69/64

(5)

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record No. 1969 / 64

The Igneous and Metamorphic Rocks of the Coen and Cape Weymouth 1:250,000 Sheet Areas, Cape York Peninsula, Queensland

by

*D.S. Trail, W.F. Willmott, W.D. Palfreyman, R.F. Spark and W.G. Whitaker **

* Geological Survey of Queensland

THE IGNEOUS AND METAMORPHIC ROCKS OF THE COEN AND CAPE WEYMOUTH 1:250,000 SHEET AREAS, CAPE YORK PENINSULA, QUEENSLAND

by

D.S. Trail, W.F. Willmott, W.D. Palfreyman,

R.F. Spark and W.G. Whitaker*

*Geological Survey of Queensland

Record 1969/64

CONTENTS

SUMMARY

In 1967 a combined party from the Bureau of Mineral Resources and the Geological Survey of Queensland mapped the igneous and metamorphic rocks of the Coen and Cape Weymouth 1:250,000 Sheet areas, in the central part of Cape York Peninsula.

The igneous and metamorphic rocks form a belt up to 50 miles wide which is bounded on the east by the Coral Sea and on the west by gently dipping Mesozoic sediments of the Carpentaria Basin. The belt consists of remnant bodies of metamorphic rocks, probably Precambrian in age, which have been intruded by the northern part of a large Upper Devonian granitic batholith, the Cape York Peninsula Batholith. The metamorphic rocks are separated into three broad divisions; in the east the Dargalong Metamorphics in the almandine-amphibolite facies of regional metamorphism; in the west the Holroyd Metamorphics in the greenschist facies; and in the north the Sefton Metamorphics, also in the greenschist facies. All three units were probably derived from a single sequence of late Precambrian or early Palaeozoic geosynclinal sediments.

The Upper Devonian Batholith is composed mainly of biotite-muscovite adamellite - the Kintore Adamellite. Some masses of adamellite of differing compositions also occur within the batholith; some grade into the Kintore Adamellite, but others appear to be distinct phases. Some small bodies of granodiorite, tonalite, and diorite are closely associated with the Kintore Adamellite in some areas.

In the Cape Weymouth Sheet area the metamorphics and the Devonian batholith are overlain by a poorly exposed sequence of Carboniferous fresh water sediments - the Pascoe River Beds, and by extensive Carboniferous or Permian acid pyroclastic rocks and lavas. The metamorphics, the batholith and the volcanics are intruded by bodies of high-level Permian granite with associated granophyric, hybrid and dioritic rocks.

Mesozoic sandstone and siltstone overlap the igneous and metamorphic rocks in the west, and the basement rocks are also overlain by small deposits of poorly consolidated ?Tertiary sandstone and by unconsolidated residual sand, alluvium and marine sediments.

Foliation, faults and many elongated bodies of igneous and metamorphic rocks almost all trend north to north-westwards. The Mount Carter block, in which the foliation strikes northeast, is a notable exception. Two large shear zones may have formed in the Devonian plutonic rocks, when they were emplaced; but later movement may also have occurred. The Carboniferous sediments were folded prior to the extrusion of the Carboniferous to Permian Volcanic rocks. The Mesozoic sediments are faulted in the Coen Sheet area and the east side of the Peninsula appears to have been tilted upwards in Tertiary times.

Gold has been won from quartz reefs in the Devonian granitic rocks, and locally from deep leads in Mesozoic sediments and from schist and Permian granite. A small quantity of wolfram has been mined from a contact between schist and granite; alluvial cassiterite has been obtained from creeks located mainly on Permian intrusives. Large lenses of magnetite-bearing and hematite-bearing schist at Iron Range contain significant quantities of iron ore and manganese. Small deposits of limestone and marble, coal, and heavy-mineral beach sands occur at various places; a large section of the coast north of the Cape Weymouth Sheet area has a thick covering of dune sand with a high silica purity.

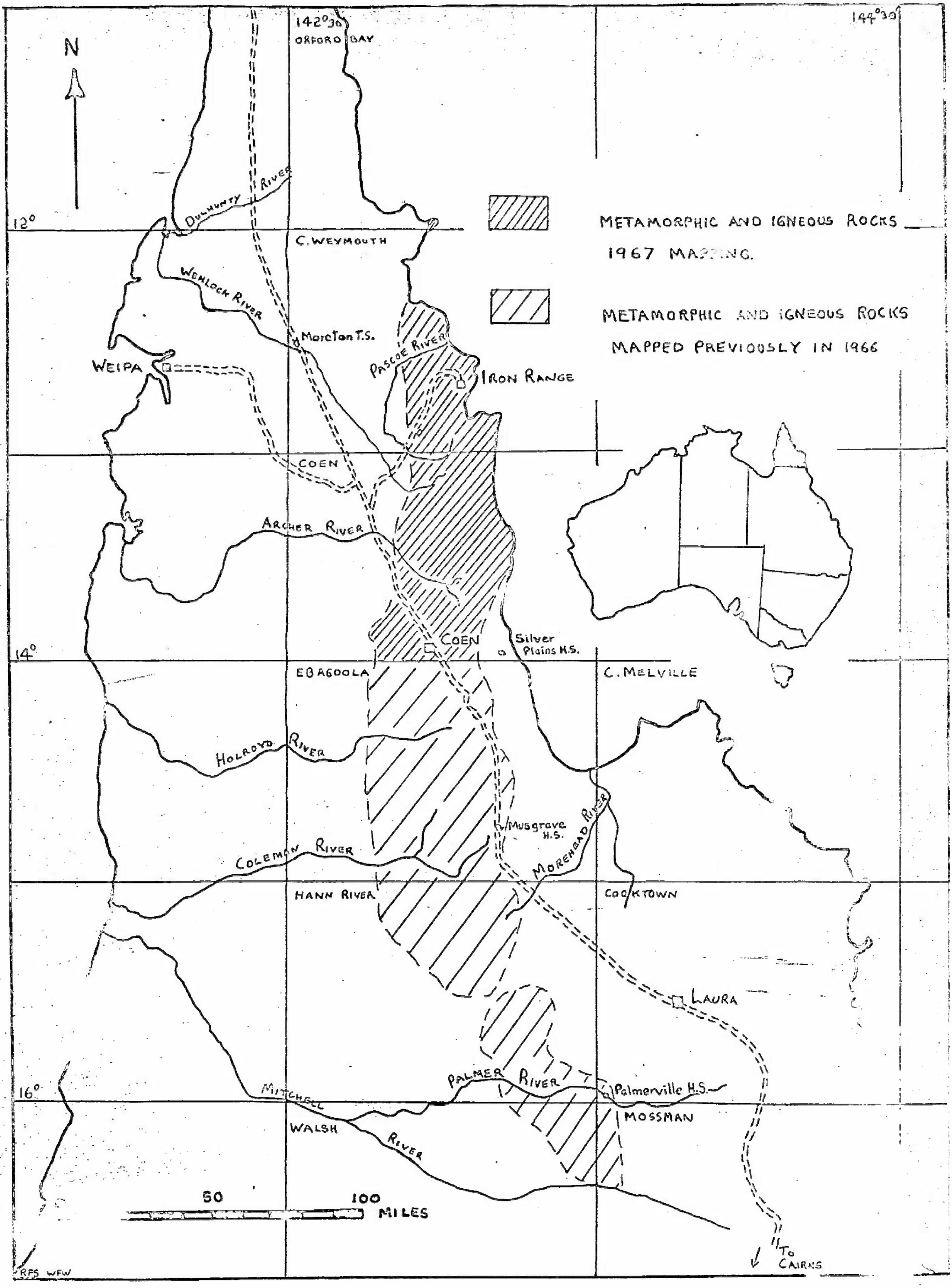


FIG. 1. LOCALITY MAP, METAMORPHIC AND IGNEOUS ROCKS OF CAPE YORK PENINSULA

INTRODUCTION

This report describes the preliminary results of the 1:250,000 scale mapping of the metamorphic and igneous rocks in the Coen and Cape Weymouth Sheet areas, in the central eastern part of Cape York Peninsula. The mapping was carried out between April and September 1967 by a combined field party from the Bureau of Mineral Resources and the Geological Survey of Queensland, which comprised five geologists (D.S. Trail, W.D. Palfreyman, R.F. Spark and W.F. Willmott - B.M.R., and W.G. Whitaker, G.S.Q.) supported by four field assistants, a mechanic and a cook.

The report follows one of a similar nature (Trail, Pontifex, Palfreyman, Willmott & Whitaker, 1968) describing the preliminary results of mapping in 1966 in the three 1:250,000 Sheet areas immediately to the south (Ebagoola, Hann River and Walsh).

In 1968 the combined field party moved further north to map the islands of Torres Strait. The results of the three-year survey of the igneous and metamorphic rocks of Cape York Peninsula will be produced later for publication.

The area mapped in 1967 forms roughly the northern half of a belt of igneous and metamorphic rocks up to 40 miles across, which runs northwards from the Mitchell River for 300 miles, to the coast north of the Pascoe River (Fig.1). In the Coen and Cape Weymouth Sheet areas the igneous and metamorphic rocks form a series of rugged mountain ranges up to 2700 feet high, which extend down the eastern side of the Peninsula. The lower flat country to the west is formed by Mesozoic sediments. The area has a higher rainfall than the southern half of the Peninsula, and thick rain forest is present on most of the eastern ranges. Table 1 gives average annual rainfall for some towns and stations throughout the Peninsula.

Northern Peninsula	Inches	Southern Peninsula	Inches
Coen	53.45	Palmerville	41.02
Silver Plains	46.89	Laura	36.13
Iron Range	80.55	Musgrave	44.85
Weipa	71.00		
Moreton	52.51		
Thursday Island	68.45		

Table 1 : Average Annual Rainfall in Cape York Peninsula. Figures supplied by the Bureau of Meteorology, Canberra.

The rainfall is seasonal, with most rain falling in between November and April. However, on the eastern mountains light falls of rain occur throughout the rest of the year. Early in the dry season water is abundant with most rivers and creeks flowing well, but they dry up rapidly, and at the end of the dry season water is obtainable only in some of the larger rivers and in the headwaters of the creeks in the McIlwraith Range.

The Coen River, Massey Creek, Rocky River, Leo Creek, Nesbit River, Archer River, Lockhart River, Pascoe River and the Claudia River are more or less perennial. The Wenlock River is less reliable.

Access to the igneous and metamorphic rocks of the eastern ranges is difficult (Fig.2). A broad, partly formed and graded dirt road extends from Mareeba on the Atherton Tableland through Laura to Coen, and continues as a track to the tip of Cape York along the telegraph line. North of the Archer River, another track branches off the telegraph line and extends to the Iron Range airport and to Portland Roads. It is irregularly maintained and may be washed out after the wet season. Apart from the track from Coen to Silver Plains Homestead, the only other route across the eastern ranges is a disused and overgrown vehicle track which crosses the McIlwraith Range in the headwaters of Falloch Creek. All tracks north of Coen are suitable only for four-wheel-drive vehicles, and are passable only in the dry season. Off the tracks the vegetation of rain forest, thick eucalypt forest and long broad-bladed grass considerably hinders overland travel by vehivle.

A regular truck service operates between Coen and Cairns during the dry season. Scheduled Friendship airlines call at the airports of Coen and Iron Range. Smaller aircraft service a few cattle stations. A shipping service is maintained approximately fortnightly by two companies to Portland Roads, near Iron Range. The majority of the small number of people living in the area are engaged in raising beef cattle. Coen has a population of about 40 Europeans and a number of people live on small holdings around Iron Range and Portland Roads. The Lockhart River Community accommodates a few hundred aborigines and is situated on a reserve comprising most of the Lockhart River Valley.

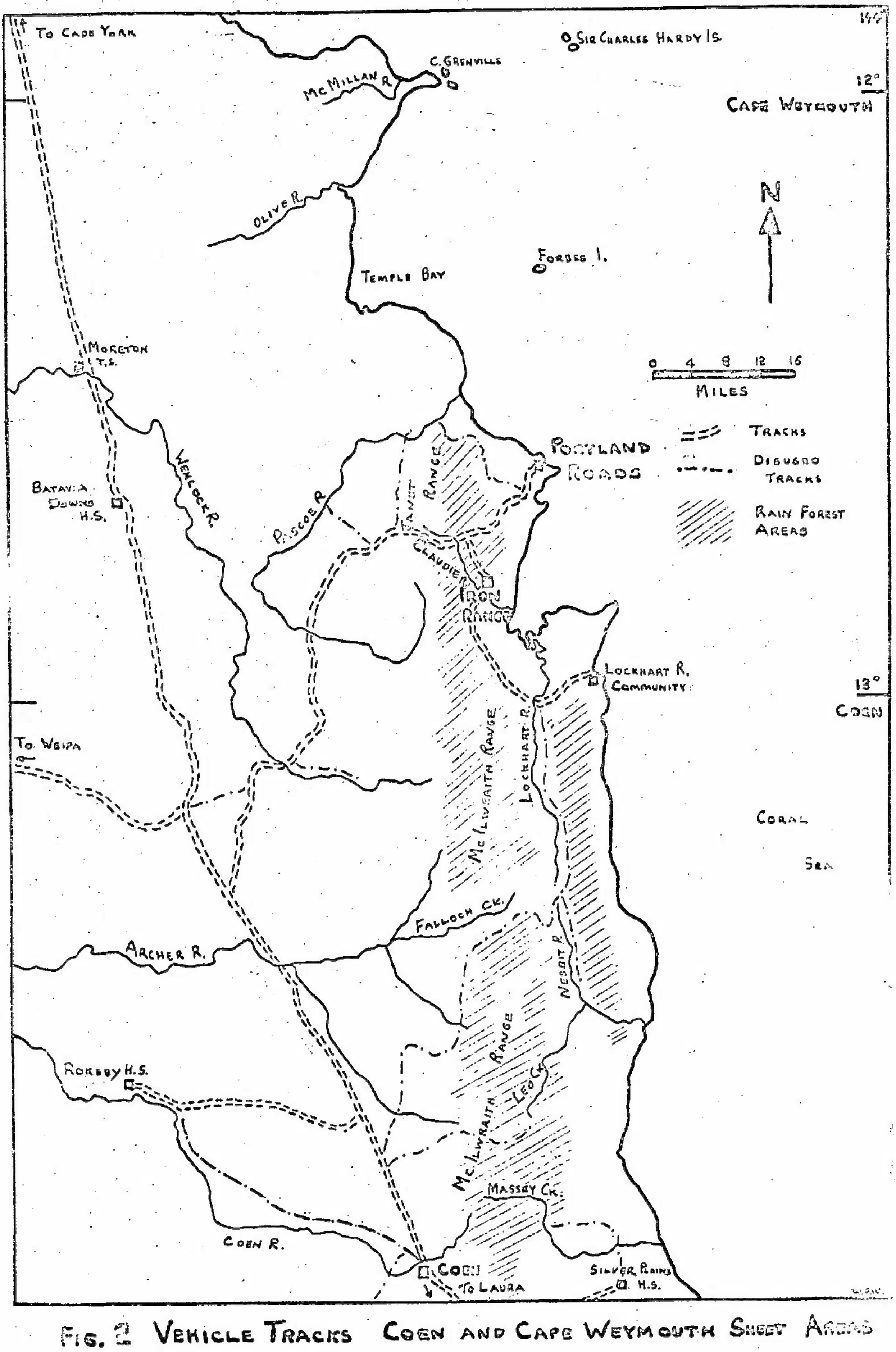


Fig. 2 Vehicle Tracks Coen and Cape Weymouth Sheet Areas

The mapping was carried out mostly by means of traverses made with Landrovers, but other methods were used to map the inaccessible parts of the area. Horses were hired for six weeks to map the flanks of the southern part of the McIlwraith Range, and a helicopter was used to land parties in clearings on the mountains. The rain-forest areas were mapped by two-man parties walking for between two and five days. A 40 foot launch was also chartered for one month to map coastal exposures and islands, and an inflatable rubber dinghy was used for a traverse down the Pascoe River and to assist in landing from the launch.

The immediate purpose of the traverse was to identify and delineate units discerned on aerial photographs. Geology was plotted on photo-scale maps (1:50,000) made by the Royal Australian Survey Corps from aerial photographs taken by Adastra Airways Pty Ltd. The photo-scale maps were then reduced to 1:250,000 scale and redrafted on to a planimetric base map.

Throughout most of the area the exposure of the igneous and metamorphic rocks is poor, and many geological problems remain to be solved.

In this report, locality grid references (e.g. 635314) refer to the 1:250,000 topographic maps, Coen and Cape Weymouth, published by the Royal Australian Survey Corps. Sample numbers (e.g. 67480378) refer to registered numbers of samples and thin sections held in the collection of the Bureau of Mineral Resources, Canberra. All isotopic dating results quoted were obtained by A.W. Webb (BMR) at the Australian National University (see Appendix I). New stratigraphic names have previously been defined in Whitaker and Willmott (1968 and 1969).

We wish to acknowledge the great assistance provided by the Broken Hill Proprietary Company and Australian Aquitaine Petroleum in freely supplying geological information, and the invaluable help provided by Dr. C.D. Branch in elucidating the structure of the Janet Ranges Volcanics.

PREVIOUS WORK

An excellent history of early geological investigation and mining in the Cape York Peninsula is given in "Northmost Australia", by the geologist R. Logan Jack (1922). Jack records that geological observations were first made along the coast of the Cape Weymouth Sheet area by Wickham in 1839, and by Blackwood, Yule and Jukes in 1843, who noted that granite cropped out at Cape Direction, Cape Weymouth and Restoration Island and that flinty slate and porphyry formed the Sir Charles Hardy islands and nearby Cape Grenville.

The first Europeans to cross the Coen and Cape Weymouth Sheet areas overland formed Kennedy's ill-fated party, in 1848. Alluvial gold was discovered at Coen in 1876; Jack consequently visited Coen to examine the workings for the Queensland Government, and made extensive geological observations in the course of an expedition in 1879 and 1880, which traversed the igneous and metamorphic rocks of Cape York Peninsula from the Mitchell River in latitude 16°30'S to Bolt Head in latitude 12°15'S. Jack noted the common rock types of the region as granite with variously quartzite, ferruginous mica schist, gneiss, micaceous greywacke, slate, porphyry, and sandstone. He also noted and examined for gold many quartz reefs and patches of alluvial material. All Jack's observations have been confirmed by other workers and by this survey, with the puzzling exception of his report of serpentine underlying the sandstone south of Bolt Head. Recently several geologists have searched for this without success; it appears to be represented by dark massive metamorphosed limestone.

Late in the 19th Century prospectors, including the very active John Dickie, discovered gold, wolfram, and tin. Prospecting has continued sporadically to the present day and geologists of the Geological Survey of Queensland and of the Aerial, Geological and Geophysical Survey of Northern Australia have periodically inspected and reported on prospects and small mines. Their reports are summarized below in the section on Economic Geology.
Jensen (1964, and in Hill and Denmead, 1960)has recently reviewed the geology of Cape York Peninsula.

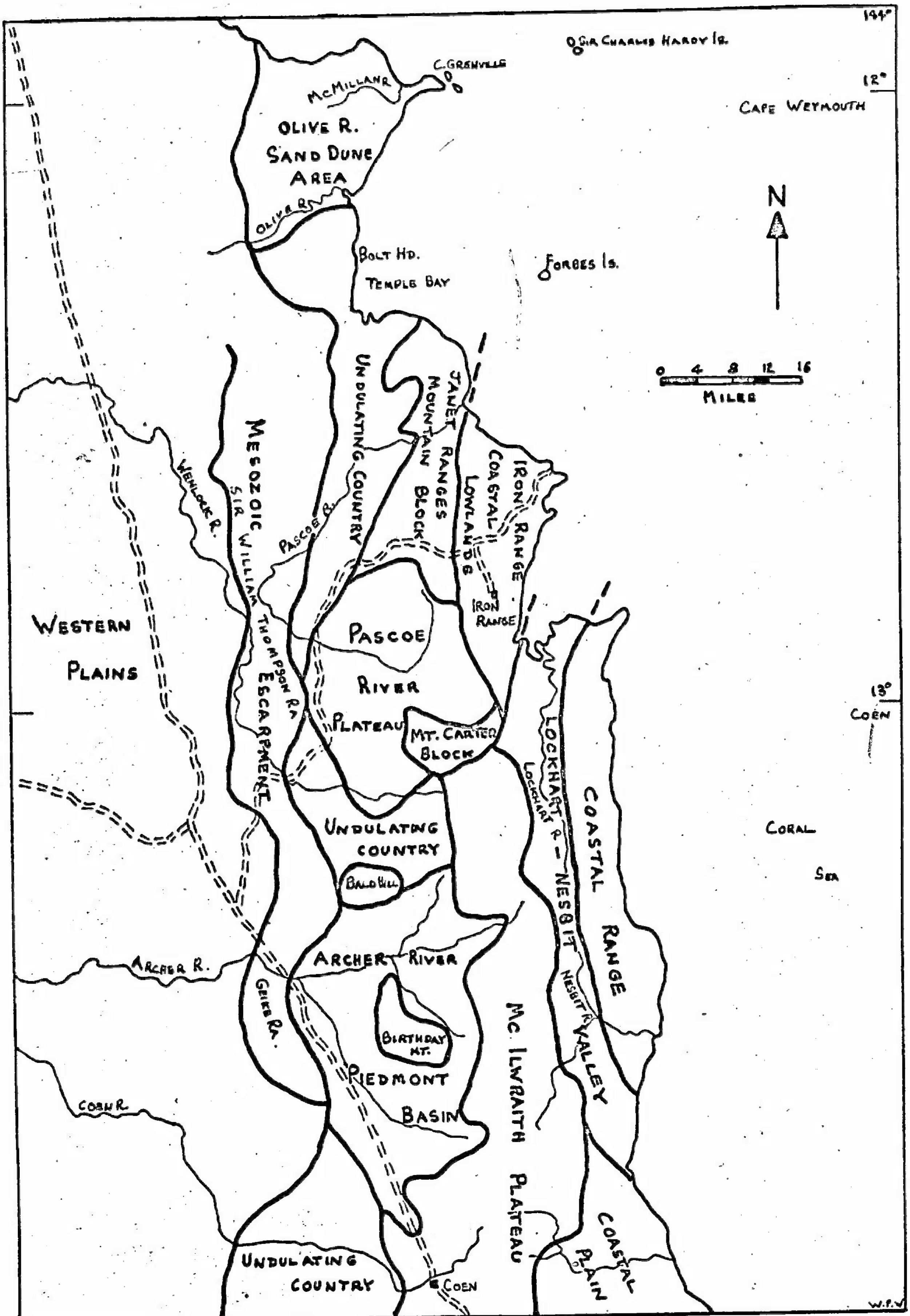


Fig. 3 Physiographic Divisions, Coen, Cape Weymouth Sheet Areas
Cape York Peninsula

Between 1957 and 1962 geologists of the Broken Hill Proprietary Company Limited carried out a reconnaissance of the igneous and metamorphic rocks of the Cape Weymouth 1:250,000 Sheet area which culminated in a detailed investigation of the iron and manganese deposits at Iron Range. In 1964 geologists of Australian Aquitaine Petroleum Limited examined and described the exposures of sedimentary rocks along the eastern limit of the Carpentaria Basin north of the Archer River, including the Carboniferous sediments exposed around the Pascoe River. These two surveys delineated most of the major rock units north of the Wenlock River and the information freely made available by the two companies has been incorporated in the maps attached to this report.

The activities of the other geologists who have reported to companies on mineral deposits since 1945 are also recorded in the section on Economic Geology.

PHYSIOGRAPHY

In the Coen and Cape Weymouth Sheet areas rugged ranges and plateaux composed of igneous and metamorphic rocks form the eastern side of Cape York Peninsula. The ranges are bordered on the east by the Coral Sea and merge westwards into flat plains extending to the Gulf of Carpentaria. They have a maximum height of 2700 feet east of Coen. To the south in the Ebagoola Sheet area they slope down to a plateau with an elevation of about 750 feet. Northwards from Coen the ranges gradually decrease in height until they are cut off by the coastline at Temple Bay.

A number of physiographic divisions can be recognized in the Coen and Cape Weymouth Sheet areas (Fig.3).

The McIlwraith Plateau is an elongate range extending from a few miles south of Coen almost to the northern margin of the Coen Sheet area. The broad, flat top of the plateau is up to 2700 feet high in the south around Coen, but slopes down to about 1000 feet further north. The southern margin of the plateau is composed of ridges of metamorphic rocks, but the remainder is developed on granite. The plateau is close to the coast and receives a high rainfall from the prevailing southeast trade winds.

The major creeks are perennial and have cut deep gorges in the edges of the plateau (Fig.4). In the south the plateau is covered by thick tropical rain forest, but to the north this becomes discontinuous and gives way to open eucalypt forest with patches of grassland. To the west of the McIlwraith Plateau two flat-topped mountains, Bald Hill and Birthday Mountain, are probably remnants isolated from the main plateau by erosion (Fig.5).

Small areas of low undulating country (500-750 feet elevation) often with a thick sand cover, occur to the west of the main plateau. These were probably derived from dissection and erosion of the plateau which was lower in elevation towards the west.

North of Coen the headwaters of the Archer River have cut back into the McIlwraith Plateau to produce the Archer River Piedmont Basin. Material derived from the erosion of the plateau has been deposited over the floor of the basin as poorly consolidated sandstone and conglomerate of the Lilyvale Beds.

A steep escarpment separates the eastern edge of the McIlwraith Plateau from the low Coastal Plain. This is an extension of the Normanby Plain, which stretches around the southern end of Princess Charlotte Bay (Lucas and de Keyser, 1965a,b). The plain is covered by thick residual sand and alluvium which are underlain by the Lilyvale Beds. The creeks which cross the plain are small and braided for most of their length, although a few major creeks descending from the plateau are perennial and flow directly to the coast. A narrow strip of marine deposits lies immediately behind the coastline.

The Coastal Plain merges northwards into the Lockhart-Nesbit Valley. This is a well watered, broad, north-trending valley which is probably formed along faults. Thick deposits of the Lilyvale Beds derived from the McIlwraith Plateau to the west cover much of the Nesbit and Lockhart valleys, but the Lockhart Valley also contains thick alluvium on which naturally treeless grassy flats are developed. The northern end of the valley has been drowned and mangrove swamps extend several miles inland from the coast.

The Lockhart-Nesbit Valley separates the McIlwraith Plateau from the Coastal Range. This is made up of a number of small ranges

Fig.4 Gorge cut in western edge of McIlwraith Plateau by the headwaters of the Coen River.

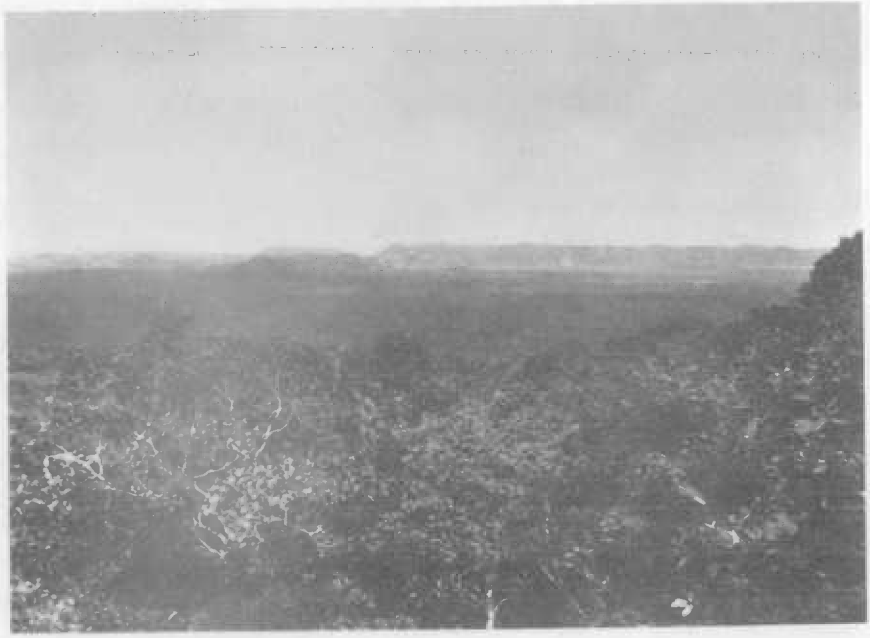


Fig.5 Looking west from the top of the McIlwraith Range across to the isolated Birthday Mountain.

separated by low saddles. The ranges average 1250 feet in height and are higher than the nearby part of the McIlwraith Plateau. They are clothed by thick rain forest with some large open grassy expanses. There is a narrow flat coastal plain between the ranges and the sea.

The Iron Range Coastal Lowlands extend northwards from the low country at the mouth of the Lockhart River Valley. They are developed on low-grade metamorphic rocks and some granite. The metamorphics crop out as low strike-ridges, up to 500 feet high, which are deeply weathered and covered by thick rain-forest. The granite forms hills of slightly higher elevation. The Coastal Lowlands are bordered on the west by the escarpment of the Pascoe River Plateau and the Janet Ranges Mountain Block. The granitic Round Back Hills (1250 feet) rise above the Lowlands in the north at Weymouth Bay.

The Pascoe River Plateau is developed on a single large sub-circular body of granite. The plateau is saucer-shaped, with a rim and escarpment around the margin, and a flat sandy depression in the centre. It has approximately the same elevation as the northern end of the McIlwraith Plateau. The eastern escarpment receives a high rainfall resulting in a thick cover of rain-forest, but the western part of the plateau supports only more open types of forest. The Pascoe River rises in the northeast of the plateau and flows across to the western margin, where it has cut through the western escarpment. A few miles further west the Pascoe River turns sharply from its northwest course to flow northeast. Originally it probably continued to flow westward into the nearby Wenlock River. The present course of the Pascoe River has apparently resulted from the capture of its head-waters by a stream flowing northeast into the Coral Sea.

The Mount Carter Block, which is composed of low-grade metamorphic rocks, is over 2000 feet in height and rises well above the southern margin of the Pascoe River Plateau (Fig.6). Creeks flowing off the block have cut deep gorges which are clothed by rain-forest, but the ridges are covered by thick, stunted heath-type vegetation. Mount Carter rises high above the surrounding country because of the greater resistance to erosion of the metamorphic rocks in comparison to the surrounding granite of the Pascoe River and McIlwraith Plateaux.

<u>The Janet Ranges Mountain Block</u> continues northwards from the Pascoe River Plateau to Temple Bay. It is a jumbled mass of steep peaks up to 1500 feet in height separated by broad, elevated valleys. A steep escarpment separates the block from the Iron Range Coastal Lowlands. The mountains are composed mainly of acid pyroclastics and volcanics with some granite. The poor soil developed on the volcanics gives rise to an open, stunted heath-type vegetation known locally as turkey-bush (Fig.7).

To the west of the Janet Ranges Mountain Block a strip of <u>low undulating country</u>, which is developed on pyroclastics, is also covered by poor soil and turkey-bush. In the same region, thick deposits of poorly consolidated Cainozoic sediments (Yam Creek Beds) form very flat turkey-bush plains. These sediments were probably deposited in a Tertiary lake which formed behind the Janet Ranges Mountain Block. Where creeks have eroded the sediments, rough broken break-away country has developed.

To the west, Mesozoic sediments overlie the igneous and metamorphic rocks. The edge of these sediments is often marked by an <u>escarpment</u> with sandstone cliffs up to 150 feet in height. The escarpment is most prominent in the Geikie Range and the Sir William Thompson Range. In places the base of the Mesozoic is as high as 1100 feet above sea level. A number of post-Mesozoic faults upthrown on the east have affected the sediments near the escarpment.

<u>The Western Plains</u> which are a northerly extension of the Carpentaria Plains (Twidale, 1966) are developed on the Mesozoic sediments and are covered by open forest. Towards the eastern escarpment they undulate gently, but further west they become very flat with only a few low rises. The creeks are broad, flat and marshy, and the interfluves are covered by residual sand and alluvium.

<u>The Olive River Sand Dune Area</u> is composed of large longitudinal dunes which trend northwest. They have an average height of 100 feet, but some are up to 300 feet high. Many dunes are still active, advancing to the northwest under the influence of the prevailing southeasterly winds. Others have been stabilized by thick low bush. The dunes have probably resulted from the reworking of residual sand derived from the weathering of the underlying Mesozoic sandstones.

Fig.6 The Mount Carter Block, rising above the Pascoe River Plateau.

Fig.7 Open stunted vegetation developed on the high mountains of the Janet Ranges Mountain Block. Mesozoic plateau in background.

Development of Physiography: The ranges on the Coen Sheet area are thought to have resulted partially from the Tertiary or Quaternary uplift of the eastern side of the Peninsula. The maximum uplift was to the south in the Coen area, where streams flowing from the McIlwraith Plateau have been rejuvenated and have cut deep gorges back into the plateau. To the west, towards the Mesozoic escarpment, the base of the Mesozoic sediments is in places as much as 1100 feet above sea level. However, to the north in the Iron Range/Temple Bay area, the base of the Mesozoic sediments disappears below sea level, and the mouths of valleys have been drowned. Thus, a general tilting of the Peninsula has taken place with uplift in the south and subsidence in the north. The movements may have been initiated along the continuation of the Palmerville Fault, which is believed to extend along the eastern coast of the Peninsula (de Keyser, 1963).

DESCRIPTION OF ROCK UNITS

Table 2 summarizes the rock units mapped in the Coen and Cape Weymouth Sheet areas.

Table 2 : Summary of Rock Units, Coen-Cape Weymouth Sheet Areas

AGE		NAME	DESCRIPTION	RELATIONSHIPS
CAINOZOIC	Quaternary	Marine sediments	Beach sand, estuarine mud, coral limestone	Thin, on old rocks along coast
		Dune sand	+100 ft quartz sand	Partly drifting over older rocks
		Laterite	+10 ft limonitic matrix in leached sandstone. Thick limonitic deposit on iron-bearing schist	Developed on Yam Creek Beds and Iron Ra. Schist
		Gravel	Small fans	Abuts steep slopes
		Alluvium	Silt and clay	Merges into sand along mature rivers
		Sand	Thin. Quartzose	Residual on granite, quartz schist and sandstone
	?Tertiary	Yam Creek Beds	200 ft max. Soft sandstone and conglomerate	Lie on volcanics, granite and Pascoe River Beds
		Lilyvale Beds	+30 ft soft sandstone and conglomerate	Mostly on granitic rocks
MESOZOIC	Cretaceous?	Carpentaria Basin sediments		
		Siltstone unit	Marine mudstone, siltstone and fine sandstone	Overlaps sandstone unit
		Sandstone unit	Medium to coarse pebbly sandstone, basal conglomerate	Unconformable on Pascoe River Beds, volcanics and older rocks
		Laura Basin sediments?	Cross-bedded coarse sandstone	?equivalent to sandstone on coast of Ebagoolen Sheet area

Table 2(contd)

	AGE	NAME	DESCRIPTION	RELATIONSHIPS
PALAEOZOIC	Permian	Twin Humps Adamellite	Hornblende-biotite adamellite, leucocratic biotite granite. Medium to coarse, porphyritic in part	Intrudes Arkara-type gneiss, Kintore and Lankelly Adamellites
	?Permian	Wolverton Adamellite	Leucocratic biotite granite on adamellite. Fine to medium, even grained.	Intrudes Lukin-type schist, Cape York Peninsula Batholith
	Permian	Weymouth Granite	Hornblende-biotite or biotite granite or adamellite. Medium to coarse, porphyritic	Intrudes Sefton Metamorphics, Cape York Peninsula Batholith, undifferentiated volcanics, Janet Ranges Volcanics, diorite and granophyric and hybrid intrusives
		diorite satellite bodies	Quartz-biotite-hornblende diorite, hornblende-biotite, tonalite. Medium, even-grained.	Intrudes Kintore Adamellite and Iron Range Schist. Intruded by Weymouth Granite
	?Permian	granophyric and hybrid intrusives	Hornblende biotite, biotite micro-adamellite to adamellite, some granodiorite. Fine-grained clotted **texture**	Intrude Kintore Adamellite, Janet Ranges Volcanics and Kangaroo River Volcanics. Intruded by Weymouth Granite
	Permian to Carboniferous	Undifferentiated volcanics	Acid tuff and agglomerate, intrusive breccia, metabasalt	Intrude Bolt Head Schist, overlie Kintore Adamellite, intruded by Weymouth Granite
		Cape Grenville Volcanics	Rhyolite flows, welded pumice-flow tuff, airfall tuff and agglomerate	None exposed
		Kangaroo River Volcanics	Basic, intermediate and acid lavas, acid welded tuff, welded crystal tuff	Intruded by granophyric granite, Weymouth Granite
		Janet Ranges Volcanics	Rhyolite flows, welded pumice-flow tuff, welded crystal tuff	Overlie Pascoe River Beds. Intruded by Weymouth Granite, granophyric and hybrid intrusives

Table 2 (contd)

AGE			NAME	DESCRIPTION	RELATIONSHIPS
PALAEOZOIC	Lower Carboniferous		Pascoe River Beds	Sandstone, shale, siltstone, chert, greywacke, arkose, some tuff and coal. Fossils: Lepidondedron, Cordaites, Rhacopteris	Overlie Sefton Metamorphics. Overlain by Janet Ranges Volcanics
	Upper Devonian	CAPE YORK PENINSULA BATHOLITH	Morris Adamellite	Biotite adamellite, Medium to coarse, porphyritic	Intrudes Lukin-type schist and Kintore Adam^llite. Intruded by Wolverton Adamellite
			Flyspeck Granodiorite	Biotite granodiorite, hornblende-biotite tonalite, biotite hornblende diorite, biotite tonalite. Fine to medium even-grained	Intrudes Holroyd, Dargalong and Sefton Metamorphics. Intruded by Wigan and Norris Adamellite
			Kintore Adamellite	Muscovite-biotite adamellite, some granite. Medium even-grained. Massive to banded	Intrudes Holroyd, Dargalong and Sefton Metamorphics. ? Intrudes Blue Mountains Adamellite
			Wigan Adamellite	Biotite adamellite, some granite. Fine to coarse, p orphyritic in p laces	Intrudes Sefton Metamorphics. Intruded by Weymouth Granite and Wolverton Adamellite. ?Grades into Kintore Adamellite
			Lankelly Adamellite	Biotite adamellite, some muscovite and leucocratic granite. Coarse-grained, largely porphyritic	Intrudes Dargalong Metamorphics. Grades into Kintore Adamellite. Intruded by Twin Humps
			Blue Mountains Adamellite	Biotite adamellite, hornblende-biotite adamellite. Fine, even-grained; coarse in places	?Intruded by Kintore Adamellite

AGE	NAME	DESCRIPTION	RELATIONSHIPS
?PROTEROZOIC	Sefton Metamorphics		
	Undifferentiated	Muscovite-quartz schist, quartzite, minor gneiss	Intruded by Cape York Peninsula Batholith, Weymouth Granite. Grades into Dargalong and Holroyd Metamorphics to south; Mount Carter Schist to north
	Bolt Head Schist	Chlorite-quartz schist, quartzite, schistose limestone	Intruded by undifferentiated volcanics
	Iron Range Schist	Muscovite-quartz schist, heamtite-quartz schist, magnetite-quartzite, greenstone, calc-silicate rocks	Intruded by Kintore Adamellite. ?Overlain by Janet Ranges Volcanics, Kangaroo River Volcanics. Intruded by Weymouth Granite
	Mount Carter Schist	Muscovite-quartz schist and phyllite, quartzite	Intruded by Weymouth Granite
	Holroyd Metamorphics		
	Pretender-type schist	Feldspar-biotite-muscovite-quartz schist, quartzite, minor greenschist	Intruded by Cape York Peninsula Batholith and Wolverton Adamellite. Grade into Dargalong Metamorphics with an increase in metamorphic grade. Pretender-type schist grades into Lukin-type schist
	Lukin-type schist	Muscovite-quartz schist and phyllite, quartzite	
	Dargalong Metamorphics		
	Undifferentiated	Biotite-quartz-feldspar gneiss, muscovite-quartz schist, quartzite; minor amphibolite, marble, calc-cilicate rock.	Intruded by Cape York Peninsula Batholith. Arkara-type gneiss grades into Saraga-type schist.
	Saraga-type schist	Muscovite-quartz schist, quartzite	
	Arkara-type gneiss	Biotite-quartz-feldspar gneiss; minor garnet-biotite-muscovite-quartz gneiss, amphibolite, quartzite	

?Proterozoic Metamorphic Rocks

Trail et al. (1968) subdivided the metamorphic rocks of the Ebagoola Sheet area into Dargalong Metamorphics and Holroyd Metamorphics. The Dargalong Metamorphics are composed of gneiss and coarse-grained schist, and the Holroyd Metamorphics are composed of fine-grained schist and phyllite. The distinction between these two subdivisions is made on metamorphic grade and location; the Dargalong Metamorphics formed under the conditions of the almandine-amphibolite facies of regional metamorphism, and occur generally in the east. The Holroyd Metamorphics formed in the greenschist facies and occur in the west. The two belts of metamorphics are now separated by a batholith of granitic rocks, but originally they were probably continuous.

On these grounds, in the Coen Sheet area, coarse-grained schist and gneiss on the east side of and within the batholith have been named Dargalong Metamorphics, and fine-grained schist on the west side of the batholith has been named Holroyd Metamorphics. The rocks are more or less continuations of similar rock types in the Ebagoola Sheet area.

In the Cape Weymouth Sheet area and in the northern part of the Coen Sheet area, fine-grained schist and quartzite crop out east of the batholith. They have been metamorphosed in the greenschist facies, and are similar in metamorphic grade to the Holroyd Metamorphics. However they are a great distance from the type area of the Holroyd Metamorphics and they contain rock types such as hematite-quartz schist and schistose limestone, which have not been found in the Holroyd or Dargalong Metamorphics. These low-grade metamorphics have therefore been named separately the Sefton Metamorphics.

The Dargalong Metamorphics, Holroyd Metamorphics and Sefton Metamorphics represent different intensities of metamorphism, and to a certain extent different rock types, within a single belt of metamorphic rocks, which is now much disrupted by the batholith (Fig.8).

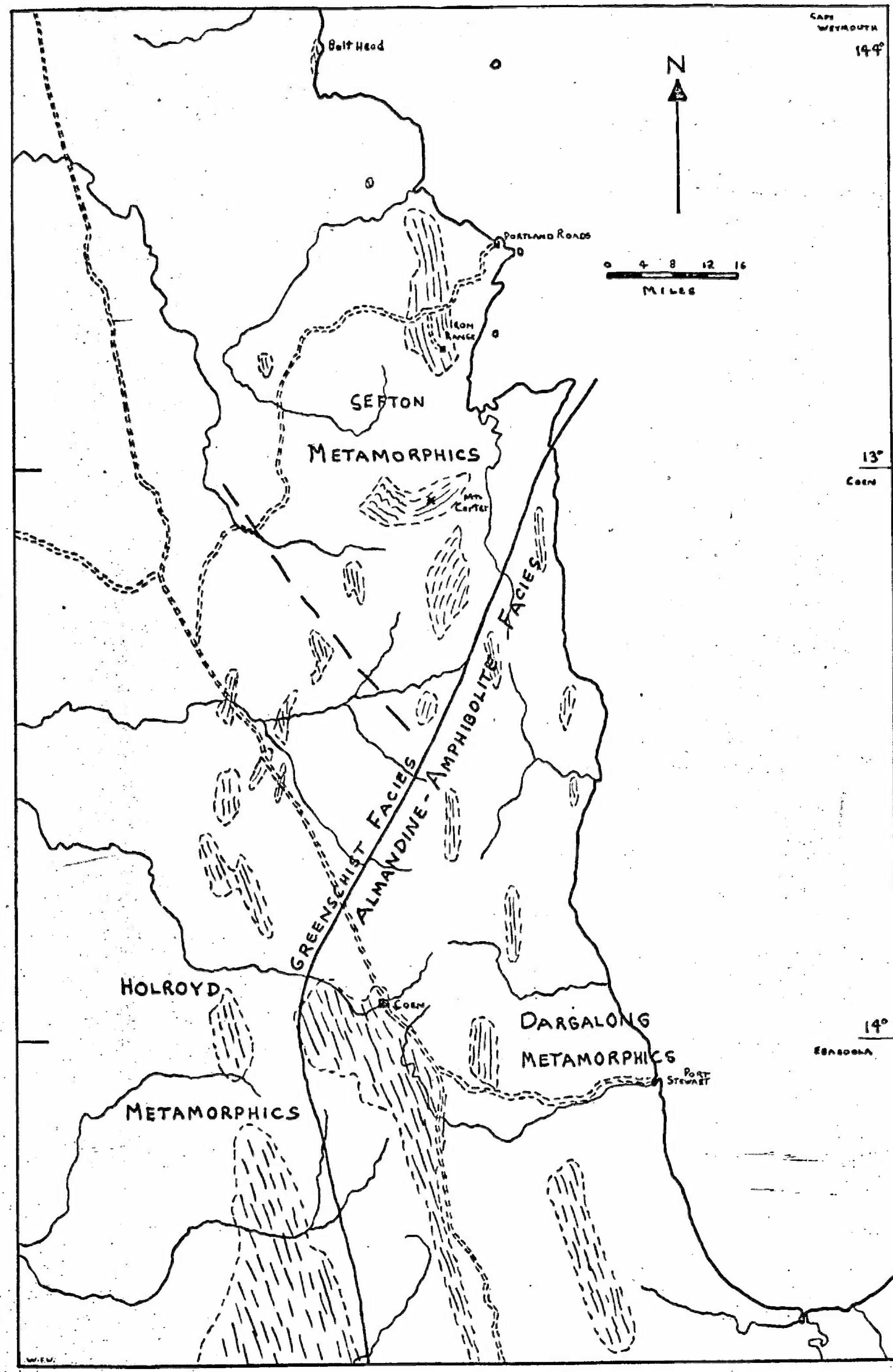


FIG.8 DISTRIBUTION OF METAMORPHIC ROCKS, EAST-CENTRAL CAPE YORK PENINSULA

DARGALONG METAMORPHICS

The Dargalong Metamorphics in the Coen Sheet area are gneisses and coarse-grained schists in the almandine-amphibolite facies of regional metamorphics and are continuations of similar rocks to the south. The two largest areas of outcrop are southwest and southeast of Coen. In these areas the metamorphics are composed of rocks of two lithological units, the Arkara-type gneiss and the Saraga-type schist, as described by Trail et al. (1968). Smaller discontinuous bodies of metamorphic rocks occur within the Devonian batholith northeast of Coen; they have been included within the Dargalong Metamorphics but have not been differentiated into lithological types.

Arkara-type gneiss

The Arkara-type gneiss extends north from the Ebagoola Sheet area in a belt immediately to the west of Coen. It is flanked on the west and east by Saraga-type schist and in the north is intruded by Twin Humps Adamellite. The main rock type is biotite-quartz-feldspar gneiss; garnet-biotite-muscovite-quartz gneiss, amphibolite and quartzite are found in small quantities.

The biotite-quartz-feldspar gneiss is massive, medium-grained to coarse-grained, banded and poorly to moderately schistose. Usually both plagioclase (calcic oligoclase to sodic andesine) and potash feldspar are present, but plagioclase is dominant, occurring in normally fresh and unstrained subhedral laths. The potash feldspar is multiple twinned microcline which occurs usually as irregular poikioblastic porphryoblasts. Untwinned grains which commonly occur together with the microcline may be plagioclase or potash feldspar. Total feldspar content ranges from 40 to 50 percent. The quartz grains are equent to irregular in shape. They show little strain and are almost devoid of inclusions. Biotite makes up from 15 to 20 percent of the rock; garnet, zircon and sphene form scattered rounded grains.

The gneiss is massive to weakly schistose; banding is usually prominent though the bands are commonly irregular, especially where feldspar phenocrysts are numerous or large. In some places the gneiss is massive and non-banded and can only be distinguished from the more basic granitic rocks nearby by the presence of garnet. The strike of the gneissic banding and of the schistosity broadly parallels the trend of the metamorphic belt, which is northwest to north-northwest.

Garnet-biotite-muscovite-quartz gneiss is generally only found bordering the muscovite-rich Saraga-type schist belts. Muscovite and quartz make up the bulk of the rock (between 70 percent and 90 percent) with biotite, potash feldspar, plagioclase and garnet forming the remainder. These rocks differ from the Saraga-type schist in their massive granoblastic nature and because they contain garnet, biotite and feldspar.

The amphibolite is massive, fine-grained to medium-grained and lineated. It is composed of roughly equal amounts of hornblende and plagioclase. The hornblende forms xenoblastic equant to elongate grains. Specimens which have a predominance of elongate grains have a well developed lineation. The plagioclase is labradorite and occurs as laths partially or completely altered to clinozoisite. Garnet and quartz are present in scattered equant grains.

Quartzite, like the muscovite-bearing gneiss, is generally only present near the contact of the Arkara-type gneiss with the Saraga-type schist. Quartz makes up over 95 percent of the rock. It forms strained, irregular to equant grains which are randomly orientated, but they appear to have a well defined optical orientation. Muscovite and feldspar are found in amounts less than 5 percent.

Thermal effects of the neighbouring granitic rocks have been slight in the main belt of gneiss southwest of Coen. However the microcline porphyroblasts which are common in the more granoblastic gneiss may have been produced by thermal or metasomatic effects. The metamorphic facies of the rock is difficult to determine because of the absence of indicative minerals; it probably lies about the middle of the almandine-amphibolite facies of regional metamorphism.

One isotopic age determination undertaken on a specimen of gneiss from the Coen/Rokeby road gave an Upper Devonian age (A. Webb, pers. comm.). As this is also the age obtained from the Kintore

Adamellite it is possibly due to overprinting caused by the intrusion of the adamellite.

Saraga-type schist

The Saraga-type schist crops out in two belts, one to the west and south of Coen, where it is interbanded with Arkara-type gneiss, and one to the southeast of Coen, north from the Port Stewart road. Interbanded resistant quartzite gives this unit a higher and more rugged relief than that developed on the Arkara-type gneiss, but the schist is poorly exposed, especially the finer-grained varieties. Two rock types are dominant. The most abundant is muscovite-quartz schist. Less abundant, though more prominent in outcrop, is quartzite and micaceous quartzite.

The muscovite-quartz schist is fine-grained to medium-grained, and even-grained apart from aggregates of muscovite. Schistosity is moderately well to very well developed, but muscovite in muscovite-rich bands shows only a poor preferred orientation. In places layers of sericite, which alternate with layers of quartz, appear to be formed of pseudomorphs of sericite after sillimanite. In places muscovite also forms random porphyroblasts. The quartz grains are either equant, or elongate parallel to the banding; both types are strained. Garnet, which forms equant, small porphyroblasts, is an uncommon accessory. Hematite and limonite(?) make up to 10 percent of some specimens. The hematite forms irregular or elongate flakes which parallel the schistosity.

The quartzite is medium-grained and massive. Apart from quartz, muscovite and hematite are the only other common minerals. The quartz forms irregular or elongate grains; the latter are aligned parallel to the schistosity. Recrystallization is evident around the margins of some grains.

Dykes and veins of muscovite-quartz-feldspar pegmatite and aplite intrude and slightly metamorphose the schist. These are most abundant near the contacts of the schist with surrounding granitic rocks.

The belt to the southeast of Coen contains minor interbanded biotite-quartz-feldspar gneiss and amphibolite in addition to muscovite-quartz schist; quartzite is uncommon in this belt. These are the rock types of the Arkara-type gneiss, but this belt has been mapped as Saraga-type schist because of the predominance of muscovite-quartz schist. The gneiss is fine-grained to medium-grained and banded. It has a moderately well developed schistosity. The amphibolite is fine-grained and even-grained and is slightly lineated. It is usually only exposed as rubble on hillsides but at one locality it is interbanded with biotite-quartz-feldspar gneiss.

The original metamorphic facies of the Saraga-type schist was middle to upper almandine-amphibolite facies. There has been subsequent retrogression to the upper greenschist facies; this may be a result of the intrusion of the Kintore Adamellite.

In the Coen Sheet area the Arkara-type gneiss and Saraga-type schist have been derived from sediments of a single sedimentary sequence. They are interbanded on a large scale in the southwest belt and on a small scale in the southeast belt. Some overlap exists between the two rock types; intermediate types such as biotite-muscovite-quartz gneiss are developed near the contact of the two units. The Arkara-type gneiss was probably derived from greywacke and the Saraga-type schist from clayey siltstone and quartz sandstone. The amphibolite contains considerable amounts of quartz in places and these rocks probably were derived from dolomitic sediments rather than from basic igneous rocks.

Undifferentiated rocks

Numerous masses of medium-grade to high-grade metamorphics occur within, or adjacent to, the Kintore Adamellite along the eastern flank and southern end of the coastal range. Similar rocks crop out along the eastern escarpment of the McIlwraith Range between Massy and Leo Creeks, and near the west flank of the range to the north and south of the Leo Creek road. Only the largest bodies are shown on the geological map, and many bodies, particularly in the coastal range, are too small to be shown on the map. The masses of metamorphic rock range from 10 miles long by 3 miles wide, at the head of the Rocky River and to the north of the Leo Creek road, to many scattered bodies only a few feet across. In all these, the metamorphic rocks are intimately associated with muscovite-biotite adamellite, muscovite granite, and pegmatite and aplite typical of the Kintore Adamellite.

The most abundant metamorphic rocks are biotite-quartz-feldspar gneiss, muscovite-quartz schist and quartzite. Amphibolite, marble, and calc-silicate rocks are less abundant. All these rock types except the marble and calc-silicate rocks grade into foliated granitic rocks, which surround the bodies and which commonly form bands within them. Consequently almost all the bodies of metamorphics are ill defined.

Biotite-quartz-feldspar gneiss is abundant in the large body on the east flank of the McIlwraith Range at Rocky River, and in the coastal range. The gneiss is a medium-grained to coarse-grained, well foliated rock; in some exposures, particularly in the south, it is crudely banded and almost massive. The gneiss is generally even grained but in many places it contains abundant porphyroblasts, boudins, or aggregates of quartz and feldspar. In many exposures small amounts of muscovite are present. On the coast 4 miles southeast of Whale Hill scattered small crystals of garnet are present in the gneiss. One thin section of the gneiss contains microcline perthite (50 percent), quartz (30 percent), calcic oligoclase (15 percent), biotite (3 percent), muscovite (2 percent), and accessory monazite.

At the First Red Rocky Point bodies of porphyroblastic biotite-quartz-feldspar gneiss up to 50 feet thick are contained in foliated biotite adamellite. The gneiss is composed of bands rich in quartz and feldspar and bands rich in biotite, each a few inches thick, interbanded with, and cut by, veins of garnet aplite up to 1 foot thick. The surrounding adamellite has irregular variations in grain size and has a foliation produced by schlieren of quartz and feldspar and schlieren rich in biotite.

Muscovite-quartz schist and muscovite quartzite form several bodies over 300 feet long in the Kintore Adamellite near the north end of Whale Hill. Muscovite-quartz schist forms xenoliths, contorted bands and at least one body hundreds of feet across in the adamellite along the eastern flank of the McIlwraith Range. Similar rocks are exposed in the Embley Range south of the Nesbit River. The muscovite-quartz schist is commonly hornfelsed or otherwise affected by the intrusion of granitic or allied pegmatitic rocks. Massive white quartzite crops out at the southeastern end of the Chester Range; at the northeastern end it is interbanded with muscovite-quartz schist, amphibolite and calc-silicate rocks. These metamorphics are intruded both by muscovite-biotite adamellite and by granitic dykes.

Small quantities of biotite are common in the muscovite-quartz schist in places, and some of the schist also contains feldspar. Muscovite-biotite-quartz schist and biotite-muscovite-quartz-feldspar schist crop out on the west side of the Macrossan Range, and a very coarse-grained muscovite-quartz schist is closely associated with muscovite granite at the summit of this range. Fine-grained to medium-grained mica-quartz schist is the dominant rock type in the large belt of metamorphics to the north of the Leo Creek road. Both muscovite and biotite are present, together with small amounts of feldspar and garnet, and in one specimen, sillimanite. These schists are interbanded with quartzite and with minor amphibolite. In the southern part of the belt the schist is fine grained and has a well developed schistosity; in the north it is coarser and approaches a gneiss in texture. A body of similar rocks crops out within the Kintore Adamellite south of the Leo Creek road.

Sillimanite-muscovite-quartz schist, in association with other mica-quartz schist, is prominent in bodies of metamorphics, too small to show on the map, along the eastern flank of the McIlwraith Range north of the Chester River. In places it is massive, elsewhere it has a contorted schistosity. A sample of this schist contains biotite and a considerable amount of feldspar. This rock is made up of quartz (35 percent), potash feldspar (35 percent), plagioclase (10 percent), biotite (15 percent), muscovite (2 percent), sillimanite (1 percent), and accessory rutile.

Amphibolite is prominent in many exposures of the metamorphic rocks. Three miles north of Whale Hill masses of amphibolite up to 50 feet across occur in isolation in foliated Kintore Adamellite. The amphibolite is generally a black, medium-grained to coarse-grained rock forming bands between 1 foot and 20 feet thick in gneiss and schist. In places between Whale Hill and the Meston Range black amphibolite is interbanded with light green calc-silicate rock.

Fig.9 Dargalong Metamorphics. Contact of amphibolite block with gneissic Kintore Adamellite.

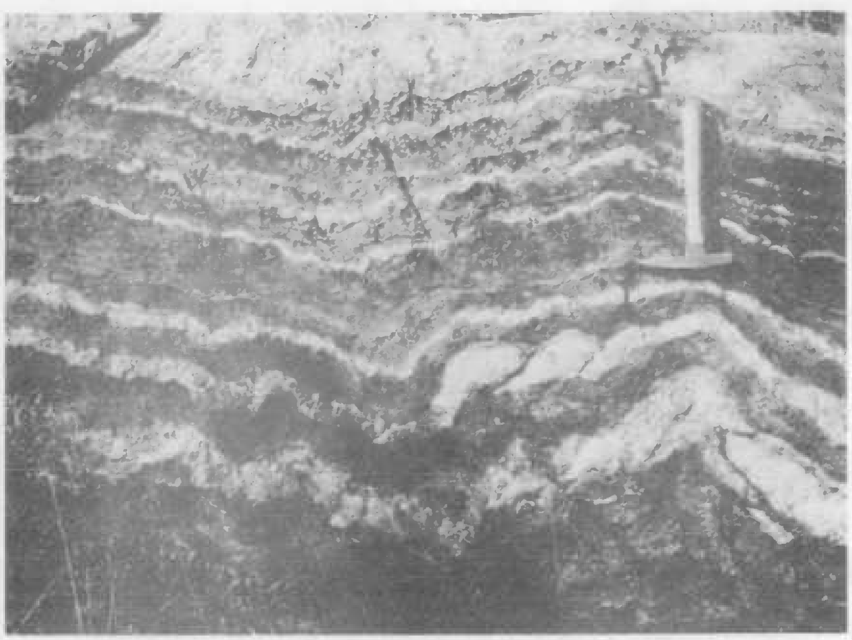


Fig.10 Holroyd Metamorphics. Hornfelsed Lukin-type schist with interbanded pegmatite veins.

The amphibolite commonly has a marked lineation produced by a strong preferred orientation of hornblende crystals, which range up to 1 inch long. Some amphibolites are massive rocks and resemble dolerite; a few of these contain small phenocrysts of feldspar. One band of amphibolite, 50 feet thick, is crowded with garnet crystals up to $\frac{1}{4}$ inch across. Many amphibolites contain bands or veins, up to 1 inch thick, of quartz and feldspar which outline tight folds; some are ptygmatic veins. A line of small blocks of amphibolite in foliated adamellite at the First Red Rocky Point resemble a disrupted dyke.

Small patches of calc-silicate rocks and associated amphibolite and amphibole-biotite-quartz schist occur within Kintore Adamellite and are interbanded with schist and gneiss at several localities in the McIlwraith Range and in the coastal ranges. The largest area of calc-silicate rocks lies just south of the Leo Creek road in the headwaters of Peach Creek, and is 4 miles long and 1 mile wide. The rocks are dark, fine-grained, banded and schistose, and rich in ferromagnesian minerals, except for one outcrop several hundred yards long of white impure marble. Two small pods of similar rocks occur a few miles to the northwest, and other calc-silicate rocks and masses of marble are present in the metamorphics on the eastern side of the McIlwraith Range south of the Rocky River.

In the coastal range the calc-silicate rocks are light green, fine-grained to medium-grained, and are commonly made up of bands $\frac{1}{8}$ inch to $\frac{1}{2}$ inch thick, alternately rich in light and dark minerals. This banding parallels the schistosity and foliation in the schist and gneiss with which the rocks are interbanded. Masses of marble up to 30 feet thick and 100 feet long occur in places. The marble is white, very coarse-grained, and massive where fresh; on some weathered surfaces bands between 1 inch and 3 feet are evident.

TABLE 3 : MINERAL ASSEMBLAGES IN CALC-SILICATE AND ASSOCIATED ROCKS OF THE DARGALONG METAMORPHICS

Calcium-magnesium-rich assemblages

Talc-serpentine-calcite
Chondrodite-serpentine-calcite
Quartz-serpentine-calcite
Chondrodite-quartz-tremolite-diopside-calcite
Diopside-quartz-calcite-tremolite
Sphene-actinolite (?)-chlorite (?)-talc-calcite-diopside

Magnesium-iron-rich assemblages

Tremolite-diopside
Brucite (?)-chondrodite-tremolite-diopside
Tremolite-anthophyllite-diopside
Rutile-calcite-garnet-forsterite(?)-talc-chondrodite

Magnesium-iron-silica assemblages

Quartz-tremolite
Clinozoisite-serpentine-diopside-quartz
Sphene-tremolite-diopside-quartz

Other assemblages

Diopside-tremolite-chondrodite-plagioclase-quartz
Plagioclase-iron oxides-biotite-quartz-hornblende
Diopside-biotite-plagioclase-hornblende-quartz
Hornblende-biotite-quartz-plagioclase
Tourmaline-pyroxene-sphene-tremolite-quartz-plagioclase

The mineral assemblages observed in the calc-silicate rocks are listed in Table 3. Minerals identified include calcite, diopside-hedenbergite, tremolite, chondrodite, forsterite, garnet, talc, hornblende, biotite, serpentine, quartz and feldspar.

Calcite is nearly always present; commonly it forms a groundmass to amphibole, pyroxene and talc crystals. However in the marble it forms up to 95 percent of the rock, and occurs as a simple mosaic of polydedral grains; grains with crenulated margins are uncommon. The twin lamellae are narrow, suggesting that the rock has not undergone such deformation during or after metamorphism.

The diopside-hedenbergite (hedenbergite has been identified in one specimen) forms large subhedral crystals which are usually intimately associated with tremolite. A poikiloblastic texture is common; the included minerals are quartz or chondrodite. Tremolite occurs as long subhedral laths which are generally colourless, though some are pale green and pleochroic. X-ray diffraction suggests that it contains about 10 percent actinolite. It is commonly poikiloblastic and encloses quartz grains. In some specimens it appears to be altering to tremolite. Chondrodite is a characteristic mineral of these calc-silicate rocks. It forms either xenoblastic porphyroblasts or it occurs in accessory amounts as small rounded grains. A pale yellow pleochroic type and a colourless type are found; the latter may be forsterite as some grains are length-slow. The chondrodite is partially or wholly altered to serpentine. Talc and garnet are of limited occurrence in these rocks. Hornblende, biotite, feldspar and quartz are restricted to the more schistose and non-calcareous assemblages.

The mineral assemblages quoted in Table 3 fit a regional metamorphism in the almandine-amphibolite facies of an interbedded impure dolomitic sequence. This is in agreement with the type of metamorphism deduced for the main bulk of the Dargalong Metamorphics in the south and east of the Coen Sheet area.

HOLROYD METAMORPHICS

The Holroyd Metamorphics are composed of fine-grained schist and phyllite which were metamorphosed under the conditions of the green-schist facies. To the south in the Ebagoola Sheet area they were subdivided into four lithological units (Whitaker and Willmott, 1968), two of which, the Lukin-type schist and the Pretender-type schist, extend into the Coen Sheet area. These units have been separated on mineral and textural differences and are not necessarily metamorphosed equivalents of specific sedimentary units.

Lukin-type schist

The Lukin-type schist occurs in a number of discontinuous outcrops within granitic rocks extending from the Coen River north to Bald Hill. It is composed of muscovite-quartz schist and phyllite with interbedded massive white quartzite. The mica-rich rocks are fine-grained with a well developed schistosity. In hand-specimen individual mineral grains are not visible in the finer grained types and these are classed as phyllite.

In the schist and phyllite, quartz and muscovite occur in about equal amounts and are the main constituents. The quartz forms xeno-blastic, interlocking grains which show some strain; they are commonly elongate parallel to the schistosity. The small flakes of muscovite or sericite in the phyllite have a well developed preferred orientation and are concentrated in bands which alternate with quartz-rich layers, giving the rock a distinct foliation. Biotite is a minor constituent of some schist and is usually associated with the muscovite. Garnet is present in accessory amounts in some schist relatively rich in biotite; it forms porphyroblasts up to 1 mm in size. Hematite is common and together with limonite makes up to 10 percent of some rocks. Graphite is also present in some specimens. The hematite-bearing schist is generally interbanded with massive quartzite.

The quartzite consists predominantly of quartz together with small amounts of muscovite, iron oxides and graphite. It is massive and granoblastic or weakly schistose. Thin bands of hematite-muscovite-quartz schist are common within the larger quartzite bands.

The schist and phyllite have a well developed schistosity due to the preferred orientation of mica flakes in some places. The schistosity is crenulated, the muscovite flakes are bent, and minor recrystallization of muscovite and possibly of quartz, has taken place along the axes of the crenulation. In one specimen microshears and zones of disruption and recrystallization cut the schistosity at a high angle. Some fragments of unaltered schistose material 2 mm to 3 mm in size are preserved; some retain their original orientation, others have been slightly rotated. This shearing and disruption and the more widespread crenulation could be due to the intrusion of the adamellites to the east or could be the result of shearing movements which have affected the Kintore Adamellite.

Bedding in the Lukin-type schist is only discernible on a large scale, where it is expressed by interbanded schist and quartzite. The strike of the schistosity ranges from 350° to 060° and is usually

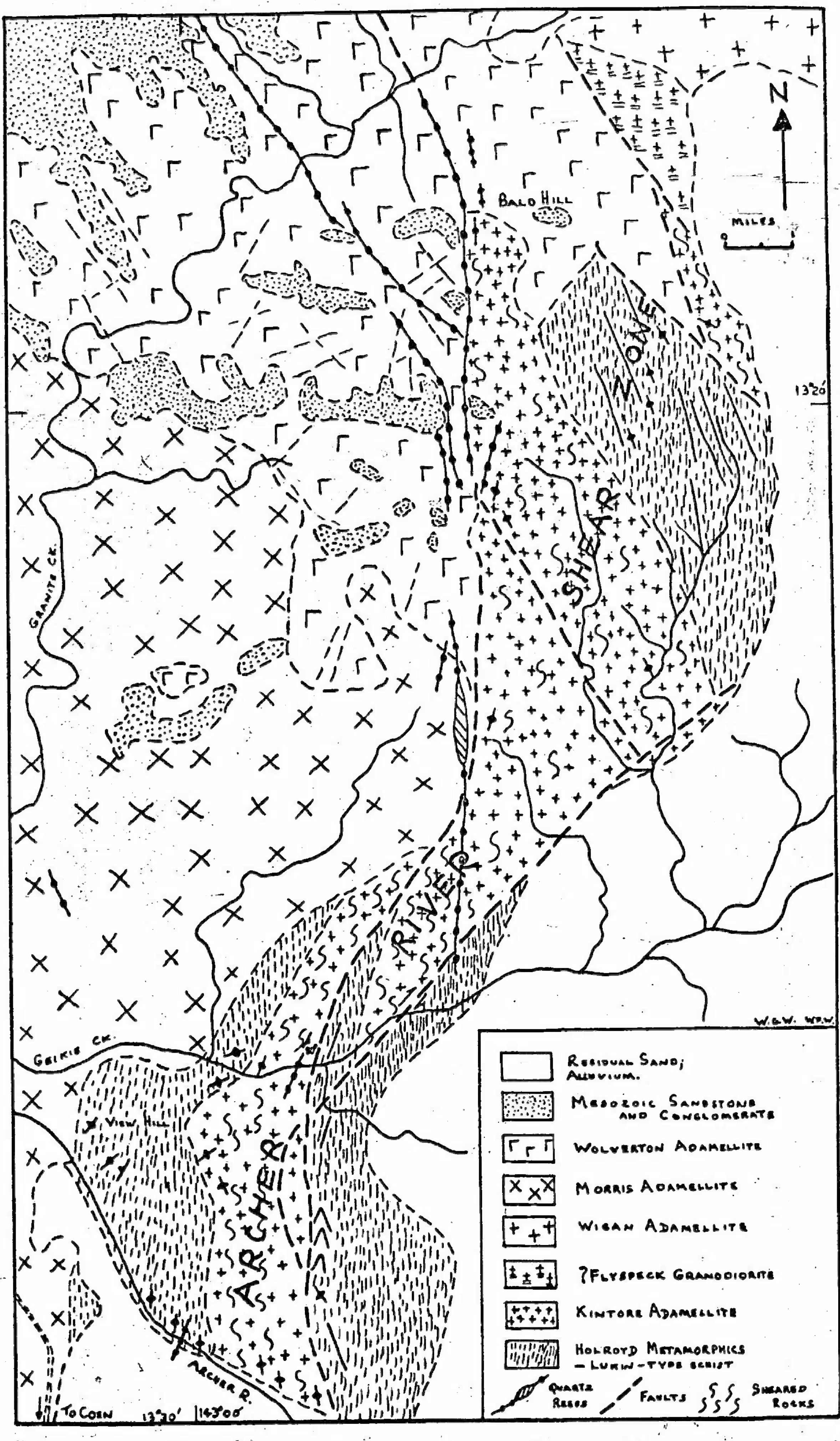


Fig. 11. The Archer River Shear Zone

coincident with the strike of the bedding. The schistosity dips steeply east or west. No large-scale folding is discernible in the Lukin-type schist. To the north of the Archer River and Geikie Creek, in the Archer River shear zone (Fig.11), the schist is cut by faults which extend into the adjoining sheared Kintore Adamellite, but it has not been noticeably affected by the shearing.

The Lukin-type schist has been intruded by the Kintore Adamellite and by the Morris Adamellite. Near the contact the Kintore Adamellite has produced hornfels and some migmatite in the schist, particularly in the Archer River shear zone. Five miles upstream from the telegraph line crossing of the Archer River, the schist has been contorted, recrystallized and injected by ptygmatic veins of quartz and feldspar; a specimen of schist has the composition biotite (5 percent), muscovite (10 percent), oligoclase (25 percent), and quartz (60 percent). The recrystallized rocks occur in a zone several hundred yards wide immediately adjacent to sheared Kintore Adamellite. Away from the contact the schist is little affected, though it is cut by quartz-feldspar veins and by muscovite-quartz-feldspar pegmatite dykes. A specimen obtained 2 miles from the contact has the composition garnet (3 percent), biotite (5 percent), muscovite (30 percent), and quartz (60 percent), together with accessory amounts of tourmaline, andalusite, and staurolite. Contacts of the schist with the Kintore Adamellite are gradational, especially in the Archer River shear zone, with recrystallized schist grading into gneiss and migmatite towards the contact.

In contrast, contacts with the Morris Adamellite are fairly sharp, although the schist adjacent to the adamellite has been recrystallized and metasomatized. Near the southwest margin of the Morris Adamellite near Baker Creek muscovite-quartz schist has been intruded by tourmaline-muscovite-quartz-feldspar pegmatite dykes which broadly parallel the schistosity. The schists have been recrystallized and metasomatized, giving rise to plagioclase-muscovite-tourmaline-quartz rocks. The tourmaline forms equant, or rarely, elongate porphyroblasts which have a random orientation. Although the rocks generally have a hornfelsic texture, the original schistosity has been preserved in places. Near the pegmatite dykes biotite and possibly muscovite have been introduced together with minor amounts of tourmaline and plagioclase.

The Lukin-type schist probably lies in the upper part of the greenschist facies of metamorphism as andalusite, sillimanite, kyanite and staurolite are not generally present. Plagioclase and tourmaline are atypical and are probably a result of thermal metamorphism and metasomation.

Pretender-type schist

The Pretender-type schist forms a small belt of low-grade metamorphics to the west of Coen. The belt trends north and extends from the Ebagoola Sheet area as far as Tadpole Creek. A small pod of metamorphics to the north of Tadpole Creek and two inliers of quartzite within the Mesozoic sediments to the west have been included with the Pretender-type schist. The metamorphics are bounded by Kintore Adamellite on the northwest, north and east, and are overlain by Mesozoic sediments on the west.

The Pretender-type schist consists predominantly of medium-grained or coarse-grained feldspar-biotite-muscovite-quartz schist, which is interbanded with massive, white quartzite and some rare chlorite-actinolite greenschist. In the schist, feldspar may or may not be present and the proportion of biotite and muscovite varies; thus the rocks range in composition from muscovite-quartz schist to muscovite-feldspar-biotite-quartz schist. Accessory minerals are tourmaline, monazite and zircon; graphite and iron oxides are the opaque minerals.

Muscovite and biotite occur as aligned flakes which form layers alternating with felsic bands. Muscovite also forms cross-cutting porphyroblasts which enclose grains of quartz and in places feldspar; irregular very fine-grained patches of muscovite or sericite are probably pseudomorphs of sillimanite. The feldspar includes plagioclase and potash feldspar. The plagioclase is oligoclase or andesine and it occurs as idioblastic porphyroblasts or as xenoblastic grains. Grey, graphite-bearing schist occurs in small amounts, commonly interbanded with quartzite.

The quartzite is medium grained, massive and contains up to 10 percent of muscovite and plagioclase. The greenschist is a fine-grained or medium-grained rock consisting of intergrown chlorite and actinolite. It is massive and not lineated.

Schistosity is moderately well developed in the schist. Coarser-grained, porphyroblastic types have a granoblastic texture approaching that of a gneiss.

The overall trend of the Pretender-type schist is north to north-northwest, though in detail it is irregular. This trend represents bedding, delineated by interbanded quartzite, and schistosity which on a large scale is coincident with bedding. There is some evidence on air photos, of isoclinol folds similar to these developed in the Holroyd Metamorphics to the south (Trail et al., 1968).

The Pretender-type schist is coarser-grained and of higher metamorphic grade than the bulk of the Holroyd Metamorphics. The presence of plagioclase suggests that it has been metamorphosed in the almandine-amphibolite facies of regional metamorphism of Turner & Verhoogen 1960). The presence of sillimanite in specimens from the Ebagoola Sheet area, indicates the upper portion of the almandine-amphibolite facies. The Pretender-type schist probably represents a gradation from the Holroyd Metamorphics to the Dargalong Metamorphics, which outcrop only 7 miles to the east.

SEFTON METAMORPHICS

In the Cape Weymouth Sheet area and the northern part of the Coen Sheet area isolated bodies of low-grade metamorphic rocks crop out south of, and near Mount Carter, at Iron Range, near Bowden and at Bolt Head. In an unpublished report of the Broken Hill Proprietary Company, Reid (1959) referred to the metamorphics in those areas as the Sefton Group, the Iron Range Group, the Bowden Group and the Bolt Head Limestone respectively. Canavan (1965) also referred to the Iron Range Group. As our knowledge of these rocks is not yet sufficient to satisfy the criteria for Group status in the Australian Code of Stratigraphic Nomenclature (Geological Society of Australia, 1964), and as it is likely that the four bodies were continuous before the emplacement of Devonian and Permian granitic rocks, we now give one name, the Sefton Metamorphics, to the rocks in these areas.

The Sefton Metamorphics are predominantly composed of muscovite quartz schist, but include a broad variety of rock types, such as hematite-quartz schist, greenstone and schistose limestone. The mineral assemblages suggest they have been metamorphosed under the conditions of the greenschist facies.

Representatives of the Sefton Metamorphics approach in composition and metamorphic grade rock-types within the Dargalong Metamorphics and the Holroyd Metamorphics; in the northern part of the Coen Sheet area gradational boundaries may have separated all three subdivisions before the emplacement of the granitic rocks. By and large the Sefton Metamorphics resemble the Holroyd Metamorphics rather than the Dargalong Metamorphics because of their predominantly low metamorphic grade. However, as the diversity of rock types in the Sefton Metamorphics is not paralleled in the Holroyd Metamorphics, and as they are a great distance from the type area of the Holroyd Metamorphics, the Sefton Metamorphics have been classed separately. Three areas of the Sefton Metamorphics are composed of distinctive rock-types; these have been described as separate units: - the Mount Carter Schist, the Iron Range Schist and the Bolt Head Schist. Several other small bodies of schist somewhat remote from these areas, including those south of Mount Carter and those near Bowden, have been mapped as undifferentiated Sefton Metamorphics.

Mount Carter Schist

The new name Mount Carter Schist is used here for the metamorphic rocks forming Mount Carter. It replaces the name Sefton Group used by Reid(1958).

The Mount Carter Schist is composed of mica-quartz schist and quartzite, which forms the high Mount Carter Block at the northern margin of the Coen Sheet area. The outcrop of the schist is almost entirely surrounded by the Weymouth Granite. The quartzite and coarser schist form rubble on hill tops and slopes; the finer schist is only exposed in creeks.

Mica-quartz schist is best exposed in the southern part of the Mount Carter Block. Phyllite and fine-grained schist in the west give way to coarser schist in the east, suggesting an increase in metamorphic grade. Muscovite and quartz are present throughout the schist in approximately equal quantities; biotite forms up to 15 percent of the schist and is generally associated with the muscovite. Accessory minerals are tourmaline, graphite, and andalsuite.

Mica and quartz are concentrated in alternating, sub-parallel bands; both mica flakes and elongate quartz grains have a moderately or well developed preferred orientation parallel to the banding.

Mild recrystallization has taken place near the contact of schist and granite, where strain-free quartz has grown, and aligned mica has recrystallized as sericite flakes with random orientation; some cross-cutting porphyroblasts of muscovite also occur in schist adjacent to the granite contact. Many bands of andalusite porphyroblasts, and some samples with abundant tourmaline (25 percent of one), may also have originated during the intrusion of the granite.

The fine-grained schist and phyllite have a good schistosity; it is particularly well developed in the graphitic schist and phyllite. The coarser schists, especially those with andalusite porphyroblasts, are more massive, possibly as a result of recrystallization accompanying the intrusion of the granite. A crenulation of the schistosity in the phyllitic rocks is expressed as a closely spaced and irregular lineation; in thin-section this appears to be an incipient development of strain-slip cleavage. In several specimens minor recrystallization has taken place along the axial planes of the crenulations.

The quartzite is generally a massive, fine-grained rock composed dominantly of strained quartz. Muscovite is a common accessory mineral; biotite and albite are less common. Iron oxide and graphite form up to 10 percent of some specimens, and a faint banding, outlined in places by segregations of these opaque minerals, may represent bedding. In thin section a poorly developed lineation is picked out by sub-parallel, elongate quartz grains with undulose extinction.

On air photographs the Mount Carter Schist is seen to crop out as a broad synform, 10 miles across, with the axis plunging northwards. Broad bands of quartzite, clearly visible on the eastern limb, dip gently northwestwards. The schistosity is approximately parallel to the bedding as shown by the quartzite bands on the air photographs. In exposures on the western limb, both the bedding and the schistosity are contorted.

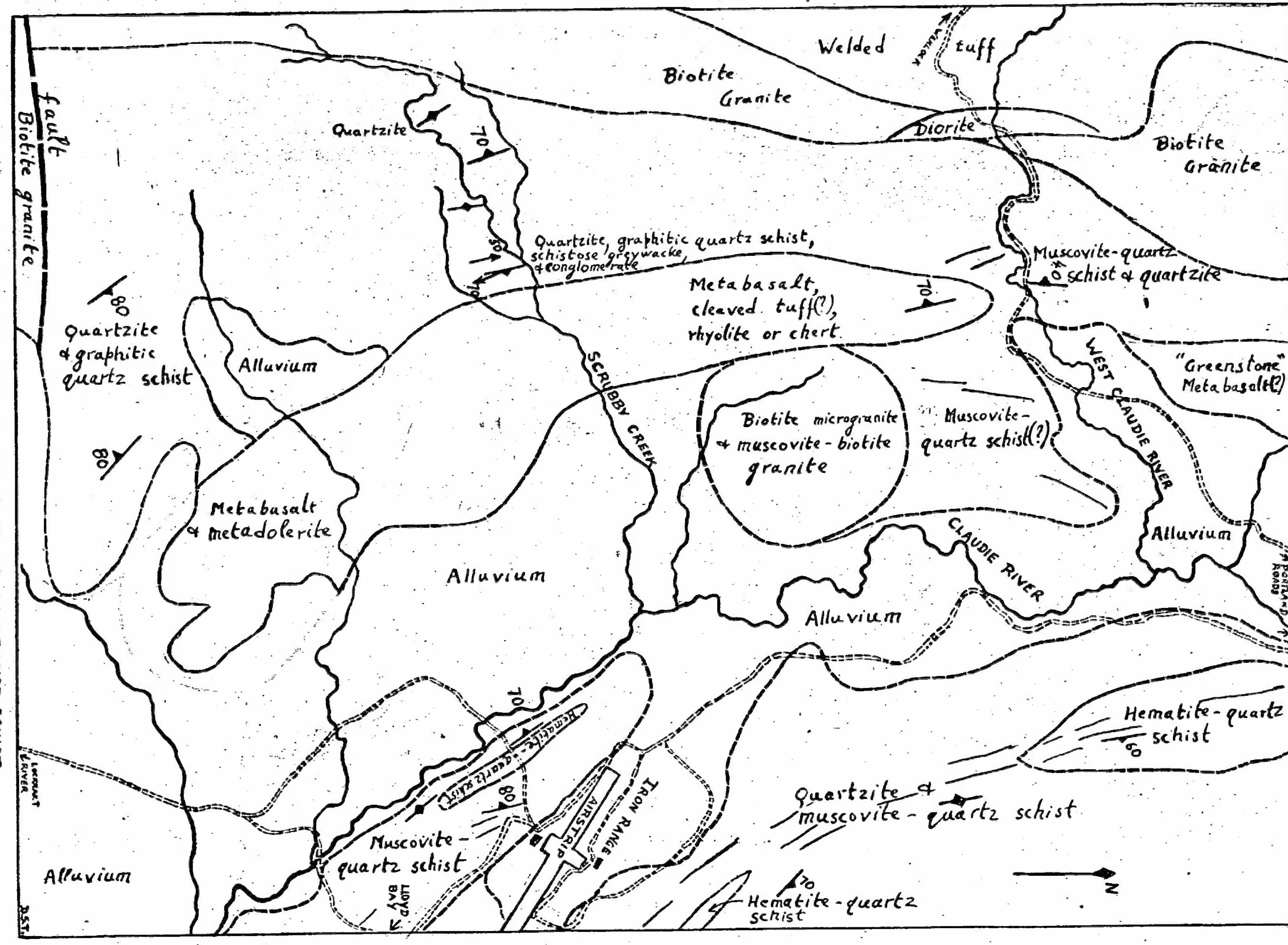
This contortion of the schistosity reveals that some deformation has taken place since the formation of the schistosity, and the concordance of schistosity and bedding throughout the synform indicates that the synform also developed after the formation of the schistosity. The deformation during which the synform developed may have accompanied the intrusion of the Weymouth Granite, and the faults which partly bound the Mount Carter Block may have formed at the same time.

Interbanded quartzite and phyllitic schist which crop out on the west side of the south end of the belt of Iron Range Schist 10 miles to the north closely resemble the Mount Carter Schist; this suggests that the Mount Carter Schist and the Iron Range Schist are contiguous in the structural succession at least. The Mount Carter Schist is almost certainly continuous with quartzite and muscovite-quartz schist, mapped as undifferentiated Sefton Metamorphics, which form the north end of a belt of metamorphic rocks to the southeast of the Mount Carter block. These rocks are not included with the Mount Carter Schist as they grade along strike into coarse schist and gneiss of more varied lithology.

Iron Range Schist

The Iron Range Schist crops out as a belt about 5 miles wide extending from a ridge four miles southwest of the Iron Range airfield, for 20 miles northwards to the Pascoe River at Cassowary Creek. Two small outcrops lie five miles northwest of the confluence of Cassowary Creek and the Pascoe River, and are surrounded by granitic and volcanic rocks (Fig.44).

The schist belt forms the inner or western margin of the Iron Range coastal lowlands, and large lenses of iron-rich schist and quartzite within the belt form a line of steep hills up to 500 feet in height. The outcrop of the Iron Range Schist is almost everywhere mantled by dense rainforest and the rocks are poorly exposed.



0

2 MILES

FIG. 11A. ROCK TYPES IN SOUTHERN PART OF IRON RANGE SCHIST

The unit is composed predominantly of muscovite-quartz schist and muscovite quartzite, with subordinate, very fine-grained graphite-muscovite-quartz schist and phyllite; hematite-quartz schist and magnetite quartzite. The unit also contains at least one layer of metamorphosed basic igneous rock, or greenstone, several hundred feet thick, and small lenses of calc-silicate rocks.

The muscovite-quartz schist is a blue-grey, medium-grained to very fine-grained rock which has an excellent schistosity. It generally contains lenses, boudins, thin bands, and irregular masses of milky quartz ranging from a few millimeters to several centimetres across. The soft muscovite-quartz schist is in many places altered to clay; it probably underlies the alluvial flats along the Claudie River and other large creeks.

South of the Wenlock Iron Range road (fig.11A), the western part of the schist belt consists of a sequence of quartzite with bands of graphitic quartz schist and phyllite, schistose greywacke or muscovite-albite-quartz-schist, and schistose conglomerate; the bands generally range from 1 foot to 10 feet in thickness. Many of the rocks in this sequence have a distinct dark grey colour, possibly produced by disseminated graphite or other opaque minerals. The conglomerate contains many fragments of quartzite and black mudstone, similar to the other rock types in the sequence, and together with the schistose greywacke, this suggests that at least part of the sequence has been deposited by turbidity currents. Towards the contact of the schist with the granite on the western side of the belt, the quartzite increases from about 60 percent to 90 percent and becomes coarser. Yellow iron staining is common in the quartzite and some bands of dark schist have small pyrite pseudomorphs partly filled by limonite.

On the east side of the sequence of quartzite described above, a belt of greenstone extends for six miles south of the Wenlock/Iron Range road. The greenstone is generally a massive, dark greenish grey rock with little or no schistosity. It is equigranular, fine grained or medium grained, and is composed basically of cloudy plagioclase, and pyroxene altered to actinolite, uralite or chlorite. Small crystals of quartz form vein-like aggregates and are almost certainly secondary. In some exposures quartz forms anygdule-like bodies up to $\frac{1}{2}$ inch across; pink and green soft zeolitic(?) minerals have a similar habit in a few places. Small boulders of altered doleritic rock with small feldspar phenocrysts are common at the south end of the greenstone belt. At the northern end pebbles of rhyolitic or cherty rocks occur in small creeks; one well cleaved band may be a tuffaceous rock.

Broadhurst and Rayner (1937) record greenstone, an altered igneous rock, one mile east of Iron Range where it is reported to form a continuous belt. They note that the occurrence of greenstone on both sides of the iron-bearing schist suggests a fold structure.

Geologists of the Broken Hill Proprietary Company (1962) mapped another large mass of greenstone one mile wide, about two miles north of the Wenlock/Iron Range Road, and several other smaller isolated bands throughout the Iron Range Schist.

The schist and quartzite containing magnetite and hematite have been intensively investigated by geologists of the Broken Hill Proprietary Company (1962) and the following description is taken from their work, supplemented by some general observations made in 1967.

In most of the iron-bearing rocks both hematite and magnetite are present; some samples also contain a few crystals of pyrite. Hematite generally predominates, and most of the iron-bearing rocks are quartz-hematite schist and hematite quartzite. Magnetite quartzite predominates in the northern part of the schist belt, at Black Hill and Robyn Hill. The iron-bearing rocks also contain manganese.

The iron-bearing rocks are very resistant to weathering and form several hills up to 1 mile long, several hundred yards across and 300 feet high. Many of these hills are mantled by debris composed almost exclusively of rocks rich in hematite or magnetite, and carry a thick lateritic cover composed of limonite with embedded blocks and fragments of magnetite and hematite. Drilling and costeaning by B.H.P. revealed that the iron-rich rocks are commonly confined to relatively thin lenses and bands.

Fig.12 Iron Range Schist. Tight fold in quartz-hematite schist.

In addition to the rock types seen during mapping in 1967, the Broken Hill Proprietary geologists report that quartz-amphibole rock is very common among the iron-bearing schists. They also record glaucophane amphibolite in their report and talc schist on the accompanying map. Cordierite-biotite-quartz-actinolite schist and hornfelsed cordierite-biotite-quartz schist are reported at the contact of the schist with the Weymouth Granite two miles south of Black Hill. In drilling at Lamond Hill, in the central part of the schist belt, bands of calcite-quartz-mica schist were found by Broken Hill Proprietary Company containing 20 percent calcite. Sillimanite-quartz schist was noted in 1967 at the contact of a body of diorite with the Weymouth Granite, four miles southwest of Portland Roads.

Bolt Head Schist

Low-grade metamorphic rocks form isolated small exposures along the coast in Temple Bay south of the mouth of the Olive River (figs 13 and 14). The rocks are commonly only exposed in a wave-cut platform extending into the inter-tidal zone, in places at the foot of sea-cliffs formed by Mesozoic sandstone. The metamorphics are exposed at Limestone Point, Bolt Head, and Intruder Head; they consist of chlorite-quartz schist and quartzite, and of schistose and massive recrystallized limestone.

The schist is fine-grained and dark and is composed of roughly equal amounts of quartz and chlorite; it has a good schistosity defined by parallel chlorite flakes and elongate quartz grains. In places the schistosity has been crenulated and a strain-slip cleavage has developed, accompanied by minor recrystallization.

The recrystallized limestone ranges from light grey to dark grey and is fine grained. It consists of a mosaic of interlocking calcite crystals; in some specimens these are elongated and have a strongly preferred orientation. Some specimens contain up to 30 percent quartz in thin bands of slightly elongated grains. The dark limestone contains scattered small grains of carbonaceous(?) material. The limestone passes into the chlorite-quartz schist by gradual increase in the proportion of chlorite-bearing quartz bands.

Many small bodies of acid intrusive rock cut the Bolt Head Schist. At Limestone Point siliceous schistose limestone has been intruded by fine-grained green quartz-feldspar porphyry; intrusion and some assimilation have taken place preferentially along joint planes and contortion is pronounced in the limestone near the porphyry contact. Interbanded limestone, schist, and quartzite at Bolt Head are cut by numerous quartz stringers and by one dyke of microgranite; a small pipe of black agglomerate cuts the quartzite, and contains fragments of quartzite.

At Intruder Head carbonaceous schist has been partially assimilated by fine-grained quartz-feldspar porphyry. Northwest of Intruder Head the schist is cut by leucocratic granite and by later aplite dykes and quartz veins.

Australian Aquitaine Petroleum (1965) grouped the schist and limestone of Bolt Head with the metamorphics of the "Sefton Group", whereas the limestone at Limestone Point and the carbonaceous schist at Intruder Head were equated with the Pascoe River Beds. Broken Hill Proprietary (1962) had previously named the rocks at Bolt Head and Limestone Point Bolt Head Limestone.

Because of the lithological and structural similarities of the metamorphic rocks in all the exposures examined, they are here named Bolt Head Schist. They are grouped with the Sefton Metamorphics because they have a similar metamorphic grade to the Iron Range Schist and Mount Carter Schist and were probably metamorphosed at the same time as these units. The Bolt Head Schist is older than the intrusive porphyry which may be related to the (?) Carboniferous volcanics, and is older than a granite which is probably related to the Permian Weymouth Granite. Thus the schist is at least as old as the Carboniferous. It probably belongs to the pre-Devonian metamorphics which occur throughout Cape York Peninsula. However, E. Druce (pers. comm.) recovered one sponge spicule and another fragment of organic material by dissolving a large sample of limestone; he therefore believes that the rock is probably not Precambrian.

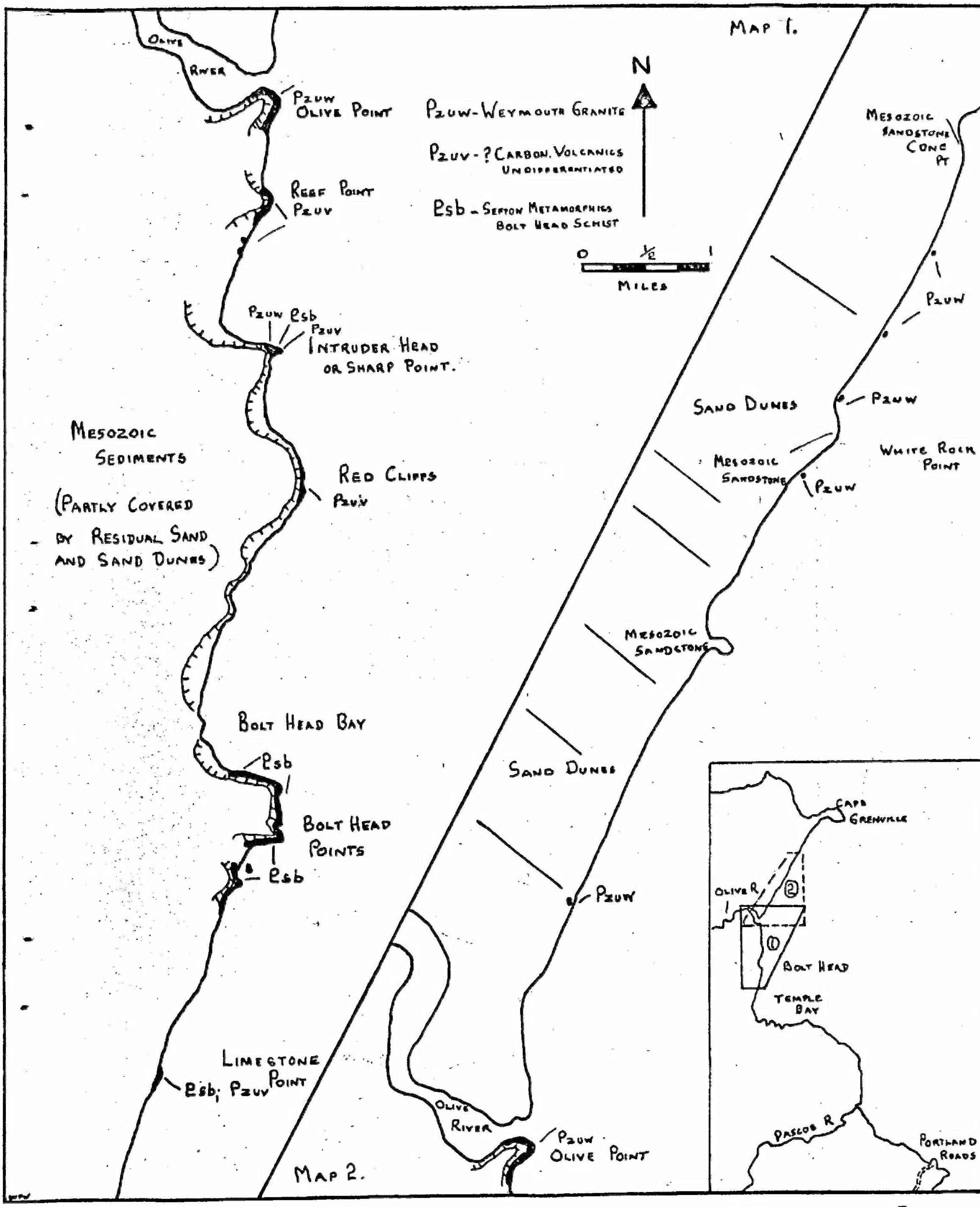


Fig. 13. Locality Diagram of Small Outcrops of Igneous and Metamorphic Rocks Temple Bay – Cape Grenville

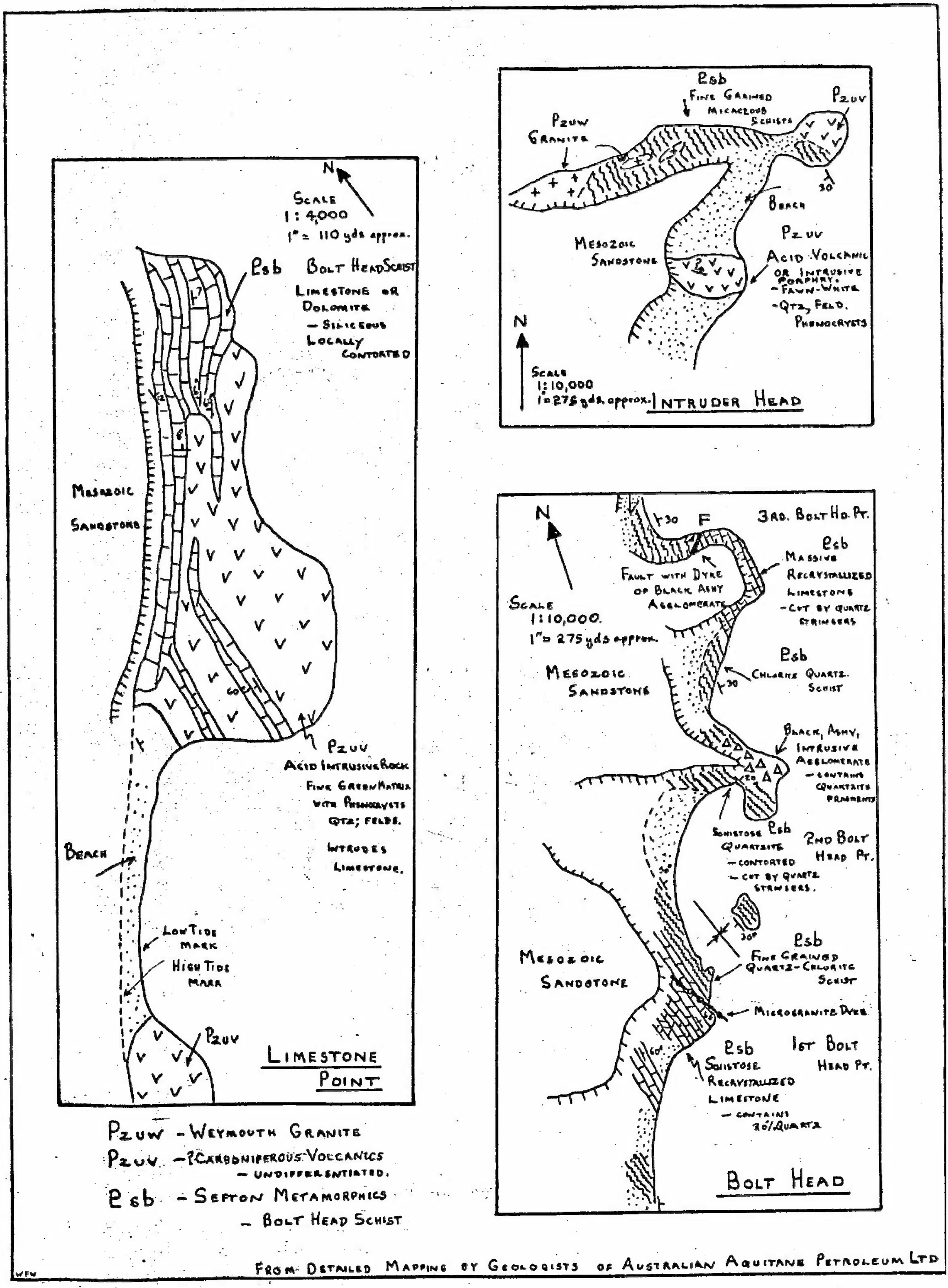


Fig. 14. Detailed Geology Limestone Point, Bolt Head, Intruder Head.

Undifferentiated rocks

In the northern part of the Coen 1:250,000 Sheet area several large bodies of metamorphics have been mapped as undifferentiated Sefton Metamorphics. They are mainly composed of muscovite-quartz schist and quartzite, with subordinate amounts of biotite-muscovite-quartz-feldspar schist and gneiss in some. Although these rocks resemble types within both the Holroyd Metamorphics and the Dargalong Metamorphics, they have been classed with the Sefton Metamorphics because in general they are most like the Mount Carter Schist, and most of the bodies were probably continuous with the Mount Carter Schist before the emplacement of the granitic rocks. Low-grade metamorphic rocks which crop out in the Bowden Mineral Field and near Luttrell Hill, in the southern part of the Cape Weymouth Sheet area, have also been described as undifferentiated Sefton Metamorphics.

The largest of these bodies is located a few miles south of Mount Carter and forms a belt up to 4 miles wide which runs south-southwestwards for 18 miles, almost to Falloch Creek. Another smaller body crops out to the south of Falloch Creek and trends southwards along the western flank of the McIlwraith Range. Both these bodies are composed dominantly of muscovite-quartz schist, and quartzite, with some biotite-bearing rocks in places. Similar rocks form the small bodies of metamorphic rocks in the vicinity of the Wenlock Goldfield and near Luttrell Hill. Small patches of metamorphics enclosed in granitic rocks in the headwaters of Leek Creek are composed of muscovite-quartz schist and biotite-quartz-feldspar gneiss.

The muscovite-quartz schist is a light grey rock with a wide range in composition and grain-size. The schist grades from muscovite quartzite through a rock in which mica and quartz occur in equal proportions, to a schist rich in muscovite with scattered small lenticules of quartz. It ranges from very fine-grained to coarse-grained; it is generally a fine-grained or medium-grained rock. The body of metamorphics running southwards from Falloch Creek contains schist which commonly has muscovite porphyroblasts between 1 and 2 mm across. This schist also contains patches of sericite forming pseudomorphs after sillimanite.

The muscovite porphyroblasts have a random orientation and many of them enclose quartz crystals. Small crystals of biotite are common in some of the muscovite-rich schists; they generally parallel the schistosity. Some muscovite-quartz schists are heavily stained by iron.

The quartzite is a light-grey fine-grained to medium-grained granoblastic rock with scattered parallel flakes of muscovite and more rarely, biotite; the mica forms less than 5 percent of the rock. Feldspar is accessory in some quartzite; a few small crystals of pyrite occur in some exposures. The quartzite in places contains bands up to 5 feet thick of massive milky quartz, which may be brecciated and re-crystallized, and partly intrusive.

Biotite-quartz-feldspar gneiss, with muscovite in places, occurs in various bodies near the contact of the metamorphics with granitic rocks. The gneiss is a dark grey to light grey rock ranging from fine-grained to coarse-grained. It is commonly porphyroblastic and is generally massive, but is banded in a few exposures. The gneiss contains both potash feldspar and plagioclase: quartz is about equal in proportion to feldspar, and biotite forms up to 10 percent of the gneiss.

In a small body enclosed by the Kintore Adamellite in the headwaters of Leek Creek, contorted banded gneiss grades into migmatite, where it is invaded by granitic material.

Amphibolite crops out in a few of the bodies of the metamorphics, and may represent either metamorphosed concordant bands or metamorphosed dykes. One sample, from a concordant band 5 feet thick, is composed of hornblende (60 percent), altered plagioclase (20 percent), quartz(10 percent), opaque minerals (10 percent), and accessory biotite. The minerals form a mosaic of interlocking xenoblastic grains.

Both the schist and the quartzite contain dykes and concordant bands of muscovite granite-pegmatite, up to 10 feet thick. One sample of the pegmatite is composed of microcline (50 percent), quartz (30 percent), muscovite (12 percent), altered plagioclase (8 percent), and accessory but large crystals of tourmaline. Tourmaline crystals up to 3 inches long occur in hornfelsed schist east of Bald Hill. In many other schist exposures, contact metamorphism has produced a second generation of large or small muscovite crystals with no preferred orientation.

The wolfram-bearing rocks of the Bowden Mineral Field, and other small bodies of metamorphic rocks nearby were referred to as the Bowden Group by geologists of Broken Hill Proprietary (1962). As they are represented by only a few small exposures, they were mapped in 1967 as undifferentiated Sefton Metamorphics. In the largest outcrop, between Canoe Creek and One-Mile Creek, a core of sheared muscovite quartzite is flanked by dark grey phyllite on the northeast and by red phyllite on the south; both phyllites are quartz-muscovite rocks; porphyroblasts in the red phyllite may be altered andalusite. Wolfram occurs along joint planes in the sheared quartzite.

In the body from which wolfram was mined, northwest of the road crossing of One-Mile Creek, coarse-grained muscovite-quartz schist is intruded by a rock which resembles sheared Kintore Adamellite. The schist contains books of muscovite up to $1\frac{1}{2}$ inches across, and has been intruded by irregular bodies of quartz and quartz-tourmaline rock. The tourmaline crystals are generally bent or broken by shearing. Wolfram was mined near the contact of the schist and the sheared adamellite. The quartz-tourmaline rock and the wolfram are thought to have been derived from the nearby Weymouth Granite rather than the Kintore Adamellite, and the sheared adamellite may in fact represent the Weymouth Granite.

The presence of sillimanite pseudomorphs in the metamorphics which crop out south of Falloch Creek suggests that these rocks were originally metamorphosed under the conditions of the almandine-amphibolite facies of Turner and Verhoogen (1964). The phyllite of the Bowden Mineral Field represents a low level in the greenschist facies of metamorphism, but no lower than that found in places in the Mount Carter Schist and the Iron Range Schist.

The relatively high grade of metamorphism in the metamorphics south of Falloch Creek indicates that a transition may have existed between the Sefton Metamorphics and the Dargalong Metamorphics which are now preserved within the Kintore Adamellite in the McIlwraith Range. The development of biotite-bearing gneiss in various outcrops of Sefton Metamorphics appears to be the result of contact metamorphism.

The Devonian Cape York Peninsula Batholith

The large north-trending batholith of granitic rocks mapped in 1966 in the Ebagoola, Hann River and Walsh Sheet areas continues northwards into the Coen and Cape Weymouth Sheet areas as far as the Little Roundbacked Hills near Weymouth Bay. The batholith, which outcrops over a total of 2500 square miles, has been named the Cape York Peninsula Batholith (Whitaker and Willmott, 1969).

In the Coen and Cape Weymouth Sheet areas the batholith is at least 45 miles across and covers about 800 square miles. Its eastern boundary is concealed by the Coral Sea, and on the west it is overlain by Mesozoic sediments. It is emplaced in low-grade to medium-grade regional metamorphic rocks of the Dargalong, Holroyd and Sefton Metamorphics. The batholith is composed mainly of biotite-muscovite adamellite - the Kintore Adamellite (Trail et al., 1968). Small masses of adamellite of differing compositions also occur within the batholith, some grade into the Kintore Adamellite (Lankelly Adamellite and Wigan Adamellite), but others appear to be distinct phases (Blue Mountains Adamellite and Morris Adamellite). Some small bodies of granodiorite, tonalite and diorite are closely associated with the Kintore Adamellite in some areas, and are collectively named the Flyspeck Granodiorite. Only the largest of these bodies have been delineated on the map. Table 4 compares the characteristics of the units within the batholith. A number of samples from various rock types within the batholith have been dated isotopically as Upper Devonian (see appendix 1).

The Cape York Peninsula Batholith exhibits many of the characteristics of granitic rocks which are associated with regional metamorphism, as described by Joplin (1964). On a regional scale it is conformable with the surrounding metamorphic rocks; it is composed mainly of adamellite with some minor granodiorite and contains patches and cross-cutting dykes of leucocratic garnet-bearing pegmatite and aplite; it contains porphyritic phases with large phenocrysts of microcline; it includes many small bodies of metamorphic rocks; and near its margins it is foliated and banded and migmatite has developed. The Cape York Peninsula Batholith is therefore considered to have accompanied a major

Table 4 : Comparison of units within Cape York Peninsula Batholith, Coen and Cape Weymouth Sheet areas

Unit	Rock types	Average mineral composition	Texture	Variations	Relationships
Kintore Adamellite	Muscovite-biotite adamellite, some biotite adamellite	Q35%, Microcl. 28%, Oligocl. 24%, Musc. 8%, Biotite 6%	Medium and even grained, generally massive, in places banded, foliated and sheared	Garnet-bearing muscovite granite; garnet muscovite pegmatite and garnet aplite	Comprises the bulk of batholith. Migmatite developed in metamorphics in places near margins; contains many small patches of metamorphics. Cut by acid and intermediate dykes
Flyspeck Granodiorite	Biotite granodiorite, hornblende-biotite tonalite	Q20%-30% Andesine 35%-60%, K-felds 10-20%(of granodiorite) Biotite 10%-20%, Hbl. up to 30%	Fine to medium grained Massive. One body foliated around margins	Biotite-hornblende diorite	Small bodies intimately associated with Kintore Adamellite. Unit probably represents a number of different periods of intrusion
Lankelly Adamellite	Biotite Adamellite	Q30%-40%, Microcl. ? (as phenocrysts only), Oligoclase. 15-40%, Biotite 5-15%	Medium-grained, porphyritic with phenocrysts of microcline up to 40 mm in length; phenocrysts oriented in places. Banded in some areas	Even-grained muscovite-biotite adamellite, leucocratic granite or alaskite with microcl. phenocrysts, muscovite granite	Probably grades into Kintore Adamellite

Unit	Rock types	Average mineral composition	Texture	Variations	Relationships
Wigan Adamellite	Biotite adamellite and granite	Q30-40%, Total feldspar 60%, biotite 5%-15%	Variable. Fine to coarse grained. Even grained to porphyritic. Massive. Sheared in two zones	Variable composition; granite-granodiorite. Some quartz-feldspar pegmatite and aplite	Probably grades into Kintore Adamellite
Morris Adamellite	Biotite adamellite	Q35%, Plagiocl. 26% microcline 24%, Biotite 15%	Medium-grained to coarse-grained, porphyritic with phenocrysts of microcline up to 40 mm in length. In places phenocrysts oriented	Leucocratic fine-grained muscovite-biotite adamellite.	Faulted against sheared Kintore Adamellite. Associated with tourmaline-bearing pegmatites which cut surrounding metamorphics
Blue Mountains Adamellite	Biotite adamellite, hornblende-biotite adamellite or granite	Q27%-40%, Microcl. 28%-35%. Plag. 20%-30%, Biotite 5%-10%. Accec. sphene, allenite abundant	Biotite adamellite fine grained, hornblende biotite adamellite coarse grained. Both even grained, massive	Fine and coarse grained leucocratic biotite granite	Appears to be intruded by Kintore Adamellite.

regional metamorphic event, and probably to have formed at a deep level. However, as the surrounding metamorphics are considered to have formed in the Precambrian, and as the batholith by isotopic dating gives Devonian ages, it is unlikely that the regional metamorphic event which generated the batholith was the same as that which gave rise to the metamorphic rocks in Cape York Peninsula. It is more likely that the formation of the batholith was related to a much later Upper Devonian event or orogeny, which has not had much effect on the pre-existing metamorphic rocks. This Upper Devonian event could have been the orogeny which folded and metamorphosed the neighbouring Hodgkinson Basin sediments.

KINTORE ADAMELLITE

The Kintore Adamellite is exposed over much of the Coen Sheet area. It forms the major part of the plateau of the McIlwraith Range, the high coastal ranges, the undulating country west of Coen and isolated exposures between the Archer River and Wenlock. Exposure is poor, both in the undulating western country, and in the mountains where deep weathering and thick rainforest make mapping difficult. In the Cape Weymouth Sheet area, the Kintore Adamellite is exposed as small patches west of the belt of younger volcanics extending from Luttrell to Bowden, northeast of the Iron Range Airport and in the Little Round Back Hills.

The Kintore Adamellite in type area on the Ebagoola Sheet area is a light grey, fine-grained to medium-grained biotite-muscovite adamellite (Trail et al. 1968). In the Coen Sheet area, the proportion of muscovite to biotite varies considerably. In general the rock is richer in biotite than in the type area and is a muscovite-biotite adamellite.

The composition of the Kintore Adamellite in the Coen Sheet area is characteristically variable (Fig.15).

In many places the muscovite-biotite adamellite grades into patches up to several square miles in extent of garnet-bearing, leucocratic muscovite granite. Associated with this granite, and also intruding the normal muscovite-biotite adamellite, are veins and dykes of pegmatitic garnet-muscovite granite. In some outcrops these dykes are sharp and well defined, but in others they merge into the surrounding garnet-bearing, leucocratic muscovite granite and muscovite biotite adamellite. In most places, a fine-grained garnet-bearing aplite is associated with the pegmatitic garnet-muscovite granite, and in some outcrops is interbanded with it (Fig.16). Garnet is more abundant in the aplite than in the pegmatite and muscovite is less common. Layers of different grain-size produce an irregular banding within the aplite. The pegmatitic garnet-muscovite granite and the aplite are thought to be late hydrous differentiates of the main adamellite. They are most abundant around the margins of the adamellite and within the surrounding metamorphics. Many massive veins, dykes and large lodes of milky quartz cut the Kintore Adamellite and the nearby metamorphics. They are probably associated with subsequent shearing within the Kintore Adamellite and are usually barren of any mineralization. However, some contain gold, which has been mined at Wenlock and Buthen Buthen. In places, particularly northeast of the headwaters of Attack Creek, muscovite is entirely absent from the adamellite and the proportion of plagioclase is greater; the rock is a leucocratic biotite granodiorite.

The Kintore Adamellite also has a variable texture. Although generally even grained and massive, orientation of mica flakes in many specimens gives the rock a foliation, which in most places strikes north or northwest and dips vertically. Banding is in places developed by alternation of layers rich in biotite with layers rich in quartz and felspar. In some exposures, especially in the Archer River immediately east of the telegraph line, the banding is finely developed and is contorted, producing a migmatite. The migmatization occurs near contacts with metamorphics and is probably a result of intense micropenetration and recrystallization of the metamorphics by the adamellite. Some small patches of coarsely porphyritic muscovite-biotite adamellite within the Kintore Adamellite contain phenocrysts of potash feldspar up to 4 inches in length. This porphyritic variety grades into the surrounding even-grained rock.

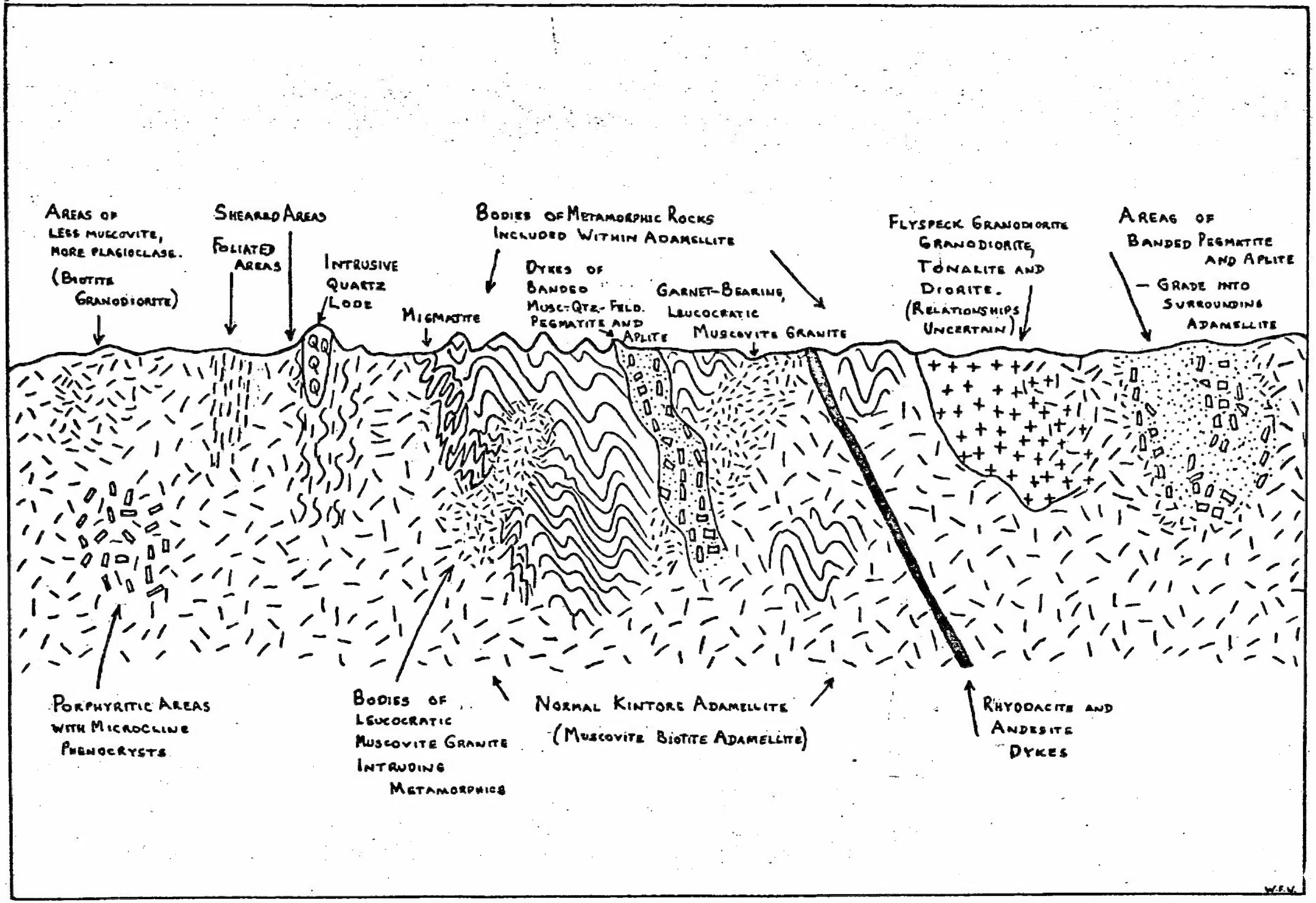


Fig. 15. Diagrammatic Representation of Variations within the Kintore Adamellite

Fig.16 Kintore Adamellite. Banded pegmatite and aplite.

Fig.17 Sheared Kintore Adamellite intruded by fine quartz veins.

Many bodies of metamorphic rocks, ranging from a few feet to 14 miles in length, occur within the Kintore Adamellite. They consist mainly of muscovite-quartz schist, but some biotite gneiss, amphibolite and impure marble also occur. They are intimately penetrated by the Kintore Adamellite, which is usually the muscovite-rich leucocratic granite phase. The metamorphics are also intruded by abundant dykes of pegmatite and aplite.

Evidence of shearing is common throughout the Kintore Adamellite. The rock is intensely foliated and jointed and has some alteration of biotite to chlorite (Fig.17). The shearing is usually concentrated in zones up to 100 yards wide and several miles long. In the main part of the McIlwraith Range and in the coastal ranges the shearing direction strikes north.

In the Archer River Shear Zone, which crosses the Archer River just east of the telegraph line, the Kintore Adamellite is extensively sheared over a wide area. This shear may be an extension of the Coen Shear Zone which is a major shear about 30 miles long on the western edge of the Lankelly Adamellite near Coen. The Coen Shear Zone is more sharply defined than the Archer River Shear Zone.

The age of the shearing is unknown, but alignment of phenocrysts in the Lankelly Adamellite parallel to the shear zone, and the development in the Kintore Adamellite of foliation parallel to the major shearing directions, may indicate that some movement occurred before the consolidation of the magma. In the gorge of Lee Creek there is evidence that shearing of the adamellite took place before the intrusion of the pegmatitic muscovite granite and aplite. However, considerable mylonitization and recrystallization of the rocks has taken place in the Coen Shear Zone and in smaller shears in the coastal ranges. This indicates that shearing has also occurred since the Kintore Adamellite crystallized.

Acid and intermediate dykes are associated with and cut the Kintore Adamellite. They occur chiefly in the central part of the McIlwraith Range and in the coast ranges. They are up to 1½ miles long, but not more than 50 to 100 feet wide. The acid dykes are the more abundant and are probably rhyodacite. Two prominent dykes cut the Kintore Adamellite at the eastern end of the Blue Mountains, and a few smaller andesitic dykes occur in the McIlwraith Range.

LANKELLY ADAMELLITE

The Lankelly Adamellite was mapped in 1966 in the northeast corner of the Ebagoola Sheet area and is described by Trail et al. (1968). During 1967 it was found that the Lankelly Adamellite extends in a belt from the Stewart River in the Ebagoola Sheet area northwards to Mount Croll in the Coen Sheet area. It forms the broad plateau of the McIlwraith Range immediately east of Coen.

The Lankelly Adamellite is typically a grey, porphyritic biotite adamellite, generally constant in composition but with some variation in places. The rock type is characterized by abundant phenocrysts of very pale pink, euhedral microcline (Fig.18). The phenocrysts average 40 mm in length and in many places have a rough preferred orientation, which is normally of small extent and is perhaps a result of flow in the magma.

In the eastern and central parts of the McIlwraith Range the porphyritic biotite adamellite is remarkably constant in composition. However, on the western side of the range between Lankelly Creek and Mount Croll, the rock is not evenly porphyritic. The phenocrysts are in places rare or absent, and the rock is even grained.

In most of these places muscovite is present in varying amounts, producing a muscovite-biotite adamellite identical to the Kintore Adamellite. In the same region the porphyritic biotite adamellite, biotite adamellite or muscovite-biotite adamellite grade into patches of leucocratic granite up to ¼ mile across, which are composed almost exclusively of quartz and feldspar with only minor muscovite. In this leucocratic granite, feldspar phenocrysts occur only in some exposures, where they are commonly very abundant, and are aligned in bands within material barren of phenocrysts.

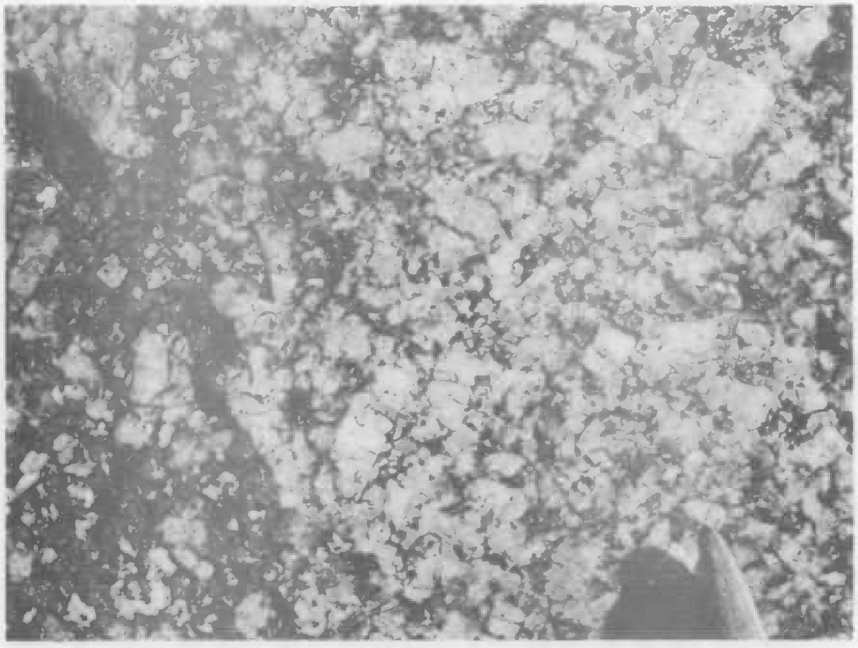


Fig.18 Microcline phenocrysts in Lankelly Adamellite.
Point of geological hammer shows scale.

Fig.19 Banding in Lankelly Adamellite, at mouth of
Massy Creek gorge.

The areas of leucocratic granite are cut by distinct bands of very coarse muscovite granite-pegmatite and veins of muscovite aplite. Otherwise pegmatite and aplite are rare within the Lankelly Adamellite.

At the summit of the McIlwraith Range and at the mouth of the Massy Creek gorge, bands of even-grained biotite adamellite about 1 foot thick alternate with bands of porphyritic biotite adamellite (Fig.19). In contrast to the western side of the range, no muscovite is present, and no leucocratic granite-pegmatite or aplite is developed.

At the mouth of the Massy Creek gorge many small xenoliths are included in the porphyritic biotite adamellite. Most are about 1 foot long, but they range up to 8 feet; they are composed of biotite (20 percent), plagioclase (40 percent), and quartz (40 percent).

In the same area as the xenoliths the porphyritic biotite adamellite is apparently sharply intruded by bodies up to 200 yards across of pink, fine-grained, even-grained leucocratic biotite adamellite. Its composition appears to be similar to that of the porphyritic biotite adamellite, but its genetic relationship to the porphyritic biotite adamellite is unknown.

At the southern margin of the Lankelly Adamellite in the Ebagoola Sheet area, a leucocratic muscovite granite intrudes metamorphics in small pods and bands. It is apparently a marginal phase of the Lankelly Adamellite and is similar to the leucocratic muscovite granite associated with the Kintore Adamellite.

Petrographically, the rocks mapped in 1967 are very similar to those seen in 1966 and described by Trail et al. (1968). In the majority of specimens quartz ranges from 30 percent to 40 percent, plagioclase from 15 percent to 40 percent, and biotite from 5 percent to 15 percent, with minor muscovite in places. A few small grains of opaque minerals and rare apatite and sphene are the only accessories. Potash feldspar occurs only as the abundant large phenocrysts; in thin section it is difficult to estimate quantitatively.

To the south near the Stewart River the Lankelly Adamellite appears to grade into the Kintore Adamellite with an increase in the amount of muscovite and a decrease in the abundance of the feldspar phenocrysts. Within the main mass of the Lankelly Adamellite the local occurrence of non-porphyritic muscovite-biotite adamellite, leucocratic granite, muscovite granite-pegmatite and aplite suggests that the Lankelly Adamellite is closely associated with the Kintore Adamellite and has a similar history of formation and intrusion. It is considered to be a major porphyritic phase of the Kintore Adamellite. The scarcity of pegmatite and aplite, and the lack of any rafts of metamorphic rocks suggest that it may have formed at a deeper level in the batholith. Preliminary results of isotopic dating give a Devonian age.

In places small patches of fine-grained biotite granodiorite are associated with the Lankelly Adamellite. It is very similar in appearance to the Flyspeck Granodiorite associated with the Kintore Adamellite further north in the Coen Sheet area. As the Lankelly Adamellite is a phase of the Kintore Adamellite, the granodiorite associated with the Lankelly Adamellite can also be considered to be Flyspeck Granodiorite.

The Lankelly Adamellite is intensely sheared along the Coen Shear Zone on its western margin; the shear zone separates the porphyritic biotite adamellite from metamorphics. A number of quartz reefs have been intruded along this shear zone, and at Coen some of these were worked profitably for gold. For about one third of a mile away from the shear zone within the Lankelly Adamellite, the feldspar phenocrysts are aligned parallel to the strike of the shear zone. This suggests that some shearing or movement occurred along this direction roughly contemporaneous with the consolidation of the magma. However, later shearing in the same zone has produced brecciation and mylonitization of the rocks along the principal planes of movement.

A few thin dykes of andesite intrude the Lankelly Adamellite, but in general dykes are rare. On the western margin of the McIlwraith Range a large acid dyke several hundred feet thick forms the summit of Mount Croll, with related smaller dykes nearby, but they are probably related to the intrusion of the nearby Permian Twin Humps Adamellite.

FLYSPECK GRANODIORITE

Small bodies of granodiorite, tonalite and diorite occur throughout the Kintore Adamellite in the Coen Sheet area. They closely resemble the rock types of the Flyspeck Granodiorite which crops out in the Ebagoola and Hann River Sheet areas, and which is described by Trail et al. (1968). The Flyspeck Granodiorite described previously consists of biotite granodiorite and hornblende biotite tonalite, which form large discrete bodies with distinct boundaries within the Kintore Adamellite. The granodiorites, tonalites and diorites in the Coen Sheet area are more variable in composition, and in many places form only small bodies intimately associated with the Kintore Adamellite. Many of these cannot be represented at 1:250,000 scale. However, some larger bodies up to 14 miles in length have been delineated on the map. Despite the above differences, the granodiorites, tonalites and diorites in the Coen Sheet area are considered to have the same origin as the Flyspeck Granodiorite, and the name has been extended to include them.

The largest areas of these rock types extends from Peach Creek to Skae Creek on the western side of the McIlwraith Range. Other patches occur 25 miles northwest of Coen on the road to Rokeby Homestead, north of Falloch Creek, and in the headwaters of Leek Creek. Smaller patches, which have not been delineated at 1:250,000 scale, are distributed along the eastern edge of the McIlwraith Range, in the centre of the range west of the Leo Creek mine, and west of Coen. A few small patches occur east of Coen within the Lankelly Adamellite. East of the Geikie Range south of the Archer River, a number of small areas of diorite and granodiorite are intruded by the Morris Adamellite.

The main rock types are biotite granodiorite and hornblende-biotite tonalite. Minor amounts of biotite-hornblende diorite are also present (Fig. 20). Some granodiorite also contains hornblende, and some tonalite is lacking in hornblende. The relationships between granodiorite, tonalite and diorite are unknown, except in the body northwest of Coen where in one exposure microdiorite has been intruded by gneissic granodiorite (Fig.21).

The rocks are fine-grained to medium-grained, even-grained, massive, and melanocratic. In the granodiorite and tonalite the amount of quartz ranges from 20 percent to 30 percent. In the diorite it ranges from 8 percent to 10 percent. The quartz forms anhedral irregular grains which have slightly sutured margins and undulose extinction. Plagioclase makes up between 35 percent and 40 percent of the granodiorite, and between 40 percent and 60 percent of the tonalite and diorite. It forms small well twinned euhedral or subhedral laths. The plagioclase is andesine in the granodiorite and tonalite; in the diorite it ranges from calcic andesine to labradorite. Potash feldspar makes up between 10 percent and 20 percent of the granodiorite. It forms small phenocrysts of anhedral or subhedral laths of poorly twinned microcline. In the tonalite and diorite it occurs only in minor amounts as small interstitial grains.

Biotite occurs as broad fresh flakes, generally pleochroic from red-brown to pale yellow. It contains many small zircon inclusions, and in places has been slightly altered to chlorite and epidote. Biotite usually makes up between 10 percent and 20 percent of all three rock types.

Hornblende is rare in most of the granodiorite but common in the tonalite and diorite; in some specimens it forms up to 30 percent of the rock. It is pleochroic from pale green to pale brown and occurs as anhedral grains, usually associated with biotite. In one diorite an amphibole makes up 40 percent of the rock. However, it appears to be an alteration product of biotite, and its very pale colour suggests that it is actinolite rather than hornblende. Sphene is the most common accessory mineral. Allanite, apatite, zircon, opaque minerals and clinopyroxene, in decreasing order of abundance, are also present in some specimens in small amounts.

The body of Flyspeck Granodiorite northwest of Coen is gneissic to migmatitic in its northern and southern margins and massive towards its centre. The most common gneissic type is porphyritic with large microcline phenocrysts. The gneissic banding parallels the north to northwesterly regional trend in the adjacent Lukin-type Schist. Compositionally the rocks are similar to the massive types described above. It is possible that the gneissic features are due to partial

Fig.20 Flyspeck Granodiorite. Fine-grained melanocratic biotite-hornblende diorite, from the headwaters of Falloch Creek.

Fig.21 Flyspeck Granodiorite. Foliated porphyritic granodiorite intruding small block of microdiorite, 25 miles northwest of Coen.

Fig.22 Intrusion breccia. Biotite adamellite of the Wigan Adamellite intruding microgranodiorite of the Flyspeck Granodiorite.

Fig.23 Porphyritic biotite adamellite of the Morris Adamellite intruding biotite-hornblende diorite of the ?Flyspeck Granodiorite, at the southern end of the Geikie Range.

recrystallization and mobilization, and limited metasomatism as a result of the intrusion of the Kintore Adamellite.

To the south, in the Ebagoola Sheet area, no conslusive evidence was found for the age of the Flyspeck Granodiorite relative to the Kintore Adamellite. However, the two rock types were considered to have been emplaced at about the same time, and to be genetically related. In the Coen Sheet area, the various bodies of granodiorite, tonalite and diorite collectively named Flyspeck Granodiorite appear to have variable relationships with the granitic rocks of the batholith. Along the track to the west of the Leo Creek mine small patches of biotite granodiorite appear to intrude the Kintore Adamellite. To the east of the southern end of the Geikie Range, granodiorite and diorite are intruded by a coarse porphyritic biotite adamellite, the Morris Adamellite (Fig.23). To the east of Bald Hill the Wigan Adamellite intrudes fine-grained, biotite-hornblende granodiorite which may be Flyspeck Granodiorite (Fig.22). The Morris Adamellite and Wigan Adamellite are considered phases of the Devonian batholith, so therefore the Flyspeck Granodiorite is Devonian or older. Preliminary isotopic age determinations confirm a Devonian age.

BLUE MOUNTAINS ADAMELLITE

The Blue Mountains Adamellite crops out in the centre of the Coen Sheet area, to the west of the Kintore Adamellite in the McIlwraith Range. It is exposed in a number of areas separated by residual sand and alluvium. The largest area includes the high isolated Birthday Mountain and the western part of the Blue Mountains, from which the name of the unit has been derived. Small patches crop out on the western flank of the McIlwraith Range north of Beetle Creek and north of Wilson Creek. The rock type apparently continues northwards under alluvium as far as Ben Lomond. A similar rock type which may be correlated with the Blue Mountains Adamellite occurs at the headwaters of Hull Creek and Falloch Creek.

The Blue Mountains Adamellite is typically a pinkish-grey, predominantly fine-grained biotite adamellite. The rock is even-grained and massive. It is generally leucocratic with only minor amounts of biotite. The typical fine-grained biotite adamellite is associated with considerable amounts of coarse-grained hornblende-biotite adamellite or granite, which contains small phenocrysts of feldspar in places (Figs 24 and 25). This rock type is found at the western end of the Blue Mountains, at the headwaters of Hull and Falloch Creeks, and in small patches elsewhere. A minor variation of the Blue Mountains Adamellite occurs along the western edge of Birthday Mountain, where the fine-grained biotite adamellite locally grades into a fine-grained leucocratic granite. At Ben Lomond, a coarse-grained leucocratic granite with minor biotite is probably also a variation of the Blue Mountains Adamellite.

The fine-grained biotite adamellite contains between 27 percent and 40 percent of quartz, which occurs as irregular anhedral grains with sub-serrate margins and undulose extinction. In many specimens small blebs of quartz occur within crystals of potash feldspar, presumably as a result of recrystallization of the feldspar. Potash feldspar is generally light pink, and in some specimens forms rare phenocrysts. It generally makes up between 28 percent and 35 percent of the rock, although it forms up to 50 percent of the more leucocratic specimens. It occurs as large anhedral grains of well twinned microcline and as smaller interstitial grains. It appears to have undergone some recrystallization which has produced small blebs of quartz. The plagioclase occurs as moderately well twinned subhedral laths which make up between 20 percent and 30 percent of the rock. It is usually much altered to sericite and epidote and is recrystallized to small blebs of quartz. Some less altered grains appear to be andesine, ranging in composition from An30 to An35. Biotite occurs in small clusters of thin flakes; it generally makes up between 5 and 10 percent of the rock, but in some leucocratic specimens it is absent. It is pleochroic from light yellow to dark chocolate brown. In general the biotite of the Blue Mountains Adamellite differs in colour from the red-brown biotite of the Kintore Adamellite. The biotite contains numerous zircon inclusions and is usually altered to pale green chlorite or to epidote. In places it is kinked and appears to be sheared. Sphene is a very abundant accessory mineral, forming as much as 7 percent of some specimens. It is usually associated with biotite. Other accessories include allanite, epidote, zircon, and apatite.

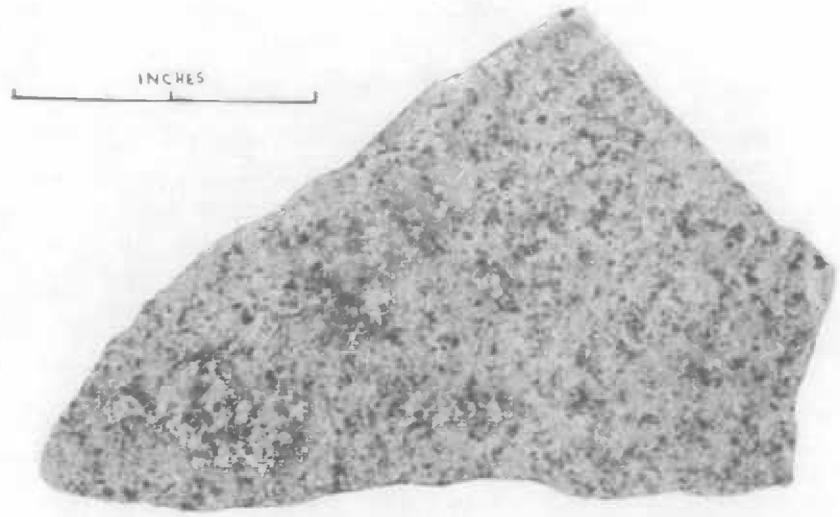


Fig.24 Blue Mountains Adamellite. Fine-grained biotite adamellite.

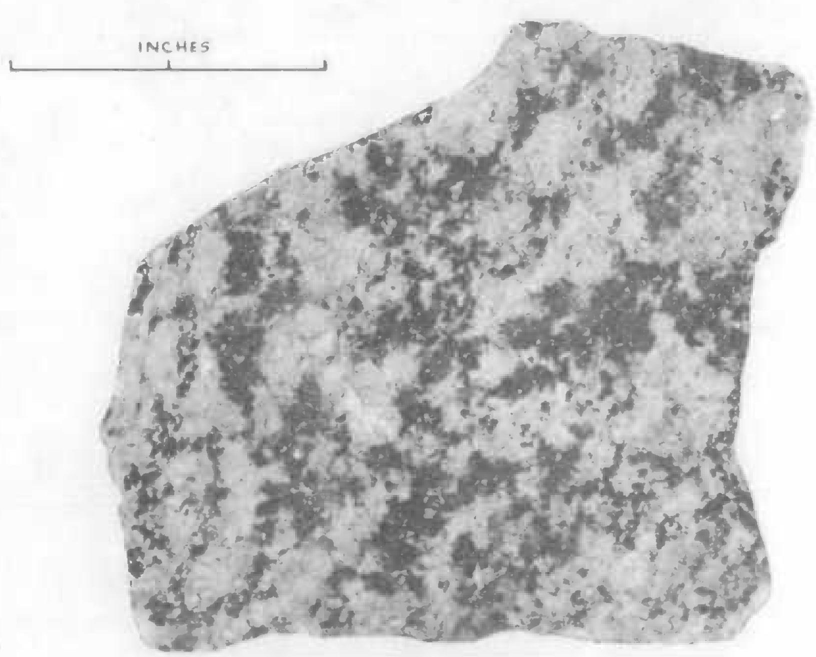


Fig.25 Blue Mountains Adamellite. Coarse-grained hornblende-biotite adamellite.

The coarse-grained, hornblende-biotite adamellite or granite is composed of black clots of hornblende and biotite set between grains of white feldspar and quartz. Phenocrysts of potash feldspar up to 40 mm in length are more common than in the fine-grained biotite adamellite. In places they are abundant and bright pink in colour.

In thin section the hornblende-biotite adamellite or granite is very similar to the fine-grained biotite adamellite. However, the potash feldspar does not show signs of recrystallization, the proportion of ferromagnesian minerals is greater, and the accessory minerals are in general more abundant. Hornblende occurs as broken subhedral to euhedral crystals which are pleochroic from light yellow to dark green-brown. It is associated in clusters with biotite, sphene and allenite. The proportions of hornblende usually ranges from 2 percent to 6 percent. In one specimen it makes up 12 percent of the rock; in others it is only accessory.

Apart from minor variations such as fine-grained or coarse-grained leucocratic granite, the two major rock types of the Blue Mountains Adamellite are constant in composition and texture. They are massive with neither foliation nor banding, and contain no xenoliths or small bodies of metamorphic rocks. They contain neither pegmatite nor aplite, and muscovite is entirely absent from them. In these features the Blue Mountains Adamellite is distinct from the Kintore Adamellite.

The age of the Blue Mountains Adamellite relative to the Kintore Adamellite is not certain. The only contact between the Blue Mountains Adamellite and the Kintore Adamellite at the eastern end of the Blue Mountains is a sharp contact between coarse-grained hornblende-biotite adamellite of the Blue Mountains Adamellite and fine-grained muscovite-biotite adamellite of the Kintore Adamellite. Veins of muscovite aplite, common in the muscovite-biotite adamellite, penetrate the hornblende-biotite adamellite for several feet. This aplite does not occur in the hornblende-biotite adamellite anywhere except near this contact. Consequently the Blue Mountains Adamellite at this point is older than the aplite associated with the Kintore Adamellite.

However, it is unlikely that the Blue Mountains Adamellite is older than the main mass of the Kintore Adamellite as the Blue Mountains Adamellite has some characteristics of a post-orogenic high-level intrusion in contrast to the synorogenic characteristics of the deeper-seated Kintore Adamellite.

MORRIS ADAMELLITE

The Morris Adamellite is a distinctive body of porphyritic biotite adamellite which occurs in the western part of the Coen Sheet area near the Archer River. The adamellite covers an area of approximately 60 square miles, lying to the east of the Mesozoic sandstone cover. It extends for an unknown distance west under the sandstone.

In its southern and southeastern exposures, the adamellite intrudes northeast trending schist and quartzite of the Lukin-type schist. For about five miles north of Geikie Creek it appears to have a faulted boundary, intruded by quartz dykes, with sheared Kintore Adamellite along the Archer River Shear Zone (Fig.11). From here north and northwest to the Mesozoic cover, the adamellite has been intruded by a fine-grained to medium-grained leucocratic adamellite, the Wolverton Adamellite, possibly Permian in age. The name Morris Adamellite is derived from the parish of Morris which covers the area of the adamellite south of the Archer River (Dept of Lands Qld, 1965).

The adamellite is well exposed, generally as large rounded boulders, immediately below the eroding Mesozoic escarpment and in the Archer River. The typical adamellite (specimen 67480132) is greyish-white, medium-grained or coarse-grained and massive. It contains regularly distributed subhedral microcline-microperthite phenocrysts up to 40 mm long, which commonly exhibit Carlsbad twinning. In the southwest part of the adamellite the phenocrysts are roughly aligned in a north—south direction.

The average composition of the adamellite is quartz 35 percent, plagioclase 26 percent, microcline-microperthite 24 percent, and biotite 15 percent. Quartz occurs in patches up to 10 mm across formed of unstrained anhedral grains. Plagioclase forms zoned grains 1 mm to 3 mm across, of sodic to calcic oligoclase, commonly with a rim of albite. The cores are generally partially altered to sericite. Microcline-microperthite forms small grains averaging 2 mm in size; no phenocrysts were encountered in thin section. Biotite forms flakes up to 2 mm long which are pleochroic from yellow to red-brown, and which are slightly altered to chlorite. The flakes have small inclusions of apatite and zircon.

Potash feldspar, which occurs chiefly in the large phenocrysts, is difficult to estimate quantitatively, and consequently the composition of the Morris Adamellite is uncertain. From observation of many hand specimens it is thought to be an adamellite, although the composition may approach that of a granite in places (defined according to Joplin, 1964).

Xenoliths are fairly common throughout the adamellite. They are apparently cognate and are composed of fine-grained dark-grey biotite adamellite which in places contains small phenocrysts of quartz or plagioclase. The xenoliths are rounded or elliptical, and average about one foot in diameter, although they range up to six feet. They contain less quartz than the host rock and are richer in accessory minerals such as sphene, zircon and apatite, with some allanite (specimens 67480114, 67480156).

The contact of the Morris Adamellite with schist and quartzite in the west and south, and near the junction of the Archer River and Geikie Creek, was not seen in the field, but it appears to be sharp with no significant contact metamorphism. The contact is largely concordant with the strike of the metamorphics except in the southwest where it appears to cut across the strike; here the metamorphics are invaded by several pegmatite dykes. The dykes are up to six feet wide and are concordant with the metamorphic foliation. The mica-quartz schist (specimen 67480112) is recrystallized immediately adjacent to the dykes, and in places tourmaline has crystallized on the footwall side of the dykes (specimen 67480111).

The pegmatites are composed of feldspar (albite, with or without some potash feldspar), quartz and tourmaline with some muscovite (67480110). The tourmaline occurs as medium-sized to very large crystals up to six inches in diameter and one foot in length. They are normally embedded in quartz and are generally elongate normal to the dip plane of the dyke. The schist adjacent to at least one of the pegmatite dykes has been broadly contorted and invaded by pods and bands of fine-grained quartz-feldspar rock (Fig.10). A thin section of a typical pegmatite (67480110) is composed of albite 50 percent, quartz 30 percent, and tourmaline 20 percent, with minor muscovite. Closer to the Morris Adamellite the pegmatite dykes contain large crystals of pink perthite, as well as albite. Pegmatite dykes are not found within the adamellite itself or invading country rocks elsewhere. The pegmatite dykes do not appear to be mineralized.

The eastern margin of the Morris Adamellite north of Geikie Creek is apparently partly intrusive and partly faulted as far north as six miles south of Bald Hill. Nearby the adamellite has been intruded both by quartz lodes and quartz-veined leucocratic microgranite of the Wolverton Adamellite.

In the northern part of the Morris Adamellite several small patches of a grey, leucocratic fine-grained or medium-grained muscovite-biotite adamellite occur. These are up to a few hundred feet across and grade laterally into typical Morris Adamellite. These bodies are well jointed; the marginal porphyritic adamellite may also be well jointed, although the main body of the Morris Adamellite is poorly jointed. Some aplite veins and a few pegmatite veins penetrate the adamellite adjacent to these patches. The presence of muscovite and twinned microcline-microperthite in the leucocratic adamellite distinguish it from the large body of leuco-adamellite to the north (the Wolverton Adamellite).

A small area of non-porphyritic biotite granite is exposed near Geikie Creek within typical Morris Adamellite. It is grey, medium-grained, and massive; one thin section (67480140) is composed of quartz (20 percent), small phenocrysts of microcline-microperthite (50 percent), plagioclase (20 percent) in zoned crystals varying from oligoclase to sodic andesine, and biotite (8 percent) in light yellow-brown to brown pleochroic flakes partly altered to chlorite, with epidote and leucoxene. Muscovite (2 percent) is largely secondary. The granite is considered to be a minor phase of the Morris Adamellite.

A specimen of the Morris Adamellite from the Coen road crossing of the Archer River has been dated isotopically as Upper Devonian (see Appendix I).

WIGAN ADAMELLITE

The Wigan Adamellite is a biotite adamellite which crops out to the south and west of the Weymouth Granite between Sefton Creek and Bald Hill. It is in contact with the Weymouth Granite and its associated phases in the north, and with the Sefton Metamorphics, the Wolverton Adamellite, the Kintore Adamellite and the Flyspeck Granodiorite in the west and south. It is overlain by Mesozoic sediments to the west. The Wigan Adamellite forms low hills which rise from an alluviated and sand covered plain. The rock is well exposed on the hillsides and forms rounded or blocky boulders. The name Wigan Adamellite is derived from the Parish of Wigan (Dept of Lands, Qld 1965) which covers much of the area of the adamellite between the Wenlock River and Bald Hill.

The Wigan Adamellite is massive, fine-grained to coarse-grained and grey, but it weathers to a pale pink colour. Throughout the body the rock has a considerable range in composition and texture over short distances. The most common rock type is leucocratic biotite adamellite or granite, which is generally medium-grained and even grained, but in places contains some phenocrysts of feldspar. The biotite forms small clots or, less commonly, streaks. In leucocratic specimens the feldspar phenocrysts are larger and more numerous, and the biotite forms more pronounced clots. Melanocratic types, which have the composition of adamellite or granodiorite, are fine-grained or medium-grained and even-grained; the biotite forms medium sized flakes.

The quartz content of the Wigan Adamellite lies between 30 percent and 40 percent. The quartz forms equant to irregular grains which are slightly strained and have clear-cut but irregular margins. The ratio of plagioclase to potash feldspar is variable so that the rock ranges in composition between granite and granodiorite; total feldspar content is constant at about 60 percent. The plagioclase (oligoclase-andesine) forms subhedral laths which are either partially or wholly altered to sericite and clay. The potash feldspar is strongly perthitic; some grains show microcline twinning and others are untwinned orthoclase(?). The potash feldspar occurs as large phenocrysts and as irregular interstitial material. The grains are dusted with clay minerals. The micas form ragged flakes; biotite makes up between 5 and 15 percent of the rock, although several specimens contain only 1 percent, and muscovite forms up to 3 percent. Accessory minerals are zircon, apatite and opaques.

Two specimens of massive, medium-grained adamellite found south of Sefton Creek and a coarse-grained adamellite found east of Bald Hill contain patches of andalusite and cordierite. These minerals generally occur separately but are both present in one specimen found south of Sefton Creek. The andalusite forms stubby, pale pink prismatic crystals or rarely, elongate pink laths. The cordierite occurs as subhedral or euhedral hexagonal crystals or, more commonly, as irregular grains. It is partially or wholly replaced by a fine-grained greenish yellow mineral, probably pinite, which in turn is altering to coarse-grained muscovite.

Cordierite is not found in the surrounding Sefton Metamorphics; andalusite is present in a few places in these metamorphics but does not possess the pink colour of the material found in the Wigan Adamellite. As the greater proportion of these two minerals occur within distinct aggregates it seems likely that they were formed by the recrystallization of small fragments of aluminous material which were caught up in the magma during intrusion. Some of the cordierite, however, forms discrete hexagonal crystals, and it is possible that these were formed by recrystallization from a granitic melt locally enriched in alumina, as suggested by Joplin (1964).

Irregular patches of quartz-feldspar pegmatite and aplite are present in the Wigan Adamellite, but are not common and are mostly found near the margins of the body. They generally grade into the surrounding adamellite, but cross cutting dykes are also present.

Two zones of intense shearing trending north to north-northwest occur within the Wigan Adamellite south of the Wenlock River. The adamellite, where it is most intensely deformed, has a cataclastic texture; the quartz grains have been crushed or strained to give the rock a "mortar" texture with large rounded grains set in a mosaic of finer grains. The feldspar is deformed and altered, and the biotite is streaky and partially or wholly replaced by chlorite. Away from the area of most intense shearing, the adamellite has a more granular texture but it still possesses a distinct schistosity which parallels the trend of the shear zone. The direction of shearing in the two shear zones is parallel to the direction developed in both the Coen Shear Zone and the Archer River Shear Zone; all the shear zones were probably formed in the same period of deformation.

The contact of the Wigan Adamellite with the Weymouth Granite in Sefton Creek appears to be sharp but the relationship between the two bodies is not obvious; however, a dyke of pale pink aplite, possibly related to the Weymouth Granite, cuts the Wigan Adamellite near the contact. Along its eastern margin the Wigan Adamellite is in contact with a pale pink aplite which has been equated with the Weymouth Granite. The contact with the hybrid and diorite phases of the Weymouth Granite south of Sefton Creek is sharp, but it is not clear which intrudes which. In the south, near Bald Hill, the Wigan Adamellite has a gradational boundary with the Kintore Adamellite which may in part be faulted. The contact with the Wolverton Adamellite is faulted in the south; in the north the contact may be intrusive, but again the relative ages of the rocks are unknown.

To the east of Bald Hill the Wigan Adamellite intrudes and thermally metamorphoses a biotite-hornblende microgranodiorite forming an intrusion breccia in some places, with only minor assimilation (Fig.22). The microgranodiorite consists of aggregates of intergrown hornblende and actinolite with rare crystals of plagioclase and quartz set in a hornfelsic groundmass. The affinity of the microgranodiorite is not known; it may be Flyspeck Granodiorite associated with the Kintore Adamellite, and has been mapped as such.

The Wigan Adamellite has its closest affinity with the Kintore Adamellite. Like the Kintore Adamellite it is variable in composition and texture and contains patches and cross-cutting bodies of pegmatite and aplite. However the Wigan Adamellite differs in composition from the Kintore Adamellite in that it does not normally contain muscovite. It also differs texturally; the Wigan Adamellite is not foliated or schistose, except locally in shear zones, and does not have migmatite developed around the margins. The Wigan Adamellite probably was emplaced at much the same time as the other rocks of the batholith, and is probably merely a compositional variant of the Kintore Adamellite.

Lower Carboniferous Sediments

PASCOE RIVER BEDS

Folded and slightly metamorphosed sediments consisting of sandstone, shale and coal were reported by Morton (1924) in the valley of the Pascoe River and its tributaries. These rocks were later investigated by The Broken Hill Proprietary Ltd (1962) and were given the informal name Hamilton Group. Subsequently geologists of Australian Aquitaine Petroleum Limited (1965) informally divided the sediments into seven formations having the collective name Pascoe River Group. No attempt was made in 1967 to define formations based on measured sections as it was considered that the outcrop was not sufficiently continuous. These sediments have therefore been named the Pascoe River Beds.

The Pascoe River Beds crop out in the valley of the Pascoe River, in the valleys of Garraway, Brown and Hamilton Creeks and in tributaries of Hamilton Creek (Fig.25a). Haggerstone Island, 8 miles southeast of Cape Grenville, is composed of sediments which may be correlated with the Pascoe River Beds.

The exposure in each of the above valleys is generally poor and discontinuous; the sediments are only exposed where the overlying Janet Ranges Volcanics, Mesozoic sediments and Cainozoic Yam Creek Beds have been stripped off. The rocks have been disrupted by faulting, which has probably resulted in the repetition of some beds. Most outcrops are in the beds of streams and are underwater during the

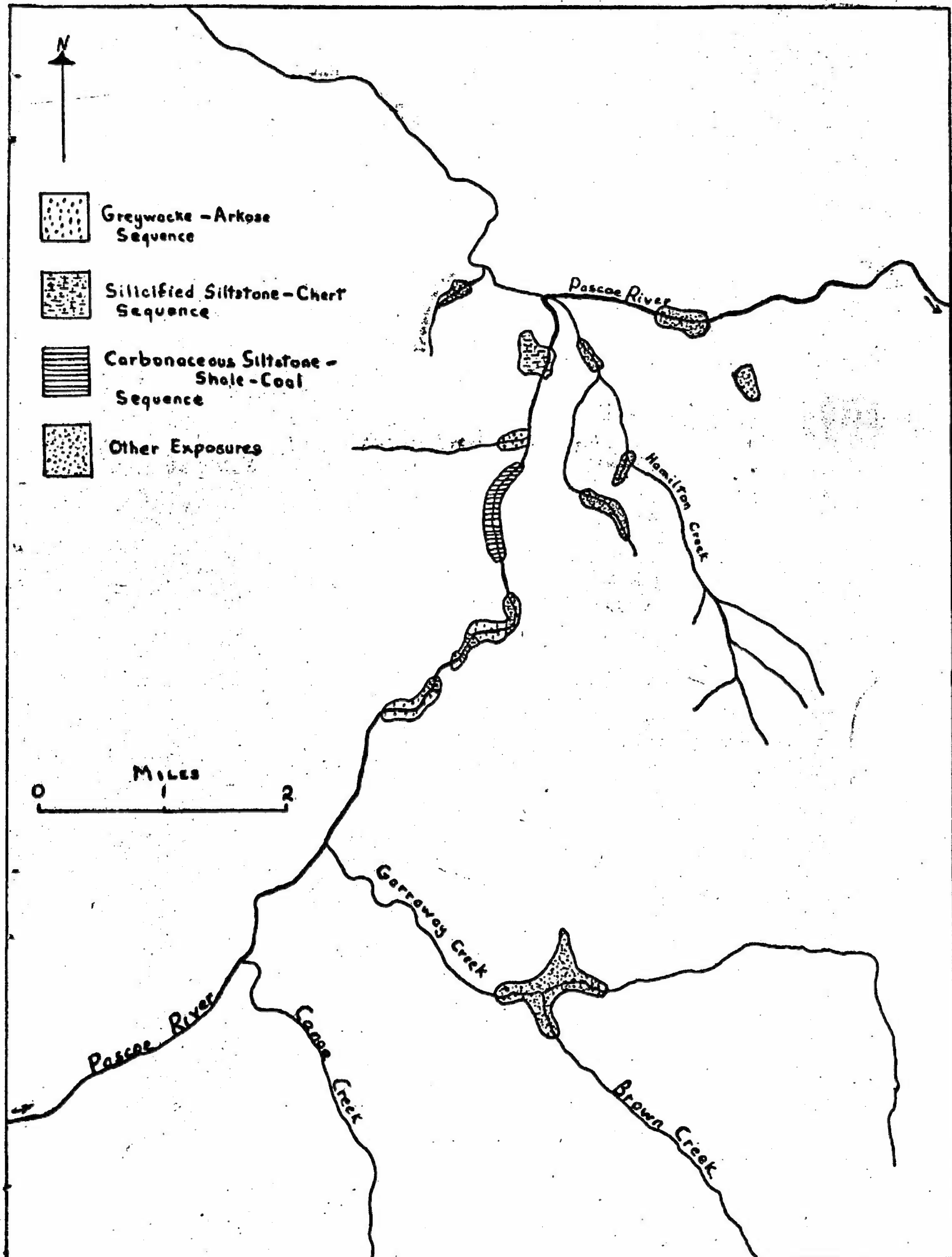


FIG. 25A. DISTRIBUTION OF THE MAIN EXPOSURES OF THE PASCOE RIVER BEDS, CAPE WEYMOUTH SHEET AREA.

wet season; consequently the less silicified rock types are deeply weathered. Weathering probably also took place during the Tertiary before the Yam Creek Beds were deposited.

Pascoe River Sequences

In the Pascoe River, the Pascoe River Beds are exposed from two miles north of the Garraway Creek junction to two miles east of the Hamilton Creek junction; they are best exposed in the middle portion of this area. They are also exposed in the west-bank tributaries of the Pascoe River at the foot of the east-facing scarp of the Mesozoic sediments. The sediments form three lithological sequences which correspond broadly to three of the formations proposed by Australian Aquitaine Petroleum Limited. These are a carbonaceous shale and coal sequence, overlain by an arkose and greywacke sequence, in turn overlain by a sequence of silicified siltstone, chert and greywacke. There is some overlap of rock types among these three sequences and the rocks probably represent one unit of continuous sedimentation now seen in discontinuous exposures.

In the carbonaceous shale and coal sequence, the most characteristic rock types are carbonaceous shale and siltstone (Fig.25B) which grade into fine-grained carbonaceous sandstone containing minor feldspar and mica. Medium-grained lithic greywacke and thin bands of coal, grading into carbonaceous shale, occur in lesser amounts. The arenites are moderately well bedded, and the lutites are thinly laminated.

The silts and shales are composed of small angular quartz grains set in a groundmass of quartz, feldspar(?), mica(?), and carbonaceous material. The lithic greywacke is made up of quartz (60-75 percent), lithic fragments (20-35 percent), and muscovite (5-10 percent), set in a siliceous cement. The quartz grains are angular or subangular and have a low or moderate sphericity. The lithic fragments are angular and are composed of a fine-grained aggregate of quartz, feldspar and mica(?); they are probably of volcanic origin. The muscovite is detrital and occurs as ragged and bent flakes.

Thin shaley coal seams are interbanded with carbonaceous shale near the top of the sequence. Both the shale and the coal contain abundant plant remains.

The arkose and greywacke sequence is characterized by medium-grained or coarse-grained, well sorted arkose or feldspathic sandstone. Less common is coarse-grained greywacke, tuff and tuffaceous sandstone. All these sediments are massive and thickly bedded, and show no cross-bedding.

The arkose and feldspathic sandstone are composed of quartz (70-80 percent) and altered feldspar (20-30 percent), with minor lithic fragments and accessory amounts of muscovite. The quartz forms sub-angular grains which have a moderate sphericity. The feldspar occurs as angular laths which are almost completely altered to sericite and clay; the bulk of the feldspar is plagioclase. The lithic fragments are composed of intergrown quartz and feldspar; muscovite forms ragged and bent detrital flakes. These rocks grade into feldspathic sandstone with an increase in the proportion of quartz, and into sub-greywacke with an increase in the amount of lithic fragments.

The greywacke is generally coarse-grained and is only moderately well sorted. One specimen is composed of quartz (25 percent), feldspar (30 percent), and matrix (45 percent), with accessory muscovite, epidote and zircon(?). The quartz grains are angular and have a low or moderate sphericity. Both plagioclase and potash feldspar are present; the latter is more abundant and is in part microcline. The feldspars form angular or sub-angular laths which are partially or almost completely altered, the plagioclase to sericite and clay and the potash feldspar to clay. The matrix consists of small quartz grains, fragments of altered feldspar(?) consisting of intergrown epidote, sericite and chlorite(?), and fine-grained inter-growths of quartz, feldspar(?) and chlorite(?), which would represent altered volcanic fragments.

The rock types comprising the siltstone, chert, and greywacke sequence are silicified carbonaceous siltstone (Fig.25C) and shale, chert, and greywacke, with minor amounts of subgreywacke, tuffaceous

Fig.25B Pascoe River Beds. Gently dipping carbonaceous siltstone.

Fig.25C Pascoe River Beds. Banded silicified siltstone, sandstone and volcanic breccia. The most characteristic rock types of this sequence are silicified siltstone and chert.

The silicified siltstone is a fine-grained banded rock consisting of alternating layers of light and dark material; one specimen is composed of quartz (5 percent) and matrix (95 percent). The quartz occurs as angular grains commonly elongate or wedge-shaped, set in a matrix of fine-grained intergrown quartz, feldspar(?) and sericite or illite(?), as well as a small amount of carbonaceous material and iron oxide. Also present are a few very small elongate flakes of muscovite and small prismatic crystals of tourmaline. The chert is similar in hand specimen to the banded silicified siltstone, but is composed almost entirely of cryptocrystalline or microcrystalline quartz.

The carbonaceous shale is usually coarser, less well sorted, and less lithified than the banded, silicified siltstone. It is dark grey and consists of angular quartz grains (40 percent) set in a matrix of intergrown sericite or illite(?), and carbonaceous material.

Siltstone and fine-grained greywacke are exposed discontinuously in the Pascoe River between $1\frac{1}{2}$ miles and 2 miles east of the Hamilton Creek junction. The siltstone is poorly exposed and deeply weathered; it contains poorly preserved plant remains. The greywacke is fawn, massive and well sorted; one specimen is composed of quartz (45 percent), feldspar (20 percent) and matrix (35 percent). The quartz is angular or subangular and has a high sphericity. The feldspar is mainly plagioclase and occurs as angular laths or subangular grains. Some grains are fresh; however, the bulk is either partially or completely altered to sericite. A small amount of untwinned potash feldspar(?) is present and is altering to clay. The matrix consists of a fine-grained intergrowth of quartz, feldspar, sericite and minor chlorite.

Immediately to the west of the greywacke is a small outcrop of phyllite. This rock differs from the sediments to the east in that it has been tightly folded and has a prominent axial plane schistosity; this has been crenulated and a fine lineation has been produced. One specimen is composed of quartz (70 percent), muscovite (25 percent), iron oxide and carbonaceous material (5 percent). This phyllite has been included with the Pascoe River Beds because of its proximity; however it is more probably related to the Iron Range Schist which lies two miles to the north.

Other exposures

In localities other than the Pascoe River, the sediments of the Pascoe River Beds differ from those described above. In the valleys of Garraway Creek and Brown Creek, the Pascoe River Beds are composed of lutites, arenites and tuffs. They crop out over a distance of $3\frac{1}{2}$ miles in the lower reaches of Brown Creek, and in Garraway Creek near the junction of Garraway Creek and Brown Creek.

In Garraway Creek the Pascoe River Beds consist of sandstone, greywacke, tuffaceous sandstone, tuff, conglomerate, siltstone and shale. The siltstone and shale are best developed in the bed of Garraway Creek while the coarser sediments are exposed on hillsides to the north of the creek.

The sandstone is generally fine grained or medium grained; in places it is coarse grained and grades into conglomerate. It is usually well sorted and contains abundant mica and small amounts of feldspar and lithic fragments. With an increase in the proportion of lithic fragments, these rocks grade into greywacke and tuff. One specimen of greywacke is composed of quartz (60 percent), lithic fragments and matrix (40 percent), and muscovite (1 percent). The lithic fragments consist of aggregates of intergrown quartz and feldspar.

Siltstone and shale are not common and are best developed near the junction of Garraway Creek and Brown Creek. They are well bedded, massive, in part carbonaceous, and are slightly recrystallized and silicified. A thin bed of siltstone immediately underlying Janet Ranges Volcanics on the north bank of Garraway Creek contains abundant plant remains.

In Brown Creek similar sediments are exposed; they include greywacke, tuffaceous sandstone and siltstone, with minor amounts of conglomerate, chert and carbonaceous shale. The coarser sediments contain a considerable proportion of volcanic material. A characteristic of these rocks is the considerable secondary silification in addition to interbedded chert.

The Pascoe River Beds are exposed as a discontinuous sequence of fine grained sandstone and shale in the beds of Hamilton Creek and its tributaries.

Isolated outcrops of fine grained greywacke, feldspathic greywacke, siltstone and shale are exposed in a small east-flowing tributary of Hamilton Creek. The greywacke is massive, well bedded and fairly well sorted. One specimen is composed of quartz (35 percent), feldspar (20 percent), muscovite (5 percent), lithic fragments and matrix (40 percent) and accessory tourmaline and epidote. The quartz forms angular grains with low sphericity. Both sodic andesine and microcline are present as angular laths. The muscovite forms ragged detrital flakes. The lithic fragments consist of a fine grained intergrowth of quartz and feldspar, or of quartz, feldspar and mica. These latter fragments grade into a matrix of similar composition. The tourmaline and epidote occur as small rounded grains and are probably of secondary origin. With an increase in the proportion of feldspar these rocks grade into feldspathic greywackes which are finer grained, lighter in colour and better sorted.

The siltstone and shale are thinly bedded, fissile and green, purple or dark grey. They contain abundant mica flakes and volcanic rock fragments.

In a north-flowing tributary of Hamilton Creek a fine grained tuff or tuffaceous siltstone overlies volcanic breccia. This in turn is overlain by tuffaceous sandstone which appears to grade upwards into volcanic rock, possibly welded tuff.

In Hamilton Creek itself the Pascoe River Beds crop out between 2 and 3½ miles upstream from the junction of the creek with the Pascoe River. The sediments consist of siltstone, fine grained sandstone and greywacke and are exposed at the base of the overlying Cainozoic Yam Creek Beds.

The sandstone is fine grained, well bedded and well sorted; constituent minerals are quartz, feldspar, mica and minor lithic fragments. This rock grades into coarser grained and less well sorted greywacke with an increase in the proportion of lithic fragments. The siltstone is in part carbonaceous and in part siliceous; the carbonaceous siltstone contains poorly preserved plant remains.

Approximately 8 miles upstream from the junction of Hamilton Creek with the Pascoe River, a small exposure of argillaceous siltstone which crops out at the base of a rhyolite flow, contains abundant plant remains.

A small exposure of carbonaceous shale and minor feldspathic sandstone, just south of the Pascoe River midway between Hamilton Creek and the north end of the Jacky Jacky Range, has been included with the Pascoe River Beds. The rock is a massive, tough, fine grained shale, which is dark grey or black; rare muscovite and pyrite are the only identifiable minerals in hand specimen. It consists of quartz (1-25 percent), matrix (75-99 percent), and muscovite (less than 1 percent). The quartz occurs as scattered angular grains with a low or moderate sphericity. Muscovite forms scattered, poorly aligned flakes which grade into sericite in the matrix. The matrix consists of intergrown quartz, feldspar, sericite or illite(?) and carbonaceous material. In places it contains thin bands of opaque material which could be pyrite. In one specimen the sericite in the groundmass is aligned, giving the rock a slaty cleavage.

Haggerstone Island, which lies approximately 6 miles southeast of Cape Grenville, is composed of quartz sandstone, conglomerate, feldspathic sandstone, greywacke and tuffaceous siltstone, with an aggregate thickness between 100 to 125 feet. These sediments are very similar to those comprising the Pascoe River Beds and thus have been included with these rocks. The dominant rock types are coarse grained quartz sandstone and conglomerate; the quartz sandstone is massive and moderately well bedded, with strong current bedding in which the foreset beds strike east-northeast and dip up to 45°. This rock consists of quartz (90 percent) and sericite (5 percent). Slight recrystallization has apparently taken place as the original argillaceous matrix has been replaced by sericite and quartz pebbles in the conglomerate are replaced by a mosaic of serrate grains.

The feldspathic sandstone is massive, fine grained and moderately well sorted; one specimen is composed of quartz (85 percent) and altered feldspar and matrix (15 percent); several fragments of rhyolite are also present. The quartz grains are angular with a low or moderate sphericity. Many grains are fractured, some are broken. The feldspar forms angular laths which are partially or completely altered to sericite. A small amount of the matrix is an intergrown aggregate of quartz and sericite. With an increase in rock fragments these rocks grade into greywacke.

Thin bands of argillite are interbedded with the greywacke and feldspathic sandstone. It is a massive, tough, grey rock which has undergone slight recrystallization. One specimen is composed of quartz (40 percent), sericite (40 percent) and carbonaceous material (20 percent). The original quartz has been recrystallized to a mosaic of interlocking grains and the argillaceous matrix has been replaced by sericite.

The rocks of Haggerstone Island show well developed subhorizontal joints which approximately parallel the bedding. The sediments have been gently folded; the beds dip at 10° towards 320°.

Age

A collection of plant fossils was made by Morton in 1923 from the section in Garraway Creek. They were determined by Dr A.B. Walkom as Lepidodendroids and Cordaites (Morton 1924), which indicate a Carboniferous age.

Plant remains from a number of horizons were collected by geologists of Australian Aquitaine Petroleum Limited and have been examined by Dr G. Playford of the University of Queensland (A.A.P.,1965). From the sequences in the Pascoe River two shale horizons were sampled; both these overlie thin coal seams. Dominant are the genera Lepidodendron and Rhacopteris. In Garraway Creek plant fossils are contained in a thin siltstone immediately underlying Janet Ranges Volcanics; here Lepidodendron is the main genus. A thin siltstone band in Hamilton Creek yielded Rhacopteris. These fossils indicate that the Pascoe River Beds are in part Lower Carboniferous.

Dr P.R. Evans (1966) has examined plant spores contained in a carbonaceous siltstone from the sequence in the Pascoe River and has concluded that they are no older than Devonian and are probably older than Upper Carboniferous. Plant remains collected in 1967 have been determined by Mary E. White (see Appendix II) as Stigmaria ficoides Bgt., the root buttress of Lepidodendron, and a species of Cardiopteris. This flora suggests a Lower Carboniferous age.

Discontinuous outcrop and the effects of faulting make thickness measurements difficult. However, geologists of A.A.P. estimate that the Pascoe River Beds have a total thickness of over 5000 feet. As far as is known the sequence is conformable or perhaps contains a few disconformities representing short time breaks.

Discussion

The Pascoe River Beds unconformably overlie the basement, here Sefton Metamorphics and probably Kintore Adamellite. Although the unconformity is not exposed the sediments contain rare schist fragments.

The relationship of the Pascoe River Beds to the Janet Ranges Volcanics is complex; rounded pebbles of quartz-feldspar porphyry or welded tuff are contained in a sandstone at one locality, which suggests that the sediments post-date some volcanism. The presence of greywacke and tuff containing abundant angular volcanic fragments also suggests contemporaneous volcanism. However, at a number of localities the Pascoe River Beds are overlain unconformably by lava flows or by thin piles of pyroclastics. In Hamilton Creek there appears to be an angular unconformity between fossiliferous siltstone and rhyolite, and in Garraway Creek a massive welded tuff sheet apparently unconformably overlies folded sediments. At a number of places dykes of quartz-feldspar porphyry intrude and slightly metamorphose the Pascoe River Beds, according to A.A.P. (1965). These dykes could be related to the Janet Ranges Volcanics or perhaps to the Weymouth Granite.

The Pascoe River Beds are overlain unconformably by Mesozoic conglomerate at the foot of the eastern scarp of the Great Dividing Range, and are unconformably overlain by Cainozoic Yam Creek Beds east of the Pascoe River, and south of Garraway and Brown Creeks.

In general the coarse, more poorly sorted and more labile sediments are most abundant in Brown and Garraway Creeks and in the siltstone, chert and greywacke sequence of the Pascoe River sequences. The lithic fragments in these sediments are of acid volcanic origin, and in general are more abundant than feldspar and mica. The sedimentation probably took place close to the source and during a time of volcanic activity.

The ratio of feldspar to lithic fragments is high in the sediments of the carbonaceous shale and coal sequence and the arkose and greywacke sequence; muscovite is also abundant in some of these rocks. This suggests a granitic, and possibly metamorphic source rather than a volcanic source for these sediments. They could have been deposited during a period of volcanic quiescence coupled with uplift of granitic rocks or with a change of source direction involving sediment coming from the west or south rather than from the north or east. The siltstone, shale and coal in these sequences represent periods of low relief and quiet sedimentation. The Pascoe River Beds appear to be entirely non-marine.

Folding is evident in the middle part of the Pascoe River outcrop, and takes the form of rather broad anticlines and tighter synclines which trend north-northwest. Three major fault directions are visible on air photos. A major structural direction trends north-northwest, and is followed by Hamilton Creek and one of its tributaries, and by one reach of the Pascoe River.

A west-northwesterly structural trend is best seen in the progressive displacement of the Pascoe River towards the east and in the sharp bend in the Pascoe River near the Hamilton Creek junction. A southwesterly structural trend is reflected in minor displacement of creeks and the Pascoe River. One major lineament follows this direction to the southeast of Hamilton Hill.

Carboniferous to Permian Volcanics

In the Cape Weymouth Sheet area, volcanic rocks, mainly acid in composition, form a series of high ranges which extend from Temple Bay south to Bowden and Mount Tozer. Further to the south acid volcanic rocks are exposed in a narrow belt up to 2 miles wide on the western edge of the Permian Weymouth Granite. These extend from near the Pascoe River road crossing to Nichol Creek, 10 miles to the south in the Coen Sheet area. Other acid volcanic rocks crop out at Cape Grenville and nearby islands in the Orford Bay 1:250,000 Sheet area, and in small exposures at Cape Griffith, the Lloyd Islands, and near the Lockhart River Community (Fig.26).

The volcanic rocks form high, rounded rubble-covered hills generally separated by alluviated valleys. Vegetation on them usually consists of low stunted turkey-bush. The more basic volcanic rocks produce a more fertile soil and are covered with a slightly thicker vegetation of stunted gum trees and grass.

No definite age can be assigned to the volcanic rocks. In places they lie unconformably on the Pascoe River Beds, which, on the basis of fossil plants, are considered to be Lower Carboniferous (A.A.P. Ltd, 1965). The volcanics are apparently unaffected by movements which folded the sediments, so it is likely that a considerable period of time elapsed between the deposition of the Pascoe River Beds and the extrusion of the volcanics. The volcanics have been intruded by the Permian Weymouth Granite. Until results of isotopic age determinations are obtained, the volcanics are assumed to have an Upper Carboniferous or Permian age.

The volcanics crop out in three main bodies, each of which is geographically distinct and is composed of different rock types. It is likely that the rocks in the three areas have originated from different centres, but they were probably erupted at much the same time. They have been named separately the Janet Ranges Volcanics, the Kangaroo River Volcanics and the Cape Grenville Volcanics. Small outcrops of volcanic rocks remote from these areas have not been named.

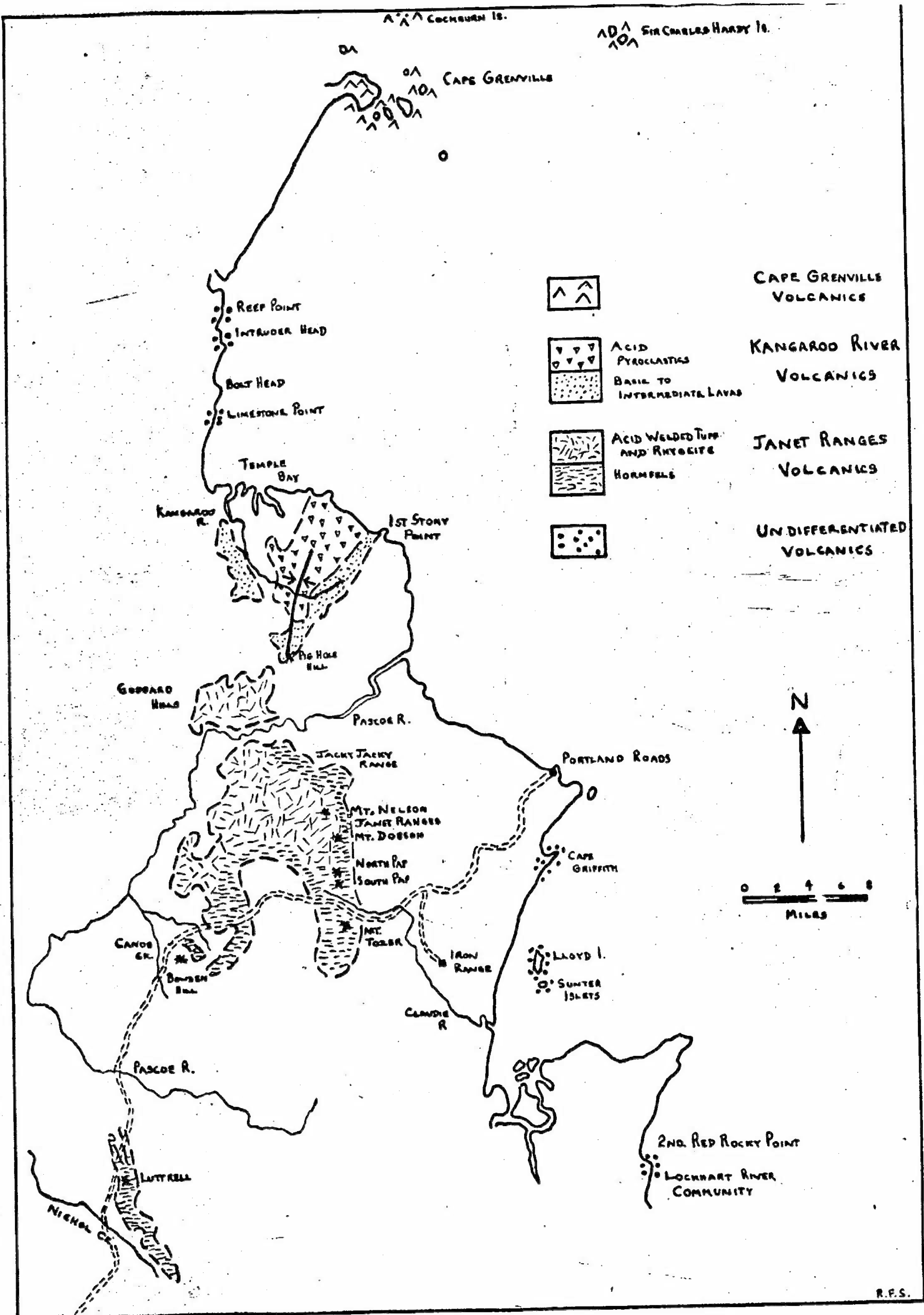


Fig. 26. Distribution of Volcanic Rocks

JANET RANGES VOLCANICS

The Janet Ranges Volcanics consist of acid pyroclastics and lavas with a maximum thickness of about 1500 feet. They crop out about 20 miles inland from Portland Roads over an irregular area which includes the Goddard Hills, Hamilton Creek, the Janet Ranges and Mount Tozer. The thin belt of volcanics to the south between the Pascoe River and Nichol Creek has also been included in the Janet Ranges Volcanics. The main body of the volcanics can be divided broadly into three (Fig.26A).

The basal unit is composed of a sequence of acid welded tuff sheets. The lower sheets consist of massive structureless light-brown welded tuffs which contain euhedral crystals of quartz, potash feldspar and plagioclase set in a groundmass of microcrystalline quartz and feldspar. The rocks were probably originally strongly welded, although any textures in the groundmass have been destroyed by re-crystallization resulting from the intrusion of the nearby granite. The upper sheets consist of black, strongly welded crystal tuffs, which in places contain abundant elongate and compressed pink pumice fragments. The pumice lenticles are devitrified into quartz and feldspar, and in places green amphibole; they commonly show axiolitic or spherulitic textures. In specimens where the groundmass is not recrystallized, glass shards are visible and are generally strongly aligned parallel to the pumice fragments. The individual welded tuff sheets apparently range in thickness from a few feet up to about 150 feet. The boundaries between sheets are difficult to determine, as the individual sheets have welded together in a limited number of cooling units (compare Branch (1966) p.22).

This sequence of welded tuff sheets unconformably overlies the Pascoe River Beds in Garraway Creek. Similar rocks occur at North and South Pap (Figs 29 and 31) and may continue northwards along the eastern edge of the Janet Ranges, although in this region the rocks are intensely hornfelsed, and their original nature is difficult to recognize. Strongly welded crystal tuffs which crop out in the Goddard Hills may belong to the same sequence. In the lower reaches of Hamilton Creek the sequence is apparently poorly developed, and is only represented by a few thin welded tuff sheets interbedded with rhyolite flows.

The sequence of welded tuff sheets is overlain by a thick pile of acid lavas. In the east near Mount Nelson they are over 500 feet thick, but apparently they thin rapidly westward. Between Garraway Creek and Hamilton Hill they are represented by coarse volcanic breccia composed of large blocks of flow-banded rhyolite set in a matrix of rhyolite fragments. Similar rocks also occur in the lower reaches of Hamilton Creek and in the western half of the Goddard Hills. Near Mount Nelson the acid flows can be traced for some distance and are strongly flow banded and spherulitic (Figs 27 and 28). The spherulites are very abundant and range in size from ¼ inch to 3 inches; they are constant in grainsize within one flow. They are probably structures which resulted from the devitrification of the originally glassy rhyolites. A few thin bands of pumice-flow breccia are interbanded with the lavas near the top of the sequence.

The acid lavas are overlain by several hundred feet of coarse pumice-flow breccia and agglomerate which are exposed mainly in the headwaters of Hamilton Creek. The rocks are incipiently to moderately welded and contain abundant large uncompressed pumice fragments and fragments of rhyolite. The matrix contains many smaller rock fragments. In the lower reaches of Hamilton Creek it is difficult to delineate the boundary of this unit with the underlying rhyolite lavas, which are generally brecciated and agglomeratic.

On the west the Janet Ranges Volcanics are more or less flat; they appear to have been confined on their western limits by a ridge of the Pascoe River Beds and the Sefton Metamorphics. On the east the rocks have been tilted up, preseumably by the intrusion of the granite, and in a few places where beds can be recognized on aerial photographs, westward dips of up to 60° have been noted. The outcrop of the 3 main rock types of the volcanics is complicated due to disruption by faulting, and by the intrusion of granite, particularly at Garraway Hill (Fig.26A).

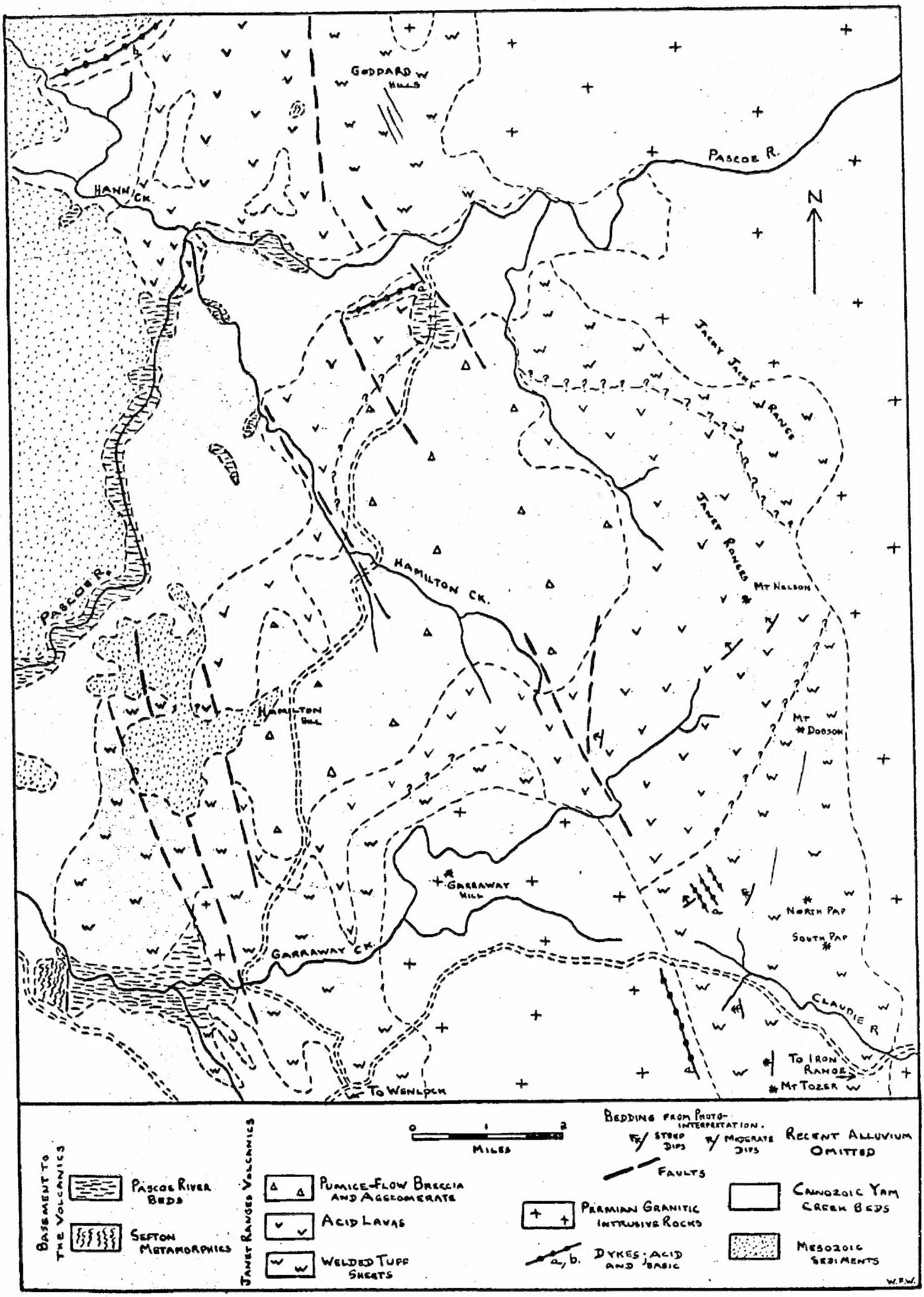


Fig. 26A. Distribution of Rock Types Within the Janet Ranges Volcanics

Fig.27 Janet Ranges Volcanics. Spherulitic rhyolite.

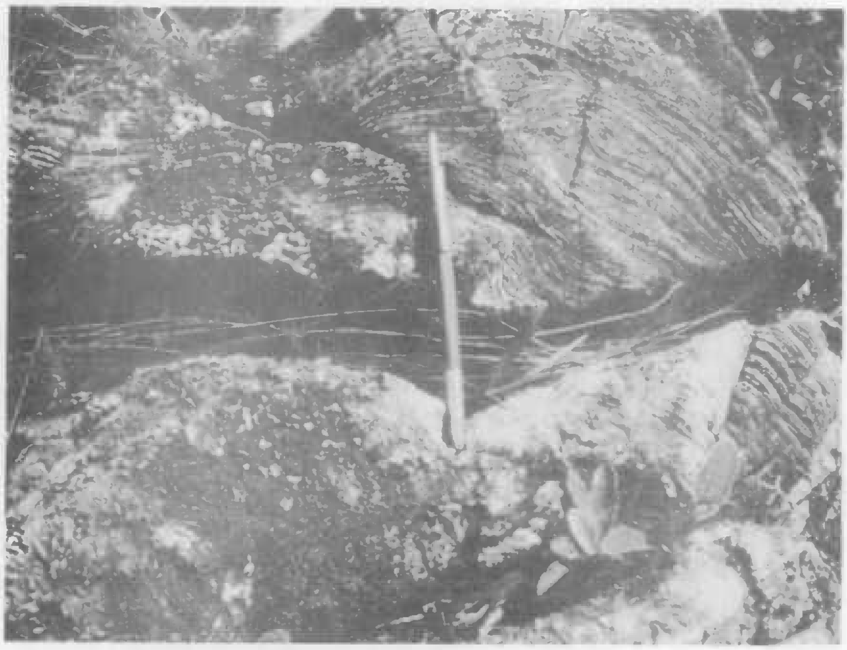


Fig.28 Janet Ranges Volcanics. Flow-banded rhyolite.

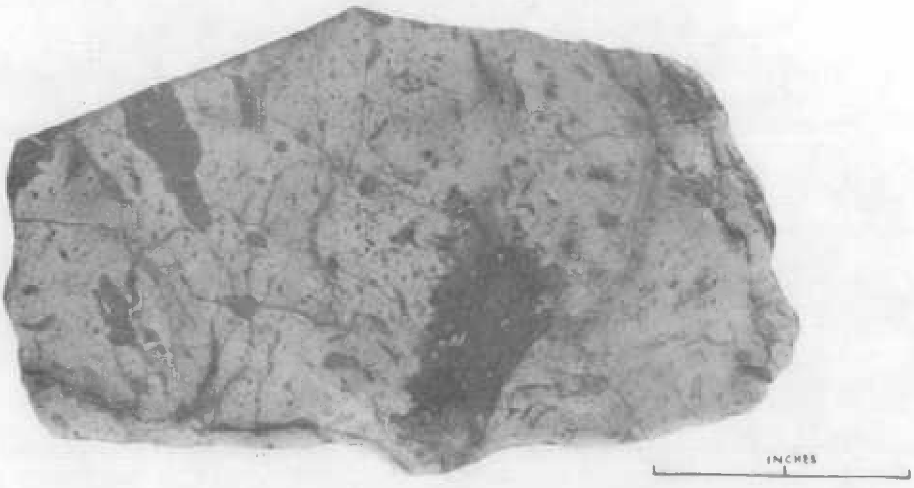


Fig.29 Janet Ranges Volcanics. Coarse pyroclastic rock containing irregular rock fragments. Groundmass is recrystallized, probably by nearby granite, from North Pap.

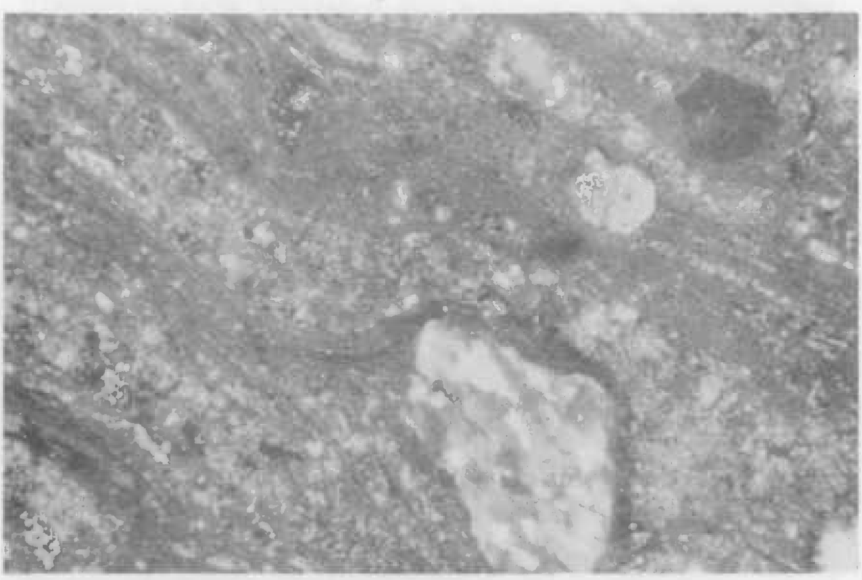


Fig.30 Janet Ranges Volcanics. Fragment of schistose quartzite included in flow-banded rhyolite. Groundmass incipiently recrystallized. Crossed nicols, x 30.

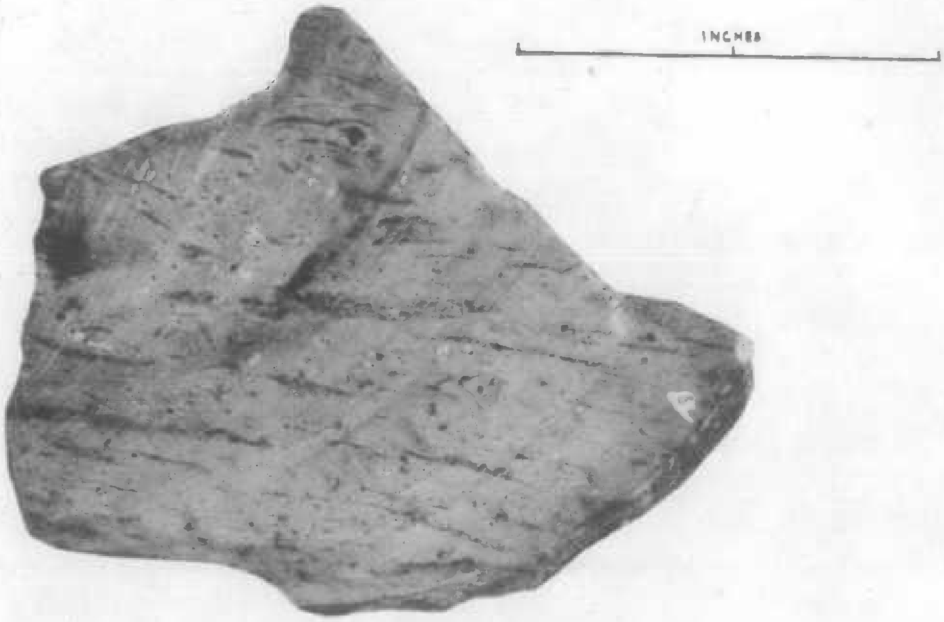


Fig.31 Janet Ranges Volcanics. Eutaxitic texture in welded tuff. Groundmass is completely recrystallized and has a hornfels texture. From North Pap.

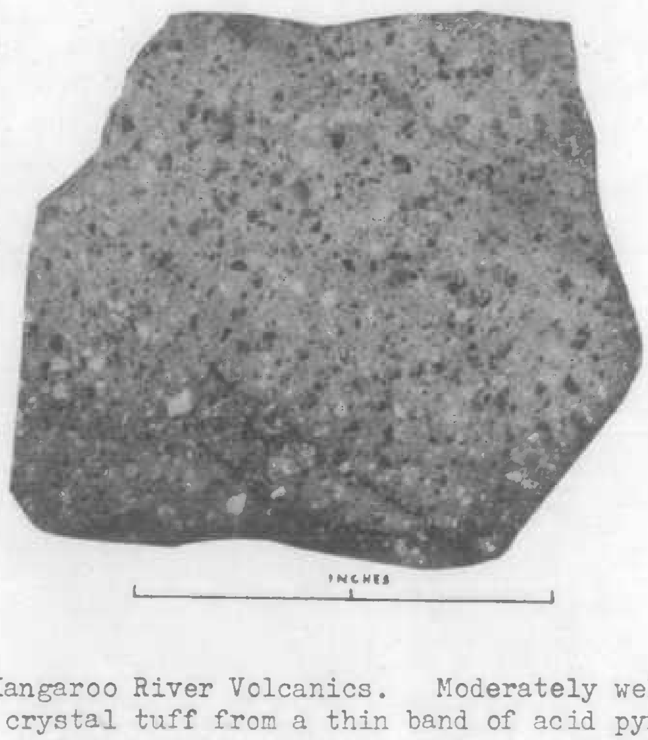


Fig.32 Kangaroo River Volcanics. Moderately welded crystal tuff from a thin band of acid pyroclastics included in the sequence of basic and intermediate lavas.

Thermal metamorphism associated with the Permian Weymouth Granite has recrystallized the volcanics for a considerable distance from the contact. In the less affected rocks, the recrystallization is only incipient and has caused only a general coarsening of the siliceous groundmass and the removal of most of the original structural features of the rock (Fig.30).

In the more intensely recrystallized rocks the groundmass has a hornfelsic or microgranitic texture and the phenocrysts are deeply embayed.

The most extensive development of hornfels has occurred along the eastern margin of the volcanics from the Jacky Jacky Range to Mount Tozer, around the Bowden area, and in the narrow belt of volcanics on the western edge of the Weymouth Granite between the Pascoe River and Nichol Creek (Fig.26). The volcanics in the Pascoe River/Nichol Creek area exhibit a range of metamorphic grades which can be roughly divided into mildly recrystallized rocks, low-grade hornfels, and high-grade hornfels.

The mildly recrystallized rocks are acid flows. They are grey to pink and have a microcrystalline groundmass containing phenocrysts of quartz and pink feldspar between $\frac{1}{8}$ inch and 1/16 inch across. Small aggregates of greenish-black mafic minerals are common. The rocks are well jointed and, in places, banded. The contact with the granite is sharp and is usually marked by numerous thin blue-grey quartz veins.

The low-grade hornfels is developed in volcanic breccia, agglomerate and ash flow tuff which form a belt up to one mile wide on the western side of the rhyolitic lavas and which are in contact with the Weymouth Granite from a point east of Luttrell southeast to Nichol Creek. Towards the west they appear to grade into higher grade hornfels. The low-grade hornfels is a dark bluish-grey massive rock with small quartz phenocrysts. It is intruded by quartz-feldspar porphyry dykes which trend southeast. The contact with the Weymouth Granite is sharp, but fine grained varieties of typical Weymouth Granite invade the hornfels for up to 200 yards from the contact. A few xenoliths of volcanic rocks occur within the granite near the contact.

The high-grade hornfels occurs in a belt lying to the west of the acid lavas and low-grade hornfels. It seems to have resulted from the intrusion of several bodies of hybrid adamellite which are generally found close to the western margin of the Weymouth Granite, between Sefton Creek in the south and Garraway Creek in the north.

The hornfels is a massive, grey, fine-grained rock with vague banding in places; it is difficult to distinguish from the hybrid rocks. Thin veins of grey, fine-grained to medium grained biotite adamellite cut the hornfels in many places. These have irregular shapes and may represent mobilized hornfels.

KANGAROO RIVER VOLCANICS

The Kangaroo River Volcanics comprise an area of about 50 square miles north of the mouth of the Pascoe River, and south of Temple Bay. The name is derived from the Kangaroo River which flows across the volcanics into Temple Bay in the Cape Weymouth 1:250,000 Sheet area. The rocks are flat-lying basic and intermediate lavas overlain by a sequence of acid pyroclastics, with minor interbedded rhyolites.

The basic and intermediate lavas form a relatively thin sequence about 250 feet thick which includes some intermediate welded tuffs and minor interbedded acid welded tuffs and rhyolite. The rocks occur in a V-shaped belt, extending from an apex at Pig Hole Hill northeastwards toward the 1st Stony Point on one side, and northwards toward Temple Bay on the other (Fig.26). The belt is about 1½ miles wide and up to 6 or 7 miles long. The outcrop is apparently the expression of a gentle syncline with dips on the flanks of about 5^{o} to 10^{o}. The nose of the syncline is strongly faulted and the dips are considerably higher. The axis of the syncline strikes north-northeast.

The lavas are fine grained to medium grained, ranging in colour from light grey through creamy brown to dark greyish black. They contain scattered phenocrysts of quartz and feldspar set in a felted groundmass of oligoclase or andesine with small amounts of ferro-magnesian minerals and silica. Generally, the feldspar is corroded and the mafic minerals are chloritized. Vesicular lavas occur towards the top of the sequence; the vesicules are now filled with calcite.

Bands of intermediate to basic welded tuffs, which occur within the lavas, are dark grey to black, with pink feldspar phenocrysts, dark grey rhyolitic and other lithic fragments, and fragments of plagioclase and hornblende. The matrix consists of microcrystalline quartz, feldspar and chlorite. Minor acid welded tuffs and rhyolites also occur in the sequence of lavas (Fig.32).

The belt of lavas is overlain by acid pyroclastics which crop out in a triangular-shaped area of about 10 square miles which has a markedly different photo pattern from the lavas. The pyroclastics are not well known but they are probably mainly acid welded tuff and volcanic breccia with some bands of flow banded rhyolite. The welded tuffs are buff to cream, very finely but irregularly jointed, commonly with small quartz veins in the joint planes. The volcanic breccias contain abundant fragments of flow-banded acid lavas with phenocrysts of quartz and feldspar in a light coloured matrix. The rock fragments are irregularly shaped and devitrified. The groundmass is commonly recrystallized to an even grained mosaic of quartz and feldspar. The relationship of the large bands of flow-banded rhyolite with the pyroclastics is difficult to determine. Structure is not evident, but the general strike direction of the flow banding appears to be 40°-60°, with a vertical dip.

CAPE GRENVILLE VOLCANICS

The Cape Grenville Volcanics are named from Cape Grenville in the Orford Bay 1:250,000 Sheet area. They are exposed on Cape Grenville and the nearby Home Islands (Orton, Gore, Perry, Hicks, Clerke and Nob Islands), on Sunday Island, the Cockburn Islands (Pig, Bootie and Manley Islands and Buchan Rock) and on the Sir Charles Hardy Islands (Fig.33).

The Cape Grenville volcanics are interbedded acid pyroclastics and flow-banded rhyolites. The thickness of the sequence and its distribution over the area now covered by the sea and by Mesozoic sediments is unknown. The volcanics were probably erupted during the same period of violent acid volcanic activity that gave rise to the Janet Ranges Volcanics and the Kangaroo River Volcanics, 2 0 to 30 miles to the south. No contacts were seen between the volcanics and the considerably younger Mesozoic sandstone which crops out a few miles west of Cape Grenville.

In the area near Cape Grenville the volcanics are well bedded, striking approximately northwest and dipping 10° to 15° to the northeast. The rock types exposed appear to form four bands (Fig.34).

The lowest band is exposed in Indian Bay and Margaret Bay and is composed of thin, well defined beds of agglomerate and coarse tuff. In these rocks pebbles and blocks, up to 18 inches across, of acid welded tuff and intermediate to basic volcanic rocks are set in a coarse pink matrix; in places the boulders form thin layers which extend for many yards.

The agglomerate is overlain by 50 to 60 feet of welded tuff, with abundant elongate lenticules of pink pumice up to 1 inch in length, set in a greyish-purple aphanitic groundmass. The lenticules are aligned and form a planar structure which is considered to be approximately parallel to the bedding surface. The groundmass of the tuff consists of microcrystalline quartz and feldspar, but some irregularly shaped glass shards are visible in places. Most specimens are moderately welded. The pink lenticules of pumice or glass have devitrified to quartz and feldspar with axiolitic and spherulitic textures. This welded tuff is also exposed on Orton and Gore Islands. The top of the unit is exposed on the east side of Waterhole Bay and consists of a number of sheets of welded tuff which have apparently cooled as one unit. Some sheets are only a few feet thick and the bedding is clearly visible.

The welded tuff is overlain by pink and white strongly flow-banded and spherulitic rhyolite (Fig.35). In places at the base of the rhyolite a 30 foot thick layer of agglomerate overlies the welded tuff. The agglomerate consists of blocks of flow-banded rhyolite up to 30 feet across. The thickness of the rhyolite is difficult to determine due to the contorted nature of the flow-banding; however the maximum thickness would be under 1000 feet. In places the rhyolite is

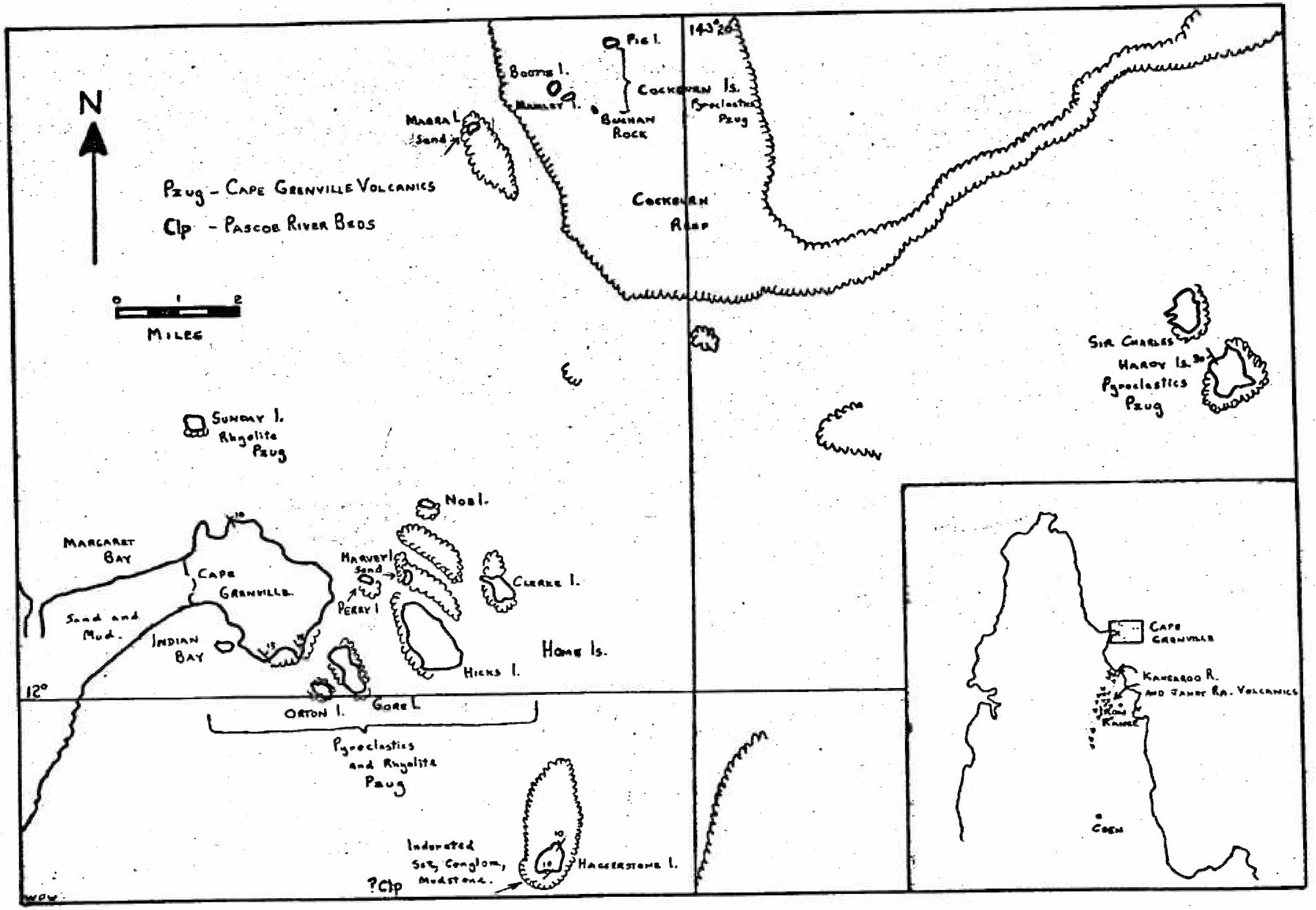


Fig. 33. Locality Map Cape Grenville Volcanics

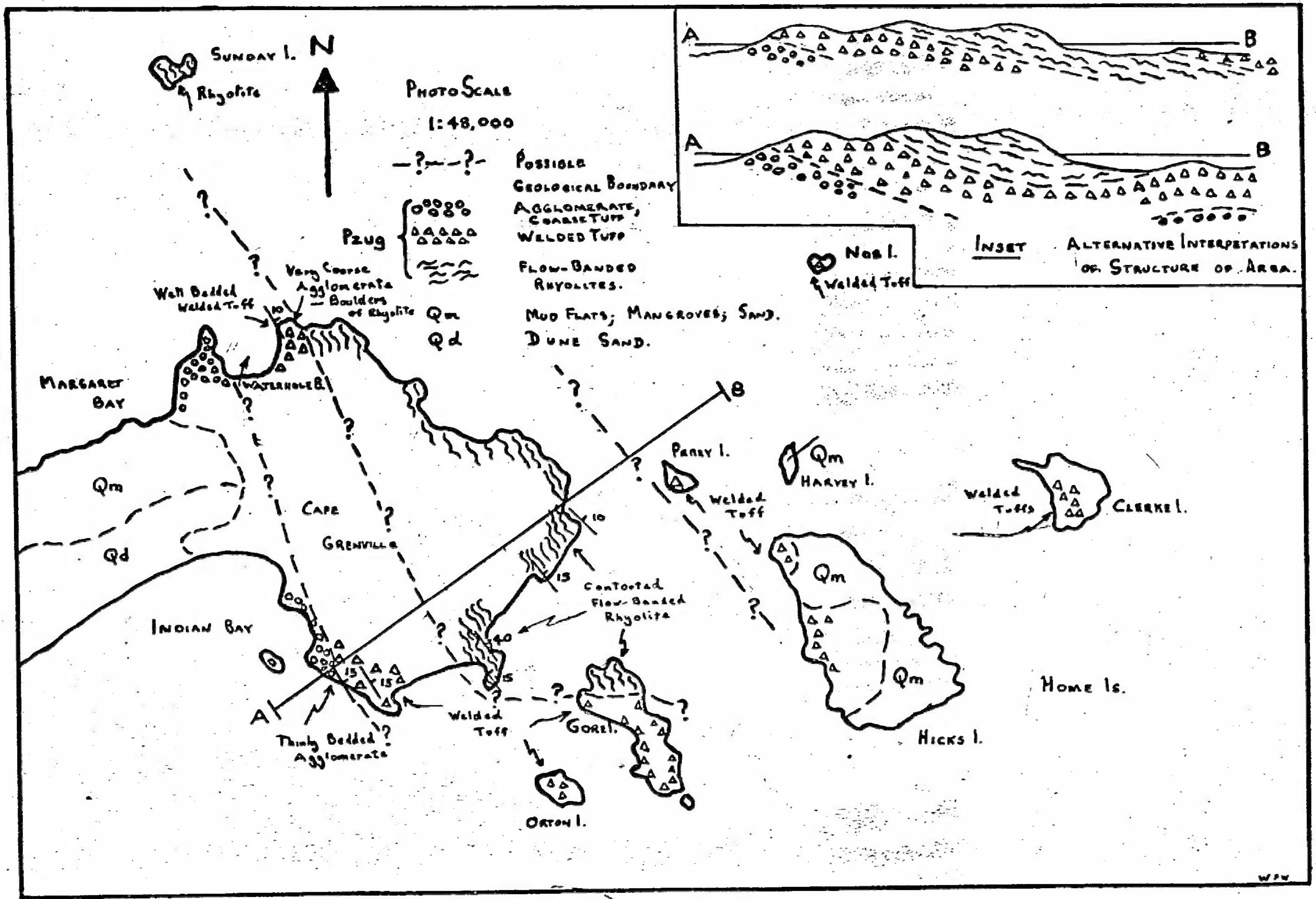


Fig. 34. Geology of Cape Grenville Area

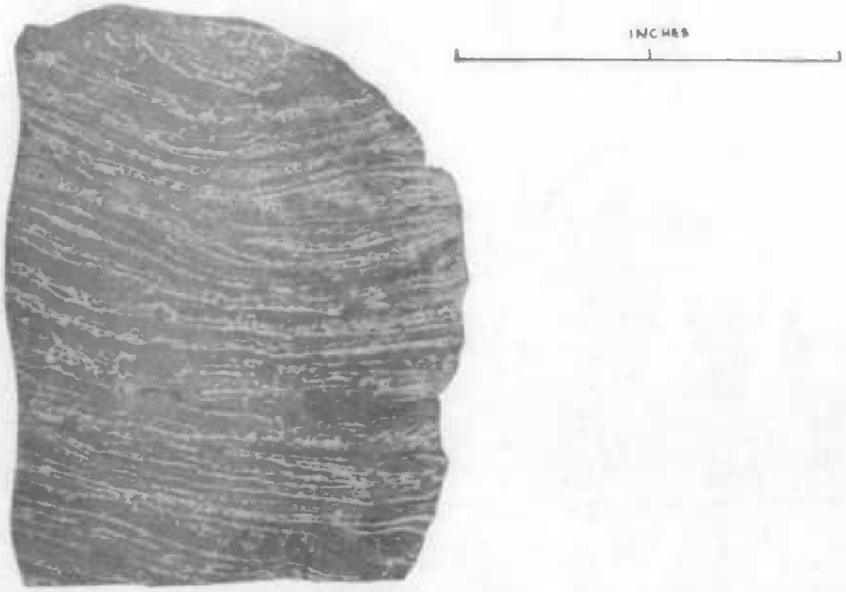


Fig.35 Cape Grenville Volcanics. Flow-banded rhyolite.

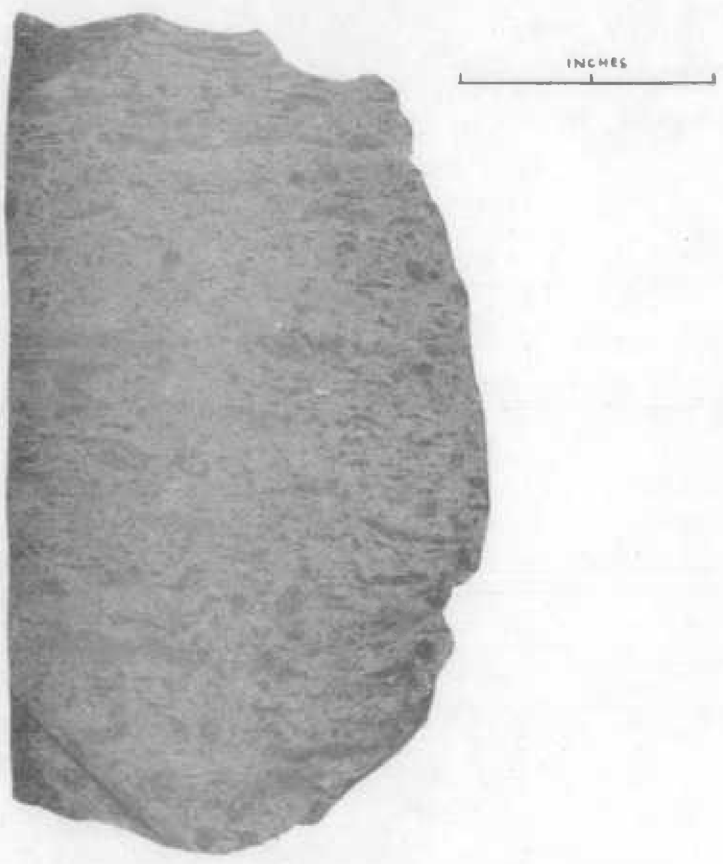


Fig.36 Welded tuff from Lloyd Islands. Eutaxitic texture produced by lenticules of devitrified pumice .

severely fractured and penetrated by thin quartz veins. The flow-bands in the rhyolite are long and continuous; they have devitrified to quartz and feldspar and have been slightly recrystallized to produce a fine granophyric texture.

Hicks, Clerke, Perry and Nob Islands consist of welded tuff with pink elongate pumice fragments, set in a grey aphanitic matrix. The rocks are very similar to the welded tuff underlying the rhyolite. As no true bedding is visible and the contact with the rhyolite is obscrued by the sea, the position in the sequence of the tuff on these islands is uncertain: it may represent a second unit of welded tuff overlying the rhyolite exposed on Cape Grenville, or it could be part of the welded tuff unit below the rhyolite which has been exposed again on the northeastern limb of a shallow syncline (inset Fig.34).

The Cockburn Islands are composed of pyroclastics. On Pig, Manley and Bootie Islands the rock is a dark, massive welded tuff with no visible bedding. Fine jointing is very well developed, striking 80° with a vertical dip. In a thin section of the tuff a few devitrified pumice fragments are set in a very fine-grained groundmass of strongly aligned devitrified glass shards. On Buchan Rock, the pyroclastics are very similar to those at Cape Grenville, with abundant elongate pink pumice fragments set in a grey aphanitic groundmass. The bedding is hard to recognize, but appears to strike 50° and 10° southeastwards.

The Sir Charles Hardy Islands are composed of welded tuff very similar to that exposed at Cape Grenville. Pink and green pumice fragments, up to 3 inches long, are set in a grey aphanitic groundmass. In places these fragments are less abundant, giving the rock a more massive appearance. No glass shards are visible in the groundmass, and the pumice fragments are recrystallized to quartz and feldspar with a granophyric texture. The bedding, as determined by the orientation of the pumice lenticules, usually strikes between 130° and 160°, and dips approximately 30° southwest. The rocks are well jointed and minor faulting has taken place.

UNDIFFERENTIATED VOLCANICS

The undifferentiated volcanic rocks form small isolated outcrops which cannot be included in any of the groups described above. They occur at Cape Griffith, Sunter Islet, Lloyd Island, and the 2nd Red Rocky Point. Small exposures of acid rocks, which may be eruptive or intrusive, occur on headlands in Temple Bay and are also discussed in this section.

Cape Griffith consists of grey rhyolitic or dacitic welded tuff composed of rock fragments and crystals of quartz and feldspar in a fine grained groundmass. A few ill defined beds of brownish-grey massive agglomerate in the welded tuff contain pebble-size fragments of intermediate volcanic rocks.

Sunter Islet is composed of very fine-grained, glassy porphyritic andesite, with blocky phenocrysts of greenish feldspar; it may be an intrusive rock. Lloyd Island is composed of acid pyroclastics ranging from fine-grained welded tuff to pebble agglomerate (Fig.36). The fragments range from small crystals to large blocks of acid volcanic rocks. Spheroidal weathering is common.

Volcanic rocks at the 2nd Red Rocky Point consist of metabasalt intruded by leucocratic microgranite dykes. The basalt is dark grey to black, fine grained, massive and in part foliated or banded. It contains a few phenocrysts of feldspar, and veins between ¼ and ½ inch thick of quartz and epidote. The metabasalt weathers to a fertile reddish soil. One thin section is a fine grained biotite-actinolite-plagioclase hornfels cut by quartz veins.

Acid eruptive or intrusive rocks in Temple Bay crop out at Limestone Point, Red Cliffs, Intruder Head and Reef Point (Figs 13,14). They are pale cream to pale green and contain phenocrysts of quartz and feldspar in an aphanitic groundmass. They are massive and structureless, and in most places are extremely altered. At Limestone Point and Intruder Head, the rocks intrude limestones and micaceous schists respectively. A similar intrusive origin is suggested for the rocks at Red Cliffs and Reef Point. At Bolt Head an acid intrusive breccia 30 to 40 feet wide cuts schistose quartzite and contains fragments of it.

The period of acid intrusive activity represented by these rocks is thought to be associated with the eruption of the Carboniferous to Permian volcanics. However, they may alternatively represent small intrusions associated with the nearby Weymouth Granite.

Permian Intrusive Rocks

WEYMOUTH GRANITE

The Weymouth Granite forms a large body of batholithic proportions exposed over 300 square miles in the northcentral part of the Coen Sheet area and the southcentral part of the Cape Weymouth Sheet area. It is composed essentially of porphyritic hornblende-biotite or biotite granite and adamellite. Especially in the northern and western parts of the body, the granite has the characteristics of a high-level granite, and it represents the latest intrusive episode in the area.

The name is derived from the County of Weymouth, which covers most outcrops of the granite (see Department of Lands, Queensland,1965). The granite is also well exposed at Cape Weymouth, and is the predominant granitic rock in the Cape Weymouth 1:250,000 Sheet area.

The Weymouth Granite crops out almost continuously as a belt 60 miles long, extending from the First Stony Point in the north to the headwaters of Hull Creek in the south. This belt ranges up to 20 miles in width in the reaches of the Pascoe River, and may extend a further 10 miles eastwards to the Heming Range. The granite also forms the Forbes Islands, Quoin Island, and small exposures along the coast of Temple Bay.

The outcrop of the granite is interrupted by superficial sediments and by large bodies of older rocks such as the Janet Ranges Volcanics, the Mount Carter Schist, and the Iron Range Schist.

Exposure of the granite is generally good, but in the upper reaches of the Pascoe River, around the Little Pascoe River, and on the coastal plain at Lloyd Bay it is concealed by superficial deposits. The granite is commonly exposed as rounded boulders, which range up to 50 feet across. At Tor Hill, near the Pascoe River, a ridge over 1 mile long is completely mantled by large boulders blackened by lichen, and resembles the black granite ridges in the Trevethan Granite near Cooktown (Lucas and de Keyser, 1965). The granite is also very well exposed as a pavement in the bed of the Pascoe River and in several of its larger tributaries.

On air photos it is difficult to distinguish the granite from adjacent volcanic rocks where these rocks have similar relief, for example in the Jacky Jacky and Tozer Ranges. Vegetation on the granite grades from rain forest on the eastern flank of the coastal ranges to sclerophyll forest in the west, and to open heath or turkey bush north of the mouth of the Pascoe River and on the high eastern ridges of the Heming Range.

The Weymouth Granite is a pinkish to white medium-grained or coarse-grained massive rock, with phenocrysts of potash feldspar which range from grey to salmon pink and which are up to 25 millimetres long. Granodiorite xenoliths are common in the granite; they are small rounded, fine grained and dark. Irregular patches and dykes of grey or pink aplite and microgranite are common throughout the Weymouth Granite.

The range of the mineral composition of the Weymouth Granite is shown by Table 5, in which proportions of minerals in 24 thin sections are listed. A little over half the sections examined are granite; the remainder are predominantly adamellite, with a few granodiorite.

Quartz generally makes up between 30 and 40 percent of these rocks, but its range extends from 15 percent to 55 percent of the samples examined. The potash feldspar is microcline in 9 of the 24 sections examined, and is probably orthoclase in the remainder. The plagioclase is commonly altered to sericite and clay minerals, but in most sections it appears to be oligoclase; in a few it is andesine. The plagioclase is commonly zoned, with a core of calcic feldspar and a rim of albite. In most of the sections the ratio of potash feldspar to plagioclase ranges from 2:1 to 1:1 and even the rocks which are

TABLE 5

MINERAL COMPOSITION OF THE WEYMOUTH GRANITE

	Percentage					
Specimen number	Quartz	Potash feldspar	Plagi-oclase	Biotite	Horn-blende	Accessories
67480445	35	30 m	25	8	2	sp,zr,ap,op
67480312*	25	53 or?	19	3		zr,op
67480314*	15	13 or?	52	5	15	al,op,ap,sp?
67480423	30	15 or?	45	5		op,zr,ap
67480421	35	45 m	15	5		ap,zr
67480422	30	15 m	45	10		zr,ap,al
67480522	40	30 m	20	5	1	mo,al,op,zr,ap
67480309	30	41 or?	21	7	1	op,zr
67480399	25	50 m	20	5		op,zr
67480569	55	15 m	20	5		op,ap,zr
67480416	25	35 m	30	9	1	zr,ap,op,al,sp
67480332*	30	39 m	24	7		zr,ap,op
67480568	30	30 or?	40	2		zr,op
67480289*	33	28 or?	27	9	3	zr,op,ap
67480297*	37	40 or?	19	3	1	zr,al,sp
67480318	20	40 or?	35	4	3	al,op
67480294	20	40 m	30	10		zr,ap,op
67480319*	33	28 or?	27	10	2	sp,al,op,zr
67480453	30	35 or?	25	10	2	zr
67480414	40	30 or?	20	5	1	al,op,zr
67480439	40	35 or?	15	5		op,al
67480440	35	50 or?	10	2		op
67480311	30	70 or + ab				op

* Proportions by point-counter

m = microcline; ab = albite

or = orthoclase, or? = untwinned potash feldspar, probably orthoclase

ap = apatite; op = opaques; zr = zircon; sp = sphene; al = allanite;

mo = monazite

classed as granite almost all contain a considerable proportion, between 20 and 30 percent, of plagioclase.

Biotite is present in almost all the sections examined and forms between 2 and 10 percent of the rocks. Hornblende is present in only half the sections examined, and generally forms less than 3 per cent of the rock. Opaque minerals are accessory in almost all the sections, zircon is present in most of them, apatite is a common accessory mineral, allanite is less common, sphene is accessory in a few specimens, and monazite in one. Monazite appears to be accessory in the Weymouth Granite at Cape Direction, and is present in beach sands there.

About 2 miles southeast of Jacks Knob a metallic sulphide mineral, probably pyrite, is accessory in the granite, and the granite has scattered small cavities, up to 5 mm across, which are partly filled with limonite.

Along the western margin of the Mount Carter Schist, a belt of microgranite up to 2 miles wide, appears to grade westwards into the Weymouth Granite. This microgranite intrudes the Wigan Adamellite and the Mount Carter Schist; north of Sefton Creek, where the belt is about ¼ mile wide, it appears to be faulted against the Mount Carter Schist.

The microgranite is a leucocratic rock ranging from grey to pink; its only dark mineral is minor biotite. It grades into aplite or felsite in places. The microgranite appears to form a group of closely spaced dykes intruded along the contact of the Weymouth Granite with the Wigan Adamellite and the Mount Carter Schist. The dyke-like form of the microgranite is especially evident near the Wigan Adamellite south of Sefton Creek and adjacent to the Mount Carter Schist north of the creek. In the latter area the microgranite could alternately represent hornfelsed volcanics forming a wedge between the Weymouth Granite and the metamorphic rocks.

Dykes and small masses of microgranite, aplite, and felsite occur in many other places within the Weymouth Granite. The dykes are generally about 5 feet thick but many dykes and masses range up to 30 feet in thickness. Thin veins as well as dykes of pink microgranite invade the Weymouth Granite exposed near the Olive River. On the coast near the Second Red Rocky Point dykes and a large mass of pinkish microgranite, over 100 feet across, intrude Kintore Adamellite and recrystallized volcanics. Pink leucocratic microgranite forms a sizeable proportion of the rocks exposed at Forbes Islands and contains small pink feldspar phenocrysts and scattered crystals of altered mafic minerals.

The pink microgranite is regarded as part of the Weymouth Granite as it is thought to be a late phase which is probably comagmatic with the rest of the Weymouth Granite. As observed above, however, some bodies of microgranite may be recrystallized acid volcanic rocks. The Weymouth Granite also contains irregular patches of grey biotite-hornblende granodiorite and is intruded by dykes of hornblende microdiorite.

The contact of the Weymouth Granite with rocks of the Sefton Metamorphics is commonly faulted. Where an intrusive contact is present, dykes of felsite and microgranite are common in the adjacent metamorphics, and the metamorphics are thermally metamorphosed.

The contact of the Weymouth Granite and the Kintore Adamellite in the Round Back Hills, a few miles west of Portland Roads, is marked by large lenses of biotite-quartz-feldspar gneiss or foliated Kintore Adamellite within the Weymouth Granite. The presence of similar lenses in Rocky Island at Portland Roads suggests that this contact lies not far to seaward of the island. The development of faint banding, produced by alternating concentrations of felsic minerals and biotite, in the Weymouth Granite near Portland Roads, may also be a reflection of the proximity of the contact.

Between the Wenlock and the Pascoe Rivers for a distance of about 12 miles, the Weymouth Granite is in contact with acid volcanics. The contact between granite and thermally metamorphosed volcanics is generally sharp, and the volcanics are less severely recrystallized than the volcanics in contact with hybrid microadamellite (see below).

Between the road crossing of the Pascoe River and the Bowden Mineral Field the contact between the granite and hybrid microadamellite is sharp, but east of Bowden Hill it is complicated by large apophyses of granite and by numerous large xenoliths of recrystallized volcanics and hybrid rocks within the granite. North of Mount Tozer the volcanics are progressively more intensively recrystallized towards the granite contact, and at Mount Tozer volcanic rocks in contact with the Weymouth Granite resemble microgranite.

Diorite satellite bodies

In the Cape Weymouth Sheet area several bodies of diorite have been mapped within or marginal to the Weymouth Granite. In the Coen Sheet area two other small bodies of diorite about ¼ square mile in area apparently intrude Wigan Adamellite. The rocks are dark grey or blue-black and medium grained, and crop out as small rounded boulders. They weather to a soil noticeably darker than that of the adjacent granitic rocks. The rocks range in composition from hornblende-biotite tonalite to quartz-biotite-hornblende diorite. Tonalite was only identified from bodies near Mount Tozer and near McKenzie Creek.

The largest body of diorite is three square miles in area and occurs at Ogilvie Hill six miles southwest of Portland Roads. It is oval in shape and is entirely surrounded by Weymouth Granite. No contacts were seen. A smaller body (1½ square miles) is exposed near Ham Hill about 6 miles northeast of Iron Range airfield and is elongated in a southeasterly direction. It is apparently intrusive into Kintore Adamellite. Another body is exposed on the Wenlock-Iron Range road about 2 miles east of Mount Tozer. It is elongated in a northerly direction and intrudes thermally metamorphosed Janet Ranges Volcanics to the west; and Iron Range Schist to the east. The body is bounded by Weymouth Granite to the north and south. A small exposure of diorite with associated porphyritic granite intrudes schists near McKenzie Creek, about 9 miles southwest of Portland Roads. This body has a fine grained margin. Other small bodies probably occur along the western margin of the Iron Range Schist near the contact with the main mass of the Weymouth Granite.

Plagioclase, largely sodic andesine, occurs as medium grained laths moderately altered to sericite; it forms 40 to 60 percent of the diorite. Larger grains may be zoned with sodic rims and some ophitic intergrowth with hornblende is common. Hornblende occurs as pale brownish-green subhedral grains, and is poikilitic in places; it forms 30 to 40 percent of the diorite and 5 to 15 percent of the tonalite. Some alteration to tremolite(?) is evident in the tonalite. Biotite is a red-brown to dark brown pleochroic variety showing some alteration to chlorite and, rarely, to zoisite(?) or clinozoisite(?). It forms 5 to 10 percent of the quartz diorite and 10 to 15 percent of the tonalite, and is generally intimately associated with hornblende. Quartz forms up to 10 percent of the diorite and 10 to 15 percent of the tonalite and is interstitial. Potash feldspar probably occurs in minor amounts (up to 5 percent) in most of the rocks but has not been definitely identified. Fine-grained opaque minerals are accessory.

A small body of diorite is exposed in Sefton Creek near the contact of the Weymouth Granite with the (?)Devonian Wigan Adamellite. It is composed of plagioclase (65 percent), hornblende (10 percent), and biotite (5 percent), with minor opaque minerals and quartz. Apart from this and one other small body 4 miles to the west, no diorite is exposed along the western margin of the Weymouth Granite. However diorite is thought to occur at depth marginal to the granite(see section on Hybridized Intrusives).

The relationship of the diorite to the Weymouth Granite has not been definitely established. The occurrence of many of the diorite bodies around the margins of the granite may indicate that the diorite was emplaced at the same time as or slightly later than the granite (cf. Joplin, 1964), but in a small exposure on a beach one mile southeast of Restoration Island altered biotite-hornblende diorite with accessory pyrite and chalcopyrite has been intruded by Weymouth Granite. The diorite has also been invaded by basaltic dykes which probably post-date the granite. Diorite also forms xenoliths in the granite at Portland Roads. On this evidence we prefer to believe that the diorite is slightly older than the Weymouth Granite.

GRANOPHYRIC AND HYBRIDIZED INTRUSIVES

Two belts of hybridized and granophyric granitic rocks are exposed along the western margin of the main body of the Weymouth Granite. The southern belt extends from near Sefton Creek in the northern part of the Coen Sheet area to Bowden in the southern part of the Cape Weymouth Sheet area. This belt is from 1 to 3 miles wide and about 25 square miles in area. It intrudes Kintore Adamellite and undifferentiated Sefton Metamorphics to the west and thermally metamorphosed volcanics elsewhere; it is intruded in the east by the Weymouth Granite. Three small bodies intrude Janet Ranges Volcanics near Garraway Creek, northeast of Bowden. A small body of granodiorite also intrudes Janet Ranges Volcanics at the northern end of the Jacky Jacky Range. The northern belt extends for about 14 miles from the western Goddard Hills near the Pascoe River to Fair Cape on the coast north of Weymouth Bay, and is exposed over about 22 square miles. This belt intrudes Kangaroo River Volcanics and Janet Ranges Volcanics in the west and is apparently intruded by the Weymouth Granite in the east.

The rocks of the southern belt are granodiorite to adamellite in composition and become progressively less recognizably of hybrid origin and progressively more granophyric in texture to the north. From the Goddard Hills northwards the rocks are entirely granophyric alkali granites.

Southern area: From Bowden Hill south to one Mile Creek the rock is principally a pink and grey granophyric hornblende-biotite microadamellite. From the Pascoe River south to the headwaters of Nichol Creek the rock is predominantly a grey biotite-hornblende microadamellite or microgranodiorite with adamellite and granodiorite in places. The relationship between these two types is not known.

The rocks are generally exposed as small rounded boulders or as angular scree. The belt forms a more or less continuous ridge separated by a high valley from the western edge of high country formed by the Weymouth Granite.

The microadamellite at Bowden Hill and southwards to the upper reaches of One Mile Creek is pink to grey and mottled greenish-black, fine grained or medium grained and massive; it generally contains small white feldspar phenocrysts. The greenish-black mafic minerals commonly form clots up to 1 cm across.

Throughout this area, especially along the northern flank of Bowden Hill and on a small inlier just west of Canoe Creek, numerous small xenoliths of recrystallized volcanics, mainly ash-flow pyroclastics, are found. This, together with the occurrence of thermally metamorphosed Janet Ranges Volcanics flanking Bowden Hill, suggests that the summit of Bowden Hill may be near the roof of the intrusion. Many of the xenoliths have been marginally assimilated by the microadamellite. Near the Kennedy road crossing of One Mile Creek, sheared quartzite and pegmatite of the undifferentiated Sefton Metamorphics have been intruded both by the microadamellite and by an outlying body of Weymouth Granite.

The microadamellite in the Bowden area consists of subhedral oligoclase laths as small phenocrysts, and irregular clots composed of an intimate mixture of biotite and hornblende in a relatively coarse grained matrix of intergrown quartz and potash feldspar. The intergrowth ranges in texture from micrographic to micropegmatitic in which beta(?) quartz is set in irregular grains of a potash feldspar which is probably orthoclase. The micrographic texture is especially well developed near the margins of euhedral plagioclase laths in some specimens. The clots of mafic minerals are generally diffuse aggregates of ragged grains of green hornblende and biotite, which are altered in part to chlorite and rarely, epidote. The clots range up to 5 mm across, and lack quartz or potash feldspar in their cores.

In the part of the belt to the south of the Kennedy Road crossing of the Pascoe River, the grey hybrid rock is massive and fine grained or medium grained, and rarely contains phenocrysts of plagioclase. In some exposures, especially towards the south, it is difficult to differentiate the hybrid rock from the recrystallized Janet Ranges Volcanics which it intrudes. However, the clotted texture of the hybrid rock generally distinguishes it from the volcanics which commonly have a banded or eutaxitic texture. Small, partially assimilated xenoliths commonly occur in the hybrid rocks in this area.

The rocks have a granitic texture, with an average grainsize between 0.5 and 1.0 mm. They consist of subhedral or anhedral zoned calcic oligoclase laths, which form small phenocrysts in places, set in an irregular intergrowth of quartz and microperthitic orthoclase. The mafic minerals, green hornblende and subsidiary dark brown biotite, occur largely in diffuse clots up to 1 cm across. Within these clots quartz and potash feldspar are subsidiary or absent and the clots have a dioritic composition. The hornblende commonly includes numerous fine grains of opaque mineral. In rock 66480398, some fine grained patches contain subhedral phenocrysts of hornblende with a well developed sieve texture. This may indicate that the rock is of metamorphic origin; it is probably a thoroughly recrystallized xenolith. A specimen of hybrid adamellite from near Luttrell exhibits both the well developed granophyric texture of the rocks near Bowden and the coarse mafic clotting described above (Fig.37). The dioritic clots are up to 1 cm across and consist of laths of plagioclase, subhedral grains of hornblende, minor biotite, and interstitial quartz. The plagioclase averages 0.5 mm across and is zoned from sodic andesine to calcic oligoclase, with sodic rims; the hornblende is pleochroic from light brown to mid-green. The clots make up approximately 20 percent of the rock, the balance being composed of small lath-like phenocrysts of oligoclase, and small anhedral phenocrysts of albite set in a granophyric matrix. Individual microperthitic orthoclase grains range up to 2 mm across. The modal composition of this rock has been estimated as 20 per cent quartz, 24 percent potash feldspar, 5 percent albite, 37 percent plagioclase, 12 percent hornblende, and 2 percent biotite.

A small body or a group of dykes of a porphyritic biotite-hornblende-plagioclase rock intruding Wigan Adamellite south of Sefton Creek has been included with the hybrid rocks. The rock is fine grained or medium grained and is composed of approximately equal amounts of feldspar and hornblende phenocrysts in a fine grained groundmass. The groundmass contains small patches of slightly more basic material with few feldspar phenocrysts.

North of Bowden Hill a body of granophyric adamellite is exposed near Garraway Creek. The adamellite consists of small euhedral phenocrysts of somewhat recrystallized plagioclase in a matrix

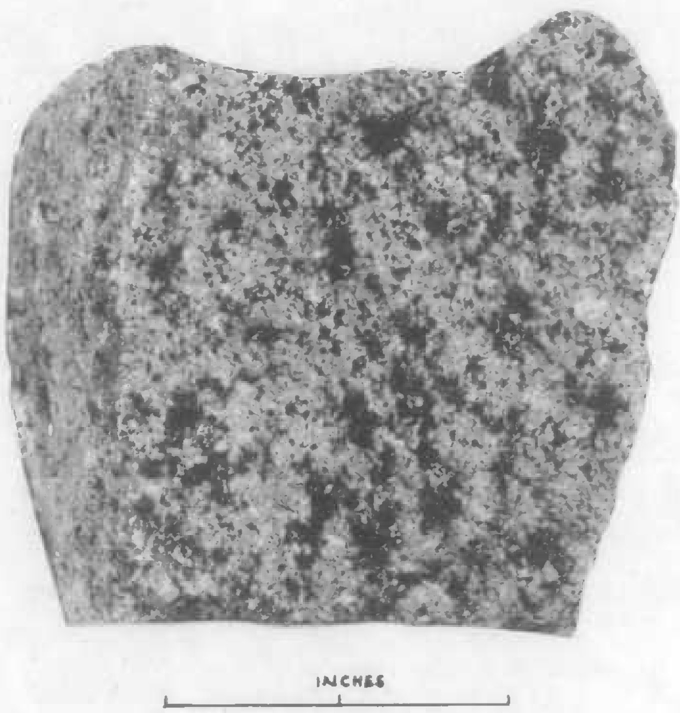


Fig.37 Clotted texture of ferromagnesian minerals in hybrid adamellite.

of micrographic quartz and potash feldspar, and scattered crystals of hornblende and biotite. The hornblende is largely altered to actinolite, and the biotite to chlorite. Two small grains of unaltered clinopyroxene were seen in a thin section from this body; minor interstitial calcite and zoisite also occur.

Two small bodies of hybrid adamellite crop out a few miles to the east. The westernmost body is intrusive into welded tuffs of the Janet Ranges Volcanics and has a clotted texture. It contains xenoliths of a dark rock up to 5 cm across, and of recrystallized welded tuff up to 8 cm across. The other body intrudes Janet Ranges Volcanics in the west and is apparently intruded by Weymouth Granite in the east.

Near the Pascoe River at the northern end of the Jacky Jacky Range, a body of medium grained granodiorite intrudes and has thermally metamorphosed Janet Ranges Volcanics on its southwestern side. The rock is white and mottled green-black in colour and the mafic minerals tend to occur in clots. One thin section consists of altered subhedral plagioclase and hornblende laths in a fine grained or medium grained micrographic intergrowth of quartz and potash feldspar.

The mafic minerals in the hybrid rocks are generally altered. Hornblende alters to actinolite and iron oxides; biotite alters to chlorite, iron oxide and more rarely, epidote. Potash feldspar alters to kaolinite(?) in most rocks; plagioclase is relatively unaltered, though its cores are commonly partially altered to sericite and a clay mineral. In the northern rocks plagioclase is in places severely altered; the calcite and zoisite in some specimens is a product of this alteration.

Accessory minerals include apatite, zircon, monazite, opaques, and rarely allanite. Apatite is particularly common as euhedral needles in mafic clots.

<u>Northern area</u>: Between the Goddard Hills and Fair Cape the granophyric alkali granite is green-grey to pink (when weathered) and sparsely mottled with light green mafic minerals. It is massive, medium grained or coarse grained, and composed of quartz and potash feldspar (probably orthoclase), with some plagioclase, and subordinate muscovite and altered biotite. The rock is well jointed and commonly

contains abundant quartz veins ranging from $\frac{1}{2}$ to 2 inches in width. The most prominent joints strike 160° and between 60° and 80°.

The alkali granite is made up of a micrographic intergrowth of quartz and altered potash feldspar with scattered crystals of oligoclase, commonly as cores to potash feldspar crystals. Small grains of biotite are largely altered to chlorite. Muscovite occurs as a few medium grained flakes. In places where the micrographic intergrowth fringes individual feldspar crystals, the rock appears to be sparsely porphyritic. Individual quartz grains are commonly embayed and are euhedral. Zircon, apatite and opaques are accessory.

The contact of the granite with the Kangaroo River Volcanics is commonly sharp; the contact zone ranges in width from 15 to 50 feet. In this zone pink microgranite lies outside the granite and is succeeded outwards by tourmaline-quartz-feldspar pegmatite, which adjoins thermally metamorphosed volcanics. The tourmaline-bearing rock may be the source of the cassiterite which has been won in small quantities from alluvium near this contact, but no sign of mineralization was seen in the pegmatite sampled. A small amount of sulphide mineralization (pyrite?), as joint coatings, and in mafic minerals, was seen in the granite near the contact. The eastern contact with Weymouth Granite was not seen but it is thought that the Weymouth Granite is intrusive into the alkali granite.

The petrography of the hybrid rocks may be summarized as follows: the oligoclase laths are subhedral to euhedral, well zoned and twinned and usually relatively unaltered; they range from small phenocrysts to grains in the matrix; some have cores of andesine. The laths are in a matrix of intergrown quartz and potash feldspar, probably orthoclase. The plagioclase is probably a high-temperature form. Where quartz and potash feldspar are not well intergrown the matrix is coarser and quartz grains tend to be subhedral and bipyramidal. Green hornblende and dark brown biotite are clustered in clots up to a few millimetres across in which potash feldspar and quartz are generally absent. In many of the rocks hornblende is partially altered to actinolite and dusty opaques, and biotite is altered to chlorite and rarely, epidote. Apatite is a common accessory in the mafic clots.

The texture of the intergrown quartz and potash feldspar ranges from a coarse intergrowth, which is granitic, through micropegmatitic and granophyric to micrographic textures. Where granophyric texture is only incipiently developed it is common in zones marginal to small plagioclase laths.

Joplin (1964, p.183) has concisely summarized the principal features of granitic rocks invading co-magmatic volcanics; " .... many are porphyritic, plagioclase is a high-temperature type and commonly shows oscillatory zoning, quartz is commonly bipyramidal, phenocrysts may be rounded or corroded, many of the rocks show micrographic intergrowths, and orthoclase is typically present instead of microcline. Also, xenoliths are abundant ...". The suite of rocks which has been described above in general has these features. In the south it also exhibits features which are the result of the assimilation of variable quantities of dioritic material by the granitic magma. The assimilated diorite may be related to the diorite satellite bodies which predate the Weymouth Granite in the east. A certain amount of contamination caused by the partial assimilation of volcanic xenoliths has also occurred, especially in the Bowden Hill area, but this is not considered to have played a significant part in the development of these rocks.

It is envisaged that the hybrid and granophyric rocks were emplaced into the base of the volcanic pile at a high level in the crust along a linear zone which, especially in the south, may have been a zone of weakness within the Devonian batholith. Until the results of age determination sampling carried out during the 1968 field season are known, the relative ages of the volcanics, the hybrid and granophyric rocks, and the Weymouth Granite will not be known. However, it is postulated here that the hybrid and granophyric rocks were emplaced only a short time after the deposition of the volcanics, and a considerable time before the emplacement of the Weymouth Granite. The Weymouth Granite may in fact be an anatectic granite and may be unrelated to the magma which produced the volcanics and possibly the hybrid and granophyric rocks. A more definite assessment of the petrogenesis of these rocks will require a more detailed study of their field occurrence and of their petrology.

WOLVERTON ADAMELLITE

The Wolverton Adamellite is a distinctive body of fine grained or medium grained leucocratic adamellite which occurs in the Coen Sheet area, to the north of the Morris Adamellite and largely to the north and west of Bald Hill. The adamellite covers an area of approximately 30 square miles, east of the Mesozoic sandstone cover. It is very well jointed and has a distinctive pattern on airphotographs.

The name Wolverton Adamellite is derived from the parish of Wolverton which covers much of the area of the adamellite (Dept of Lands, Qld 1965).

The adamellite is fairly well exposed as small boulders and blocks, especially immediately below the eroding Mesozoic cover. Essentially it is a grey to pink fine grained or medium grained leucocratic granite or adamellite. The latter appears to predominate. Some aplite or microgranite, which is granophyric in part, occurs towards its eastern margin. Sparse, small potash feldspar phenocrysts up to 7 mm across are found in the medium-grained varieties. The granite is massive but very well jointed. The dominant joints strike 140° to 150° and dip vertically; minor joints strike between 80° and 100°.

The composition of samples of the leucocratic adamellite (67480142, 67480144, 67480151) ranges from adamellite to granite with 30 to 35 percent quartz, 35 to 43 percent untwinned orthoclase(?) microperthite, 19 to 30 percent plagioclase, and minor dark brown biotite, largely altered to chlorite. A specimen of leucocratic granophyric microgranite (67480135) from near the southeast margin of the adamellite consists of 50 percent microperthitic orthoclase(?), 35 percent quartz and 15 percent oligoclase. This rock has been invaded by quartz veins and has subsequently been fractured.

Quartz veins are very common in the adamellite. It is invaded by two or three major systems of quartz reefs which trend between 140° and 150°. The southern ends of the reefs trend between 170° and 180° and intrude the eastern margin of the adamellite where it is faulted against older rocks. Quartz in small veins is generally translucent and appears to fill tension cracks. Adjacent to a large quartz reef in Granite Creek at least three sets of quartz veins trend at about

150^{o} in the leucocratic adamellite. The quartz is white in the earliest vein but translucent in the narrower later veins. The main reef is 15 to 20 feet wide and is fine grained to coarse grained with a variety of textures, including comb, radiating, and finely laminar textures; the last commonly forms complex fold patterns around a crystalline core. Small crystals are generally euhedral, but the larger crystals are subhedral. Within the reef small patches of greyish laminar or granular quartz appear to be the product of crushing. There are at least two generations of quartz in the reef, which is exposed for at least five miles. No mineralization was seen in any of the reefs. Pegmatite or aplite dykes are not found in Wolverton Adamellite.

The adamellite extends under the Mesozoic sandstone to the northwest. Its southern margin south of Bald Hill is generally formed by faults which have been intruded by quartz reefs. The large quartz reefs described above are likewise younger than the faults. Faulting has been active since the deposition of the Mesozoic sandstone along the line of the northeasternmost quartz reef, with a downthrow to the west of several tons of feet. North of Bald Hill, the Wolverton Adamellite has a partially faulted and a partially intrusive contact with ?Flyspeck Granodiorite associated with the Kintore Adamellite and with the Wigan Adamellite.

It appears probable that the Wolverton Adamellite is Permian in age and is related to the Weymouth Granite to the north. Several features suggest this: the leucocratic adamellite is generally pink and the potash feldspar is apparently orthoclase. Elsewhere in the Coen and Cape Weymouth Sheet areas orthoclase is generally restricted either to the Permian Twin Humps Adamellite near Coen, or to parts of the Weymouth Granite. Some specimens from small areas of microgranite marginal to the Weymouth Granite near Sefton Creek are similar to,though finer grained than, the Wolverton Adamellite. A specimen of pink porphyritic biotite granite from 4.5 miles north-northwest of Bald Hill is very similar to typical Weymouth Granite and it is possible that a small area of Weymouth granite occurs near the northern end of the Wolverton Adamellite. The Wolverton Adamellite is intrusive into all rocks with which it has contact; Morris Adamellite, Kintore Adamellite, Flyspeck Granodiorite and Wigan Adamellite, all of which are thought to be Upper Devonian rocks.

The locally reported occurrence of small pockets of tin-bearing sand in Granite Creek and its tributaries about five or six miles upstream from its junction with Geikie Creek also tends to indicate an Upper Palaeozoic age for the Wolverton Adamellite, as elsewhere in the area mapped, tin is only known to be associated with the Permian Weymouth Granite. However it is possible that the tin may have been eroded from concentrations at the base of the Mesozoic sandstones to the west.

TWIN HUMPS ADAMELLITE

The Twin Humps Adamellite is exposed in The Twin Humps, an isolated semicircular range of hills to the northeast of Coen, and in the McIlwraith Range northeast of Mount Croll. The adamellite crops out almost continuously along the whole Twin Humps range, and exposure is also good northeast of Mount Croll. The adamellite forms large rounded boulders.

The Twin Humps Adamellite is a medium-grained or coarse-grained grey or pink hornblende-biotite adamellite. A phase of the main body is a fine-grained pink leucocratic granite which crops out on the western and southwestern flank of the Twin Humps Range and also in the body near Mount Croll.

The adamellite is generally even grained, but has porphyritic patches in places, containing anhedral phenocrysts of microcline up to 1.5 cm across, set in a fine grained biotite-rich groundmass.

A medium-grained or coarse-grained pink hornblende-biotite adamellite is also exposed in the Twin Humps range. The pink colour is due to microcline which is more abundant than plagioclase; the composition ranges from granite to adamellite. This rock shows more variation in grainsize than the grey hornblende-biotite adamellite, and patches and crosscutting bodies of quartz-feldspar pegmatite and aplite are more prevalent in it. It appears to be a minor variant rather than a distinct and significant phase of the grey hornblende-biotite adamellite. The contact between the two rock types is gradational except in the valley of a tributary of the Coen River, where the contact is sharp.

Although the ratio of microcline to plagioclase has a considerable range in the adamellite the total feldspar content is constant at about 60 percent. The potash feldspar forms anhedral phenocrysts up to 1 cm in size. These grains have a well developed perthitic texture and poorly developed cross-hatched microcline twinning. In one specimen the potash feldspar is untwinned though strongly perthitic, and is probably orthoclase. Microcline also occurs in small amounts as irregular interstitial material. Oligoclase forms subhedral laths which are smaller in size than the microcline. They are slightly or moderately altered to sericite and clay. Mafic minerals are biotite and hornblende, which together make up no more than 5 percent of the rock. Allanite and zircon are accessory.

The fine grained pink leucocratic granite in the Twin Humps Adamellite appears to be a slightly younger marginal phase of the main body. Hornblende and allanite are not present in it and biotite is only accessory. Microcline is the dominant feldspar and the rock is a granite. Irregular patches and cross-cutting bodies of quartz-feldspar pegmatite and aplite are common. The contact with the grey hornblende-biotite adamellite is sharp but with the pink hornblende-biotite adamellite it is probably gradational in places.

The Twin Humps Adamellite intrudes gneiss and quartzite of the Arkara-type gneiss to the southwest and south, though no contact is seen. The metamorphics are not appreciably affected by thermal metamorphism as by metasomatism. The recrystallization and partial mobilization of schist and gneiss to the west of the Twin Humps range can be attributed to the Kintore Adamellite. No contact is visible between the Twin Humps Adamellite and the Kintore Adamellite to the west and to the north of the Twin Humps Range, nor with the Lankelly Adamellite to the east of the range. The contact with the latter is possibly faulted as the boundary lies on the northern extension of the Coen Shear Zone.

A specimen of the pink hornblende-biotite adamellite has been dated isotopically as Upper Permian (see Appendix 1).

A body of Twin Humps Adamellite is exposed in an elongate east-trending belt immediately east of Mount Croll and south of the Leo Creek track. It is bounded on the north and east by Kintore Adamellite and on the west and south by Lankelly Adamellite. The rock is well exposed and forms large rounded boulders and spalls. It is well jointed and has a distinctive pattern on air photographs.

It is a pale pink, leucocratic biotite adamellite or granite and is generally even grained. Small patches of quartz-feldspar pegmatite and crosscutting pegmatite and aplite are abundant in some places. In the north the grain size is variable, although in general the rock is coarse grained with more abundant patches of quartz-feldspar and aplite.

The Twin Humps Adamellite in this area ranges in composition from granite to adamellite; an average composition is close to the adamellite-granite boundary. In contrast with the rocks exposed on the Twin Humps range the potash feldspar is orthoclase rather than microcline. No hornblende or allanite are present. Two specimens have the following composition: (67480117)-quartz 38 percent, orthoclase 37 percent, plagioclase 22 percent, and biotite 3 percent; (67480127)-quartz 35 percent, orthoclase 24 percent, plagioclase 36 percent, and biotite 5 percent.

The contact with the Lankelly Adamellite to the southwest is sharp. The Twin Humps Adamellite becomes progressively finer towards the contact and at the contact it is aplitic. The Lankelly Adamellite is cut by veins of biotite-quartz-feldspar pegmatite which are probably derived from the Twin Humps Adamellite. To the northeast, the contact with the Kintore Adamellite is sharp.

The Twin Humps Adamellite was emplaced at a high level in the crust and probably at much the same time as the Weymouth Granite to the north.

Between the two separate bodies of Twin Humps Adamellite, the Lankelly Adamellite is intruded by a number of acid dykes, the largest of which forms the summit of Mount Croll. The dykes are composed of a light cream aphanitic rock which is probably rhyodacite. It is porphyritic, with small phenocrysts of quartz, potash feldspar and rare plagioclase forming up to 20 percent of the rock. The dykes are probably related to the nearby Twin Humps Adamellite.

DOLERITE

An oval body of quartz dolerite,about one square mile in area, intrudes Kangaroo River Volcanics about 8 miles south of Temple Bay, near the Kangaroo River. No contact with the volcanics was observed in the field. Similar dolerite or basalt crops out five miles to the southwest, intruding volcanics in a poorly exposed ring structure.

The dolerite is a dark grey, fine grained or medium grained, even grained and massive rock. A few thin veins of dark green, fibrous chlorite are seen in some exposures. In others some joint surfaces are coated by small crystals of pyrite(?). The dolerite is composed of euhedral intergrown laths of labradorite (55 percent), subhedral,sub-ophitic hypersthene (15 percent), clinopyroxene (10 percent), and pale green-brown hornblende, largely an alteration product of pyroxene (10 percent). Fine grained opaque minerals and minor quartz (5 percent) are interstitial.

The modal composition of the dolerite suggests that it crystallized from a saturated tholeiitic magma. The dolerite intrudes ?Carboniferous volcanics and is probably a product of the same period of activity as the Weymouth Granite.

Twelve miles to the southeast at Pigeon Island and on the adjacent headland on the mainland near the mouth of the Pascoe River, an altered basic rock with the texture of a dolerite may represent a similar small intrusion. To the south of the main mass of the Weymouth Granite on the Coen Sheet area, two dolerite dykes intrude ?Upper Devonian granitic rocks north of Geikie Creek.

Mesozoic

MESOZOIC SEDIMENTS

Carpentaria Basin

Mesozoic sediments crop out in the west of the Coen and Cape Weymouth Sheet areas; they represent the eastern margin of the Carpentaria Basin which overlaps the igneous and metamorphic rocks from the west. The sediments have a similar lithology and mode of occurrence to those in the Ebagoola, Hann River and Walsh Sheet areas to the south described by Trail et al. (1968).

As in the south, the Mesozoic sediments may be divided into a continental sandstone formation with basal conglomerate and a marine siltstone-shale-marl formation overlying it. The former may be equivalent to the Neocomian Wrotham Park Sandstone to the south, but may include late Jurassic rocks which could be time equivalents of the upper part of the Dalrymple Sandstone of the Laura Basin (Lucas and de Keyser, 1965a). The sandstone-conglomerate formation was informally named the "Cape York Peninsula Formation" by Australian Aquitaine Petroleum (1965, 1967) but no formal name is introduced here. The overlying marine sequence was named the Mein Formation by Morton, (1924).

Medium grained to coarse grained sandstone with basal conglomerate is exposed in cliffs along the eastern margin of the Mesozoic sediments from a point some 20 miles northwest of Coen northwards beyond Cape Grenville. The cliffs are up to 100 feet high; three successive scarp lines are recognizable in the Sir William Thompson Range (Australian Aquitaine Petroleum, 1965). Outlying mesas are common immediately to the east of the main sandstone scarp. The height above sea level of the base of the unit along the scarp ranges from about 500 feet in the south to 700 feet near Wenlock, and rises to about 1000 feet in outliers such as Bald Hill. North of Wenlock the base falls to about 250 feet in the Pascoe River and to sea level in Temple Bay.

The Mesozoic rocks near Wenlock, the Pascoe River and Temple Bay have been described by Morton (1924,1930) and Australian Aquitaine Petroleum (1965).

Morton subdivided the Mesozoic into the sandstone forming the Sir William Thompson Range and the overlying marine Mein Formation to the west. The former he described as consisting principally of pebbly sandstone and grit, with a basal conglomerate in places, and thin beds of highly micaceous shale and carbonaceous material, including thin coal seams in the lower portion. The overlying marine beds are principally of shale, light grey to dark grey, and sandy and micaceous in part. Impure concretionary limestone boulders up to 2.5 feet across occur irregularly throughout the shale. Lower Cretaceous marine macrofossils were collected by Morton from near Mein Telegraph Station (now abandoned) about 13 miles southwest of Wenlock.

Several sections through the Mesozoic sediments were examined by Australian Aquitaine Petroleum (1965) between Wenlock and the Olive River. The lower sandstone unit was informally named the "Cape York Peninsula Formation" and subdivided into three members (AAP, 1967); the basal "Wenlock Member" consisting of up to 100 feet of conglomerate, shale, coal seams and some sandstone; the "Wreath Creek Member" of up to 950 feet of oblique-bedded sandstone and some conglomerate; and the "William Thompson Member" of up to 850 feet of cross-bedded sandstone and minor conglomerate. Little if any lithological difference was noted between the Wreath Creek and William Thompson members. The former appears to have been deposited in a limited basin-like structure extending from north of Wenlock to Temple or Shelburne Bays.

Fossils, except for worm casts and some fossil wood, are generally lacking from the sandstone unit. However, fossil plants from near the base of the unit collected from a shaft in the Wenlock mining area by Morton, were determined as Lower Cretaceous by Walkom (1928).

Australian Aquitaine Petroleum described the Mein Formation as medium to dark grey siltstone, argillite, marl and mudstone, with typical calcareous concretions and apparently minor fine grained sandstone and marl towards the base. It is noteworthy that the type locality of the formation is situated towards the base of the formation. Abundant macrofossils and microfossils indicate a Neocomian to Albian age (Morton, 1924; Crespin, 1956; Cookson and Eisenack, 1958, 1960; Eisenack and Cookson, 1960; Fleming, 1965; Evans, 1966). Z.C.L. Weipa No.1 bore encountered approximately 1900 feet of marine Createaceous

(Zinc Corporation Limited, 1957). The Mein Formation was subdivided into seven local but distinct members by Australian Aquitaine Petroleum (1967). The type localities only were given and no estimate of thickness or areal extent was attempted. It may extend southwards to include mudstone, shale and sandstone west of Coen, and siltstone and mudstone mapped in the Ebagoola Sheet area by Trail et al. (1968).

No continuous section exposing the continental sandstone and the Mein Formation was found by Australian Aquitaine Petroleum. However, both in the Z.C.L. Weipa No.1 bore and in seismic shot holes (Compagnie General de Geophysique, 1965) the marine sediments overlap the continental beds. Between Coen and Moreton Telegraph Station the boundary between the two units is almost a straight north-trending line. Morphological and some photogeological evidence indicate that this contact is faulted over the greater part of the Coen and Cape Weymouth Sheet areas approximately along the 620 Grid line. Australian Aquitaine Petroleum suggests that the uppermost part of the "Cape York Peninsula Formation" and the base of the Mein Formation may be time equivalents, and that some interfingering could exist between the two formations.

Lithology. In the sandstone unit the basal conglomerate (Fig.38) varies in thickness from a few feet to about 100 feet but is generally only about 10 feet or so thick. It consists of angular to subrounded pebbles and cobbles up to 3 feet in diameter; it is poorly sorted and has a silty to sandy matrix which is often rich in mica. Pebbles and cobbles are of white quartz (the most numerous), quartzite, quartz-rich mica schist and, rarely, granitic and volcanic fragments. The last two are generally confined to the Pascoe River area where coal fragments are also found. The conglomerate exhibits coarse current bedding, and has been derived from a local source. Some thin beds of shale and coal are interbedded with conglomerate between Wenlock and the Pascoe River (Morton, 1924).

The conformably overlying sandstone blankets basement irregularities, which in places are partly or completely infilled by the basal conglomerate. In general, where the basement topography was relatively flat the basal conglomerate is thin or absent; where it was relatively rugged the conglomerate is thick and well developed.

Fig.38 Coarse conglomerate at base of Mesozoic sediments, near Bald Hill.

The sandstone is quartzose, medium grained to coarse grained and poorly sorted, with pebbly bands throughout. The matrix is usually kaolinitic but may be silicified. Small clayey and silty lenses are scattered through it. In some beds the sandstone is feldspathic. When fresh the sandstone is grey to white but commonly it is iron-stained, and the matrix has been replaced by limonitic material. The sandstone is generally porous and friable.

The sandstone is in part current bedded; the topset beds are normally truncated by horizontal beds generally with a pebbly band at their base. The foreset beds have moderate dips usually to the northwest to southwest. Current-bedded units range up to 10 feet thick.

Towards the north in the Temple Bay area the sandstone is medium grained with silty layers. The basal conglomerate, where exposed, is thin. The sea-cliff exposures are heavily iron-stained.

The plateaux formed by the flat-lying sandstone are generally covered by white or red residual sand and scattered concentrations of pisolitic ironstone. This is well seen on the plateau east of Rokeby Homestead and northwest of Coen, at the southern end of the Geikie Range.

West of Coen the siltstone unit is represented by exposures of mudstone, siltstone and silty, micaceous, fine grained sandstone. The mudstone and shale overlie the sandstone, generally with a sharp break. These sediments are brown, purple, grey or white, with limonitic cement in part, and are commonly silicified, with the formation of silcrete in places.

Structure. The Mesozoic sediments have a very gentle westerly dip; it is best seen in a sandstone escarpment from a distance. Local oblique or current bedding is steeper and also generally has a westerly component.

Meridional faults are evident in air photographs of the area between the Archer River and Wenlock. They probably occurred along much of the eastern margin of the Mesozoic, and were downthrown to the west. One north-striking fault just west of the Coen road crossing of the Archer River has displaced the Mesozoic at least 200 feet. Northwest of Bald Hill the eastern margin of the Mesozoic is controlled by a northwesterly trending fault with a throw of 100 to 200 feet. This fault probably extends to the northwest along the Wenlock River valley. Both these faults almost certainly represent movement on pre-Mesozoic fractures in the basement. As noted above, the boundary between the siltstone unit and the underlying sandstones is probably largely a faulted one in the area mapped.

Laura Basin

In the southeast of the Coen Sheet area, a low flat ridge of thick white sand rises above the coastal plain. The ridge extends northwards for several miles and has a well defined, straight eastern margin which is apparently controlled by faulting. In one creek cutting this ridge a poorly consolidated, cross-stratified coarse sandstone was seen. This ridge may represent a small outlier of the Mesozoic sediments of the Laura Basin. Such sediments occur not far to the south on the Cliff Islands and near Gorge Creek in the Ebagoola Sheet area.

Cainozoic

CAINOZOIC SEDIMENTS

Lilyvale Beds

The Lilyvale Beds were described by Trail et al. (1968) in the Ebagoola Sheet area where they form a blanket deposit on the low country at the base of the granitic escarpment from Musgrave Homestead to the Stewart River. In the Coen Sheet area they underlie thick residual sand and alluvium at the base of the eastern escarpment of the McIlwraith Range, at least as far north as the headwaters of the Nesbit River. They also occur east of the coastal range. They are well exposed only in the Nesbit River valley. On the western side of the McIlwraith Range the Lilyvale Beds floor the Archer River piedmont basin; they are best exposed in the south (Fig.39), but in the north they are overlain by thick residual sand and alluvium.

The beds are composed of poorly consolidated clayey sandstone and conglomerate. They are generally massive and are poorly sorted. The sparse matrix is composed of kaolinitic clay and grains of quartz

Fig.39 Lilyvale Beds in the Archer River Piedmont Basin, at the crossing of Croll Creek on the Coen/Blue Mountains road.

Fig.40 The Olive River sand dune area. View from the coast south of Cape Grenville northwest towards Shelburne Bay.

and weathered feldspar ranging from silt to granule; flakes of muscovite are common. Quartz pebbles are scattered through the sandstone and the conglomerate contains pebbles of quartz, quartzite, and rhyolitic rocks; pebbles of granitic rocks and schist are rare. The conglomerate forms ill defined beds or lenses up to tens of feet in thickness, and grades into pebbly sandstone. Horizontal surfaces in the Lilyvale Beds weather to form a characteristic pattern of small saucer-shaped depressions a few inches deep, separated by sharp ridges.

The Lilyvale Beds closely resemble decomposed granite and commonly overlie granitic rocks; in places angular quartz pebbles in the beds are clearly remnants of quartz veins or aplite veins, and the material forming the beds has been transported only a very short distance from its source. Individual exposures of Lilyvale Beds range up to 30 feet in thickness in eastern tributaries of Hull Creek. The thickness of these beds in the Archer River piedmont basin may exceed 100 feet.

Yam Creek Beds

The Yam Creek Beds consist of poorly consolidated clayey sandstone and conglomerate which form elevated and dissected plains around the Pascoe River and its tributaries, in the southern part of the Cape Weymouth Sheet area. These rocks were first informally named Browns Creek Grit by the Broken Hill Proprietary Company (1962). They were renamed, also informally, the Yam Creek Formation by Australian Aquitaine Petroleum (1965); the name has been altered to Yam Creek Beds in this report as the unit is not completely exposed and is only partly preserved.

The Yam Creek Beds are described by Australian Aquitaine Petroleum as "poorly sorted sandstones with scattered angular or rounded pebbles, argillaceous with white clay bands, little or no bedding". In lithology the Yam Creek Beds differ little from the Lilyvale Beds; conglomerate is less abundant in the Yam Creek Beds and they lack the characteristic weathering pattern of the Lilyvale Beds. The principal distinguishing feature of the Yam Creek Beds is that they form broad platforms surfaced by a layer of hard red lateritic material about 10 feet thick, which lies on 50 feet or more of soft, pallid and mottled clayey quartz sandstone. The platforms are generally about 50 feet higher than the levels of the Pascoe River and its main tributaries such as Canoe and Garraway Creeks. They probably represent constructional surfaces formed during the deposition of the Yam Creek Beds, which were subsequently lateritized, ensuring their preservation. The relief of the basement under the Yam Creek Beds is considerable, and at Garraway Creek a quartzite hill rises through the sediments.

The Yam Creek Beds may have been deposited in a Tertiary fresh-water lake which formed when the ancestral Pascoe River was dammed, perhaps somewhere between the Jacky Jacky Range and Barret Hill. The damming could have been caused by slight uplift of the mountains on the east. The platforms on the Yam Creek Beds may represent the floor of the lake, before it was drained by the Pascoe River finally breaking through the eastern mountain barrier. Since that time, the Pascoe River has cut down into the Yam Creek Beds and has exposed the basement rocks, which here are the Carboniferous Pascoe River Beds. Alternatively, the sediments may have been deposited on a flat alluviated plain which has since been uplifted and dissected.

Residual sand

A thin covering of residual sand extends over a very large part of the area mapped in 1967. The great bulk of the bedrock, including the granitic rocks, the quartz-bearing schists and the Mesozoic and Cainozoic sediments, weather to form quartz sand. The sand is generally only thin and merges locally into patches of finer residual soil, or alluvium.

Alluvium

Most of the deposits mapped as alluvium range from silty clay to silty sand. Clay appears to be abundant only in the rivers draining the Iron Range Schist, and blue-grey to brown silty clay underlies much of the plain of the Claudie River. Alluvium flooring parts of the valley of the Lockhart River is capped by black soil, and the extensive development of mangrove swamp at the mouth of this river suggests that a considerable proportion of its load is silt and clay.

The bulk of the load carried by most other rivers in the area is sand, and the alluvium which they have deposited is mainly silty sand. This merges laterally into the residual sand and soil developed on the interfluvial areas.

Gravel

Gravel deposits are small and consist mainly of fans formed along creeks at conspicuous breaks in slope along the McIlwraith and coastal ranges. Other gravel deposits no doubt occur in river beds in many places in the two Sheet areas, but the bulk of the material transported by almost all the rivers appears to be sand.

Laterite

A layer of massive ferruginous laterite about 10 feet thick overlies the platforms developed on the Yam Creek Beds around the Pascoe River and its tributaries Garraway Creek and Canoe Creek. Ferruginous laterite also forms a capping on the Mesozoic sandstone at Bolt Head and is probably common on Mesozoic sediments throughout the area mapped. Laterite is abundant and very rich in iron towards the north end of the belt of Iron Range Schist; Canavan (1965) states that it may form a considerable proportion of the reserves of iron ore there. Near lateritic cappings, small pockets of unconsolidated pisolitic laterite are common on lowlying ground.

Dune Sand

Sand dunes rise up to 300 feet above sea level over 150 square miles extending from the mouth of the Olive River northwards to Shelburne Bay in the Orford Bay 1:250,000 Sheet area (Fig.40). They are longitudinal dunes aligned in a northwest direction, and extend up to 10 miles inland. They were probably formed by the prevailing southeasterly winds re-working thick residual sand derived from the weathering of the underlying Mesozoic sandstone. Two other large accumulations of dune sand, each approaching 50 square miles in area, occur farther north along the coast in the Orford Bay Sheet area. Other small accumulations of dune sand are banked up south of large outcrops of bedrock near Cape Griffith, Cape Direction, and Bolt Head.

Marine sediments

Marine sediments recently deposited in the Coen and Cape Weymouth Sheet areas include coral limestone, sand and mud. The sand and mud are the deposits of beaches and estuaries respectively, while the coral limestone is almost all deposited a few miles offshore, beyond the domain in which terrestrial sedimentation predominates.

Coral limestone forms the Great Barrier Reef, which runs northwards along the eastern margins of the Coen and Cape Weymouth Sheet areas. A great many shoals of coral limestone, up to several miles across, lie between the Great Barrier Reef and the coast, and small cays of shell-sand have been built up on many of these to a few feet above sea level. Thin layers of water-borne pumice occur in or on this shell-sand in places. Little coral limestone was observed on the shore of the mainland, its main occurrence is at Bobardt Point, Portland Roads and Weymouth Bay, where small reef knolls lie within a few hundred yards of a muddy shore. A few islands composed of bedrock are surrounded by fringing reefs.

Quartz sand with subordinate shell debris and heavy minerals forms a narrow ridge at the top of practically all the beaches from the south of the Coen Sheet area to the northern margin ofthe Cape Weymouth Sheet area. The ridge ranges from a few yards to a few hundred yards across, and is between 5 and 15 feet in height. A large sand spit also extends west of Cape Direction for about 5 miles into Lloyd Bay. On the east side of the Lockhart River mouth, a fossil beach, about 10 feet above sea level, extends from Orchid Point south towards the Hemming Range.

Scattered pumice fragments are common among driftwood on top of the sand ridge. Small discontinuous seams rich in heavy minerals and ranging up to 4 inches in thickness occur in places, generally adjacent to exposures of bedrock, between the mouth of the Nesbit River and Cape Direction.

Mud commonly underlies the sand ridge, extending in many places both seawards below the low-tide level and landwards into mangrove swamps and salt flats behind the beach ridge.

The most extensive marine sediments are located in the estuaries of the Lockhart and Kangaroo Rivers. The sediments are mud and silt on which extensive areas of mangroves have grown. They have been deposited from streams carrying fine sediment, in the mouths of structurally depressed valleys.

STRUCTURE

The structural elements in the Coen and Cape Weymouth Sheet areas are shown in figure 41.

The dominant structural trend in Cape York Peninsula strikes north or north-northwest. In the Coen and Cape Weymouth Sheet areas, the foliation and banding in the metamorphic rocks, the contacts of the Devonian batholith, shear zones in the granitic rocks, and faults which cut Mesozoic sediments all parallel the northerly trend of the Peninsula. The synform formed by the metamorphics at Mount Carter has probably resulted from distortion caused by the intrusion of the Permian Weymouth Granite.

In the small patches of metamorphics included within the Devonian batholith, the dominant structure is a well developed axial plane foliation. Banding is also present and is parallel to the foliation; it probably represents the original bedding. The foliation is assumed to have developed in a similar manner to that in the metamorphics in the Ebagoola Sheet area, where it parallels the axial planes of north-trending isoclinal folds. The only folds visible in the Coen and Cape Weymouth Sheet areas are in the Iron Range Schist where north-trending isoclinal folds are outlined on aerial photographs.

The Devonian batholith has a northerly trend, although in contrast to the Ebagoola Sheet area, its eastern and western margins are not exposed. The batholith has been extensively faulted and sheared, and although a number of episodes of shearing probably have occurred, all the shear zones generally strike north or north-northwest.

The Coen Shear Zone faults the Devonian Lankelly Adamellite against metamorphics between the Stewart River and Mount Croll. It may continue northwards beneath alluvium to the Archer River Shear Zone. Near Coen, the alignment of phenocrysts in the Lankelly Adamellite parallel to the shear zone indicates that movement may have taken place in the Devonian before the consolidation of the magma. Later movement at an unknown date has resulted in mylonitization along the shear zone. The Archer River Shear Zone is more diffuse. Again, the shearing probably took place in the Devonian, as sheared Devonian Kintore Adamellite is cut by unsheared Morris Adamellite, which is also Devonian.

The Archer River zone of shearing may continue northeast along the southeastern margin of the Permian Weymouth Granite. The relative positions of Kintore Adamellite and Lukin-type schist near Geikie Creek may indicate some right-lateral transcurrent movement along this zone. A similar sense of movement along the Coen Shear Zone may be interpreted from the disposition of the two bodies of Saraga-type schist on either side of the shear zone to the southeast of Coen (see also Ebagoola 1:250,000 Sheet area).

The Lockhart-Nesbit Valley is probably formed along a fault zone, although no large faults were seen. The main period of faulting is unknown, but small fault traces in alluvium in the floor of the valley indicate that some recent movement has occurred. De Keyser (1963) considered that the Palmerville Fault continues some distance offshore up the eastern coast of the Peninsula and that movement along this fault has occurred from Silurian to Recent times. It would be parallel to the Lockhart-Nesbit valley fault, which may be related to it.

The Carboniferous Pascoe River Beds have been folded into broad anticlines and tighter synclines with axes trending north-northwest, and small faults are very common. The folding and faulting movements probably took place in late Carboniferous or early Permian times. The thick, apparently flat-lying sequence of the Janet Ranges Volcanics overlies the Pascoe River Beds. The volcanics have been tilted upwards near their eastern margin but otherwise exhibit little structure apart from a well developed joint system; movement may have occurred on some of the joint planes. North of the Pascoe River the Kangaroo River Volcanics are folded in a gentle syncline with the axis striking north-northeast.

The volcanics form an elongate north-trending mass. No ring fractures or cauldron structures could be recognized in them, but such structures may have been disrupted by the subsequent intrusion of the

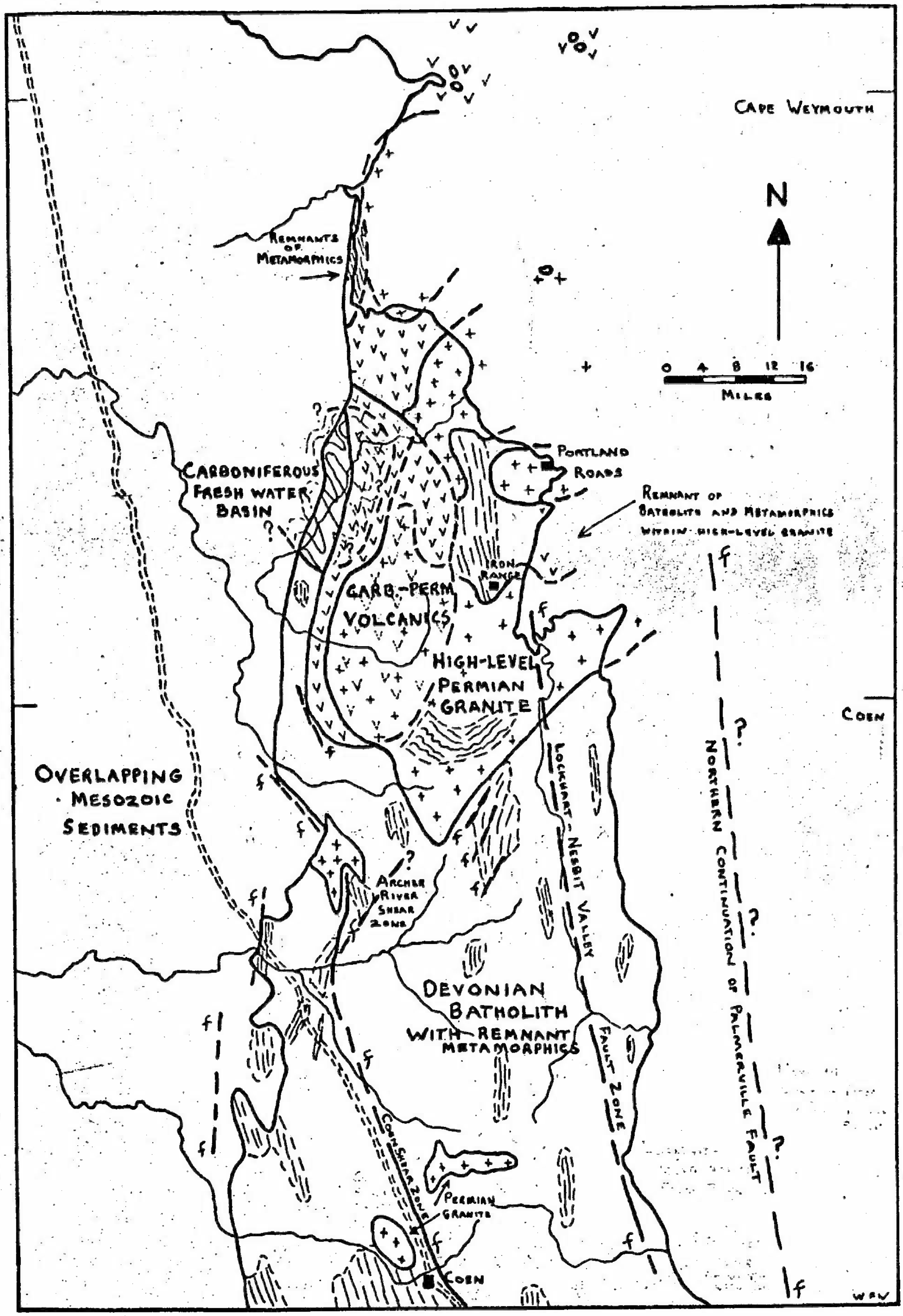


Fig. 41. Structural Elements, Coen and Cape Weymouth Sheet Areas

Weymouth Granite. The high-level Permian Weymouth Granite, intruding the Devonian batholith and the Carboniferous to Permian volcanics, crops out within an oval area elongated northwards, but it is not one continuous body. Small subsidiary bodies such as that west of Portland Roads are generally subcircular.

Geologists of Australian Aquitaine Petroleum (1965) consider that east-trending faults have been of considerable importance in the Cape Weymouth Sheet area, but no major east-trending faults were mapped in 1967. All lithological, structural and physiographic units have a northerly trend and none of these has been displaced in an easterly trending direction. The eastwest trends of the coastline in Lloyd Bay and Temple Bay are probably features resulting from the drowning of the mouths of the Lockhart and Kangaroo Rivers respectively.

Structures in the Mesozoic sediments on the west are fairly gentle, with minor folding and faulting. Australian Aquitaine Petroleum (1965) report that the westerly dip of the sediments near the eastern escarpment seems to flatten out towards the west, and that west of the telegraph line it is horizontal. Between Wenlock and Coen, the eastern margin of the Mesozoic sediments has been affected by north-trending faults with a westerly downthrow. North from Shelburne Bay the sediments are flat and are apparently undisturbed by faults. The base of the Mesozoic sediments between Wenlock and the Archer River is relatively high compared to that in the Temple Bay area. This may indicate that down-tilting to the north and west has occurred since Cretaceous times.

During the Tertiary, uplift probably took place on the eastern side of the Peninsula, and was greatest in the south in the McIlwraith Plateau. The movements may have taken place along the northern continuation of the Palmerville Fault. Gentle downtilting to the west and north probably accompanied this eastern uplift; alternatively it could have occurred later in Cainozoic times.

GEOLOGICAL HISTORY

During Precambrian or Lower Palaeozoic times, a great thickness of clayey sediments with some quartz sandstone was deposited in a geosynclinal trough which may have extended parallel to the trend of Cape York Peninsula. Some of the sediments were rich in iron, and in places small patches of limestone developed. Some basic lavas were included within the sedimentary pile. Late in the Precambrian or early in the Palaeozoic these rocks were folded into north-trending isoclinal folds, and an axial plane foliation developed. During the period of folding the rocks were metamorphosed under conditions which ranged from those of the almandine-amphibolite facies, in the south and east, to those of the greenschist facies, in the west and north.

In the Upper Devonian, a large batholith of granitic rocks was intruded into the metamorphics, probably at a deep level in the geosyncline. In the Coen and Cape Weymouth Sheet areas, the metamorphics remain only as small bodies within the batholith. The intrusion of the main component of the batholith, the Kintore Adamellite, was accompanied by many shearing movements. Other phases and plutonic bodies within the batholith were intruded at about the same time in the Devonian.

During the Lower Carboniferous a small fresh-water basin developed in the Cape Weymouth Sheet area. The sediments included greywacke, feldspathic sandstone, carbonaceous siltstone and minor coal bands with some plant fossils. They were folded probably at the end of the Carboniferous. Similar sediments exposed on Haggerstone Island may indicate that there were other areas of Carboniferous sedimentation.

Extensive acid volcanic activity, which was probably much later than the deposition of the sediments, occurred over much of the Cape Weymouth Sheet area, in the Upper Carboniferous or Lower Permian.

During the Permian the pile of volcanics, together with the underlying older granitic and metamorphic rocks, was intruded by a large body of high-level granite. Subsidiary bodies of diorite, granophyric granite and hybridized microadamellites predate the high-level granite; the latter two may be as old as to be comagmatic with the volcanics. In the volcanics hornfels developed around the margins of

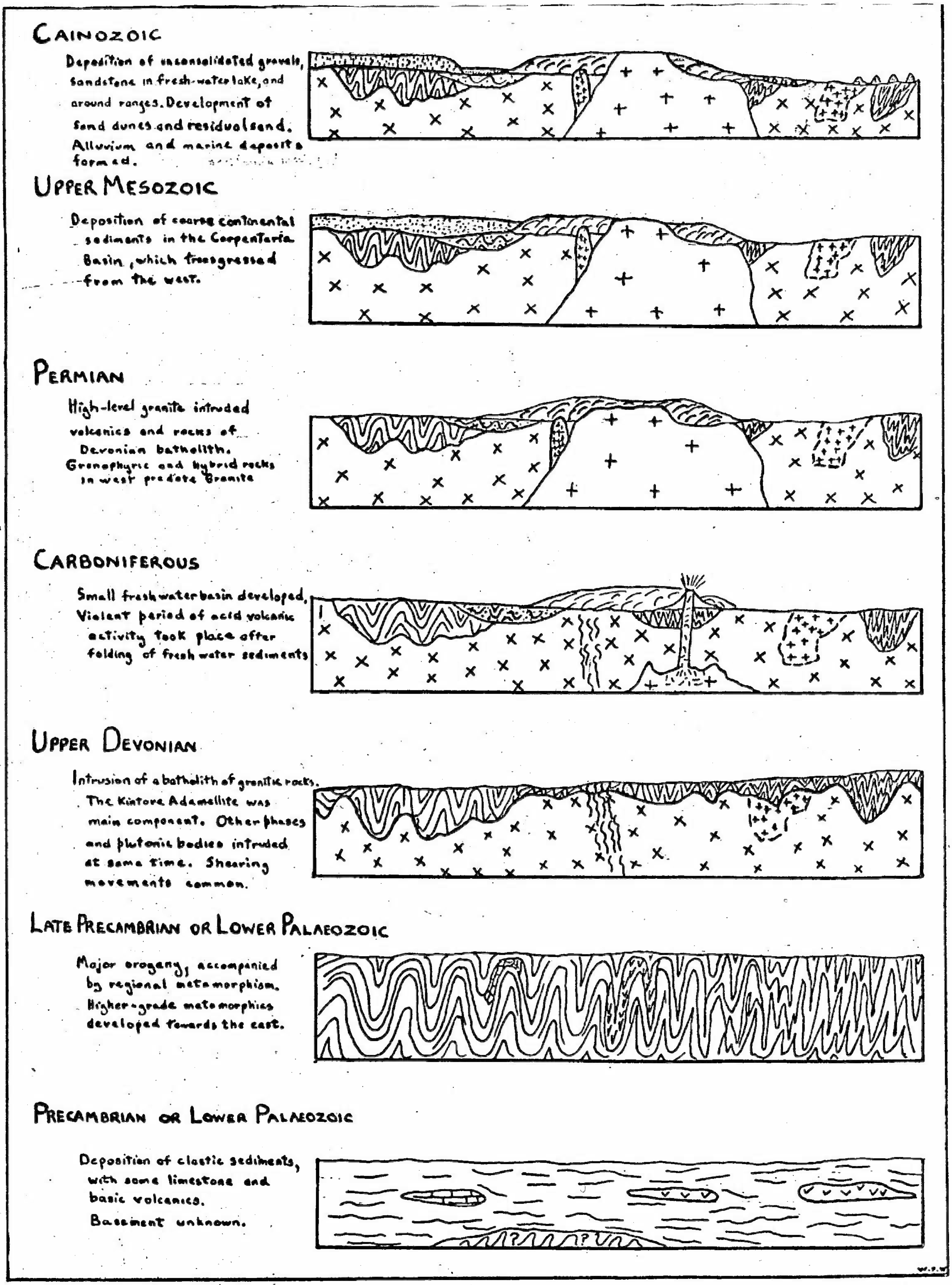


FIG 42. GEOLOGICAL HISTORY, COEN AND CAPE WEYMOUTH SHEET AREAS

the granite. Smaller bodies of adamellite and granite a few miles north of Coen and near Bald Hill were also intruded in the Permian.

From Upper Permian to Cretaceous times the belt of metamorphic and igneous rocks was relatively stable. During the Cretaceous, the sea advanced from the west onto the outcrop of igneous and metamorphic rocks. The basal sediments deposited were coarse conglomerates which varied in thickness from place to place. They were covered by coarse sandstone, and later, further west, marine siltstone was deposited.

Uplift of the eastern side of the Peninsula occurred from the late Cretaceous to Tertiary times, and resulted in the emergence and faulting of the Mesozoic sediments. The uplift was greatest northeast of Coen, forming the McIlwraith Range and rejuvenating the streams running from it. Following this uplift, poorly sorted sediments of the Lilyvale Beds were deposited in valleys around the edges of the ranges. In the Cape Weymouth Sheet area, the Yam Creek Beds were deposited in a large lake or on an alluviated plain.

Deep weathering in the Quaternary in areas underlain by granite, Mesozoic sediments and the Lilyvale Beds resulted in extensive superficial layers of white quartz sand. North of the Olive River, sand derived from the weathering of Mesozoic sandstone has been reworked by the prevailing wind into large longitudinal dunes. Thick layers of alluvium have been deposited in the valleys of the larger streams.

ECONOMIC GEOLOGY

The most valuable mineral product of the Coen and Cape Weymouth Sheet areas has been gold. Most of the gold was produced before 1914 from shallow workings in quartz reefs in the oxidized zone. During the industrial depression in the 1930's, gold was produced from deep leads in Mesozoic sediments at Wenlock, and from the Claudie Gold and Mineral Field, around Iron Range. Later attempts to renew gold mining have not been successful.

About 70 tons of wolfram were obtained from lodes in the Bowden Mineral Field over a few years and a considerable amount of alluvial cassiterite may have been won in the 19th century from sites near the Archer and Pascoe Rivers. Various attempts to follow up the mining of wolfram and tin have also been unsuccessful. Traces of molybdenite are associated with wolfram in places.

Large lenses of hematite-bearing and magnetite-bearing schist and quartzite crop out near Iron Range. Significant amounts of manganese are associated with these iron deposits, but they do not appear to be large enough for exploitation.

Small deposits of coal and of limestone and marble occur in a few places. Small pockets of heavy-mineral beach sands are found on some narrow beaches. A large section of the coast north of the Cape Weymouth Sheet area has a thick covering of dune sand which may be worthy of exploration as a source of silica.

Surface water is abundant for at least the greater part of the year and could be conserved by building dams to form large reservoirs at suggested sites. Groundwater is present in superficial deposits and in Mesozoic sediments fringing the igneous and metamorphic rocks.

A few samples of rocks which, from their appearance or from their location, might contain metallic minerals, were tested by Australian Mineral Development Laboratories. The only sample containing an unusually large proportion of any metallic mineral came from amphibolite exposed at the north end of Whale Hill, 6 miles northwest of the mouth of the Nesbit River. The sample carried a thin smear of malachite, and contained 2500 parts per million (p.p.m.) of copper. Most of the basic rocks sampled contained about 120 p.p.m. copper.

The background value of nickel in the rocks tested appears to be approximately 50 p.p.m. The amphibolite at Whale Hill, and a thermally metamorphosed basic volcanic at the Lockhart River Settlement contained 100 p.p.m. of nickel, and one sample of greenstone from the Iron Range Schist contained 120 p.p.m. of nickel.

Two samples from the headwaters of Tin Creek north of the Pascoe River contained 25 p.p.m. of tin and one contained 6 p.p.m. Tin was absent or formed less than 5 p.p.m. of all other samples submitted.

ARSENIC

From Coen to Iron Range, arsenopyrite is possibly the most common metallic mineral associated with known gold mineralization. Its concentration is rarely recorded; Shepherd (1938) notes up to 1 percent of arsenic in gold-bearing samples from the Hayes Creek Provisional Goldfield, and ore assayed from the Peninsula Hope mine at Iron Range contains 4.4 percent arsenic (C.S.I.R.O. , 1953).

COAL

Morton (1924) investigated coal deposits reported on the Pascoe River and Hamilton Creek, in the Cape Weymouth 1:250,000 Sheet area. Most of the coal he found to be carbonaceous shale, with bands or streaks of coal up to a few inches thick in places. A supposed coal seam 10 feet thick, located 20 miles up the Pascoe River from its mouth, is described by Morton as highly metamorphosed carbonaceous strata, 50 percent of which is formed by stony bands, and in which the carbon is graphitic.

Spratt (1958) reporting to Consolidated Zinc Pty Ltd, reported two coal seams about 2½ miles apart, near the Pascoe River where it changes from a dominantly northerly to a dominantly easterly direction. One seam is 12 feet thick and the other 8 feet thick; the exposed coal is weathered. Spratt concluded they were not suitable for exploitation because of the intense folding and faulting evident in the nearby sediments. Miller (1957) had found that coal pebbles in the Pascoe River were composed of material which was suitable as fuel, with a high calorific value and a low or moderate ash content. Morton (1924) reports that 2 coal pebbles from the Pascoe River contained 9.5 and 22.7 percent ash respectively, 51.3 and 42.6 percent fixed carbon, 37.9 and 34.1 percent volatile matter, and 1.3 and 0.6 percent moisture.

Geologists of Australian Aquitaine Petroleum Company (1965) describe three thin seams of coal exposed in coaly shale in the Pascoe River and its tributaries. Observations made in 1967 confirmed the presence of thin seams similar to those described by Morton. The thick seams described by Spratt were not visited.

GOLD

Gold is the only important product of mining in the Coen and Cape Weymouth Sheet areas. Gold was discovered at Coen in 1876. Much of the gold produced had been won by 1914, but subsequent discoveries were made at Wenlock and near Iron Range. Very small quantities of gold are still being obtained in a few places.

Most of the gold was won above the water table from small quartz reefs and veins in Devonian granitic rocks. or in schist within or near the granitic rocks. Some gold was mined from deep leads in Cretaceous sediments at Wenlock.

The histories of the goldfields shown in figure 43 are outlined below.

Coen Gold and Mineral Field

The Coen Gold and Mineral Field was proclained as an area of 43 square miles in 1892 and enlarged to 187 square miles in 1898 (Ball, 1901). Jack (1922) records that alluvial gold was discovered at Coen in 1876. In 1878 there was a small rush of men from the Palmer River to Coen, but few of them stayed more than two weeks and the workings were abandoned in that year. Chinese miners attempted to work the alluvium in 1880 without success.

In 1885 land was taken up for mining silver and machinery was erected in 1886, but productive reef mining does not seem to have started until 1892. Annual Reports of the Department of Mines reveal that between 1893 and 1899, 16,425 tons of ore crushed at Coen yielded 28,553 ounces of gold. Ball (1901) visited the field in 1900 and recorded mining activity at Coen town, at The Springs 9 miles southeast of Coen, and at Klondyke 8 miles northeast of the Springs. According to Ball the reefs worked at all these localities range from a few inches to 5 feet in thickness and generally have a strike between northwest and north, with a steep dip. Most of them are fissure veins composed of quartz; a few are siliceous slate; some of the poorer reefs contain pyrite or arsenopyrite. Ball records the country rocks as granite, schist, and slate, one specimen of which contained kyanite and sillimanite. Slickensides were commonly exposed in the walls of the reefs.

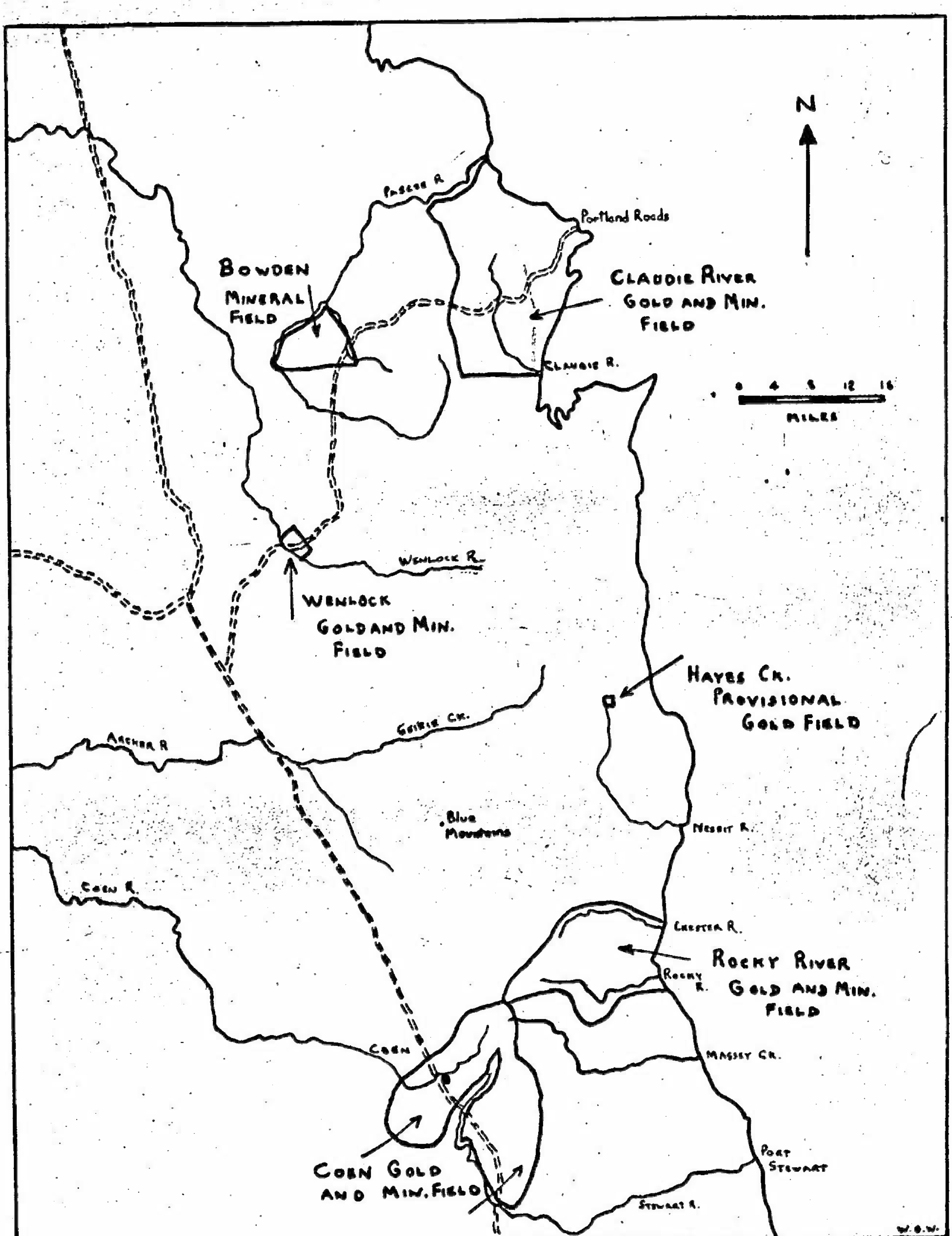


Fig. 43. Gold and Mineral Fields, East-Central Cape York Peninsula

TABLE 6

COEN GOLDFIELDS AND GREAT NORTHERN MINE RETURNS

(from Annual Reports, Department of Mines, Queensland)

YEAR	QUARTZ tons	TAILINGS tons	GOLD ounces	REMARKS
1892	892		3,218	
1893	1,837		3,553	
1894	1,438		1,772	Great Northern only
1895	2,622		3,953	
1896	520		1,968	
1897	824		965	Gt Nthrn. Av. thickness reef 2 ft
1898	395		976	Gt Nthrn returns
		2,402	4,898	From Gt Nthrn from 1894
1899	528		1,548	Gt Nthrn
1900	644		1,800	" "
1901	1,161		2,221	" " more than half Coen production
		1,770	1,235	Cyanidation of tailings from Coen & Rocky Goldfields
1902	1,104		1,472	Gt Nthrn returns - two-thirds Coen production
		1,140 (old)	673	Cyan. old & new tailings from Coen & Rocky Goldfields
		1,180 (new)	708	
1903	943		2,641	Gt Nthrn. Most of the Coen production
		560	370	Cyan. of new tailings from Coen
1904	1,477		4,235	Gt Nthrn. Practically all Coen production
		1,530	826	Cyan. new tailings from Coen
1905	3,186		11,839	Gt Nthrn. Practically all Coen production
		2,290	1,420	Cyan. new tailings from Coen Goldfield
1906	2,644		5,394	Gt Nthrn. Practically all Coen production
		1,500	698	Cyan. new tailings from Coen Goldfield
1907	1,304		1,923	Gt Nthrn

YEAR	QUARTZ tons	TAILINGS tons	GOLD ounces	REMARKS
1908	1,636		2,911	Gt Nthrn. Most of Coen production
		2,650	1,128	Cyan. new tailings from Coen Goldfield
1909	2,135		2,389	Gt Nthrn - practically all Coen production
1909		1,130	395	Cyan. Gt Nthrn - old tailings
1910	1,920		2,971	Gt Nthrn
		480	237	Cyan. Gt Nthrn old tailings
1911	530		1,542	Gt Nthrn returns
		2,050	567	Cyan. Gt Nthrn old tailings
1912	317		1,102	Gt Nthrn returns
		880	95	Cyan. Coen Goldfield
			155	Gt Nthrn battery plates clean-up
1913	181½		590	Gt Nthrn
	22½		12	Gt Nthrn mullock dump
1914	7		32	Gt Nthrn, closed down this year
1915	14		49	Surface parcel Gt Nthrn
1916	245		537	Probably from Gt Nthrn
TOTAL QUARTZ	28,527	TOTAL GOLD	75,012	

The most successful mine was the Great Northern, one mile southeast of the Coen township, which in 1901 had levels at 80 feet, 164 feet and 180 feet. Between 1894 and 1899 this mine produced 7422 ounces of gold from 4325 tons of ore; Ball (1901) refers to the poor quality of the gold, which had a high silver content. In 1900 activity at Coen was almost at a standstill as a result of the opening of the Hamilton Goldfield nearby, but gold continued to be won there for many years, mostly from the Great Northern and from the treatment of tailings with cyanide. From the Annual Reports of the Department of Mines, the total recorded production of reef gold at Coen from 1892 to 1916 was about 75,000 ounces; of this 56,600 came from ore from the Great Northern Mine, and 13,259 ounces from the treatment of 20,000 tons of tailings and mullock at that mine. The total amount of ore recorded as won between 1892 and 1916 was 28,527 tons, 25,820 from the Great Northern mine. After 1910 production of ore fell off rapidly, and in 1914 only 7 tons of ore were won. Table 6 lists the recorded production of the Coen Goldfield in these years.

The total depth of the main shaft in the Great Northern was 500 feet, but little work was done at that depth. The north end of the number 4 level, somewhere below 180 feet, was reported in 1909 to be 251 feet from the shaft. The reef in the lower levels ranged in width from 2 feet 6 inches to 4 feet. After 1909 production came from small rich leaders in the hanging wall and the footwall above number 3 level, possibly at 180 feet. Little is known of the mine after 1914, but attempts were made to re-open it as late as 1949 (Jones, 1949).

Trail et al. (1968) note that a shear zone extends parallel to and east of the Coen/Laura road from Hanna Creek, in the Ebagoola 1:250,000 Sheet area to the Coen River near Coen. The Great Northern mine and many small workings lie on this shear zone over a length of about 12 miles southeast from Coen, within the Lankelly Adamellite. In places the sheared adamellite within the zone resembles a schist, and the sheared rocks contain accessory pyrite and arsenopyrite. Quartz reefs are common along the shear and at its southern end they range up to 3 miles in length and 300 feet in width. Trail et al. describe material from the mullock dump at the Great Northern as breccia composed of fragments of silicified granitic rock in a matrix of white quartz; the country rock is sheared Lankelly Adamellite. They conclude that the gold lodes have a hydrothermal origin and that the gold was emplaced with siliceous fluids following the shearing.

The Blue Mountains, 25 miles north of Coen, are not included in the Coen Gold and Mineral Field, but some gold mining was carried out there from some time before 1934 until 1949. Beck in 1935 recorded that little work had been done at the Blue Mountains since 1934, though a small battery at Coen was processing ore from the Blue Mountains. A Warden's Report in 1941 states that a number of mines were operating then, shafts were being sunk, and 40 ounces of gold had been produced. In 1946 Jolly identified three mines as the Yarraman, Hit-or-miss, and Blue Mountains Gold N.L.; the last had produced nothing for 4 years. Banks (1947) noted that the Yarraman was working a quartz vein, between 6 and 8 inches thick, in granite, and in a newspaper report of 1948, the Department of Mines states that gold with a value of £1500 was produced from the Yarraman mine, including a 21½ ton parcel which contained 3½ ounces of gold to the ton, won from a leader 9 inches wide at the 200 foot level.

Peninsula Inspections, recorded in the Queensland Government Mining Journals for the relevant years, reveal that in 1951 3 mines produced a total of 32 tons of ore with between 26 and 30 pennyweights of gold to the ton. By 1952 mining had ceased.

During the 1967 survey, mining machinery, including small batteries, was found on the eastern and southern sides of Birthday Mountain, in the Blue Mountains Adamellite, but no mines were located.

Annual Reports of the Department of Mines reveal that between 1956 and 1959 aborigines held 4 leases at Nullumbidgee, about 54 miles northeast of Coen on the eastern fall of the McIlwraith Range, possibly in the headwaters of Leo Creek and the Nesbit River, and outside the Coen Gold and Mineral Field. The workings are reported to be in quartz veins up to 2 feet wide with no visible gold. 3½ tons of ore gave 12.7 ounces of gold.

In 1965 and 1966 a party bulldozed a road into the headwaters of Leo Creek, to a point which may be close to Nullumbidgee. A shaft was sunk near the creek bed through a few feet of alluvium into biotite adamellite with bands of pegmatite. No material resembling ore was seen at the abandoned shaft in 1967, and no production is recorded from it.

Rocky River Gold and Mineral Field

The history of the Rock River Gold and Mineral Field is recorded mainly in the Annual Reports of the Department of Mines. Jack (1922) records that William Lakeland discovered alluvial gold in the Rocky River in 1893. Reef mining began on Neville Creek, whose location is unknown, in 1896 and the Gold and Mineral Field was proclaimed in 1897. Between 1896 and 1901, 936 tons of ore yielded 4586 ounces of gold. Interest in the field waned in 1901 following the discovery of the Hamilton Goldfield, but it revived for a short time in 1910 and 1911 when 56 tons of ore yielded 282 ounces of gold. Jack (1922) notes that only 4 people lived on the field in 1914, and there were no returns that year. No mines were located during the 1967 survey.

Hayes Creek Provisional Goldfield

The site of the Hayes Creek Provisional Goldfield was noted by Dickie and Campbell (in Jack, 1922) in the course of a prospecting journey to Lloyd Bay in 1907, when parties were working alluvial gold. Jack (1922) had found colours of gold in Hayes Creek during his journey in 1880. Shepherd (1938) records that the Hayes Creek Goldfield was discovered by Messrs Preston and Dodd in 1909; this no doubt refers to the start of reef mining, as Jack (1922) notes that Dickie, Dick and Sheffield visited the Golden Gate Reef and Dodd and Preston's workings there in 1910.

The Peninsula Inspections recorded in the Queensland Government Mining Journal, and the Annual Reports of the Department of Mines reveal that the Golden Gate claim produced 36½ tons of ore in 1909, which yielded 219 ounces of gold and a further 55 ounces on cyanidation. In 1911 production of the Hayes Creek Provisional Goldfield was 20¾ tons which yielded 102¼ ounces of gold. In 1914 reefs yielded 36 ounces 15 pennyweights and alluvial mining produced

12 ounces of gold, but the field was deserted in 1915. Some prospecting was done there from time to time into the 1930's, and mining was active again in 1938. Shepherd (1938) noted 4 sets of workings at Buthen Buthen. At the Theodore lease a quartz reef between 12 inches and 14 inches wide was exposed for 200 feet striking 140° and dipping 47° southwest. The reef carried small amounts of pyrite and arsenopyrite.

Shepherd noted that the reefs on Battery Hill were too small to supply much ore. A reef on the Diana lease was 8 inches wide and carried pyrite with a little free gold; on the Campbell and Buthen Buthen leases Shepherd saw only shallow trenches and small shafts. One crushing of 53 tons in the Buthen Buthen area in 1938 produced 30 ounces of gold and 11 hundredweights of concentrate. At Companimano Creek, 4 miles south-southwest of Buthen Buthen, a quartz reef 3 to 4 feet wide carried free gold, galena, pyrite, and arsenopyrite. Shepherd records that the gold occurs in quartz reefs in granite which occupies almost the entire goldfield. Near the reefs the granite shows a limited amount of shearing.

<u>TABLE 7 : Samples from Hayes Creek Provisional Goldfield</u>

(from Shepherd, 1938)

	Gold			Silver			Arsenic	Location
	Oz	dwt	grs	oz	dwt	grs	percent	
	per ton			per ton				
Sample 1		1	12		2	17	0.5	Companimano Creek
" 2*	5	1	10	2	18		1.0	Companimano Creek
" 3	2	9	19		11	19	0.06	Battery Hill
" 4		16	19		4	22	0.05	Battery Hill
" 5			22		2	7	0.60	Theodore
" 6	3	3	2	1	8		0.46	Theodore
" 7		13	5	1	8		0.22	Theodore

*Sample 2 also contains 4.6 percent lead.

Jones (1951) visited 8 sets of workings in and near Buthen Buthen in 1951, some of which had produced gold in 1950 and possibly earlier. Most of these were on leaders striking between north and northwest and dipping westwards at angles up to 40°. The ore being produced in small parcels was said by the miners to contain between 2½ ounces and 4 ounces of gold to the ton; one 4-ton crushing from the Dingo lease returned 6.55 ounces of 850-fine gold. A prospect not mentioned previously is recorded by Jones as the Rocky Lease, 5 miles southeast of Buthen Buthen, on Watalamo or Rocky Parrot Creek; this was a leader striking 132° and dipping 39° southwest; a grab sample from the cap of the leader contained 1 ounce 17 pennyweights of gold to the ton.

No further activity is known from the Hayes Creek Provisional Goldfield, but Gibson (1964) describes an investigation of the Nesbit River as a dredging prospect. The alluvium of the Nesbit River was tested between Buthen Buthen and Kampanjinbanyo, possibly Companimano, Creek. A basin on Leo Creek, almost enclosed by hills, 5 miles southwest of its junction with the Nesbit River was also tested. In none of the tests was enough gold found to make dredging worthwhile.

Wenlock Gold and Mineral Field

In the vicinity of the Wenlock Gold and Mineral Field, gold was first discovered at Retreat Creek, a tributary of the Batavia or Wenlock River, in 1892, according to Morton (1930). Further prospecting disclosed small alluvial deposits at Downs Gully, Chock-a-block Creek and other nearby sites, mainly between 1905 and 1911. A larger deposit, named Plutoville, was found by an aboriginal prospector named Pluto in 1910, and was rushed by miners from Coen and Ebagoola (Morton, 1930; Jack, 1922). Fisher (1966) describes the early workings as occupying about 400 yards square on shallow alluvium with small outcropping reefs, worked to a maximum depth of 15 feet. Morton (1930) mentions a shallow lead of cemented wash with rich gutters at these workings. The total recorded production from Plutoville is given by Fisher as 6000 ounces of gold.

In 1922 an aboriginal woman discovered the outcrop of the Main Leader, a narrow quartz reef with payable gold for over 1000 feet along strike, about 3 miles northeast of Plutoville. Several parties moved from Plutoville to the new discovery which became known as Lower Camp and later as Wenlock, according to Fisher (1966).

Fisher describes the Main Leader as a fissure reef striking northwest with a few cymoid loops, and dipping 60° to the south at the north end of the field and 35° at the south end, where it is cut by the Main Reef, a quartz reef over 20 feet wide. Its average width is 8 inches, its walls carry slickensides, and it contains free gold to at least 300 feet in depth, or about 100 feet below the water table. Gold occurs evenly as coarse particles in the reef, and in places forms concentrations of several hundred ounces. The average grade was about 1½ ounces of gold to the ton. The reef lies in Devonian Kintore Adamellite, overlain by Cretaceous sediments and thin alluvium. Deep leads in the surface of the granite on the west side of the Main Leader also contained gold.

Morton (1930) notes that one lead had been proved for 600 feet under 70 feet of sediments, in 1923. The old drainage system in which the leads formed at the base of the Mesozoic had no resemblance to the existing topography, Morton claims. Six leads were known in 1930; one, at Lower Camp, had only its head exposed at the lode; it had steep walls and ranged up to 15 feet in width. The total production of gold from both Plutoville and Wenlock amounted to 14,441 ounces by 1929.

Fisher (1966) records that small claims were worked at Wenlock until 1942, when the field was closed for the duration of the war. The Fisher family amalgamated the claims along the Main Leader and re-opened the field in 1946; the field closed again in 1952, partly as a result of flooding in 1950. Prospectors have continued to be active in and around the field, and in 1966 a party from Cairns obtained a very small amount of gold there.

Fisher notes that water in the mines was always a problem at Wenlock; two mines each pumped between 150,000 and 200,000 gallons per day, and in 1939 and 1950 the Wenlock River flooded the workings completely. Mining was primitive until 1932, and tailings produced before then were treated in 1934 and 1935 for an average yield of 15 pennyweights of gold per ton.

Connah (1951) visited the Wenlock field in 1950. By then it was found that the main deep lead, a narrow rich gutter at the base of the Mesozoic sediments, spread out into a wide drainage channel trending west-southwest. Connah thought that the extension of the channel beyond the workings had been thrown down an unknown distance by a fault trending in a southeasterly direction. He noted that a continuous cover of auriferous wash might extend at depths from 45 to 90 feet over the bedrock north and west of the workings; the wash extends eastwards and therefore upstream of the Main Leader, and some of the gold in the wash must have come from another source. He thought that if the low gold values proved in the wash were maintained over a large enough area, large-scale mining might be possible.

Connah notes that Wenlock bullion has usually ranged from 800 to 820 in fineness. He describes the Main Leader as being formed by quartz with distinctive white and blue banding, and ranging in thickness from 1 inch to 18 inches. Short rich shoots with a northerly pitch are characteristic of the reef. The Big Reef or Main Reef carries some gold at its junction with the Main Leader. The gold is distributed erratically, but 300 tons of ore yielded 5 pennyweights of fine gold per ton. Connah found that a sample of sheared granite in the footwall of the Main Reef carried 1 pennyweight and 23 grains to the ton. He recommended testing of the Big Reef, which he regarded as a shear zone, away from the Main Leader.

Gold-bearing wash has been encountered at depth elsewhere in the field, carrying up to 5 pennyweights of gold to the ton, and again Connah recommends further testing of this.

Connah estimates that by the end of 1949 the Wenlock Field had produced 40,700 fine ounces of gold.

Claudie River Gold and Mineral Field

Gold was discovered in 1933 in the Claudie River Gold and Mineral Field according to Beck (1935), and the field was proclaimed in 1936. Gold was mined at Iron Range, Scrubby Creek, and Packers Creek. Shepherd (1939) records the total production of the field from 1935 to June 1938 as 5572 ounces of gold, of which Iron Range produced 4315 ounces, Scrubby Creek 1082 ounces, and Packers Creek 175 ounces. Shepherd notes that the gold occurs free in quartz reefs, or in association with quartz-limonite rocks, or in talc schist one or two miles from its contact with granite. The richest ore and the largest amounts of gold were produced from quartz reefs in the schist; the best of these was Gordon's Reef, which produced 80 percent of the gold recorded for the Iron Range centre.

Broadhurst and Rayner (1937) describe most of the gold deposits as quartz reefs or quartz veins. At Iron Range they note that the reefs worked in the iron-bearing schist are large and poor in gold while reefs worked in the schist zone east of the iron-bearing rocks are small but rich. In the southern part of the schist zone some reefs parallel the schistosity and others have components both along and across the schistosity; where the components intersect, short ore shoots have formed. In the northern part of the schist zone the lodes are composed of crushed sericite schist with quartz stringers. Broadhurst and Rayner suggest that in the primary zone the ore shoots will prove to be lenses of silicified schist impregnated with sulphides, chiefly arsenopyrite. At Packers Creek and Scrubby Creek they describe the reefs as auriferous quartz in granite.

Jarman, Rayner, and Nye (1937) carried out a magnetic survey at Iron Range in an attempt to elucidate the geological structure by tracing iron-bearing bands. The survey suggested that the iron occurred in short bands only, but supported the presence of folds and faults suggested by the geological evidence. Rayner (1937) notes that a wide body of sulphide ore had been discovered on the Peninsula Hope lease at Iron Range.

Various reports in the Queensland Government Mining Journal and in the files of the Department of Mines reveal that after 1945 mines in the Claudie River Gold and Mineral Field were re-opened, and between 1950 and 1953 the Cape York Development Company attempted to develop a few mines at Iron Range without success. One crushing of about 150 tons of ore obtained from an open cut at the Northern Queen and from shallow leaders produced only 25¼ ounces of fine gold; it is reported that much gold was lost. 43 tons from a vein at the Iron Range lease produced 37.72 fine ounces.

At Packers Creek and perhaps at Scrubby Creek a few mines operated for short periods after the war. Ted Densley still gets small quantities of gold from a mine at Packers Creek, and has done so intermittently since 1946.

A C.S.I.R.O. (1953) investigation of the treatment of arsenical gold ore from the Peninsula Hope mine at Iron Range gives the head assay of the ore as: 11.65 pennyweights gold, 1.15 pennyweights silver, 4.4 percent arsenic, 20.7 percent iron, 9.79 percent sulphur, and less than 0.05 percent copper. The specimens are composed of sulphides, chiefly arsenopyrite and pyrite, in chlorite schist, quartz, and carbonate. Arsenopyrite is the most abundant sulphide, forming crystals up to 5 mm across and massive aggregates. These are much fractured and contain veinlets of quartz, carbonate, and altered pyrrhotite, with traces of chalcopyrite, sphalerite and gold. Pyrite forms a few crystals 0.5 to 1 mm across, but the bulk of it forms ragged aggregates derived from the alteration of pyrrhotite and accompanied by siderite and magnetite, and marcasite. Chalcopyrite and rarer sphalerite form very small particles associated with altered pyrrhotite in veinlets cutting arsenopyrite. Small crystals of rutile and sphene are included in arsenopyrite and gangue; grains of ilmenite and magnetite with rims of sphene also occur in the gangue. Gold particles are associated with pyrite and arsenopyrite crystals; some gold occurs in veins cutting the arsenopyrite.

HEAVY-MINERAL BEACH SAND

Thin seams containing abundant heavy-mineral grains are common in the narrow quartz-sand beach extending from Cape Sidmouth to Cape Direction. This beach is generally formed by a single ridge of sand less than 100 feet across and about 10 feet thick. A hole 12 inches deep in the beach at Cape Sidmouth intersected 2 seams of heavy-mineral sand half an inch thick and one seam 4 inches thick; the lateral extent of the seams is probably small. The most abundant heavy mineral in these seams appears to be ilmenite; other minerals found in samples of the sands are magnetite, rutile and monazite.

Paterson (1957) reported for Mineral Deposits Pty Ltd on the beach sands north of the Olive River. He found only small deposits; one of these at red cliffs in Shelburne Bay yielded a sample 65 percent of which was heavy minerals; these are recorded as 30 percent zircon,

TABLE 8

HEAVY MINERAL CONSTITUENTS OF SAND SAMPLES, COEN AND CAPE WEYMOUTH SHEET AREAS

(From A.M.D.L. report MP390-69)

LOCALITY	REG. NO.	HEAVY MINERAL %	% PRINCIPAL MINERALS IN HEAVY FRACTION				
			ZIRCON	RUTILE	OPAQUES✱	MONAZITE	GARNET
2 miles north of Lockhart River Settlement (old site)	67480523	88.50	5.1	3.1	90.7	Trace	Trace
Cape Sidmouth	67480524	34.25	2.3	1.8	91.0	-	3.9
3 miles northwest of Friendly Point	67480525	91.15	24.9	1.2	70.6	-	1.5
First Red Rocky Point	67480526	85.35	7.8	1.7	48.0	42.7*	-
Lockhart River	67480527	10.70	4.9	2.0	77.0	2.0	Trace
Geikie Creek	67480528	7.15	6.6	0.7	77.8	0.3	-
Palmer River	67480533	30.80	14.2	0.8	38.8	13.7	Trace

*Hand picked sample.

✱ Mostly ilmenite with hematite, magnetite, rare pyrite, goethite and leucoxene

53.5 percent rutile, 2.06 percent ilmenite, and the remainder garnet, monazite and others.

Samples of heavy-mineral sands collected in 1967 from beaches in the Coen and Cape Weymouth Sheet areas were described by Australian Mineral Development Laboratories. The heavy fraction of the beach sands is predominantly ilmenite, which forms between 43 and 95 percent of the fraction. Table 8 lists the constituents of the heavy fraction of the seven samples containing greater than 1 percent heavy minerals. Four samples of sand from Granite Creek, a tributary of the Archer River, contain no cassiterite but do contain tourmaline. Tourmaline is also present in the sand from the Lockhart River.

IRON

The iron deposits at Iron Range were described by Canavan (1965a) following investigations by the Broken Hill Proprietary Company extending from 1957 to 1962. The iron deposits (Fig.44) are formed by large steeply dipping lenses of schist and quartzite rich in magnetite and hematite, and by the ferruginous weathering products of these rocks. The iron-bearing rocks also contain substantial amounts of manganese.

Canavan (1965b) states that the deposits at Iron Range have indicated reserves of 1 million tons of ore containing between 54 percent and 62 percent iron, including manganese, and inferred reserves of 300,000 tons of ore containing between 45 and 55 percent iron, including manganese.

Some of the richest ore lies only 5 miles from the sea, and all the ore crops out between 10 miles and 20 miles from Portland Roads, a deep-water anchorage sheltered from the southeast trade wind.

Canavan (1965a) divides the iron-bearing rocks into the Black Hill or northern type, composed of magnetite and quartz with subordinate amounts of manganese oxides, rhodocrosite, calcite, pyrite and pyrrhotite, and the Lamond Hill or southern type composed of hematite and quartz. He points out that, in the northern type, an important proportion of the total ore reserves are formed by a highly oxidised residual capping, which usually has a high manganese content. The combined iron and manganese content of the capping is about 60 percent, and of this iron and manganese each form between 15 and 45 percent. Silica normally forms less than 2 percent of the capping. Below this a zone between 50 and 100 feet thick has a lower degree of oxidation and contains between 20 and 30 percent silica. Below this again, in the primary iron-bearing schist and quartzite the silica content is high.

The manganiferous ore is described by Canavan as follows: "the bulk of it consists of pitted magnetite grains. Fine-grained hematite is interstitial and psilomelane and pyrolusite are confined to veinlets and microjoints". The residual cappings are most common on outcrops of the northern type of ore. Outcrops of the southern type, in which there is little manganese, commonly have no residual cappings. Some manganese is present near the contacts of the ore lenses with the surrounding weathered schist in the southern type.

During mapping in 1967 it was found that the residual capping on the northern deposits obscured the structure of the iron-bearing schist. Hematite-quartz schist and hematite quartzite are well exposed at Lamond Hill, the largest of the southern deposits, where thin quartzite bands outline isoclinal folds in the schist. The spread of the bodies of iron-bearing schist a few miles north of the north end of Lamond Hill suggests that a large fold exists there.

Broadhurst and Rayner (1937) note that the iron-bearing schist, or quartz stringers within it at Iron Range, may carry up to a few pennyweights of gold per ton.

The iron deposits are described in detail in a report by the Broken Hill Proprietary Company (1962).

<u>LIMESTONE AND MARBLE</u>

Small pods of marble and calc-silicate rocks, rarely more than 100 feet across, are contained in the Kintore Adamellite on the east flank of the coastal range, and on the northwest side of the McIlwraith Range about 20 miles northeast of Coen. Larger deposits than these may be concealed by dense vegetation. Some of the marble is almost pure white and coarsely crystalline, mainly in the coastal range; some

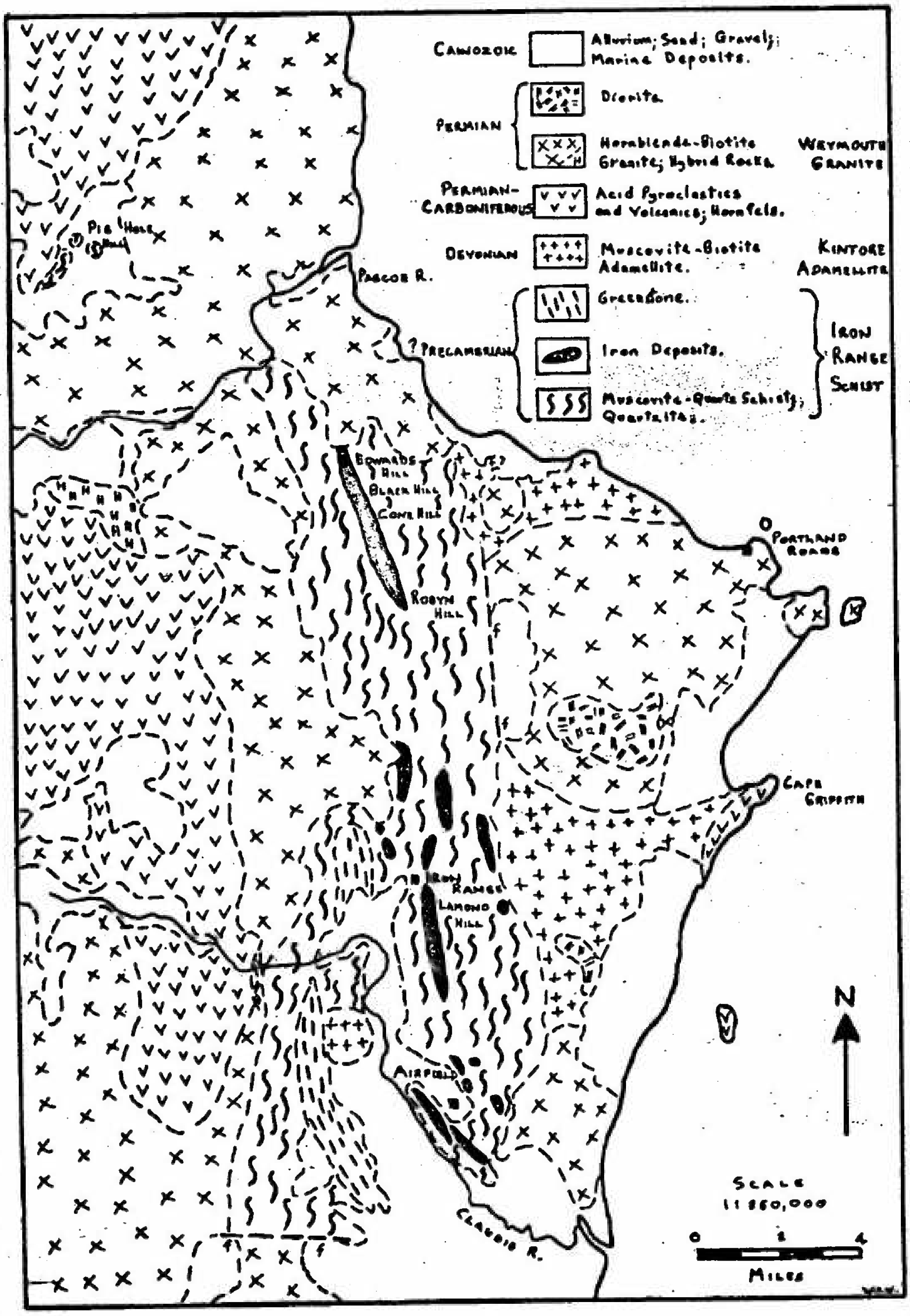


Fig. 44. Iron Deposits of the Iron Range District — After Canavan (1965)

exposures northeast of Coen contain small quantities of serpentine. Both the white marble and the green serpentine marble could be used as ornamental building stone.

The limestone exposed at Bolt Head was examined by geologists of the Broken Hill Proprietary Company (1962), who noted that quartz veins would probably lower the grade of the deposit to an undesirable level. They estimate that the deposit contains less than 1 million tons of limestone, of which about 25,000 tons is easily available. Miller (1957) found the carbonate content of the limestone to be between 83.7 and 96.84 percent.

Almost all the coral limestone seen lies below sea level, and is more likely to be an attraction for tourists than a source of lime.

MANGANESE

The occurrence of manganese at Iron Range is described under Iron. No other manganese deposits are known, but some of the earthy material described as graphite in schists may be manganiferous.

MOLYBDENUM

Traces of molybdenite occur in association with wolfram at the Bowden Mineral Field, at the wolfram occurrence reported to Ball (1901) east of Coen, and in a quartz reef on the summit of Rocky Island, at Portland Roads.

OIL AND GAS

The sediments seen in the Coen and Cape Weymouth Sheet areas are not likely to contain substantial quantities of oil or gas. The Carboniferous sediments are tightly folded and are in close proximity to Permian intrusive rocks. Oil and gas may have accumulated in the Lower Cretaceous Mein Formation, described by Australian Aquitaine Petroleum (1965), which extends westwards from the Sir William Thompson Range to the west coast of Cape York Peninsula at Weipa and beyond. The Mein Formation overlies the basal Mesozoic sandstone described in this report and mapping in 1967 did not cover the formation. It is composed of siltstone and fine-grained sandstone; the siltstone contains glauconite in places. It is 200 feet thick at the abandoned Mein Telegraph Station, and is about 1900 feet thick in the Weipa No.1 bore, according to Australian Aquitaine Petroleum.

The results of seismic work by the Compagnie Generale de Geophysique (1965) indicate that possibly 1200 feet of sediments underlie the Olive River, on the coast north of Bolt Head. Marine Mesozoic sediments may also occur in a basin lying between the volcanic rocks at Cape Grenville and the volcanic rocks at Cape York. Gravity information recently obtained by the Geophysical Branch of the Bureau of Mineral Resources suggests that the depth of this trough may be considerable. Australian Aquitaine Petroleum (1965) believe that the trough may deepen considerably to the northeast, under the Coral Sea.

PHOSPHATE

The Cairns Post newspaper in 1967 noted that a phosphate deposit on Raine Island was being investigated by local interests. Raine Island lies on the Great Barrier Reef in latitude 11°36'S longitude 144°01'E, 1 mile east of the eastern margin of the Orford Bay 1:250,000 Sheet area. The Australia Pilot (1961) notes that the depressed centre of the island "was formed of guano from 6 to 8 feet thick divided at about 2 feet from the surface by a layer of coral sand rock". It states that the deposit of guano has been worked out.

SILICA SAND

Sand dunes cover 150 square miles between the Olive River and Shelburne Bay, on the Orford Bay 1:250,000 Sheet area. The dunes are generally covered by vegetation, but those exposed are strikingly white. Samples from these dunes, taken on the coast, are composed almost entirely of quartz grains, accompanied by a few grains of limonite. Almost all the quartz grains are clear; a few are coloured. The dunes form hills rising up to 300 feet above sea level, and extend up to 10 miles inland. Two similar but smaller accumulations of sand dunes are located farther north along the coast in the Orford Bay Sheet area, and two other small accumulations are located to the south of Bolt Head and Cape Griffith respectively, in the Cape Weymouth 1:250,000 Sheet area.

In samples from the last two many of the quartz grains are yellow and some contain clay in cracks. White sand dunes also occur along a few miles of coastline between Cape Direction and the Lockhart River Mission.

Three specimens were analysed by the Australian Mineral Development Laboratories and were found to contain upwards of 99.8 percent silica.

TABLE 9 : ANALYTICAL RESULTS FROM POTENTIAL CLASS SANDS
(From A.M.D.L. Report AN390/69)

	ANALYSIS %		
	Shelburne Bay		Bolt Head
	67480534	67480535	67480536
Silica	99.8	99.6	99.6
Ferric Oxide	0.015	0.015	0.030
Aluminium Oxide	0.10	0.08	0.11
Calcium Oxide	0.01	0.04	0.01
Loss on ignition	0.11	0.10	0.12

TIN

Cassiterite has been obtained, mostly from alluvial deposits, at Stony Point and Tin Creek in the Cape Weymouth 1:250,000 Sheet area, and at Tin Creek or Granite Creek in the Coen 1:250,000 Sheet area. The Annual Report of the Department of Mines for 1880 records that 759 tons of tin (cassiterite) had been obtained from Granite Creek, a tributary of the Archer River located about 1 mile east of the Coen/Weipa road. Presumably the alluvial deposits were then exhausted, though inhabitants of Coen report that a few bags of cassiterite may be obtained from the creek after some wet seasons.

Jack (1922) records that tin was being worked 6 miles from the mouth of the Pascoe River, probably at Tin Creek, in 1887.

The files of the Department of Mines contain a report made by an inspector of mines in 1953 on the tin deposits north of the Pascoe River. He noted that the tin was distributed in enriched zones or areas and that values were low. Mining was confined to the heads of gullies.

He recorded wash with fair values under 18 feet of overburden; a sample of the wash contained 1 percent cassiterite; the overburden contained 0.3 percent. The granitic country rock contained only a trace of tin.

In 1959 the Broken Hill Proprietary Company (1962) carried out a survey for tin north of the Pascoe River. They report that at First Stony Point, 8 miles north of the mouth of the Pascoe River, cassiterite is distributed patchily through thin alluvium overlying acid volcanics. At Tin Creek cassiterite forms small irregular deposits in alluvium; most of the best patches have been worked by gougers. They conclude that the tin deposits are not worthwhile.

TUNGSTEN

Morton (1924) records that wolfram was discovered at the site of the Bowden Mineral Field in 1892, by William Bowden and party. Claims were taken up in 1904, and a rise in the price of wolfram in 1907 produced a small rush and caused the mineral field to be proclaimed. The field covers 13 square miles and extends for 10 miles southeastwards from the confluence of Canoe Creek and the Pascoe River, which also form boundaries of the field. By 1924 the only part of the field worked was a strip 1½ miles long and 1 mile wide trending north-northeast near the southern end of the field, on both sides of the watershed between Canoe Creek and the Pascoe River.

Morton notes that much of the field is covered by Mesozoic sandstone; the wolfram-bearing quartz lodes occur only in disturbed mica schist close to the contact of an intrusive granite. The lodes generally concord with the strike and dip of the schistosity. A few lodes occupy almost vertical fissures cutting the schist. The wolfram forms bunches of all sizes up to tons in weight in the quartz; in places it is accompanied by tourmaline, arsenopyrite, pyrite, and bismuth. In one claim only the wolfram is disseminated in the lode.

Morton records the production of the field from 1905 to 1913 as 70 tons, and notes that only a fdw tons had been won between 1913 and 1924. He recommended that surface gouging should be replaced by underground mining. Jones (1951) reports that 4 bags of wolfram were won from one lease in that year from a lode 4½ feet wide striking 232° and dipping 60° southeast.

Jack (1922) records that small quantities of tin and molybdenite were also produced from the Bowden Mineral Field. He also notes that Dickie found wolfram 8 miles north of the Pascoe River, near payable tin.

On the summit of Rocky Island at Portland Roads a small shaft is sunk on a reef of milky quartz, a few feet thick, in the Weymouth Granite. This reef is said to have been worked for wolfram. Quartz debris near the shaft contains only rare small specks of molybdenite.

Ball (1901) notes a prospector's report that wolfram occurs in a 9 inch vein, as bunches in quartz and as layers with molybdenite on the sides, on a creek running east about 8 miles east of Coen. The Peninsula Inspection reported in the Queensland Government Mining Journal for September, 1952, records that 2 tons of ore containing 7.5 percent wolfram had been won from an open-cut near Coen. No further work was planned.

WATER

Although the wet season extends from December to April in the Coen and Cape Weymouth Sheet areas, the larger rivers draining the eastern side of the dividing range are replenished by rain at intervals until July at least and many of them probably flow throughout the dry season. West of the dividing range, the large Wenlock River had ceased to flow early in September, 1967 and the flow of the Archer River had been much reduced by that time. The Coen River, fed from the highest part of the McIlwraith Range, carried a good flow in September, 1967.

The water resources of many parts of the Sheet areas could be greatly improved by building dams. Suitable sites for dams were not sought during the mapping programme, but dams creating large reservoirs could perhaps be constructed on the Archer River near the crossing of the Coen/Weipa road, on the Wenlock River near Wenlock, and on the Pascoe River at various points. Water from the upper part of the Pascoe River could perhaps be channelled into the Wenlock River from a suitable reservoir.

The valleys of the Lockhart River and the Nesbit River are broad and flat and are comparatively well watered. They appear to be suitable for agricultural development though the soil, derived mainly from granitic rocks, is not rich. Water could possibly be supplied to these valleys from small reservoirs on various tributaries of the main rivers; Leo Creek is perhaps the best example of a tributary which might be dammed at its outlet from the hills to form a sizeable reservoir.

The richest agricultural land, which lies along the Claudie River and is formed by alluvium derived from the Iron Range Schist, is well supplied with surface water by the Claudie River and other small streams rising in the mountains west of Iron Range.

The Pascoe River, the West Claudie River, Massy Creek, and several other rivers and large creeks rising in the Dividing Range, in places fall many feet in short distances and might be used for generating electricity.

Underground water could be most easily obtained from shallow basins occupied by sand or by the Cainozoic Lilyvale Beds. The Archer River piedmont basin is likely to yield good supplies of underground water, as the basin is almost closed by the rock ridge through which the Archer River cuts at the crossing of the Coen/Weipa road. Lilyvale Beds in the valleys of the Lockhart and Nesbit Rivers may also yield large quantities of underground water.

Nothing is known of the occurrence of underground water in the igneous and metamorphic rocks, but the Mesozoic sandstone along the western margin of these rocks should yield groundwater in favourable situations.

BIBLIOGRAPHY

AMOS, B.J., 1961 - The tectonic history of the Palaeozoic sediments of the Mossman 1:250,000 Sheet area. Bur. Miner. Resour. Aust. Rec. 1961/89 (unpubl.).

AMOS, B.J., and DE KEYSER, F. , 1964 - Mossman - 1:250,000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes E/55-1.

ANDREWS, E.C., 1902 - Preliminary note on the geology of the Queensland coast. Proc. Linn. Soc. N.S.W. 27, 146-185.

ANDREWS, E.C., 1910 - Geographical unity of eastern Australia in late and post-Tertiary time. J. Roy. Soc. N.S.W. 44, 419-480.

AUSTRALIA PILOT, 1960 - Volume III. The east coast of Australia from Port Jackson to Sandy Cape, the Coral Sea, and Torres Strait. London, The Admiralty.

AUSTRALIAN AQUITAINE PETROLEUM PTY LTD, 1964 - An airborne magnetometer survey of Wenlock River (Cape York Peninsula). Rep. for Aust. Aquit. Pet. (unpubl.) .

AUSTRALIAN AQUITAINE PETROLEUM PTY LTD, 1965 - Pascoe "B" - William Thompson. Aust. Aquit. Pet. Field Rep. 12 (unpubl.).

AUSTRALIAN AQUITAINE PETROLEUM PTY LTD, 1967 - Final report on surrendering the permit, Authority to Prospect 95P. Aust. Aquit. Pet. Rep. (unpubl.) .

BALL, L.C., 1901 - Hamilton and Coen Goldfields. Qld Govt Min. J. 2, 358-364, 415-420. (Also in Publ. geol. Surv. Qld 163).

BANKS, J.G., 1947 - Mining in Cape York Peninsula. Qld Govt Min. J. 48, 319-320.

BECK, J.G., 1935 - Cape York Peninsula fields. Qld Govt Min. J.36,379.

BECK, J.G., 1936 - Report on inspection of Peninsula Division. Qld Govt Min. J. 37, 324.

BRANCH, C.D., 1966 - Volcanic cauldrons, ring complexes, and associated granites of the Georgetown Inlier, Queensland. Bur. Miner. Resour. Aust. Bull. 76.

BROADHURST, E., and RAYNER, E.O., 1937 - Claudie River gold and mineral field. Aer. Surv. N. Aust. Qld Rep. 12.

BROKEN HILL PROPRIETARY COMPANY, 1962 - Final report on Authority to Prospect 86M. Broken Hill Pty Co. Ltd Geol. Sect. Rep. (unpubl.).

BRYAN, W.H., 1928 - The Queensland continental shelf. Rept Gt Barrier Reef Comm. 2, 58-69.

BRYAN, W.H., 1930 - The physiography of Queensland. Aust. Ass. Adv. Sci., 17-20.

BRYAN, W.H., and JONES, O.A., 1946 - The geological history of Queensland. Pap. Univ. Qld Dep. Geol. 215.

CANAVAN, F., 1965a - Iron ore deposits of Australia. In GEOLOGY OF AUSTRALIAN ORE DEPOSITS, 8th Comm. Min. Metall. Cong. 1, 13-23.

CANAVAN, F., 1965b - Iron and manganese ore deposits of Iron Range. In GEOLOGY OF AUSTRALIAN ORE DEPOSITS, 8th Comm. Min. Metall. Cong. 1, 391-393.

CHERRY, F.J., 1907 - Report on Cape York Peninsula Goldfields. Qld Govt Min. J. 8, 430.

COMPAGNIE GENERALE DE GEOPHYSIQUE, 1965 - Archer River seismic and gravity survey. Rep. for Aust. Aquit. Pet. Co. (unpubl.).

CONNAH, T.H., 1951 - Wenlock Goldfield. Qld Govt Min. J. 52, 301.

COOKSON, I.C., and EISENACK, A., 1958 - Microplankton from Australian and New Guinea Upper Mesozoic sediments. Proc. Roy. Soc. Vic. 70(1), 19-78.

#

COTTON, C.A., 1949 - A review of tectonic relief in Australia. J. Geol. 57, 280-296.

CRESPIN, I., 1956 - Micropalaeontological examination of samples from Cape York Peninsula. Bur. Miner. Resour. Aust. Rec. 1956/1 (unpubl.).

#COOKSON, I.C., and EISENACK, A., 1960 - Upper Mesozoic microplankton from Australia and New Guinea. Palaeontology 2 (2), 243-261.

C.S.I.R.O., 1953 - Treatment of arsenical gold ore from the Peninsula Hope Mine. Ore Dress. Invest. sci. ind. Res. Org. Melb. 453.

DAVID, T.W.E., 1950 - THE GEOLOGY OF THE COMMONWEALTH OF AUSTRALIA (W.R. Browne ed.). London, Arnold.

DEPT OF LANDS, QLD, 1965 - Sheets 4M.6 and 4M.8 (new series) QUEENSLAND FOUR MILES SERIES. Brisbane, Dept of Lands.

DEER, W.A., HOWIE, R.A., and ZUSSMAN, J., 1962 - ROCK-FORMING MINERALS. London, Longmans Green.

DEER, W.A., HOWIE, R.A., and ZUSSMAN, J., 1966 - AN INTRODUCTION TO THE ROCK-FORMING MINERALS. London, Longmans Green.

DE KEYSER, F., 1963 - The Palmerville Fault. J. geol. Soc. Aust. 10, 273-278.

DE KEYSER, F. , 1965 - The Barnard Metamorphics and their relation to the Barron River Metamorphics and the Hodgkinson Formation, North Queensland. J. geol. Soc. Aust. 12, 91-102.

DE KEYSER, F., and LUCAS, K.G., 1967 - Geological map, Hodgkinson and Laura Basins, Queensland. Bur. Miner. Resour. Aust. 1:500,000 Map.

DE KEYSER, F., and WOLFF, K., 1964 - The geology and mineral resources of the Chillagoe area.
Bur. Miner. Resour. Aust. Bull. 70. (Also Publ. geol. Surv. Qld 317).

EISENACK, A., and COOKSON, I.C., 1960 - Microplankton from Australian Lower Cretaceous sediments. Proc. Roy. Soc. Vic. 72(1), 1-11.

EVANS, P.R., 1966 - Contributions to the palynology of northern Queensland and Papua. Bur. Miner. Resour. Aust. Rec. 1966/198 (unpubl.).

FAIRBRIDGE, R.W., 1950 - Recent and Pleistocene coral reefs of Australia. J. Geol.58, 330-349.

FISHER, W.J., 1966 - The Wenlock Goldfield.
Bull. Aust. Inst. Min. Metall. July, 1966, 12-13.

FLEMING, P.J.G., 1965 - Lower Cretaceous marine fossils from the Coen and Cape Weymouth 1:250,000 Sheet areas. Geol. Surv. Qld (unpubl. rep.).

GEOLOGICAL SOCIETY OF AUSTRALIA, 1964 - Australian Code of Stratigraphic Nomenclature, 4th ed. J. geol. Soc. Aust. 11, 165-171.

GIBSON, C.R., 1964 - Report on Nesbit River alluvial gold, N. Qld. Rep. for Clutha Development Co. on A. to P. 231M (unpubl.).

GREENFIELD, W.H., 1911 - Sketch Map of Cape York Peninsula Gold and Mineral Fields. Publ. geol. Surv. Qld, 233.

GULF INTERSTATE OVERSEAS LIMITED, 1962 - Aerial magnetic report, Authority to Prospect 88P. Rep. for Gulf Interstate Overseas Ltd (unpubl.).

GULF INTERSTATE OVERSEAS LIMITED, 1965 - Final report seismic survey AP88P Torres Strait, Princess Charlotte Bay, Queensland, Australia. Gulf Interstate Overseas Ltd Rep. (unpubl.).

HADDON, A.C., SOLLAS, W.J., and COLE, G.A.J., 1894 - The geology of Torres Strait. Trans. Roy. Irish Acad. 30, 419-476.

HADLEY, B.A., 1934 - Report on inspection of Peninsula Division. Qld Govt Min. J.. 35, 389.

HANN, W., 1873a - Report from Mr W. Hann, leader of the northern expedition party. Notes Proc. Legisl. Assem. Qld 1031-1043.

HANN, W., 1873b - Copy of the diary of the northern expedition under the Leadership of W. Hann. Notes Proc. Legisl. Assem. Qld 1045-1070.

HILL, D., and DENMEAD, A.K. (eds), 1960 - The geology of Queensland. J. geol. Soc. Aust. 7.

JACK, R.L., 1881 - Report on exploration in Cape York Peninsula. 1879-1880. Publ. geol. Surv. Qld 8.

JACK, R.L., 1922 - NORTHMOST AUSTRALIA. Melbourne, George Robertson.

JARDINE, F., 1928 - Bramble Cay, Torres Strait and Darnley Island. Rept Gt Barrier Reef Comm. 2, 93-109.

JARMAN, C.A., RAYNER, J.M., and NYE, P.B., 1937 - Geophysical report on the Iron Range area. Aer. Surv. N. Aust. Qld Rep. 13.

JENSEN, H.I., 1964 - Sketch of the geology and physiography of Cape York. Qld geogr. J. 62.

JOLLY, J.L., 1946 - Mining in Cape York Peninsula goldfields. Qld Govt Min. J. 47, 327-328.

JONES, L.S., 1949 - Peninsula Inspection. Qld Govt Min.J. 50,730.

JONES, L.S., 1951 - Peninsula Inspections, August, 1951. Qld Govt Min.J. 52, 980-987.

JONES, O.A., and JONES, J.B., 1956 - Notes on the geology of some north Queensland islands. Rep. Gt Barrier Reef Comm. 6, 45-54.

JOPLIN, G.A., 1964 - A PETROGRAPHY OF AUSTRALIAN IGNEOUS ROCKS. Sydney, London, Melbourne, Angus and Robertson.

LUCAS, K.G., and DE KEYSER, F., 1965a - Cooktown - 1:250,000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes D/55-13.

LUCAS, K.G., and DE KEYSER, F., 1965b - Cape Melville - 1:250,000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes D/55-9.

MAXWELL, W.G.H., 1948 - The geology of Cape York Peninsula. Dept Geol., Univ. Qld. (Ms in library).

MILLER, P.G., 1957 - Reports on Authorities to Prospect 63M and 116M. Comm. Alum. Corp. Pty Ltd Rep. (unpubl.).

MIYASHIRO, A., 1961 - The evolution of metamorphic belts. J. Petrol. 2, 277.

MORGAN, W.R., 1964 - The petrography of specimens collected by the 1962 Cape Melville field party. Bur. Miner. Resour. Aust. Rec. 1964/1 (unpubl.).

MORTON, C.C., 1924 - Geology and mineral occurrences, Pascoe River district. Qld Govt Min. J. 25, 78-83, 129-134.

MORTON, C.C., 1930 - Batavia River gold diggings. Qld Govt Min. J. 31, 452-455, 492-498.

MORTON, C.C., 1932 - Batavia River diggings. Qld Govt Min. J.33,257.

PATTERSON, O.D., 1957 - Report on Authority to Prospect 25M, Cape York. Olive River to Fly Point. Rep. for Mineral Deposits Pty Ltd (unpubl.).

RAYNER, E.O., 1937 - The Claudie River Gold and Mineral Field. Aer. Surv. N. Aust. Qld Rep. 30.

REID, I.W., 1959 - Report of the prospecting party, Cape York Peninsula, 1958. Broken Hill Pty Co. Ltd Rep. (unpubl.).

RICHARDS, J.R., WHITE, D.A., WEBB, A.W., and BRANCH, C.D., 1966a - Chronology of the acid igneous rocks of north Queensland, Australia. Earth Plan. Sci. Lett. 1, 107-109.

RICHARDS, J.R., WHITE, D.A., WEBB, A.W., and BRANCH, C.D., 1966b - Isotopic ages of acid igneous rocks in the Cairns Hinterland, North Queensland. Bur. Miner. Resour. Aust. Bull. 88.

ROSS, C.S., and SMITH, R.L., 1961 - Ashflows: their origin, geologic relations, and identification. Prof. Pap. U.S. geol. Surv. 366.

SHEPHERD, S.R.L., 1938 - Hayes Creek Goldfield. Qld Govt Min. J. 37, 336-338.

SHEPHERD, S.R.L., 1939 - Claudie River Goldfield. Qld Govt Min. J. 40, 6-13.

SHEPHERD, S.R.L., 1941 - Wenlock Goldfield. Qld Govt Min. J. 42, 259.

SPRATT, R.N., 1958 - Pascoe River coal, Qld. Consolidated Zinc Pty Ltd Rep. (unpubl.).

SUSSMILCH, C.A., 1938 - The geomorphology of east Queensland. Rep. Gt Barrier Reef Comm. 4, 105-134.

TENNECO AUSTRALIA INCORPORATED, 1967 - Final report, seismic and magnetic survey, northern Great Barrier Reef area AP 88P and 111P. Tenneco Australia Inc. Rep. (unpubl.).

THOMPSON, J.E., 1967 - Summary of a geological history of eastern New Guinea. Proc. Ann. Conf. Austral. Petrol. Explor. Ass. 1967.

TRAIL, D.S., PONTIFEX, I.R., PALFREYMAN, W.D., WILLMOTT, W.F., and WHITAKER, W.G., 1968 - The igneous and metamorphic rocks of the southern part of Cape York Peninsula, Queensland. Bur. Miner. Resour. Aust. Rec. 1968/26 (unpubl.).

TURNER, F.J., and VERHOOGEN, J., 1960 - IGNEOUS AND METAMORPHIC PETROLOGY. New York, McGraw-Hill.

TWIDALE, C.R., 1966 - Geomorphology of the Leichhardt-Gilbert area, Northwest Queensland. Comm. Sci. ind. Res. Org. Melb., Land. Res. Ser. 16.

#

WHITAKER, W.G., and WILLMOTT, W.F., 1968 - The nemenclature of the igneous and metamorphic rocks of Cape York Peninsula, Queensland, Part I. - the southern area. Qld Govt Min. J. 69, 344-355. [Also Bur. Miner. Resour. Aust. Rec. 1968/48 (unpubl.)]

WHITAKER, W.G., and WILLMOTT, W.F., 1969 - The nomenclature of the igneous and metamorphic rocks of Cape York Peninsula, Queensland. Part II - The Coen-Iron Range area. Qld Govt Min. J. 70, 130-142.

WHITE, D.A., 1965 - The geology of the Georgetown/Clarke River area, Queensland. Bur. Miner. Resour. Aust. Bull. 71.

WHITE, MARY E., 1969 - Report on the 1967 collection of plant fossils from Cape York Peninsula. Bur. Miner. Resour. Aust. Rec. 1969/53 (unpubl.).

WILLIAMS, H., TURNER, F.J., and GILBERT, C.M., 1954 - PETROGRAPHY. San Francisco, W.H. Freeman.

ZINC CORPORATION LIMITED, 1957 - Z.C.L. No.1 (Weipa) completion report. Zinc. Corp. Ltd Rep. (unpubl.).

WALKOM, A.B., 1928 - Fossil plants from Plutoville, Cape York Peninsula. Proc. Linn. Soc. N.S.W. 53 (2), 145-150.

Appendix 1

ISOTOPIC DATING

by

A.W. Webb

The predominance of K-Ar mineral dates between 365 and 375 m.y. in the Kintore Adamellite and the Morris Adamellite suggests a widespread intrusive event at this time in the region of the Hann River, Ebagoola and Coen Sheet areas. The significance of the slightly younger dates around 345 m.y. measured on samples of the Lankelly Adamellite and Flyspeck Granodiorite is uncertain because of the small amount of work done on these rocks.

K-Ar biotite dates on the Arkara-type gneiss also fall within the time range 345-375 m.y. and are probably minimum ages which reflect the approximate time of intrusion of the adjacent igneous rocks. Preliminary Rb-Sr dating suggests that these metamorphic rocks are considerably older than Devonian.

Early Permian ages between 260 and 270 m.y., have been measured on an intrusion to the north of Coen (Twin Humps Adamellite) and on granite near Portland Roads in the Cape Weymouth Sheet area (Weymouth Granite).

TABLE 10 : K-Ar Analyses

No.	Mineral	% K	$^{40}Ar^{*}/^{40}K$	% ^{40}Ar atm.	Age($\times 10^6$ yrs)
Kintore Adamellite					
GA 5723	Muscovite	8.869) 8.872) 8.87	0.02410	1.8	373
	Biotite	7.218) 7.212) 7.22	0.02385	12.0	370
GA 5724	Muscovite	8.759) 8.719) 8.74	0.02423	0.8	375
	Biotite	6.385) 6.416) 6.40	0.02370	1.1	367
GA 5745	Muscovite	8.746) 8.803) 8.77	0.02349	2.4	365
	Biotite	6.658) 6.695) 6.68	0.02297	1.3	357

TABLE 10 (contd)

No.	Mineral	% K		$^{40}Ar^{*}/^{40}K$	$\%^{40}Ar^{atm.}$	Age($X10^{6}$yrs)
GA 5738	Muscovite	8.819) 8.797)	8.81	0.02481	13.9	383
	Biotite	6.967) 6.933)	6.95	0.02429	0.8	376
GA 5739	Muscovite	8.925) 8.930)	8.93	0.02354	11.9	365
	Biotite	4.941) 4.978)	4.96	0.02236	3.0	348
Flyspeck Granodiorite						
GA 5742	Biotite	7.748) 7.748)	7.75	0.02216	1.3	346
Lankelly Adamellite						
GA 5744	Biotite	7.350) 7.310)	7.33	0.02204	2.8	344
Morris Adamellite						
GA 5737	Biotite	7.174) 7.158)	7.17	0.02407	3.1	373
Twin Humps Adamellite						
GA 5736	Biotite	4.684) 4.710)	4.70	0.01580	2.4	253
Weymouth Granite						
GA 5767	Biotite	7.143) 7.084)	7.11	0.01713	2.8	273
GA 5768	Biotite	6.298) 6.290)	6.29	0.01641	5.8	262
Arkara-type Gneiss						
GA 5743	Biotite	7.698) 7.674)	7.69	0.02220	2.3	346
GA 5746	Biotite	7.865) 7.819)	7.84	0.02312	1.1	359
GA 5747	Biotite	7.721) 7.734)	7.73	0.02408	1.3	372

APPENDIX II

The material contained in this appendix will be issued separately as BMR Record 1969/53. This Record will contain illustrations of the plant fossils described.

Report on 1967 Collection of Plant Fossils from Cape York Peninsula

by
Mary E. White

Plant fossils were collected from two localities on the east coast of Cape York Peninsula, about 180 miles south of Thursday Island, by W.D. Palfreyman in 1967. At both localities elements of the same flora are present.

Stigmaria ficoides Bgt., the root buttress of *Lepidodendron* is present associated with a species of *Cardiopteris* which shows diversity of pinnule form. A Lower Carboniferous age is suggested by the flora.

Locality 1: In Hamilton Creek; 4 miles above its confluence with the Pascoe River and 22 miles west of Portland Roads. Field nos of specimens 67480476-67480495 inclusive. Grid ref. E6492 N33912 on the Cape Weymouth 1:250,000 Sheet SD 54/4.

Specimen no. F 22963-F22984
(F22963, F22966, F22969, F22970, F22976 illustrated)

Two plant species are identified at Locality 1. *Stigmaria ficoides* Bgt. the root buttress of *Lepidodendron* is present in a number of specimens. Circular markings are attachment points for *Stigmarian* roots which had a central vascular strand. This appears as a spot in the centre of the rootlet scar in many cases. Among the stem-like impressions in the specimens are some smooth, ribbon-like impressions which may have a median sulcus. These are impressions of Stigmarian rootlets.

The other plant present is a species of <u>Cardiopteris</u>. The material consists of a great quantity of dissected leaf tissue impressions. In some instances specimens are almost a solid mass of plant impressions. Much of the leaf material is broken up into fragments of single pinnules and this is misleading as on first inspection the fragments appear to be referable to <u>Rhacopteris</u>. Close examination shows that there is diversity of pinnule type depending on the position of the pinnule on the pinna, and further it is seen that the frond is a bipinnate one. This feature precludes it from <u>Rhacopteris</u> which is by definition once pinnate with alternate, often overlapping flabelliform pinnules which range from entire to deeply dissected.

There are many stem impressions in the material. Some of these show regular pitting of the surface with a pattern of horizontally elongated depressions. Others have fine vertical striation. Some show both pitting and striation, having different decortication levels. The ornamentation of the fork has a strongly Psilophyte appearance. The stems are presumably referable to <u>Cardiopteris</u> sp.

Diversity of pinnule form is a well known phenomenon in Carboniferous plants of <u>Cardiopteris</u> type. It is difficult to classify plant fragments from the Carboniferous fern-like genera. If there are only a few specimens in a collection containing pinnule fragments with <u>Rhacopteris</u> appearance, naturally they are determined as belonging to that genus. Therefore records of occurrences of the genera involved are far from reliable and determination of species even less so. A large collection showing the full range of variation of pinnule form as in the present case is necessary before safe determination can be made. Even then the choice of a generic name remains somewhat arbitrary. It has been suggested that the Genus <u>Ultopteris</u> should be used for plants bearing both <u>Rhacopteris</u> and <u>Cardiopteris</u> pinnules. It might be more useful to determine all examples in which the limitations in the size of the collection make it impossible to be certain as <u>Ultopteris</u>. Positive identification to either of the other genera would take into account the bipinnate nature of the frond in <u>Cardiopteris</u>.

<u>Cardiopteris</u> in the form of examples of the most variable species <u>Cardiopteris polymorpha</u> Goeppert occurs in the Lower Carboniferous in Australia in abundance. <u>C. polymorpha</u> is a much larger and

more robust plant than the species under investigation. All pinnules and pinnae of the species are delicate and fern-like and the plant must have been very different in gross form from the substantial Cardiopteris polymorpha.

The range of Cardiopteris is Carboniferous. There are references in literature to its presence in passage beds to Permian associated with Glossopteris. In view of the latest evidence on the presence of a Glossopteris-Cardiopteris assemblage in Middle Carboniferous (Richards, Morgan and White, in press) there is reason to doubt its extension into Permian. It is not impossible that it may range from Upper Devonian.

Locality 2: In Pascoe River, $1\frac{1}{2}$ miles above its confluence with Hamilton Creek and 24 miles west of Portland Roads.
Field specimen nos 67480496-67480507.
Grid ref. E6473 N33931, on the Cape Weymouth 1:250,000 Sheet SD 54/4

Specimens F22985-F22996

The specimens from locality 2 are poorly preserved. Most have indeterminate plant remains in the form of stem impressions, minute branching filaments, and some macerated plant material. In specimens F22990 and F22992 are fragments of Cardiopteris sp. the same as at locality 1. Some of the stem-like impressions are probably Stigmarian roots.

The specimens are of the same age as those at Locality 1.

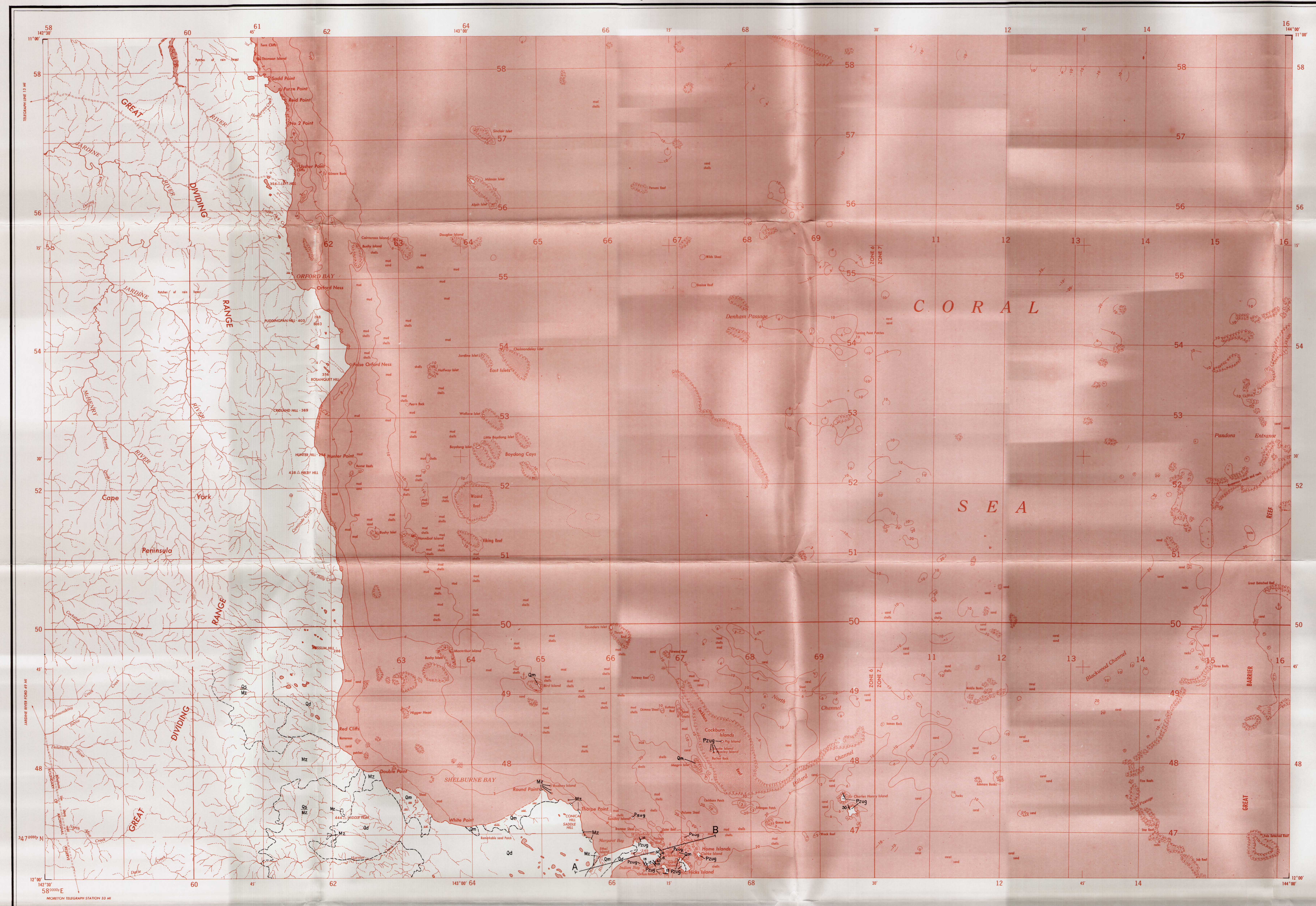
Age: Plant evidence indicates a Carboniferous age for the fossil horizon.

AUSTRALIA 1:250,000 GEOLOGICAL SERIES

ORFORD BAY

QUEENSLAND

SHEET SC 54-16



Reference

CAINOZOIC — QUATERNARY

Qm	Mud, coral sand, sand, sand cays
Qs	Sand, residual
Qd	Sand, mainly in dunes

MESOZOIC

Mz	Coarse sandstone

PALAEOZOIC — CARBONIFEROUS? — Cape Grenville Volcanics

Pzug	Tuff, agglomerate, welded tuff, rhyolite

Geological boundary, position approximate

Strike and dip of strata

Strike and dip, prevailing or unmeasured

Marsh, swamps

Coral reef

Fathom line

Vehicle track

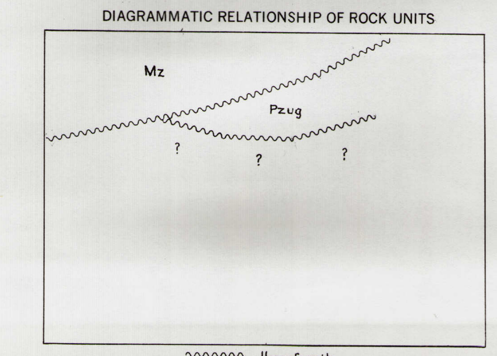
Lighthouse

Trigonometrical station, height in feet

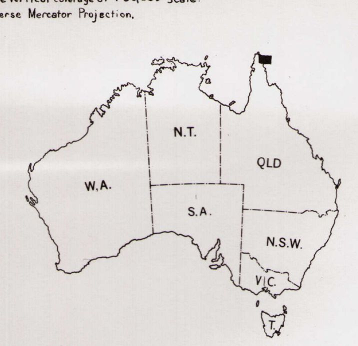
Astronomical station

Spot elevation, instrument levelled

DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS

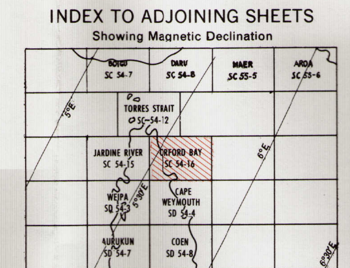


Compiled by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Developement. Issued under the authority of the Hon. David Fairbairn, Minister for National Development. Base map compiled by the Royal Australian Survey Corps. Commonwealth aerial photography. Complete vertical coverage at 1:50,000 scale.
Transverse Mercator Projection.

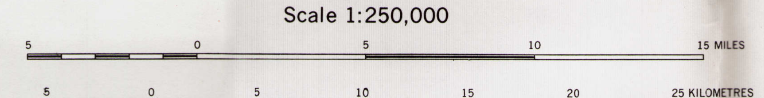


INDEX TO ADJOINING SHEETS

Showing Magnetic Declination



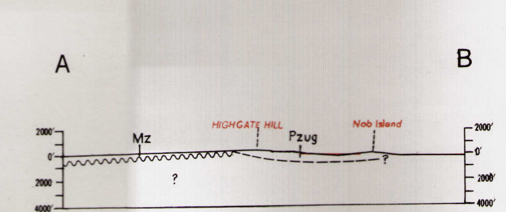
Scale 1:250,000



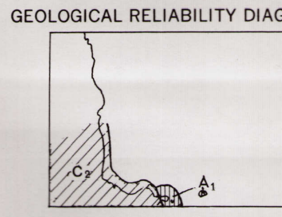
Section

Cainozoic sediments omitted

Scale: $\frac{V}{H} = 2$



GEOLOGICAL RELIABILITY DIAGRAM



Geology, 1967, by: R.F. Spark, W.F. Willmott (B.M.R.), W G Whitaker, (G.S.Q)
Compiled, 1968 by: W. F. Willmott
Cartography by: Geological Branch, B.M.R.
Drawn by: R.D Reeks

PRELIMINARY EDITION, 1968

SUBJECT TO AMENDMENT

ORFORD BAY

SHEET SC 54-16

Complimentary

AUSTRALIA 1:250,000 GEOLOGICAL SERIES

COEN
QUEENSLAND

SHEET SD 54-8

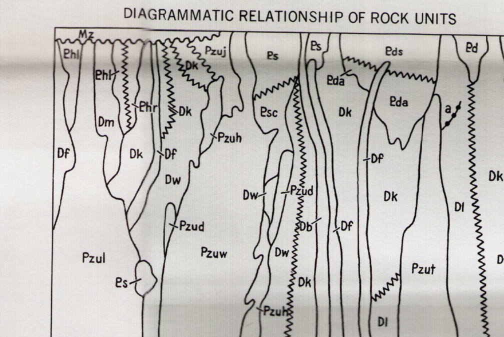
Reference

Era	Period	Unit	Symbol	Description
CAINOZOIC	QUATERNARY		Qm	Marine sediments, mainly sand and mud
			Qa	Alluvium, mainly silty
			Qs	Sand, mainly residual
	UNDIFFERENTIATED	Lilyvale Beds	Czy	Soft sandstone and conglomerate
MESOZOIC			Mz	Pebbly sandstone and conglomerate
PALAEOZOIC	PERMIAN	Wolverton Adamellite	Pzul	Leucocratic adamellite and granite
		Twin Humps Adamellite	Pzut	Hornblende-biotite adamellite
		Weymouth Granite	Pzuw	Biotite granite and adamellite, commonly porphyritic, some microgranite
			Pzuh	Granophyric hybrid rocks
			Pzud	Diorite
	PERMIAN TO CARBONIFEROUS	Janet Range Volcanics	Pzuj	Hornfelsed acid volcanics
	DEVONIAN (Cape York Peninsula Batholith)	Morris Adamellite	Dm	Porphyritic biotite adamellite
		Wigan Adamellite	Dw	Biotite adamellite
		Blue Mountains Adamellite	Db	Biotite adamellite, hornblende-biotite adamellite
		Flyspeck Granodiorite	Df	Biotite granodiorite, hornblende-biotite tonalite, diorite
		Kintore Adamellite	Dk	Muscovite-biotite adamellite
		Lankelly Adamellite	Dl	Porphyritic biotite adamellite
PROTEROZOIC ?	Sefton Metamorphics	Mount Carter Schist	Ɇsc	Muscovite-quartz schist, phyllite, quartzite
		Undifferentiated	Ɇs	Muscovite-quartz schist, quartzite, minor gneiss
	Holroyd Metamorphics	Lukin-type schist	Ɇhl	Muscovite-quartz schist, phyllite, quartzite
		Pretender-type schist	Ɇhr	Feldspar-biotite-muscovite-quartz schist, quartzite
	Dargalong Metamorphics	Saraga-type schist	Ɇds	Muscovite-quartz schist, quartzite
		Arkara-type gneiss	Ɇda	Biotite-quartz-feldspar gneiss, amphibolite, quartzite
		Undifferentiated	Ɇd	Biotite-quartz-feldspar gneiss, muscovite-quartz schist, quartzite, amphibolite, marble, calc-silicate rocks, dolerite

Geological boundary
Fault, showing horizontal movement and dip of fault-plane
Where location of boundaries and faults is approximate, line is broken; where inferred, queried; where concealed, faults are shown by short dashes
Shear zone
Shearing, diffuse
Strike and dip of strata, measured
Strike and dip of strata, prevailing or unmeasured
Dip < 15° (air-photo interpretation)
Dip > 45° (air-photo interpretation)
Trend lines (air-photo interpretation)
Joint pattern (air-photo interpretation)
Strike and dip of foliation
Horizontal foliation
Vertical foliation
Plunge of lineation
Foliation with plunge of lineation
Dip of banding in igneous rocks
Vertical banding in igneous rocks
Vertical joint
Dyke or vein: a-acid, b-basic, q-quartz
Mine not worked
Battery, not operating

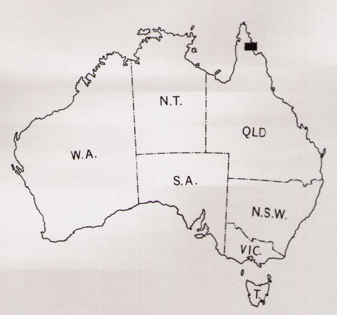
Au Gold
Waterhole
Waterhole on stream
Swamp
Mangroves
Coral reef
Fathom line
Shoal
Road
Vehicle track
Airport
Landing ground
"Rokeby" Homestead
Hut or building
Yard
Fence
Telephone line
Trigonometrical station, height in feet
Astronomical station
Cliff

DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS

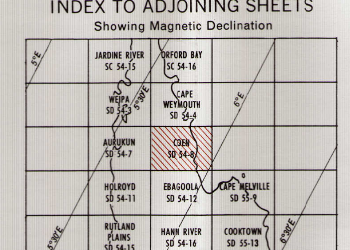


Unconformity
Gradational boundary

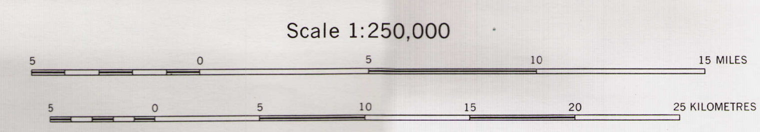
Compiled by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Issued under the authority of the Hon. David Fairbairn, Minister for National Development. Base map compiled by the Royal Australian Survey Corps. Commonwealth aerial photography; complete vertical coverage at 1:48,000 and 1:85,000 scale Transverse Mercator Projection



INDEX TO ADJOINING SHEETS
Showing Magnetic Declination

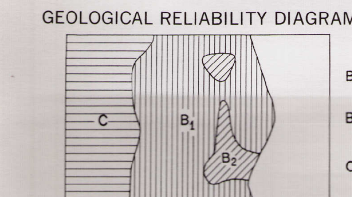


Scale 1:250,000



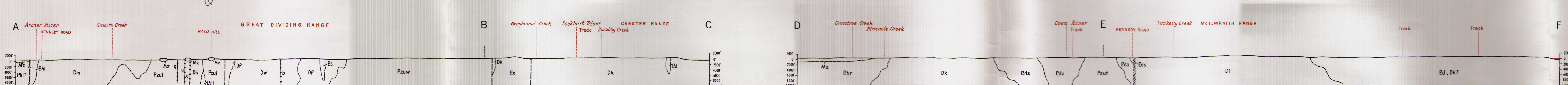
Sections
Cainozoic sediments omitted from sections
Scale: $\frac{V}{H} = 1$

GEOLOGICAL RELIABILITY DIAGRAM



B_1 Many traverses
B_2 Few traverses
C Air-photo interpretation

Geology, 1967, by: W. F. Willmott, W. D. Palfreyman, R. F. Spark, D. S. Trail (BMR), W. G. Whitaker (GSQ)
Compiled, 1968, by: W. D. Palfreyman and A. S. Mikolajczak
Cartography by: Geological Branch, BMR
Drawn by: G. Matveev and A. S. Mikolajczak



PRELIMINARY EDITION, 1968

SUBJECT TO AMENDMENT

COEN

SHEET SD 54-8

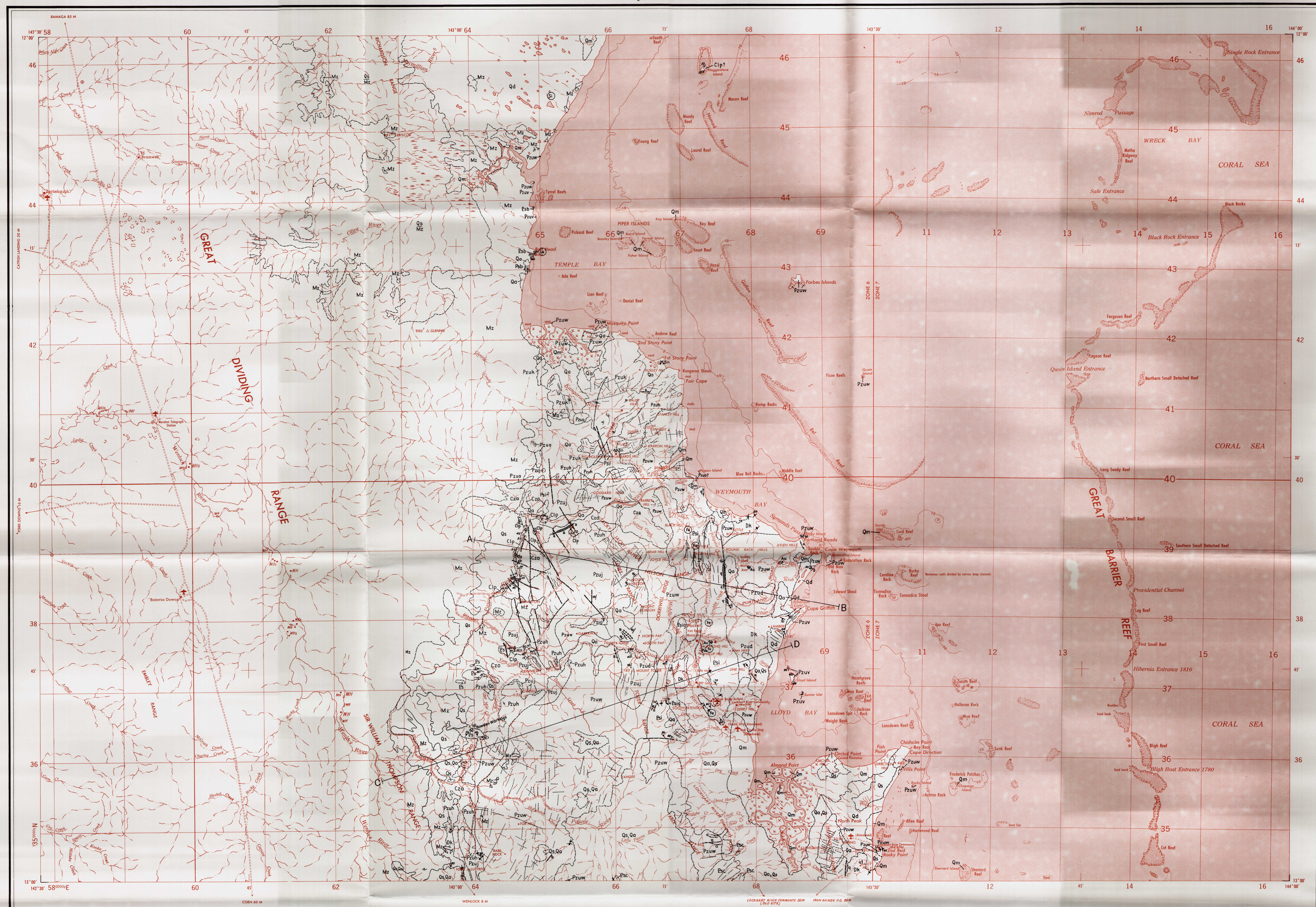
Complimentary

AUSTRALIA 1:250,000 GEOLOGICAL SERIES

CAPE WEYMOUTH

QUEENSLAND

SHEET SD 54-4



Reference

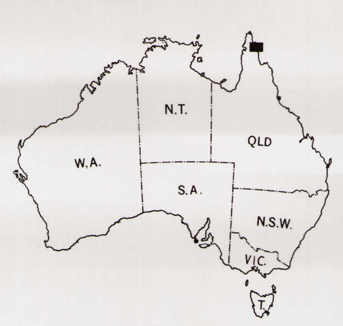
Era	Period	Unit	Symbol	Description
CAINOZOIC	QUATERNARY		Qm	Marine sediments, mainly sand and mud
			Qa	Alluvium, mainly silty
			Qs	Sand, mainly residual
			Qd	Sand, mainly in dunes
	UNDIFFERENTIATED	Yam Creek Beds	Cza	Soft sandstone and conglomerate
MESOZOIC			Mz	Pebble sandstone and conglomerate
PALAEOZOIC	PERMIAN		Pzuo	Dolerite
		Weymouth Granite	Pzuw	Biotite granite and adamellite commonly porphyritic
			Pzuh	Granophyric and hybrid rocks
			Pzud	Diorite
	PERMIAN TO CARBONIFEROUS	Kangaroo River Volcanics	Pzuk	Acid pyroclastic rock and basic lava
		Janet Ranges Volcanics	Pzuj	Acid pyroclastic rock and lava, hornfels
		Undifferentiated Volcanics	Pzuv	Acid pyroclastic rock, intrusive breccia, metabasalt
	LOWER CARBONIFEROUS	Pascoe River Beds	Clp	Feldspathic sandstone, greywacke, shale, tuff
	DEVONIAN	Kintore Adamellite	Dk	Muscovite - biotite adamellite, even-grained
PROTEROZOIC ?		Sefton Metamorphics: Bolt Head Schist	Esb	Chlorite - quartz schist, quartzite, schistose limestone
		Iron Range Schist	Esi	Muscovite - quartz schist, hematite - quartz schist, magnetite quartzite
			Esig	Greenstone
		Mount Carter Schist	Esc	Muscovite - quartz phyllite and schist, quartzite
		Undifferentiated	Es	Muscovite - quartz schist, quartzite, minor gneiss

Geological boundary
Anticline
Syncline
Fold axis, closure unknown
Fault
Where location of boundaries, folds and faults is approximate, line is broken, where infferred, queried; where concealed, boundaries and folds are dotted, faults are shown by shortdashes
Strike and dip of strata
Horizontal strata
Vertical strata
Dip < 15° } air-photo interpretation
Dip 15°-45° } air-photo interpretation
Trend lines } air-photo interpretation
Joint pattern } air-photo interpretation
Strike and dip of foliation
Vertical foliation
Foliation with plunge of lineation
Vertical joint
Plant fossil locality
Fossil wood locality
Dyke; a-acid, b-basic, q-quartz
Mine
Mine not worked
Alluvial workings not worked
Unworked mineral deposit

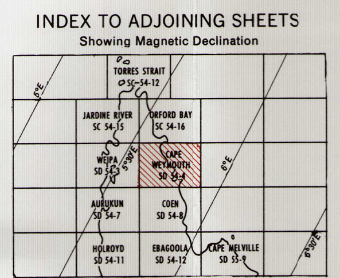
Au	Gold
Fe	Iron
Ls	Limestone
Si	Silica sand
Sn	Tin
W	Tungsten (wolfram)

Waterhole on stream
Waterhole
Swamp
Mangroves
Coral reef
Fathom line
Shoal
Road
Vehicle track
Airport
Landing ground
"Bramwell" Homestead
Hut or builaing
Yard
Telephone line
Trigonometrical station, height in feet
Astronomical station
Lighthouse

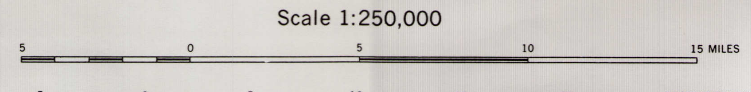
Compiled by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Issued under the authority of the Hon. David Fairbairn, Minister for National Development. Base map compiled by the Royal Australian Survey Corps. Commonwealth aerial photography. Complete vertical coverage at 1:50,000 scale.
Transverse Mercator Projection



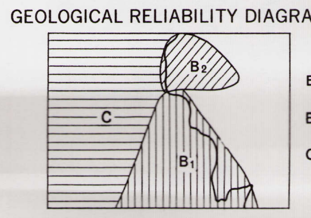
INDEX TO ADJOINING SHEETS
Showing Magnetic Declination



Scale 1:250,000



GEOLOGICAL RELIABILITY DIAGRAM

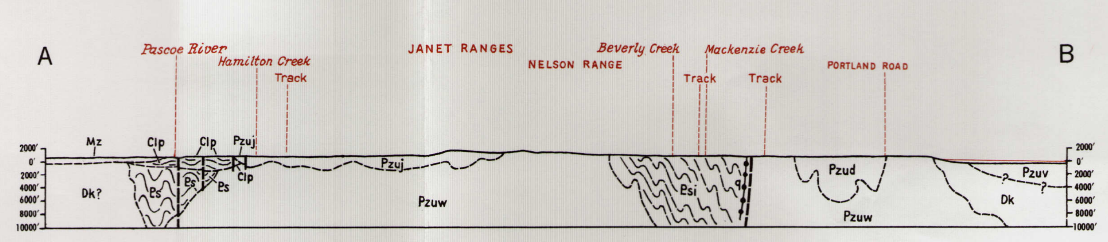


B_1 Many traverses
B_2 Few traverses
C Air-photo interpretation

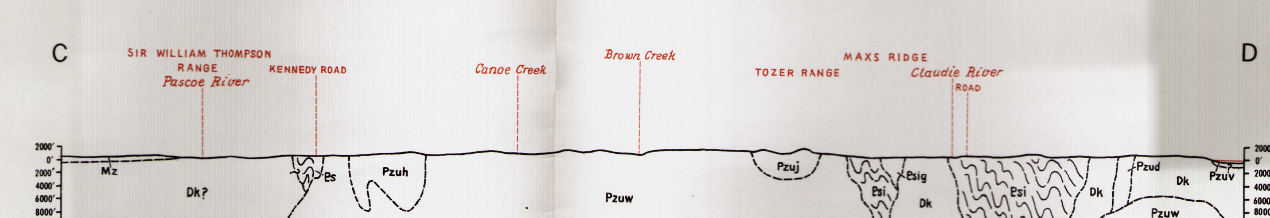
Geology, 1967-68, by: W.F.Willmott, W.D.Palfreyman, R.F.Spark, D.S.Trail (B.M.R.), W.G.Whitaker, (G.S.Q.), with information supplied by Broken Hill Pty. Co. Ltd., and Australian Aquitaine Petroleum
Compiled, 1968, by: R.F. Spark and A.S. Mikolajczak
Cartography by: Geological Branch, B.M.R.
Drawn by: D.E. Brentnall and A.S. Mikolajczak

Sections
Cainozoic sediments omitted
Scale $\frac{V}{H} = 1$

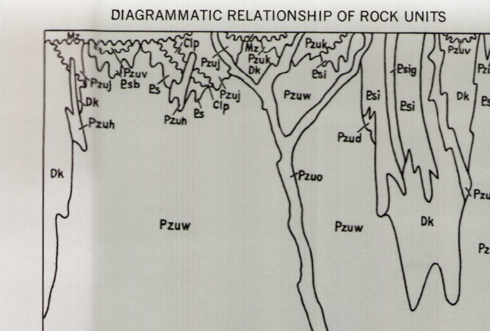
A — B



C — D



DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS



Unconformity

PRELIMINARY EDITION, 1968
SUBJECT TO AMENDMENT

CAPE WEYMOUTH
SHEET SD 54-4

Complimentary