COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

REPORT No. 65

GEOLOGICAL RECONNAISSANCE OF THE RAWLINSON AND MACDONALD 1:250,000 SHEET AREAS, WESTERN AUSTRALIA

BY

A. T. WELLS, D. J. FORMAN, AND L. C. RANFORD

Issued under the Authority of the Hon. David Fairbairn
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by

A.T. Wells, D.J. Forman, and L.C. Ranford

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GEOLOGICAL RECONNAISSANCE OF THE RAWLINSON AND MACDONALD 1:250,000 SHEET AREAS, WESTERN AUSTRALIA

SUMMARY

Precambrian, Palaeozoic, Tertiary, and Quaternary sediments are preserved in the Rawlinson-Macdonald area, which is in the western part of the Amadeus Basin. Their aggregate thickness is in excess of 20,000 feet.

On the northern and southern margins of the Amadeus Basin outliers of Upper Proterozoic quartzite and dolomite rest unconformably on older Precambrian rocks which are regarded as basement. In the Macdonald Sheet area the Upper Proterozoic Heavitree Quartzite rests unconformably on a basement of granite, gneiss, quartzite, acid and intermediate igneous rocks, and low grade metasediments. In the Rawlinson Sheet area the Upper Proterozoic Dean Quartzite rests, in places, with no visible unconformity on a thick sequence of clastic sedimentary rocks (Dixon Range Beds), and in places on undifferentiated Precambrian schist, phyllite, sheared basalt, and quartz-feldspar porphyry. The Dixon Range Beds and the undifferentiated Precambrian rocks are probably equivalent; the Dean Quartzite is correlated with the Heavitree Quartzite.

After the comformable deposition of the Bitter Springs Limestone on the Dean and Heavitree Quartzites, the succession was exposed to a strong diastrophism along the southern margin of the Rawlinson Sheet area, and the resultant land masses were a source of sediment to the Amadeus Basin. A thick sequence extending from Upper Proterozoic possibly to Lower Palaeozoic was laid down in the Basin: fine-grained clastics, carbonates, and a possible basal tillite in the northern part of the area, and coarser clastics in the southern part.

After folding, faulting, and erosion of these rocks the area was invaded by an epicontinental sea, and thin deposits of Ordovician limestone and sandstone were deposited on a surface of considerable relief. The Mereenie Sandstone was deposited after regression of the Ordovician sea. The Ligertwood Beds were deposited locally after a period of faulting. Further erosion took place before the deposition of the continental Permian glacial deposits of the Buck Formation.

Since the Permian Period, the only preserved deposits are superficial Tertiary pluvial sediments, and Quaternary evaporites, alluvium, travertine, sand, and sand dunes in a more arid phase.

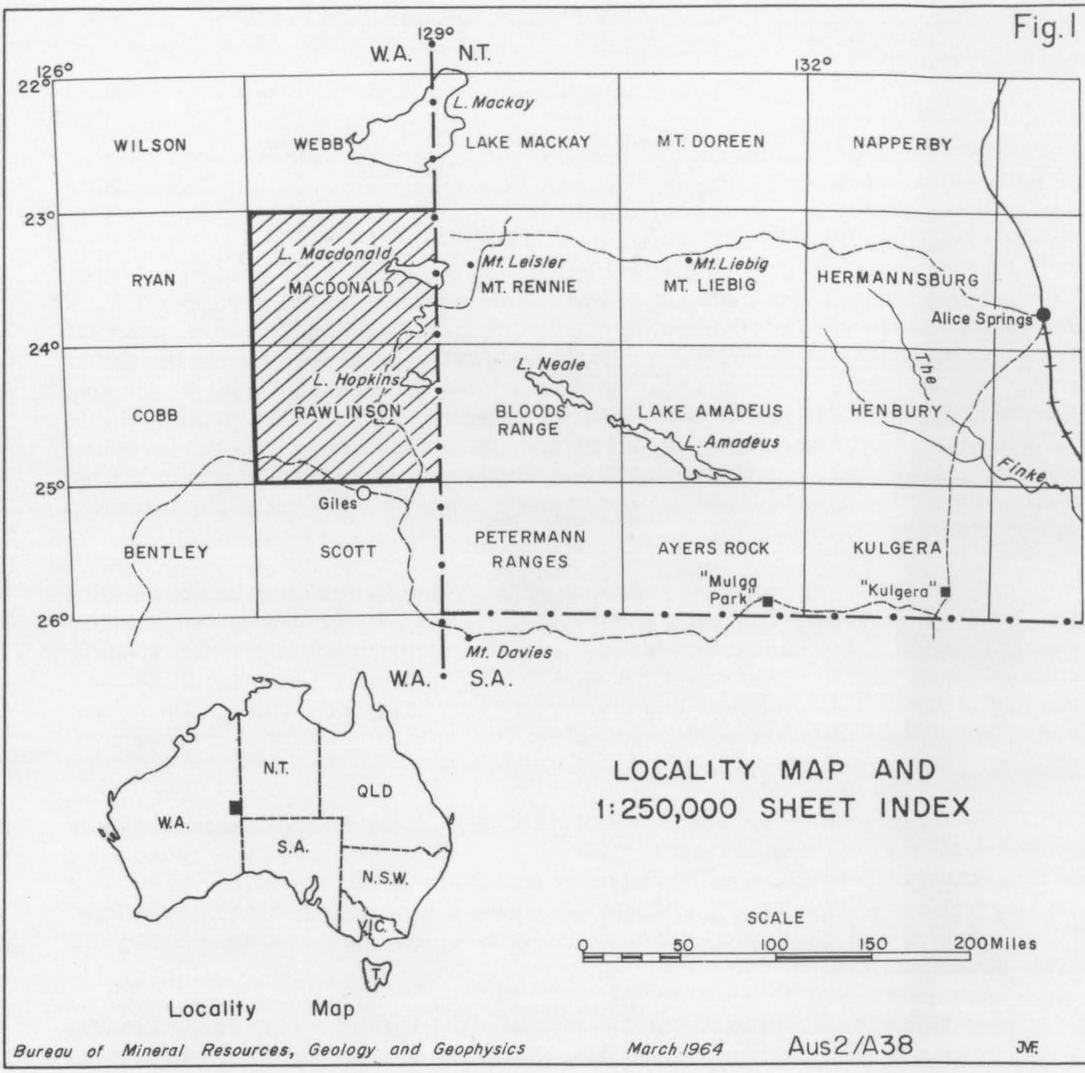


Fig. 1
129°
W.A.
N.T.
126°
22°
132°
23°
24°
25°
26°
L. Mackay
WILSON
WEBB
LAKE MACKAY
MT. DOREEN
NAPPERBY
RYAN
L. Macdonald
MACDONALD
Mt. Leisler
MT. RENNIE
Mt. Liebig
MT. LIEBIG
HERMANNSBURG
Alice Springs
COBB
L. Hopkins
RAWLINSON
L. Neale
BLOODS RANGE
LAKE AMADEUS
L. Amadeus
HENBURY
The Finke
Giles
BENTLEY
SCOTT
PETERMANN RANGES
AYERS ROCK
KULGERA
"Mulga Park"
"Kulgera"
Mt. Davies
W.A.
S.A.
N.T.
QLD
W.A.
S.A.
N.S.W.
VIC.
T.
Locality Map
LOCALITY MAP AND
1:250,000 SHEET INDEX
SCALE
0
50
100
150
200 Miles
Bureau of Mineral Resources, Geology and Geophysics
March 1964
Aus2/A38
JMF.

INTRODUCTION

In 1960 the Bureau of Mineral Resources mapped the Rawlinson and Macdonald 1:250,000 Sheet areas to trace the extension of the Palaeozoic rocks of the Amadeus Basin, and to determine the eastern limit of the Canning Basin.

The adjoining Sheets to the east of Rawlinson and Macdonald have been mapped subsequently, and eventually the whole of the Amadeus Basin will be mapped at a scale of 1:250,000.

In 1963, part of the south-eastern corner of the Rawlinson Sheet area was re-examined by D.J. Forman and P.M. Hancock.

Location and Access

The area lies in Western Australia between latitudes 23° and 25°S and longitudes 127°30' and 129°E (Fig. 1). The Giles Weather Station, which is operated jointly by the Bureau of Meteorology and the Weapons Research Establishment, lies a few miles south of the Rawlinson area and is the closest permanent settlement. A dirt road branches westwards from the Adelaide-Alice Springs highway ten miles south of Kulgera and leads for 400 miles to Giles via Mulga Park Station and Mount Davies. The total distance by road from Adelaide to Giles is 1300 miles, and from Alice Springs to Giles 570 miles.

Access to the northern part of the area is by a dirt road which branches north from the Mount Davies-Giles road 18 miles east of Giles. This road runs north to a point about five miles south of the Bonython Range and then east to Mount Liebig in the Northern Territory via Mount Leisler. At Mount Liebig it joins an older road which leads into Alice Springs. The road from Giles to Mount Leisler, which runs through the Rawlinson and Macdonald Sheet areas (Fig. 1), was constructed in 1960 and a branch road west from Mount Leisler to the Canning Stock Route was constructed later.

The Rawlinson and Macdonald Sheet areas lie within a Native Reserve, and permission to enter was given by the Native Welfare Department. The natives are nomadic, and although many smokes were seen very few natives were encountered away from the area around Giles.

Supplies are brought to Giles monthly by a Bristol Freighter from Adelaide, and weekly by a mail plane from Alice Springs. Some equipment comes by train to Finke and then by truck to Giles, a distance of 487 miles.

Climate

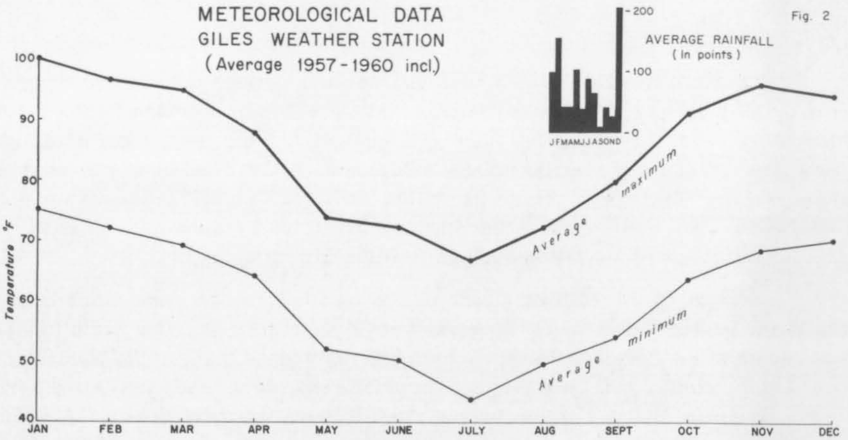
The average annual rainfall is about 9 inches, falling mostly during the summer months, although both distribution and amount are very variable. The maximum temperature is above 90°F during much of the summer, but the winters are pleasant, with an average maximum of approximately 70°F and an average minimum of between 45° and 50°F. Occasional frosts are experienced in June. Meteorological data for Giles have been provided by the Bureau of Meteorology and are plotted on Figure 2.

Flora

The area lies within the Eremean Province and Desert Formation of Gardner (1941) and is characterized by extreme aridity, absence of permanent surface water, high mean annual temperatures with an extreme diurnal range, and a paucity of vegetation. North of the Rawlinson Range and Schwerin Mural Crescent, sand dunes cover most of the area and the dominant vegetation is spinifex (Triodia) and desert oak (Casuarina decaisneana). The gibber plain between the high ranges in the south carries dense mulga (Acacia).

Development

The land is undeveloped except for a few bores, immediately south of the Pass of the Abencerrages, which provide water for the Giles Weather Station. The bore waters are potable and were used by the field party throughout the season. The graded dirt road which passes through the eastern side of the Sheet areas was constructed by the Weapons Research Establishment primarily to provide access for topographic mapping parties and other surveys.



Survey Method

As access was restricted and travelling very slow, the work was done by a series of reconnaissance traverses lasting usually between 6 and 11 days. Three base camps were established during the field season; the first at Giles, the second about five miles south of the Bonython Range, and the third a few miles north-east of the Robert Range.

The geology was plotted on to air-photographs (scale 1:40,000) and then transferred to uncontrolled 1-mile photomosaics of the MacDonald Sheet area, and controlled transparent overlays at photo-scale of the Rawlinson Sheet area; both these bases were prepared by the Western Australian Department of Lands and Surveys. The maps were reduced to 1:250,000 for publication.

Barometric heights were recorded at intervals during traverses and were corrected for diurnal variation. The datum point for these readings was Giles Weather Station, which lies 1990 feet above sea level.

Sections were measured, where outcrop permitted, by either tape or abney level, depending on the dip of the strata. Location of large-scale maps and columnar sections is shown in Figure 5.

Previous Investigations

Although many exploration and prospecting expeditions have described outcrops within the Rawlinson and Macdonald Sheet areas, no previous attempt has been made to map the units and determine their succession.

The explorer Ernest Giles (1889) passed through the southern part of the area just north of the Rawlinson Range in 1873. In 1889, W.H. Tietkins (1891) travelled from Alice Springs to the Western Australian border and then around Lake MacDonald. In 1897 D.W. Carnegie (1898) journeyed south along the Western Australian/Northern Territory border and then moved west immediately north of the Rawlinson Range. W.R. Murray prospected along the Western Australian/ Northern Territory border during an exploratory trip in 1901 (Murray, 1904), and R.T. Maurice prospected in the area during an exploratory trip in 1902 (Murray, op. cit.); only minor mineralization was found. In 1905, F.R. George and W.R. Murray (George, 1907) led a Government Prospecting Expedition into the south-western corner of the Northern Territory and described rocks exposed along the eastern margin of the Rawlinson Sheet area. In 1926 Basedow (1929) visited the Petermann Ranges and described the rocks and their relationships in that area. An aerial expedition led by D. Mackay (1934), and temporarily based on Docker Creek near the western end of the Petermann Ranges, surveyed the area in 1930. A prospecting expedition to the Petermann and Tomkinson Ranges was led by M. Terry (1931) in 1930. C. Chewings (1935) made the first attempt to correlate rocks from the Rawlinson area with the better-known succession to the east and north-east, and also proposed the concept of an Amadeus Sunkland. In 1936 H.A. Ellis (1937) accompanied an expedition searching for 'Lasseter's Reef' and penetrated as far as the Wallace Hills on the Rawlinson Sheet. In 1951 G.F. Joklik (1952) accompanied a similar expedition, which crossed the Western Australian border north of the Kathleen Range and then traversed around 'Mount Ant' and part of the Walter James Range. Frome-Broken Hill Co. Pty Ltd (Gillespie, 1959) made the first attempt to study the geology of the area in 1958. They measured about 12 sections and traversed the eastern half of the Rawlinson Sheet area and the south-eastern corner of the MacDonald Sheet area.

The results of geological investigations in the Canning Basin, to the north west of this area, are summarized by Veevers & Wells (1961).

PHYSIOGRAPHY

The Rawlinson and Macdonald areas are characterized by their senile landscape and internal drainage. Four main physiographic divisions have been recognized within the area (see Fig. 3): Sand plain with longitudinal dunes; low ranges and isolated hills; mountain ranges and hills; and salt lakes.

The sand plain with its long sinuous east-west sand dunes is most extensive in the western and north-western parts of the area. The dunes stand up to 60 feet above the level of the sand plain and are fixed by a sparse to fairly dense cover of spinifex and small shrubs. Drainage channels are few and poorly defined within this division. Much of the area may by underlain by Permian sediments, which in places protrude through the sand cover as low isolated hills and mounds.

The areas of outcrop of sediments of the Amadeus Basin and the Precambrian rocks of the northern margin of the Basin form low ranges and hills with intervening areas invariably of sand plain, which may or may not have longitudinal dunes. The sediments form strike ridges of hogbacks and cuestas as well as more rounded hills; the Permian sediments form mesas and buttes. Drainage is restricted to small creeks in the immediate vicinity of the ranges and hills.

The Upper Proterozoic Dean Quartzite and some of the undifferentiated Precambrian rocks of the southern half of the Rawlinson Sheet area form high ranges and mountains with intervening areas of both alluvial and red soil plains and sand plain (Pl. 1, Fig. 1). Braided

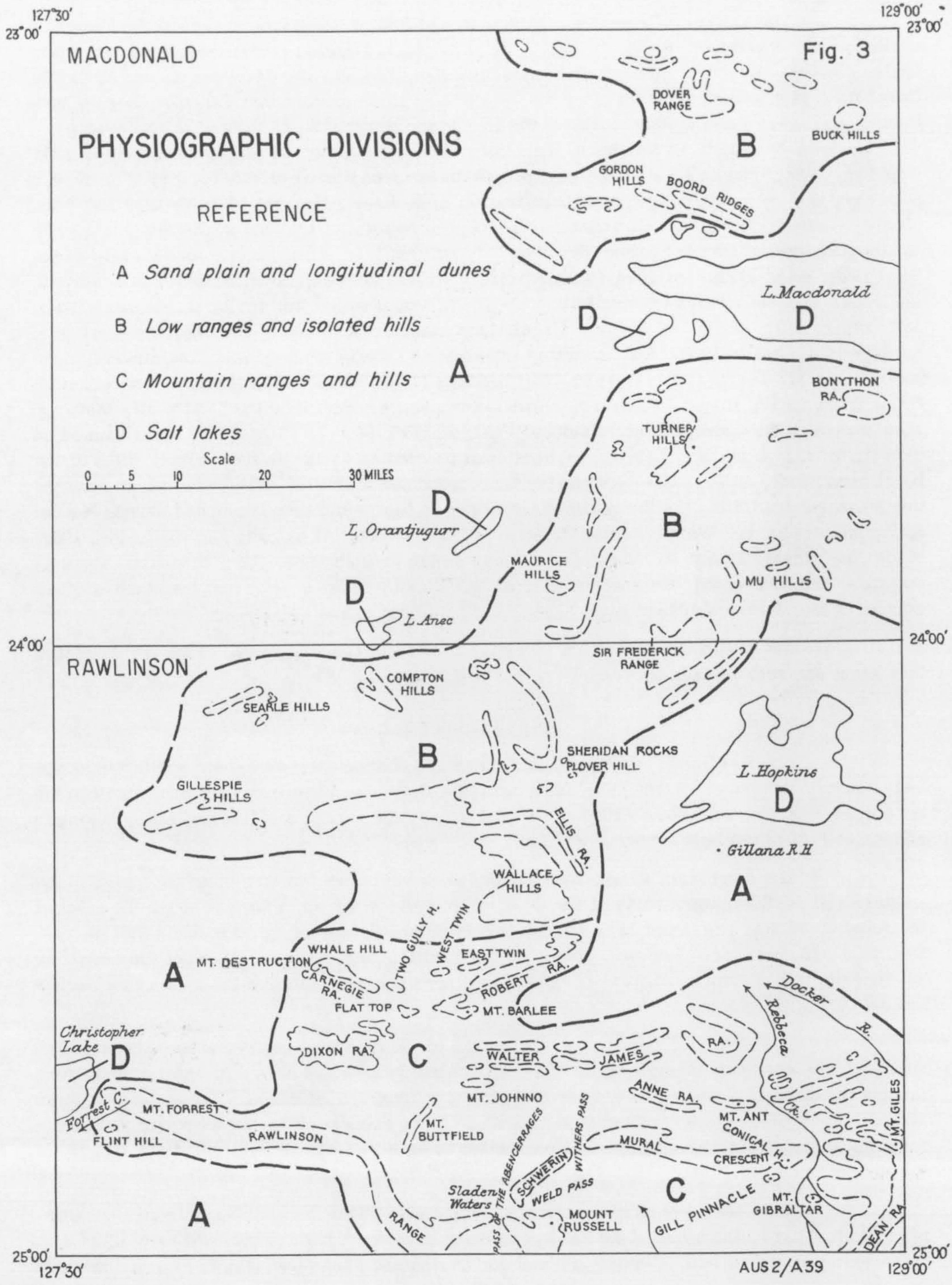

127°30'
23°00'
129°00'
23°00'
MACDONALD
Fig. 3
PHYSIOGRAPHIC DIVISIONS
REFERENCE
A Sand plain and longitudinal dunes
B Low ranges and isolated hills
C Mountain ranges and hills
D Salt lakes
Scale
0 5 10 20 30 MILES
DOVER RANGE
BUCK HILLS
GORDON HILLS
BOORD RIDGES
L. Macdonald
BONYTHON RA.
TURNER HILLS
L. Orantjugurr
MAURICE HILLS
MU HILLS
L. Anec
24°00'
24°00'
RAWLINSON
SIR FREDERICK RANGE
COMPTON HILLS
SEARLE HILLS
SHERIDAN ROCKS
PLOVER HILL
L. Hopkins
GILLESPIE HILLS
ELLIS RA.
Gillana R.H.
WALLACE HILLS
TWO GULLY H.
WEST TWIN
WHALE HILL
EAST TWIN
MT. DESTRUCTION
CARNEGIE RA.
ROBERT RA.
FLAT TOP
MT. BARLEE
Docker R.
Rebbeca
Christopher Lake
DIXON RA.
WALTER
JAMES
RA.
MT. JOHNNO
ANNE RA.
Forrest C.
MT. FORREST
FLINT HILL
RAWLINSON
MT. BUTTFIELD
PASS OF THE ABENCERRAGES
WITHERS PASS
MT. ANT
CONICAL H.
MURAL
CRESCENT
Cr.
MT. GILES
SCHWERIN
WELD PASS
Sladen Waters
MOUNT RUSSELL
GILL PINNACLE
MT. GIBRALTAR
RANGE
DEAN RA.
A
B
C
D
25°00'
127°30'
25°00'
129°00'
AUS 2/A39

TABLE 1 - STRATIGRAPHY OF THE RAWLINSON - MACDONALD AREA

AGE	FORMATION	MAP SYMBOL	MEASURED THICKNESS (feet) AND LOCALITY	PHOTO-INTER-PRETED THICKNESS (feet)	LITHOLOGY AND PALAEONTOLOGY	TOPOGRAPHY	CORRELATION AND REMARKS
QUATERNARY		Qs			Aeolian sand	Seif dunes and sand plain	
		Qa			Alluvium	Soil plain and scree slopes	
		Qt			Evaporites	Salt lakes	
		Ql			Travertine	Low rounded hills generally bordering salt lakes	
TERTIARY?		Tc	100		Conglomerate	Scree slopes	
PALAEOZOIC: PERMIAN	Undifferentiated	P		-	Sandstone and siltstone ?	-	Not visited in the field. Considered Permian, but formation not identified. Grant Formation, Braeside Tillite, Paterson Formation of Canning Basin (Veevers & Wells, 1961)
	BUCK FORMATION	Pb	137; (M18)	-	Poorly sorted coarse sandstone, conglomerate with tillitic texture, siltstone, striated and faceted erratics. Possible glacial pavement on contact with Heavitree Quartzite	Rarely mesas and buttes, mostly rounded low hills	
	? ANGULAR UNCONFORMITY						
	LIGERTWOOD BEDS	Pzl			Breccia, sandstone, conglomerate, and conglomeratic sandstone	Low hills	
	?		?	?			
	MEREENIE SANDSTONE	Pzm			Fine-grained quartz sandstone	Low ridge	
ORDOVICIAN		O	10; (M71)	-	Mottled pink and white calcarenite with pelecypods, gastropods, orthid and strophomenoid brachiopods, asaphid trilobites, echinoderm ossicles, and conodonts. Sandstone with 'pipe-rock'	Low mounds almost obscured by travertine and sand	Orthis leviensis beds, MacDonnell Range (Stokes Formation)
	UNCONFORMITY						
UPPER PROTEROZOIC – LOWER PALAEOZOIC	MAURICE FORMATION	Pza	757; (M57)	6300 Maurice Hills	Cross-bedded, quartz sandstone, quartz-greywacke, fine micaceous siltstone and sandstone. Abundant clay pellets; heavy mineral concentrations	Thick bedded sandstone forms strike ridges, otherwise poor outcrop	Tentatively correlated with Winnall Beds
	ELLIS SANDSTONE	Pze	1995; East of Gillespie Hills	1600 South-east of Maurice Hills	Kaolinitic quartz-sandstone, and minor interbedded calcareous sandstone and siltstone. Cross-bedded, clay pellets and few rounded quartzite pebbles. Heavy mineral concentrations	Sandstone forms strike ridges or prominent ranges	Lateral Equivalents
	SIR FREDERICK CONGLOMERATE	Pzs	1200; East of Gillespie Hills	-	Pebble, cobble and boulder conglomerate with phenoclasts mainly quartz sandstone with quartz-mica schist and quartzite, and kaolinitic sandstone matrix. Lenses of sandstone and pebbly sandstone	Forms prominent hills and ranges with characteristic rounded profiles and even slopes	
	? DISCONFORMITY						
UPPER PROTEROZOIC	CARNEGIE FORMATION	Puc	4123; East of Gillespie Hills	3950 South of Maurice Hills	Quartz-greywacke, sandstone, siltstone, and shale. Heavy mineral concentrations	Poor outcrops in low hills and in places forms beds of clay-pans	The Carnegie and Boord Formations are lateral equivalents, and are correlated with Areyonga Formation of Hermannsburg Area, and Inindia Beds of southern part of Amadeus Basin
	BOORD FORMATION	Puo	2794; Boord Ridges	-	Calcarenite, calcilutite, dolomite, limestone, dolomitic limestone, with interbedded siltstone. Abundant stromatolites. Pebble, cobble and boulder conglomerate with tillitic texture, breccia and sandstone near base	Poor outcrops on alluvial flats. Limestone forms low strike ridges	
	BITTER SPRINGS LIMESTONE	Pub	1200; West of Gordon Hills (M89)		Dolomite with chert bands and nodules. Minor limestone, calcilutite, and gypsiferous siltstone. Stromatolites	Low mounds and rarely ranges	
	HEAVITREE QUARTZITE	Puh	391; Dover Range	880 East of Dover Range	Quartz sandstone, shale, siltstone and some fine conglomerate. Basal pebble conglomerate	Strike ridges and ranges	Dean Quartzite) Macdonald Area Only
	DEAN QUARTZITE	Pud	?3911; Robert Range		Quartzite, sericitic quartzite, sandstone, sericitic-quartz schist, schistose sericite quartzite, and some conglomerate	High ranges	Heavitree Quartzite) Rawlinson Area Only
	ANGULAR UNCONFORMITY						
PRECAMBRIAN		pЄs			Quartz-feldspar porphyry, dacite and rhyolite, porphyritic microgranite, microgranodiorite, quartz diorite, siltstone, chert, conglomerate, low-grade metasediments		Macdonald Area Only
		pЄg			Granite and some aplite		
		pЄ			Gneiss, and quartzite, dolerite and quartz-feldspar-mica schist		
	DIXON RANGE BEDS	pЄd	?6730; Dixon Range		Quartz sandstone, micaceous siltstone, fine conglomerate, shale, arkose, arkosic sandstone, some quartz-mica schist and probable greywacke. Ripple-marked and cross-bedded	Low ranges and strike ridges	Rawlinson Area Only
		pЄ			Quartzite, quartz sandstone, quartz-sericite schist, quartz-feldspar-sericite schist, sericite-quartz schist, phyllite, sheared basalt, minor slate and chlorite schist	High ranges and prominent mounts	Probably equivalent to the Dixon Range Beds
		pЄp			Quartz-feldspar 'porphyry'	Poor outcrops on alluvial flats	

dunes are common on the sand plain in these areas. The ranges stand between 500 and 1200 feet above the sand plain, and approximately 3000 feet above sea level at their highest points (e.g. Mount Russel, Mount Sargood, Gill Pinnacle, and others).

The only drainage channels of any consequence are Docker Creek and Rebecca Creek, both lying in the south-eastern corner of the area and flowing north towards Lake Hopkins. Rebecca Creek has a gradient of about four feet per mile between the Schwerin Mural Crescent and the Anne Range. The ranges are strike-ridges and are skirted by fans of recent alluvium and boulder scree.

Lake Macdonald and Lake Hopkins are large salt lakes which are centres of internal drainage; they are about 1450 feet above sea level. The drainage is mostly subsurface, with very few small surface channels visible. At the time of our investigation the water-level in Lake Macdonald was approximately four inches below the surface, and the water-level on the western edge of Lake Hopkins was more than three feet below the surface. Other smaller salt lakes are Christopher Lake, Lake Orantjugurr, and Lake Anec.

Specimens of limestone found near the edge of Lake Hopkins, and the distribution and structure of rocks about Lake Macdonald, suggest that both lakes may be underlain, at least in part, by the Bitter Springs Limestone.

STRATIGRAPHY

The western end of the Amadeus Basin, as preserved in the Rawlinson and Macdonald Sheet areas, contains unfossiliferous carbonate rocks, sandstone, and siltstone. These rocks appear to be overlain by fossiliferous Ordovician outliers, and on the basis of stratigraphical position and lithological correlation they are tentatively regarded as Upper Proterozoic; but they may extend into the Palaeozoic. They occur between older Precambrian rocks with infolded masses of Upper Proterozoic rocks in the southern half of the Rawlinson Sheet area, and the undifferentiated Precambrian rocks in the north-eastern corner of the Macdonald Sheet area. Thin Permian continental glacial deposits, which are marginal to the marine sediments of the Canning Basin, crop out on the western side of the area. The stratigraphy is summarized in Table 1, and the relationships of the various formations in Figure 4. The locations of the measured sections on Plates 3, 4, 5, and 6 are shown in Figure 5.

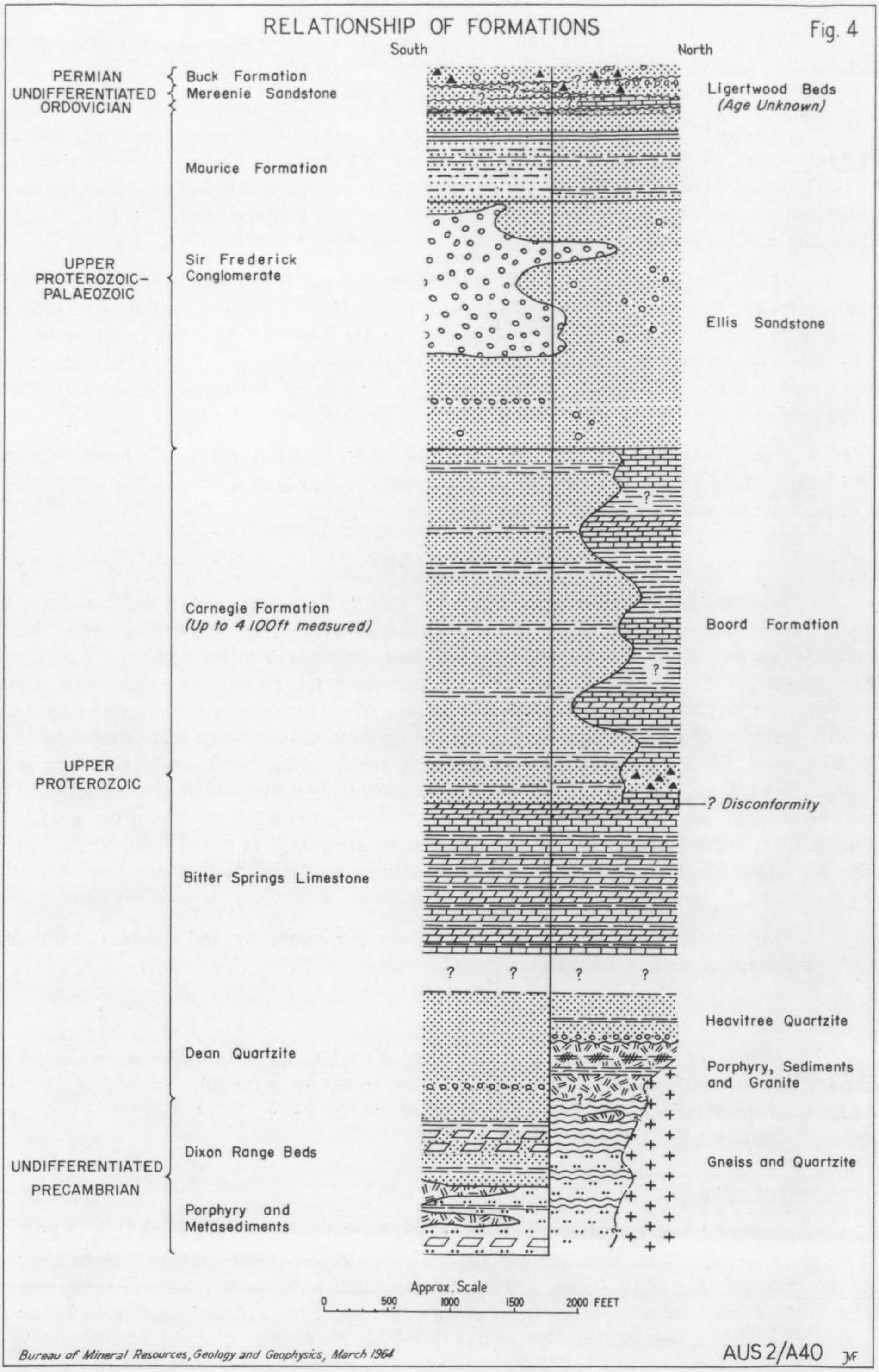
All new formation names have been approved by the Western Australian Stratigraphic Nomenclature Committee.

PRECAMBRIAN

Precambrian basement rocks crop out north and south of the western part of the Amadeus Basin in two widely separated areas, one in the north-eastern corner of the Macdonald Sheet area and the other in the southern half of the Rawlinson Sheet area. The two areas are described separately.

Macdonald Sheet Area

Foliated and massive porphyry, fine-grained igneous rock (including dacite and rhyolite), dolerite, quartzite, foliated gneiss, granite, and low-grade metasediments crop out in the north-east Macdonald area. The relationships between the various rocks are not visible; consequently they have not been subdivided into Lower Proterozoic and Archaean. They are all overlain unconformably by the Heavitree Quartzite of Upper Proterozoic age.


RELATIONSHIP OF FORMATIONS
Fig. 4
South
North
PERMIAN
UNDIFFERENTIATED
ORDOVICIAN
Buck Formation
Mereenie Sandstone
Ligertwood Beds
(Age Unknown)
Maurice Formation
UPPER
PROTEROZOIC–
PALAEOZOIC
Sir Frederick
Conglomerate
Ellis Sandstone
Carnegie Formation
(Up to 4 100ft measured)
Boord Formation
UPPER
PROTEROZOIC
? Disconformity
Bitter Springs Limestone
Heavitree Quartzite
Dean Quartzite
Porphyry, Sediments
and Granite
Dixon Range Beds
Gneiss and Quartzite
UNDIFFERENTIATED
PRECAMBRIAN
Porphyry and
Metasediments
Approx. Scale
0 500 1000 1500 2000 FEET
Bureau of Mineral Resources, Geology and Geophysics, March 1964
AUS 2/A40

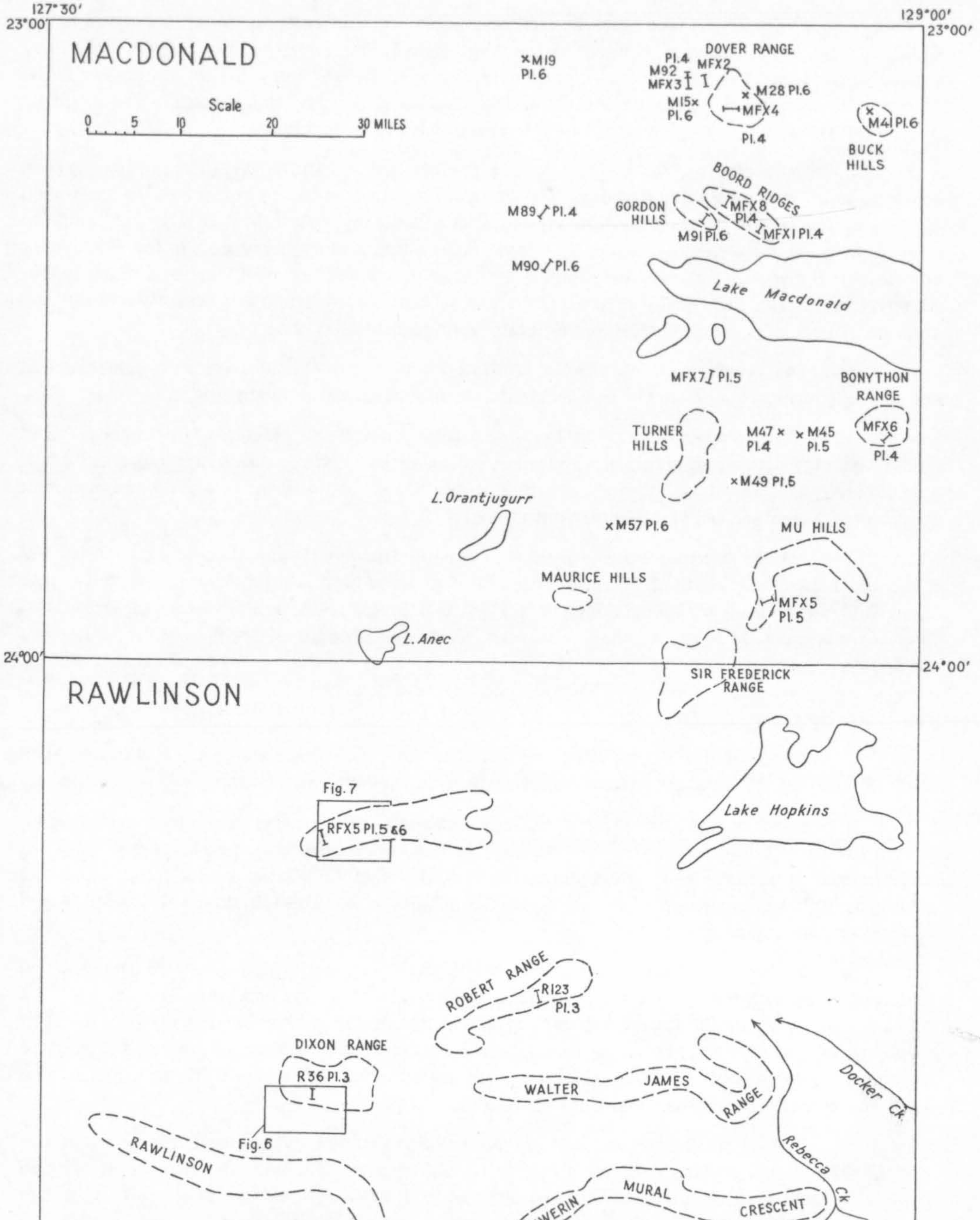


Figure 5. Location of large scale maps and columnar sections

Foliated granitic gneiss, quartzite, granite, and aplite crop out about ten miles south of the north-eastern corner of the Macdonald area, north-east of Buck Hills. They appear to be separated from an outcrop of metasediments by an inferred east - trending fault. At M42 the foliation in the gneiss strikes 270°-285° and dips 70° to the south. The foliation trends can be seen on air-photographs even where outcrop is lacking.

Granodiorite, microgranite, and granite are associated with the granitic gneiss and quartzite, and may intrude them. The metasediments north-east of Buck Hills have been altered by low-grade regional metamorphism from, probably, siltstone and silty sandstone to grey fine to medium-grained sericitic quartz schist with a slaty cleavage. In the Buck Hills and Dover Range similar metasediments are associated with igneous rocks of many types; porphyritic dacite and rhyolite are predominant, but porphyritic microgranite and microgranodiorite, quartz diorite, albitized dolerite, and granite also occur.

The porphyritic rhyolite is a foliated brown or pinkish-brown fine-grained rock containing phenocrysts of quartz and feldspar. At M30 it contains fresh pyrite.

The porphyritic dacite is hard, grey, and fine-grained, with phenocrysts of bluish quartz, white plagioclase, and grey microcline, and contains black aggregates of hornblende and biotite. At many localities it is foliated and altered to a grey and greenish grey medium-grained quartz-feldspar-mica schist.

A light pinkish brown coarse even-grained muscovite granite crops out as tors at M33, and half a mile south of M21 a coarse even-grained biotite granite is associated with a black and white feldspar-quartz-biotite schist, and is overlain by the Heavitree Quartzite. Granite crops out at M39, together with vein quartz and pegmatite, but the relationships are not known.

Rawlinson Sheet Area

Precambrian rocks crop out beneath the Dean Quartzite in the Rawlinson area south of Latitude 24°30'S and extend southwards on to the Scott Sheet area.

South of the Schwerin Mural Crescent and the Rawlinson Range they are sheared brown and grey feldspar 'porphyry', sheared basalt, slate, phyllite, quartz-sericite schist, sericite-quartz schist, and quartz-feldspar-sericite schist. These rocks form the slope leading up to the escarpment of the overlying Dean Quartzite. Their mutual relationships and thicknesses are unknown.

South of the Pass of Abencerrages in the Rawlinson Range a body of fine-grained schistose rock with medium and coarse-grained crystals of quartz and feldspar crops out. It is not certain whether the larger crystals of quartz and feldspar are phenocrysts in a sheared porphyry or porphyroblasts in a fine-grained schist. Other bodies of rock of porphyritic aspect occur south of Gill Pinnacle in the Schwerin Mural Crescent. These appear to be conformable with the enclosing schists and slate.

It is not known whether these 'porphyries' are of metasomatic or magmatic origin. The 'porphyry' is foliated, grey or brown, and fine-grained, and contains scattered medium to coarse-grained crystals of quartz and albite. Quartz veins and narrow pegmatite veins intrude it. Under the microscope phenocrysts or porphyroblasts of quartz, albite, and in some places microcline are visible. The feldspars are pink or white, and are up to 1.2 centimetres in length. The quartz is pale blue and is up to 0.3 centimetre in diameter. The groundmass consists typically of a fine-grained schistose aggregate of quartz, biotite, sericite, iron oxide, and epidote in variable proportions.

These sedimentary and metamorphic rocks lie apparently conformably beneath the Dean Quartzite. In the Dixon Range and south of the Walter James Range the little altered sediments of the Dixon Range Beds crop out, with no visible unconformity, beneath the Dean Quartzite.

Dixon Range Beds

Dixon Range Beds is the name given to the sequence of sandstone, siltstone, shale, arkose, some quartz-mica schist, and fine conglomerate which crops out in the Dixon Range and south of the Walter James Range. The base of the beds is not exposed, but they are considered to be older than the Dean Quartzite because sediments of the Dixon Range Beds crop out a short distance south of the Walter James Range (Dean Quartzite) and dip north beneath it; and in the Robert Range and some of the hills to the north (localities R125, R126) the Dixon Range Beds appear to be conformable beneath the Dean Quartzite.

About 6700 feet of sediments of the Dixon Range Beds crop out in a west-plunging syncline in the Dixon Range (Fig. 6 and Pl. 3). The measured section is incomplete and crosses an inferred fault; so part of the section may be repeated. The sediments in the Dixon Range are dominantly sandstone, with interbedded micaceous siltstone and varying amounts of coarse arkosic sandstone, arkose, shale, pebble conglomerate, and probable greywacke. Cross-stratification and both current and wave ripple marks are common. The many large scree-filled strike valleys in the Range obscure a great deal of the outcrop.

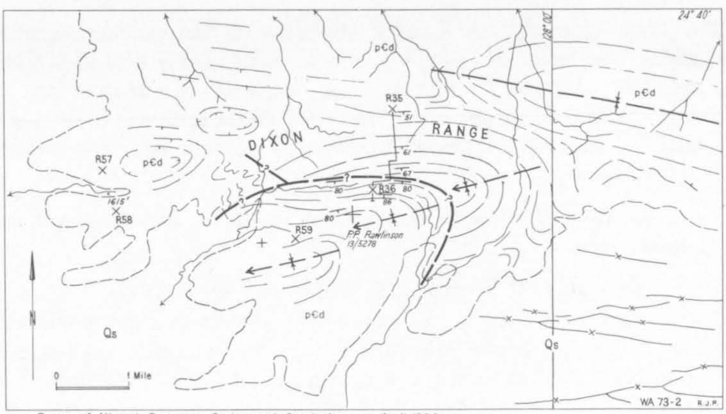


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Fig. 6 Dixon Range Beds (pЄd), DIXON RANGE

The sandstone is pale yellow, pale yellow-brown, pale grey, pale purple, and purple. The clastic material is poorly sorted and subrounded or subangular. The coarse sandstone and fine conglomerate contain quartz, feldspar, and rock fragments. The arkose is pale purple, yellow-brown, or pink. It ranges from medium-grained arkose to pebbly arkose containing subrounded to angular grains of microcline up to three quarters of an inch in length.

Immediately to the south of the Walter James Range the Dixon Range Beds crop out as a sequence of fine sandstone, siltstone, shale, and arkose. These rocks are better sorted and finer-grained than those in the Dixon Range. The sandstone contains a considerable amount of pyrite. Current and wave marks are very common.

The effects of low-grade metamorphism are obvious in several places. A recrystallization lineation was measured trending at 207^{o}, and a vertical fracture lineation at 155^{o}. The sequence is intruded by quartz veins.

UPPER PROTEROZOIC

A sequence of sandstone, limestone, dolomite, and siltstone crops out at the base of the Upper Proterozoic succession in the western Amadeus Basin. No fossils other than stromatolites have been discovered in these sediments, but the basal units can be traced in discontinuous outcrops from the Macdonald Sheet area across the Mount Rennie and Mount Liebig Sheet areas (Wells et al., 1965) to Ellery Creek in the western MacDonnell Ranges. They are therefore identified with the Heavitree Quartzite and Bitter Springs Limestone.

The overlying Boord Formation and its lateral equivalent in part, the Carnegie Formation, cannot be traced in a similar manner, but by lithological similarity they are correlated with the Areyonga Formation of the MacDonnell Ranges area (Prichard & Quinlan, 1962).

In the southern half of the Rawlinson Sheet area the Dean Quartzite overlies older Precambrian rocks and is overlain by calcareous rocks and fine clastics which may be equivalent to the Bitter Springs Limestone. This relationship has been demonstrated more clearly in the Bloods Range Sheet area, and the Dean Quartzite is correlated with the Heavitree Quartzite (Forman, 1965).

Dean Quartzite (Forman, 1965)

The Dean Quartzite is a thick sequence of fine to coarse-grained quartzite, sandstone, and minor conglomerate, and in places sericitic quartz schist, schistose sericitic quartzite, and sericitic quartzite, which overlies Precambrian metamorphic rocks and the Dixon Range Beds. Siltstone, shale, slate, and calcareous siltstone overlying the unit may belong to the base of the Bitter Springs Limestone, but were not differentiated during the mapping.

The Dean Quartzite forms the prominent hills and ranges on the southern half of the Rawlinson Sheet area.

About 3900 feet of section was measured in the Robert Range (Pl. 3). The dominant lithology is fine and medium, coarse and very coarse-grained, moderately to poorly sorted, pebbly, cross-bedded, partly silicified and partly kaolinitic sandstone. The colour varies from white to fawn, pinkish brown, red-brown and purplish black, depending largely on the nature of the matrix or cement (e.g., kaolinitic, siliceous, ferruginous). The thickness of cross-bedded units averages about 18 inches. Current ripple marks are dominant on the finer-grained and better-sorted material, but wave ripples are also preserved. Clay pellets are found in large numbers in some beds, but are not a general feature of the sequence.

Conglomerate occurs in the Anne Range at R78 and R79; it is interbedded with sandstone at the base of the unit and forms lenses about ten feet thick. The fragments are up to eight inches across but average only about half an inch. The smaller fragments are angular, whereas the larger cobbles are rounded. The cobbles are predominantly quartzite, vein quartz, siltstone, and chert. There is some cross-stratification in the matrix of the conglomerate and the interbedded sandstone.

The degree of metamorphism in the formation is variable; the rocks range from dense foliated and lineated quartzite and sericitic quartzite to friable sandstone. Typically the

Dean Quartzite is more highly metamorphosed in the Rawlinson Range, Schwerin Mural Crescent, and Dean Range than in the Robert Range and Walter James Range, where it is almost unaltered.

Sections RFX1, RFX2, RFX3 and RFX4 (Pl. 3) show the metamorphic rock-types exposed in the Dean and Rawlinson Ranges. Thicknesses given do not show the true thickness of the formation at these localities, because it is probably repeated by folding.

The Dean Quartzite is correlated with the Heavitree Quartzite of the northern margin of the Amadeus Basin.

Heavitree Quartzite

The Heavitree Quartzite is defined by Joklik (1955), and the type locality is inferred to be Heavitree Gap. The unit has been mapped across the Hermannsburg, Mount Liebig, and Mount Rennie Sheet areas to the Macdonald Sheet area. It crops out in the north-eastern quarter of the Macdonald Sheet area as cuestas, mesas, and hogbacks.

In the MacDonnell Ranges and in the type area at Heavitree Gap it is evident that the original rocks were quartz sandstone and silty sandstone which have since been cemented and silicified to quartzite. In the Macdonald Sheet area the formation is not so intensely indurated, although some superficial silicification is evident.

In the Dover Range the formation unconformably overlies weathered Precambrian quartz-feldspar porphyry. Between the Dover Range and Mount Webb (in the Webb Sheet area), the unmetamorphosed Heavitree Quartzite overlies foliated quartz-feldspar porphyry, granite, and biotite schist. The foliation in the schist and quartz-feldspar porphyry is not parallel to the bedding in the Heavitree Quartzite.

The sandstone is typically white, grey, or pale brown. Near the base it is very coarse to medium-grained, cross-bedded in part, poorly sorted, subangular, and silicified. Higher in the sequence it is ripple-marked in part and is typically medium-grained, moderately sorted, subrounded, and silicified. About 270 feet above the base there is a distinctive ten-foot section, of grey medium-grained sandstone, moderately sorted, with subrounded grains, and laminated, platy, and silicified. Siltstone is interbedded with it.

Three sections have been measured (Pl. 4), in each of which the top of the Heavitree Quartzite is concealed by superficial deposits. Sandstone and siltstone, about 390 feet thick, crop out in the Dover Range and in the ridges to the north-west. The contact with the Bitter Springs Limestone is concealed except for some rubble, probably derived from ferruginous siltstone at the base of the Bitter Springs Limestone.

When struck with a hammer many specimens of Heavitree Quartzite give off a foetid smell.

Bitter Springs Limestone

The name Bitter Springs Limestone (Joklik, 1955) is used for a tightly folded sequence of interbedded dolomitic and calcareous rocks, siltstone, and gypsiferous siltstone which overlies the Heavitree Quartzite and is overlain by the Carnegie Formation, apparently conformably, and the Boord Formation; the contact with the Boord Formation has not been seen.

The formation crops out as low mounds and hills over the eastern halves of the Macdonald and Rawlinson Sheet areas as far south as the ranges north of the Wallace Hills. Lakes Macdonald and Hopkins may have formed in part over the Bitter Springs Limestone.

The rocks are dominantly laminated fine-grained - rarely medium-grained (0.25mm -1mm) - hard flaggy non-porous crystalline dolomite, crystalline limestone, calcilutite, dololutite, and dolarenite. The carbonates show a wide range of colours, but are typically grey or brown or interlaminated grey and brown. Oolites are common in the dolarenite and calcarenite. Stromatolites with a cylindrical form and with laminae convex upwards form biostromes in some beds (Pl. 1, Fig. 2). Secondary silicification of the limestone and dolomite is widespread and has produced lenses, beds, and laminae of chert, silicified dolomite, and silicified limestone. The dolomite and limestone, particularly the dark grey or black varieties, give off a foetid odour when cracked open. The interbedded siltstone is rarely exposed. It crops out typically as a fine white or yellow silt which contains calcium and sodium sulphates. Gypsum is the most abundant mineral. Field work in the Mount Rennie Sheet area (Wells et al., 1965) has shown the presence of diapiric structures caused by the intrusion of masses of gypsum, and possibly other evaporites at depth, derived from the Bitter Springs Limestone.

Isoclinal folding and poor exposure make it impossible to measure the total thickness of the Bitter Springs Limestone. A section 800 feet thick was measured in the Bonython Range (MFX6, Pl. 4); it contains a higher proportion of silty dolomite and siltstone beds than MFX3 (800 feet), which was measured in dolomite overlying the Heavitree Quartzite. Neither MFX6 nor MFX3 can be compared closely with the section at M89, where 1200 feet of section was measured (Pl. 4).

Boord Formation (new name)

The Boord Formation is defined as a sequence of calcilutite, calcarenite, dolomitic limestone, sandstone, and siltstone, with boulder beds of possible glacial origin near the base of the formation. The type section of the formation is MFX1 at Boord Ridges. No contacts with underlying or overlying units were seen. Because the boulder beds contain boulders of Bitter Springs Limestone and Heavitree Quartzite in addition to basement rocks, a disconformity is inferred between the Boord Formation and the underlying Bitter Springs Limestone. The contact with the overlying Ellis Sandstone is concealed. Twelve miles west of the Bonython Range, at M47, there is some evidence of interfingering of the Boord Formation with the Carnegie Formation, and from this evidence and their similar stratigraphical position, the two formations are inferred to be lateral equivalents.

Exposures of the formation are poor. It crops out at Boord Ridges, Gordon Hills, 8 miles west of Gordon Hills, and 12 miles west of the Bonython Range. Sections were measured at MFX1 (2800 feet) and MFX8 (475 feet) in the Boord Ridges and at M47 (1430 feet), 12 miles west of the Bonython Range. Columnar sections are shown in Plate 4. None of these sections can be accurately measured because of the few and poorly defined dips.

At Boord Ridges the limestone and dolomitic limestone were exposed in widely spaced low ridges separated by areas of alluvium. Small fragments of siltstone and shale occur on the alluvium, and may indicate thick sections of these sediments interbedded with the carbonate rocks.

The exposed base of the Boord Formation at Boord Ridges and north of the Gordon Hills is a persistent horizon of angular debris of chert, ferruginous material, and limestone, in long low mounds which parallel the bedding trend in the formation. No solid outcrop is present where this debris occurs, but it can be traced for several miles on the air-photographs, and is presumably derived from a sedimentary breccia. To the west of the Gordon Hills sandstone crops out above it. Better exposures are present farther west near M69, where a bed of pale brown well-sorted medium-grained thin and medium-bedded sandstone grades upwards into coarse poorly sorted and bedded sandstone which contains subangular pebbles and grains. Near the top of this exposed section, chocolate siltstone is interbedded with the sandstone. The breccia and possibly some non-outcropping sandstone occur stratigraphically a few feet below the sections MFX1 and MFX8.

MFX8 (Pl. 4) is a section across the best exposure of the pebble, cobble, and boulder conglomerate beds with tillitic texture, which are 250 feet thick. The conglomerate contains rounded to angular pebbles, cobbles, and boulders up to eight feet across of algal limestone, sandy limestone, dolomite, fine conglomerate, chert, quartz sandstone, quartzite, jasper, vein quartz, schist, and quartz-feldspar porphyry. Many of the phenoclasts are faceted and a few are striated, and may be glacial. The matrix is a yellow-green medium-grained friable moderately sorted and subangular sandstone. The conglomerate beds are underlain and interbedded with medium-grained kaolinitic and calcareous sandstone, and overlain by thin-bedded red fine-grained laminated limestone.

MFX1 (Pl. 4) is a section through the basal breccia horizon and a considerable thickness of concealed rock, into the limestone sequence which occurs in the top half of the Boord Formation. Here the calcilutite is blue, grey, and dark grey to yellow and pink, laminated or thin-bedded, and in some places undulate-bedded. The freshly broken rock is commonly foetid. Some of the limestone contains stromatolites of algal origin. Silicification has produced nodules, laminae, and irregular bodies of chert. Where an oolitic limestone has been silicified, the oolites are preserved as rounded bodies of chert cemented by radiating spherulitic silica. The top limestone ridge at Boord Ridges is a pisolitic blue-grey calcarenite.

At M47 the Boord Formation is underlain by a tongue of Carnegie Formation at least 360 feet thick: the basal breccia, sandstone, and boulder bed sequence appears to be missing. Stylolites were found in one medium-grained limestone in the section. In some places where calcarenite has been deposited on calcilutite small angular pieces of calcilutite have been incorporated in the overlying beds.

The angular debris in mounds at the base of the Boord Formation may be derived from an intraformational breccia, and indicates some erosion of the Bitter Springs Limestone before deposition of the Boord Formation. There is no evidence of an angular discordance between the two formations. Evidence of interfingering of the Boord Formation and the Carnegie Formation occurs at M47, south-west of Lake Macdonald: outcrops are poor, but the beds of stromatolitic limestone can be traced laterally into beds of friable sandstone and siltstone of the Carnegie Formation.

Carnegie Formation (new name)

The Carnegie Formation is defined as the sequence of sandstone, quartz greywacke, and siltstone and minor shale which rests apparently conformably on the Bitter Springs Limestone, underlies the Ellis Sandstone and Sir Frederick Conglomerate, and interfingers with the Boord Formation. The name is taken from the Carnegie Range. Incomplete sections were measured at RFX5 (4123 feet) in the range north of the Wallace Hills, and at MFX7 (657 feet), MFX5 (2052 feet), M45 (366 feet), and M49 (490 feet) in the Macdonald Sheet area. All these sections are shown on Plate 5.

Most of the outcrop is poor and occurs on low strike-ridges and low rubble-covered hills. In several places the Carnegie Formation underlies claypans on which lines of quartz greywacke and sandstone rubble indicate the strike of the beds. Outcrops occur between the Turner Hills and the Bonython Range, in the Mu Hills, and from the Maurice Hills south to the Ellis Range. The southernmost outcrop is a low ridge east of the Ellis Range.

The quartz greywacke and sandstone are typically purple-brown, thin to medium-bedded, moderately sorted with subrounded grains. Clay pellets, ripple marks, and cross-bedding are common throughout the section. Average grainsize ranges from 0.1 mm to 0.5mm (very fine to medium). The arenites contain 2 percent to 20 percent of rock fragments of quartzite, chert, and fine sericitic quartzite. A very fine arenite from M73 is composed of about 50 percent subrounded quartz and 50 percent granular calcite together with rare quartzite and muscovite grains. A medium-grained arenite from M63 is also calcareous and contains 10 percent rock fragments (chert, quartzite), and about 70 percent quartz grains in a matrix of calcite. Most of the sediments contain very little matrix. Rare rock fragments (less than 5 mm across) and some muscovite flakes are present in some of the coarser cross-bedded quartz greywacke. The siltstone is typically purple-brown or chocolate-brown, laminated, and finely micaceous. In many places it contains gypsum.

North of the Turner Hills, near M63, the sediments are slightly different, and consist of poorly bedded sandstone, laminated siltstone, fine-grained laminated siliceous sandstone, and a few thin beds of fine conglomerate.

Near Plover Hill and in the unnamed range north of Wallace Hills the top of the Carnegie Formation is composed of interbedded white sandstone and siltstone, unlike the formation farther north (see Section RFX5, Pl. 5). The attitude of the cross-beds in the ranges north of the Wallace Hills indicates that the direction of currents was from the west or west-south-west.

The Carnegie Formation is correlated with the Upper Proterozoic Inindia Beds (Ranford et al., 1965) and Areyonga Formation (Prichard & Quinlan, 1962).

UPPER PROTEROZOIC OR LOWER PALAEOZOIC

The Maurice Formation, the Ellis Sandstone, and its lateral equivalent the Sir Frederick Conglomerate, were laid down in the interval between the deposition of the (Upper Proterozoic) Carnegie Formation and the Ordovician outliers. By their similar stratigraphical position they are tentatively correlated with the Winnall Beds which have been mapped to the east of the Rawlinson Sheet area in the southern part of the Amadeus Basin. The Winnall Beds unconformably overlie the Inindia Beds and are unconformably overlain by Cambrian and Ordovician sediments.

Sir Frederick Conglomerate (new name)

The name Sir Frederick Conglomerate is introduced for a sequence of pebble, cobble, and boulder conglomerate with a kaolinitic sandstone matrix and thin beds and lenses of sandstone and pebbly sandstone. The formation is conformably overlain by the Maurice Formation and presumably unconformably overlies the Carnegie Formation; it lenses laterally into the Ellis Sandstone (Fig. 7).

The Sir Frederick Conglomerate crops out in the south-eastern corner of the Macdonald Sheet area in the Sir Frederick Range (Pl. 2, Fig. 1) and Mu Hills, and in the northern part of the Rawlinson area in the ranges north of the Wallace Hills, in the Gillespie Hills, Searle Hills, and as low mounds to the north of the Robert Range.

The only section through the formation was measured in the range east of the Gillespie Hills at RFX5 (Pl. 6). Possibly the greatest exposed thickness of conglomerate is in the Sir Frederick Range, but no section could be measured for lack of dip information. North of the Sir Frederick Range the massive conglomerate interfingers with, and grades into, the sandstone and pebbly sandstone of the Ellis Sandstone, and here the combined thickness of the two units is estimated (by air-photo interpretation) to be at least 7000 feet. From north-east of the Sir Frederick Range to the area of the Mu Hills, the Sir Frederick Conglomerate lies immediately above the Carnegie Formation and no Ellis Sandstone is exposed.

The dominant rock is a moderately to poorly sorted conglomerate with subrounded to well-rounded ellipsoidal pebbles, cobbles, and boulders (Pl. 2, Fig. 2) set in a white sandstone matrix. The rock is very friable and dips are difficult to obtain owing to the rubble lying on the surface. The boulders measure up to 42 inches in length and are composed predominantly of silicified sandstone and metaquartzite, with smaller quantities of vein quartz and quartz-mica schist. All these rock types are represented in the Upper Proterozoic and metamorphic Precambrian rocks to the south.

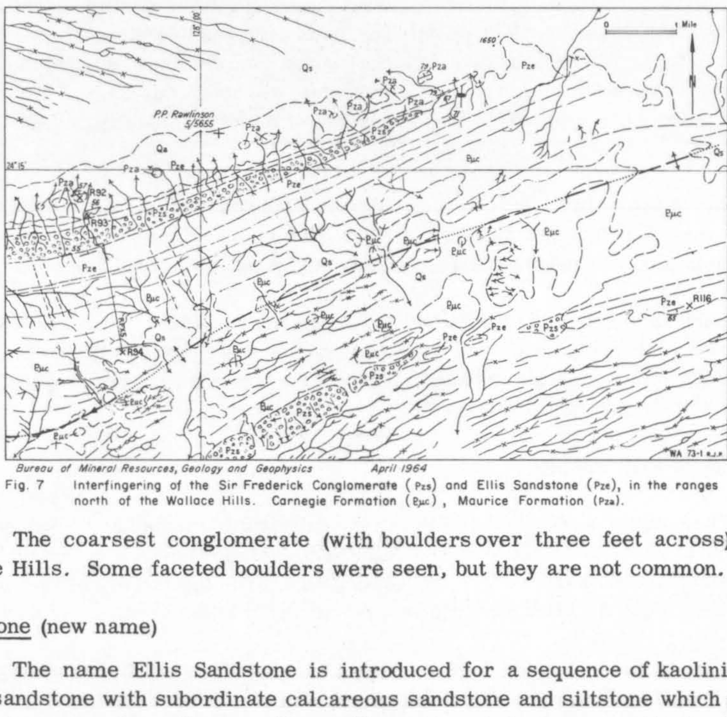

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Fig. 7 Interfingering of the Sir Frederick Conglomerate (Pzs) and Ellis Sandstone (Pze), in the ranges north of the Wallace Hills. Carnegie Formation (Ꞓμc), Maurice Formation (Pza).

The coarsest conglomerate (with boulders over three feet across) crops out in the Gillespie Hills. Some faceted boulders were seen, but they are not common.

Ellis Sandstone (new name)

The name Ellis Sandstone is introduced for a sequence of kaolinitic sandstone and pebbly sandstone with subordinate calcareous sandstone and siltstone which probably lies above the Carnegie Formation or Boord Formation, interfingers with the Sir Frederick Conglomerate, and is conformably overlain by the Maurice Formation. The contact between the Ellis Sandstone and the Boord Formation is not exposed; the relationship between the Ellis Sandstone and Sir Frederick Conglomerate is shown in Figure 7.

Sections were measured at RFX5 in the ranges east of the Gillespie Hills, at M91 in the Gordon Hills, and at M90 approximately 12 miles west-south-west of the Gordon

Hills; they are shown in Plate 6. The maximum thickness measured was about 2000 feet north of the Wallace Hills.

The Ellis Sandstone crops out in the northern half of the Rawlinson Sheet area and over most of the Macdonald Sheet area as low hills and long sinuous strike-ridges. The main outcrops are in the Turner Hills, the ranges north of the Wallace Hills, the Ellis Range, the Gordon Hills, the Compton Hills, and Plover Hill. The most northerly outcrop is in the Gordon Hills.

The predominant rock type is a white laminated or thin-bedded medium-grained sandstone, cross-laminated and cross-bedded, moderately to well sorted, with clay pellets scattered irregularly throughout. Pale brown, purple-brown, and red-brown varieties are found at some localities. The sandstone is a kaolinitic quartz sandstone with well rounded grains and very little fine-grained matrix. The grain-size varies between 0.14 mm and 0.28 mm. Chert and metaquartzite make up between 6 percent and 15 percent of the rock. Tourmaline occurs as rare rounded grains. Authigenic growth of the quartz grains has resulted in sutured contacts and tends to disguise the roundness of the grains.

Cross-bedding is common; the sets have an average thickness of about 18 inches. Interpretation of the cross-beds in the Carnegie Range suggests currents from the west and south-west. Current lineation is a prominent feature on bedding planes in many exposures of the Ellis Sandstone. Current and wave ripple marks, current crescents, slump structures, and scour-and-fill structures were seen in various outcrops, but none of these features is characteristic of the formation. Thin laminae of heavy minerals, mostly hematite, were seen in several places.

At Plover Hill and in the Turner Hills, though not in any of the measured sections, the sequence includes 30 feet of light grey massive calcareous sandstone. Some rare beds of laminated micaceous siltstone also occur in the Ellis Sandstone.

Pebbles scattered irregularly throughout the Ellis Sandstone are common in the outcrops in the southern half of the Macdonald area and the Rawlinson area. North of the Sir Frederick Range and at the western end of the Carnegie Range the pebbly sandstone grades into the Sir Frederick Conglomerate.

Maurice Formation (new name)

The name Maurice Formation is introduced for the sequence of sandstone, quartz greywacke, fine micaceous sandstone, and micaceous siltstone which conformably overlies the Ellis Sandstone and the Sir Frederick Conglomerate. The top of the Formation is eroded. The name is taken from the Maurice Hills in the Macdonald Sheet area.

The thickest measured section is 757 feet at M57 (Pl. 6), but photo-interpreted thicknesses of the formation are of the order of 6000 feet near the Maurice Hills.

The Maurice Formation crops out in mesas, ranges, and hills in the northern half of the Rawlinson Sheet area; farther north in the Macdonald Sheet area outcrops are poor, except on a few low ridges. The quartz greywacke and the sandstone are more resistant to erosion than the micaceous sandstone and siltstone. No complete section is exposed, but rock types grade from predominantly even-grained quartz sandstone and siltstone in the northern outcrops to predominantly cross-stratified quartz greywacke with minor greywacke and micaceous siltstone in the south.

The lowermost beds of the Maurice Formation were seen three miles east of the Maurice Hills, where they conformably overlie the Ellis Sandstone. The sediments are well sorted reddish brown and white sandstone, medium to fine-grained, medium to thin-bedded, poorly bedded, cross-bedded, finely micaceous, with some clay pellets up to half an inch across.

Eight miles north of Plover Hill the basal beds are finely micaceous yellow and red-brown thin-bedded and laminated sandstone grading into the underlying even-grained Ellis Sandstone, which at this point contains some thin beds of coarse sandstone. Rare rounded pebbles occur in the quartz sandstone in some places.

The Maurice Hills contain quartz sandstone interbedded with micaceous siltstone. The sandstone is brown, medium-grained, poorly thick-bedded, and moderately sorted; it contains thin zones rich in clay pellets, and in places is cross-bedded and has wave and current ripple marks. This sandstone, with minor interbedded fine sandstone and minor siltstone, occurs near the middle of the formation and is responsible for the more resistant topographic features. The arcuate ridges at Maurice Hills, which form the nose of a north-plunging syncline, continue intermittently to the north to a point about ten miles west of the Turner Hills. A similar ridge of resistant sandstone occurs in the Maurice Formation at R99 north-west of Plover Hill. At this point the sandstone is red-brown, siliceous, and moderately well sorted, with some ripple marks. It is interbedded with chocolate siltstone and overlies blue-grey micaceous friable calcareous sandstone. No other outcrops of calcareous sandstone were seen, but a large area of travertine between M56 and M57 north of the Maurice Hills is possibly underlain by soft calcareous sandstone. Some heavy mineral concentrations in thin beds and laminae were seen in the sandstone at some localities.

The youngest exposed beds of the formation were seen at M56 and consist of thin-bedded and laminated fine sandstone interbedded with chocolate siltstone and minor shale. Some of the sandstone is well bedded and sorted, is finely micaceous, and has thin beds rich in clay pellets.

In the Wallace Hills and in the ranges to the north the sediments of the Maurice Formation become coarser-grained, cross-bedding becomes so pronounced that true bedding is almost impossible to distinguish, and the bulk of the sandstone is composed of rock fragments and clay pellets in a clay cement.

In the southernmost outcrops at Wallace Hills, the main rock types are quartz greywacke with minor greywacke and minor interbedded, dark chocolate-brown, laminated, micaceous siltstone. The quartz greywacke is usually medium to coarse, cross-bedded, and poorly sorted and bedded; it contains abundant purplish brown (rarely white) irregular clay and siltstone fragments up to three inches across, white kaolinitic flecks, heavy mineral concentrations in thin beds and laminae, and rare subangular and subrounded pebbles.

The majority of the cross-bedding directions in the Maurice Formation at Wallace Hills suggest derivation of the sediments from the south-east and south.

Specimens of the quartz greywacke from the Maurice Formation in the northern part of the Rawlinson Sheet area consist of subangular quartz and rock fragments (fine quartz - sericite schist, quartzite, and chert), which together compose up to 20 percent of the sediment. There are rare large mica flakes. The matrix consists of fine sericite, limonite, and kaolin. A specimen from R100 in the Wallace Hills contains up to 20 percent kaolinite as tabular cleaved plates, which may be a product of weathered feldspar grains.

The sediments were probably derived from source areas in the south and south-east, with comparatively rapid deposition of coarser sediment in the near-shore areas to the south near the Wallace Hills, and better-sorted sandstone deposited farther north.

PALAEOZOIC

Ordovician

A small outlier of fossiliferous calcarenite crops out about seven miles north-west of the summit of the Sir Frederick Range. The calcarenite contains fragmentary pelecypods, gastropods, orthid and strophomenoid brachiopods, asaphid trilobites, echinoderm ossicles, and conodonts which were dated by R.A. Mactavish (pers. comm.) as undoubtedly Ordovician.

The calcarenite is speckled pink and white. The fragmentary nature of the organic remains indicates reworking of the sediment. It crops out in two small mounds that are almost obscured by sand and travertine (M71, M77).

At M71 the calcarenite appears to be overlain by several feet of white medium-grained well sorted sandstone, but no contacts are exposed. Some of this sandstone is red-brown owing to iron staining. Fine to medium-grained, well sorted, and well-rounded sandstone crops out nearby.

The poorly exposed bedding planes in the calcarenite seem to dip at 5° to 10° to the east. The Bitter Springs Limestone and Carnegie Formation, which crop out within 50 feet of the Ordovician rocks, are steeply dipping. Therefore, although no contacts were seen, it is probable that the Ordovician rocks unconformably overlie the Bitter Springs Limestone and the Carnegie Formation. The calcarenite is correlated with the *Orthis leviensis* beds of the Stokes Formation in the MacDonnell Ranges (Joyce Gilbert-Tomlinson, BMR, pers. comm.).

Red limestone and calcarenite of probable Ordovician age crop out east of Lake Hopkins in the Rawlinson Sheet area. No fossils were found in these sediments, but they dip at a low angle to the north beneath an isolated outcrop of the Mereenie Sandstone. Similar rocks have been mapped in sediments of the Larapinta Group in the Bloods Range Sheet area farther east. A small outcrop of sandstone with 'pipe rock' occurs in the south-eastern part of the Rawlinson Sheet area near Mount Sargood. The outcrop is lithologically similar to Ordovician rocks exposed farther east.

Mereenie Sandstone

The name 'Mareenie Sandstone' was first used by Madigan (1932) and later amended to Mereenie Sandstone and redefined by Prichard & Quinlan (1962).

It crops out in the Rawlinson Sheet area as a low inconspicuous ridge. It is a white fine-grained quartz sandstone which dips northwards at 10°. About 30 feet of sandstone is exposed.

Ligertwood Beds (Wells, Forman, & Ranford, 1965)

In the Macdonald Sheet area two units of the Ligertwood Beds may be distinguished. The lower unit consists of a bedded deposit comprising cobble, boulder and pebble-sized fragments of angular to subrounded dolomite and limestone. Fragments from near the base of this unit are larger and more angular than fragments from higher up. Weathering has produced a secondary matrix of travertine.

The upper unit consists of pebble, cobble, and boulder conglomerate, white and yellow-brown poorly sorted angular medium and thin-bedded conglomeratic kaolinitic sandstone and gritty sandstone. The conglomeratic phenoclasts are well rounded to angular, and are composed of quartz sandstone probably derived from the phenoclasts in the Sir Frederick Conglomerate south of the Mu Fault. The lower unit appears to grade upwards into the upper, but the transitional zone is very thin and hence does not preclude the possibility of a disconformity between the two.

The distribution of the Ligertwood Beds follows the trend of the Mu Fault. Exposure of the Bitter Springs Limestone by weathering after faulting has probably provided the material for the lower angular dolomite and limestone conglomerate. The upper unit was derived from the Sir Frederick Conglomerate and the Maurice Formation on the southern side of the Mu Fault.

The Beds dip locally at more than 10^{o}, but are flat-lying in most localities.

Two outcrops of moderately dipping conglomeratic and gritty sandstone (brown, angular, poorly sorted, thin-bedded to massive) are mapped as possible Ligertwood Beds because of their stratigraphical position and structure. One outcrop lies directly north of the Mu Fault and trends parallel to it, the other occurs discontinuously on the eastern side of the Mu Hills along a probable fault. Both are thought to be younger than the Sir Frederick Conglomerate and the Maurice Formation, and to have formed in depressions caused by faulting and differential erosion.

All that is known of the age of the Ligertwood Beds is that it is younger than the Maurice Formation, which is pre-Ordovician. Part of the Buck Formation of Permian age is lithologically similar to the Ligertwood Beds, but is flat-lying.

Buck Formation (new name)

The Buck Formation is defined as a sequence of quartz sandstone, boulder beds, siltstone, and conglomerate with tillitic texture. The unit includes the terrestrial products of a continental glaciation. The name is taken from the Buck Hills in the north-eastern corner of the Macdonald Sheet area. The Buck Formation is unconformable on the underlying rock units; its top has been eroded.

The formation crops out in the Buck Hills and near the Dover Range as isolated buttes. A section 137 feet thick was measured at M28 in the Dover Range (sections of Buck Formation are shown in Pl. 6). In the western half of the Macdonald and Rawlinson Sheet areas the unit crops out in low rounded hills, and rarely in low mesas, surrounded by sand plain. Exposure is mostly very poor owing to a capping of duricrust. Many of the outcrops, particularly along the western edge of the area, have not been visited and are referred to as Permian undifferentiated on the Macdonald Sheet area when the formation cannot be reliably identified. Outcrops of conglomeratic and coarse sandstone, siltstone, and conglomerate near the Mu Hills are tentatively placed in the Buck Formation. Many of the rock types occur as lenses, and the relative positions of the sandstone, siltstone, and conglomerate vary from one outcrop to another. The sandstone is typically white or yellow, coarse-grained, and cross-bedded, and contains angular fragments and erratics up to three feet across. The conglomerate contains rounded, flattened, and striated boulders and cobbles, mostly of quartzite, and silicified quartz sandstone. In places granite, schist, vein quartz, acid porphyry, and black and white banded chert make up much of the phenoclasts. The siltstone is usually white and poorly sorted, and contains erratics up to two feet across. Load casts are common where the siltstone is overlain by sandstone.

Five miles west of the Dover Range the sediments are contorted, probably as a result of ice action rather than slumping.

The Buck Formation unconformably overlies the Maurice Formation south-east of Compton Hills and in the Maurice Hills; the Ellis Sandstone in the Searle Hills; the Bitter Springs Limestone west of the Dover Range; the Heavitree Quartzite in the Dover Range; quartz-feldspar porphyry and granite at the Buck Hills and Dover Range; and stromatolitic dolomite at R111 (Boord Formation or Bitter Springs Limestone). The surface of the unconformity shows considerable relief: in the Dover Range the Buck Formation was deposited next to steep cliffs the tops of which are now about 150 feet above the base of the unit; in the Buck Hills the surface of the unconformity is irregular and there is a difference of 15 to 20 feet in elevation in the small mesa at M41; in mesas about a quarter of a mile away the unconformity is about 100 feet lower. This relief was responsible for the local contribution of debris.

The elongated outcrops of Buck Formation on the north side of Buck Hills lie on a fault zone. In these outcrops the unit contains numerous quartz stringers and veins which have made the unit more resistant to erosion.

A possible glacial pavement, where pebbly sandstone and conglomerate of the Buck Formation rest on the Heavitree Quartzite, is exposed seven miles west of the Buck Hills. Faint striae on the pavement trend nearly north-south, but they are not sufficiently well preserved to indicate the direction of movement of material on this surface.

The presence of faceted and striated pebbles, cobbles, and boulders, large angular erratics both in the sandstone and siltstone, and a possible glacial pavement suggest a glacial origin. The closest outcrop of glacial sediments is the Sakmarian Grant Formation in the Canning Basin to the west (Veevers & Wells, 1961). The Buck Formation may have been part of a blanket of terrestrial and fluvio-glacial deposits which rimmed the Sakmarian sea, hence, despite the lack of fossils, the formation is tentatively dated as Permian.

TERTIARY

Pisolitic Ironstone and 'Billy'

Ironstone and 'billy' are most abundant as a capping on the Buck Formation. Minor outcrops of ironstone occur as low mounds between sand dunes, and 'grey billy' crops out as isolated boulders throughout the area; neither is common, and nowhere is a full laterite profile developed.

Conglomerate

Dissected remnants of flat-lying, poorly sorted, ferruginized and silicified conglomerate crop out along the southern margin of the Rawlinson Range. The maximum exposed thickness is approximately 100 feet at R51. The fragments in the conglomerate average four inches across and reach a maximum of two feet. They are mostly quartzite, with smaller amounts of quartz-mica schist, phyllite, and vein quartz, and were derived from the adjacent mountain range. The angularity of the fragments, the poor sorting, and the position of the sediments indicate their piedmont origin.

Conglomerate of this type may be much more extensive than indicated, as much of the area adjacent to the ranges is covered by more recent scree and alluvium.

QUATERNARY

Quaternary sediments cover roughly three-quarters of the Rawlinson and Macdonald Sheet areas.

Sand Dunes

Seif dunes up to 60 feet high cover about two-thirds of the Rawlinson and Macdonald Sheet areas. They are fixed by a scattered growth of spinifex and therefore changes in form are very slight under the prevailing conditions.

The general trend of the dunes is east-west, but they vary between west-south-west and north-west, depending on the proximity of wind-deflecting mountain ranges, as well as local differences in the wind regime. This is clearly demonstrated in the variation in dune direction between the Robert Range and the Schwerin Mural Crescent in the Rawlinson Sheet area. Another effect of the deflecting barriers is the wind-scoured channels around the western end of some hills.

Dunes are best developed in the western part of the area away from the mountain ranges; in part this is probably due to the more easily abraded rocks in the western area. The areas with the least dunes are the north-eastern part of the Macdonald area and south of the Schwerin Mural Crescent. The most effective winds for sand movements are bi-directional, and such winds have been measured at Giles (Veevers & Wells, 1961). The prevailing wind (at Giles) blows from the south-south-east and the less frequent wind from the north to north-north-east. According to the theory proposed by Bagnold (1941), the present wind directions, as measured at Giles, would be suitable for dune formation provided the other necessary conditions were favourable. However, previous workers have deduced that these dunes were formed during an arid part of the Pleistocene (see discussion in Veevers & Wells, 1961, p.211).

Travertine and Caliche

Calcareous deposits are marginal to all the salt lakes and occur also as isolated mounds and sheets away from the salt lakes. The travertine and caliche marginal to the salt lakes is thought to have formed by precipitation from groundwater at or near the surface, and forms botryoidal masses of banded grey and white fine-grained limestone. Isolated outcrops of travertine commonly occur over the Bitter Springs Limestone, the Carnegie Formation, and the Ellis Sandstone. These deposits are massive and in places banded fine-grained grey, white, and pink limestone many of which contain irregular masses of chert. They may have formed in the soil or the weathered rock as caliche, and have been exposed by erosion.

The large sheet of travertine limestone in the northern part of the Macdonald area is possibly an old lake deposit which has been subsequently indurated and dissected.

Evaporites

Evaporite deposits occur in and around Lake Macdonald, Lake Hopkins, Lake Anec, and Lake Orantjugurr. Salt forms a thin crust about an eighth of an inch thick on these lakes, and the underlying material is a mixture of gypsum, clay, and silt. Banks of gypsum and travertine occur around Lake Macdonald and also as remnants standing within the Lake. A remnant at M6 stands about 25 feet high and contains many fragments of freshwater gastropods. An analysis of a grab sample from M6 gave:

SiO_2	CaO	SO_3	$H_2O(180^{\circ}C)$	Fe_2O_3 Al_2O_3
10.36%	27.20%	39.35%	18.13%	1.50%

(Analyst: S. Baker, BMR)

At M59 on Lake Macdonald, three samples were collected. M59A consisted of fine crystalline salt forming a layer approximately 1/8 inch thick. M59B was a grab sample of dark brown mud with small gypsum crystals and was taken from the layer between 12 and 15 inches below the surface; it consisted of dark grey to black fine-grained clayey mud with large gypsum crystals. The water-table was approximately 4 inches below the surface at the time of collection.

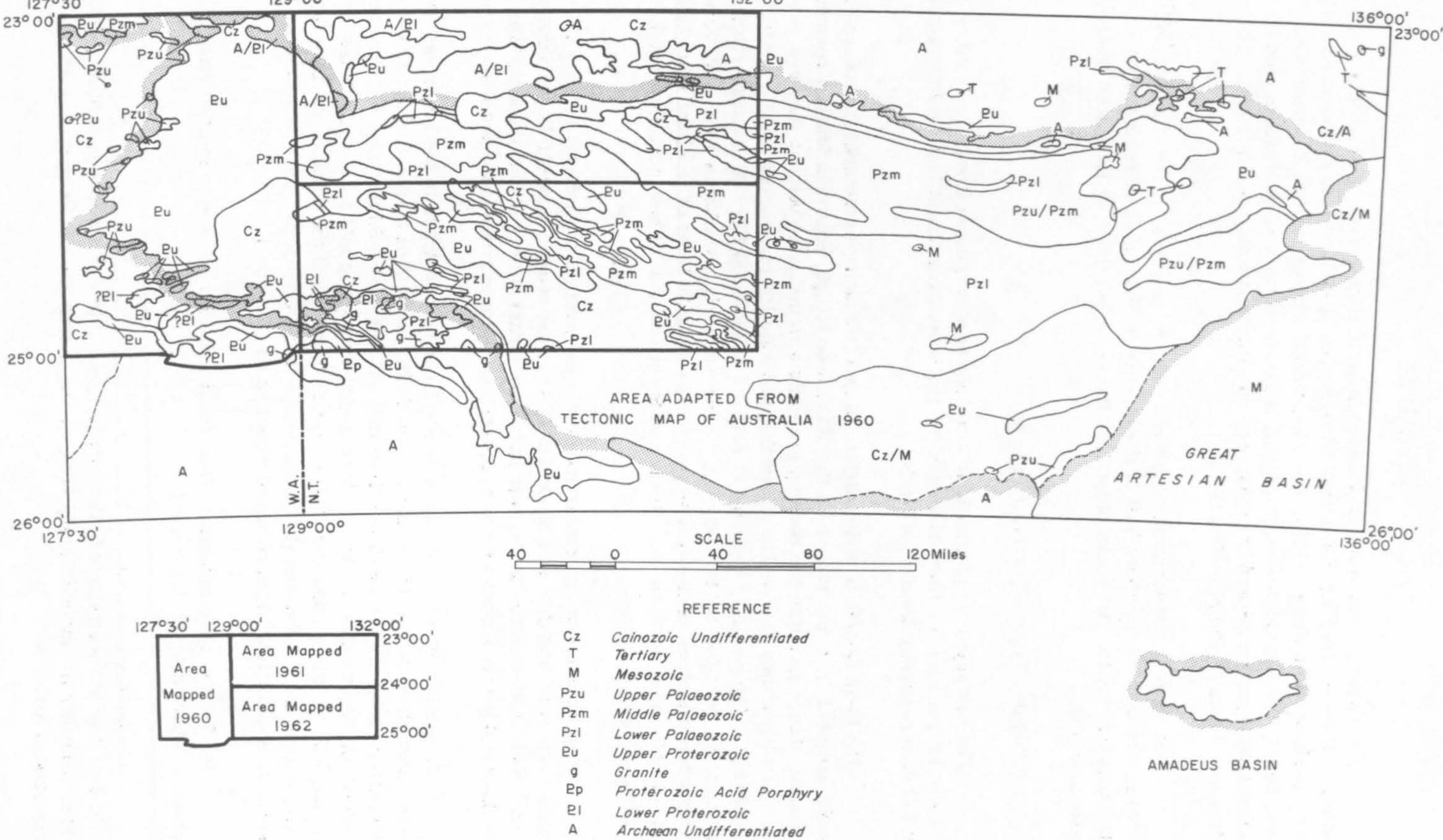
Other samples were collected at M65 on the western edge of Lake Macdonald and at R107 on the western edge of Lake Hopkins. Both these samples were from the surface salt which is approximately 1/8 inch thick. The five samples have been analyzed by S. Baker for water-soluble salts, as percentage weight of the dry material:

	M59A	M59B	M59C	M65	R107
Calcium	0.40	4.57	6.41	2.24	0.24
Magnesium	0.19	0.27	0.24	1.63	0.53
Sodium	36.80	2.95	3.35	28.00	30.00
Chloride	57.70	4.75	4.75	41.25	42.10
Sulphate	1.93	12.42	16.00	13.47	6.44
Total	97.02	24.96	30.75	86.59	79.31

Alluvium

Gravel and sand are found along the creek beds and as alluvial fans marginal to the mountain ranges and hills. Small patches of alluvium also occur in hollows between the sand dunes. The largest alluvial patches are in the south-eastern portion of the area, where the ranges are higher and the creeks larger.

Fig. 8 — SKETCH MAP OF THE AMADEUS BASIN



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STRUCTURE

The Upper Proterozoic and Palaeozoic sediments are contained within a structural depression, 450 miles long by 100 miles wide, which at different times has been called the Amadeus Sunkland (Chewings, 1935), the MacDonnell Trough and MacDonnell Geosyncline (Andrews, 1938), the Amadeus Trough (David, 1950), the Amadeus Depression (Joklik, 1952), the Amadeus Geosyncline (Hossfeld, 1954), and the Amadeus Basin (BMR, 1956). The outline of the Amadeus Basin is shown in Figure 8.

The upper Proterozoic quartzite which appears to be infolded with older Precambrian rocks in the southern half of the Rawlinson Sheet area is regarded as an outlier from the Amadeus Basin. All rocks older than the Dean Quartzite or Heavitree Quartzite we term basement rock.

Basement and Infolded Upper Proterozoic Rocks

The 'porphyry' is generally foliated and in some places lineated. In many places the foliation is parallel to that developed in the enveloping schist and the lineation on the plane of foliation generally trends northerly.

The Dean Quartzite and undifferentiated Precambrian metasediments are foliated and doubly lineated in many places in the Rawlinson Range, Schwerin Mural Crescent, and farther south. Where foliation and bedding are visible in the same outcrop they are generally parallel. Two lineations are visible on bedding and foliation planes: one trends westerly, the other northerly. The westerly lineation is parallel to the axial lines of isoclinal folds whose axial planes lie parallel to the bedding. The northerly lineation is a strongly developed recrystallization lineation, probably also parallel to the axial lines of isoclinal folds, although no proof of this was seen in the Rawlinson Sheet area. It is also not clear which folding was the first.

Two schistosity directions are developed south of the Schwerin Mural Crescent. One strikes east-west, and dips at a moderate angle to the south. It parallels the axial planes of isoclinal folds and chevron folds, and the other schistosity is folded about it. The Dixon Range Beds are folded about east-west axes but schistosity is either weakly developed or absent.

A number of north-trending faults have been mapped in the south-east portion of the Rawlinson Sheet area. These are normal faults with small displacement. Folds within the sedimentary rocks are of three types: isoclinal and recumbent folds whose axes lie parallel to the trend of the ranges in which they occur, broad regional folds such as the syncline between the Robert Range and the Walter James Range, and the dome of the Dean Range - Petermann Range area. Forman (1965) considers that the isoclinal and recumbent folds are minor structures associated with recumbent folding on a regional scale.

Joints are very common. The most common are a set of strike and dip joints which trend at about 340^{o}

The detailed structure of the Precambrian igneous and metamorphic rocks of the Macdonald area has not been studied. The porphyritic dacite and rhyolite and minor sediments in this area probably lie unconformably between the gneiss and the Heavitree Quartzite in the core of an eroded anticline.

Upper Proterozoic and Palaeozoic Sediments in the Amadeus Basin

The northern margin of the Basin is marked by the unconformity between the Heavitree Quartzite and the Precambrian igneous and metamorphic rocks. At the southern margin the Maurice Formation and Ellis Sandstone probably onlap the Dean Quartzite and basement rocks.

The Upper Proterozoic and Palaeozoic sediments are folded and faulted. The discovery in 1961 of a diapiric structure in the Mount Rennie Sheet area has suggested that the Bitter Springs Limestone contains incompetent beds. No piercement domes or gypsum plugs are known in the Rawlinson or Macdonald Sheet areas, although a small area of secondary gypsum and travertine in the south-eastern corner of the Macdonald Sheet area may overlie gypsiferous beds in the Bitter Springs Limestone. The folding and faulting of the Upper Proterozoic and Palaeozoic rocks may be explained by the concept of mobile beds in the Bitter Springs Limestone. The incompetent folding in the Bitter Springs Limestone may form a decollement in the succession and the structure of the Heavitree Quartzite or Dean Quartzite at the base of the sequence may be different from that of the units overlying the Bitter Springs Limestone.

The major faults trend in two general directions, west and north. The fault planes do not crop out and their presence has been deduced from stratigraphic relationships. The Mu Fault and the Buck Fault trend in a westerly direction. Along the Mu Fault the Maurice Formation is thrown against the Bitter Springs Limestone, and possible Ligertwood Beds on the upthrown side dip northwards at 40°. The Buck Fault has downthrown the Bitter Springs Limestone against the Precambrian crystalline igneous and metamorphic rocks.

The Sir Frederick Fault trends north-south across the junction of the two Sheet areas: outcrops are discontinuous on both sides of the fault and consequently a precise interpretation of the structure is difficult. The stratigraphy and structure of the section to the east and west of the fault suggests that faulting followed folding with both transcurrent and hinge faulting contributing to the present attitude.

The folding is shown on Plates 7 and 8. The strata dip from 15° to 80° on the flanks of the regional folds. The folds trend in two general directions; one westerly, parallel to the margin of the Amadeus Basin, and the other northerly. The northerly-trending structures probably developed soon after the others.

The age of the folding and faulting is not precisely known. The presence of metamorphosed Dean Quartzite boulders in the Sir Frederick Conglomerate shows that the Dean Quartzite was folded and metamorphosed before the Conglomerate was laid down. Faulting and folding probably affected the Carnegie Formation, Sir Frederick Conglomerate, Ellis Sandstone, and Maurice Formation before the gently folded Ordovician sediments and the Mereenie Sandstone were deposited. Hence three periods of folding may have occurred, one in the Upper Proterozoic, the second before the Ordovician sediments were deposited, and the third after the deposition of the Ordovician sediments and the Mereenie Sandstone.

Aeromagnetic Reconnaissance

In 1960 the Geophysical Branch of the Bureau of Mineral Resources flew aeromagnetic traverses from Alice Springs to Giles, and other flights from Giles (Goodeve, 1961); these

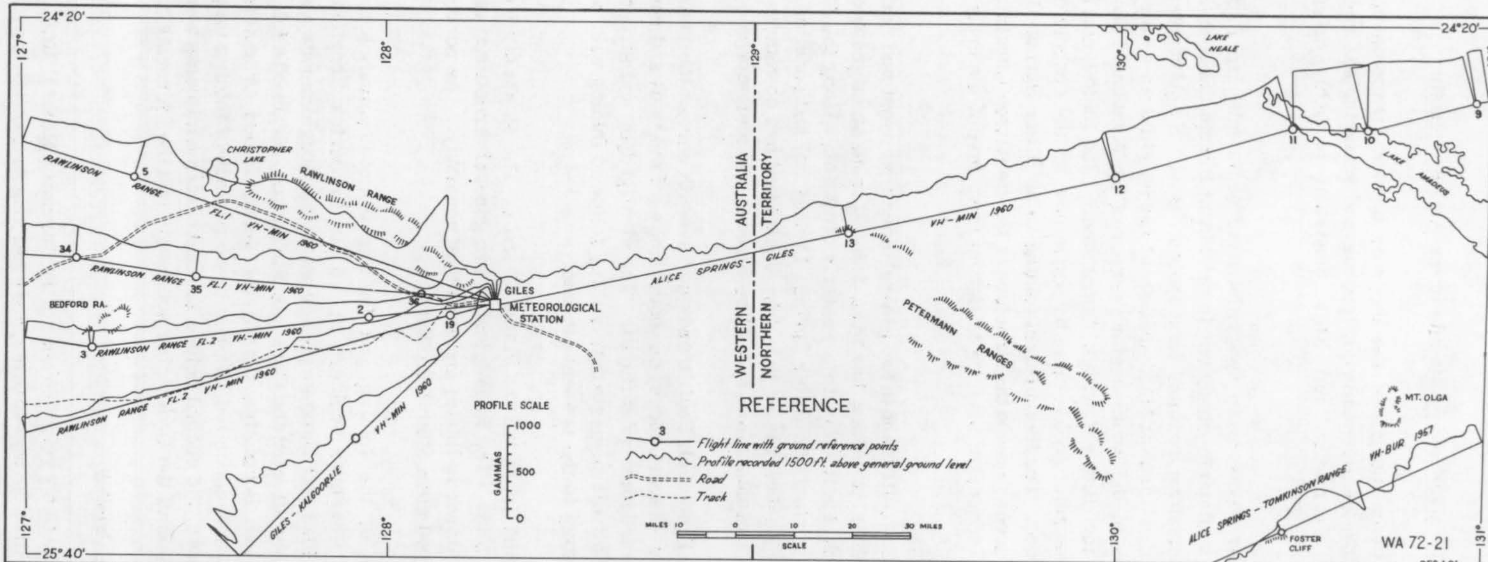

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Fig. 9 MAGNETIC PROFILES

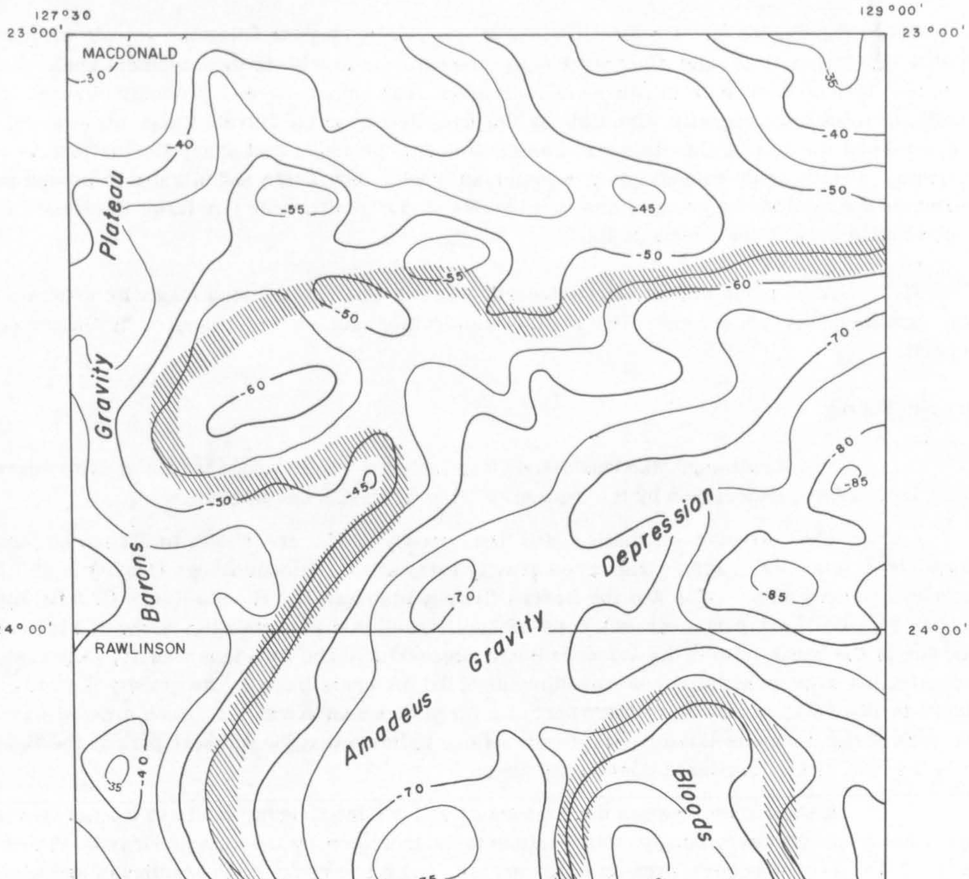

Fig. 10 Preliminary Bouguer gravity map.

are shown on Figure 9. On the traverse from Alice Springs to Giles the smooth magnetic profile indicated that any fluctuations in magnetic intensity of the basement rocks were obscured by a considerable thickness of sediments. The smooth profile suddenly changed to a profile of moderate magnetic variation, as the plane flew over the Bloods Range Sheet area, at the southern margin of the Amadeus Basin. It seems probable that sharp fluctuations in the magnetic profile are caused by Precambrian rocks and basic and ultrabasic intrusions, moderate fluctuations by younger basement rocks, and smooth profiles by large thicknesses of sedimentary rock in the Amadeus Basin.

At a point ten miles west-north-west of Giles an isolated magnetic anomaly of 600 gammas was recorded. The rocks causing this anomaly are obscured by Quaternary deposits.

Gravity Survey

The Rawlinson-Macdonald area was included in a reconnaissance gravity survey using helicopters, undertaken by the Bureau of Mineral Resources in 1962.

The Bouguer anomalies and the gravity units are shown in Figure 10 (after Lonsdale & Flavelle, 1963). The three gravity units are the Bloods Range Gravity High, the Amadeus Gravity Depression and the Barons Gravity Plateau. The Bloods Range Gravity High occurs for the most part over outcrops of undifferentiated Precambrian rocks and infolded masses of the basal units of the Amadeus Basin succession. The Amadeus Gravity Depression indicates the area underlain by thick sediments of the Amadeus Basin. The gravity depression shown in Figure 10 is only the western part of a large depression which outlines approximately the area of the Amadeus Basin. The gravity values indicate that the thickest part of the Basin is to the east of the Rawlinson-Macdonald area.

A shelf area between the Amadeus Basin and the Canning Basin to the north-west and west with correspondingly thin sediments is indicated by the Barons Gravity Plateau. Part of the plateau occurs over granite, gneiss, and other rocks of Precambrian age which crop out in the north-eastern part of the Macdonald Sheet area. Rocks of similar age and lithology probably underlie the Permian sediments on the eastern side of the Macdonald and Rawlinson areas.

GEOLOGICAL HISTORY

The history of the area since Upper Proterozoic time may be summarized as follows:

1. Deposition in the Upper Proterozoic of the Heavitree Quartzite and Dean Quartzite over Precambrian rocks.

2. Deposition of the Bitter Springs Limestone in a stable epicontinental shallow marine environment.

3. Rapid deltaic or paralic clastic sedimentation adjacent to an unstable area in the south (Carnegie Formation) and clastic, chemical, and organic marine, and possibly glacial sedimentation to the north (Boord Formation). Boulders in the glacials indicate erosion of the Precambrian rocks, the Heavitree Quartzite, and the Bitter Springs Limestone.

TABLE 2. WATER SUPPLY, GILES BORES

Bore No.	Locality from Giles	Date commenced	Depth of hole below surface (in feet)	Water Cut (feet below surface)	Standing Water Level (Feet below surface)	Supply (Gallons per hour)	How Tested	Analysis Total Saline Matter. (Grains per gallon)
10	300 yards north	10/7/56	120	90	65	300*	2 hours bailer D.D.L. 90'	75.83
9	1 mile north	2/7/56	75	38	34	700	1 hour bailer D.D.L. 39'	43.72
11	Lat. 25°02'07" Long. 128°17'48" Giles Aerodrome	4/8/56	130	98	59	300	2 hours	87.3
8	2 miles north	18/6/56	70	28	28	1000	9 hours pump test	73.38
7B	Giles	8/6/56	20	not completed				
7A	3/4 mile south	5/5/56	182	80	40	150 estimated	1 hour bailer	227.01
7	1 mile south	23/4/56	42	not completed				
6	3 miles north	30/5/56	63	30	30	700	2 hours bailer	119.81 or 347.78
5	4.9 miles north	16/5/56	60	8	6	1100	2 hours bailer	347.78 or 119.81

* Dry at end of 1959

4. Folding, thrusting, recumbent folding, and low-grade dynamic metamorphism of the Dean Quartzite and older rocks, and possibly the Bitter Springs Limestone in the southern part of the area during the Upper Proterozoic. Parts of the area became land masses and contributed sediment to the Amadeus Basin.

5. Completion of folding in the southern area.

6. Deposition of the Ellis Sandstone and the Sir Frederick Conglomerate, probably in a sea retreating eastwards.

7. Deposition of the Maurice Formation, probably in a fluviatile or near-shore environment. Coarse clastics were deposited in the southern parts of the area and finer sediments to the to the north.

8. Folding, faulting, and erosion.

9. Transgression by an Ordovician sea, and deposition of the Ordovician limestone and sandstone. The higher ranges of Upper Proterozoic rocks were probably islands.

10. Regression of the sea and deposition of the Mereenie Sandstone by possibly aeolian and fluviatile reworking of older sediments in a lacustrine environment.

11. Minor folding and faulting; deposition of the Ligertwood Beds.

12. Continental glaciation in the Permian and deposition of the Buck Formation over a landscape with moderate relief. Marine equivalents may have been deposited on the western side of the sea.

13. Weathering and erosion; deposition of superficial Tertiary pluvial deposits, and Quaternary evaporites, alluvium, travertine, sand, and sand dunes during a more arid phase.

ECONOMIC GEOLOGY

No mineral deposits of economic significance are known in the Rawlinson or Macdonald Sheet areas.

Water

Water of variable quality is being obtained south of the Rawlinson Range near Giles from bores sited along the creek which flows north from near Giles through the Pass of the Abencerrages (see Table 2). The water is probably being obtained from alluvium.

Two other areas which may yield shallow water supplies are at Withers Pass, south of the Schwerin Mural Crescent, and Rebecca Creek, south of the Schwerin Mural Crescent near Gill Pinnacle and Conical Hill. In both these areas creeks flow in narrow gorges through quartzite ridges with deposits of alluvium on the upstream side of the outcrops. The structure in both these areas is analogous to that present at Giles and good water supplies may be present in the alluvial deposits.

Surface water occurs in permanent and semi-permanent rock-holes and native soaks. The largest of these is Bungabiddy Rock-hole in the Walter James Range; it contains several large pools and is fed by a permanent spring.

Evaporites

Lakes Hopkins, Macdonald, Anec, and Orantjugurr contain deposits of gypsum and sodium chloride; however, remoteness from markets renders them uneconomic at present.

Petroleum Prospects

The Bitter Springs Limestone is a possible source rock for petroleum. Marine Permian sediments could occur below the Quaternary sand on the western side of the area, but at present the only rocks of this age appear to be thin fluvio-glacial deposits.

The Lower Palaeozoic sediments of the central Amadeus Basin have not been proved to extend across the Western Australian border, except as small outliers. The search for oil should be directed therefore to finding suitable cap and reservoir rocks over the possible source beds of the Bitter Springs Limestone. However, the petroleum prospects of the area are considered to be poor because there are no thick sequences of fossiliferous Palaeozoic rocks.

Copper

No mineralization was found in the Rawlinson Sheet area, but during the survey some secondary copper minerals were found in rocks in the Scott Sheet area to the south. The minerals are mainly malachite and occur in a quartz-mica schist three miles south-east of the Kathleen Range. A specimen of the highest-grade material assayed 2.3 percent copper. The deposits are small and uneconomic. The Precambrian schists appear to be a continuation along strike of similar rocks that crop out in the south-eastern part of the Rawlinson Sheet area.

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Fig. 1. Gill Pinnacle in the Schwerin Mural Crescent. Dean Quartzite overlying Precambrian metasediments. Mountains and ranges of physiographic division C.

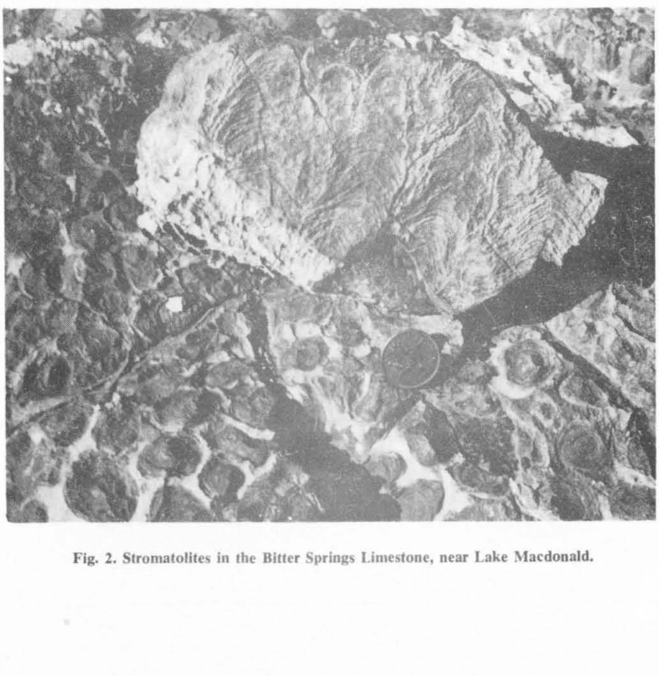


Fig. 2. Stromatolites in the Bitter Springs Limestone, near Lake Macdonald.

Fig. 1. Sir Frederick Conglomerate, from the summit of the Sir Frederick Range.

Fig. 2. Sir Frederick Conglomerate, Sir Frederick Range.


R123
R10/5019
Robert Range
RFX1
R18/5055
Dean Range
RFX2
R18/5055
Dean Range
RFX3
R18/5053
2 miles west of Dean Range
RFX4
R18/5035
West side Pass of the Abencerrages
R36
R13/5278
Dixon Range
REFERENCE FOR COLUMNAR SECTIONS
Shale
Siltstone
Sandstone
Coarse sandstone
Fine conglomerate
Conglomerate
Arkose
Conglomerate with tillitic texture, erratics
Limestone
Silty limestone
Sandy limestone
Dolomite
Chert
Quartzite
Sericitic quartzite
Schist
Gneiss
Granite
Quartz - feldspar porphyry
Grain Size
f - fine 0·12 - 0·25 mm.
m - medium 0·25 - 1·0 mm.
c - coarse 1·0 - 2·0 mm.
v.c. - very coarse 2·0 - 4·0 mm.
Fine conglomerate 4·0 - 16·0 mm.
Pebble conglomerate 3/4 - 2½ inches
Cobble conglomerate 2½ - 10 inches
Boulder conglomerate > 10 inches
Si Silicified
Fe Ferruginous
Mi Micaceous
Calc. Calcareous
Kl Kaolinitic
G Gypsum
Bedding
Very thick > 40 inches
Thick 12 - 40 inches
Medium 4 - 12 inches
Thin 0·4 - 4 inches
Laminate < 0·4 inches
Cross-bedded
Cross-laminated
Graded bedding
Undulate
Slumped
Ripple marks - wave
Ripple marks - current
Load cast
Oolites
Macrofossil
M6/5556 Sheet, run and photo number
P.P. Principal point of photograph
Gaps in columnar sections are concealed areas.
DEAN QUARTZITE
DIXON RANGE BEDS
Section continues from top RFX1

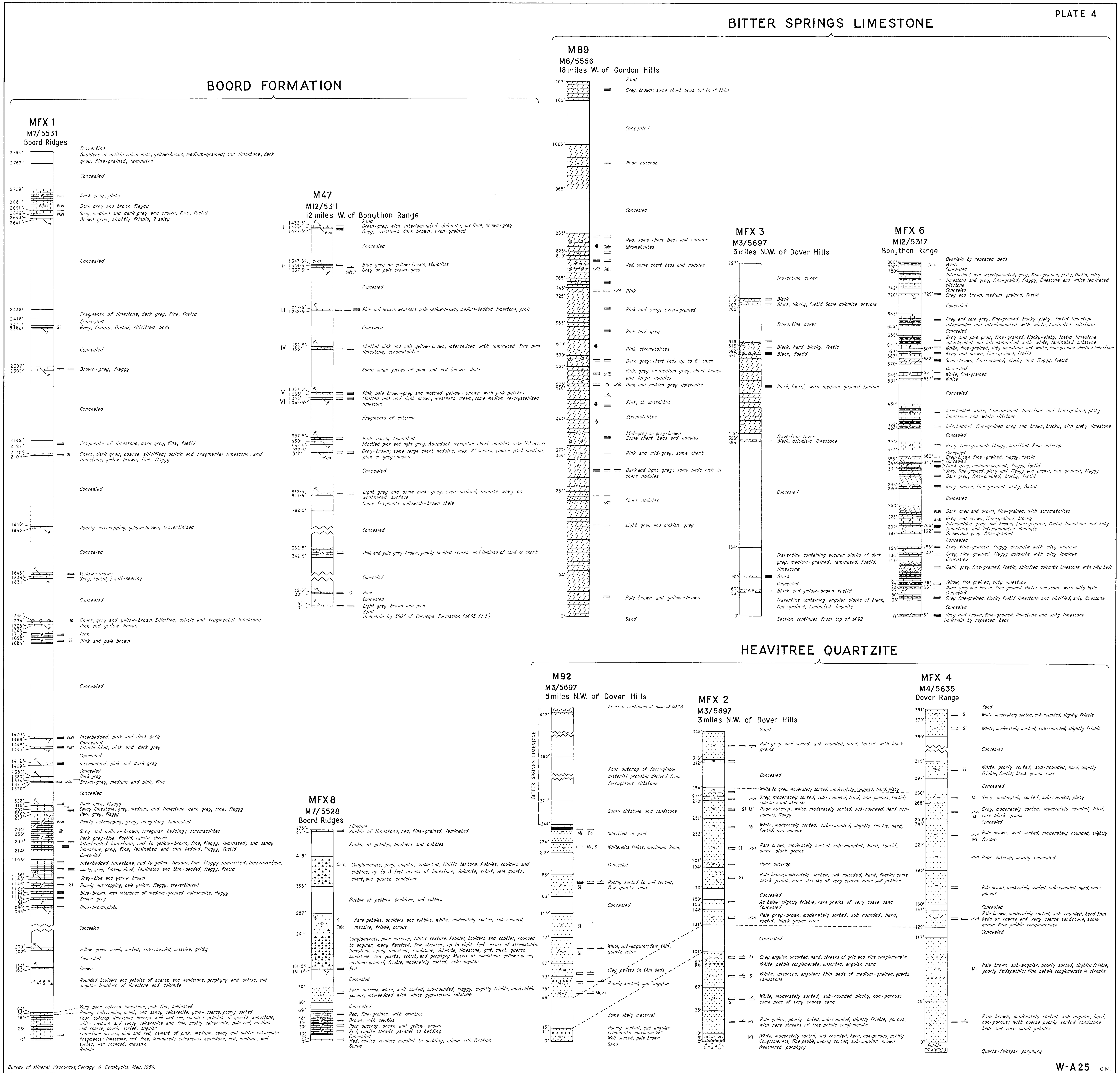


PLATE 4
BOORD FORMATION
MFX 1
M7/5531
Boord Ridges
M47
M12/5311
12 miles W. of Bonython Range
MFX8
M7/5528
Boord Ridges
BITTER SPRINGS LIMESTONE
M89
M6/5556
18 miles W. of Gordon Hills
MFX 3
M3/5697
5 miles N.W. of Dover Hills
MFX 6
M12/5317
Bonython Range
HEAVITREE QUARTZITE
M92
M3/5697
5 miles N.W. of Dover Hills
MFX 2
M3/5697
3 miles N.W. of Dover Hills
MFX 4
M4/5635
Dover Range
Bureau of Mineral Resources, Geology & Geophysics. May, 1964.
W-A25

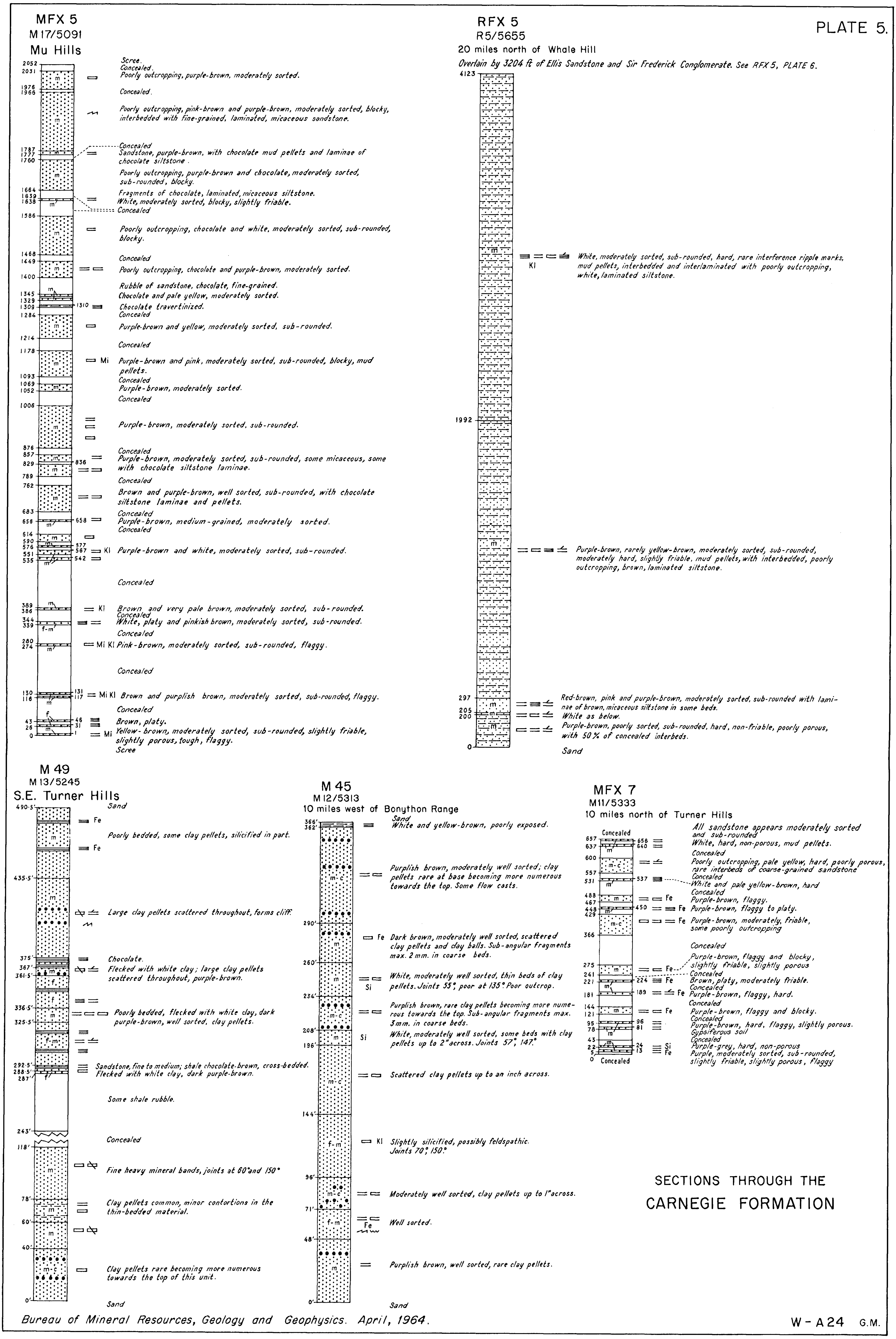


PLATE 5.
MFX 5
M 17/5091
Mu Hills
Scree.
Concealed.
Poorly outcropping, purple-brown, moderately sorted.
Concealed.
Poorly outcropping, pink-brown and purple-brown, moderately sorted, blocky, interbedded with fine-grained, laminated, micaceous sandstone.
Concealed
Sandstone, purple-brown, with chocolate mud pellets and laminae of chocolate siltstone.
Poorly outcropping, purple-brown and chocolate, moderately sorted, sub-rounded, blocky.
Fragments of chocolate, laminated, micaceous siltstone.
White, moderately sorted, blocky, slightly friable.
Concealed
Poorly outcropping, chocolate and white, moderately sorted, sub-rounded, blocky.
Concealed
Poorly outcropping, chocolate and purple-brown, moderately sorted.
Rubble of sandstone, chocolate, fine-grained.
Chocolate and pale yellow, moderately sorted.
Chocolate travertinized.
Concealed
Purple-brown and yellow, moderately sorted, sub-rounded.
Concealed
Purple-brown and pink, moderately sorted, sub-rounded, blocky, mud pellets.
Concealed
Purple-brown, moderately sorted.
Concealed
Purple-brown, moderately sorted, sub-rounded.
Concealed
Purple-brown, moderately sorted, sub-rounded, some micaceous, some with chocolate siltstone laminae.
Concealed
Brown and purple-brown, well sorted, sub-rounded, with chocolate siltstone laminae and pellets.
Concealed
Purple-brown, medium-grained, moderately sorted.
Concealed
Purple-brown and white, moderately sorted, sub-rounded.
Concealed
Brown and very pale brown, moderately sorted, sub-rounded.
Concealed
White, platy and pinkish brown, moderately sorted, sub-rounded.
Concealed
Pink-brown, moderately sorted, sub-rounded, flaggy.
Concealed
Brown and purplish brown, moderately sorted, sub-rounded, flaggy.
Concealed
Brown, platy.
Yellow-brown, moderately sorted, sub-rounded, slightly friable, slightly porous, tough, flaggy.
Scree
RFX 5
R5/5655
20 miles north of Whale Hill
Overlain by 3204 ft of Ellis Sandstone and Sir Frederick Conglomerate. See RFX 5, PLATE 6.
White, moderately sorted, sub-rounded, hard, rare interference ripple marks, mud pellets, interbedded and interlaminated with poorly outcropping, white, laminated siltstone.
Purple-brown, rarely yellow-brown, moderately sorted, sub-rounded, moderately hard, slightly friable, mud pellets, with interbedded, poorly outcropping, brown, laminated siltstone.
Red-brown, pink and purple-brown, moderately sorted, sub-rounded with laminae of brown, micaceous siltstone in some beds.
White as below.
Purple-brown, poorly sorted, sub-rounded, hard, non-friable, poorly porous, with 50 % of concealed interbeds.
Sand
M 49
M 13/5245
S.E. Turner Hills
Sand
Poorly bedded, some clay pellets, silicified in part.
Large clay pellets scattered throughout, forms cliff.
Chocolate.
Flecked with white clay; large clay pellets scattered throughout, purple-brown.
Poorly bedded, flecked with white clay, dark purple-brown, well sorted, clay pellets.
Sandstone, fine to medium; shale chocolate-brown, cross-bedded. Flecked with white clay, dark purple-brown.
Some shale rubble.
Concealed
Fine heavy mineral bands, joints at 60° and 150°
Clay pellets common, minor contortions in the thin-bedded material.
Clay pellets rare becoming more numerous towards the top of this unit.
Sand
M 45
M 12/5313
10 miles west of Bonython Range
Sand
White and yellow-brown, poorly exposed.
Purplish brown, moderately well sorted; clay pellets rare at base becoming more numerous towards the top. Some flow casts.
Dark brown, moderately well sorted, scattered clay pellets and clay balls. Sub-angular fragments max. 2 mm. in coarse beds.
White, moderately well sorted, thin beds of clay pellets. Joints 55°, poor at 135°. Poor outcrop.
Purplish brown, rare clay pellets becoming more numerous towards the top. Sub-angular fragments max. 3 mm. in coarse beds.
White, moderately well sorted, some beds with clay pellets up to 2" across. Joints 57°, 147°.
Scattered clay pellets up to an inch across.
Slightly silicified, possibly feldspathic. Joints 70°, 150°.
Moderately well sorted, clay pellets up to 1" across.
Well sorted.
Purplish brown, well sorted, rare clay pellets.
Sand
MFX 7
M11/5333
10 miles north of Turner Hills
All sandstone appears moderately sorted and sub-rounded
Concealed
White, hard, non-porous, mud pellets.
Concealed
Poorly outcropping, pale yellow, hard, poorly porous, rare interbeds of coarse-grained sandstone
Concealed
White and pale yellow-brown, hard
Concealed
Purple-brown, flaggy.
Purple-brown, flaggy to platy.
Purple-brown, moderately friable, some poorly outcropping
Concealed
Purple-brown, flaggy and blocky, slightly friable, slightly porous
Concealed
Brown, platy, moderately friable.
Concealed
Purple-brown, flaggy, hard.
Concealed
Purple-brown, flaggy and blocky
Concealed
Purple-brown, hard, flaggy, slightly porous.
Gypsiferous soil
Concealed
Purple-grey, hard, non-porous
Purple, moderately sorted, sub-rounded, slightly friable, slightly porous, flaggy
Concealed
SECTIONS THROUGH THE
CARNEGIE FORMATION
Bureau of Mineral Resources, Geology and Geophysics. April, 1964.
W - A24 G.M.

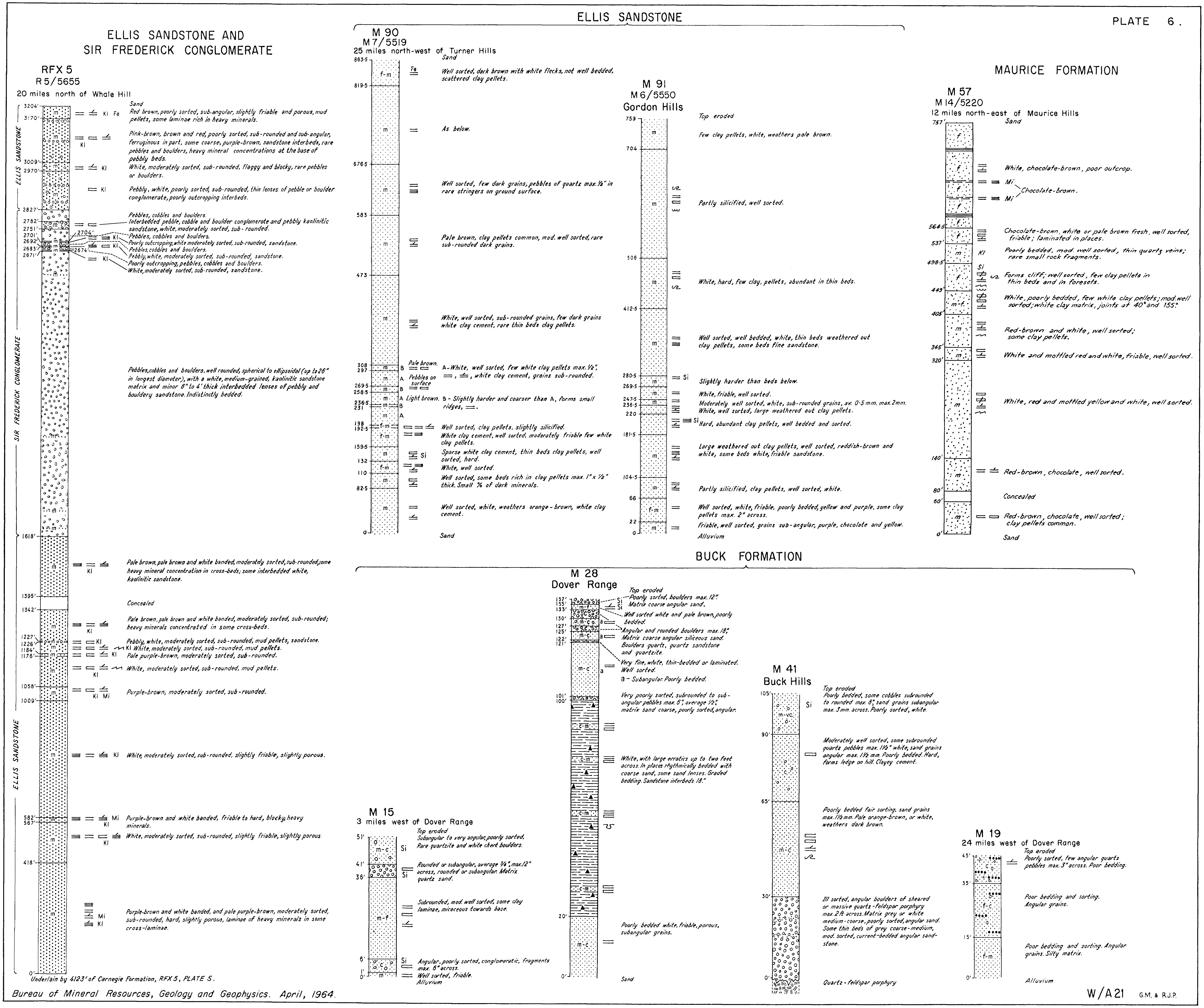


PLATE 6.
ELLIS SANDSTONE AND
SIR FREDERICK CONGLOMERATE
RFX 5
R 5/5655
20 miles north of Whale Hill
Sand
Red brown, poorly sorted, sub-angular, slightly friable and porous, mud pellets, some laminae rich in heavy minerals.
Pink-brown, brown and red, poorly sorted, sub-rounded and sub-angular, ferruginous in part, some coarse, purple-brown, sandstone interbeds, rare pebbles and boulders, heavy mineral concentrations at the base of pebbly beds.
White, moderately sorted, sub-rounded, flaggy and blocky, rare pebbles or boulders.
Pebbly, white, poorly sorted, sub-rounded, thin lenses of pebble or boulder conglomerate, poorly outcropping interbeds.
Pebbles, cobbles and boulders.
Interbedded pebble, cobble and boulder conglomerate and pebbly kaolinitic sandstone, white, moderately sorted, sub-rounded.
Pebbles, cobbles and boulders.
Poorly outcropping, white moderately sorted, sub-rounded, sandstone.
Pebbles, cobbles and boulders.
Pebbly, white, moderately sorted, sub-rounded, sandstone.
Poorly outcropping, pebbles, cobbles and boulders.
White, moderately sorted, sub-rounded, sandstone.
Pebbles, cobbles and boulders, well rounded, spherical to ellipsoidal (up to 26" in longest diameter), with a white, medium-grained, kaolinitic sandstone matrix and minor 6" to 4' thick interbedded lenses of pebbly and bouldery sandstone. Indistinctly bedded.
Pale brown, pale brown and white banded, moderately sorted, sub-rounded; some heavy mineral concentration in cross-beds; some interbedded white, kaolinitic sandstone.
Concealed
Pale brown, pale brown and white banded, moderately sorted, sub-rounded; heavy minerals concentrated in some cross-beds.
Pebbly, white, moderately sorted, sub-rounded, mud pellets, sandstone.
White, moderately sorted, sub-rounded, mud pellets.
Pale purple-brown, moderately sorted, sub-rounded.
White, moderately sorted, sub-rounded, mud pellets.
Purple-brown, moderately sorted, sub-rounded.
White, moderately sorted, sub-rounded, slightly friable, slightly porous.
Purple-brown and white banded, friable to hard, blocky; heavy minerals.
White, moderately sorted, sub-rounded, slightly friable, slightly porous.
Purple-brown and white banded, and pale purple-brown, moderately sorted, sub-rounded, hard, slightly porous, laminae of heavy minerals in some cross-laminae.
ELLIS SANDSTONE
SIR FREDERICK CONGLOMERATE
ELLIS SANDSTONE
Underlain by 4123' of Carnegie Formation, RFX 5, PLATE 5.
ELLIS SANDSTONE
M 90
M 7/5519
25 miles north-west of Turner Hills
Sand
Well sorted, dark brown with white flecks, not well bedded, scattered clay pellets.
As below.
Well sorted, few dark grains, pebbles of quartz max. ½" in rare stringers on ground surface.
Pale brown, clay pellets common, mod. well sorted, rare sub-rounded dark grains.
White, well sorted, sub-rounded grains, few dark grains white clay cement, rare thin beds clay pellets.
Pale brown.
Pebbles on surface
Light brown.
A - White, well sorted, few white clay pellets max. ½".
white clay cement, grains sub-rounded.
B - Slightly harder and coarser than A, forms small ridges.
Well sorted, clay pellets, slightly silicified.
White clay cement, well sorted, moderately friable few white clay pellets.
Sparse white clay cement, thin beds clay pellets, well sorted, hard.
White, well sorted.
Well sorted, some beds rich in clay pellets max. 1" x ½" thick. Small % of dark minerals.
Well sorted, white, weathers orange-brown, white clay cement.
Sand
M 91
M 6/5550
Gordon Hills
Top eroded
Few clay pellets, white, weathers pale brown.
Partly silicified, well sorted.
White, hard, few clay, pellets, abundant in thin beds.
Well sorted, well bedded, white, thin beds weathered out clay pellets, some beds fine sandstone.
Slightly harder than beds below.
White, friable, well sorted.
Moderately well sorted, white, sub-rounded grains, av. 0·5 mm. max. 2mm.
White, well sorted, large weathered out clay pellets.
Hard, abundant clay pellets, well bedded and sorted.
Large weathered out clay pellets, well sorted, reddish-brown and white, some beds white, friable sandstone.
Partly silicified, clay pellets, well sorted, white.
Well sorted, white, friable, poorly bedded, yellow and purple, some clay pellets max. 2" across.
Friable, well sorted, grains sub-angular, purple, chocolate and yellow.
Alluvium
MAURICE FORMATION
M 57
M 14/5220
12 miles north-east of Maurice Hills
Sand
White, chocolate-brown, poor outcrop.
Chocolate-brown.
Chocolate-brown, white or pale brown fresh, well sorted, friable; laminated in places.
Poorly bedded, mod. well sorted, thin quartz veins; rare small rock fragments.
Forms cliff; well sorted, few clay pellets in thin beds and in foresets.
White, poorly bedded, few white clay pellets; mod. well sorted; white clay matrix, joints at 40° and 155°.
Red-brown and white, well sorted; some clay pellets.
White and mottled red and white, friable, well sorted.
White, red and mottled yellow and white, well sorted.
Red-brown, chocolate, well sorted.
Concealed
Red-brown, chocolate, well sorted; clay pellets common.
Sand
BUCK FORMATION
M 28
Dover Range
Top eroded
Poorly sorted, boulders max. 12".
Matrix coarse angular sand.
Well sorted white and pale brown, poorly bedded.
Angular and rounded boulders max. 18".
Matrix coarse angular siliceous sand.
Boulders quartz, quartz sandstone and quartzite.
Very fine, white, thin-bedded or laminated.
Well sorted.
a - Subangular. Poorly bedded.
Very poorly sorted, subrounded to sub-angular pebbles max. 5", average ½", matrix sand coarse, poorly sorted, angular.
White, with large erratics up to two feet across. In places rhythmically bedded with coarse sand, some sand lenses. Graded bedding. Sandstone interbeds 18."
Poorly bedded white, friable, porous, subangular grains.
Sand
M 15
3 miles west of Dover Range
Top eroded
Subangular to very angular, poorly sorted. Rare quartzite and white chert boulders.
Rounded or subangular, average ¾", max. 12" across, rounded or subangular. Matrix quartz sand.
Subrounded, mod. well sorted, some clay laminae, micaceous towards base.
Angular, poorly sorted, conglomeratic, fragments max. 6" across.
Well sorted, friable.
Alluvium
M 41
Buck Hills
Top eroded
Poorly bedded, some cobbles subrounded to rounded max. 8", sand grains subangular max. 3mm. across. Poorly sorted, white.
Moderately well sorted, some subrounded quartz pebbles max. 1½" white, sand grains angular max. 1½ mm. Poorly bedded. Hard, forms ledge on hill. Clayey cement.
Poorly bedded fair sorting, sand grains max. 1½ mm. Pale orange-brown, or white, weathers dark brown.
Ill sorted, angular boulders of sheared or massive quartz-feldspar porphyry max. 2 ft across. Matrix grey or white medium-coarse, poorly sorted, angular sand. Some thin beds of grey coarse-medium, mod. sorted, current-bedded angular sandstone.
Quartz-feldspar porphyry
M 19
24 miles west of Dover Range
Top eroded
Poorly sorted, few angular quartz pebbles max. 3" across. Poor bedding.
Poor bedding and sorting. Angular grains.
Poor bedding and sorting. Angular grains. Silty matrix.
Alluvium
Bureau of Mineral Resources, Geology and Geophysics. April, 1964.
W/A 21
G.M. & R.J.P.

RAWLINSON

WESTERN AUSTRALIA

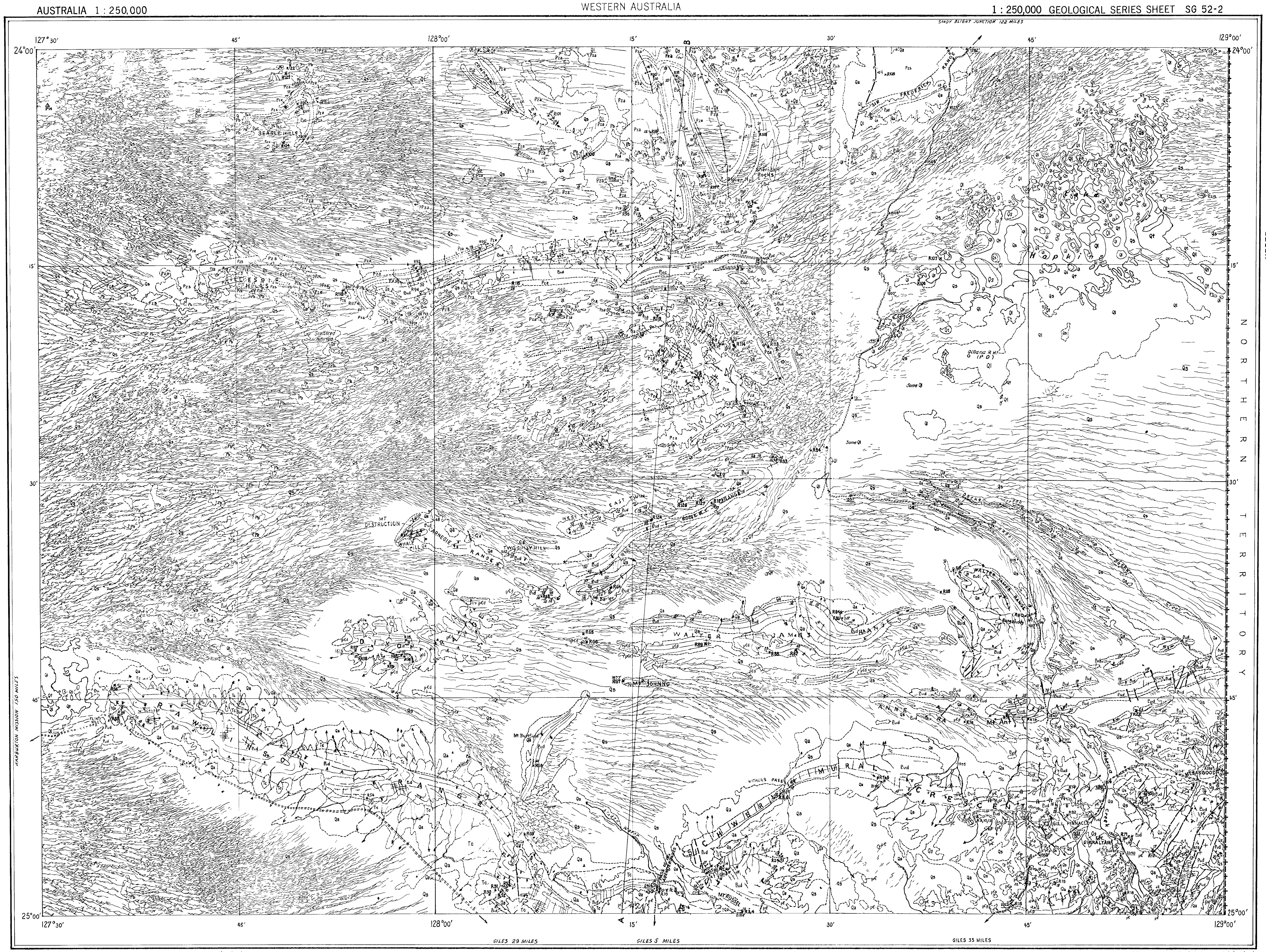
AUSTRALIA 1 : 250,000

1 : 250,000 GEOLOGICAL SERIES SHEET SG 52-2

PRELIMINARY EDITION, 1964

SUBJECT TO AMENDMENT

PLATE 7



Reference

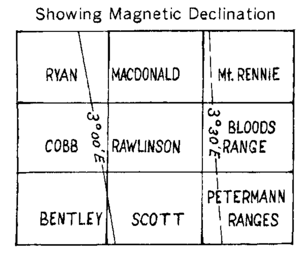
CAINOZOIC	QUATERNARY		Qs	Sand
			Qa	Alluvium
			Qt	Evaporites
			Ql	Travertine
	? TERTIARY		Tc	Conglomerate
PALAEOZOIC	PERMIAN	Buck Formation	Pb	Coarse sandstone, conglomerate with tillitic texture and silt-stone, erratics
		Mereenie Sandstone	Pzm	Fine, cross-bedded quartz sandstone
	ORDOVICIAN		O	Mottled pink and white limestone, sandstone with 'pipe rock'
	Unconformity			
UPPER PROTEROZOIC – LOWER PALAEOZOIC		Maurice Formation	Pza	Quartz sandstone, quartz greywacke and micaceous siltstone and sandstone
		Sir Frederick Conglomerate	Pzs	Boulder pebble and cobble conglomerate. Lenses of sandstone
		Ellis Sandstone	Pze	Quartz sandstone, some interbedded calcareous sandstone, pebbly sandstone, siltstone
	Unconformity ?			
PRECAMBRIAN	UPPER PROTEROZOIC	Carnegie Formation	Ꞓuc	Quartz greywacke, sandstone, siltstone and shale
		Bitter Springs Limestone	Ꞓub	Dolomite, limestone, calcilutite and siltstone. Stromatolites
		Dean Quartzite	Ꞓud	Quartzite, sericitic quartzite, sandstone, sericitic quartz schist, schistose sericitic quartzite and some conglomerate
		Dixon Range Beds	p€d	Quartz sandstone, siltstone, fine conglomerate, shale, arkose, arkosic sandstone, some quartz-mica schist and greywacke
			p€	Quartzite, quartz sandstone, quartz-sericite schist, quartz-feldspar-sericite schist, slate, chlorite schist, phyllite and sheared basalt
			p€g	Granite (section only)
			p€p	Quartz-feldspar porphyry

Geological boundary
Syncline, showing plunge
Anticline, showing plunge
Overturned anticline
Fault
Where location of boundaries, folds and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries and folds are dotted, faults are shown by short dashes
48 Strike and dip of strata
Prevailing dip
Vertical strata
Horizontal strata
Dip < 15° } Air-photo interpretation
Dip 15°–45°
Dip > 45°
Trend of bedding
Joint pattern
80 Strike and dip of joints
Vertical joints
60 Strike and dip of foliation
Vertical foliation
50 Plunge of lineation
Measured section
Macrofossil locality
× R21 Text reference to specimen locality

B Bore with windpump
○ R.H. Rock hole
Sand dune
Road
Track
△ Trigonometrical station
•1710 Height in feet, instrument levelled } Datum mean sea level. Port Augusta
•1624 Height in feet, barometric
P.D. Position doubtful

Compiled and issued by the Bureau of Mineral Resources, Geology & Geophysics, Department of National Development. Topographic base compiled from controlled air-photo mosaics supplied by the Western Australian Department of Lands and Surveys. Aerial photography by the Royal Australian Air Force; complete vertical coverage at 1:40,000 scale. Transverse Mercator Projection.

INDEX TO ADJOINING SHEETS
Showing Magnetic Declination



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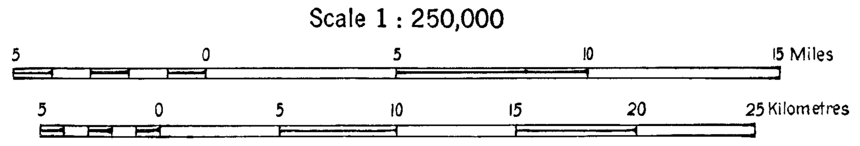
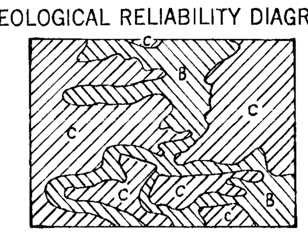
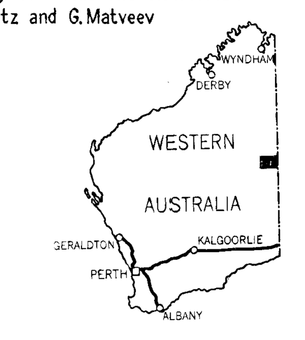


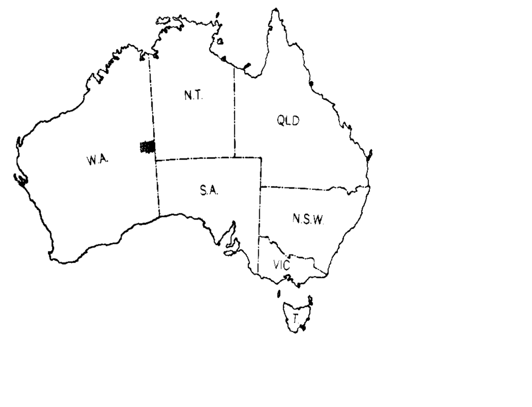
GEOLOGICAL RELIABILITY DIAGRAM



B Reconnaissance: traverses and air-photo interpretation
C Sketchy: air-photo interpretation

Geology and compilation 1962 by: A.T. Wells, D.J. Forman, L.C. Ranford
Geology 1963 by: D.J. Forman and P.M. Hancock
Recompiled 1964 by: A.T. Wells and D.J. Forman
Drawn by: H.F. Boltz and G. Matveev





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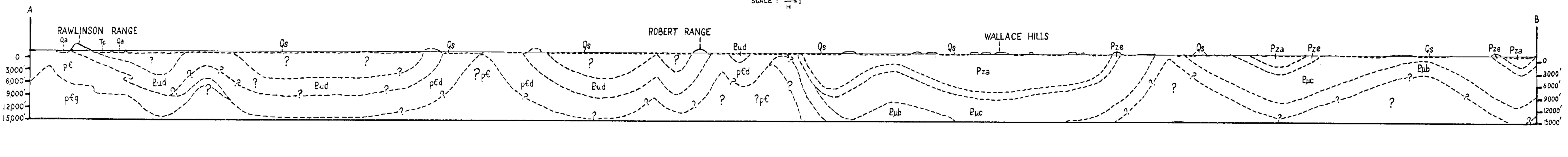


RAWLINSON
SHEET SG52-2

MACDONALD

WESTERN AUSTRALIA

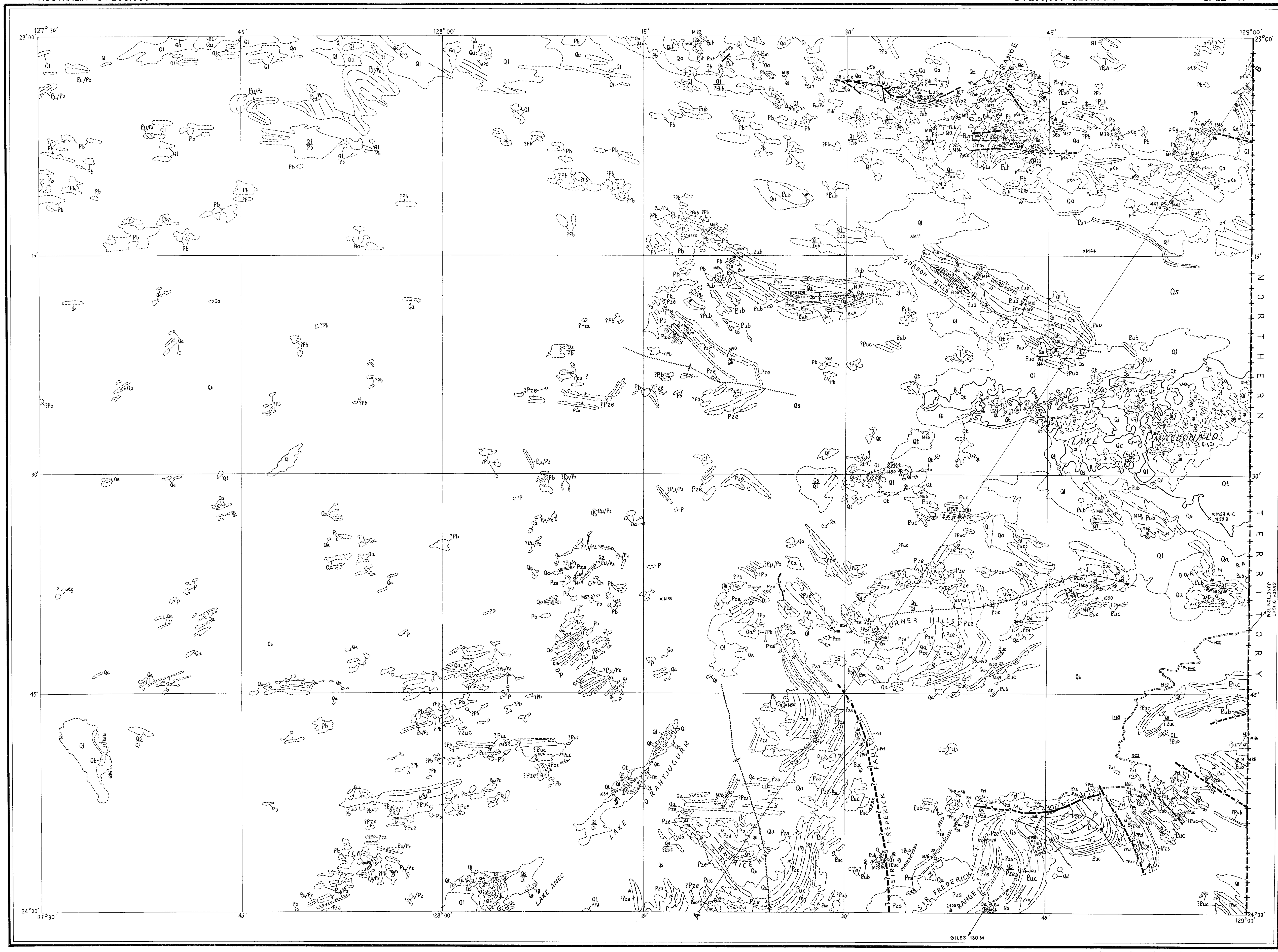
AUSTRALIA 1 : 250,000

1 : 250,000 GEOLOGICAL SERIES SHEET SF52 - 14

PRELIMINARY EDITION, 1964

SUBJECT TO AMENDMENT

PLATE 8



Reference

CAINOZOIC	QUATERNARY		Qs	Aeolian sand
			Qa	Alluvium
			Qt	Evaporites
			Ql	Travertine
PALAEOZOIC	PERMIAN		P	Sandstone and siltstone
		Buck Formation	Pb	Coarse sandstone, conglomerate with tillitic texture, siltstone erratics
		Ligertwood Beds	Pzl	Breccia, sandstone, conglomerate, conglomeratic sandstone
	ORDOVICIAN		O	Fossiliferous mottled pink and white limestone, sandstone
	Unconformity			
UPPER PROTEROZOIC-LOWER PALAEOZOIC		Maurice Formation	Pza	Quartz sandstone, quartz greywacke, micaceous siltstone, sandstone
		Sir Frederick Conglomerate	Pzs	Pebble, cobble, and boulder conglomerate, thin interbeds of sandstone
		Ellis Sandstone	Pze	Quartz sandstone, some interbedded calcareous sandstone, pebbly sandstone, siltstone
			Ꝑu/Pz	Quartz greywacke, sandstone, siltstone
	Unconformity ?			
PRECAMBRIAN	UPPER PROTEROZOIC	Carnegie Formation	Ꝑuc	Quartz greywacke, sandstone, siltstone, shale
		Boord Formation	Ꝑuo	Calcarenite, calcilutite, dolomite, limestone and dolomitic limestone with stromatolites. Interbedded siltstone. Pebble, cobble and boulder conglomerate with tillitic texture, breccia and sandstone near base
		Bitter Springs Limestone	Ꝑub	Dolomite, limestone, calcilutite, siltstone. Stromatolites. Chert bands and nodules
		Heavitree Quartzite	Ꝑuh	Quartz sandstone with shale, siltstone, fine conglomerate
	Angular Unconformity			
			p€s	Quartz-feldspar porphyry, low-grade metasedimentary rocks, siltstone, chert, conglomerate, acid igneous rocks, dolerite, quartz-feldspar-mica schist
			p€g	Granite and some aplite
			p€	Gneiss and quartzite

Geological boundary

Syncline, showing plunge

Anticline, showing plunge

Fault

Where location of boundaries, folds and faults is approximate, line is broken: where inferred, queried; where concealed, boundaries and folds are dotted, faults are shown by short dashes.

Strike and dip of strata

Overturned strata

Prevailing dip

Horizontal strata

Dip < 15° }

Dip 15°—45° }

Dip > 45° } air-photo interpretation

Trend of bedding }

Joint pattern }

Strike and dip of joints

Vertical joints

Strike and dip of foliation

Vertical foliation

Macrofossil locality

Quartz vein

MFX8 Measured section

× M 85 Text reference to specimen locality

·1710 Height in feet, instrument levelled } datum: mean sea level,

·1624 Height in feet, barometric } Port Augusta

Road

Trig. station

Compiled and issued by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Topographic base compiled from semi-controlled air-photo mosaics by the Western Australian Department of Lands and Surveys. Aerial photography by the Royal Australian Air Force ; complete vertical coverage at 1: 40,000 scale. Transverse Mercator Projection.

INDEX TO ADJOINING SHEETS
Showing Magnetic Declination

WILSON	WEBB	LAKE MACKAY
RYAN	MACDONALD	MT RENNIE
COBB	RAWLINSON	BLOODS RANGE

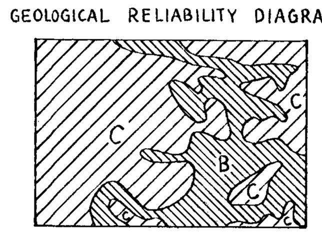
ANNUAL CHANGE 1' E.

Scale : 1 : 250 000

5 0 5 10 15 Miles

5 0 5 10 15 20 Kilometres

GEOLOGICAL RELIABILITY DIAGRAM



B *Reconnaissance: Traverses and air-photo interpretation*

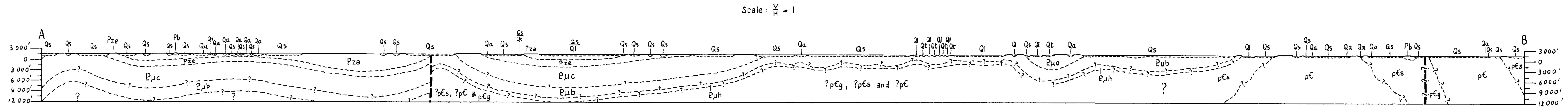
C *Sketchy: Air-photo interpretation*

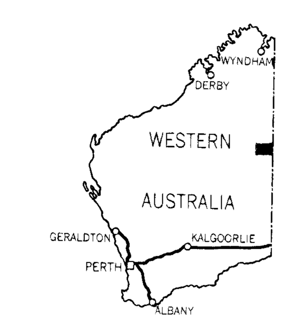
Geology and compilation 1962, by: A.T. Wells, D.J. Forman, L.C. Ranford.

Drawn by : K. Matveev

Section

Scale: V/H = 1





MACDONALD
SF 52-14