COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

REPORT No. 135

Anare 1961 Geological Traverses on the Mac.Robertson Land and Kemp Land Coast

BY

D. S. TRAIL

Issued under the Authority of the Hon. R. W. C. Swartz
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GEOLOGICAL TRAVERSES ON THE MAC.ROBERTSON LAND AND KEMP LAND COAST

by

D. S. TRAIL

SUMMARY

Members of the Mawson party of the 1961 Australian National Antarctic Research Expeditions began 1:250,000 scale geological mapping in the northern part of the Framnes Mountains, and along parts of the Mac.Robertson Land and Kemp Land coast, where bedrock is well exposed, between the Robinson Group of islands and Edward VIII Gulf. W. R. McCarthy (Australian Mineral Development Laboratories) later described the specimens collected in the course of the mapping.

Nine raised beaches, 3 to 6 metres above sea level, were found between the Stanton Group and the Oygarden Group of islands.

Porphyroblastic charnockite forms most of the Robinson Group of islands, the northern Framnes Mountains, and many islands near Mawson in Holme Bay. Even-grained charnockite forms most coastal exposures between Holme Bay and Byrd Head, near Taylor Glacier. Both types, which together constitute the Mawson Charnockite, are hypersthene-quartz-feldspar rocks; orthoclase is dominant in some and plagioclase in others. Almost all of the charnockite in the Robinson Group contains garnet and minor biotite; hornblende occurs in places in the Framnes Mountains. Thin seams of mylonitic rocks are abundant throughout the charnockite.

The Painted Gneiss is made up of bodies of gneiss in the charnockite; they are composed predominantly of garnet-quartz-feldspar gneiss, with subordinate biotite-bearing, sillimanite-bearing, and scapolite-clinopyroxene-bearing gneisses and rare marble and dolerite.

The Colbeck Gneiss is made up of sillimanite-garnet-quartz-feldspar gneiss between Taylor Glacier and Scoble Glacier, and garnet-biotite-quartz-feldspar gneiss and red granitic rocks east of Taylor Glacier. Orthoclase predominates in both types of gneiss and in the granitic rocks; some andesine or labradorite is mostly present; hypersthene is confined to a well defined body of banded gneiss, similar to the Stillwell Gneiss, on the west side of Taylor Glacier.

The Stillwell Gneiss forms the bulk of the bedrock exposed on the coast between Scoble Glacier and Edward VIII Gulf. It consists of light-coloured bands of quartz-feldspar gneiss, up to several metres thick, alternating with thinner dark bands of hornblende-pyroxene-plagioclase rock. Orthoclase predominates in the light bands and plagioclase is subordinate; orthoclase is rare in the dark bands. Between the Scoble Glacier and the Hoseason Glacier, hornblende and hypersthene are the most

abundant dark minerals in the light bands; west of the Hoseason Glacier, garnet and biotite predominate among the dark minerals in the light bands. The pyroxenes in the dark bands are hypersthene and subordinate clinopyroxene. Thin, atypical, dark bands, which occur at several places, are rich in dark minerals such as clinopyroxene, pargasite, or garnet, and bytownite is commonly the only feldspar present.

The pegmatite dykes are mostly biotite-garnet-quartz-plagioclase rocks, but a few of them consist of quartz and microcline. The metamorphosed basic dykes in the banded gneiss are similar in composition to the typical dark bands.

The Mawson Charnockite may be the metamorphosed equivalent of greywacke, andesitic volcanics, or basic plutonic rocks. The Painted Gneiss and the Colbeck Gneiss are, at least in part, metamorphosed clayey, sandy, and calcareous sediments; they may also be partly of metasomatic origin. The Stillwell Gneiss probably represents a sequence of basic volcanic rocks, minor intrusives, and sediments; the light bands may be greywackes, the typical dark bands eruptives or intrusives, and the atypical dark bands are probably metamorphosed calcareous sediments.

The first discernible metamorphism took place under granulite facies conditions, and was followed by deformation, intrusion of basic dykes, and a second, localized metamorphism under almandine-amphibolite facies conditions.

INTRODUCTION

This Report describes the results of geological work undertaken on the Mac.Robertson Land and Kemp Land coast and in the Framnes Mountains by members of the 1961 Mawson party of the Australian National Antarctic Research Expeditions (ANARE). Geological reconnaissance by this party in the southern Prince Charles Mountains has been described elsewhere (Trail, 1963).

Systematic geological mapping at 1:250,000 scale was carried out at the Robinson Group of islands, among islands in the eastern part of Holme Bay, and in the northern part of the Framnes Mountains, excluding the Casey Range. Most of the large outcrops in these areas were visited.

Many islands and coastal exposures were examined briefly during a return journey by dog sledge from Mawson to Kloa Point; mapping was undertaken during halts of a few days on this journey at the Stanton Group, the islands and coastal exposures between Byrd Head and Taylor Glacier, the Hobbs Islands and Tilley Nunatak, Fold Island, Broka Island, and the Oygarden Group.

Geological mapping of this coast at 1:250,000 scale was completed in 1965 by McLeod et al. (1966), and the maps which accompany this Report (Pls 1, 2) include the results of the 1965 work.

The late W. R. McCarthy, of the Australian Mineral Development Laboratories, Adelaide (AMDL), described over 100 specimens collected in 1961 in an unpublished report (McCarthy, 1963), and later summarized their petrography (McCarthy & Trail, 1964).

Almost all the detailed petrological information in this Report is taken directly from McCarthy's unpublished reports, and the subdivision and interpretation of these rocks are derived to a great extent from the results of discussion with him. So great is his contribution to this Report that it cannot conveniently be credited throughout the text. However, the conclusions and interpretations are the responsibility of the author only.

I. R. Pontifex and G. J. G. Greaves, of the Bureau of Mineral Resources, identified the opaque minerals in many specimens, and Pontifex described a few thin sections.

Previous work

The British, Australian, and New Zealand Antarctic Research Expedition in 1931 collected specimens from Cape Bruce, which were described by Tilley (1937).

Rayner & Tilley (1940) described specimens collected at Bertha Island in 1936 by the crew of R.R.S. *William Scoresby*.

Reconnaissance geological mapping of this coast by ANARE between 1954 and 1960 has been described by Stinear (1956), Crohn (1959), McLeod (1959), and Ruker (1963). Crohn first visited various exposures in almost every major locality described in this Report. Many important localities, including the gneiss bodies in the Framnes Mountains, Taylor Glacier, and western part of the Oygarden Group of islands, have been described in some detail by him, and his work covers so much ground that it cannot everywhere be credited in the text. However, all descriptions in this Report have been assembled only from the work of the author, McCarthy, Pontifex, and Greaves, and in general it complements and adds detail to the descriptions published by Crohn.

The results of the investigation described here have been summarized by McLeod (1964) and McCarthy & Trail (1964).

Raised Beaches

The geomorphology of the coast has been described by Crohn (1959) and McLeod et al. (1966). Only the raised beaches found in 1961 are recorded here.

Nine small raised beaches were found along the coast traversed in 1961 (Fig. 1), between the Stanton Group and the Oygarden Group. Two more were noted by McLeod et al. (1966). Most of them lie at the heads of small coves open to the north.

The beaches found in 1961 are composed predominantly of locally derived pebbles, cobbles, and boulders between 1 centimetre and 1 metre across, ranging from subangular to subround. Sand-size and smaller material is rare.

The beaches slope upwards from sea level to a well defined platform, several metres broad, between 3 and 6 metres above sea level. Most of the beaches terminate at the inner edge of the platform; at the north end of the easternmost member of the Crooked Islands the raised beach slopes upwards from this platform to reach a height of about 15 metres, where it butts against steep bedrock.

PRINCIPAL ROCK TYPES

The characteristics of the principal rock types are listed in Table 1.

Broadly, the *Mawson Charnockite* forms the bulk of the Framnes Mountains, and the islands and coastal exposures between the Robinson Group of islands and Byrd Head. The large bodies of garnet-bearing and biotite-bearing quartz-feldspar gneiss contained in charnockite in the Framnes Mountains have been named collectively the *Painted Gneiss*. Between Byrd Head and the Scoble Glacier, the coastal exposures and islands are almost all composed of biotite-bearing, garnet-bearing, and sillimanite-bearing gneiss named the *Colbeck Gneiss*, which includes small bodies of granite. From the Scoble Glacier to Edward VIII Gulf, the coastal exposures and islands are composed of gneiss made up of bands of pyroxene-plagioclase rock alternating with bands of quartz-feldspar gneiss. This rock unit is named the *Stillwell Gneiss*.

Mawson Charnockite (new name)

The Mawson Charnockite is here defined as the charnockite which crops out along the coast of Mac.Robertson Land between Austskjera (lat. 67°30′S., long. 64°00′E.) and Byrd Head (lat. 67°21′S., long. 61°00′E.), and extends seawards to Nelson Rock (lat. 67°25′S., long. 62°45′E.) and inland to the southern limit of the Framnes Mountains and to Mill Peak (lat. 67°59′S., long. 61°10′E.). The name is derived from Mawson, the ANARE station built on an exposure which is designated the type area of the charnockite.

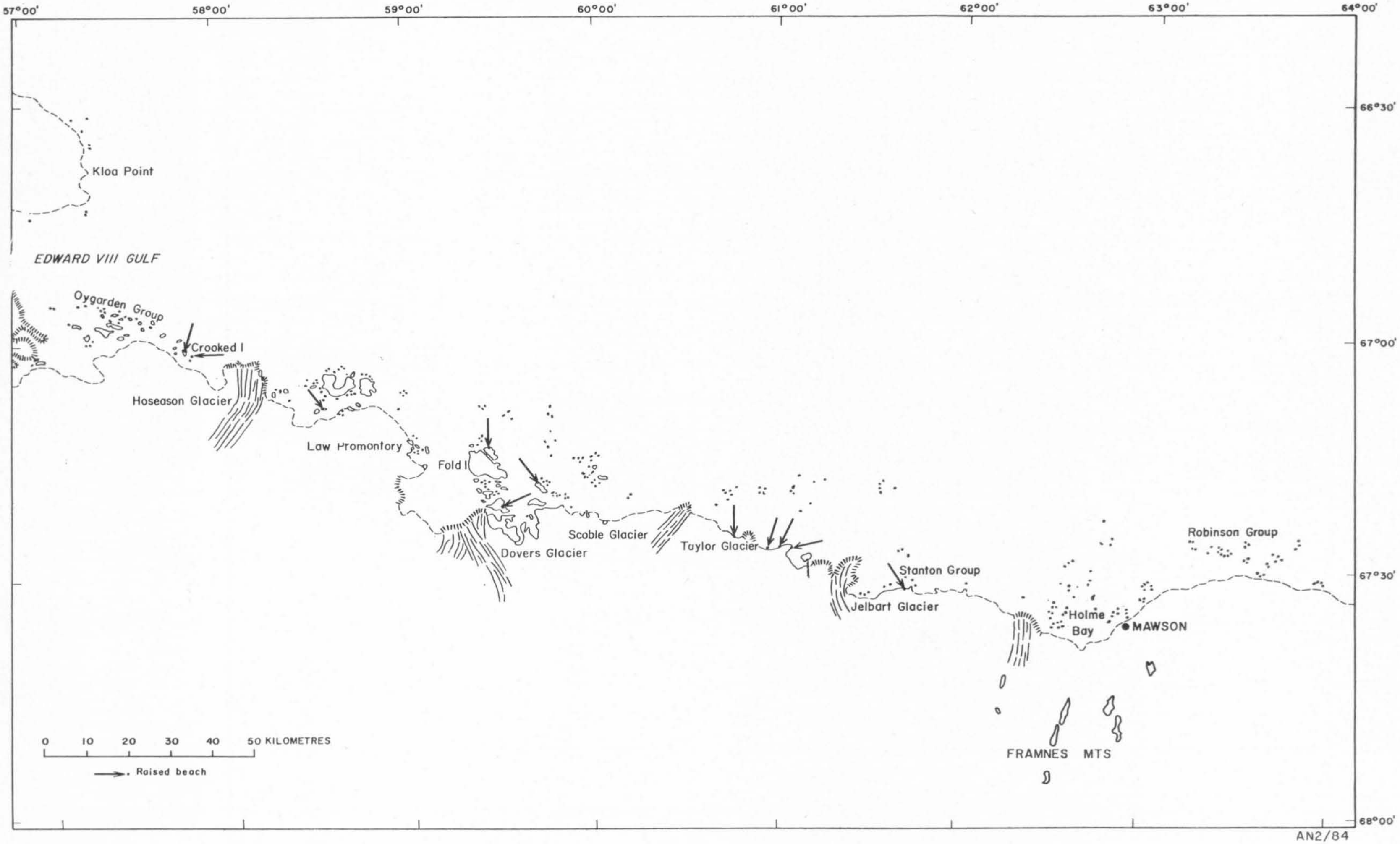

FIG. 1. Locality map of the Mac.Robertson Land and Kemp Land coast—showing raised beaches.

TABLE 1: MINERAL ASSEMBLAGES AND OTHER CHARACTERISTICS

(OF ROCKS DESCRIBED BY MCCARTHY, 1963)

Major rock types	Subdivisions and associates	Structure and texture	Mineral assemblages	Accessory minerals	Deformation and recrystallization	Distribution
MAWSON CHARNOCKITE	Porphyroblastic charnockite	Uniform, poorly foliated, coarse	Hypersthene-quartz-(andesine, labradorite)-orthoclase. Garnet, biotite in Robinson Gp, hornblende in Framnes Mts	Opaques, apatite, zircon	Sheared; plagioclase and hypersthene deformed; some orthoclase, plagioclase, and biotite recrystallized	Framnes Mts, E & W Robinson Gp, E Holme B, Ufs I
	Even-grained charnockite	Uniform, well foliated, coarse to medium	Hypersthene-quartz-orthoclase- (andesine, labradorite). Garnet, biotite in Robinson Gp	Opaques, apatite, zircon	Sheared; plagioclase and hypersthene deformed; recrystallization of feldspar locally	S Framnes Mts, central Robinson Gp, Rookery Is to Byrd Hd
	Mylonitic rock	Massive, microcrystalline	Hypersthene-quartz-feldspar	Opaques locally abundant	Intensely sheared, granulated	Framnes Mts, Holme B, Taylor Gl
	Recrystallized mylonitic rock	Some banded, very fine	Biotite-quartz-feldspar, orthoclase porphyroblasts	Opaques	Recrystallized	Mainly Robinson Gp
	Garnet-quartz-feldspar rock	Foliated, fine to very coarse	Biotite-garnet-quartz-(andesine, labradorite)-orthoclase. Garnet-quartz	Opaques, apatite. Rarely graphite, rutile, sphene, spinel, monazite	Sheared in Holme Bay	Robinson Gp to Byrd Hd
	Fine-grained granulitic rock	Massive, fine; a few ophitic	Hypersthene-quartz-orthoclase- (labradorite, bytownite); many with biotite, some with garnet, some with clinopyroxene	Opaques, apatite, zircon; sphene in some	Little deformed	Holme Bay, Robinson Gp, Stanton Gp
	Metallic sulphides	Massive	Chalcopyrite-marcasite-pyrrhotite	Molybdenite	Occupies a shear	Entrance I
PAINTED GNEISS	Garnet-quartz-feldspar gneiss	Generally foliated, very coarse to fine	Garnet- (andesine, labradorite)-quartz-orthoclase. Minor biotite in most, hornblende in a few, microcline in one	Opaques, apatite, zircon, rutile, sphene, spinel	Sheared in places; folded at Painted Peak	N. Framnes Mts, Robinson Gp, Holme B

	Biotite-quartz-feldspar gneiss	Well foliated, medium to fine	Biotite-quartz- (oligoclase to bytownite), with hypersthene, clinopyroxene, hornblende, garnet; rarely sillimanite, spinel, or andalusite	Apatite, zircon, opaques, sillimanite in a few	Some sheared before biotite crystallized. Folded in places	Common in Holme B, N Framnes Mts. Scattered in Robinson Gp
	Quartz-feldspar rock	Massive, coarse	Andesine-quartz-orthoclase	Hypersthene	Sheared, blue strained quartz	Painted Peak
	Calcareous rock	Massive to banded, medium to coarse	Muscovite-diopside-calcite, graphite-dolomite-sillimanite	Magnetite, pyrite, wollastonite(?)	None evident	N Framnes Mts
	Scapolite-clinopyroxene-bearing rock	Well banded, fine to coarse	Scapolite- (diopside or augite)-(andesine to bytownite); quartz rare, potash feldspar minor; wollastonite(?) vesuvianite, calcite reported	Sphene, opaques, zoisite(?) in one	Plagioclase recrystallized to scapolite. No scapolite at Mt Elliott	N Framnes Mts, Holme B
	Dolerite	Relic ophitic, poorly foliated, medium	augite(?)-hypersthene-(andesine to bytownite), minor quartz, biotite; hornblende in one	Opaques, apatite, rare zircon and rutile(?)	Sheared	N Frames Mts, Robinson Gp
COLBECK GNEISS	Garnet-biotite-bearing gneiss	Well foliated, medium to coarse. Migmatite locally	Garnet-biotite-quartz-orthoclase-(andesine, labradorite)	Opaques, apatite, zircon	Tightly folded; sheared in places; migmatitic	Chapman Ridge to E side Taylor Gl, Stanton Gp
	Sillimanite-bearing gneiss	Well foliated, medium to coarse	Sillimanite-cordierite-garnet-quartz-orthoclase. Some oligoclase, andesine, or microcline(?)	Opaques, zircon biotite; one has spinel and sphene	Sheared in places	W side Taylor Gl to Campbell Hd, near Norris I, Stanton Gp, Low Tongue
	Clinopyroxene-bearing rock	Massive, fine	Sphene-quartz-augite-(labradorite, bytownite)	Zircon	Sheared	Near Norris I
	Granite	Massive to foliated, coarse	Garnet-biotite-andesine-quartz-orthoclase, some microcline(?)	Sphene, apatite, zircon, opaques	Sheared in places; migmatitic	Norris I to C Bruce

Major rock types	Subdivisions and associates	Structure and texture	Mineral assemblages	Accessory minerals	Deformation and recrystallization	Distribution
	Banded gneiss	Foliated, medium to coarse	Light garnet-quartz-feldspar bands, dark garnet-biotite-hypersthene-quartz-feldspar bands		Folded	W side Taylor Gl
	Mylonitic rock	Microgranular	Granular quartz and feldspar. Hypersthene in one	Opaques	Patchy recrystallization	Byrd Hd to Campbell Hd
STILLWELL GNEISS	Hypersthene-bearing light bands	Foliated, coarse	Hornblende-hypersthene-andesine-quartz-orthoclase. Minor biotite, garnet in places	Opaques, apatite, zircon	Sheared or folded in places. Some hornblende, orthoclase, and biotite crystallized post-shearing	Hobbs Is to Hoseason Gl
	Biotite-garnet-bearing light bands	Foliated, coarse	Biotite-garnet-quartz-orthoclase (andesine in some); minor hornblende, hypersthene common in places	Opaques, apatite, zircon; rarely rutile, spinel	Plagioclase deformed in some. Tightly folded in places	Hoseason Gl to Edward VIII Gulf; Tilley Ntk
	Sillimanite-bearing light bands	Foliated, coarse	Sillimanite-garnet-orthoclase-quartz-andesine. Hypersthene-sillimanite-biotite-garnet-quartz-orthoclase	Opaques, zircon, spinel	Tightly folded in places	Tilley Ntk, Hobbs Is
	Scapolite-bearing light band	Massive, coarse	Biotite-scapolite-andesine-quartz	Opaques, sphene	Scapolite replaces andesine	W Shaula I
	Scapolite-bearing dark band	Massive, coarse	Scapolite-andesine-(augite or diopside)-hypersthene	Hornblende, biotite	As above; accessories replace pyroxene	Tilley Ntk
	Andesine-labradorite-bearing dark bands	Massive, medium	(Diopside or augite)-hypersthene-hornblende-(andesine, labradorite); some with biotite and garnet	Opaques, apatite, zircon	Sheared or folded in places. Some hornblende replaces pyroxene	Tilley Ntk to Edward VIII Gulf

	Orthoclase-quartz-bearing dark bands	Massive to foliated and migmatitic	Hypersthene-biotite-garnet-(andesine, labradorite)-quartz-orthoclase; hornblende in some	Opaques, apatite, zircon	Migmatitic in Law Is; some garnet replaces hypersthene; some plagioclase recrystallized	W Law Is, Tilley Ntk
	Mafic-rich, bytownite-bearing dark bands	Massive to finely banded, coarse to fine	Hypersthene-(diopside or augite)-hornblende-bytownite; biotite locally common. Biotite-pargasite-bytownite. Clinopyroxene-hypersthene-hornblende-bytownite-garnet. One is biotite-orthoclase-quartz-labradorite-hypersthene-garnet	Opaques, apatite, spinel, rutile; metallic sulphides or oxides in some	Pyroxene replaces hornblende in some	Near Fold I, Crooked I, near Shark I, Shaula I, Kloa Pt
	Migmatitic light bands	Foliated, coarse	Biotite-garnet-orthoclase-(andesine, labradorite)-quartz		Disrupt and permeate dark bands	Law Is, islands near Mule Pt
PEGMATITE		Massive to foliated banded, very coarse	Biotite-garnet-quartz-(andesine, labradorite-orthoclase). Quartz-microcline. Quartz-orthoclase	Opaques, apatite, zircon, xenotime(?), ilmenite, titan-hematite, allanite(?) in one	Some foliated, otherwise not deformed	Robinson Gp to Edward VIII Gulf
BASIC DYKES		Poorly foliated, medium	Clinopyroxene-hypersthene-hornblende-labradorite or andesine; biotite, quartz, or garnet in some	Opaques, apatite, zircon	Some sheared and deformed. All recrystallized	Havstein I to Edward VIII Gulf; Mawson

The charnockite is typically a dark brown medium-grained to coarse-grained hypersthene-quartz-feldspar rock with a foliation produced by the parallel alignment of stringers and small lenses of light or dark minerals, and alignment of porphyroblasts where present. It has been metamorphosed under the conditions of the hornblende-granulite subfacies of the granulite facies of metamorphism, as defined by Turner & Verhoogen (1960). It crops out within an area of at least 2000 square kilometres, the bulk of which is covered by ice. The thickness of the charnockite is unknown.

Radiometric ages obtained from the charnockite and its inclusions at Mawson range from 490 to 655 m.y. (Ravich & Krylov, 1964).

The rock contains bodies, up to 1000 metres thick, of the Painted Gneiss, and is interbanded with the Colbeck Gneiss. Crohn (1959) records that it intrudes members of the Colbeck Gneiss.

The Mawson Charnockite includes the Mawson Granite and the charnockitic granular gneiss of Crohn (1959). It has been renamed because the bulk of the charnockite has the composition of granodiorite or adamellite, and granite is rare, and because the name identifies the rock more accurately than the less specific names granite and gneiss.

The name charnockite is used here in the sense in which Holland (1900) used the name 'charnockite series', for 'great masses of rock whose two leading characteristics are a granulitic structure and the invariable presence of a rhombic pyroxene among the constituents'. Thus some of the light bands in the Stillwell Gneiss, which crops out west of the Scoble Glacier, have the composition of charnockite, but they are not great masses of rock and are therefore not named charnockite.

The field characteristics of the Mawson Charnockite have been described in detail by Crohn (1959) and McLeod et al. (1966). Its essential minerals are hypersthene, quartz, and feldspar; the feldspar commonly includes both orthoclase and andesine or labradorite. Garnet and biotite are common in places, and hornblende is present in a few specimens. Zircon, apatite, and opaque minerals are common accessories.

McLeod et al. (1966) subdivided the Mawson Charnockite, for the purpose of mapping, into porphyroblastic charnockite, with common large feldspar porphyroblasts, and even-grained charnockite, without porphyroblasts. The two types have a fairly well defined geographical distribution. Porphyroblastic charnockite forms most of the exposures in the northern part of the Framnes Mountains, in the islands within 15 kilometres of Mawson, and in the western part of the Robinson Group. Even-grained charnockite (the charnockitic granular gneiss of Crohn, 1959) forms most of the eastern part of the Robinson Group and the islands west of and including the Rookery Islands. Ufs Island and the Einstoding Islands are isolated masses of porphyroblastic charnockite.

In most of the porphyroblastic charnockite from the Robinson Group, perthitic orthoclase alone forms the porphyroblasts. In the specimens from Holme Bay and the Framnes Mountains, plagioclase, generally andesine, forms the porphyroblasts in some and orthoclase forms the porphyroblasts in others. At a few localities, notably at Ufs Island and the Einstoding Islands, both orthoclase and plagioclase form porphyroblasts in the same rock.

Plagioclase is almost everywhere dominant in the groundmass of the porphyroblastic charnockite. It is generally the more abundant feldspar in the even-grained charnockite and in a few places it is the only feldspar.

Where soda and potash feldspars occur together, the plagioclase crystals are invariably deformed and broken, and the orthoclase is little deformed. In many of the sheared rocks, small crystals of orthoclase have grown after the shearing. The orthoclase porphyroblasts commonly include small crystals of plagioclase.

McCarthy & Trail (1964) subdivided the charnockite according to its feldspar content into intermediate charnockite, in which the proportion of potash feldspar and plagioclase is approximately equal, and basic charnockite, in which plagioclase exceeds potash feldspar. These types have no regular geographical distribution. The intermediate charnockite is generally associated with small lenses and dykes of granite pegmatite and commonly contains a second, undeformed generation of quartz and feldspar with biotite in places. It is commonly porphyroblastic charnockite, in which the porphyroblasts are orthoclase, and it appears to represent basic charnockite to which potash and silica have been added by metasomatic processes.

Quartz is abundant in all the charnockites. It is commonly strained and granulated, but in many of the intermediate charnockites a second generation of unstrained quartz is present. Most of the quartz is equigranular with the feldspar of the matrix.

Hypersthene forms up to 25 percent of the basic charnockite, and up to 15 percent of the intermediate type, but in many places, particularly in the Robinson Group and the Rookery Islands, the hypersthene is relatively minor and is accompanied by equal or greater amounts of garnet and biotite. In most of the rocks, the garnet and biotite appear to have been formed at least partly by the alteration of hypersthene. In almost every specimen the hypersthene crystals are deformed or broken by shearing; the hypersthene grains are generally smaller than the quartz and feldspar of the groundmass.

Garnet, and smaller quantities of biotite, are common almost everywhere in the Robinson Group, and in many places in the Rookery Islands and in the islands and coastal exposures between Ufs Island and Byrd Head. Garnet is rare in the charnockite in the Framnes Mountains.

Biotite, unaccompanied by garnet, is common at Gibbney Island, the Stanton Group, and the islands in Allison Bay. It is generally closely associated with deformed hypersthene.

A little hornblende is generally present in the charnockite in the Framnes Mountains, in association with biotite and hypersthene. A little hornblende also occurs in the Rookery Islands, at Einstoding Island, and at Ufs Island; it is associated with biotite, and is accompanied by stringers of garnet in some exposures. Hornblende is absent from the charnockite in the Robinson Group.

Clinopyroxene, probably diopside, is present in addition to hypersthene in one specimen of charnockite from the Robinson Group, and in one specimen from the North Masson Range.

The rock from a small island 500 metres north of the north end of Ufs Island closely resembles the porphyroblastic charnockite in colour and texture. It is composed of plagioclase, orthoclase, and quartz, with minor biotite and garnet, but contains no hypersthene.

The common accessory minerals in both the porphyroblastic and equigranular charnockite are opaque minerals, apatite, and zircon.

Mylonitic rock

Black very fine-grained mylonitic rock forms seams up to a few millimetres thick in most of the charnockite exposures. The seams commonly have no preferred trend, and curve or branch in a haphazard fashion. In a few exposures, bands of granulated charnockite several centimetres thick are separated by parallel seams of mylonitic rock up to a few centimetres thick.

The mylonitic rocks in the Framnes Mountains are generally composed of porphyroclasts of feldspar and hypersthene, or of sheared charnockite, set in a granular microcrystalline matrix of feldspar, quartz, and hypersthene. Stringers of opaque minerals, with a marked preferred orientation, are common in the mylonitic rocks. At Mount Elliott, augen gneiss composed of large feldspar porphyroblasts in a matrix of black mylonitic rock forms a considerable proportion of the charnockite. Recrystallized mylonitic rocks are rare in the Framnes Mountains.

All the specimens of the mylonitic rocks from the Robinson Group are partly recrystallized and are composed of a fine-grained matrix of quartz, feldspar, and biotite, containing porphyroclasts which are predominantly orthoclase; plagioclase, hypersthene, and garnet form porphyroclasts also. The feldspar of the matrix is predominantly orthoclase, with minor plagioclase. The lenticles of quartz and biotite have a common orientation in these rocks and, as McCarthy (1963) reports, have probably recrystallized under stress after the shearing which produced the mylonitic rock.

In the easternmost island of the Robinson Group, there is a lens 20 metres long in the charnockite; it is composed of bands of mylonitic rock up to 1 metre thick alternating with bands of sheared charnockite up to 4 metres. Both types of band are cut by irregular bodies of biotite-garnet-quartz-feldspar pegmatite.

Garnet-quartz-feldspar rock

The charnockite in the Robinson Group contains many lenses up to a few metres thick of garnet-quartz-feldspar rock, which commonly contains biotite. Thicker, sheared lenses and bands, up to 100 metres across, were noted on several islands in Holme Bay. Small bodies and a few thick bands of this rock are also common on the coast between Howard Bay and Byrd Head. The small bodies of garnet-quartz-feldspar rock in the Framnes Mountains generally occur near outcrops of the Painted Gneiss and are described with it, below.

The garnet-quartz-feldspar rock is commonly composed of bands with different textures, ranging from fine-grained to very coarse-grained, and with a foliation produced by stringers of garnet. On Thorgaut Island, a dyke of massive pegmatitic rock grades along strike into well foliated and banded garnet-quartz-feldspar gneiss, which is broadly concordant with the foliation in the surrounding charnockite.

The feldspars consist of orthoclase and andesine or labradorite; orthoclase predominates in most of the specimens examined, and encloses small crystals of plagioclase. In the Robinson Group, both types of feldspar form porphyroblasts, which in places are broken, strained, and altered. Quartz is abundant in all these rocks, and is commonly a distinctive blue colour. The garnet is generally associated with a little biotite, and is commonly fractured. Opaque minerals and apatite are common accessories; one specimen from the Robinson Group contains 3 percent apatite. A few lenses of these rocks, in the Robinson Group and Holme Bay, contain accessory graphite. Other rare accessories are rutile, sphene, and spinel. Crohn (1959) records monazite in one body in the Robinson Group.

Some of the larger lenses of garnet-quartz-feldspar rock contain bands of garnet quartzite up to 1 metre thick.

Fine-grained granulitic rock

Lenses of dark fine-grained granulitic rocks, up to 1 metre thick, are common in the charnockite in a few islands in the Robinson Group, and in the charnockite within a few kilometres of Mawson and in the Stanton Group. They also occur on Einstoding Island. In places in the Stanton Group, bands of charnockite up to several centimetres thick alternate with bands of dark granular rock of similar thickness, and together they form a rock type which resembles closely the Stillwell Gneiss, described below.

Many of the dark granulitic rocks, particularly in the vicinity of Mawson, are composed of hypersthene, quartz, orthoclase, and plagioclase; they are essentially charnockite but differ strikingly from the surrounding charnockite in that they are massive and fine-grained.

Specimens of the lenses in the Stanton Group and Robinson Group contain clino-pyroxene in addition to hypersthene. In one specimen from the Robinson Group, some of the pyroxene is ophitic and McCarthy has named the rock a norite. In all the specimens from both groups, plagioclase predominates over orthoclase, and it is notably calcic, generally labradorite or bytownite. Biotite is abundant in many of the lenses and is accompanied by garnet in a few; opaque minerals are abundant accessories. In addition to apatite and zircon, sphene is an accessory mineral in some lenses.

Metallic sulphides

A small lens a few metres long in charnockite at Entrance Island, 1 kilometre north of Mawson, is composed of marcasite, pyrrhotite, chalcopyrite, and minor molybdenite. It appears to occupy a shear zone, and has been fully described by McLeod et al. (1966).

PAINTED GNEISS (new name)

The Painted Gneiss is here defined as the gneiss which forms several bodies, up to several hundred metres thick, within the Mawson charnockite of the Framnes Mountains, in Mac.Robertson Land. The known exposures of the Painted Gneiss occur from Mount Henderson (lat. 67°42′S., long. 63°00′E.) to the Casey Range (lat. 67°45′S., long. 62°15′E.) and to Mount Hordern (lat. 67°55′S., long. 62°30′E.).

The name is derived from Painted Peak (lat. 67°45′S., long. 62°50′E.) in the Framnes Mountains, which is formed by one of the largest bodies of this gneiss. Painted Peak is designated as the type area.

The Painted Gneiss is a heterogeneous unit, but is predominantly composed of garnet-quartz-feldspar gneiss, with a considerable amount of biotite-quartz-feldspar gneiss and minor quantities of scapolite-clinopyroxene-feldspar gneiss, calcareous rocks, and doleritic rocks. It has been metamorphosed under the conditions of the hornblende-granulite subfacies of the granulite facies of metamorphism, as defined by Turner & Verhoogen (1960).

The thickness of the gneiss at Painted Peak is about 300 metres, but the section may have been partly duplicated by folding. The age of the gneiss is not known. It is at least as old as the Mawson Charnockite, and is almost certainly Precambrian.

The Painted Gneiss is entirely enclosed by the Mawson Charnockite. The garnet-bearing and biotite-bearing members of the Painted Gneiss are closely similar to the garnet-bearing and biotite-bearing members of the Colbeck Gneiss.

The gneiss has no synonyms. Several of the exposures were described but not named by Crohn (1959).

Garnet-quartz-feldspar gneiss

The most common rock type in the Painted Gneiss is garnet-quartz-feldspar gneiss, which predominates in the gneissic bodies at Mount Henderson, at two localities in the North Masson Range, and at another three in the David Range. The feldspar is predominantly perthitic orthoclase, and any porphyroblasts present are also perthitic orthoclase. A little andesine or labradorite is commonly present. Some microcline is present in the gneiss at Gap Nunatak. Quartz is abundant in the gneiss and is strained in places. At Painted Peak, the gneiss contains veins, up to a few centimetres thick, of coarse brecciated quartz with a distinctive blue colour.

Garnet commonly forms only a few percent of the rock, and in places it is associated with or is partly altered to biotite. In a few specimens it is associated with small quantities of hornblende. The accessory minerals include zircon, apatite, opaque minerals, sphene, rutile and spinel.

The garnet-quartz-feldspar gneiss forms bands up to 100 metres thick. The bands commonly have a banded texture, and contain bands of garnet quartzite up to a few metres thick. The gneiss is generally well foliated by the parallel orientation of stringers of garnet and lenticles of quartz and feldspar.

Biotite-quartz-feldspar gneiss

At Painted Peak, Mount Elliott, and Mount Hordern, the bands of garnet-quartz-feldspar gneiss alternate with bands, up to 20 metres thick, of ironstained biotite-quartz-feldspar gneiss. In the few specimens of biotite-quartz-feldspar gneiss obtained, plagioclase, in the range oligoclase to bytownite, is the only feldspar present. Biotite is generally much more abundant than the proportion of garnet in the adjacent garnet-quartz-feldspar gneiss; in some bands, biotite forms up to 60 percent of the rock. At Mount Hordern, the biotite is closely associated with pale brown hornblende, hypersthene, and augite(?). McCarthy (1963) suggests that the biotite and the hornblende have been partly converted to pyroxene.

Similar biotite-bearing gneiss forms lenses, tens of metres in length, in the charnockite forming the bulk of the North Masson Range, within a few hundred metres of the main gneiss body at Painted Peak. One lens is a quartz-andalusite-oligoclase-biotite rock; McCarthy suggests that the andalusite has been formed from the biotite. Another is a spinel-garnet-labradorite-biotite rock with small inclusions of sillimanite(?) in the biotite. Associated with these biotite-bearing lenses, and included in them in places, are lenses of similar size composed of bytownite, clinopyroxene, and sphene.

Trost Peak, in the South Masson Range, is composed of biotite-rich gneiss interfolded with pyroxene-bearing quartzite. The gneiss consists mainly of biotite, orthoclase, and bytownite, with some hypersthene and quartz. The biotite is probably annite and is intimately associated with small crystals of sillimanite and spinel. The quartzite is 95 percent quartz and contains diopside and hypersthene associated with a little bytownite, biotite, and sphene.

Scapolite-clinopyroxene-feldspar gneiss

Scapolite-clinopyroxene-bytownite gneiss forms bands up to 50 centimetres thick within the garnet-quartz-feldspar gneiss at Painted Peak; the bands are linked in places by very coarse-grained massive veins, also composed of scapolite, clinopyroxene and feldspar, which cut sharply across the intervening garnet-quartz-feldspar gneiss.

The scapolite-clinopyroxene-bytownite gneiss is itself composed of bands, up to a few centimetres thick, of pyroxene-rich material alternating with bands of similar thickness rich in bytownite and scapolite.

The scapolite has been formed by alteration of the bytownite. In one specimen scapolite predominates and only small relics of bytownite persist. The pyroxene is diopside in one specimen, and is probably augite in the rest. Sphene is an abundant accessory in this gneiss; one of the specimens contains a little quartz.

Scapolite-pyroxene-feldspar gneiss forms grey bands, at least a few metres thick, in a geologically little-known body of gneiss forming Phillips Ridge. It is composed of andesine, clinopyroxene (probably augite), and scapolite in close association with sphene. Opaque minerals are common, and a little zoisite(?) is also present.

Similar sphene-scapolite-diopside-bytownite rocks have been described by Bayly (*in* Roberts, 1961), from samples collected by Stinear in 1954 in Holme Bay near Mawson, where they form small lenses in the charnockite. One of the specimens from Mawson contains wollastonite(?); another contains scapolite, calcite, vesuvianite and 50 percent diopside.

The clinopyroxene-feldspar gneiss at Mount Elliott in the David Range is composed of thin black and white bands and is closely similar in texture to the scapolite-bearing rocks described above. It forms a band a few metres thick in brecciated charnockite within several metres of the contact of a body of Painted Gneiss at least 500 metres thick. Scapolite is absent from this banded gneiss, which is composed of clear grains of bytownite and cloudy grains of antiperthite, with diopsidic augite (about 30%), and a little sphene, and apatite.

Calcareous rock

The calcareous rocks in the Painted Gneiss are represented by an illdefined body of marble at Painted Peak and by bands of dolomite-sillimanite schist at Phillips Ridge.

The marble is composed of muscovite, diopside, and calcite, and appears to form a pod, a few metres thick, near the boundary of the Painted Gneiss with the charnockite, on the south side of Painted Peak.

The dolomite-sillimanite schist forms bands, several metres thick, alternating with bands of scapolite-clinopyroxene-feldspar gneiss, and of other gneisses which were not examined, at Phillips Ridge. The schist contains a few percent of graphite, and accessory magnetite, pyrite, and wollastonite(?).

Quartz-feldspar rock

Massive quartz-feldspar rock occupies at least part of the southern boundary of the gneissic body forming Painted Peak. The rock is intensely sheared; the quartz is strained and has a distinctive blue colour. Most of the feldspar is perthitic orthoclase; the rest is antiperthitic andesine. Angular or embayed grains of hypersthene are scattered through the rock.

Similar rocks form small concordant lenses up to a few metres long, in the Mawson Charnockite in various places.

Dolerite

Metamorphosed doleritic rocks form three massive dark concordant lenses within the Painted Gneiss at Painted Peak, near the contacts with the charnockite. The lenses are composed of plagioclase in the range andesine to bytownite, hypersthene, and a clinopyroxene which is probably augite. One specimen also contains abundant hornblende; small quantities of quartz and biotite occur in the others. All three have traces of an ophitic texture, though the rocks have probably been recrystallized. The accessories are opaque minerals and apatite; zircon occurs in one, and rutile(?) in another.

Specimens of a basic dyke cutting the charnockite at Entrance Island, near Mawson, and a basic charnockite from the Robinson Group and a dark lens in it, all resemble closely the doleritic rocks of Painted Peak.

Boundaries

On the north side of Painted Peak, the contact of the Painted Gneiss with the Mawson Charnockite (Fig. 2a) grades over about 100 metres from light grey garnet-quartz-feldspar gneiss through a light grey quartz-feldspar rock with only scattered crystals of dark mineral into yellow-brown even-grained charnockite. A concordant foliation runs through all the rocks. There is a similar type of gradational boundary between the garnet-quartz-feldspar gneiss of the Painted Gneiss and the Mawson Charnockite at Mount Henderson and Gap Nunatak.

The southern boundary of the gneiss at Painted Peak is poorly exposed and appears to be occupied by blue quartz-feldspar rocks which are intensely sheared. A band of charnockite, about 100 metres thick, occurs within the Painted Gneiss

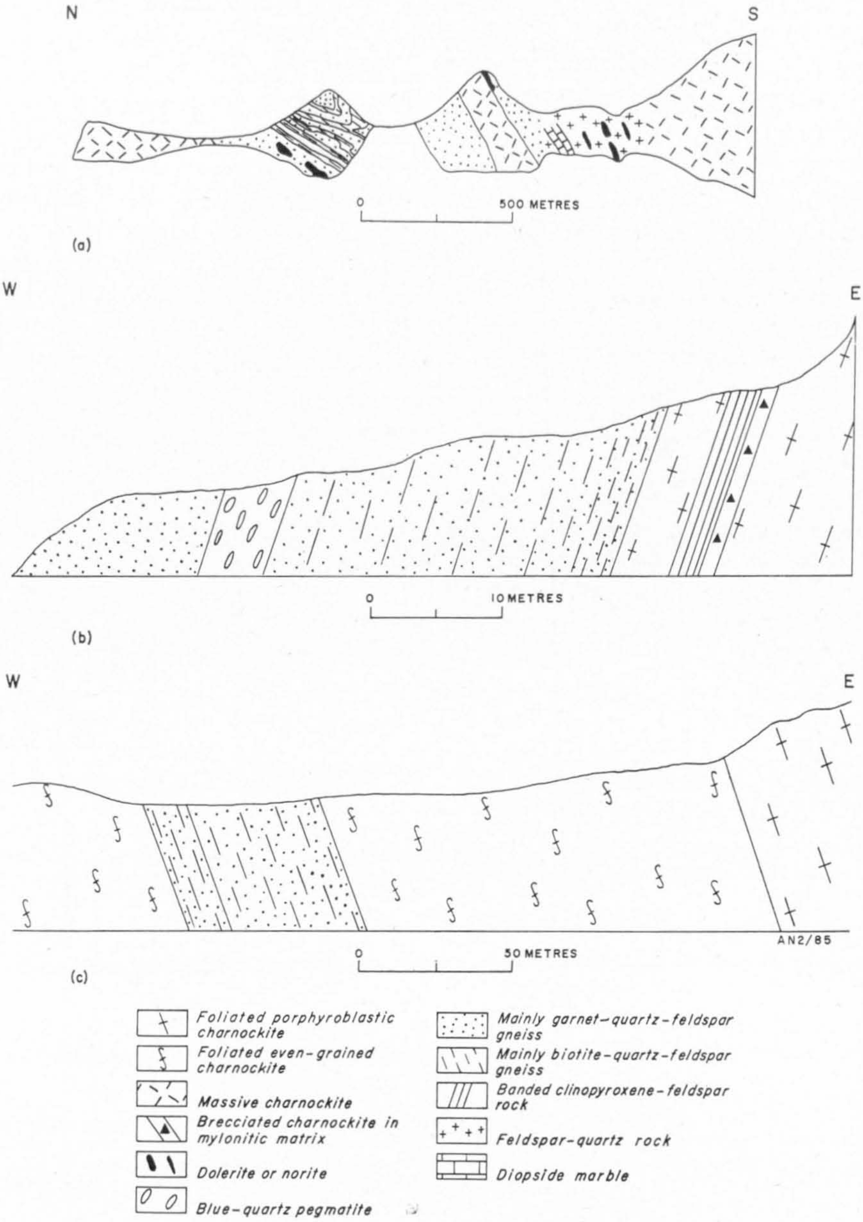

Fig. 2.

(a) Diagrammatic section of north end of North Masson Range

(b) Diagrammatic section of contact of gneiss body with charnockite at Mount Elliott

(c) Diagrammatic section of gneiss body on west side of Mount Hordern

about 400 metres from the southern boundary. At the contact of this band with the gneiss, bands of even-grained charnockite alternate with bands of garnet-quartz-feldspar gneiss and with bands of biotite-quartz-feldspar gneiss. All the bands are several centimetres thick.

The gneissic body is overlain and underlain by charnockite, dipping at 40° to 70°, but the structure of the body suggests that it occupies a synform, and may have been folded into the charnockite.

The body of gneiss on the west side of Mount Elliott is in contact with sheared charnockite and augen gneiss (Fig. 2b). The contact is sharply defined by a narrow zone of breccia, composed of angular fragments of charnockite in a matrix of black mylonitic rock, adjoining banded clinopyroxene-feldspar gneiss which does not appear to be deformed. Biotite-quartz-feldspar gneiss forms abundant bands and lenses in the predominant garnet-quartz-feldspar gneiss near the contact, but it diminishes in abundance away from the contact.

Biotite-quartz-feldspar gneiss is also abundant near the contact of the garnet-quartz-feldspar gneiss with the Mawson Charnockite on the west side of Mount Hordern (Fig. 2c), and is also less abundant in the central part of the gneissic body.

The contact of the body of garnet-quartz-feldspar gneiss with charnockite at the southwest end of the North Masson Range has an intrusive appearance. It is sharp, and within a few metres of the contact the gneiss contains blocks of charnockite up to a metre across; angular promontories of the gneiss project a few centimetres into the charnockite. Bands of biotite-rich gneiss, several centimetres thick, are again abundant in the gneiss near the contact.

The little-known gneissic body at Phillips Ridge dips at about 30° beneath the charnockite forming the adjacent Ferguson Peak. The contact has not been visited.

COLBECK GNEISS (new name)

The Colbeck Gneiss is here defined as the gneiss which forms the coast of Mac.-Robertson Land between the Colbeck Archipelago (lat. 67°25′S., long. 61°01′E.) and Campbell Head (lat. 67°25′S., long. 60°39′E.). It also forms a few bodies, up to 100 metres thick, within the Mawson Charnockite in the Stanton Group, and the isolated islets of Low Tongue and Tongue Rock.

The name is derived from the Colbeck Archipelago, which is predominantly formed by this gneiss. The type area comprises the exposures on the east and on the west sides of Taylor Glacier.

Garnet-biotite-quartz-feldspar gneiss crops out east of Taylor Glacier, and sillimanite-cordierite-garnet-quartz-feldspar gneiss is exposed west of Taylor Glacier and at the Stanton Group and Low Tongue. The outcrops also contain bodies of red granite up to 100 metres long.

The Colbeck Gneiss has been metamorphosed under the conditions of the hornblende-granulite subfacies of the granulite facies or of the sillimanite-almandine subfacies of the amphibolite facies (Turner & Verhoogen, 1960).

The thickness of the gneiss is unknown, as it is intensely contorted and deformed. It covers an area in excess of 50 square kilometres.

The age of the Colbeck Gneiss is unknown. It appears to be interbanded with the Mawson Charnockite south of the Colbeck Archipelago, but Crohn (1959) has described exposures in which the charnockite intrudes this gneiss. It is at least as old as the charnockite, and is almost certainly Precambrian. It probably has a gradational contact with the Stillwell Gneiss, which forms the coast 25 kilometres west of Campbell Head, on the west side of the broad Scoble Glacier.

Many of the rocks in the Painted Gneiss closely resemble the garnet-biotite-quartz-feldspar rocks in the Colbeck Gneiss east of Taylor Glacier. However, they are so widely separated that they have been named separately. The gneisses at Low Tongue and Nora Island which are included in the Colbeck Gneiss are identical with the cordierite-sillimanite-bearing rocks in the Colbeck Gneiss exposed west of Taylor Glacier.

The garnet-biotite-quartz-feldspar gneiss between Byrd Head and Taylor Glacier contains abundant orthoclase and plagioclase. The plagioclase is generally predominant, and ranges from andesine to labradorite. Quartz is also abundant and biotite and garnet are common. The gneiss is sheared and some of the orthoclase, quartz, and dark minerals have been recrystallized. The accessories are opaque minerals, apatite, and zircon.

Bands of quartzite, up to several metres in thickness, are common in the gneisses, and bodies of red granite, up to 100 metres long, are generally elongated parallel to the foliation of the gneisses. In many places where the foliation is intensely folded on a small scale, the granitic material has permeated the deformed gneiss, forming migmatite.

The relationships of gneiss, quartzite, and granite on a large scale are shown in the sketch map of Norris Island (Fig. 3). At Cape Bruce, dykes of fine-grained granitic rock, less than 1 metre thick, cut the foliation of the gneiss.

The coarse-grained granite is generally red, in contrast to the grey colour of the gneiss. It ranges from massive to well foliated and is predominantly composed of perthitic orthoclase, with microcline(?) in places. Quartz is abundant; andesine is prominent in a few specimens, but is generally subordinate. Garnet and biotite are also subordinate. Accessory minerals are scarce, but opaque minerals, zircon, apatite, and sphene occur in various specimens.

The sillimanite-cordierite-garnet-quartz-feldspar gneiss between Taylor Glacier and Campbell Head is composed predominantly of perthitic orthoclase, microcline(?), and abundant quartz. Oligoclase or andesine is common in places. Sillimanite, garnet, and cordierite may each form up to 5 percent of some of the rocks, but are rare in others. Biotite is generally accessory, as are opaque minerals and zircon; spinel and sphene occur in one specimen. The gneiss is commonly sheared.

Intensely sheared sillimanite-garnet-quartz-feldspar gneiss also forms one small island about 3 kilometres east of Taylor Glacier.

A body of distinctively banded gneiss similar to the Stillwell Gneiss was mapped by McLeod et al. (1966) for 2 kilometres southwards along the west side of Taylor Glacier. It is composed of light bands of garnet-quartz-feldspar gneiss alternating with dark bands of garnet-biotite-hypersthene-quartz-feldspar gneiss. Bands of both types range up to a metre in thickness. A typical light band is similar in appearance

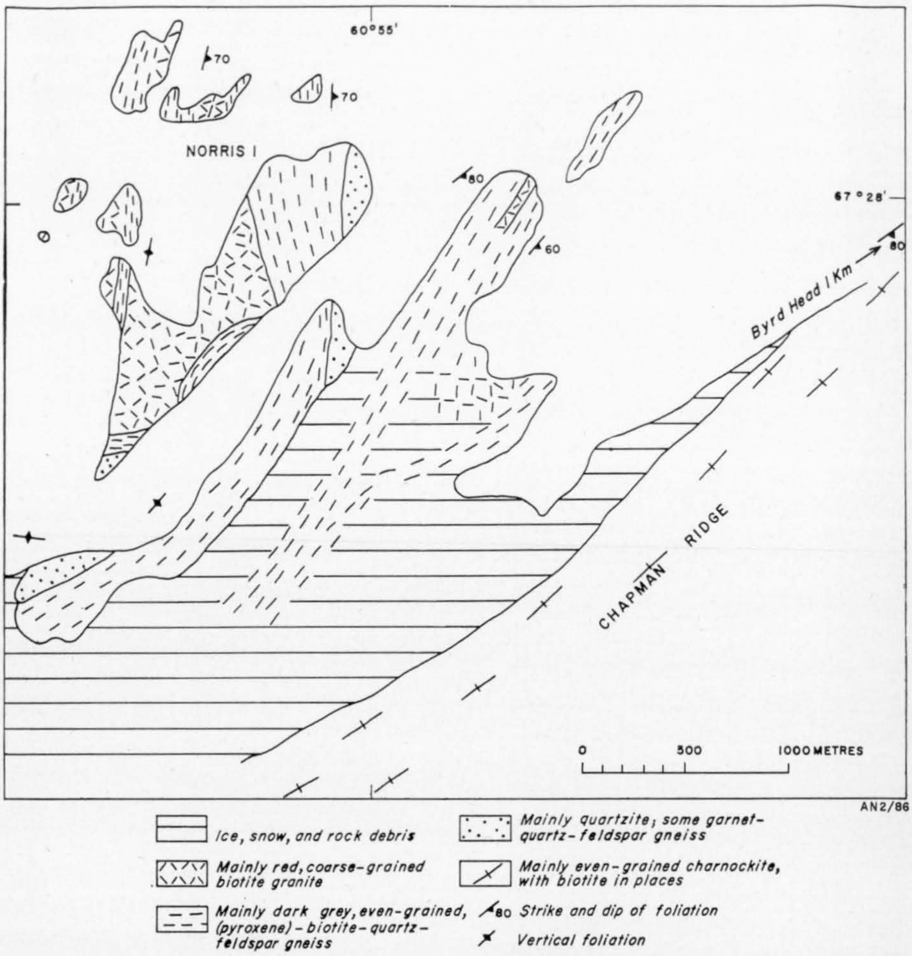

Fig. 3. Interpretative geological sketch map, Norris Island to Chapman Ridge

to garnet-quartz-feldspar gneisses of the Colbeck Gneiss on the east side of Taylor Glacier; it contains plagioclase and orthoclase in approximately equal proportions. In a typical dark band, plagioclase predominates and biotite, quartz, and hypersthene occur together in the darker parts of the rock. The biotite is closely associated with hypersthene and minor garnet.

On a small island 300 metres northwest of the west point of Norris Island (Fig. 3) irregular patches of a light green sphene-quartz-pyroxene-plagioclase rock occur within a seam of mylonitic rock about 1 metre thick. The plagioclase is labradorite or bytownite and the pyroxene is diopsidic augite; zircon is accessory.

Straight seams of mylonitic rock, commonly with a remarkably constant strike and ranging up to 3 metres in thickness, cut the foliation of the gneisses in many places between Byrd Head and Campbell Head. Some thick seams contain large blocks of gneiss. The mylonitic material is composed of finely granulated minerals present in the gneiss, though a specimen from Norris Island contains hypersthene, which is absent from the adjoining gneiss. Opaque minerals have recrystallized along lines of shearing in one of the mylonitic rocks; another, which contains patches of pegmatitic material, appears to have been at least partly recrystallized.

Much information on the boundary of the Colbeck Gneiss with the Mawson Charnockite has been obtained from Crohn (1959) and from McLeod et al. (1966). Between Ufs Island and Byrd Head, garnet-biotite-quartz-feldspar gneiss of the Colbeck Gneiss is interbanded on a large scale with charnockite. Crohn (1959) notes that charnockite forming ridges south and west of Byrd Head contains both hypersthene and biotite. At Byrd Head, the charnockite contains more biotite than hypersthene; Chapman Ridge, which extends southwestwards from Byrd Head, appears to be a band of biotite-bearing charnockite, a few hundred metres thick, which is the westernmost representative of the Mawson Charnockite.

The biotite-quartz-feldspar gneisses on Norris Island and on the mainland a few hundred metres west of Byrd Head are dark granular rocks which superficially resemble even-grained charnockite. Further west, near Taylor Glacier and in the central and western parts of the Colbeck Archipelago, the biotite-quartz-feldspar gneiss is commonly banded and has a varied texture and colour.

The boundary appears to be gradational through a zone in which Colbeck Gneiss is interbanded with Mawson Charnockite. Crohn (1959), however, has described contacts between charnockite and gneiss on Ufs Island which indicate that the charnockite intrudes the gneiss.

Stillwell Gneiss (new name)

The Stillwell Gneiss is here defined as the gneiss which forms the coast of Kemp Land from the Tilley Nunatak (lat. 67°24′S., long. 62°02′E.) to the head of Edward VIII Gulf and to the Jagar Islands (lat. 66°33′S., long. 57°15′E.) north of the Gulf.

The name is derived from the Stillwell Hills (lat. 67°25′S., long. 59°28′E.), where the gneiss is extensively exposed. The Stillwell Hills are designated the type area.

The gneiss is made up of light-coloured bands of quartz-feldspar gneiss alternating with dark bands of massive hornblende-pyroxene-plagioclase rock; both types of band range from a few centimetres to a few hundred metres in thickness. The Stillwell Gneiss has been metamorphosed under the conditions of the hornblende-granulite subfacies of the granulite facies, as defined by Turner & Verhoogen (1960).

The thickness is not known, but it probably exceeds 10,000 metres. Exposures are scattered over an area of 1000 square kilometres. Its age is Precambrian; Ravich & Krylov (1964) quote ages ranging from 620 to 535 m.y. for samples of migmatite and pegmatite taken within the outcrop of the Stillwell Gneiss in the Oygarden Group.

The Stillwell Gneiss appears to have a gradational contact with the Colbeck Gneiss, and with the unnamed quartz-feldspar gneiss near the head of Edward VIII Gulf (McLeod et al., 1966). It also contains bodies of charnockite up to a few hundred metres across, which appear to be conformable light-coloured bands, but which are closely similar to the Mawson Charnockite.

Around the Stillwell Hills, dark bands form up to 30 percent of the Stillwell Gneiss, and they are commonly less than 10 metres thick. West of Stefansson Bay, and particularly west of the Hoseason Glacier, the proportion of dark bands in many places ranges from about 5 to about 25 percent. Between Havstein Island and the head of Edward VIII Gulf, scattered dark bands up to 30 metres thick occur; these thick bands are also common in places on many large islands in the Oygarden Group, and at Kvars Promontory. A few of the thick dark bands cut across the foliation of the light bands and truncate thin dark bands; they appear to be metamorphosed basic sills. However, the bulk of the thick dark bands are concordant, and in texture and mineralogy are identical with the thinner dark bands. The distribution of the thick bands is similar to that of the basic dykes in the Stillwell Gneiss, described below, and they are possibly all metamorphosed minor intrusives.

The contacts between the light and dark bands are generally sharp, though gradations extending up to a few centimetres are common.

Light bands

The light bands in the Stillwell Gneiss consist essentially of medium-grained plagioclase-quartz-orthoclase gneiss with small quantities of dark minerals. The foliation is produced by the preferred alignment of lenticular masses of quartz and feldspar and of individual crystals of dark minerals.

The plagioclase ranges from oligoclase to labradorite; typically it is andesine. In a few of the light bands, orthoclase is the only feldspar present, and in a very few, plagioclase is the only feldspar. Quartz is abundant and forms over 50 percent of many of the light bands; in several places some of the light bands are quartzites.

Hornblende and hypersthene are the predominant dark minerals in the light bands between Scoble Glacier and Hoseason Glacier; small quantities of biotite and garnet also occur in most of the rocks.

Westwards from Hoseason Glacier to Edward VIII Gulf, biotite and, in particular, garnet increase in abundance in the light bands and hornblende and hypersthene decrease; plagioclase is absent from some bands. At Kvars Promontory, in Edward VIII Gulf, garnet is the predominant dark mineral in the light bands.

Clinopyroxene is rarely present in the light bands, though it occurs in most of the dark bands. The common accessory minerals of the light bands are opaque minerals, apatite, and zircon.

Sillimanite occurs in the garnet-bearing light bands at Hobbs Islands and at Tilley Nunatak, at the eastern limit of the Stillwell Gneiss; spinel is accessory in some of the bands. The exposures are separated only by the Scoble Glacier from the sillimanite-garnet-bearing gneisses forming Campbell Head, at the western limit of the Colbeck Gneiss.

Scapolite has been formed by the alteration of andesine in a sphene-bearing light band at the west end of Shaula Island. Rutile is accessory in a quartzite at the west end of Shaula Island and in a light band in the Crooked Islands. Spinel is accessory in a light band adjoining a magnetite-bearing dark band near the west of Shaula Island.

Dark bands

The dark bands of the Stillwell Gneiss are typically massive medium-grained granulitic clinopyroxene-hypersthene-hornblende-plagioclase rocks. The plagioclase is andesine or labradorite, and the clinopyroxene ranges from diopside to augite.

The common accessory minerals are opaque minerals, apatite, and zircon. Orthoclase predominates over plagioclase in a dark band at Tilley Nunatak.

Whereas in the light bands garnet and biotite increase in abundance westwards, in the dark bands the only change is that the garnet is probably more common west of Hoseason Glacier than to the east.

A concordant dark band, 10 metres thick, at Kvars Promontory contains towards one margin well defined aggregates of quartz and feldspar which resemble, in size and shape, vesicles in a lava flow. At the westernmost island of the Crooked Islands, a concordant dark band about 6 metres thick is composed of pillow-like masses up to 2 metres long by 1 metre thick, separated by selvedges of felsic material; the band closely resembles a pillow lava.

The differences between the discordant dark bands and the typical concordant dark bands are slight. At Kvars Promontory, a concordant dark band contains a little less dark mineral than the discordant band which cuts it, and is coarser. The discordant band contains relatively more pyroxene, and the concordant band more hornblende.

Atypical thin dark bands occur at various localities between Fold Island and the west end of the Oygarden Group. The bands are unusually rich in dark minerals, which form over 50 percent of some, and contain bytownite instead of the typical andesine or labradorite. They are generally less than 2 metres thick. In some exposures they are composed of thinner bands, up to a few centimetres thick, which are alternately rich in feldspar and dark minerals.

The atypical dark bands comprise bands rich in garnet and pyroxene, common on islands within a few kilometres of Fold Island, pargasite-bearing rocks at Crooked Islands and at Kloa Point, and garnet-rich rocks at Shark Island.

The pargasite-bearing rocks contain no clinopyroxene and little hypersthene. The amphibole pargasite, closely related to hornblende, constitutes almost all of the dark mineral. In the other atypical bands the minerals present are not very different from those which form the typical bands, but opaque minerals are generally abundant. Ilmenite, sphalerite, pyrite, and chalcopyrite occur in small quantities in these bands, and one band about 30 metres thick, at the northeast corner of Shaula Island, contains about 30 percent magnetite, concentrated in small lenses up to several centimetres long.

Migmatitic and other bands

The Stillwell Gneiss forming the western part of the Law Islands is predominantly composed of thick light bands of biotite-garnet-quartz-feldspar gneiss which invade and disrupt the dark bands. In many places parts of dark bands have been converted to migmatite composed of frayed-out bodies of dark material apparently permeated by the light material—the dark material contains quartz, and orthoclase is the predominant feldspar in it.

In these light bands quartz is abundant or predominant, and garnet and biotite are the only dark minerals observed; andesine or labradorite predominates over orthoclase. The dark bands are composed mainly of plagioclase, hornblende, and hypersthene, but here biotite, garnet, quartz, and orthoclase, which are typically rare or absent in dark bands of the Stillwell Gneiss, are not uncommon.

Light bands similar to those in the western part of the Law Islands occur on a few small islands between the west side of Broka Island and Mule Point, on the east side of Hoseason Glacier. Dark bands are thin and scattered on these islands, and textural and compositional varieties of light-coloured garnet-bearing and biotite-bearing quartzite and quartz-feldspar gneiss form the bulk of all the exposures.

At Mule Point, bands of massive white quartz, resembling reef quartz, occur in the Stillwell Gneiss; they range up to a few metres in thickness. A typical band contains only scattered crystals of feldspar and a few grains of zircon and opaque mineral, in addition to quartz. A few dark bands at Mule Point are composed almost entirely of hypersthene, with a little quartz and green hornblende.

Some of the light bands, up to several metres thick, of garnet-quartz-feldspar gneiss and garnet quartzite which crop out on islands between Fold Island and the Stillwell Hills are heavily stained by iron. In a few of the exposures patches of the bands up to a metre across are stained bright green by copper, but the proportion of chalcopyrite is well below 1 percent.

A large mass of this type of garnet-quartz-feldspar gneiss, which also contains sillimanite and graphite, forms Ives Tongue and adjacent small islands. This outcrop has been tentatively identified as Colbeck Gneiss by McLeod et al. (1966).

Boundaries

The boundary of the Stillwell Gneiss with the Colbeck Gneiss is concealed by the Scoble Glacier. The presence of a concordant body of hypersthene-bearing banded gneiss, similar to the Stillwell Gneiss, within the Colbeck Gneiss on the west side of Taylor Glacier, and the presence of sillimanite-bearing garnet-quartz-feldspar gneiss at Tilley Nunatak and Ives Tongue, within the Stillwell Gneiss, suggest that the boundary is gradational. The relationship of the sillimanite-bearing gneiss to the pyroxene-bearing banded gneiss is shown in Figure 4.

McLeod et al. (1966) note that the Stillwell Gneiss probably grades into the unnamed quartz-feldspar gneiss west of the head of Edward VIII Gulf.

Pegmatite Dykes

The pegmatites are generally very coarse-grained massive biotite-garnet-quartz-feldspar rocks. They form dykes, up to 10 metres thick, which cut sharply across the foliation of the country rock.

The pegmatite dykes are most abundant in the Stillwell Gneiss and the Colbeck Gneiss. They occur in the Mawson Charnockite mainly in the Robinson Group, on some islands in Holme Bay, and along the coast between Gibbney Island and Byrd Head. In all these formations and in the Painted Gneiss many of the very coarse-grained concordant lenses composed of biotite, garnet, quartz, and feldspar resemble pegmatites. They are not described with the pegmatite dykes, because most of them are foliated parallel to the foliation in the country rock, and they commonly grade into coarse-grained or medium-grained gneisses of similar composition in the Colbeck, Painted, and Stillwell Gneisses.

The pegmatite dykes are composed largely of quartz and feldspar, with a few percent of garnet and biotite. Most of them contain some orthoclase and some

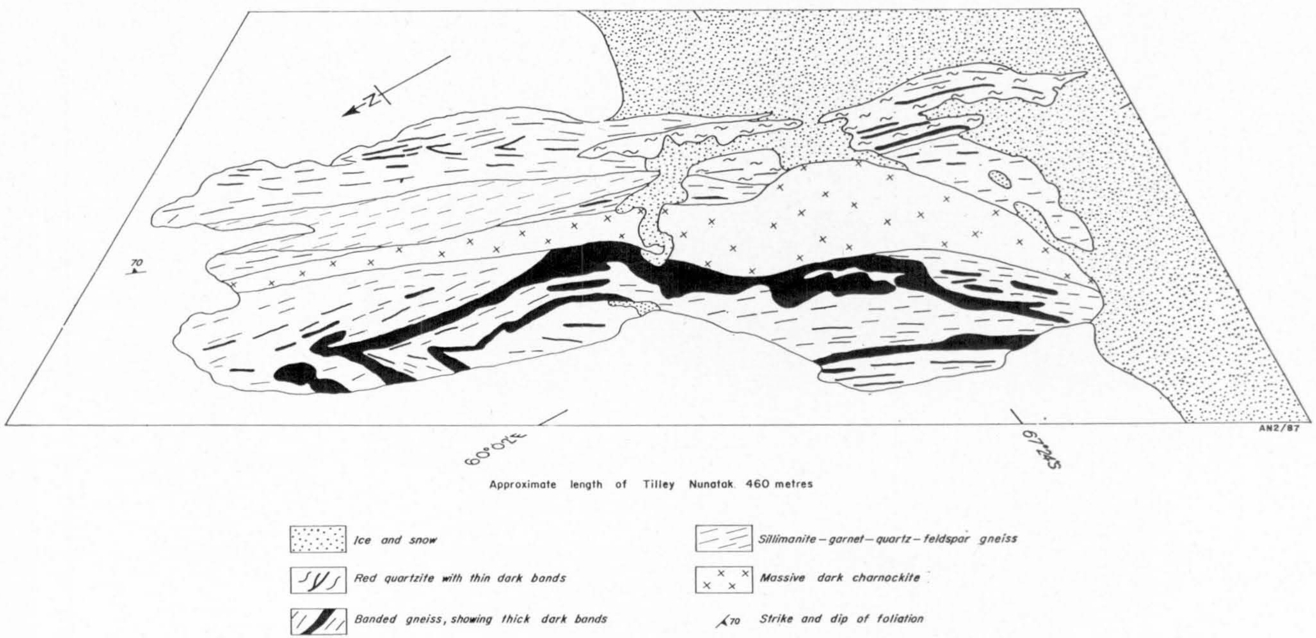

Fig. 4. Geological sketch of Tilley Nunatak (based on oblique air-photographs)

andesine or labradorite. Orthoclase is predominant in some and plagioclase in others. Some of the pegmatites in the Stillwell Gneiss contain no orthoclase.

In the Colbeck Gneiss east of Taylor Glacier, the central parts of pegmatite dykes are rich in feldspar and the margins are rich in biotite and garnet.

On the north coast of Broka Island, a dyke several metres thick is composed partly of massive quartz-microcline rock and partly of foliated coarse-grained biotite-orthoclase-quartz-plagioclase rock.

Opaque minerals are the most abundant accessory minerals in the pegmatite dykes. One dyke at Tilley Nunatak contains a little ilmenite and titanhematite, and ilmenite is present in at least one dyke in the Robinson Group.

A little xenotime(?) occurs in at least two pegmatite dykes in the Colbeck Gneiss and in one dyke in the Stillwell Gneiss, and dark glassy crystals of allanite(?), up to a few centimetres across, occur in a pegmatite dyke at Tilley Nunatak.

Basic Dykes

Metamorphosed basic dykes occur in the Stillwell Gneiss between Broka Island and the head of Edward VIII Gulf. They range up to 10 metres in thickness, and closely resemble the typical dark bands in the Stillwell Gneiss. The dykes have a granular texture, and are commonly faintly foliated. All the minerals in them appear to have been recrystallized.

The dykes are composed mainly of labradorite or andesine, and hornblende; hypersthene is generally more abundant than clinopyroxene. Biotite is commonly intergrown with the other dark minerals, and small garnet crystals are scattered through some dykes. Opaque minerals and apatite are present in most of the dykes.

At Kloa Point and in the western part of the Oygarden Group, the dykes are little deformed. In the eastern part of the Oygarden Group, some of the dykes are discordant lenses only 20 metres long, and have a faint foliation parallel to their long axis. On the south coast of Broka Island, the dykes are deformed into sinuous bodies; in one of the dykes a zone of mylonitic rock a few millimetres thick marks the contact with the gneiss.

Concordant lenses of doleritic or noritic rock, with relics of ophitic texture, occur in the Painted Gneiss at Painted Peak and in the Mawson Charnockite in the Robinson Group. They probably represent deformed and metamorphosed basic dykes.

Stinear (1956) has described a basic dyke which cuts the Mawson Charnockite on West Arm at Mawson and on the adjoining Entrance Island as a hypersthene granulite. A dolerite dyke, 1 metre thick, cuts poorly foliated charnockite on Stinear Island, and is distinguishable from it only because of its smaller grainsize. It has relics of ophitic texture in places, and is composed of calcic andesine (55%) and pyroxene (45%). The pyroxene includes both hypersthene and augite(?), and the accessory minerals are biotite, opaque minerals, apatite, and zircon.

STRUCTURE

The structure of the rocks described in this Report has been discussed broadly by McLeod et al. (1966). Foliation is well expressed in all the major rock units. In the Mawson Charnockite and the Painted Gneiss the dominant trend of the foliation is northwards. In the Colbeck Gneiss the trend of the foliation ranges from north to northeast, and in the Stillwell Gneiss the foliation and the banding trend predominantly eastwards.

No abrupt changes in the direction of these trends occur near the boundaries of the major rock units, and there is no evidence of structural unconformity between any of them. The large bodies of Painted Gneiss at Painted Peak, Phillips Ridge, Mount Elliott, and Mount Hordern appear to dip concordantly beneath the adjacent charnockite, and the trends of foliation are concordant in both units along the steeply dipping boundary between Mawson Charnockite and Colbeck Gneiss, between Byrd Head and Taylor Glacier.

Small-scale isoclinal or near-isoclinal folds, up to 1 metre across, are common in the Stillwell Gneiss and Colbeck Gneiss, and are also present in the Painted Gneiss at Trost Peak. Larger folds of similar type, 100 metres and more across, are distinguishable in several places in the Stillwell Gneiss, and in the Painted Gneiss at Trost Peak and Painted Peak.

Shearing on a microscopic scale is evident in many of the specimens of all the major rock units, but of mylonitic rocks are restricted to the Colbeck Gneiss and Mawson Charnockite, and are much more abundant in the latter. In most exposures of the charnockite, the seams of mylonite are only a few centimetres thick and have no preferred trend; in a few exposures, in the Robinson Group and Holme Bay, there are relatively thick seams of mylonitic rock parallel to the foliation in the charnockite.

The scattered seams of mylonite in the Colbeck Gneiss range up to 2 metres in thickness; in places two seams run parallel for distances up to 100 metres, and almost all of the seams cut abruptly across the foliation of the folded gneiss.

Some of the basic dykes in the Stillwell Gneiss, at Broka Island in particular, have been deformed into irregular shapes. Most of the dykes are at least faintly foliated, and one in the western islands of the Oygarden Group has been intruded along a thrust plane which displaced the folded Stillwell Gneiss.

At least one episode of deformation has followed the development of foliation in all the major rock units. In the Stillwell Gneiss and Colbeck Gneiss, and to a lesser extent in the Painted Gneiss, it is represented by near-isoclinal folds; in the Mawson Charnockite what is probably the same episode is represented by the mylonitic rocks.

The presence of mylonitic rocks cutting folds in the Colbeck Gneiss and of deformed basic dykes suggests a second episode of deformation. The wide variation in the degree of deformation in the dykes and the absence of mylonitic rocks in the Stillwell Gneiss suggests that this episode was localized, and it may be merely the waning stages of the first.

GEOLOGICAL HISTORY

Original rocks

McLeod et al. (1966) have discussed the origins of the major rock types described in this Report.

The probable origin of the Stillwell Gneiss is most readily discerned. The typical concordant dark bands, composed of hornblende, pyroxene, and andesine or labradorite, probably represent andesitic or basaltic lavas and pyroclastic rocks. The presence of pillow-like structures in a dark band in the Crooked Islands and of amygdale-like aggregates in a dark band at Kvars Promontory, and the strong mineralogical similarities between the dark bands and metamorphosed basic dykes, strengthen this conclusion. The partly discordant dark bands in the banded gneiss possibly represent minor intrusions emplaced during or shortly after the volcanic activity.

The atypical dark bands characterized by the predominance of bytownite, including the pargasite-bearing bands, the garnet-rich bands, and many bands exceptionally rich in hornblende and pyroxene, may be metamorphosed calcareous sediments. The pargasite-bearing bands and some of the bands rich in hornblende and pyroxene display small-scale compositional banding that could have originated during deposition. The garnet-rich bands, with sulphide and iron-oxide minerals, are similar to the skarns produced from limestone by regional metamorphism (Ramberg, 1952).

The light bands in the Stillwell Gneiss which contain sillimanite or scapolite represent clayey and calcareous sediments respectively. Most of the quartzites are probably recrystallized sandstones. Discordant light bands are common only in the western part of the Law Islands where the rocks have evidently been mobilized and recrystallized. Elsewhere, the light bands appear to be concordant with most of the dark bands, and represent sediments of various compositions separating the volcanic rocks represented by the typical dark bands. None of the light bands appears to be intrusive.

The sillimanite-bearing gneisses which form the bulk of the Colbeck Gneiss between Cape Bruce and Campbell Head probably represent clayey sediments. The biotite-garnet-quartz-orthoclase gneisses which form the great bulk of the Colbeck Gneiss between Chapman Ridge and the east side of Taylor Glacier are of uncertain origin. They probably also represent sediments, since they contain a few small bodies of sillimanite-bearing gneiss.

The calcite-bearing and scapolite-bearing members of the Painted Gneiss probably represent calcareous sediments, and the sillimanite-bearing gneiss and associated quartzite at Trost Peak are probably also metamorphosed sediments. Many small lenses in the Mawson Charnockite are bytownite-bearing rocks rich in dark minerals, and are similar to the atypical dark bands in the Stillwell Gneiss, which may be metamorphosed calcareous sediments.

The garnet-quartz-feldspar rocks which are abundant in the Painted Gneiss may have various origins. Some, which are interbanded with gneisses of sedimentary origin, probably represent clayey sandstones. Others which form isolated bodies in charnockite are commonly similar in texture to the charnockite; they may be bodies of charnockite altered by metasomatism to biotite-garnet-orthoclase-bearing hybrid rocks (see McCarthy & Trail, 1964).

The origin of the Mawson Charnockite is uncertain. A chemical analysis of porphyroblastic charnockite from Mawson is classed by Joplin (1963) with diorites; the composition is also compatible with andesites and greywackes listed by Joplin (1963; 1965), except that the charnockite has a higher content of potash.

The gneiss bodies which contain rocks of sedimentary origin dip under charnockite at Phillips Ridge, Painted Peak, Mount Elliott, and Mount Hordern. At Painted

Peak, the charnockite is interbanded with and grades into garnet-quartz-feldspar gneiss, which contains gneisses of sedimentary origin. Some of the light bands in the Stillwell Gneiss are essentially charnockite, and all this evidence suggests that the Mawson Charnockite may represent a very thick pile of sediments of greywacke type, or of pyroclastic rocks containing masses of other sediments represented by the Painted Gneiss.

Alternatively, the charnockite represents a huge plutonic body which contains large rafts of metamorphosed sediments (the Painted Gneiss). The contacts of the charnockite with the Painted Gneiss and Colbeck Gneiss may represent zones in which layers of metasomatized sediments have been caught up in concordantly injected magma.

The intrusive contacts described by Crohn (1959) suggest an intrusive origin for the charnockite. Crohn states that the charnockite has been emplaced as an intrusive rock, but that it may be either an igneous mass or at least a mass of rock mobilized under the conditions of very high-grade metamorphism.

The widespread potash metasomatism in the charnockite suggests that the original rock had a more basic composition and, if igneous, may have been a gabbro or a norite, which was granitized to produce the charnockite. It is suggested that such a large mass of basic plutonic rock, devoid of radical variations in composition, is a rarity, but possibly the charnockite masses of Gondwanaland represent a particular and unique phase of emplacement of massive basic plutonic rocks of this type.

Metamorphism and metasomatism

The widespread distribution of biotite or hornblende throughout the Mawson Charnockite, the Painted Gneiss, and the Stillwell Gneiss, and the presence of cordierite in the sillimanite-bearing phase of the Colbeck Gneiss indicate that these rocks should be classed in the hornblende-granulite subfacies of metamorphism, which was erected by Turner & Verhoogen (1960) to include rocks containing these minerals but associated with rocks metamorphosed in the granulite facies.

The recrystallized mylonites, the migmatitic biotite-garnet-bearing gneiss bands in the western Law Islands, the western part of the Colbeck Gneiss, and most of the discordant pegmatites have mineral assemblages characteristic of the almandine-amphibolite facies; they are generally biotite-garnet-quartz-orthoclase rocks; the abundance of plagioclase in the Law Islands migmatites is anomalous. These rocks represent either a waning retrogressive phase of granulite-facies metamorphism or a second episode of metamorphism under less extreme conditions than the first. The common occurrence of orthoclase in these rocks, in contrast to the predominance of plagioclase in the other rock types, suggests that in places potash metasomatism accompanied the later phase or episode of metamorphism.

The effects of the later metamorphism are also evident in the charnockite; they include the presence of broken and deformed hypersthene crystals partly altered to biotite and garnet and the widespread development of biotite and garnet in the Robinson Group. The prominence of orthoclase in the recrystallized mylonites and the widespread occurrence of orthoclase porphyroblasts and biotite in the sheared charnockite again suggest that potash metasomatism accompanied the later metamorphism.

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Sequence of events

If the Mawson Charnockite represents metamorphosed greywacke or pyroclastics and the light bands of the Stillwell Gneiss are regarded as diversified sediments, then the formation of these rocks may be reconstructed simply.

The Colbeck Gneiss and the Stillwell Gneiss in turn either precede or succeed the Mawson Charnockite in the succession. These three main rock units may represent three phases of deposition. The charnockite could represent a great associated thickness of greywacke or pyroclastics, with much smaller quantities of calcareous, siliceous, and aluminous sediments (the Painted Gneiss), and the Colbeck Gneiss a sequence of predominantly clayey sediments. The Stillwell Gneiss represents a sequence of feldspathic arenaceous sediments and calcareous and minor clayey sediments and associated basic lavas and pyroclastic material into which basic sills and dykes were intruded. The doleritic rocks in the charnockite may also have been emplaced as dykes at this time.

If the charnockite represents a plutonic body, it was emplaced after the formation of the sediments represented by the Colbeck Gneiss and possibly at the same time as the volcanic activity which prevailed during the formation of the rocks represented by the Stillwell Gneiss. The Painted Gneiss comprises rafts of sediment caught up in the intrusive body.

The metamorphic history of the area is outlined by McLeod et al. (1966). The first discernible metamorphism took place under the conditions of the lower part of the granulite facies or of the uppermost part of the almandine-amphibolite facies.

After the recrystallization the rocks were deformed. The massive charnockite was sheared and the more mobile Painted Gneiss was folded; the Colbeck Gneiss was tightly folded and sheared in places; the Stillwell Gneiss was tightly folded.

A later phase of intrusion resulted in the formation of basic dykes intruded perhaps during the late stages of this episode of deformation, into the Stillwell Gneiss and possibly to a lesser extent into the Mawson Charnockite.

Their intrusion was followed by recrystallization under the conditions of the almandine-amphibolite facies, accompanied by potash metasomatism in places and by the emplacement of granite in the Colbeck Gneiss; some of the mylonitic rocks were recrystallized, the Stillwell Gneiss was recrystallized as migmatitic rocks in the western Law Islands, and the basic dykes were metamorphosed and locally distorted. The second episode of metamorphism may represent a retrogressive phase of the first, but they appear to have been separated at least by the intrusion of the basic dykes.

ECONOMIC GEOLOGY

No significant mineral deposits were found in 1961, and almost all the metallic mineral samples were found to be oxides or sulphides of iron.

A small lens of sulphides, a few metres long by a metre wide, in the charnockite forming Entrance Island, near Mawson, was found to contain 45 percent marcasite, 35 percent pyrrhotite, 10 percent chalcopyrite, 10 percent hydrated iron oxide, and minor molybdenite. The lens has been fully described by McLeod et al. (1966); no other bodies of this type have been found in this area.

A few garnet-rich dark bands, up to about 2 metres in thickness, in the Stillwell Gneiss forming the islands south of Fold Island, contain bright green copper stains and visible metallic minerals. Two samples were found to consist predominantly of pyrite and ilmenite, with smaller quantities of sphalerite and chalcopyrite.

Magnetite is prominent in a pegmatite in the banded gneiss at Keel Island, and a pegmatite at Tilley Nunatak contains ilmenite, titanhematite, magnetite, and possibly allanite.

A dark band, 30 metres thick, at the northeast corner of Shaula Island, is composed of pyroxene, garnet, and about 30 percent magnetite.

Sillimanite and graphite occur in places in the Colbeck Gneiss, including one large outcrop at Ives Tongue within the Stillwell Gneiss. They form no concentration of economic interest, though one sample of the gneiss at Low Tongue contains 20 percent sillimanite.

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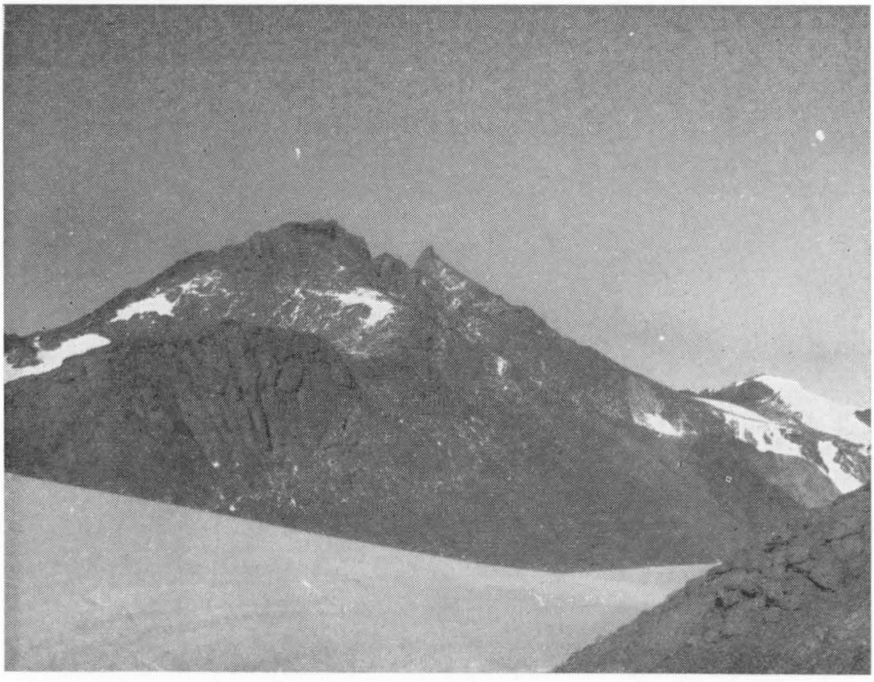
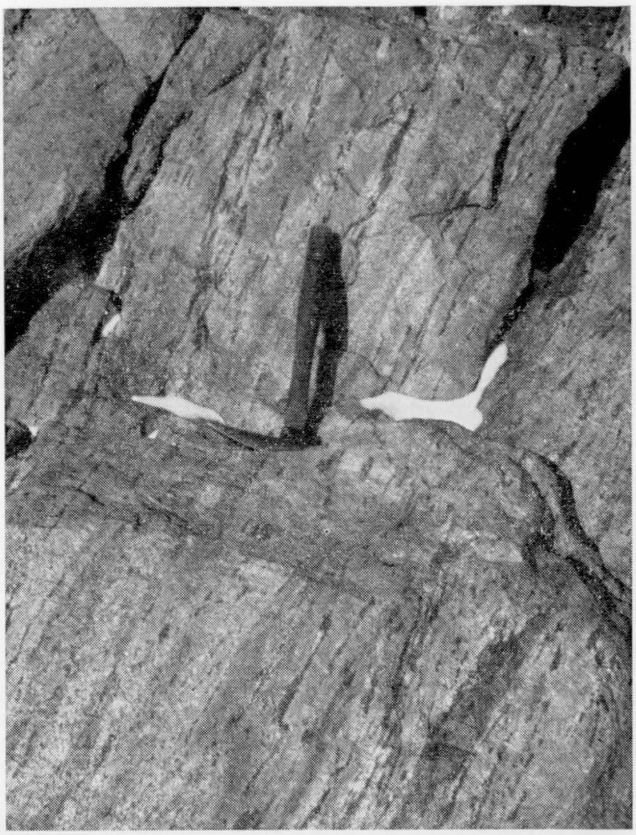
1. Charnockite mountains of the David Range. A small nunatak of Painted Gneiss is in the right foreground.

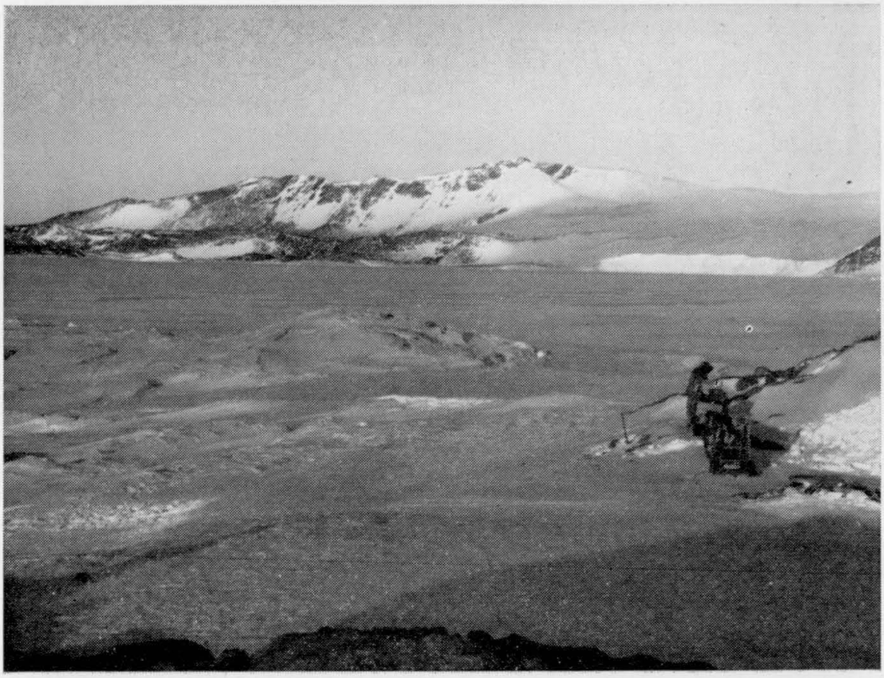


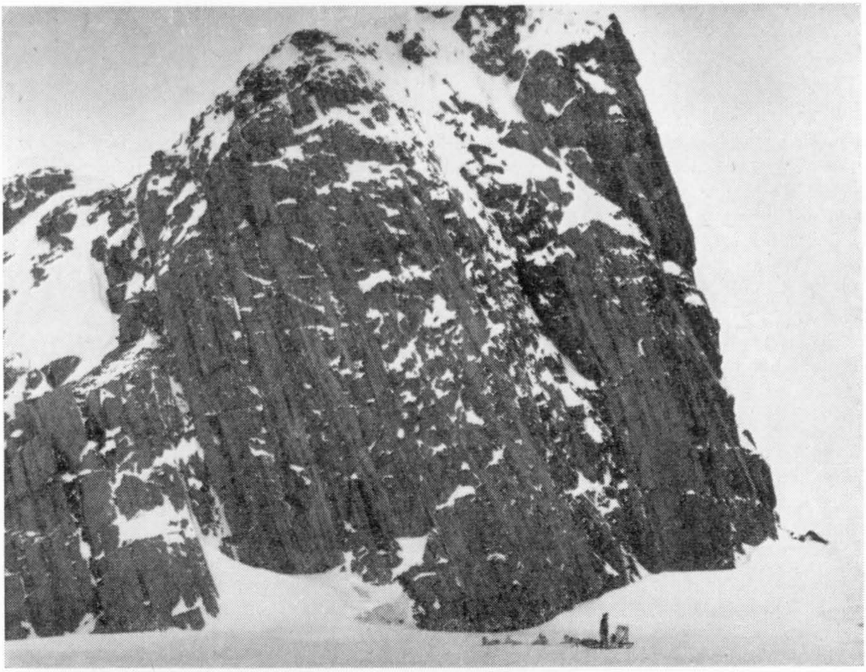
2. Charnockite forming Mount Henderson, Framnes Mountains. Light bands of Painted Gneiss on right.



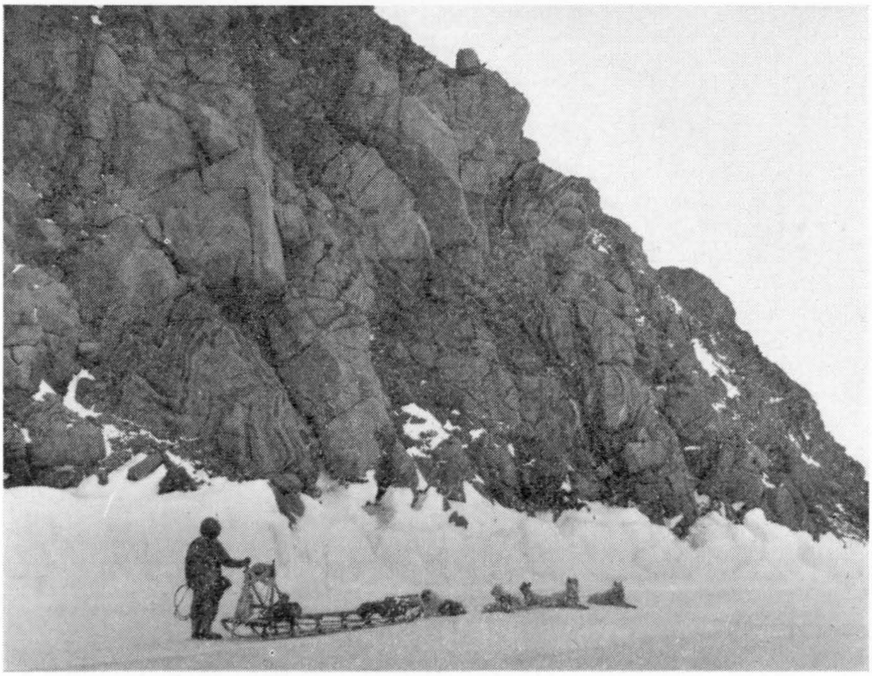
3. Well foliated even-grained charnockite at Mount Elliott, Framnes Mountains.

4. Charnockite forming Chapman Ridge behind low ground formed by Colbeck Gneiss. View east from Taylor Glacier.

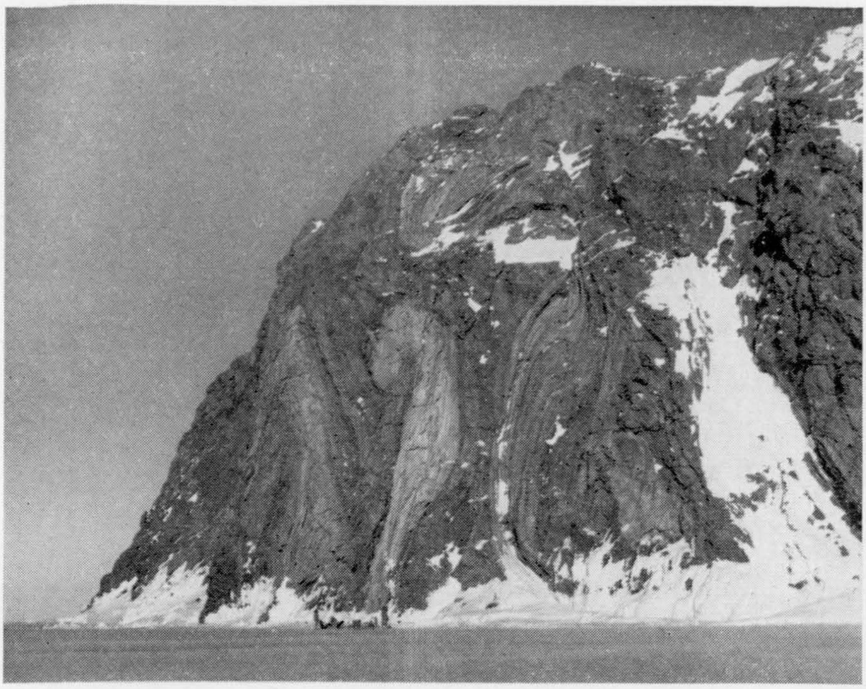




5. Stillwell Gneiss near Fold Island.

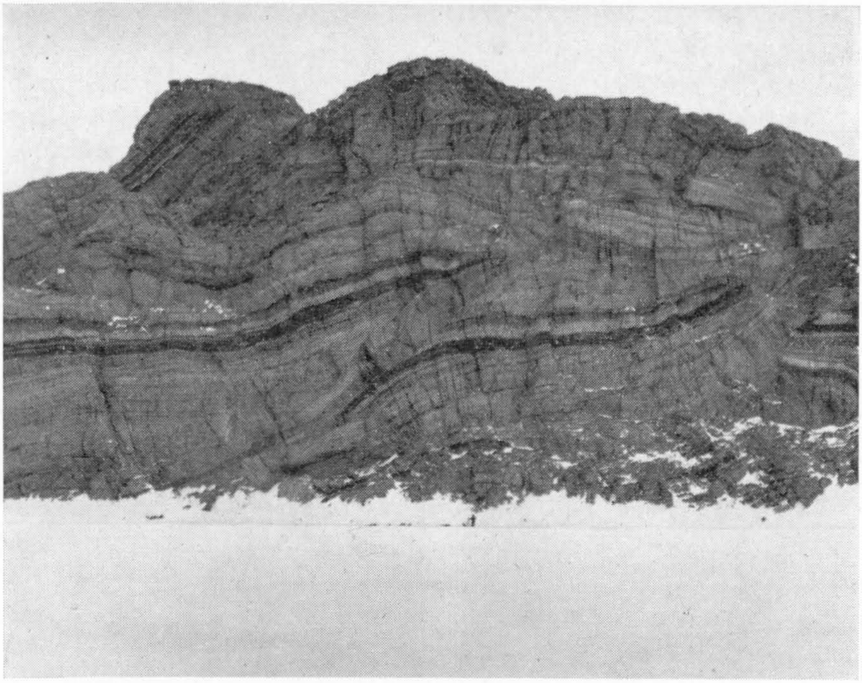


6. Folded bands in Stillwell Gneiss. Alphard Island, Oygarden Group.



7. Folds in Stillwell Gneiss at Crooked Islands. Figures are near site of pillows in dark band.

8. Folded Stillwell Gneiss with folded basic intrusives(?). Near Depot Island, Oygarden Group.



9. Disrupted Stillwell Gneiss with basic intrusive(?) occupying discontinuity. Near Alphard Island in Oygarden Group.

1:250,000 GEOLOGICAL SERIES

MAWSON AND MOUNT HENDERSON

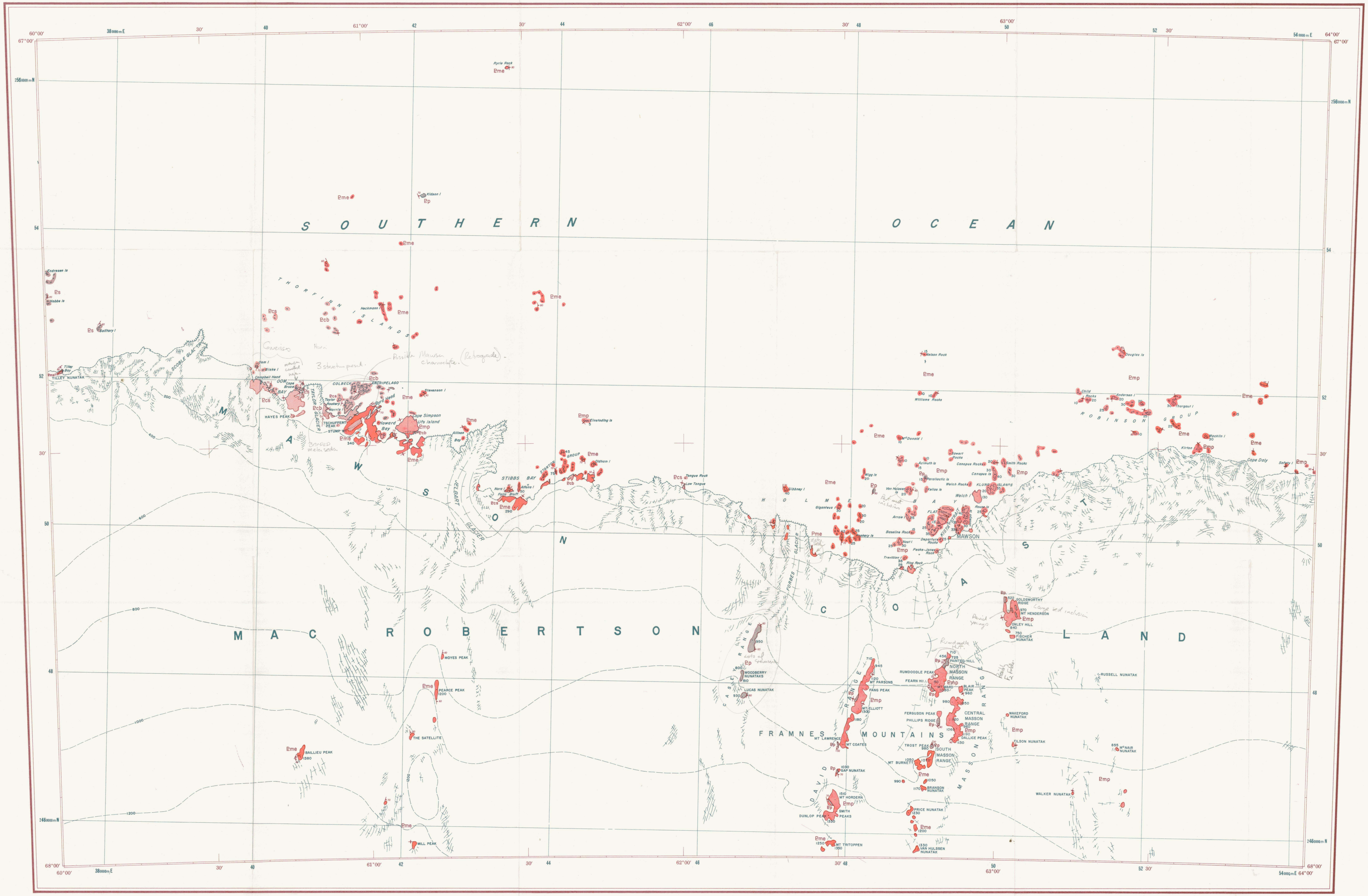
AUSTRALIAN ANTARCTIC TERRITORY

SHEETS SQ 40-41/15 & SQ 40-41/16 (PART)

PRELIMINARY EDITION, 1967

PLATE 1

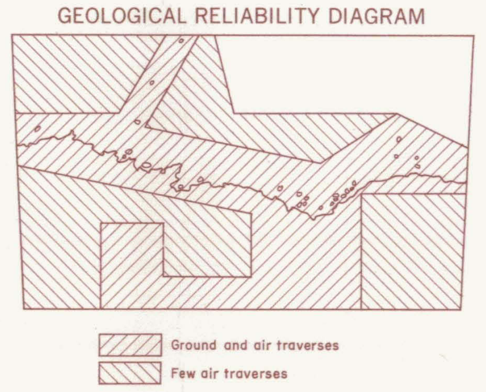
SUBJECT TO AMENDMENT



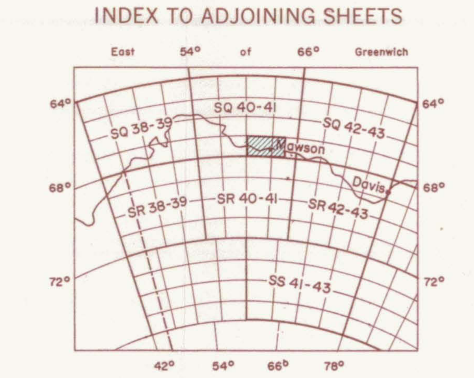
PRECAMBRIAN?	Mawson Charnockite	Ꝑmp	Porphyroblastic hypersthene-quartz-feldspar rock
		Ꝑme	Even-grained hypersthene-quartz-feldspar rock
	Painted Gneiss	Ꝑp	Quartz-feldspar gneisses with biotite or garnet, sillimanite in places; pyroxene-plagioclase gneiss, some with scapolite; marble
	Colbeck Gneiss	Ꝑcb	Garnet-biotite-quartz feldspar gneiss; granite and migmatite
		Ꝑcs	Sillimanite-cordierite-garnet-quartz-feldspar gneiss; minor granite
	Stillwell Gneiss	Ꝑs	Quartz-orthoclase gneiss alternates with pyroxene-plagioclase rock

Geological boundary
Edge of exposed rock
Plunge of minor fold
Strike and dip of foliation
Vertical foliation
Rake (lineation measured in plane of foliation)
Dyke, b- basic, metamorphosed
Glacier
Glacier tongue
Ice coastline
Rock coastline
200 Contour line on ice or snow (metres)
·190 Height in metres

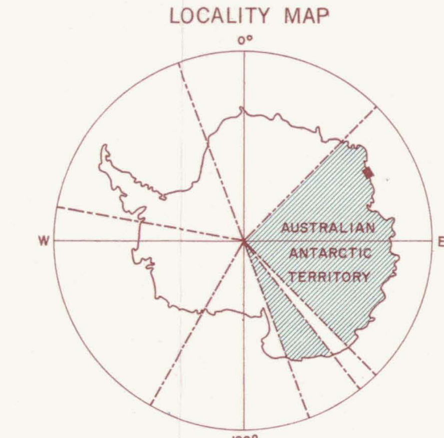
GEOLOGICAL RELIABILITY DIAGRAM



INDEX TO ADJOINING SHEETS



LOCALITY MAP



Compiled and issued by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Base map compiled by the Antarctic Mapping Branch, Division of National Mapping, Department of National Development.
Universal Transverse Mercator Projection, International Spheroid

Names have been approved by the Antarctic Names Commitee of Australia

Absence of the depiction of crevasses does not necessarily indicate a crevasse-free area

Scale 1:250,000

5 0 5 10 15 MILES

5 0 5 10 15 20 25 KILOMETRES

BLUE NUMBERED LINES INDICATE THE 20000 METRE UNIVERSAL TRANSVERSE MERCATOR GRID, ZONE 41

Magnetic Declination 1964 varies from 57° to 54° west, increasing annually 15' west

Geology, 1954-1965, by: P.W. Crohn, P.J. Cook, I.R. McLeod, R.A. Ruker, B.H. Stinear, D.S. Trail, G.R. Wallis (B.M.R.), attached to Australian National Antarctic Research Expeditions
Compiled, 1967, by: D.S. Trail
Cartography and drawn, 1967, by: R. Swoboda (B.M.R.)

MAWSON AND MOUNT HENDERSON

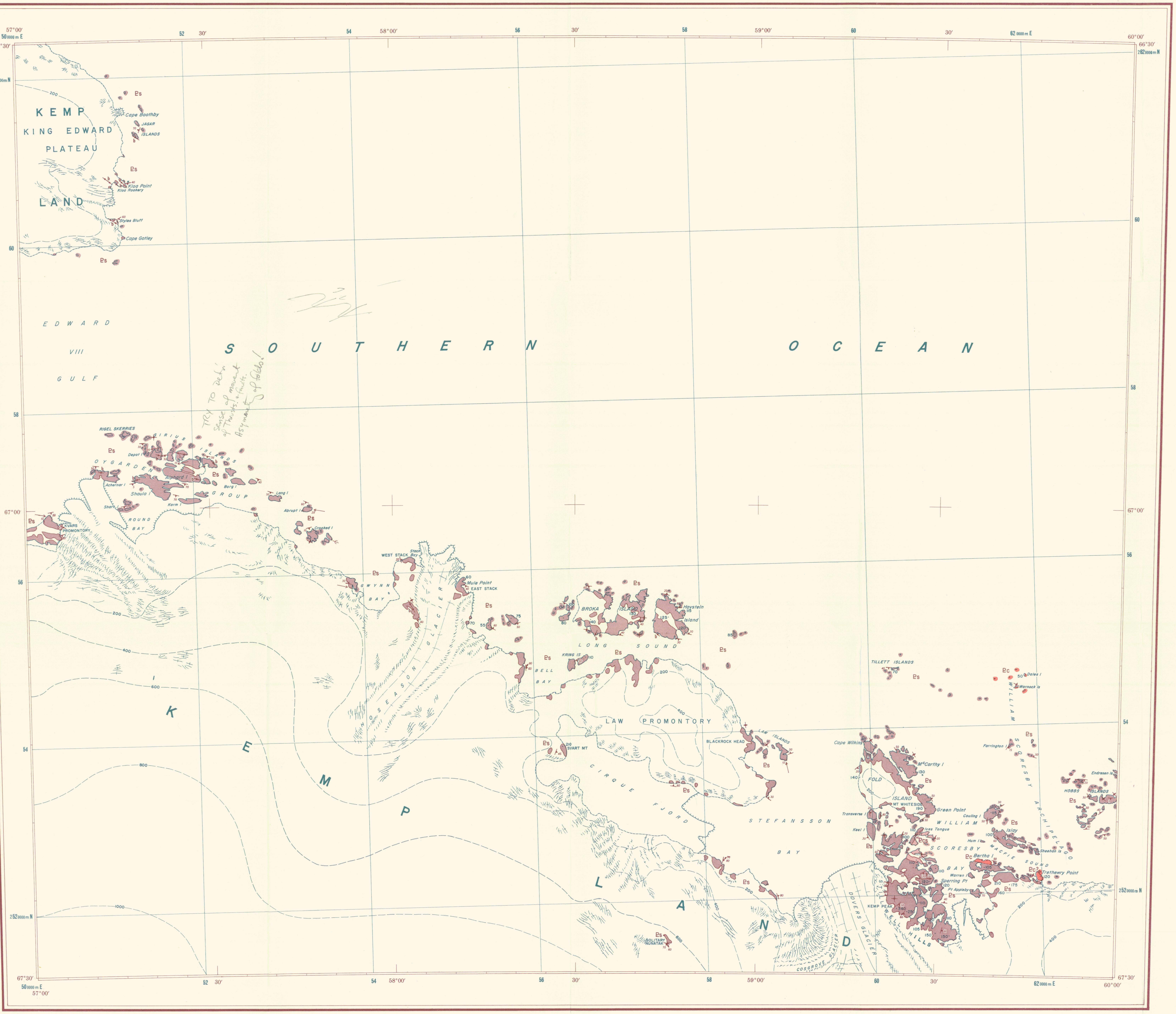
SHEETS SQ40-41/15 and SQ40-41/16 (Part)

1:250,000 GEOLOGICAL SERIES

OYGARDEN AND LAW PROMONTORY

AUSTRALIAN ANTARCTIC TERRITORY

SHEETS SQ 40-41/10 & SQ 40-41/14 (PARTS)



PRELIMINARY EDITION, 1967

SUBJECT TO AMENDMENT

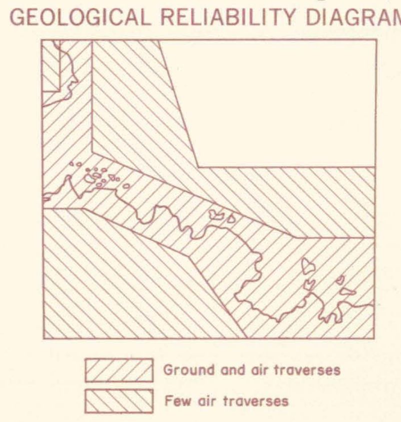
PLATE 2

PRECAMBRIAN ?

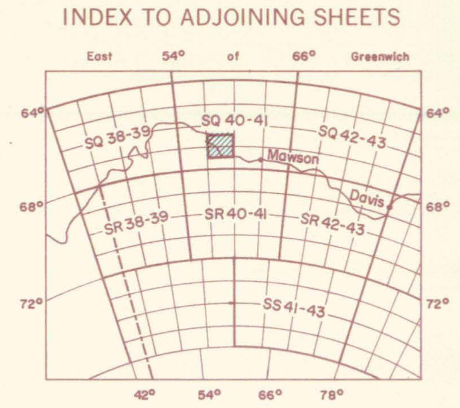
Charnockite	Ꝑc	Even-grained hypersthene-quartz-feldspar rock
Colbeck Gneiss	Ꝑcs	Garnet-quartz-feldspar gneiss; sillimanite, graphite in places
Stillwell Gneiss	Ꝑs	Quartz-orthoclase gneiss alternates with hornblende-pyroxene-plagioclase rock

- Geological boundary
- Edge of exposed rock
- Minor fold, no visible plunge
- Plunge of minor fold
- Strike and dip of foliation
- Vertical foliation
- Horizontal foliation
- Rake (lineation measured in plane of foliation)
- Dyke; b - basic, metamorphosed
- Glacier
- Glacier tongue
- Ice coastline
- Rock coastline
- 200 Contour line on ice or snow (metres)
- ·190 Height in metres

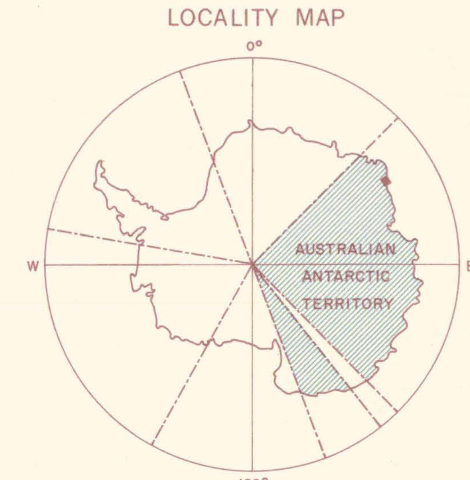
GEOLOGICAL RELIABILITY DIAGRAM



INDEX TO ADJOINING SHEETS



LOCALITY MAP



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Absence of the depiction of crevasses does not necessarily indicate a crevasse-free area

Scale 1:250,000

5 0 5 10 15 MILES

5 0 5 10 15 20 25 KILOMETRES

BLUE NUMBERED LINES INDICATE THE 20000 METRE UNIVERSAL TRANSVERSE MERCATOR GRID, ZONE 40

Magnetic Declination 1964 varies from 57° to 54° west, increasing annually 15' west

Geology, 1954-1965, by: P.W. Crohn, P.J. Cook, I.R. McLeod, R.A. Ruker, B.H. Stinear, D.S. Trail, G.R. Wallis (B.M.R.), attached to Australian National Antarctic Research Expeditions
Compiled, 1967, by: D.S. Trail
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OYGARDEN AND LAW PROMONTORY
SHEETS SQ 40-41/10 and SQ 40-41/14 (Parts)