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REPORT ON GEOLOGICAL WORK DONE DURING THE RELIEF VOYAGE OF THE M.S. "THALA DAN", DECEMBER-MARCH, 1961-62

by

C.M. Gregory

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CONTENTS

SUMMARY

During the 1961-62 Summer cruise of the "Thala Dan" the ship visited and relieved the base at Wilkes, then sailed east along the coast to continue the programme of mapping the coastal area of Australian Antarctic Territory. Points as far east as Cape North, Oates Land, on the Antarctic continent were visited to allow the surveyor, geophysicist and geologist to go ashore.

The following geological work was done during the voyage:

1. Five of the Windmill Islands, also the Donovan and Frazier Islands, were sampled for radioactive age determination work. Samples of granite, pegmatite and gneiss were collected.

2. The Balaena Islands, 25 miles north-east of Wilkes, were briefly examined. These islands consist of granite and gabbro.

3. Penguin Point, George V Land, was examined. This is a cliff of massive granite.

4. An examination was made of a number of outcrops around Cape North, Oates Land, as well as an aerial examination of others. The results of this work are shown on a sketch map of the area. Granite and chloritic, highly cleaved sediments were recognised.

5. Two areas in "Ob Bay"* were examined. The first area consisted of hornfelses which were uniform in dip, strike and lithology for approximately four miles across their strike. A granite found at the second area visited possibly intrudes these hornfelses.

6. An examination was made of specimens of granite and related rocks collected by the surveyor from an isolated nunatak in the Wilson Hills on the border of Australian Antarctic Territory and Ross Dependency.

INTRODUCTION

The M.S. "Thala Dan", chartered by the Antarctic Division of the Department of External Affairs, carried the relief party to be stationed at Wilkes, Antarctica, for 1962. The main work to be done on the voyage, apart from the relief operations at Wilkes, included overhauling two automatic weather stations, photographic flights over the length of coast from Wilkes to 165°E, establishing astrofixes, depth soundings in the waters along the coast, and geological reconnaissance work. The main geological reconnaissance work was to be done in Oates Land.

To carry out the mapping work the O.I.C. of the Antarctic Mapping Section, a surveyor, a geologist, four RAAF personnel and three helicopter personnel were carried as supernumeraries. A Beaver aircraft was carried on the

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*Geographical names in inverted commas are unofficial names.

deck and two helicopters (Bell 47G-2, as used in 1960-61) were carried on a landing platform built over the stern of the ship. The Beaver was to be employed taking photographs over the coast and inland. Landings on the continent were to be made by the helicopters.

NARRATIVE

The M.S. "Thala Dan" (Captain H. Nielsen), sailed from Melbourne in the afternoon of the 22nd December, 1961 and reached Lewis Island, the site of an automatic weather station, on the 29th. As this island had been examined in 1958 (McLeod, 1959), no further geological work was done here. After the equipment at the station was completely replaced, the ship sailed west towards Wilkes.

At Cape Carr, near Porpoise Bay, an unscheduled stop was made to allow photographic flights and an astrofix to be made. Wilkes was reached on the 10th January.

At Wilkes, after most of the unloading had been completed, I had the opportunity of doing some geology. Brief visits were made to a number of islands of the Windmill Islands, also the Frazier, Donovan and Balaena Islands. The glaciologist of the 1961 party (Mr W. Budd) and I made a reconnaissance flight in the Beaver aircraft over all the islands around Wilkes within a radius of 20 miles, and also part of the plateau and the shear moraine. It was not possible to visit the previously unvisited nunataks at the southern end of the Windmill Islands due to poor weather.

The "Thala Dan" sailed from Wilkes for Chick Island, the site of another automatic weather station, on the 18th January. It reached there on the 23rd. Little work was needed there so we departed again on the 24th.

The ship was now six days ahead of schedule, so a decision was made to visit Commonwealth Bay (67° S., 142°40' E.), the site of the Australasian Antarctic Expedition, 1911-14, Station. We arrived there on the 30th; however the weather prevented any landing until the late afternoon of the 31st. On the 1st February the weather again prevented a landing so we left and retraced our course to Dumont d'Urville, the French base, where we were able to go ashore and spend a few hours. At midday on the 2nd the ship sailed east again towards the Mertz Glacier, arriving there on the 5th.

On the 7th the weather cleared sufficiently for the surveyor and me to go ashore by helicopter to Penguin Point, a cliff on the ice-coast between the Mertz and Ninnis Glaciers. The Australasian Antarctic Expedition had visited this outcrop in 1911-12, but I briefly re-examined it before being forced to return to the ship by a change in the weather.

The ship waited unsuccessfully another day for the weather to clear, then sailed north to 66° S. to clear the pack-ice. She then sailed east and south to Cape North, Oates Land, in Ross Dependency.

On the 11th and the 12th, the first two days at Cape North, it was possible to examine the two off-shore islands and briefly examine the cliffs of Cape North. Cloud and white-out conditions over the continent prevented flights inland. The next three

days brought snow, but on the 16th a helicopter flight was possible to 60 miles west of Cape North. On this flight no accessible rock was found. The next three days it snowed again but on the 20th the weather cleared and I visited a peak due south of the islands, near Mt Elliott, and was able to examine other outcrops from the helicopter.

During the night of the 20th the ship moved westwards around the coast to 162°E. The next day was still fine so the surveyor and geophysicist landed on a mountain peak in the Wilson Hills, near the boundary of the Australian Antarctic Territory and Ross Dependency. The surveyor (Mr S. Kirkby) collected some rock samples which was fortunate because the weather had deteriorated again by mid-afternoon, preventing my planned visit.

In the afternoon of the 23rd the ship broke down and drifted for about 15 hours. It took all the next day to get back to the coast, this time at a point about 20 miles east of Rennick Bay. New ice had formed in patches in this area. The following morning, 25th February, was again fine so the surveyor, geophysicist and I were able to visit two peaks in from the coast here, and also an off-shore island, "Sputnik Island".

In the evening of the 25th the ship put to sea, heading for Macquarie Island which it reached in bright sunshine on the 2nd March. The work to be done on Macquarie Island was quickly completed and we sailed again at midday on the 3rd. We arrived back at Melbourne in the evening of the 8th March.

GEOLOGICAL WORK

Windmill Islands (Lat. 66°S., Long. 110°E.)

The Windmill Islands (fig.3, photos 1-3), were geologically examined by Robertson (1959). During relief operations in the summer of 1959-60 McLeod was able to visit briefly several islands of the group (McLeod, 1960), and likewise during relief operations this year further brief visits to a few islands were possible.

This year samples for radioactive age determination were collected and brief notes on the geology were made.

Ford Island. A landing was made on the north-west corner of this island and a sample taken for age determination. The rock here is a coarse-grained, slightly foliated granite. In the granite, phenocrysts of feldspar stand out on the light buff-coloured weathered surface. The fresh rock is dark brown, due to the dark colour of the quartz. Thin veins of pegmatite cut the rock in places.

McLeod and Robertson describe other types of granite on the island but time was not available to examine them.

Cloyd Island. This island is geologically similar to Ford Island. It is composed of massive and slightly foliated, coarse-grained granite. The strike of the foliation is 340°, the dip is vertical. Quartz veins and thin dykes of pegmatite and aplite occur throughout the granite. The pegmatite is commonly

zoned with very coarse feldspar in the inner zone and finer grained quartz and feldspar in the outer zone. Most of the veins are parallel to the foliation direction.

Pods of richly garnetiferous pegmatite, up to one foot long, were noted, also wispy and pod-like biotite-rich xenoliths.

A sample for age determination was taken from the massive granite.

Browning, O'Connor and Ardery Islands. Both Browning and O'Connor Islands were visited but no samples were taken for age determination because the rock was very deeply weathered. Ardery Island was examined from the air and appeared to be similarly weathered.

Cameron and Berkley Islands. Two samples were taken for age determination from Cameron Island. These represent the two distinct rock types on the island. The first is a massive leucocratic granite which contains some wispy, dark biotite-rich xenoliths and also dykes of pegmatite. This part of the island is similar to Ford and Cloyd Islands.

The second rock type is a migmatite. It is intruded by the granite. The migmatite consists of layers averaging three to four inches thick. These layers are of two types, one black and biotite-rich and the other white and quartz-rich. Anyone of them is not continuous; it may be one or two feet long or many yards long. There is no apparent regularity of thickness or length in these layers either. Thin very coarse pegmatite veins and quartz veins are common. Augen of biotite-rich gneiss outlined by quartz, and eyes of quartz and feldspar are plentiful.

On Berkley Island a similar migmatite has developed.

Donovan and Frazier Islands (Lat. 66°05'S., 110° 27'E.; and 66°05'S., 110° 10'E.)

Chappel and Lilienthal Islands were visited in the Donovan Islands. Also Nelly and Carlton Islands were visited in the Frazier Islands (fig.3, photo 4). The rocks on these four islands and presumably the others of the groups, are all very similar to the migmatite on Berkley and Cameron Islands. However there are local variations. Biotite becomes more abundant in the rocks westward from Berkley Island. Pegmatite becomes less common westward until in the Frazier Islands it is rare. Deep red garnets speckle the rocks in various places and have developed in concentrations in some small pegmatites.

Balaena Islands (Lat. 66° S., Long. 111° 10' E.)

The Balaena Islands are about 25 miles north-east of Wilkes. They consist of six islands, of which Thompson Island is the largest, (fig.1, photo 5). Robertson (1959) visited Thompson Island and McLeod (1960) revisited it as well as visiting the second largest island of the group, south of Thompson Island. This year it was possible to visit all six.

There are two rock types making up these islands. The southernmost and easternmost islands are gabbro, and the other four are granite. No contact was seen between the two rock types.

The gabbro is massive, leucocratic and medium-grained. It crops out as low rounded tors with many joints. Deuteric alteration along these joints has caused zones of epidotization in the parent rock for up to six inches on either side of the joints. The joints themselves are filled with a half-inch thick, green, epidote-rich material. No dykes or xenoliths were seen in the gabbro.

The major rock type of the islands is a leucocratic, grey granite with numerous thin dykes of pegmatite and small to large dark, biotite-rich xenoliths. A few phenocrysts are scattered throughout the granite.

Two different types of granite were noted on the islands. They are both grey and most properties are similar, except that one contains a higher percentage of biotite and magnetite than the other. The contact between these two types is very sharp and where seen can be traced for up to 50 yards. Phenocrysts of plagioclase stand out on the weathered surface.

The pegmatite dykes are up to about one foot thick. They are coarse-grained and are composed of quartz, feldspar, biotite and magnetite. There is a wide range of percentages of each mineral along any one of these dykes. Biotite and magnetite may be absent or may form up to 15 per cent. Pyrite is a common accessory mineral. Magnetite is commonly euhedral. Both biotite and magnetite crystals have a maximum diameter of approximately one inch. Crystals of quartz and feldspar are generally subhedral; they are larger and may be three inches in diameter. The two most common directions of dyke emplacement are 010° and 340°.

Dark, biotite rich xenoliths are found throughout the granite but there is a very noticeable increase in number and size from the north-east of the group to the south-west. The size ranges from two or three inches to three feet in diameter, and the number ranges from one percent to about four or five percent.

Cape Carr, Wilkes Coast (Lat. 66° S., Long. 131° E.)

At Cape Carr, near Porpoise Bay, four samples of rock were collected by the surveyor (S. Kirkby) from moraine in the base of an overturned iceberg. This iceberg was locked in the bay-ice a couple of miles from the coast, 20 miles east of Cape Carr. These specimens are:

1. A leucocratic, massive granite containing brown quartz with pink and white feldspar and very minor biotite.

2. A biotite-plagioclase-quartz gneiss with elongate patches of plagioclase up to two inches long. The matrix is granular quartz and plagioclase with fine biotite flakes. The rock appears to be granulated. It is the main rock type in the moraine.

3. A porphyritic pink granite. It contains large pink orthoclase crystals in a groundmass of medium-grained greenish plagioclase, chlorite and quartz.

4. A dark green, aphanitic, finely banded rock, possibly of high grade metamorphic origin. It appears to be highly chloritic, although it has not developed a good cleavage.

Penguin Point, George V Land.

Penguin Point (67°39'S, 146°12'E) is a cliff of granite which rises to 150 feet above sea level (photo 7). The outcrop is approximately 100 yards long by 50 yards wide on top of the cliff. This cliff is one of a line of outcrops which extends along the coast for about 15 miles in this area, between the Mertz and Ninnis Glacier Tongues (photo 6). It was not possible to visit any of the other outcrops.

The rock forming Penguin Point is a very coarsely porphyritic, grey, biotite-rich granite (photo 8). It is weakly foliated in patches. Phenocrysts of perthite are up to three inches long and almost square in section. They stand out from the surface up to about one quarter of an inch. Clots of biotite, up to thumb-nail size, are numerous throughout the mass. Surface weathering, with abundant iron staining, to a depth of one inch is very marked.

Two types of xenolith are abundant. One type contains up to 90 per cent biotite and is small (maximum diameter one foot), either round or elongate. The second type is aplitic and generally of the order of three feet long by six inches wide. This aplitic rock contains about five percent biotite. All the xenoliths appear randomly oriented on the flat horizontal surface, but in the vertical cliff face they are oriented with their long axes approximately vertical.

Two strong joint patterns were noted, both striking east-west, but dipping 30°north and 80°north respectively.

Cape North, Oates Land (Lat.70° 30' S., Long. 165° 55' E.)

Ten days were spent at anchor off two islands four miles north-east of Cape North. During that time it was possible to examine a number of outcrops in an area about ten miles square. Two rock units were recognised, granite and chloritic, slightly metamorphosed sediments. Their distribution is shown in the accompanying sketch map (fig.2).

Two islands, north-east of Cape North (photo 9). Both these islands are fairly low features, the northernmost rising to 100 feet above sea-level, and the other to 200 feet above sea-level. They are identical geologically, consisting of homogeneous medium-grained, massive, grey granite. This granite is composed of white feldspar, light brown quartz and small thin flakes of biotite.

Xenoliths are about one or two percent of the rock. These are of two types: dark biotite-rich rocks, and porphyritic micro-granitic rocks. The dark biotite-rich xenoliths are by far the most abundant. They are subrounded to irregularly shaped masses, from three inches to three feet in diameter and are scattered randomly through the granite. They consist of a fine-grained mass of biotite, quartz and feldspar, with porphyroblasts of quartz and feldspar. The porphyroblasts average $\frac{1}{8}$ to $\frac{1}{4}$ inch diameter, but range from one inch downwards. Xenoliths of the porphyritic micro-granite are rare. They are sub-round and between two and three feet in diameter. They consist of a fine grained quartz-feldspar-biotite mass with scattered phenocrysts of feldspar; the biotite is partly replaced by chlorite. Both these xenolith types weather more readily than the granite and form slight depressions in the rocks.

Dykes of aplite, ranging in thickness from an inch to twelve feet, were noted in many places. These are equigranular masses of quartz and feldspar with minor biotite and chlorite. The two most common directions of emplacement measured for these were 090°, dip 25°N, and 180°, dip 80°W.

One thin vein of quartz pegmatite was noted, also a very few, one foot diameter, pods of quartz.

Joints are very well developed. One prominent set, striking 180°, dip 80°W, has slickensides plunging 80°N along its chloritized surfaces. Flat-lying joints form large horizontal slabs in many places on the islands.

Very little moraine was noted on either of the islands, but a few small pebbles of slate and shale were picked up. These are identical with rocks found outcropping to the south-west at Cape North.

Two other outcrops of granite were visited, one at the cliff across the fjord, south-east of Cape North, and the second on a peak south of the two islands, near Mt. Elliott. These were geologically identical with the two islands.

Cape North (photos 10 and 11). This is the only place that the chloritic sediments were examined on the ground.

Cape North is a sequence of thin to medium-bedded, chloritic, very highly cleaved, slates, greywackes and lithic sandstones; chloritic slates are the commonest lithology. These beds are folded into a series of quite tight folds, plunging south-east at approximately 30°. The folds are accentuated on the cliff faces at Cape North and at the other outcrops of these chloritic rocks by the snow settling along jutting beds. This feature makes these rocks recognisable at a distance.

The rocks are all highly chloritic. They are a product of regional metamorphism. The granite in this area is thought to intrude them but no contact was seen.

"Ob Bay", Oates Land (Approx. Lat. 70°40' S., Long. 165° E.)

In the "Ob Bay" area three landings were made, two on peaks on either side of a large glacier (photo 12) and one on "Sputnik Island", an island in "Ob Bay". The two peaks were at 22 miles on a bearing of 135°, and 28 miles on a bearing of 166°, from "Sputnik Island".

The first peak visited consisted of purplish-brown fine grained hornfelses interbedded with blasto-porphyritic varieties of the same rock. Beds average about two feet in thickness and dip uniformly to the south-west at 50°; their strike is 320°.

Cleavage is well developed in most beds; some are quite schistose also. Thin quartz veins and small quartz blows are numerous.

The second peak visited was about five miles away across the glacier to the south-west. The rock here was almost identical with the rock at the first peak, although it was neither as well cleaved nor as schistose. The strike and dip were still the same and appear to be the same in other places in the glacial valley, as observed from the air.

These rocks are quite distinct from any other seen in the region, but may be related to the chloritic sediments at Cape North.

On "Sputnik Island" only a very small outcrop was accessible. This was visited and found to be a medium to fine-grained massive, grey granite containing a few two-inch diameter biotite-rich xenoliths. These xenoliths tended to weather more readily than the granite.

Wilson Hills, Oates Land

A landing was made on a mountain top at 160°01'E, 69°52'S, by the surveyor who collected some rock samples. It was not possible for me to visit this peak.

The main rock type there is a grey porphyritic granite. It is composed of pink and white feldspar phenocrysts in an equigranular mass of quartz and plagioclase. Biotite has developed as small grains and as larger thumb-nail-size patches. Dykes of aplite and pegmatite, up to two feet wide, intrude the mass. Dark biotite-rich xenoliths are scattered through the mass; they are up to 18 inches across. Thin veins of quartz are quite dommon as joint fillings.

Sampling for Radioactive Age Determination

Thirteen samples for radioactive age determination were taken from the Windmill, Donovan, Frazier and Balaena Islands (fig.1 & 3) using a sledge-hammer. The load capacity of the helicopter prevented carrying the rock drill for drill-and-blast sampling. This method would have allowed fresher rock to be collected.

From the Windmill Islands samples were taken of the granite on Ford and Cloyd Islands, the pegmatite at Wilkes Station, the granite and gneiss on Cameron Island and the gneiss on Berkley Island.

One sample of gneiss was taken from each of Chappel and Lilienthal Islands of the Donovan Islands and from Carlton and Nelly Islands of the Frazier Islands.

From the Balaena Islands one sample of gabbro was taken from the southern island of the group and samples of granite from Thompson Island and the small island to its east.

Two samples of granite were also taken from the two off-shore islands near Cape North, Oates Land.

ACKNOWLEDGEMENT

Thanks are due to the Director, Antarctic Division, Department of External Affairs, who lead this expedition, without whose interest and co-operation the above work would not have been possible.

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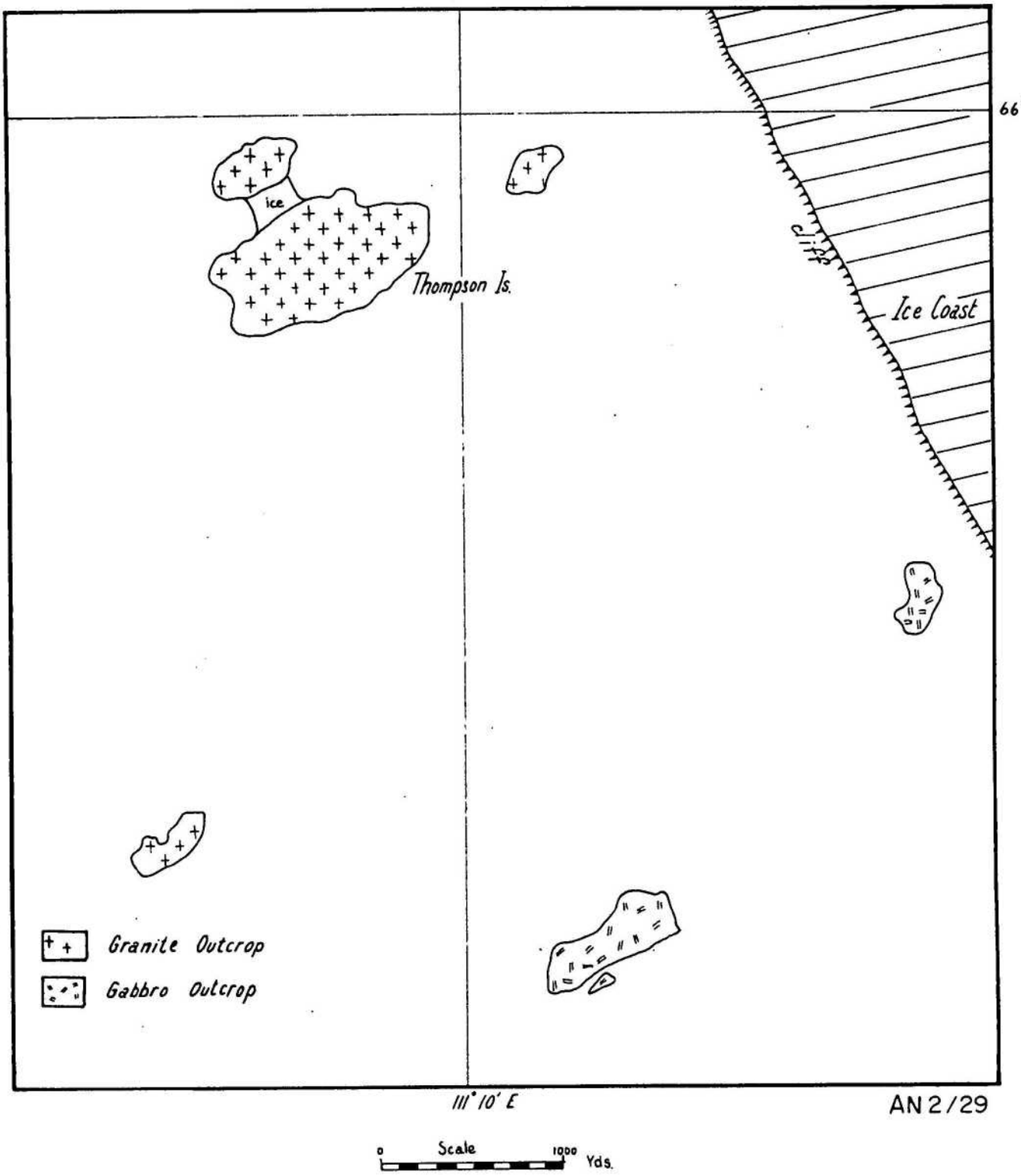
Sketch map of

BALAENA ISLANDS

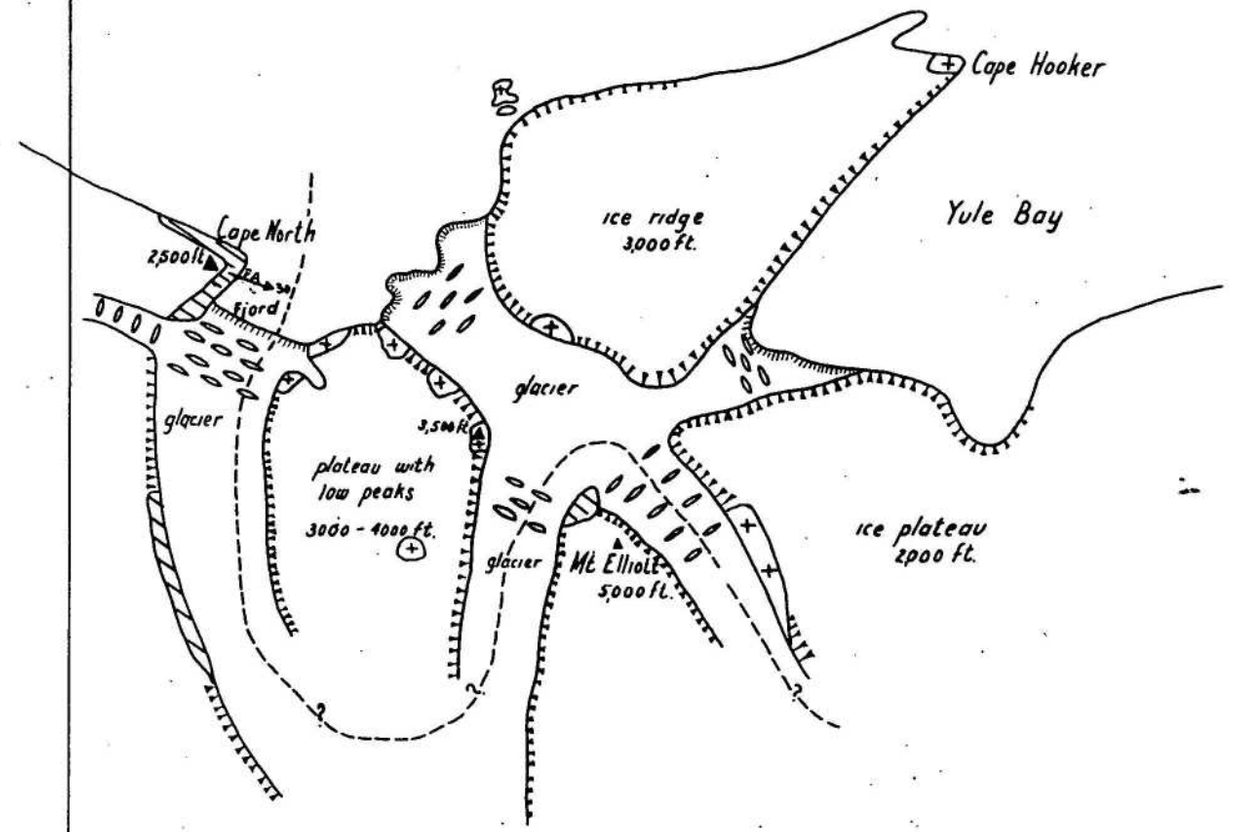
Wilkes Land, Antarctica

fig. 1.



AN 2/29

fig. 2.



REFERENCE

- Ice cliff
- End of glacier
- Tightly folded chloritic sediments outcrop
- Granite outcrop
- Geological boundary, approx.
- Geological boundary, inferred
- Plunge of fold axes
- Crevasses

Sketch map of

CAPE NORTH AREA

Ross Dependency (N.Z.)

Approx. scale in miles

71°S

165°E

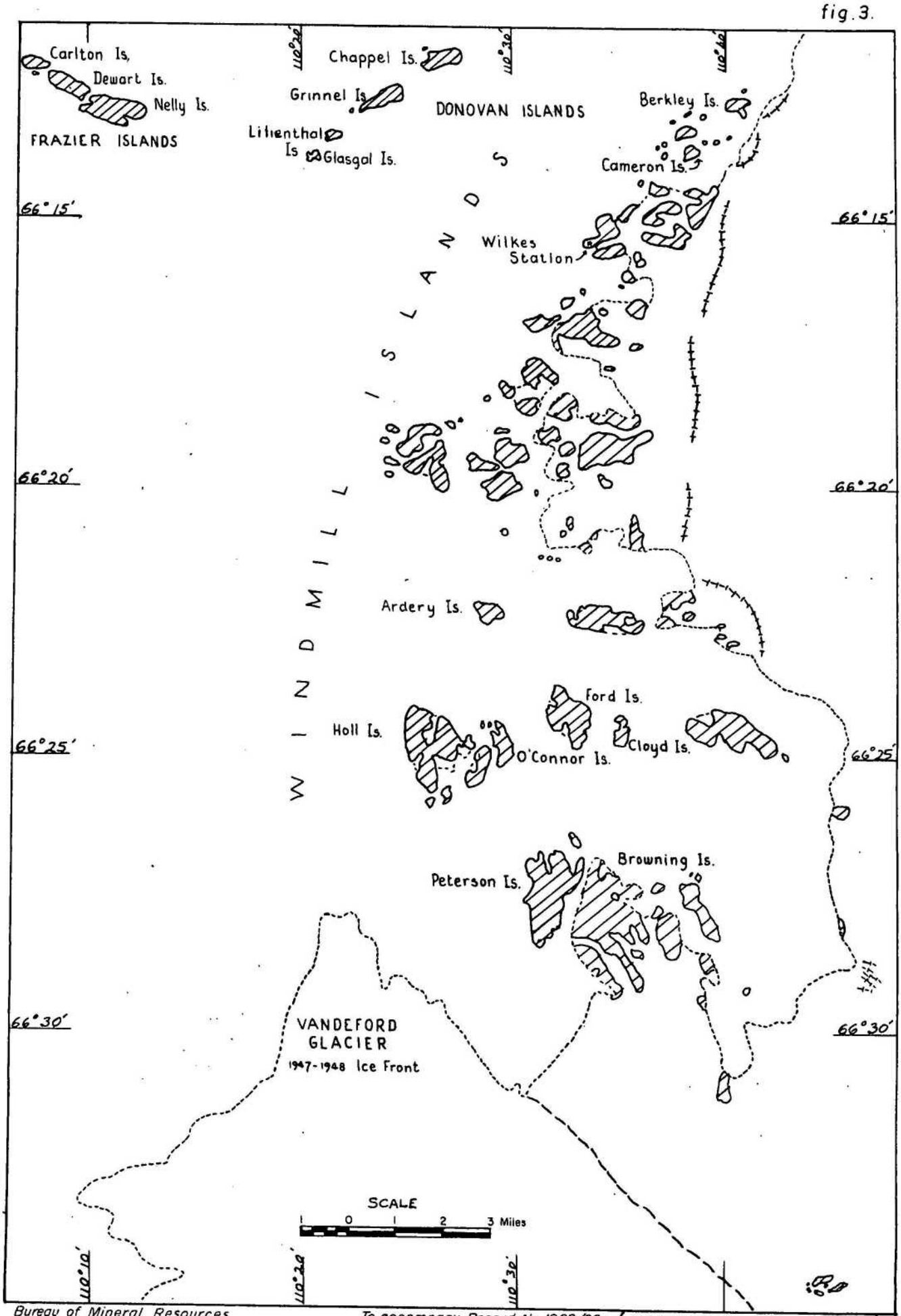
Bureau of Mineral Resources
Geology and Geophysics May 1962

To accompany Record No 1962/88

AN 2/30

Outcrop map of
WILKES AREA
ANTARCTICA

fig. 3.



Bureau of Mineral Resources Geology and Geophysics

To accompany Record No 1962/88 (After Robertson, 1959.)

Reference

..... Ice front

— — — Edge of glacier

Outcrop

Moraine

AN 2/31

fig. 4.

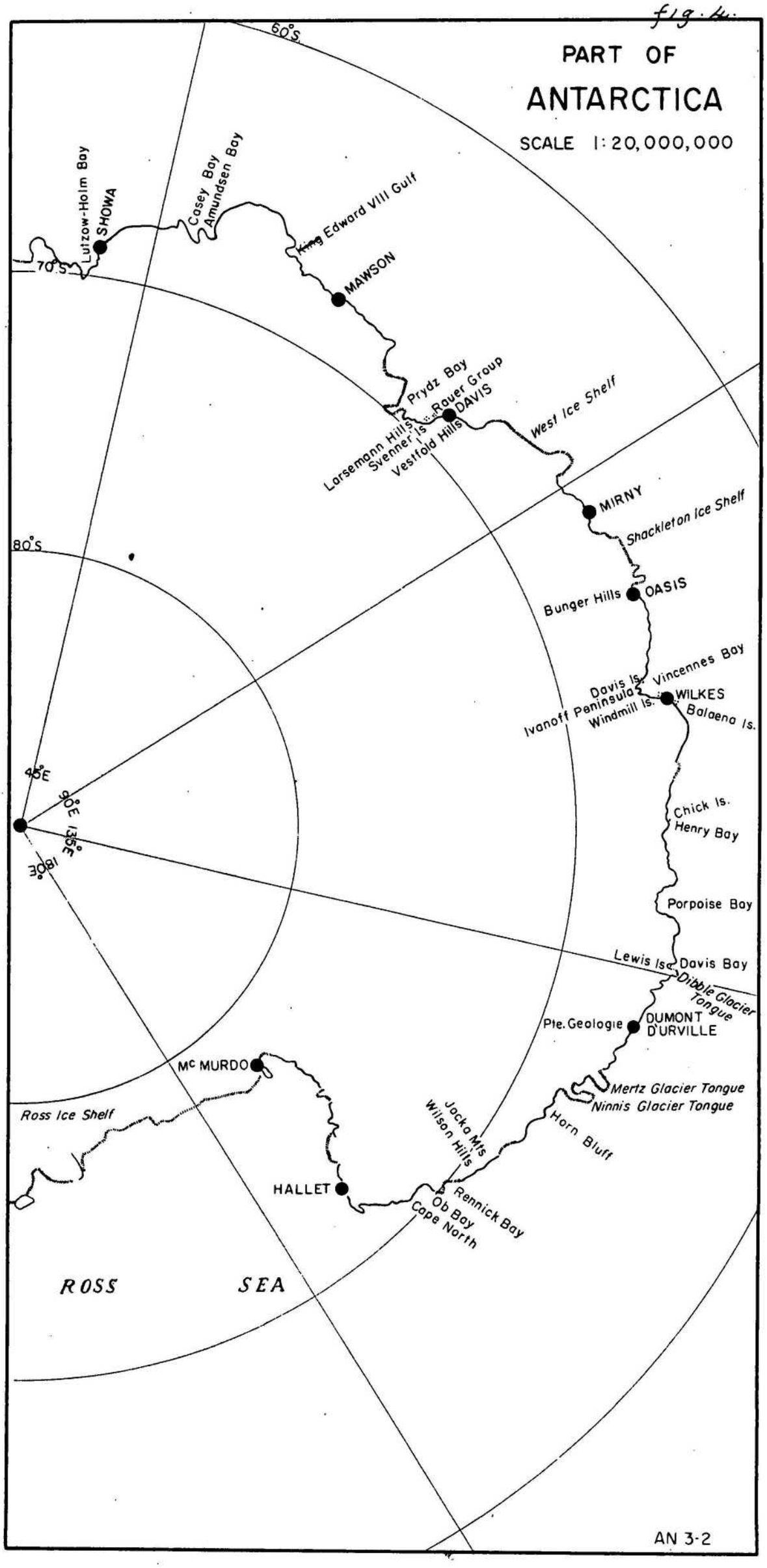

PART OF
ANTARCTICA
SCALE 1:20,000,000
60°S
70°S
80°S
45°E
90°E
135°E
180°E
Lutzow-Holm Bay
SHOWA
Casey Bay
Amundsen Bay
King Edward VIII Gulf
MAWSON
Prydz Bay
Rouer Group
DAVIS
Larsemann Hills
Svenner Is.
Vestfold Hills
West Ice Shelf
MIRNY
Shackleton Ice Shelf
Bunger Hills
OASIS
Davis Is.
Vincennes Bay
Ivanoff Peninsula
Windmill Is.
WILKES
Balaena Is.
Chick Is.
Henry Bay
Porpoise Bay
Lewis Is.
Davis Bay
Dibble Glacier Tongue
Pte. Geologie
DUMONT D'URVILLE
Mertz Glacier Tongue
Ninnis Glacier Tongue
Horn Bluff
Jacka Mts
Wilson Hills
Rennick Bay
Ob Bay
Cape North
HALLET
Mc MURDO
Ross Ice Shelf
ROSS SEA
AN 3-2

PHOTO 1

Holl Island (intermediate igneous rock), in the Windmill Islands Group, 11 miles S.S.W. of Wilkes Station, looking N.W.

(M/211/26)

PHOTO 2 In the Windmill Islands Group, looking N. Ardery Island (intermediate igneous rock), 8 miles S.S.W. of Wilkes Station, in the foreground.

(M/211/27)

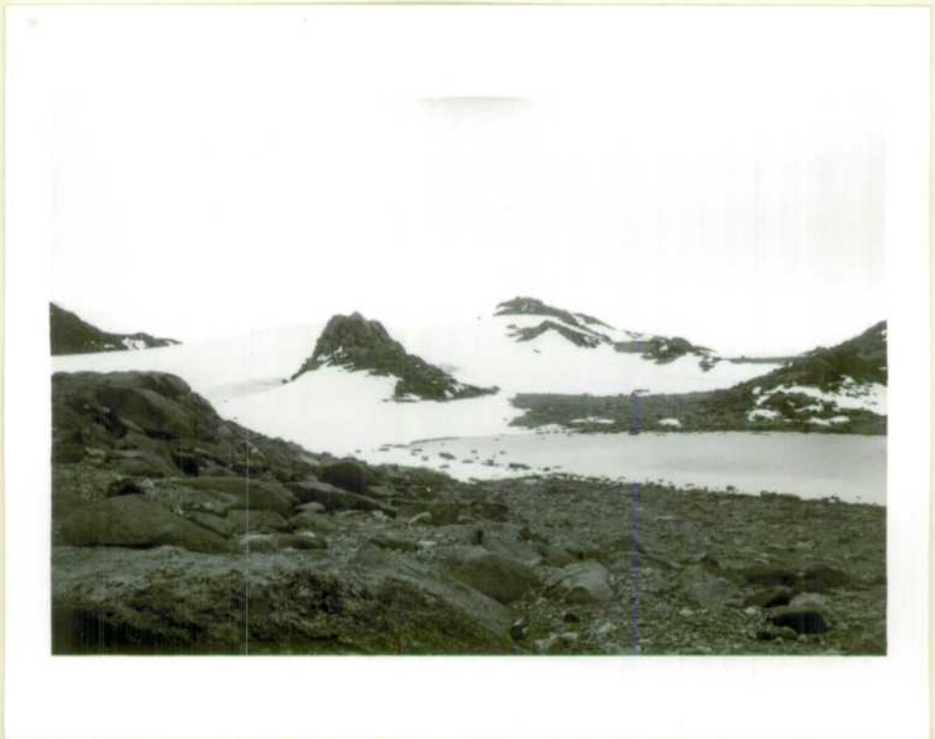


PHOTO 3 On Browning Island, in the Windmill Islands Group, 14 miles S. of Wilkes Station, showing typical outcrop of intermediate igneous rock. Melt-water lake appears in centre right.

(M/211/25)

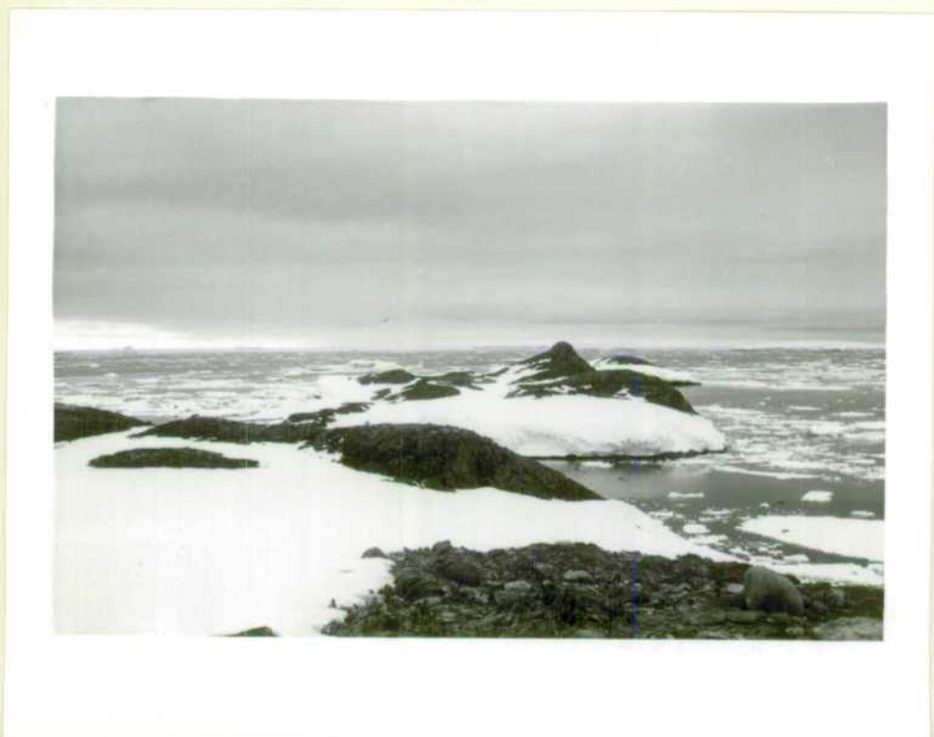


PHOTO 4 Frazier Islands (banded gneiss), 11 miles W.N.W. of Wilkes Station, looking N.W. from Nelly Island.

(M/211/31)

PHOTO 5 An aerial view of the Balaena Islands, looking S. from 3,000 feet.

(M211/17)

PHOTO 6 Looking S. from 1,500 feet at line of outcrops between the Mertz and Ninnis Glaciers, George V Land. Bay ice and trapped icebergs extend to the base of the outcrops.

(M/212/26)

PHOTO 7 Well jointed, massive granite, Penguin Point, George V Land.

(M/212/28)

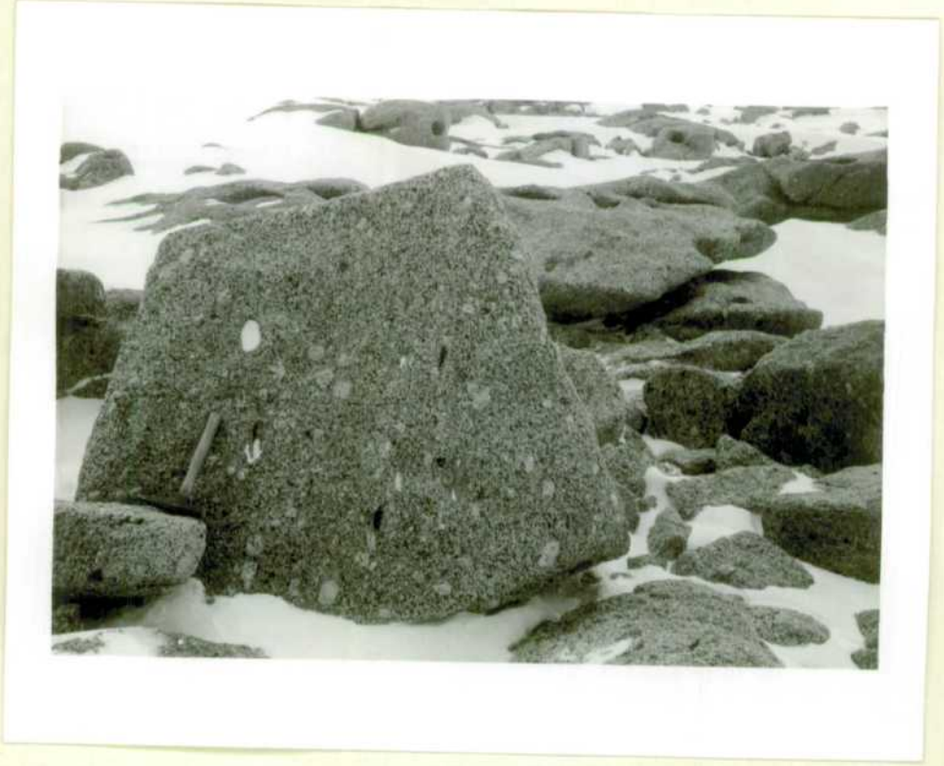


PHOTO 8 Porphyritic granite, Penguin Point, George V Land.

(M/212/29)

PHOTO 9 Looking S. from 1,000 feet at the two islands 4 miles N.E. of Cape North, Oates Land.

(M212/31)

PHOTO 10 Looking S.W. to Cape North, at a distance of about four miles. The cliffs at the right are chloritized sediments, and those at the left are massive granite.

(M/212/35)

PHOTO 11 Cape North. Folded, medium bedded, chloritized sediments. The snow on the jutting beds accentuates the folds. The cliff is approximately 2,000 feet high.

(M/213/5)

PHOTO 12 "Ob Bay", Oates Land. The first point visited in this area is the small ridge nearest the sea in the centre of the photograph. It is about 1,500 feet above sea-level and five miles across the glacier from the second point visited at 4400 feet. The photograph was taken from the second point, looking north. (M/213/10)