, as the ship was about to proceed eastward from Lewis Island in mid-February, 1960, to attempt an approach, it was discovered that, owing to a mistake by the ship's steward, insufficient rations were held on board and the ship was forced to return to Melbourne. This costly error meant that yet another year was to elapse before any further exploration in Oates Land was possible.

1961

The following summer, at the beginning of March, 1961, I decided to use at Oates Land what little time remained of the season when returning from relieving Wilkes Station and carrying out other work along the coast of Australian Antarctic Territory. The ship was the *Magga Dan* (Captain Vilhelm Pedersen), my lieutenant for the voyage was Group Captain Robert Dalton, our two chartered helicopters were flown by Captains John Stanwix and John Arthurson and our Beaver aircraft was piloted by Wing-Commander Richard Cresswell.

We made our approach at about longitude 160° E. (see Map 5) and pushed into the ice at latitude $67^{\circ} 32' \text{ S.}$ on 3 March. Using the ship's searchlight the Captain was able to push on through the night in broken pack and brash ice.

At 0600 hours next morning the continent was visible about 40 miles

to the south, with high coastal mountains rising from the creamy slopes of the plateau. The largest peaks bore about 190° from the ship while the lower Wilson Hills could be seen around to starboard on a bearing of 235° . The ice was thickening up, with new ice cementing together the old brash, and it was obvious that a couple of fine, calm days of heavy freezing would seal up the whole area. Our time here was going to be very limited.

By 0800 we had slowed down to a crawl and, as our time was so precious, we turned and retraced our track to where the ice was easier. There Captain Arthurson flew me on a reconnaissance by helicopter to examine the ice while the ship moved slowly westwards.

I found open water in the form of a long polynya stretching along the coast in front of the Wilson Hills but due south the sea ice appeared to be solid. Far away to the east and north-east there was open water, although it was by no means certain that it was accessible from where we were. I wondered whether it might lead clear through to the open ocean in the north.

Ahead of us was a series of pools half covered with ice and the most westerly ones seemed to lead to an expanse of fairly easy pack through which we might push to reach the coastal polynya.

After landing I directed the Captain by a devious route to reach these pools but by lunch time we were again slowed down in heavy ice and I was forced to fly again to seek an easier path.

By deviating to the south we were able to reach these pools but by the time we arrived there at 1430 they had all but disappeared and we were again hemmed in by heavy floes. At 1445 the Captain and I both flew in the helicopter and found that all the slack ice between us and the shore lead had disappeared. The Captain was rather appalled at the amount of ice around us and suggested that we should give up our attempt to reach the coast. He was afraid that a freeze-up or a deterioration in conditions would trap us there for the winter.

Being convinced that this closing of the ice was again a tidal effect, I persuaded him to wait until morning to see if the ice would open again. By 1530 hours conditions were so tough that it took us two hours to go thirty yards and at 1800 hours the Captain stopped any further attempts. Next morning, Sunday 5, there was no change in the ice and we were fast beset; but after breakfast the coast began to emerge from its grey pall of mist and I decided to send a party in to the coast. After some trouble in starting the cold engines of the helicopters, Stanwix and Arthurson took off at 1005 hours with McLeod (geologist) and Parkinson (magnetician). Their objective was a medium-sized peak near the base of a glacier tongue which extended out from the coast to within 10 miles of our ship. They landed at 1105 hours.

Around the ship the ice remained fast and everybody was very gloomy. However, at about 1130, it suddenly began to ease and I again had a talk with the Captain. I suggested we try to push through to a long east-west polynya about ten miles to the south which would give us a certain amount of freedom in moving up and down the coast. He was not very happy about this proposal as he was concerned at the possibility of being unable to retreat from there; however, while we were having lunch he came down and said, "We have started." I found that the ice had suddenly slackened and the ship was under way.

The going was very tough amongst heavy rafted floes, four to eight feet thick and 20 or 30 yards in diameter, and for the first half hour we progressed very slowly; but then a fair-sized pool opened up south of us and when we reached it we gradually made better speed. We arrived at the open water of the polynya at about 1335 hours and proceeded southwards, running a line of soundings as we went. At 1435 hours we broke our run to take on the helicopters which had returned from the coast after a successful stay.

The pilots had found difficulty in landing. They had encountered steep slopes, cliffs of ice and sharp scree rock. However, they had managed to land on a ridge about 3000 feet high, although they had poked two holes in the rubber pontoons of one aircraft in doing so. Parkinson had taken a full set of magnetic readings and McLeod had made a good geological survey. They had sketched the iceberg accumulations off the main glacier tongue on their return.

Meanwhile, the ship had reached the southern edge of our open pool and we found ourselves barred from the main coastal lead by a strip of pack-ice about one mile wide. I decided to stay where we were and to send Cook and McLeod in the helicopters towards the Pennell Glacier Tongue, stopping where possible for rock collections and taking photos of the coast with a F24 camera. In addition I planned that Cresswell and I would fly a photo run in the Beaver aircraft at low altitude beneath the cloud ceiling to obtain a series of oblique photographs of the coast to the west of the ship.

However, by the time the aircraft were ready, the wind had risen to 25 knots and the gustiness around the helicopter deck prevented the "choppers" from taking off. At the same time Cresswell and Dalton advised against hoisting out the Beaver aircraft in case the wind eddies in the lee of the ship should swing the plane and crush a wing against the ship's side. I had to content myself with the photography from the ship by telephoto lenses on small cameras while my wife made a long strip sketch of the rock features showing along this expanse of coast.

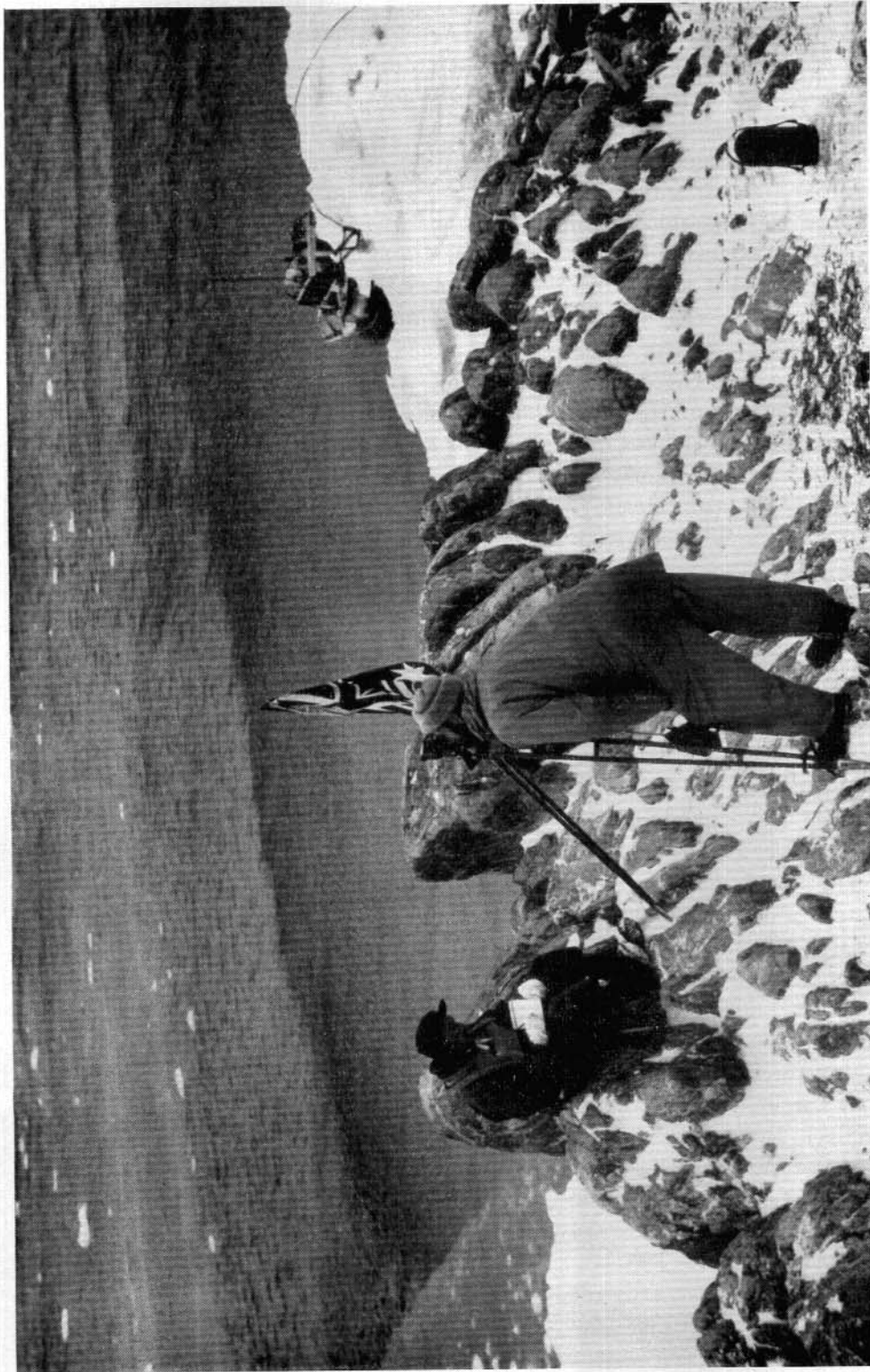
Our stay at Oates Land was nothing but a series of frustrations. On

Monday, 6 March, I rose at 0400 hours but the weather was still bad with fog and a 40-knot wind so I did not call the others. At 0740 I asked the Captain to move in as close as possible to the coast. We could see nothing through fog and driving snow and our large 10-cm radar was not working. The small 3-cm one was almost useless for delineating coastal features. We were aiming at the Aviation Islands (mapped by the Russians in 1958) but could not find them and did not know where we were. We completely circumnavigated our restricted shore lead and when we were reaching the eastern end of our first complete circuit the weather cleared enough for us to see a few bluffs and two islands.

At 1015 we found a lead through the intervening pack-ice into the shore water right against the coast. This open water also surrounded the Aviation Islands but it took us two hours to reach it. We anchored west of the most southerly of these islands, about a half mile off shore, at 1210 hours. Just north of the ship was a long reef where waves were breaking and east of that an ice island about one quarter of a mile long.

At 1325 a party of us, including my wife, went ashore in the Mac. Robertson launch. It was blowing about 40 knots and was very chilly, although the temperatures were only in the low twenties. I nudged the launch in against an ice ledge on the side of the largest island and we finally tied it up to the ice there with Geysen and Jennings taking turns to watch it. Cook set up a tripod for a sun observation but the sun disappeared just as we arrived and at no time could he see anything through the mists, nor could he take any angles or do any survey work. McLeod made a geological survey and Parkinson managed a set of magnetic observations by obtaining a bearing from the ship's gyro compass. We built a cairn on the summit and planted a flag and a statement of our landing in a small tin. However, the visibility did not permit a round of photographs. Cook estimated that our island was approximately 260 feet high. On it were about 300 moulting Adelie chickens and there were two main deserted rookeries, one on the summit and the other on a ridge or saddle half-way up. Heavy pack surrounded our island on three sides. About one mile away on its eastern side there passed the ice cliffs of a glacier tongue extending from near the eastern edge of Davies Bay.

At 1500 hours I collected all except Cook and Marshall and chugged off in the launch to land McLeod on another island. We found that there were four main islands, together with an ice island built up on a submerged reef near the ship. The most northerly island was a twin with a saddle of snow separating the two rocky peaks. The next was a symmetrical, conical, rock feature of jagged pieces of stone. The next was a snow-covered, rather low, domed island with only spots of rock visible. Our large island was the fourth and most southerly. I took the motor-boat close in to two of the



ANARE photo 10076

PLATE 7

Surveyor David Cook taking observations at Aviation Islands, 6 March, 1961.

Phillip Law

other islands while McLeod examined them and I finally put him ashore on the most northerly island because its rocks appeared to be different from those of the other three. Coming out from the second island we struck a submerged rock about 40 yards offshore just as the launch was picking up speed. Fortunately no damage was done.

At one stage from our first landing we could see something of the mainland coast. Davies Bay, south of us, appeared as a deep bay half-choked with ice shelf. From its base a series of mountain bluffs ran eastwards in almost a straight line but these did not represent the coast because a wide ice piedmont extended in front of them to meet the sea some miles to the north. The glacier tongue I have already mentioned extended at least five miles further beyond this again. On the western side of Davies Bay there was another, but smaller, piedmont but the glacier tongue marked on the map compiled from the 1947 "Operation Highjump" photographs no longer existed. From the western arm of Davies Bay the line of mountain bluffs appeared to run practically in a straight line as far as Williamson Head.

After looking at the most northerly island we returned to our original one, picked up Cook and Marshall, and landed back on *Magga Dan* at 1645 hours. The Captain immediately hoisted anchor and proceeded out from the shore lead, through a mile of weak pack, into a long, large, open pool for the night, arriving at its most easterly end at about 1900 hours. The barometer had flattened out at the bottom of its deep depression. Again the mountain tops cleared and emerged from their fog shroud. Why could they not have done this during the afternoon?

On Tuesday, 7 March, I looked at the scenery at 0400 hours, but it did not look promising. I looked again at 0700 and found the wind was reasonable and the sky cloud breaking up. The visibility around the mountains had improved, even though the cloud level was low. I was able to take a bearing upon a glorious pyramidal peak many miles inland which was lit by sunlight. Later on I was able to take a bearing on this peak from another point on our track and thus fix its position. It appeared to be at least 8000 feet high. I named it Mt. Gorton in honour of Senator John Gorton, the Minister responsible in the Australian Government for our Antarctic work.

The helicopters were ready at 0830, one in the water and one running on deck. However, once again the wind rose rapidly and we had to abandon our plan for their flights. At 0900 the Beaver was started, but by 0915 the visibility again closed in and its flight was also cancelled. By 1000 hours we were in heavy snow showers and close mist and I was glad we had no parties or aircraft out.

It was a most frustrating period. The men returning from a year at

Mawson and Wilkes were bored and anxious to go home. I wanted a chance to bring the ship in against some coastal ice so that they could go ashore and take part in some of the landings. As it was, the interesting work was falling almost completely upon the men enlisted for the round trip—the air crews, the geologist, the geophysicist, the surveyor, etc. We were well equipped to carry out good work and we were well placed to do so; all we needed was one day of clear weather.

After lunch we brought the ship back about 6 miles nearer the coast to the southern extremity of our pool and just off Davies Bay. From here I noticed a long, high, ice ridge running out from the coast on our port side with a great rock bluff as its terminus. This rock bluff, being at the northern edge of the ice piedmont, is quite a long way north of the main line of mountain bluffs stretching eastward. It therefore appears as a very conspicuous cape. However, aerial photos taken from flights made south of this do not show the rock bluffs, which face north, and do not depict the height of the spine of snow which runs south at a fair elevation to join this bluff to the other mountain features. This illustrates some of the difficulties inherent in Antarctic mapping.

The fog and snow showers persisted. The Captain was becoming more and more worried about the ice to the north of us, because already the open pool about us had completely frozen over and he was concerned that newly freezing ice between the ice floes would prevent the ship from handling the pack we had to traverse to get out. By 1600 hours the mists were bad, the barometer was low and there seemed no prospect whatever of any improvement. However, I suggested to the Captain that it would be better for us to wait a little longer and try to obtain a helicopter reconnaissance before leaving, as I did not like the idea of pushing blindly back into the heavy pack, but he was impatient to get moving, so I agreed.

We sailed north through our pool to reach the ice edge, then followed it eastwards. When it trended south-east the Captain decided to break in and head north. At first the pack consisted mainly of young floes made of new ice 18 inches thick. It was reasonably loose and easy to push and we made good progress. But after the first few miles the pack thickened up and was constituted mainly of heavy, old floes, 4 to 8 feet thick and 15 yards across. There was about $\frac{2}{3}$ cover and visibility was poor. At 1900 hours the ice suddenly tightened and we stuck fast. This sudden change in the ice conditions seems to be characteristic of this region and is probably due to some combination of wind and tide.

On Wednesday, 8 March, I rose at 0400 hours with the Captain but visibility was too bad for a helicopter flight. At 0700 the ice slackened and the ship was able to proceed again. I found that we had drifted about 6 miles WNW during the night. However, at 0945, we again suddenly became

beset. All the floes around the ship developed pressure frills around the edges and the ice alongside rafted up on end. The wind was gusting from the east at up to 44 knots and this was probably the reason for the pressure.

As the day progressed the visibility improved once again and the wind dropped. I was able to take a number of overlapping telephoto shots of the coast while the ship's officers obtained some sun shots and bearings on known coastal features in the Wilson Hills region to determine our position. I decided to make one last attempt at survey work and despatched the two helicopters with McLeod and Cook at 1500 hours. They flew against head winds for 40 miles and headed for Davies Bay. At about 1610 hours they landed on a flat ice area upon a rocky ridge at an altitude of about 2000 feet at the base of a peak behind and slightly east of Davies Bay. Cook obtained a rough astrofix from two separated sun shots and was very lucky to get it because the sun disappeared a moment or two after his second observation. He also obtained some bearings for triangulation and a series of stereoscopic photos of the coast. McLeod examined the geology and obtained rock samples. Altogether it was a valuable result, salvaged from what remained of a disappointing day.

As the aircraft radioed that they were about to land on the shore, cloud covered the sun at our ship and the weather began to close in from the south-east. I anxiously watched this weather while out of radio contact with the grounded helicopters but the approaching storm moved slowly and the aircraft just beat the bad weather back to the ship at 1840 hours. By nightfall it was overcast and snowing. While they were away I was able to take some interesting bearings of features along the coast and also discovered two small new islands about 8 miles to the west of the ship's position. I called these the Terra Nova islands after Pennell's ship. During the day and evening the Captain kept trying to free the ship from the ice, but without success.

When the aircraft returned I went up with the Second Mate for a short reconnaissance and found open water about 8 miles east of our position. This was obviously the open water I had seen 40 or 50 miles to the east when we first approached but a strong easterly gale had driven it across towards us. It appeared that if we could reach this it might lead us out to the north. North of the ship itself along the course we were travelling the pack-ice extended heavy and unbroken as far as I could see. It seemed certain that there were at least 70 miles of ice in this direction. Half an hour later we were back with this heartening news but the ship was still held fast and we began to wonder if we might remain here to freeze in, within such a small distance of freedom.

At 2200 hours the ice suddenly loosened up and the ship was able to



ANAKE photo 12401

PLATE 8

Cook Ridge showing the cirque on the north face of the most northerly peak.

I. R. McLeod

move. Again there seemed no explanation for the very sudden change in the conditions. The Captain turned east and moved continuously but very slowly through "concrete mix" ice. The floes were semi-welded by freezing brash and it took all the power of the ship to move through them. By this time it was dark and the ship was moving with the aid of the searchlight in snow showers with a light wind. Soon a swell was evident, indicating that the open water to the east was quite extensive.

I started soundings at midnight and at 0100 hours on Thursday 9 March we reached the edge of the close pack. From there on we proceeded through strips of ice cakes and thin brash at good speed. The brash and pancake ice gradually thinned out and by 0230 hours we were in water which was quite open except for a few strips of pancake ice.

On Thursday I rose at 0700 hours. I was still hoping that the weather would clear and permit me to fly the Beaver aircraft back towards the coast for some photographic work but the weather was still bad with snow showers and poor visibility and the freezing condition of the sea surface would have prevented a take-off in any case. By evening there was no doubt that we were clear of pack-ice; we therefore set course for Macquarie Island, all very relieved at having extricated ourselves from the Oates Land position.

Captain Vilhelm Pedersen and his officers and crew had handled their difficult task in masterly fashion and had left nothing to be desired in co-operation. The helicopter team led by Captain John Stanwix had performed with dash and courage under most trying conditions while Ian McLeod, David Cook and Dudley Parkinson had refused to allow bad weather to prevent their determined attempts to land and carry out their work. It was bad luck that the "Beaver" had no opportunity to fly and this was a great disappointment to Wing Commander Richard Cresswell and his team who had worked extremely hard, assisted by ANARE deck teams, to hold the "Beaver" ready for immediate use should conditions have permitted.

From this attempt and our 1959 voyage we had learned some valuable lessons. First, the Oates Land area is a region of heavy snowfalls and frequent cloud and fog. Fine days are rare. It appears that depressions diverted south by the Australian continent, sweep down to move across the coast of Oates Land and Victoria Land into the Ross Sea, bringing warm moist ocean air into contact with the cold continental air. The mountains are all heavily covered with snow and there is little bare rock.

Secondly, dense pack-ice makes this coast a difficult one to approach and the open season is short. The ice does not appear to break up before about mid-February and it freezes together again early in March. Pack swirls out of the Ross Sea and drifts westwards from Cape Adare to

bank up against the promontories and glacier tongues of Oates Land and George V Land. Ships coming in anywhere to the east of such obstructions must expect to experience pressure.

Thirdly, the ice clears from the east and an approach from the Cape Adare end of the coast can probably be made in late February in almost open water. A southerly approach from further west will probably encounter sixty to eighty miles of intervening pack-ice.

1962

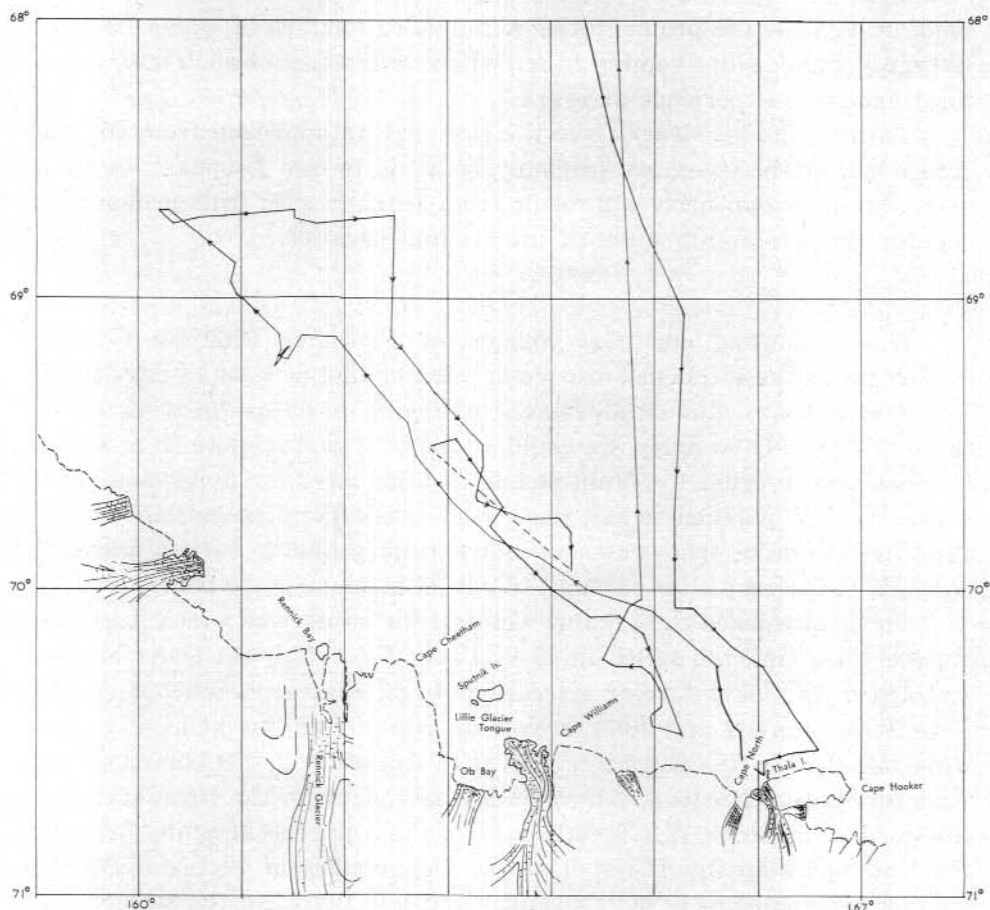
When planning our next voyage for February 1962 we took into consideration these conclusions. We decided to allot at least 14 days for the job of attacking Oates Land, instead of trying to do useful work in only three or four. By so doing we could afford to wait for more than a week, if necessary, in order to obtain one or two fine days for flying and survey work. We also planned to sail south past the Balleny Islands in what we expected would be open water in mid-February and to turn in along the coast from the east in an attempt to outflank the pack-ice belt.

The plan worked remarkably well and the result was a most successful voyage. This time we sailed in M.V. *Thala Dan* (Captain Hans Nielsen) and again we took a Beaver aircraft and two chartered helicopters. Captains John Stanwix and John Arthurson were again our helicopter pilots, while the Beaver was flown by a R.A.A.F. Antarctic Flight commanded by Squadron Leader Norman Ashworth. My lieutenant for the voyage was Tom Harwood. Commander d'A.T. Gale, head of the Antarctic Mapping Branch of the National Mapping Division of the Department of National Development, accompanied us as hydrographer and consultant for the aerial survey work. We left the Oates Land attempt until the middle of February, after we had completed the relief of Wilkes Station and the other coastal exploration further west.

It was the morning of Saturday, 10 February, when we sailed south at about 164° 40' E. long. past the Balleny Islands (see Map 7). It was fourteen years since, in the Wyatt Earp, I had last seen these bleak, forbidding islands and I remembered the occasion as though it were yesterday.

That night at 2145 hours, at about 70° 04' S. lat., 165° 23' E. long., we met a bank of depth 100 fathoms stretching across our course, on which were stranded many icebergs. This was obviously the 100-fathom bank plotted by Pennell and we turned east to avoid the bergs, for they were cluttered up with pack-ice.

We decided to make Cape Hooker our objective as it seemed on the chart to be a distinctive feature for which to aim. At about 2210 I was looking at a high, white bank of what looked like an orographic cloud on



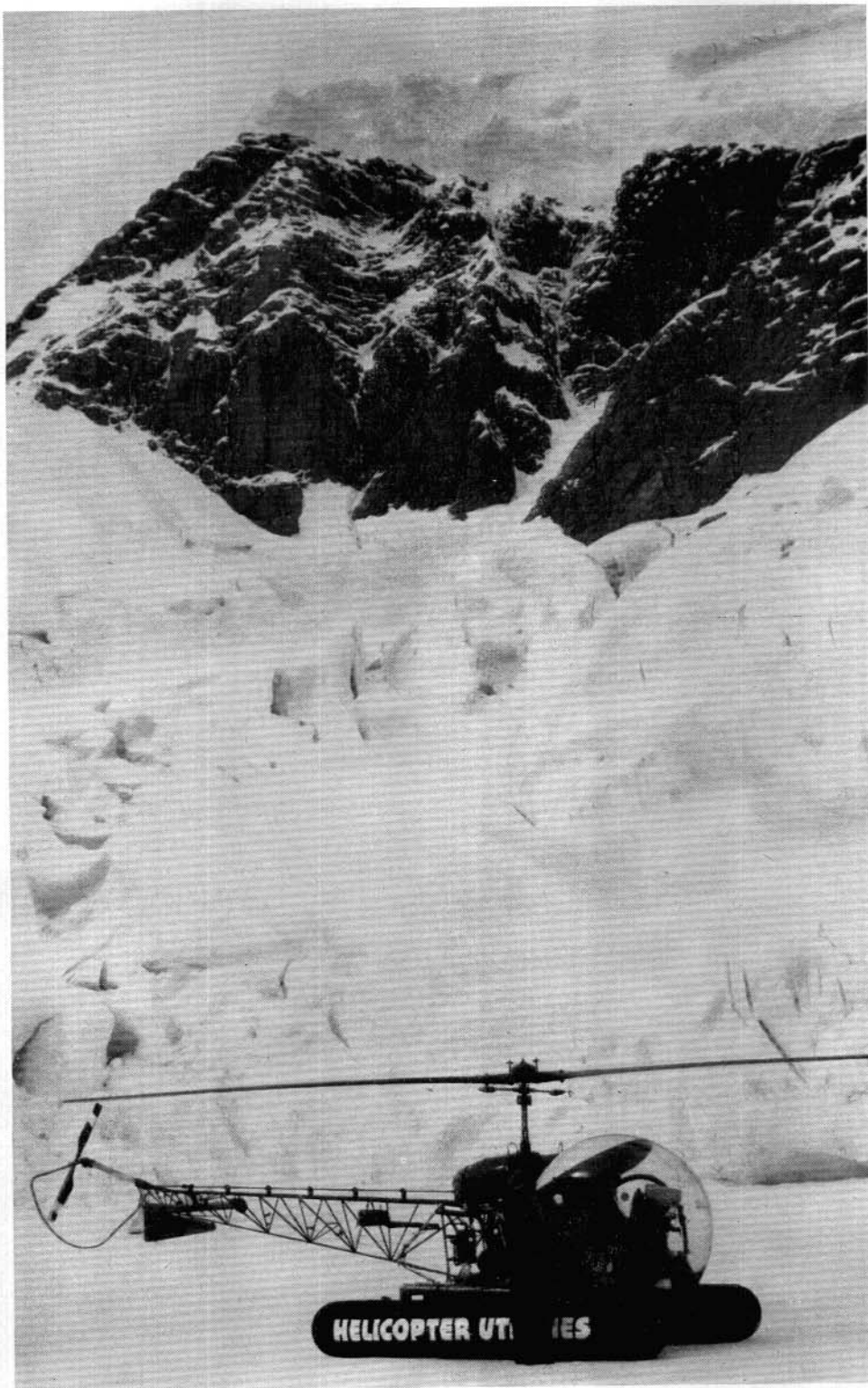
MAP 7

Chart showing the track of ANARE ship *Thala Dan* in 1962.

bearing 220° when suddenly I realized it was the coast. It was 40 miles away, several thousand feet high, and showed dark patches of either rock or ice falls. When we had gone a few miles it disappeared in the mist. However, at 2240 hours, the Captain picked up the coast on the 40-mile range of the radar, the nearest point being 30 miles away on bearing 190° and the rest stretching westwards as far as 220° .

Upon rounding the icebergs the Captain found open water reaching to the continent and we approached through fog at 0200 hours on Sunday 22 February to see a rugged coast loom up, stretching from Cape Hooker in the east to Cape North in the west. At 0408 hours we anchored close to the western sides of two rocky islands close to the coast a few miles north-east of Cape North.

At 0900 hours Tom Harwood and I went ashore by helicopter on the island closest to the mainland and erected the New Zealand flag. The

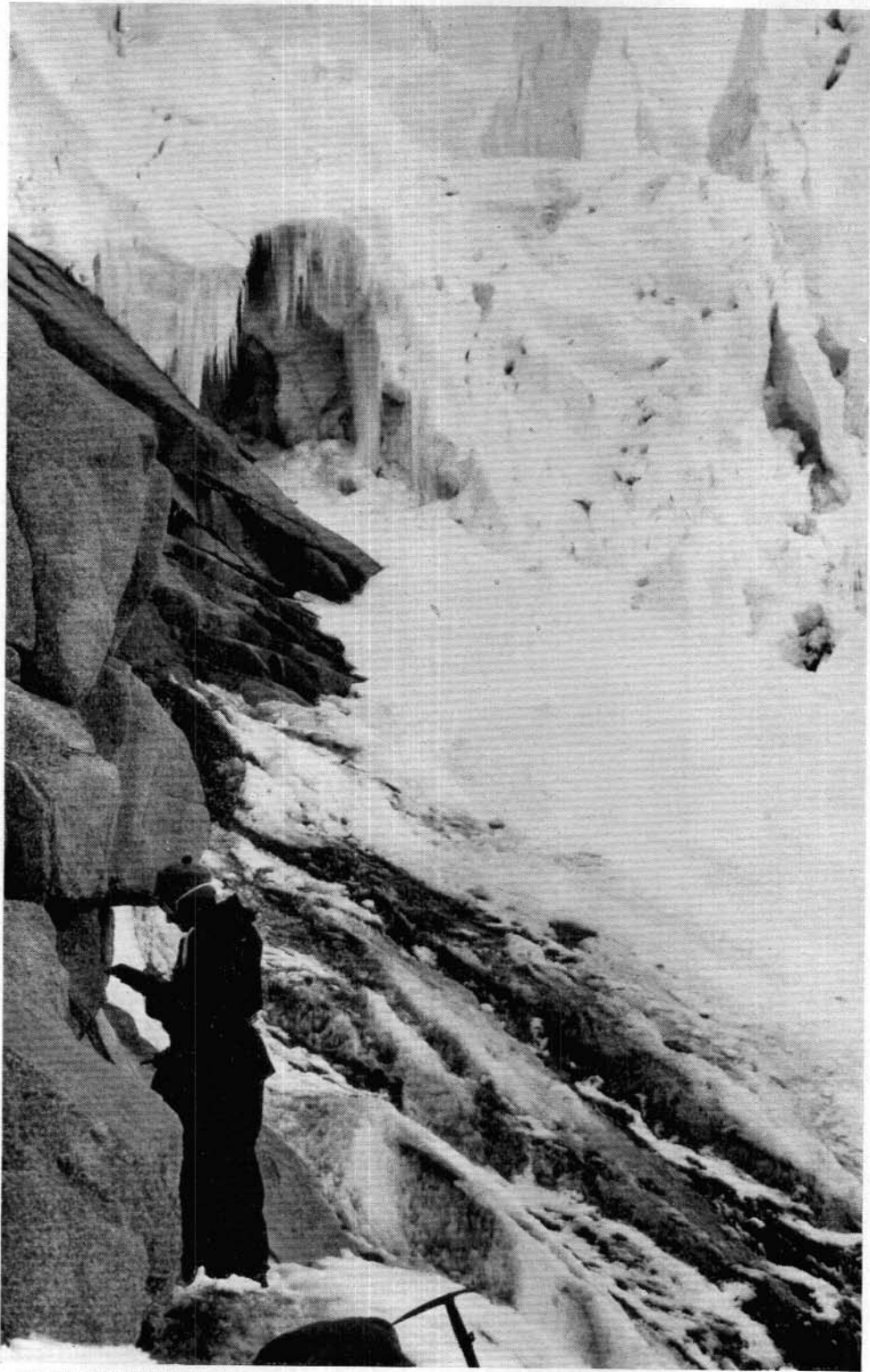


ANARE photo 10538

PLATE 9

Phillip Law

Helicopter on sea ice at the foot of Gregory Bluffs, 12 February, 1962.



ANARE photo 10537

Phillip Law

PLATE 10

Geologist Chris Gregory working at the foot of Gregory Bluffs, 12 February, 1962.

weather was still overcast and some snow had fallen. Other men were set down on the smaller island to make a bird census and then were transferred to the larger one. I named these islands Thala Island (the larger southern one) and Nella Island, after the two ships we were using in 1962. We built a cairn, Burch (geophysicist) began geomagnetic observations and Kirkby (surveyor) set up his theodolite in case a chance occurred for an astrofix.

From Cape Hooker in the east a long, high, ice ridge like a whale's back ran westwards almost to Cape North. The ice of this ridge was shattered by ice falls and crevasses where the underlying rock approached the surface and from its northern slopes an ice piedmont extended as a long, narrow apron to the sea. Back beyond the ice ridge to the south were a number of high mountains, the most striking of which rose to a peak at least 5000 feet in height. This mountain I named Mount Gale. A little to the south-west of Thala Island two extensive valleys swept back inland: one was fjord-like in nature and ran inland in direction 220° , with Cape North on its western side and high rock bluffs on its eastern side; the second was a glacier valley commencing at the northern end of these high rock bluffs and extending in a south-easterly direction past the northern and eastern sides of Mt. Gale. The glacier in this valley I named Kirkby Glacier.

The fjord with Cape North at its entrance I named Nielsen Fjord after the Captain of the *Thala Dan*. Fast ice extended about five miles up the fjord and there met the terminal ice falls of a glacier (Nielsen Glacier) which extended far back up the valley. Cape North was an impressive sight, rising as a two-sided rocky bluff surmounted by a thick crust of ice to a height of more than 2000 feet. Low cloud and mist prevented our seeing much further to the west.

In the afternoon Arthurson flew Gregory (geologist) and me to land on the fast ice just off Cape North. From there we floe-hopped to the foot of the towering cliffs, having trouble crossing from the sea-ice onto rocks owing to the surge of the ice back and forth in the swell and the rotten nature of the floes. We then faced a steep scree slope of slate rock fragments below slate cliffs with loose pieces jammed together in overhanging clusters ready, it seemed, to crash down at any moment. Gregory began to examine the base of one of the vertical faces while I tried to scramble up the loose scree slope. I found, however, that the scree was underlain by hard slippery ice which prevented one from negotiating the scree slope in the normal fashion. I therefore cut steps in a bare ice slope to reach a rock face, up which I scrambled for some thirty feet to obtain some rock specimens. However, it was loose, crumbling rock which did not encourage climbing.

The slate faces of Cape North were magnificently folded and snow which had lodged in crevices in the rock outlined the twisted strata so that they were visible from some distance away. The snow-capped, rounded summit of Cape North was measured by the helicopter's altimeter to be 2,500 feet high.

After about an hour we returned to the helicopter, photographed the surroundings and flew back to the ship. The weather appeared to be clearing.

On Monday 12 February I arranged for our launch and a party of men to cruise eastwards along the ice front of the piedmont coast as far as Cape Hooker, to measure sea depths and heights of the cliffs and to note whether the coastal ice was rock-based or floating. However, bad weather and engine trouble forced them to return about lunch time without having accomplished anything of value.

At 0945 Stanwix took Gregory and me out again, this time to the foot of the high rock bluffs which formed the eastern side of Nielsen Fjord. I named these Gregory Bluffs. We first walked back across the fast ice to photograph the disintegrating ice cliffs which formed the seaward termination of the Kirkby Glacier. These were chasmed, rifted and grottoed in fantastic fashion, but the photographs failed to reproduce the cold, shimmering blues of the caverns. We felt like visitors to the moon.

We went back to the rock bluffs and Gregory found, somewhat surprisingly, that they were all granite. Our later observations showed that this difference was maintained far back into Nielsen Fjord, the rock on the western side being slate like Cape North and that on the eastern side granite.

We next flew up the fjord, over the ice-falls and crevasses of the Nielsen Glacier, and on to climb alongside a conical snow peak rising above the granite cliffs to the south of Gregory Bluffs. We tried to land on this peak but its summit was smooth, rounded and narrow and swept by currents of air which would have made it difficult for the helicopter to alight safely, so we satisfied ourselves by noting its elevation, which was 3,400 feet. I named this peak Mt. Harwood. The height of Gregory Bluffs was 2000 feet. (The scale of magnitude of features in Antarctica never failed to astonish me. Gregory Bluffs looked at most 1000 feet while the small conical peak would have been assessed by most observers as no more than 1500 feet high.)

Inland we could see a number of peaks, snow covered and pointed, rising above the plateau ice. Most seemed at least 7,000 feet above sea level and some, I would guess, might exceed 10,000 feet. It was a glorious panorama and the perspex bubble of the helicopter gave us an uninter-



Phillip Law

PLATE 11

Thala Dan off Nielsen Fjord, 15 February, 1962. The main features visible are (from left to right) Kirkby Glacier, Mount Gale, Gregory Bluffs, Mount Harwood, Nielsen Glacier and Cape North.

ANARE photo 10542

ted view of it. We returned to the ship just as low cloud and snow showers came in from the north.

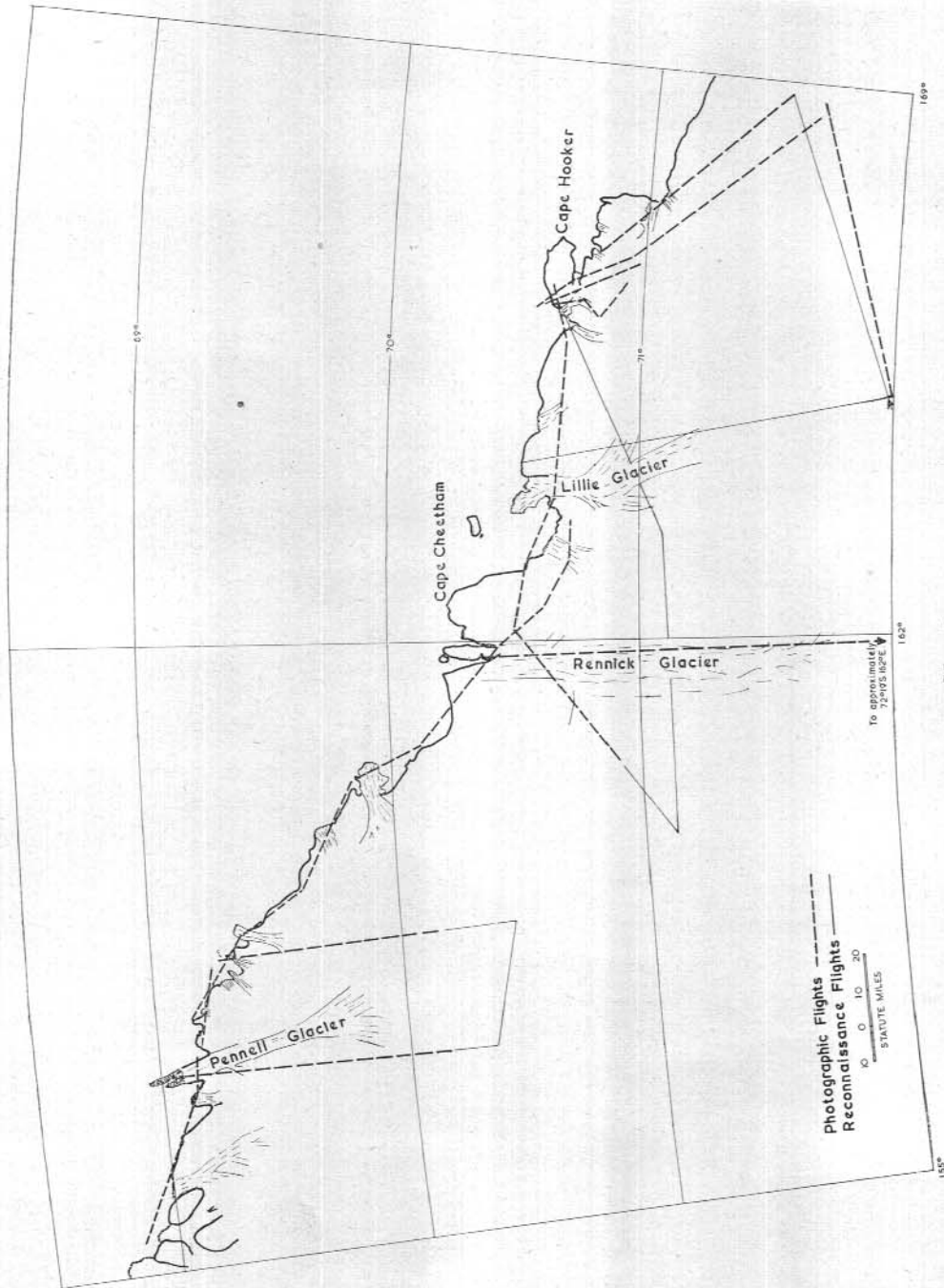
As a result of this flight I was able to start a sketch of the Nielsen Fjord and Kirkby Glacier area to which I added as information was gathered during the ensuing days observations in this region. (See inset, Fold Map)

Tuesday was a calm day, with fog and snow showers preventing any work. Wednesday produced a full-scale blizzard from the east-south-east with winds gusting to 60 knots. On Thursday, although the wind had dropped and swung around to blow gently from the south-west, the visibility was still poor and there were intermittent snow showers. The westerly breeze drifted ice in around the ship and transformed the landscape. The aircraft, the launch and the deck were covered with a soft and gracious mantle of snow. In the late afternoon a few shafts of sunshine penetrated the clouds and at 2300 hours the clouds suddenly began to clear. I sent Kirkby and Burch to Thala Island at once by helicopter to seize any opportunity that occurred for star shots during the night to fix the position of the island.

At 0300 hours on Wednesday I awakened to find the sky clear and the sun shining for the first time since we arrived. Kirkby and Burch completed the astrofix and were flown back at 0400, and the Captain then moved the ship to the west to push clear of the 8/8ths pack-ice which had moved in around us. The Beaver crew began to prepare their plane for a flight. However, when we reached what had been open water north of Nielsen Fjord, the wind swung around to the south-east and covered the surface with brash ice. I took numerous photos and sketches of the coast while the opportunity for clear observation existed and for the first time we could see the mountains inland and to the west of Nielsen Fjord. Kirkby calculated the astrofix at Thala Island as being $70^{\circ} 37' 07''$ S., $166^{\circ} 05' 42''$ E.

The ship moved further north to provide clear water for the Beaver but, as we were about to hoist out the aircraft, the wind freshened to 35 knots from the south-east and the pilot decided against attempting a take-off. This strong wind rapidly cleared the ice from our original anchorage so we returned there and, in the shelter of nearby icebergs, where the wind strength was less and the sea not so choppy, the Beaver successfully took off at 0930 hours. With Ashworth and Cooper it flew 200 miles westwards along the coast to Williamson Head, then turned about and flew a photographic run from there to Ob Bay (named by the Russians). There they met coastal cloud and turned inland to use up their film. They returned to the ship at 1400. (See Map 8)

Meanwhile the helicopters had departed at 1050 with Kirkby and



MAP 8

Aircraft flights during February, 1962. Radar altimeter heights of the surface were obtained during all flights. Oblique photography was carried out during reconnaissance flights.

D



ANARE photo 10542

PLATE 12

The author wades through deep powder snow on Arthurson Bluff,
16 February, 1962.

J. Stanwix



ANARE photo 10842

PLATE 13
Frecker Ridge and Mount Gale from Arthurson Bluff

Phillip Law

Gregory to fly to Ob Bay to attempt an astrofix. At the ship it started to cloud over again at 1130 and, as white-out conditions developed over the plateau and the coast, I began to worry about the return of this party. However, they arrived back safely at 1645 after a difficult flight during which they first followed coastal ice cliffs and, later, made a break north through white-out over fast ice to reach broken pack, where the dark water cracks provided enough detail for assessment of height and position of the aircraft. Kirkby's observations had been interrupted by cloud and he had obtained only two sun shots.

I spent most of the clear part of the day improving my sketch of the Nielsen Fjord area with radar plotting and compass bearings to prominent features. The day had proved a mixture of frustration and achievement, of disappointment and success.

Saturday, 17 February, was again cloudy and overcast with snow showers, so no surveying or flying was possible. The bad weather continued through Sunday with heavy snow showers and fog. It had appeared to offer promise at 0300, so at 0500 we roused the Beaver and Helicopter crews. The R.A.A.F. Flight spent an hour clearing snow from their aircraft and were ready to depart when at 0645 a heavy snow shower enveloped us and they had to carry out the whole task again. Finally at 0715 the Beaver was hoisted out and made three runs in attempts to take off but the calm sea, sludge on the surface, and icing up of the machine combined to prevent it becoming airborne.

It was fortunate that no flight was made, for shortly afterwards the weather deteriorated to the point where nothing further could be done all day. After the promise of good weather the day before it was a disappointing development.

Monday was another bad day, with the barometer down to 973 mb, a 20-knot SE wind and early snow showers. Although the Beaver was held in readiness for a flight, the cloud persisted along the coast and the plateau did not clear until it was too late for a photo run.

However, we were able in the late afternoon to make a helicopter flight about seven miles from the ship to a high point which I named Arthurson Bluff, about half-way between Gregory Bluffs and Mt. Gale. We took one helicopter at 1700 hours with Stanwix, Kirkby and myself, and after "feeling out" the wind across the top of the Bluff the pilot lowered the machine gently onto a flat narrow strip of snow-covered rocks. Its altitude was 3,500 feet. We stepped out and sank into soft, light, powder snow about three feet deep. The air temperature was $+4^{\circ}\text{F}$. Kirkby began a series of phototheodolite shots of the surrounding features while I took panoramic colour photographs.

The scenery was superb—plateau and mountain peaks to the south,

valley glaciers and mountains to the north and east, with the sea and icebergs stretching into the distance. I was surprised to see that Yule Bay extended so far inland, almost joining Kirkby Glacier, from which a small steep glacier plunged down through a gap in the valley wall into the bay. The small glacier I named Chapman Glacier after the helicopter mechanic.

Directly beneath us on the northern side, Kirkby Glacier ran westwards to join the sea near the mouth of Nielsen Fjord, while on the eastern side our Bluff plunged down into a steep, broken up glacier which separated us from a striking cirque and ridge, beyond which towered Mt. Gale. I named this steep glacier Ludwig Glacier, after the Second Mate, and the ridge Frecker Ridge, after the Beaver fitter. The low afternoon sun lit and softly enhanced the features of the dozen or so peaks away to the south which I estimated to rise to 8,000 or 10,000 feet. Little rock was visible, except in almost vertical faces, and it was apparent that the whole region was one of high precipitation.

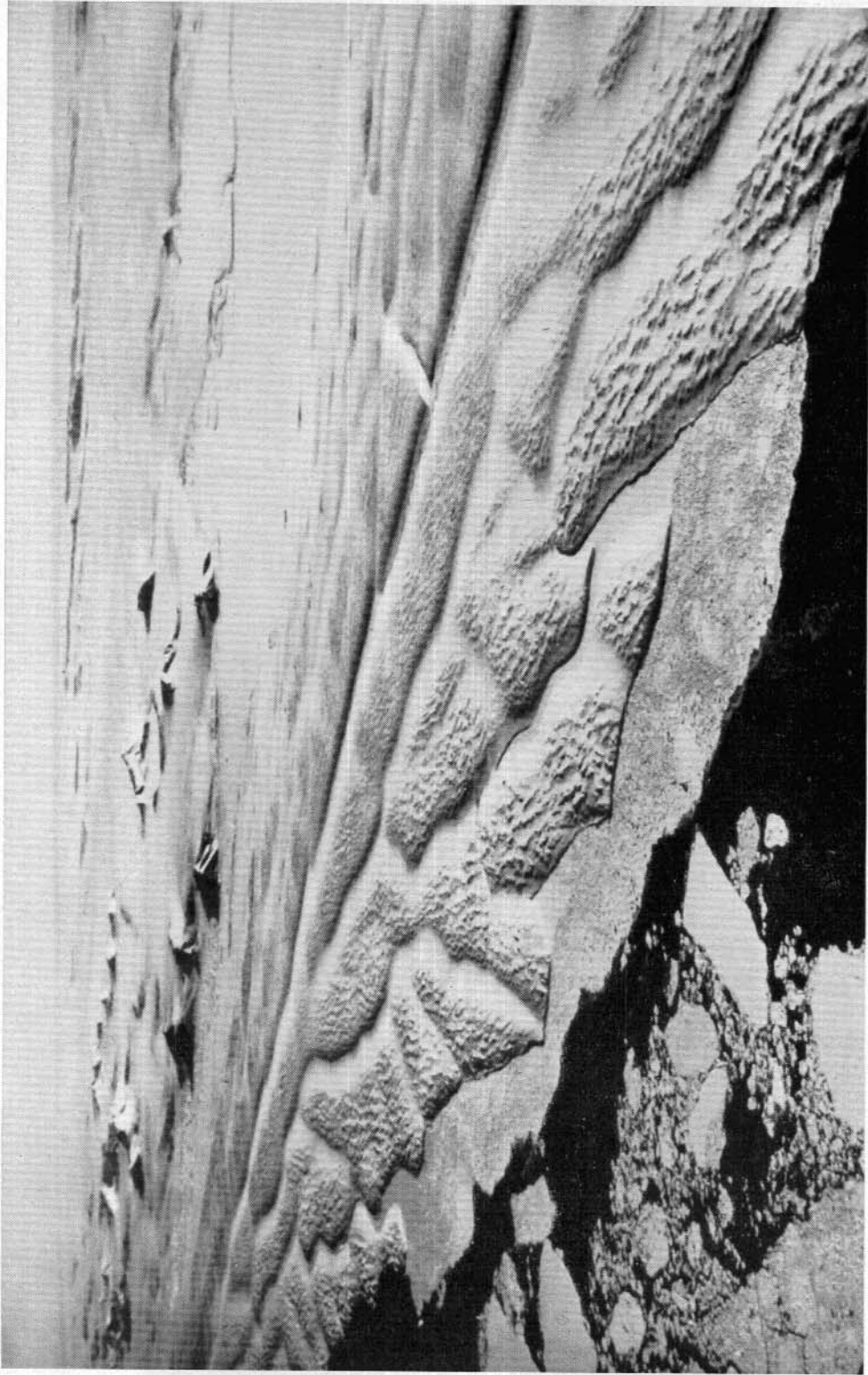
It was cold work handling cameras and theodolite and, when we came to start the helicopter, it ran very roughly. Stanwix suspected carburettor icing but failed to remedy it by increasing carburettor heating, so we finally took off and risked it. The engine smoothed out when we reached a lower altitude.

Although there was only a light breeze on Arthurson Bluff and a medium breeze at the ship, we passed through a streaming 50-knot katabatic wind over Kirkby Glacier at an altitude of 500 feet as we were flying back.

Tuesday 20 February dawned clear to the west with heavy broken clouds in the east. I called the aircraft crews at 0430 and the two helicopters flew off at 0630 to return Kirkby and Burch to Ob Bay to repeat the incomplete astrofix which Kirkby had obtained on the previous Friday. The Beaver was ready to be unloaded at 0600, but the ship's motor-boat broke down and we had, instead, to hoist out our own motor launch, so that it was 0725 before the 'plane took off. With Ashworth and Cooper it flew a photo run due west along the coast from Cape North to the Rennick Glacier then turned south-west to run on inland until its film was finished. On the return flight—all inland—heights of the plateau were taken by radar altimeter.

The Beaver returned to the ship at 1105 and took off again at 1245, this time to fly to the Rennick Glacier and to run a photo flight inland for 80 miles south. From there the aircraft flew a heighting run east-north-east till south of Yule Bay, then returned to the ship with a short photo run on the last leg of the flight, landing at 1615. A number of hand-held coloured photos was taken during the flight inland.

At 1500 the sky began to cloud over rapidly from the west. I still



ANARE photo 10922

G. Cooper

PLATE 14
The Pennell Glacier Tongue and the Lazarev Mountains photographed on
21 February, 1962.

wished to obtain a photo run due south from Cape North, so at 1745 the Beaver set off again. However, the clouds were so low that adequate photography of the high land was not possible and the fliers gave up and landed at 1830.

The helicopters returned safely at 1533 after a good day. Kirkby had obtained a good astrofix on a snowy dome which he named Platypus Ridge about five miles inland from the coast just south of Sputnik Islands (a Russian discovery) giving a position of $70^{\circ} 41' 18''$ S., $163^{\circ} 43' 33''$ E., and Burch had taken geomagnetic observations. When they arrived back the Captain was taken up on a short ice reconnaissance while Gregory and Harwood flew to Kirkby Glacier to have a quick look at the extent of rock outcrops visible.

With the weather deteriorating and the Nielsen Fjord area reasonably well covered, I decided to move further west so as to extend our flying range beyond Williamson Head and Harald Bay. Accordingly, the ship sailed at 1915 and headed north-west. Although the coast was reasonably clear of ice for 15 to 20 miles westwards, the pack extended out from the shore after that and we planned to skirt it.

The ship continued during the night and on Wednesday I rose at 0330 to find the sky cloudy over the sea but clear over the plateau. There was a light southerly breeze and we had a fine distant view of the coast, with the mountains "looming" as a result of mirage, appearing exaggeratedly large in the vertical dimension and looking more like tors than ordinary peaks.

In good conditions, Ashworth and Cooper took off at 0730 on a photo-



ANARE photo 10539

J. Stanwix

PLATE 15

Looking east from Mount Ellery, 21 February, 1962.

graphic flight in which they proceeded due south from Cape Kinsey, then west with a heighting run, then due north with photography to the Pennell Glacier Tongue. The ship immediately sailed due south into light pack-ice to decrease the flying distance to the coast for the helicopters.

The two helicopters left at 0910 with Burch and Kirkby to attempt an astrofix and magnetic observations on the continent at about 160°E . They flew south against a strong head wind for about 60 miles and at 1040, just as they were about to land, Stanwix noticed that his oil pressure had suddenly dropped to zero. Both helicopters landed at once on a snow ridge 4000 feet high about 10 miles inland from the coast and north-east of Mt. Gorton. They named it Mt. Ellery.

They reported by radio that the oil breather tube of the helicopter had iced up and that pressure had built up in the oil sump which had forced oil up the driving shaft of the rotor, bursting the oil seals on the way and spraying oil out the top all over the machine. Although the other machine was suffering from the same trouble the breather had not blocked completely and they were able to clear it.

I instructed them to send the good helicopter back to the ship to collect oil at 1230, bringing Burch who would by then have completed his magnetic observations. Meanwhile we took the ship back to open water to pick up the Beaver, which landed at 1130 after an excellent flight.

Stanwix and Burch in the good helicopter returned safely at 1400 hours. The breather tube was cut off with a hacksaw, lubricating oil and a thermos and sandwiches were loaded and Stanwix and Chapman (mechanic) left at 1500 to return to the damaged helicopter.

One of our major photographic requirements was aerial coverage of Mawson Peninsula, about 170 miles to the west. Ashworth and Cooper accordingly set out at 1430 on a second flight with this objective. However, they had reached a point only half-way along the peninsula when Ashworth radioed that two cameras had broken down and he was returning. He reached the ship at 1730. Altogether, this was not one of our better days.

Back at Mt. Ellery at 4000 feet and a temperature of 0°F , the helicopter crew hacked off the breather tube from the damaged machine, filled its sump with oil and started froghopping both machines over the sea-ice 60 miles back to the ship. Every fifteen miles they landed, inspected the oil level and topped it up. It was a great relief when they arrived back safely at 1905. Kirkby had obtained a good astrofix on Mt. Ellery at $69^{\circ} 53' 29'' \text{S}$., $159^{\circ} 39' 06'' \text{E}$.

I decided to try to approach closer to Mawson Peninsula, so at 1915 the ship headed west. Next day, Thursday 22 February, was overcast with a falling barometer and a temperature of 14°F . The plateau was covered



N. Ashworth

PLATE 16

Aerial photograph from above Kirkby Glacier, 23 February, 1962, looking west over Nielsen Fjord and Cape North.

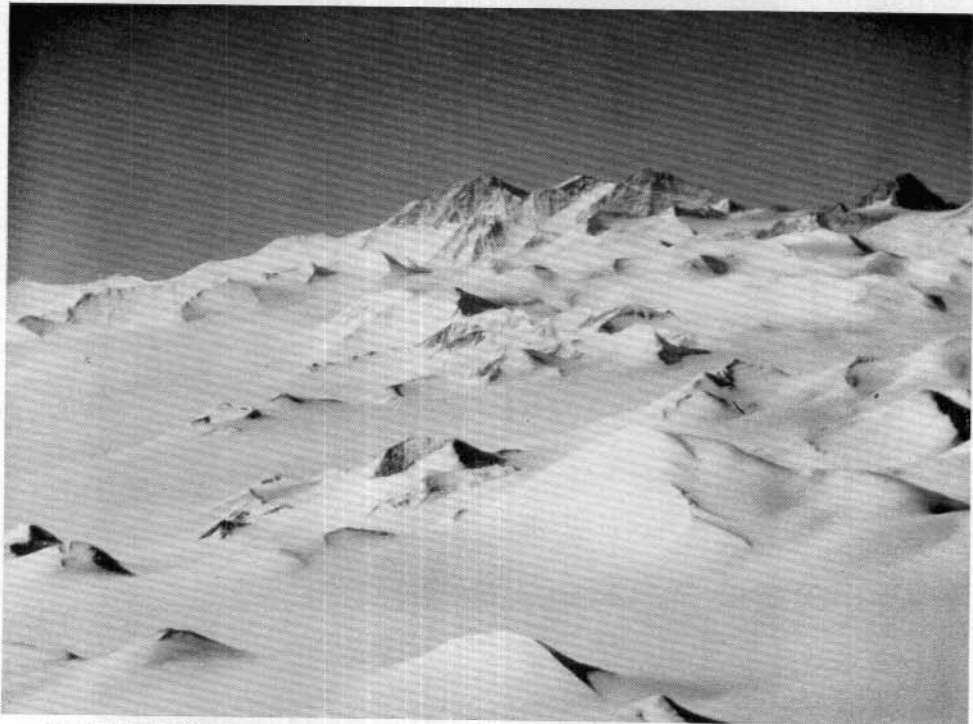
ANARE photo 10882

with cloud and photography was not possible. The aircraft mechanics fixed the cameras and began the long job of dismantling the rotor shaft of the damaged helicopter and replacing a carburettor. The good helicopter was also overhauled.

The ship reached $68^{\circ} 44' \text{ S.}$, $160^{\circ} 21' \text{ E.}$, where pack-ice prevented any further progress westwards. At 0855 I decided to abandon any further attempt to fly to Mawson Peninsula and at 0855 we turned back towards the east.

After discussion with Commander Gale and the aircraft team, it was decided that: (a) a Beaver flight to Mawson Peninsula would be risky, as this objective would be at the extreme limit of the aircraft's range, the ship could not move there in case of trouble, and with the helicopters in their present condition no safe backing for the flight could be guaranteed; (b) we would return in an easterly direction to $162\frac{1}{2}^{\circ} \text{ E.}$, then strike south to reach as close to the coast as possible for further flights. (There was only enough aviation spirit for one more Beaver flight.)

There was an interesting mirage early in the morning. Mt. Gorton showed up 93 miles away, towering brightly into the sky with a smaller peak

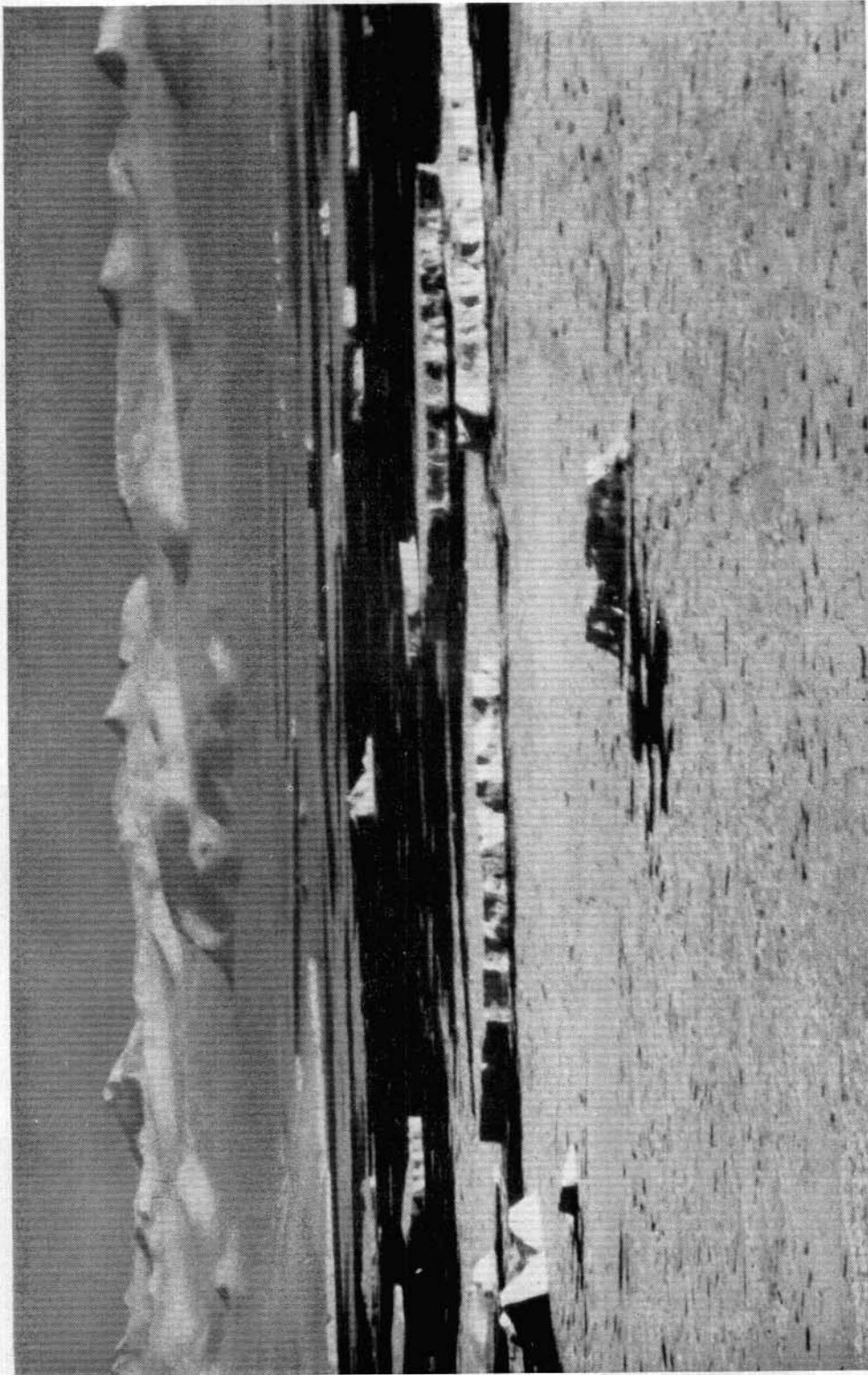


ANARE photo 10872

N. Ashworth

PLATE 17

Looking south-east across the mountains of Victoria Land from about
 $71^{\circ} 45' \text{ S.}$, $168^{\circ} 30' \text{ E.}$



Phillip Law

PLATE 18

Looking south over Ob Bay, 25 February, 1962.

ANARE photo 10806

close on its western side, yet no other peaks were visible on either side or in front of Gorton, although most of them were at least as high as the small peak and some nearly as high as Gorton itself. This mirage was almost telescopic in its restricting selectivity.

After lunch the sky cleared and at 1325 we turned south. Although we were about 120 miles from the coast we decided to take advantage of the clear weather, so at 1535 we hoisted out the Beaver for its final flight. However, the wind had produced a nasty, choppy sea and the aircraft iced up so badly from spray that the flight had to be abandoned. We proceeded south-east along an edge of pack and at 2030 stopped for the night at $69^{\circ} 40' \text{ S.}, 163^{\circ} 17' \text{ E.}$

Friday dawned perfectly clear. The helicopters still were not repaired but the Beaver was ready and, after the ship had moved north a little to reach open water, it took off at 0805 for a photo-flight which started at Cape North and ran south for 60 miles, then west-south-west for about 50 miles, at which stage the film was finished. It returned north to the coast at about Zykov Glacier (named by the Russians), carrying out only height determinations during this last leg of the flight. The pilot was lucky, for by the time he landed at 1140 clouds had spread over the plateau and the rest of the day was overcast.

This was the last "Beaver" flight, as our stocks of fuel for this aircraft were now exhausted. In any case there was little left to be done in this area. It was a great relief to have finished the Beaver programme, for it was a constant source of worry to have a small, single-engined aircraft, fitted with floats, flying up to 100 miles inland over highly mountainous country. The pilots deserved the highest praise for their courage in pushing this hazardous programme through so enthusiastically. Altogether on this voyage (including earlier work further west) they had flown 6650 miles, carried out 3376 miles of aerial photography and measured plateau heights over 900 miles of the interior.

As soon as the Beaver was on board, the ship moved off south-east towards a lead reported by Ashworth to run in towards Sputnik Island. Unfortunately, engine trouble developed and the ship stopped at 1450 for repairs.

The wind rose and we drifted helplessly westwards under the influence of a 30-knot south-east wind until 0800 next day. Fortunately there were no reefs so far off land and no icebergs in our path. When we started again we could find no trace of Ashworth's lead, which had probably been closed by the wind.

I thought this would probably be the end of our work here, but surprisingly found next day, Sunday 25, to be fine and sunny. Even had we been able to provide fuel for the Beaver it could not have been flown, as all



Phillip Law

PLATE 19

ANARE helicopter on Cooper Bluffs, 25 February, 1962. The tongue of the Zykov Glacier is in the background.

ANARE photo 12879

open sea was freezing over with black new ice. However, the helicopter repairs were completed by 1100. The ship had moved in towards the coast but was stopped by pack about 30 miles off-shore. Harwood and I went up with Stanwix for a quick look. Right alongside the cliffs of the Continent we found open water leading west to Sputnik Island but nowhere else to the south or west of us.

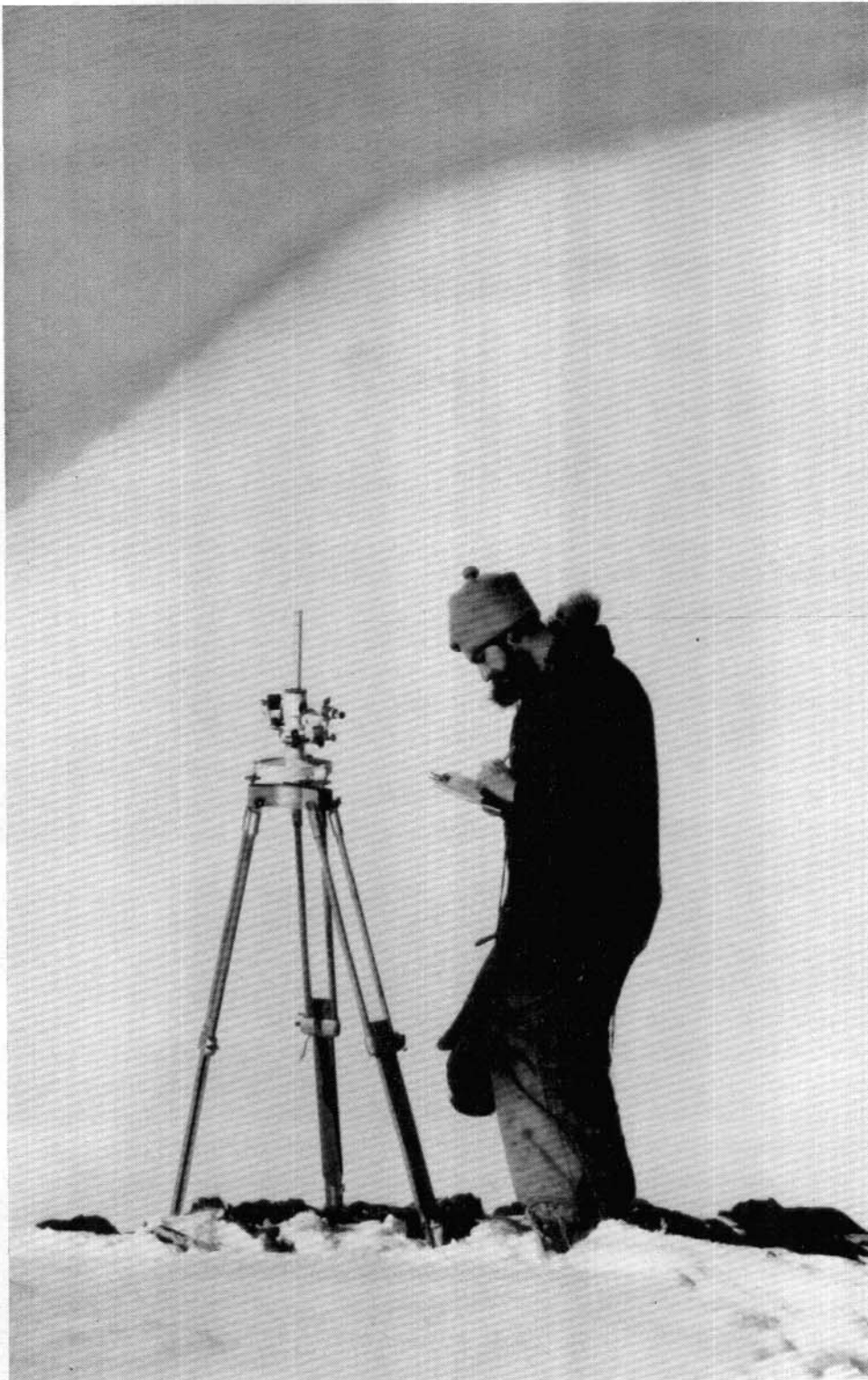
After lunch the two helicopters flew Burch, Gregory and me to the coast at Zykov Glacier. We landed on a ridge 1500 feet high with a narrow, flat top flanked on the eastern side by a steep scree slope and on the west by a snow cornice and a steep ice cliff. To our ridge on the east was joined a lower rock saddle beyond which again was a high snow and rock peak. In line with and joined to the northern end of this peak, a series of snow bluffs ran eastwards almost to Cape North which I named the Dwyer Escarpment after the late Director of the Australian Bureau of Meteorology. Extending north from the feet of these bluffs to the sea was a wide ice piedmont.

The southern ends of our ridge and the high peak to our east fell away precipitously into Zykov Glacier, which ran inland rising rapidly to the south-east. Further snow bluffs extended inland along its northern side. The southern wall of the glacier was composed of a series of rock bluffs rising to mountains and ridges, the most conspicuous one being, as we later determined, 4,400 feet high with a rocky northern face. We decided to fly over later and examine it.

Burch started geomagnetic observations and Gregory studied the rocks of our ridge and its connecting saddle while I took panoramic views of the surrounding country.

While we were on this ridge I advised the ship by radio to start breaking its way northwards out of the pack to reach open water and it began at 1430. Then, leaving Burch to finish his observations, Gregory and I flew with Stanwix across the Glacier to the prominent mountain which the Russians had named Mt. Kostka. The summit was quite narrow and we found it covered with beautiful, elongated snow crystals, like ferns two or three inches long, lapped over each other at an angle of 30° to 40° like scales on a fish. Under six inches of this dry, brittle substance was slippery blue ice, so we did not dare walk more than a few yards to the south of the helicopter, where the flat top of the peak rolled steeply over to fall 3000 feet as an ice slope at an angle of 70° .

Looking north we had a fine view of Zykov Glacier, Cooper Bluffs and the coastal ice plain extending towards Cape North. Just north-west of Cooper Bluffs, where Zykov Glacier joined the coast, a small glacier tongue, heavily broken up, ran into the sea. It formed the eastern end of an ice shelf which ran west to Cape Williams and the Lillie Glacier Tongue. Extending from the south-east of our mountain, around through south and



ANARE photo 12378

PLATE 20

Phillip Law

Geophysicist William Burch taking observations with a magnetometer on Cooper Bluffs,
25 February, 1962.

south-west to west, stretched a series of mountain peaks, mostly completely snow clad from the aspect they presented to us. About 15 miles to the west they gave place to a vast ice plain which ran inland to form the Lillie Glacier, on the other side of which the mountains rose again.

The rocks of Cooper Bluffs were slaty, hornfelsed, finegrained sediments, highly polished by ice on some faces. At Mt. Kostka the rock was also slate, but more layered and flaky than at the first ridge.

After photographing the surrounding country we flew back to Cooper Bluffs, joined forces with the second helicopter carrying Burch, and proceeded in company to the ship, which was moving very slowly towards the open sea through heavy pack.

While on these peaks with both helicopters, the pilots and I had been worried by the thought of what we could have done if the engines had failed to start.

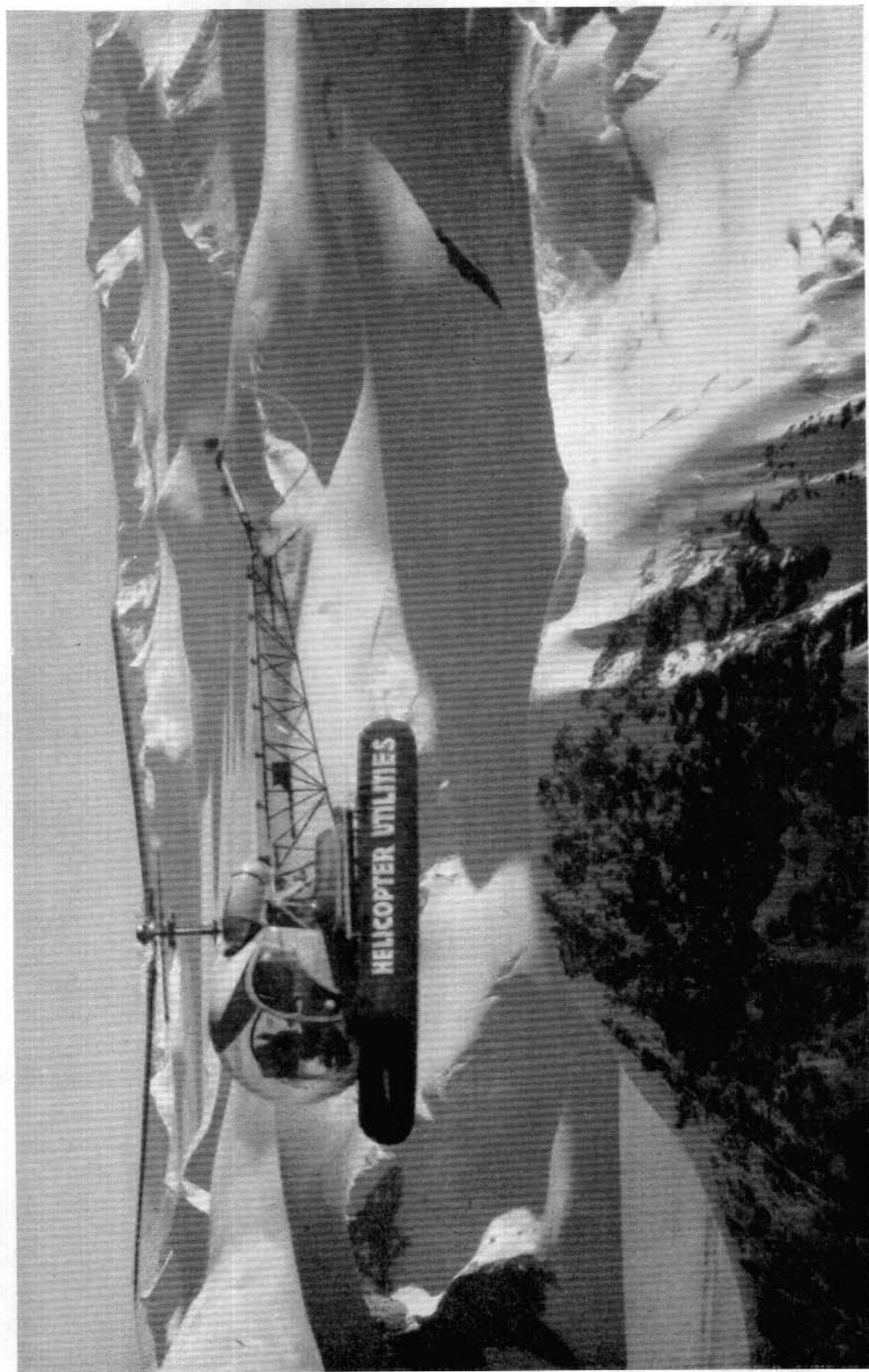
Arriving at the ship at 1610 we refuelled quickly and set off on one last flight—to Sputnik Islands, about 25 miles to the west-south-west.

It was rather late as we approached the main island and a haze had settled over the mountains and the coastal ice, causing near white-out conditions. We found a few exposed rocks on the northeastern corner of the island and, landing near them on the sea ice, let Gregory and Burch scramble up to set up instruments and examine the rocks. I then flew around to look at the island, but the light was too bad for good photography.

I found the main Sputnik Island to be almost completely ice-covered. It was an asymmetrical dome, the highest part being south of centre. This shape and the rock outcrops at the north-east corner showed it to be based on rock probably mostly above sea level and not an ice island like Drygalski Island.

To the south, on the mainland, the first major feature was a high ice dome, probably embracing the ice ridge upon which Kirkby had obtained an astrofix on 20 February. It was strikingly unusual from our viewpoint. Beyond were the serried peaks of the Bowers Hills. Surrounding the ice dome and extending mainly eastwards from it was the ice shelf which I had observed from Mt. Kostka. Inland from this was an extensive plain of gradually rising ice (the Lillie Glacier), fed by several well-defined valley glaciers. To the west of this ice plain was an ice coast running flatly back for some distance, with only a few low rock nunataks to break the level before reaching the Bowers Hills.

Burch obtained a declination measurement and Gregory found the rock to be massive granite with no variations. We flew south for a while to find that the nearest other rock was a long way south in the Bowers Hills so we decided to call it a day. We headed for the ship but she had reached open water and was proceeding north-east at full speed. For a long time



Phillip Law

PLATE 21

ANARE helicopter flying over Mount Kostka. The view is to the south.

ANARE photo 10891

we failed to see her against the darkening sky but finally landed at 1900 hours. I asked the Captain to proceed to Macquarie Island.

It has been a most interesting and rewarding final day, unexpectedly sandwiched between two bad days, for the next day turned out to be overcast and misty, with some rain.

We were very content with what we had achieved, which was more than we had expected. The results thoroughly justified the tactics we had adopted and showed the way for further work in the future. Although there had been numerous frustrations, the good patches had been glorious. From our observations it was possible for the first time to give an accurate and detailed account of much of the coast of Oates Land.

We had carried out aerial photography along 300 miles of coast and 650 miles of hinterland. Height determinations by radar altimeter over 300 miles of plateau had been made. Landings had been carried out by helicopter at eight points and three new astrofixes had been obtained, while geomagnetic observations had been made at four stations.

All this work had been possible only because of the excellent services rendered by Captain Nielsen and the crew of the *Thala Dan*, the helicopter and Beaver crews, the hydrographer, the surveyor, the geologist, the geophysicist, the Army DUKW crews and all the other ANARE men who helped so willingly with the numerous tasks involved during the voyage.

The new data obtained during the 1959, 1961 and 1962 voyages of exploration by the ANARE has been used, in conjunction with information available from the earlier expeditions already mentioned, to compile the map of Oates Land which accompanies this report.

I would like to express my thanks for the valuable assistance given me by my lieutenant, Tom Harwood, and for the intrepid efforts of the R.A.A.F. Flight led by Squadron Leader Norman Ashworth and the helicopter team from Helicopter Utilities Pty. Ltd. led by Captain John Stanwix. Our hydrographer, Commander Thomas Gale, gave much valuable advice in planning the mapping programme and worked meticulously on track charts, soundings and coastal survey work. Surveyor Syd Kirkby, geologist Chris Gregory and geophysicist William Burch shared with the pilots the hazards of long flights and difficult landings and worked enthusiastically in the cold and exposed conditions ashore. The returning Wilkes party and the supernumeraries on the ship also, in particular the meteorological team, contributed to the success of the venture.

ACKNOWLEDGEMENTS

I wish to acknowledge gratefully the work of the Antarctic Mapping Branch, Division of National Mapping, Department of National Develop-

ment, which has analysed the survey data and produced the maps of Oates Land given in Map 6 and Fold Map and has prepared the track charts in Maps 5 and 7.

My thanks are due to the British Admiralty for permission to publish the charts of Ross and Pennell given in Maps 1 and 2.

Acknowledgements are due also to the collaborating ANARE authorities responsible for specific aspects of the programme: to the Bureau of Mineral Resources (geology and geomagnetism), the National Mapping Division (survey and cartography), the Bureau of Meteorology and the Royal Australian Air Force.

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FOLD MAP (opposite)

Sketch map of the coastal regions between longitudes 156° East and 168° E.
from all data available in 1963.

Cook Ridge
↓

Davies Bay

Drake Head
↓

Williamson Head
↓



Cape North
↓

Dwyer Escarpment
↔

Cooper Bluffs
↔

Mount Kostka
↓

Saddle Peak
↓



Mount Gale
↓

Arthurson Bluffs
↓

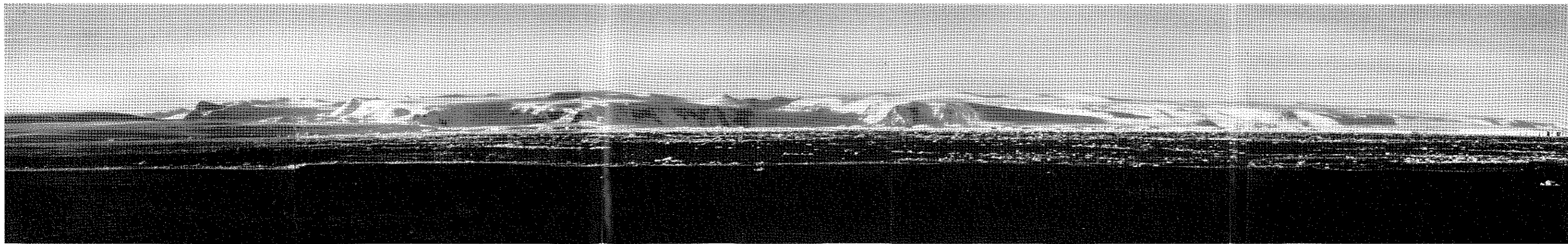
Gregory Bluffs
↓

Mount Harwood
↓

Buskirk Bluffs
↓

Cape North
↓

Dwyer Escarpment
↓



Davies

Bay

Drake Head

Williamson Head

Harald Bay

Mount Archer



Cooper Bluffs

Mount Kostka

Saddle Peak



Gregory Bluffs

Mount Harwood

Buskirk Bluffs

Cape North

Dwyer Escarpment



PLATE 24

Panorama from off Nielsen Fjord, 16 February, 1962.

ANARE photo 10820-10824

Phillip Law

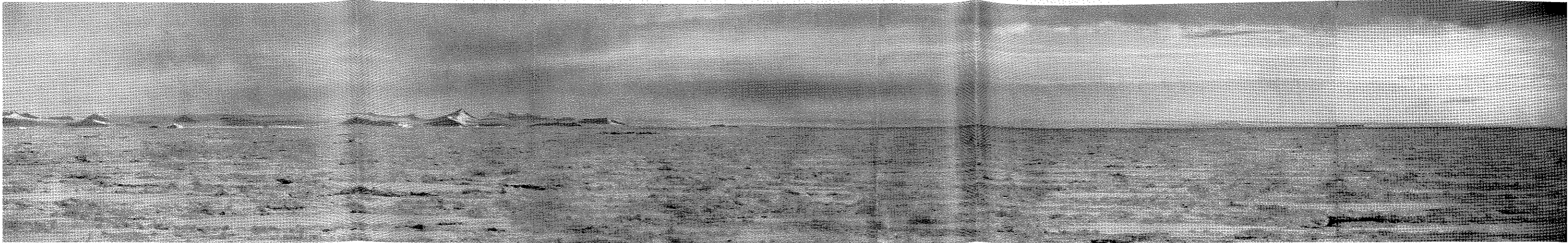
Eld Peak



Coombes Ridge



Berg Mountains



Lillie Glacier

Ob Bay

Mount Ashworth

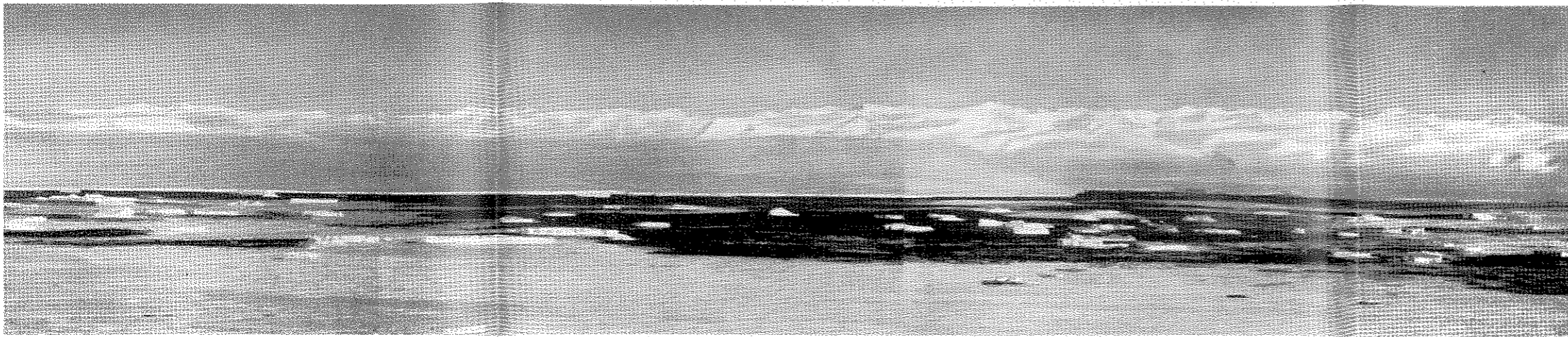


PLATE 22

Panorama from off Davies Bay, 8 March, 1961.

ANARE photo 9396A-9406B

Phillip Law

PLATE 23

Panorama from off Lillie Glacier, 25 February, 1962.

ANARE photo 10830-10837

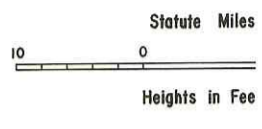
Phillip Law

Phillip Law

ANTARCTIC

SKETCH I OF THE COASTAL REGION BETWEEN LONGITUDES

INTERNATIONAL
UNIVERSAL TRANSVERSE MER
ZONES 57 AND



LEGEND

- Prominent Peaks *
- Isolated Nunataks *
- Dense Crevasses *
- Mountains and Hills *
- Rock Cliffs *
- Ice Ridges *
- Position Doubtful P.D.



A U S T R A L I A N
O A T E S
A N T A R C T I C

T E R R I T O R Y

REGION

MOUNTAINOUS

R O S S

REGION

MOUNTAINOUS

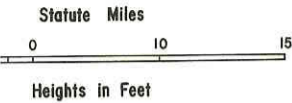
MOUNTAINS
EXTEND
SOUTHWARDS

Produced by Division of Nat
Department of National I
for
Antarctic Divisi
Department of Externa
October 1963

ARCTICA

KETCH MAP OF THE STAL REGIONS GITUDES 156°E AND 168°E

INTERNATIONAL SPHEROID
TRANSVERSE MERCATOR PROJECTION
ZONES 57 AND 58



Compiled by Division of National Mapping
Department of National Development
for
Antarctic Division
Department of External Affairs
October 1963

Compiled from United States
air photography 1947.
Revised from air photography,
astronomical control and other
information from A.N.A.R.E.
1959 to 1962.

Place-names underlined have
not yet been approved by
Antarctic place-names
committees of Australia
and New Zealand.

