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GEOLOGY OF THE LONGREACH-JERICHO-LAKE BUCHANAN AREA,

QUEENSLAND

by

R.R. VINE, W. JAUNCEY, D.J. CASEY and M.C. GALLOWAY

THE GEOLOGY OF THE LONGREACH - JERICHO - LAKE BUCHANAN AREA, QUEENSLAND.

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(*Geological Survey of Queensland)

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SUMMARY

During 1964 the Mesozoic sequence and overlying Cainozoic sediments of the Maneroo, Longreach, Jericho, Galilee and Buchanan 1:250,000 sheets were mapped, and subsurface occurrences of Upper Palaeozoic sediments studied.

In the Galilee Basin up to 6000 feet of Upper Carboniferous to Lower Permian sediments are unconformably overlain by approximately 3000 feet of Upper Permian and Triassic sediments. The Triassic sequence is comparable with that on the Springsure Shelf.

In the Eromanga Basin in the Barcaldine area the Jurassic sequence is thin - mainly less than 1000 feet. To the west the oldest sediments are Upper Jurassic; there, up to 1500 feet of Upper Jurassic to Lower Cretaceous sediments are overlain by up to 4000 feet of sediments of the Cretaceous Rolling Downs Group.

Several major faults, active intermittently during the Late Palaeozoic and Mesozoic, have influenced sedimentation.

Aquifers are present in almost all stratigraphic units. Several oil shows have been reported, and the petroleum potential of the area is considered to be fairly good. Opal was once mined in the area but there has been no significant production for 50 years.

INTRODUCTION

Geological mapping by the Great Artesian Basin party during the 1964 field season was part of a long-term project to map the whole of the Queensland portion of the Great Artesian Basin. The work is being done jointly by the Bureau of Mineral Resources and the Geological Survey of Queensland. The 1964 field season lasted from the beginning of June to early October; much time was spent plotting accurately the position of bores and new major roads. The party consisted of R.R. Vine, W. Jauncey, M.C. Galloway and I. Chertok (draftsman) of the Bureau of Mineral Resources, and D.J. Casey of the Geological Survey of Queensland.

The whole of the Longreach* and Maneroo* 1:250,000 Sheet areas, and parts of the Buchanan*, Galilee* and Jericho* Sheet areas were mapped. Over the greater part of the region only the Mesozoic sequence could be mapped; the Permian and older sequences are exposed only in JERICHO and BUCHANAN.

The area mapped and main access routes within the area are shown on Fig. 1. Late in 1964 sealed roads in the area were:

(a) the Landsborough highway between Barcaldine and Blackall
(b) the Capricorn Highway for about 10 miles east of Barcaldine
(c) the Landsborough highway between Barcaldine and Longreach
(d) the Landsborough highway for about 10 miles north-west of Longreach
(e) the road from Ilfracombe to Isisford for about 15 miles south of Ilfracombe.

*Throughout this report 1:250,000 Sheet areas are referred to simply by the name in capitals, e.g. LONGREACH; towns of the same name are written normally e.g. Longreach.

Most unsealed roads are impassable for a few days after heavy rain, but major roads have been constructed with high crowns to improve drainage. Regular air services operate from Brisbane to Longreach and from Rockhampton to Alpha, Barcaldine, and Longreach. The area is linked to Brisbane by the Landsborough Highway and Rockhampton by the Capricorn Highway.

R.A.A.F. aerial photos, at an approximate scale of 1:48,000, taken in 1951 and 1952, provide a complete coverage of the whole area except for a small gap on the boundary between JERICHO and GALILEE. In addition, BUCHANAN was rephotographed in 1962 by Adastra Airways; these more modern photos are at an approximate scale of 1:85,000. Planimetric maps at 4 miles to 1 inch are available from the Queensland Department of Public Lands, Brisbane. The Buchanan 4 miles to 1 inch topographic sheet, produced by the Royal Australian Survey Corps in 1943, and provisional editions of Longreach, Maneroo, Jericho and Galilee 1:250,000 planimetric sheets are available from the Division of National Mapping, Canberra.

Water supplies in the area are obtained mainly from bores, most of which have to be pumped. Flowing bores are now restricted to LONGREACH and the eastern quarter of MANEROO. Some supplies are also obtained from waterholes along the larger rivers and creeks, but few of these are permanent.

During the field season 9 shallow core holes were drilled; 5 in LONGREACH, 3 in JERICHO and 1 in GALILEE. The main conclusions from this drilling are incorporated in the relevant sections of this report; the details are recorded separately (Vine & Galloway, 1965). Cores are stored at the Bureau of Mineral Resources Core and Cuttings Laboratory, Fyshwick, A.C.T.

The classification of arenites used is that proposed by Crook (1960). The term 'shale' is restricted to fissile claystone; 'mudstone' is used for all fine-grained lutites for which size analyses are not available, or for fine-grained lutites of mixed clay and silt grades. Grain sizes terms follow the Wentworth Scale. Bedding terminology follows that proposed by McKee and Weir (1953).

All fossil collections are stored in the Bureau of Mineral Resources Museum in Canberra. Collection numbers are prefixed "GAB"; the localities are shown on the maps with the abbreviated prefix "G".

PREVIOUS INVESTIGATIONS

Before the 1964 survey there had been little systematic geological work in the area. Some fairly detailed mapping was carried out for Shell (Queensland) Development Pty Ltd in the area south of Jericho and Alpha by Woolley (1941; with summary, including photo-geological interpretation, in S.Q.D., 1952). Several detailed and reconnaissance surveys supported by shallow scout drilling were carried out in the Longreach area, mainly for Longreach Oil Ltd, Delta Oil and Westland Oil Ltd; most of the reports and results are only retained as file records. Isolated observations in the Longreach area were reported by Ball (1927a, b) and Crespin (1945). Jackson (1902) described the opal deposits at Opalton, and Cribb (1948) added a note on later production. A photo-interpretation of GALILEE and JERICHO was made by Drummond and Scanvic (1963).

An understanding of the regional stratigraphy and the structural setting of the whole basin gradually developed from widely spaced observations. Whitehouse was the first to attempt to map the Great Artesian Basin as a whole and co-ordinate previously recorded observations and stratigraphic nomenclature. The most complete accounts of the geology of the whole basin were compiled by Whitehouse (1954) and in 'The Geology of Queensland' (Hill and Denmead, eds., 1960).

Drilling in the search for petroleum has yielded a considerable amount of geological information which has been drawn on extensively in this report. Published information on the wells is limited to summaries of oil exploration activity (particularly G.S.Q., 1960 and supplements), but practically all the well completion reports are available on open file at the Geological Survey of Queensland; completion reports of wells subsidized under the Petroleum Search Subsidy Acts are also available on open file at the Bureau of Mineral Resources, Canberra. References to the well completion reports are listed below; these are not repeated throughout the body of the report.

L.O.L. No 1 (Cleeve)	Mott, 1955a
L.O.L. No 2 (Longreach)	Mott, 1955b
L.O.L. No 3 (Longreach)	Mott, 1955c
L.O.L. No 4 (Longreach)	Mott, 1955d
L.O.L. Saltern Creek No 1	Mott & Associates, 1964a
L.O.L. Hulton No 1	Mott & Associates 1964 b
L.O.L. Marchmont No 1	Mott & Associates 1964 c
F.D. Alice River No 1	Hare & Associates 1963
A.O.D. Maranda No 1	Le Blanc, 1963
Exoil Lake Galilee No 1	Pemberton, 1965
A.A.O. Penrith No 1	MAP 1963
A.A.P. Fermoy No 1	AAP 1965a
A.A.P. Mayneside No 1	AAP 1965b

The results of the subsidized Alliance Oil Development Jericho No. 1 well were still confidential during the preparation of this report.

Geophysical surveys are listed in Table 1. The results are discussed under 'STRUCTURE'.

TABLE 1 - GEOPHYSICAL SURVEYS

Survey	Organisation	Reference
Isolated gravity traverses	Shell (Queensland) Development	S.Q.D., 1952
Isolated gravity traverses	University of Sydney	Marshall & Narain, 1954
Close gravity traverses	Westland Oil	Unpublished
Close gravity traverses	Longreach Oil	Unpublished
Helicopter gravity	Bureau of Mineral Resources	Gibb, 1963 & in prep.
Barcaldine gravity	Farmout Drillers	Harkey, 1964
Bowen Basin aeromagnetic	Bureau of Mineral Resources	Wells & Milson, in prep.
Tambo-Augathella aeromagnetic	Magellan Petroleum	M.P.C., 1963
Aramac-Mount Coolon aeromagnetic	Exoil	A.H.G., 1962
Isolated aeromagnetic traverses	Bureau of Mineral Resources	Jewell, 1960; and not reported
Mayne seismic reflection	Conorada Petroleum	A.G.P., 1962
Ruthven seismic reflection	Marathon Petroleum	Harwood and Vind, 1963
Binburi seismic reflection	Marathon Petroleum	G.S.I., 1964
Fermoy seismic reflection and refraction, gravity and magnetic	Australian Aquitaine Petroleum	C.G.G., 1964a
Vergemont seismic reflection and refraction	Australian Aquitaine Petroleum	C.G.G. 1964b
Longreach-Silcoe seismic reflection	Cree Oil of Canada	C.O.C., 1962
Maneroo seismic reflection	Associated Australian Oil	G.S.I., 1962
Balmoral seismic reflection	Longreach Oil	G.A.L., 1962b
Rodney Downs seismic reflection	Longreach Oil	G.A.L., 1963
Brixton seismic reflection	Longreach Oil	U.G.C., 1964
Coreena seismic reflection	Oil Development	G.A.L., 1962a

Survey	Organisation	Reference
Lagoon Creek seismic reflection	Farmout Drillers	G.G.C., 1963a
Alpha seismic refraction	Oil Development	G.G.C., 1963b
Jericho seismic reflection and refraction	Alliance Oil Development	N.I.I., 1964
Lake Galilee - Lake Buchanan	Exoil	A.G.P., 1963

PHYSIOGRAPHY

The watershed between streams draining to the Pacific Ocean and those forming part of the Lake Eyre internal drainage basin extends through the eastern part of the area mapped; most maps show this watershed as the Great Dividing Range. In parts of BUCHANAN and JERICHO the watershed follows lines of hills formed by outcrops of Triassic sandstones, but the relief is mainly less than 300 feet above the surrounding plains. In GALILEE the watershed is on a flat sand plain, and the term 'Great Dividing Range' has no topographic meaning whatsoever.

Neither Lake Buchanan nor Lake Galilee is permanent. For the major part of each year Lake Buchanan is a salt pan and the water it contains at other times is very saline. Water in Lake Galilee, when present, varies from salty to brackish, but is invariably fresher than Lake Buchanan.

Regionally the area is flat, but seven physiographic divisions can be recognized on minor relief and land form (Fig. 1).

Outcrops of Jurassic, Triassic and Permian sandstones form three <u>hilly belts</u>. Jurassic sandstones form the westernmost belt, which typically has an east-facing scarp up to 200 feet high. Within the belt are many sheer cliffs and narrow gorges, but westwards the hills merge gradually with sand plains. Permian sandstone with interbedded finer sediments form the easterly hilly belt in north-eastern JERICHO. These hills are rounded and generally less than 50 feet high. The central hilly belt which extends through JERICHO, GALILEE and BUCHANAN, is composed of Triassic sandstones. It is the most varied; in BUCHANAN, southern GALILEE, and northern and southern JERICHO, the hills are deeply dissected to produce the most rugged topography of the area. Relief in those areas is mainly between 200 and 300 feet and attaining 400 feet in some parts of BUCHANAN. Here bare sandstone hills are intersected by deep gorges and traversing the area is difficult. In central and northern GALILEE, the sandstone hills are generally rounded, with relief less than 100 feet; they merge into the surrounding sand plain.

A nearly flat plain west of the central belt of sandstone hills was called the <u>Alice Tableland</u> by Whitehouse (1940). It includes the internal drainage

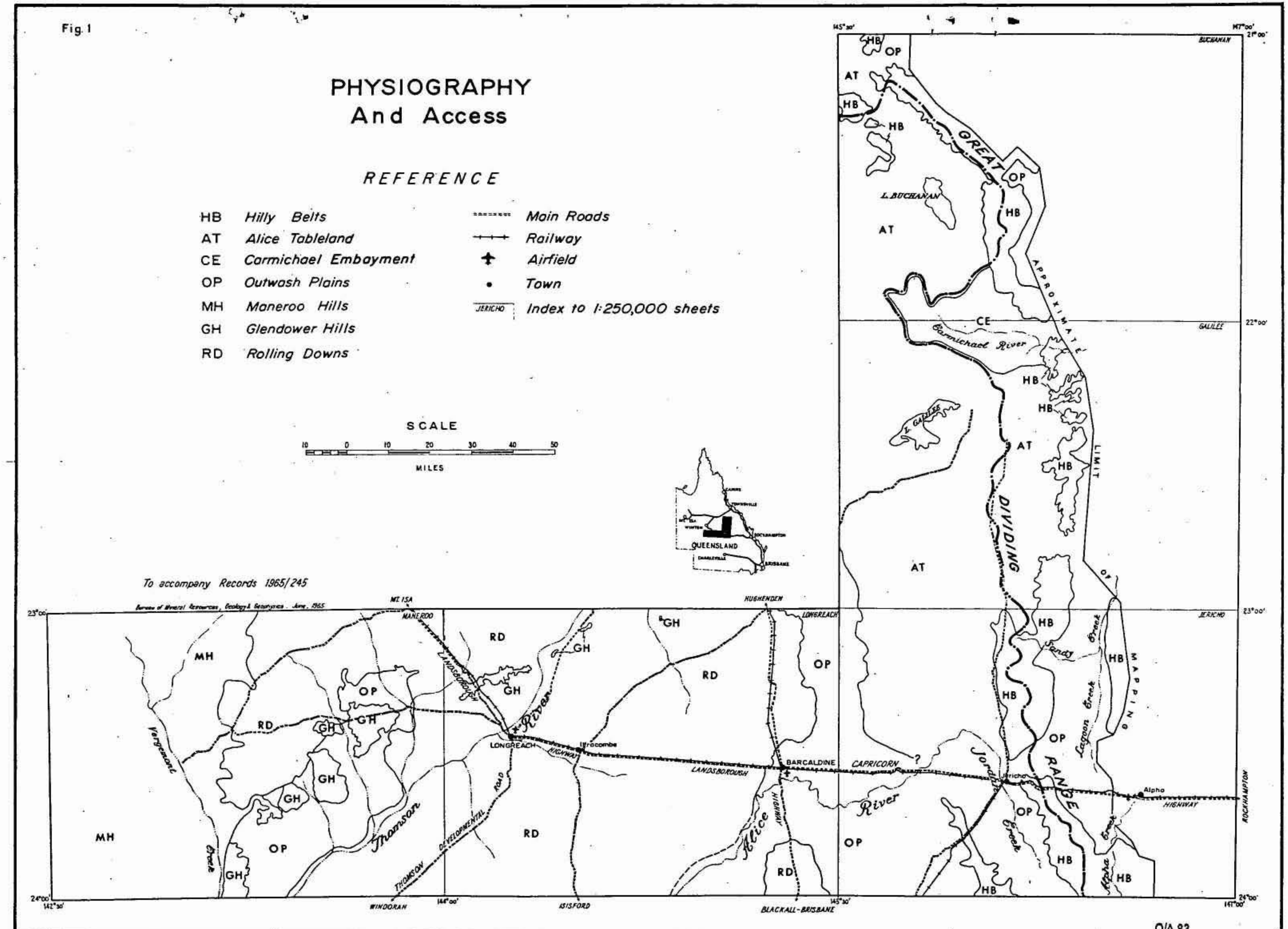


Fig. 1
PHYSIOGRAPHY
And Access
REFERENCE
HB Hilly Belts
AT Alice Tableland
CE Carmichael Embayment
OP Outwash Plains
MH Maneroo Hills
GH Glendower Hills
RD Rolling Downs
Main Roads
Railway
Airfield
Town
JERICHO Index to 1:250,000 sheets
SCALE
10 0 10 20 30 40 50
MILES
QUEENSLAND
To accompany Records 1965/245
BUCHANAN
GALILEE
JERICHO
LONGREACH
MANEROO
L. BUCHANAN
L. GALILEE
Carmichael River
GREAT
DIVIDING
RANGE
APPROXIMATE LIMIT OF MAPPING
Thomson
River
Alice
Jordan
Sandy Creek
Lagoon Creek
Alpha Creek
Vergemont Creek
LANDSBOROUGH
LONGREACH
Ilfracombe
BARCALDINE
CAPRICORN
Jericho
Alpha
HIGHWAY
THOMSON DEVELOPMENTAL ROAD
MT ISA
HUGHENDEN
WINDORAH
ISISFORD
BLACKALL-BRISBANE
ROCKHAMPTON
23°00'
24°00'
22°00'
21°00'
142°30'
144°00'
145°30'
147°00'
Q/A 83

basins of Lakes Galilee and Buchanan. Essentially it is an extensive plateau of low surface relief which once had a protective cap of duricrust developed on Mesozoic and Cainozoic sediments. Erosion has locally sharpened the pre-existing relief to form small discontinuous scarps of Jurassic sandstone and has removed some of the duricrust. Most of the Alice Tableland is now covered by thin Recent sediments and soil.

In three places only are the margins of the Alice Tableland distinct: the northern and north-western margins in HUGHENDEN and TANGORIN are abrupt scarps (Vine, Casey and Johnson, 1964); the Alice Tableland is bounded on the east by a hilly belt in BUCHANAN, southern GALILEE, and northern JERICHO; headward erosion of the Carmichael River has cut into the original duricrust-capped plateau and produced the Carmichael Embayment near the border between BUCHANAN and GALILEE. Within the Carmichael Embayment is a maze of duricrust-capped mesas and buttes bordered by gentle, rubble-covered, slopes and separated by creeks.

Elsewhere, the margins of the Alice Tableland are poorly defined. Over most of GALILEE and at the southern boundary near Jericho the superficial sediments which cloak the Alice Tableland merge imperceptibly into outwash plains composed of detritus from erosion of parts of the Alice Tableland and sandstone hills. The outwash plains are flat, but slope gently up to the areas from which the sediments were derived.

The Maneroo Hills comprise numerous mesas and buttes in the western half of MANEROO, and a large plateau in north-western MANEROO extending into WINTON. Relics of the duricrust form the protective caps to the hills but the flat top of the plateau is covered by superficial sediments derived from the erosion of the Tertiary Werite Beds in WINTON. Most of the watercourses in the Maneroo Hills are strongly braided.

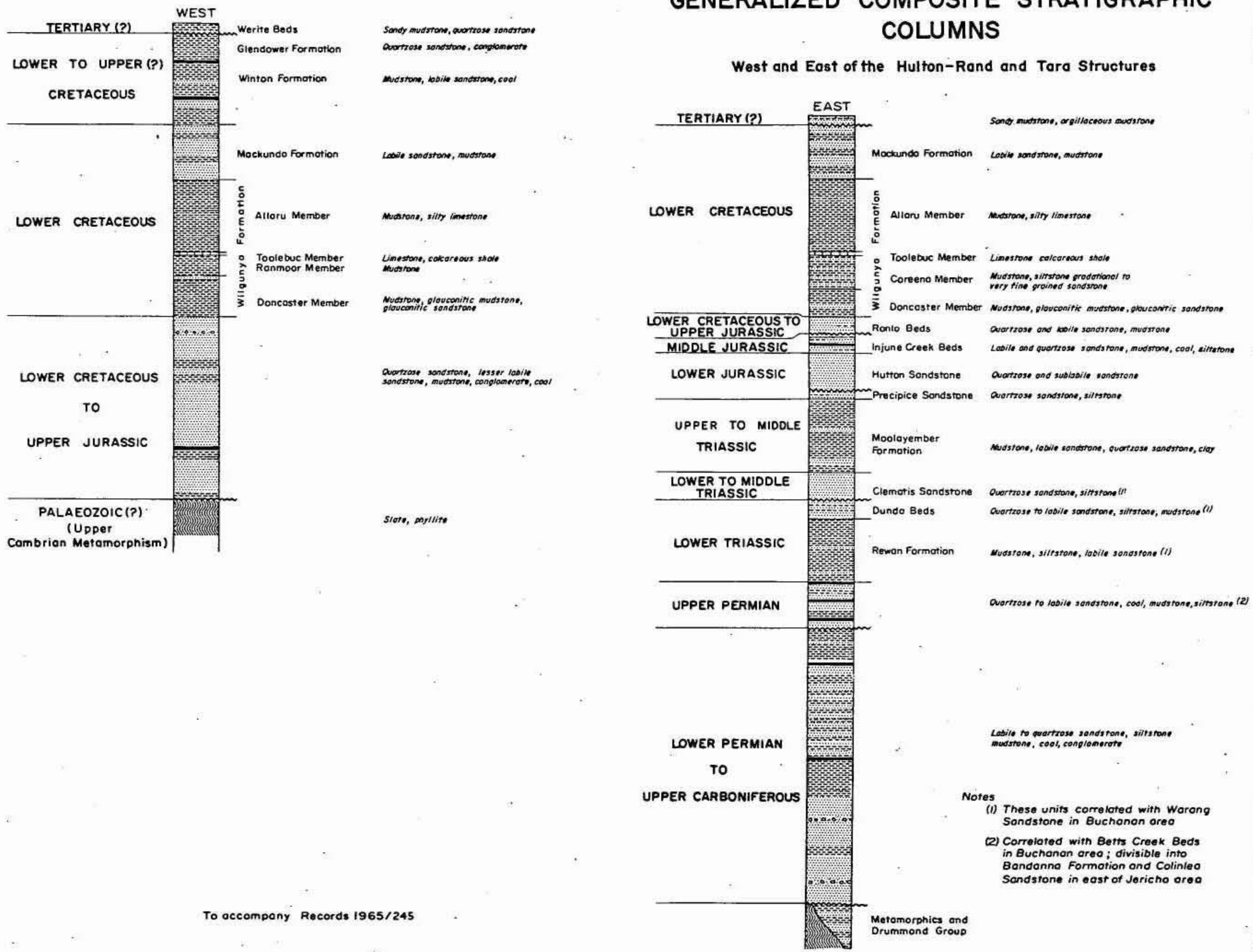
Poorly consolidated fluviatile sandstone and conglomerate of the Tertiary Glendower Formation once occupied a valley which extended to HUGHENDEN. They are more resistant than the surrounding Cretaceous sediments, and the relief has been inverted by differential erosion. Outliers of Glendower Formation form a chain of low rounded hills - the Glendower Hills - with marginal outwash plains.

Cretaceous sediments of the Rolling Downs Group (Wilgunya, Mackunda and Winton Formations) form rolling downs throughout much of LONGREACH and MANEROO. These are gently undulating grassland, almost tree-less, except for tree-lined watercourses and scattered, stunted trees on low stony rises. The rolling downs grade into the outwash plains as the thickness and extent of unconsolidated Cainozoic sediments increases. This transition is accompanied by a change from open grassland to lightly timbered country.

Fig. 2

GENERALIZED COMPOSITE STRATIGRAPHIC COLUMNS

West and East of the Hulton-Rand and Tara Structures



Notes
(1) These units correlated with Warang Sandstone in Buchanan area
(2) Correlated with Betts Creek Beds in Buchanan area; divisible into Bandanna Formation and Colinlea Sandstone in east of Jericho area

To accompany Records 1965/245

Bureau of Mineral Resources, Geology and Geophysics. July, 1965.

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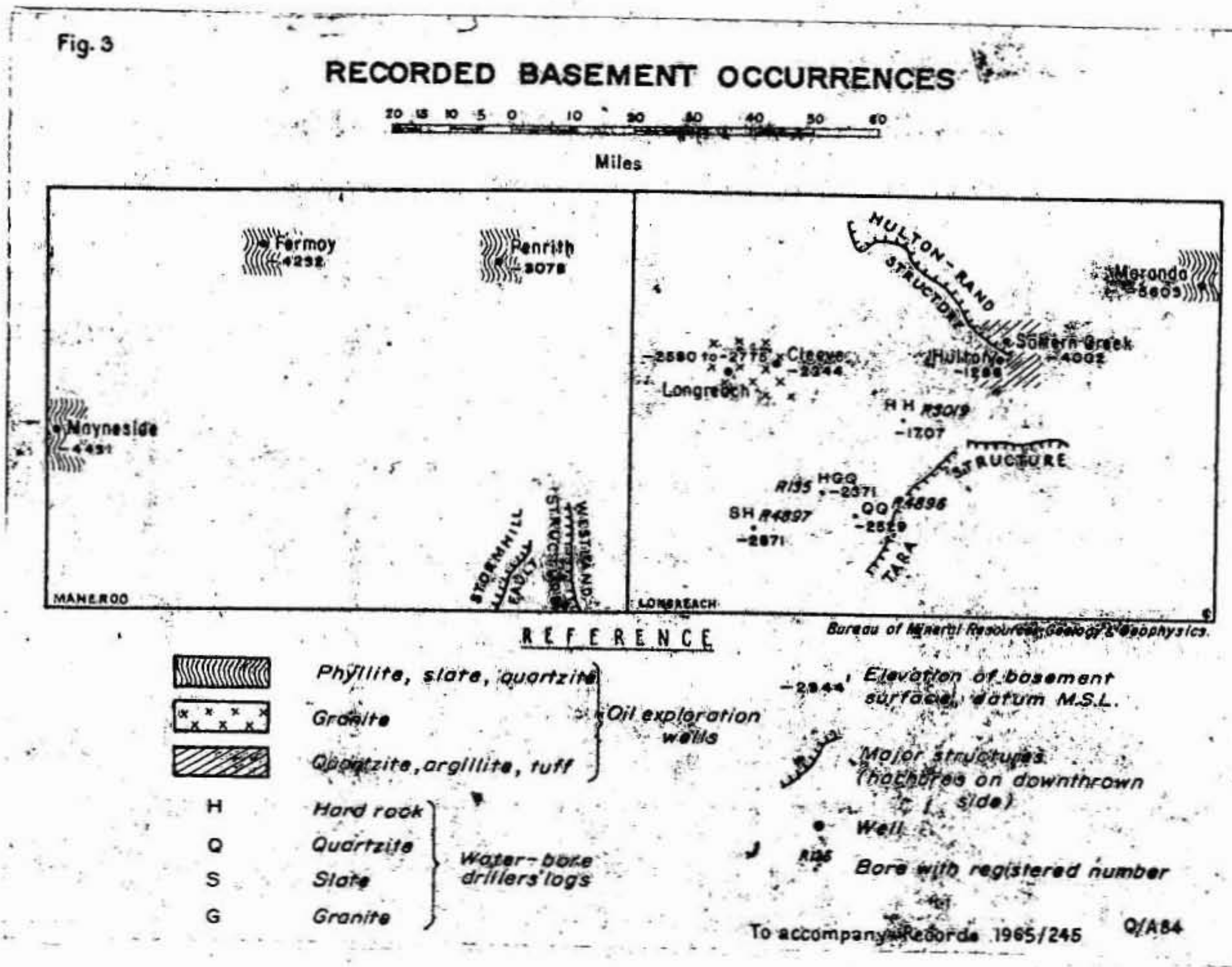
STRATIGRAPHY

Generalized stratigraphic columns are shown in Fig. 2.

CRYSTALLINE BASEMENT

Crystalline basement does not crop out in the area mapped during 1964. However, its presence subsurface in MANEROO and LONGREACH has been proved by several deep oil exploration wells, and indicated by the drillers' logs of some water bores. The occurrences, and the depths below sea level are shown on Fig. 3.



Some oil exploration wells did not reach basement; Q.O.D. No. 1 (Langdale) and L.O.L. No. 5 and 6 (Balmoral) were terminated in Jurassic sediments; Marchmont No. 1 and Alice River No. 1 in conglomerates, possibly of Upper Carboniferous to Lower Permian age; and Lake Galilee No. 1 in Devonian sediments of the Drummond Basin sequence.

Basement drilled by the oil exploration wells is broadly of three types:

(a) low grade metamorphics, in Mayneside No. 1, Fermoy No. 1, Penrith No. 1 and Maranda No. 1.

(b) granite, in the wells in the town of Longreach and in L.O.L. No. 1 (Cleeve).

(c) altered sediments and tuff in Saltern Creek No. 1 and Hulton No. 1.

Type (a) consists of steeply dipping and distorted phyllite and slate, which are black to grey in the Mayneside and Fermoy wells, but green in the Penrith and Maranda wells. (Green phyllite and slate also occur as basement in Beryl No. 1, 60 miles north of Penrith No. 1). Age determinations (A.A.P. 1965a, App. X) of the metamorphism of basement cores of Fermoy No. 1 are given in Table 2.

Table 2 - Age determinations of basement cores, Fermoy No. 1

Depth (feet)	K/Ar method ($\times 10^6$ years)	Rb/Sr method ($\times 10^6$ years)
5255	482	509
5260	540	526

Average: 510×10^6 years, i.e. Upper Cambrian

The name 'Diamantina Formation' was proposed by Australian Aquitaine Petroleum Pty Ltd (.A.A.P. 1965b) for these metamorphics.

Granite recorded in the wells at Longreach and Cleeve is weathered. That at Cleeve was dated by the K/Ar method as 418×10^6 years, i.e. Silurian (Webb, Cooper and Richards, 1963); it was noted that because of the weathering, the age should be regarded as minimal. Possibly the emplacement of the granite is related to the Upper Cambrian metamorphism.

Granite was also drilled in Brookwood No. 1, 68 miles north of Longreach and 24 miles east of Beryl No. 1; samples from the basement core of this well were unsuitable for age determination. However, the granite at Brookwood is probably continuous at depth with that at Longreach and Cleeve, because they are associated with a north-trending belt of negative Bouguer anomalies.

Granite at Ooroonoo No. 1 (about 170 miles west of Longreach) which was dated as Precambrian (860×10^6 years; Webb et al, op cit) is west of a major basement discontinuity represented at the surface by the Cork Fault and the Holberton Structure, and unrelated to the Palaeozoic history of the MANEROO-LONGREACH area.

Basement in Saltern Creek No. 1 and Hulton No. 1 poses a problem. In the completion reports on the wells the basement interval is described as quartzite and tuff (Mott and Associates, 1965a, b). D.C. Green (Mott et al, op cit, App. 1) described quartzites from the basement cores of both wells. He originally suggested that the quartzite of Saltern Creek No. 1 was formed from a quartz arenite by strong diagenesis because the rock lacked any trace of metamorphic orientation. In core 4 of Hulton No. 1, however, he noted the development of chlorite at the expense of muscovite, the introduction of epidote, and a slight degree of orientation of the fabric. Comparing the basement cores of the two wells he concluded that 'Although very similar rocks in appearance, the material from Hulton No. 1 appears to be of a more definite metamorphic type'.

Mott et al (op. cit) described the basement intervals under the heading 'Drummond Group'. The degree of alteration is considerably greater than in sediments of the Drummond Group drilled in Lake Galilee No. 1 at depths in excess of 10,000 feet (and in which spores are preserved), and in the sediments seen in outcrop in the Drummond Basin by the authors. Diagenesis alone, therefore, probably could not account for the degree of alteration. If the alteration was due to dynamic metamorphism of Drummond Group sediments by faulting movements of the Hulton-Rand Structure, an obvious, and probably steep, mineral orientation would be expected, but this is not evident. Correlation with the Drummond Group is, therefore, considered unlikely. The basement in Saltern Creek No. 1 and Hulton No. 1 may be metamorphics of similar age but lower in grade than the Diamantina Formation or the Anakie Metamorphics, or, more likely, it consists of younger sediments which have been slightly metamorphosed.

The descriptions of 'hard rock','slate', 'quartzite', and 'granite' in drillers' logs of several water-bores south-east of Longreach can best be interpreted as crystalline basement. The occurrences are on the upthrown side of the Tara Structure in an area where gravity and structural trends are NNE and continue to near Hulton No. 1. It is most likely, therefore, that basement recorded in these water bores is equivalent to that in Hulton No. 1 and Saltern Creek No. 1.

DEVONIAN - LOWER CARBONIFEROUS

DRUMMOND BASIN SEQUENCE

The only proven occurrences of sediments of the Drummond Basin sequence in the area mapped are in the interval 9320-11, 175 feet (T.D.) in Lake Galilee No. 1. The sediments are mainly argillaceous, with fine sandstone at the top and bottom of the drilled interval. A poorly preserved and generally sparse microflora of probable Upper Devonian age was obtained from cores throughout most of the interval (Playford, App. 1 (a) in Pemberton, 1965).

These sediments will be discussed fully following the systematic mapping of outcrops in the Drummond Basin immediately east of the area mapped in 1964.

Mott and Associates (1965a, b) inferred the presence of Drummond Basin sediments at the bottom of Saltern Creek and Hulton wells. These occurrences are discussed under 'Crystalline Basement' (above).

UPPER CARBONIFEROUS TO LOWER PERMIAN

The time interval from Upper Carboniferous to Lower Permian is represented in the northern Eromanga Basin by a little-known sequence of sediments, the upper and lower limits of which are major regional unconformities. Outcrops are, apparently, few; most of the information is obtained from subsurface intersections in widely scattered oil exploration wells. The sequence discussed in this section corresponds to Evans' (1964b) palynological divisions C1 and C2, of Upper Carboniferous age, and P1a, P1b and P1c of Lower Permian age. Dr. Evans' analysis of the microfloras and availability for discussion has been vital to the compilation of the following section. It must be emphasised that the Upper Carboniferous to Lower Permian sequence is essentially a time-rock unit, as identification is largely on palaeontological evidence.

In the Galilee sediments of these palynological divisions overly the Drummond Group on the eastern margin, and crystalline basement further west; they are overlain by the Colinlea Sandstone and its correlates (the base of Evans' palynological division P3-4).

To the south-east, on the Springsure Shelf, the Joe Joe Formation is of C1 and possibly C2 age and is overlain disconformably by the Reid's Dome Beds of P1c age. Outcrop of the Joe Joe Formation is continuous through TAMBO into JERICHO, but the Reids Dome Beds wedge out in TAMBO (Exon and Kirkegaard, 1965). In Galah Gorge, north of Hughenden, on the north-eastern margin of the Eromanga Basin, the Boonderoo Beds of P1a and possibly P1b age (Evans, 1964a) are unconformably overlain by the Betts Creek Beds of P3-4 age (Vine, Casey & Johnson, 1964).

Within, and adjacent to, the area mapped during 1964 sediments of this time interval crop out only poorly, and no attempt was made to investigate them in detail. The following comments are made as a result of a limited number of observations, but serve as a basis for discussion of the subsurface intersections.

The outcrop belt of the Joe Joe Formation of TAMBO (Exon and Kirkegaard, op. cit.) extends into the south-east of JERICHO, east of Alpha Creek. In this area outcrops are generally poor and widely scattered. They are mainly mudstone, with thin to thick interbeds of siltstone, gradational in grain-size to very fine-grained sandstone. The mudstone is grey or green (yellow where weathered) commonly blocky, but some is fissile or, apparently shale. Sole markings were observed. The siltstone and sandstone are mainly labile, and commonly argillaceous. Minor amounts of sandy limestone and quartzose sandstone are also present.

A single plant fossil collection, GAB 1742, was made from the Joe Joe Formation in this area. From it White (1965) recorded mainly indeterminate stem casts, but noted some fragments with Glossopteris venation which she suggested indicated a Permian age for the unit. Samples from a depth of approximately 100 feet in a new bore at Omega Homestead (roughly along strike from GAB 1742) contain spores which Evans (in prep) identified as included in his palynological divisions P1a or C2. The close association of spores of P1a or C2 age with Glossopterid fragments also occurs in the Boonderoo Beds, and suggests that this part of the Joe Joe Formation is of comparable age.

Another outcrop of the Joe Joe Formation occurs in JERICHO at Grid Reference 461090, within a belt of outcrops marked 'P' on the map. This occurrence was noted during a brief re-examination of the area in 1965. Here, about 20 feet of weathered, labile, fine-grained sandstone is disconformably overlain by polymictic conglomerate and quartzose sandstone of the Colinlea Formation. Further outcrops of the Joe Joe Formation probably occur northwards in the eastern part of the belt marked 'P'.

Lower Triassic Warang Sandstone overlies about 10 feet of labile sandstone at White Cliffs in BUCHANAN; the two units are apparently concordant. The lower unit is designated on the map by the symbol 'Pz'. It contains common wood pieces, but the collection made, GAB 1448, contained nothing determinate (White, 1965). To the west the Upper Permian Betts Creek Beds form a belt of SW-dipping sediments, apparently overlying this sandstone, and unconformably overlain by the Warang Sandstone.

Similar labile sandstone occurs as scattered floaters to the north-east near Mirtna Homestead. Core 19 from Lake Galilee No. 1, from within the Upper Carboniferous to Lower Permian sequence is also very similar. Possibly, the White Cliffs exposure is part of a large area of sediments east of the Great Dividing Range which may be correlated, in part at least, with the Joe Joe Formation.

SUBSURFACE

Subsurface intersections of sediments corresponding to the C1-P1c divisions are shown on Plate 1. Spores of Pla-c age have also been recorded from Exoil Brookwood No. 1 (Evans, 1964b) and A.A.O. Beryl No. 1 (Evans, Appendix 2 in MAP, 1964).

No detailed lithological correlation has been attempted at this stage because of

(a) lack of well documented outcrops for comparison
(b) marked lateral and vertical variability of rock types
(c) marked differences in thicknesses
(d) distance between wells.

The following general comments apply to the palynological correlation suggested by Evans (1964b, Figure 2) supplemented by later comments (Appendix 1 (b) in Pemberton, 1965) on Lake Galilee No. 1. As the divisions are based on spot determinations in cores, boundaries are only approximate.

Palynological divisions C1 and C2

Intersections: Lake Galilee No. 1 (approx. 5900' - 9320')
Maranda No. 1 (approx. 4800' - 6465')
Alice River No. 1 (approx. 3500' - T.D.)

Rock types: (Generalized lithology of each intersection is shown on Plate 1)

Sandstone; dominantly light grey, quartzose, with minor amounts of feldspar or sand sized grains of clay; more labile at base of sequence; reworked shale fragments common in some beds in Alice River No. 1 and Maranda No. 1; commonly with argillaceous matrix or siliceous cement, rarely with calcareous cement. Mainly fine-grained, but ranges from very fine-grained to coarse-grained and pebbly.

Mudstone (including shale), grey, green and brown, some vari-coloured; generally slightly micaceous, commonly siliceous, commonly silty; in Lake Galilee No. 1 commonly carbonaceous.

Siltstone mainly grey, minor green and brown, commonly sandy and muddy; in Lake Galilee No. 1 commonly carbon-aceous and, between 6880' and 7500', very calcareous, gradational to silty limestone.

Conglomerate mainly as thick intervals of quartzose pebble conglomerate. At base of Alice River No. 1 and Maranda No. 1 pebble to cobble polymictic conglomerate, with abundant granitic clasts.

Coal In Lake Galilee No. 1, mainly thin seams gradational from carbonaceous partings and carbonaceous shale.

Thickness: 3400 feet approx. in Lake Galilee No. 1
1700 feet approx. in Maranda No. 1
1800 feet approx. in Alice River No. 1; base not seen.

Fossils and age: Plant remains recorded in Lake Galilee No. 1 and Maranda No. 1, but no determinations attempted. On palynological evidence the sediments were identified as Lower Permian in Maranda No. 1 by De Jersey (Appendix 2 in Le Blanc, 1963) and in Lake Galilee No. 1 by Playford (Appendix 1 (a) in Pemberton, 1965). Evans (Appendix 1(b) in Pemberton, 1965), following review of criteria of Carboniferous/Permian boundary (Evans & White, in prep.), assigns sediments to Upper Carboniferous (palynological units C1 and C2). The differences is only one of nomenclature; the microflora and relative stratigraphic position are agreed by all. Evans' nomenclature is followed in this report. Correlates with Joe Joe Formation of SPRINGSURE.

In Lake Galilee No. 1, sediments of C1 age disconformably overly Upper Devonian (or possibly Lower Carboniferous) sediments of the Drummond Basin sequence. In Maranda No. 1, C1 sediments unconformably overly low grade metamorphics of probable Lower Palaeozoic age. Alice River No. 1 terminated in conglomerate at the base of a sequence of sediments of C1 age; seismic evidence and the abundance of granitic fragments indicate that the conglomerate rests on crystalline basement a little below the bottom of the well.

As sediments of both C1 and C2 age are present in all three wells, variations in thickness are interpreted as due to original differences in rate of sedimentation, and not to conditions of onlap or subsequent erosion.

In Lake Galilee No. 1 the sediments are predominantly argillaceous and commonly carbonaceous apart from a thick interval of sandstone at the base of the sequence. By contrast in Maranda No. 1 and Alice River No. 1 the sequence is sandier and poorly carbonaceous.

The association of thickest sedimentation with lutites and thinnest with arenites is broadly indicative of central and marginal positions respectively in a depositional basin. The western limit of the basin in Upper Carboniferous time was east of the Hulton-Rand structure (and probably the Tara Structure) where Lower Permian sediments directly overly pre-Upper Carboniferous rocks. Abundance of coal and carbonaceous material and lack of marine organisms in Lake Galilee No. 1 suggests that that part of the basin was probably continental. There is, as yet, no evidence of evaporitic sediments, so drainage was probably good. The thick sequence suggests downwarping which may have favoured marine incursions.

Palynological Divisions Pla and Plb

Intersections: Lake Galilee No. 1 (3476' - approx. 5900')
Maranda No. 1 (approx. 3400'-approx. 4800')
Alice River No. 1 (2822'-approx. 3500')
Saltern Creek No. 1 (approx. 3000'-4770')
Hulton No. 1 (1830'-2058')
Marchmont No. 1 (approx. 4100-T.D.(?))

Rock types: (Generalized lithology of each intersection shown on Plate 1).

Mudstone (including shale) grey and green, minor brown and red-brown; generally slightly micaceous, commonly carbonaceous; commonly slightly calcareous in Saltern Creek No. 1, Hulton No. 1 and Marchmont No. 1.

Sandstone mainly grey, lesser white, rare brown; mainly fine to medium-grained, subordinate very fine-grained and coarse-grained. Composition varies from quartzose to labile (variously described as greywacke, feldspathic sandstone, arkosic sandstone); commonly argillaceous, some micaceous, some carbonaceous, some calcareous.

Siltstone generally subordinate to mudstone and sandstone, and gradational from both.

Conglomerate and pebbly beds occur sporadically, but mainly in Maranda No. 1, Alice River No. 1, and Marchmont No. 1. Confined to the middle and lower parts of the interval; mostly quartzose, but in the lower part of Marchmont No. 1 include many granitic pebbles. Pebbles also occur as erratics in labile sandstone, mudstone and siltstone beds.

Coal Occurs as thin seams or partings throughout interval in Lake Galilee No. 1 and Marchmont No. 1, and to a lesser extent in Saltern Creek No. 1; almost completely absent in Alice River No. 1 and Maranda No. 1.

Thickness: 2400 feet approx. in Lake Galilee No. 1; top eroded.
1400 feet approx. in Maranda No. 1
700 feet approx. in Alice River No. 1; top eroded.
1800 feet approx. in Saltern Creek No. 1; erosional base.
228 feet in Hulton No. 1; erosional base and top eroded.
2400 feet approx. in Marchmont No. 1; base not seen.

Fossils and age: Plant remains recorded in Lake Galilee No. 1 and Maranda No. 1 but no determinations attempted. On palynological evidence interval identified as Lower Permian (De Jersey, Appendix 2 in Le Blanc, 1963; Playford Appendix 1 (a) in Pemberton, 1965; Playford, Appendix 2 in Mott et al, 1965 a, b, c; Evans Appendix 1 (b) in Pemberton, 1965).

Sediments of P1 a-b age overly sediments of C2 age with apparent conformity in Lake Galilee No. 1, Maranda No. 1 and Alice River No. 1. In Saltern Creek No. 1 Pla sediments unconformably overlie altered sediments regarded as basement. In Marchmont No. 1, the base of the Lower Permian sequence was apparently not reached, but the well bottomed in a conglomeratic sandstone containing pebbles of granite and a quartzite similar to basement in Saltern Creek No. 1 and Hulton No. 1. It is inferred, therefore, that basement is not far below the bottom of Marchmont No. 1. By lithological correlation the thin Lower Permian sequence in Hulton No. 1 is the uppermost part of unit Plb; it rests unconformably on basement similar to that in Saltern Creek No. 1.

Sediments of Plb age are overlain with apparent conformity by Plc sediments in Maranda No. 1, Saltern Creek No. 1 and Marchmont No. 1. They are overlain disconformably by Upper Permian (Palynological divisaon P3-4) sediments in Lake Galilee No. 1 and Alice River No. 1, and by the Lower Jurassic Hutton Sandstone correlate in Hulton No. 1.

The subsurface intersections indicate that the Upper Carboniferous basin of sedimentation spread considerably during Lower Permian time. Probably the effective western limits of the basin were the Hulton-Rand and Tara Structures, although late in Plb time sedimentation transgressed beyond the Hulton-Rand Structure and the very thin sequence encountered in Hulton No. 1 was deposited. Periodic local erosion or non-deposition near the margin of the basin is indicated by the sequence in Alice River No. 1 which is considerably thinner than in the other wells.

The Pla-b sequence is comparable with the Boonderoo beds. In particular varves, which characterise the Boonderoo Beds in Galah Gorge north of Hughenden (Vine et al, 1964) occur in the upper part of the interval in the wells (Pemberton, 1965). Galcial or periglacial conditions, postulated for the Hughenden area during Lower Permian time (Vine et al, op. cit) were probably widespread. But, whereas the area west of the Hulton-Rand Structure was being actively glaciated during most of this period, the resultant debris was being deposited as outwash or in glacial lakes in the lower sedimentary basin to the east.

Palynological Division Plc

Intersections:	Maranda No. 1 (2900'-approx. 3400') Saltern Creek No. 1 (approx. 2700'-approx. 3000') Marchmont No. 1 (approx. 3450'-approx. 4100')
Rock types:	(Generalized lithology of each intersection shown on Plate 1).

Mudstone, grey to black, mainly carbonaceous, somewhat silty, in part calcareous, micaceous, or pyritic.

Quartzose sandstone, grey, medium to coarse-grained (slightly pebbly in Maranda No. 1), and as interbeds of fine to medium-grained sandstone in argillaceous intervals. Main development is at top of Plc interval in Maranda No. 1.

Siltstone, grey, generally carbonaceous and micaceous; as minor interbeds.

Coal Hard, black, common in cuttings, and interpreted as thick seams from sonic logs.

Thickness: 500 feet approx. in Maranda No. 1
400 feet approx. in Saltern Creek No. 1
650 feet approx. in Marchmont No. 1

Fossils and age: Maranda No. 1, Core 9 at 3169 feet contains Glossopteris indica and Noeggerathiopsis sp. of Permian age (Day, Appendix 2(g) in Le Blanc, 1963). On palynological evidence interval identified as Lower Permian (De Jersey, Appendix 2(f) in Le Blanc, 1963; Evans, 1964b).

Palynological division Plc includes the Reid's Dome Beds (previously 'Undivided Freshwater Beds') of the Denison Trough and the Springsure Shelf. On the Springsure Shelf the Reid's Dome Beds rest unconformably on the Joe Joe Formation of C1-2 age, and are overlain unconformably by the uppermost Lower Permain Colinlea Sandstone (Mollan, Exon & Kirkegaard, 1964; the unit was named 'Reid's' Dome Beds subsequently to the 1964 report).

Plc sediments overlie Plb sediments with apparent conformity. They are overlain disconformably by Upper Permian (palynological division P3-4) sediments, and in Lake Galilee No. 1, Alice River No. 1 and Hutton No. 1 Upper Permian P3-4 sediments overlie Plb sediments disconformably. The base of the P3-4 sequence (the Colinlea Sandstone on the margin of the Eromanga Basin) is a regional unconformity, which reflects slight tectonic movement late in Lower Permian time. It is inferred, therefore, that the absence of Plc sediments in the Lake Galilee, Alice River and Hutton wells is due to subsequent erosion, and not non-deposition.

It is envisaged that by the end of Plb time erosion, including glaciation, had largely reduced the elevated land west of the Hulton-Rand Structure, and that the depositional level of the basin to the east was not much lower. On this surface of low relief the late Plb sedimentation was mainly of fine-grained deposits in glacial lakes. The change from the Plb to Plc microflora is possibly a reflection of a major floral change brought about by a general climatic change, i.e. a general warming at the end of the Upper Carboniferous to Lower Permian glacial period. The warm climate probably favoured the development of abundant, plant growth on wide, muddy, alluvial flats and in swamps, which resulted in the formation of carbonaceous mudstone and coal.

LOWER(?) - UPPER PERMIAN

The time interval of Evans' palynological division P2 is represented in the northern Eromanga Basin by a regional unconformity. The overlying sediments, corresponding to Evans' unit P3-4, comprise the Betts Creek Beds on the northern margin of the basin in BUCHANAN and the Colinlea and Bandanna Formations on the eastern margin in JERICHO. The Peawaddy Formation, which occurs between the Colinlea and Bandanna Formations on the Springsure Shelf, thins northwards across TAMBO, and cannot be recognized beyond the northern margin of that sheet area(Exon & Kirkegaard, 1965).

BETTS CREEK BEDS

'Betts Creek Series' was originally used by Reid (1916) in describing a sedimentary sequence in the Betts Creek area, west of Pentland in HUGHENDEN. The unit was renamed and defined as the Betts Creek Beds by Vine, Casey and Johnson (1964), and extended to include comparable sequences in the Oxley Creek area and Galah Gorge in HUGHENDEN, and a small area in western CHARTERS TOWERS. An Upper Permian (Evans' palynological division P3-4) age was inferred from macro and micro-floral evidence. (Vine et al, op cit.)

Distribution: In BUCHANAN, within a narrow NW-trending belt forming the east flank of the Great Dividing Range north of 21°30'S. Outcrops mainly poor in rubble-covered slopes marginal to the main sandstone hills of the Great Dividing Range, and as low hog-backs of some resistant beds.

Rock types: A sequence of interbedded sandstone, siltstone and mudstone

Sandstone: Grey, buff and white; labile to quartzose, but mainly labile to sub-labile, containing both feldspar and lithic grains; kaolinitic matrix common. Grains mainly sub-angular or angular. Dominantly medium-grained, some fine-grained. Some pebbly beds and lenticular beds of pebble to cobble conglomerate, with clasts of quartz, jasper, quartzite, schist, acid volcanics and reworked argillaceous sediments.

Siltstone: Yellow or grey, commonly micaceous, rare carbonaceous fragments or partings. Some fissility developed along carbonaceous partings and micaceous laminae.

Mudstone: Yellow or grey, some scattered mica, rare carbonaceous fragments and partings.

Bedding: Rock types are mainly thickly interbedded. Bedding of sandstone varies from thick to thin, and trough cross-stratification is fairly common. Argillaceous beds massive or laminated.

Thickness: Estimated to be at least 200 feet thick by photo-interpretation, but poverty of exposure precludes reliable measurement of thickness.

Fossils and age: Mainly only poorly preserved plant fragments found. Collection GAB1447 contains Vertebraria indica and Sphenopteris polymorpha of Permian age, but not diagnostic of any particular part of the Permian (White, 1965). An Upper Permian age inferred by stratigraphic relationships (discussed below).

The base of the Betts Creek Beds was not seen in BUCHANAN; photo-interpretation indicates that it is not exposed. By analogy with the relationships in HUGHENDEN the base is regarded as a regional unconformity, the unit resting on sediments of Pla-c age in BUCHANAN.

The contact with the overlying Lower Triassic Warang Sandstone is concealed by rubble in the areas examined. However, the Betts Creek Beds dip at angles up to 27° to the south-west, in contrast to the uniformly gently dipping Warang Sandstone, and the contact is regarded as an angular unconformity. The Betts Creek Beds are also unconformably overlain by the Warang Sandstone in HUGHENDEN. Lithological similarity and similar stratigraphic position to the Betts Creek Beds of the type area justify use of the name for the sediments in BUCHANAN, even though 30 miles from the nearest outcrops in CHARTERS TOWERS. The age of the sediments in BUCHANAN is, therefore, regarded as Upper Permian.

Correlates of the Betts Creek Beds to the south are the Colinlea Sandstone and Bandanna Formation. Although rock types similar to these two formations are present in the Betts Creek Beds, the poor exposures in BUCHANAN preclude a similar lithological division.

The Betts Creek Beds form a thin sequence of wide distribution. Evidence of a marine depositional environment is lacking, whereas the presence of a terrestrial flora and, to the north in HUGHENDEN, widespread coal seams indicates continental deposition. The variety of rock types, the grain size and composition of the arenites, and the common occurrence of trough cross-stratification indicate the sedimentation was mainly fluviatile, with local development of coal-forming swamps.

COLINLEA SANDSTONE.

"Colinlea Formation" was first published by Hill (1957); the name was later changed to Colinlea Sandstone by Mollan, Exon & Kirkegaard (1964) and restricted to the lower arenaceous part of Hill's unit.

Distribution: Discontinuously in a near-meridional belt at longitude 146° 35' approximately, in JERICHO. (Re-examination in 1965 of some outcrops marked as undifferentiated Permian on the preliminary edition of the Jericho Sheet established that the sediments are lithologically comparable with the Colinlea Sandstone of southern JERICHO and TAMBO. The exposures shown on the map which are affected are:

(a) those marked 'P' or 'Qs/P' near the railway west of Alpha

(b) those marked 'P(?)' a few miles to the north-east of Red Tank and White Tank Bores

(c) the western half of those marked 'P' further north; the eastern half of these are of the Upper Carboniferous to Lower Permian sequence. In the south of JERICHO,

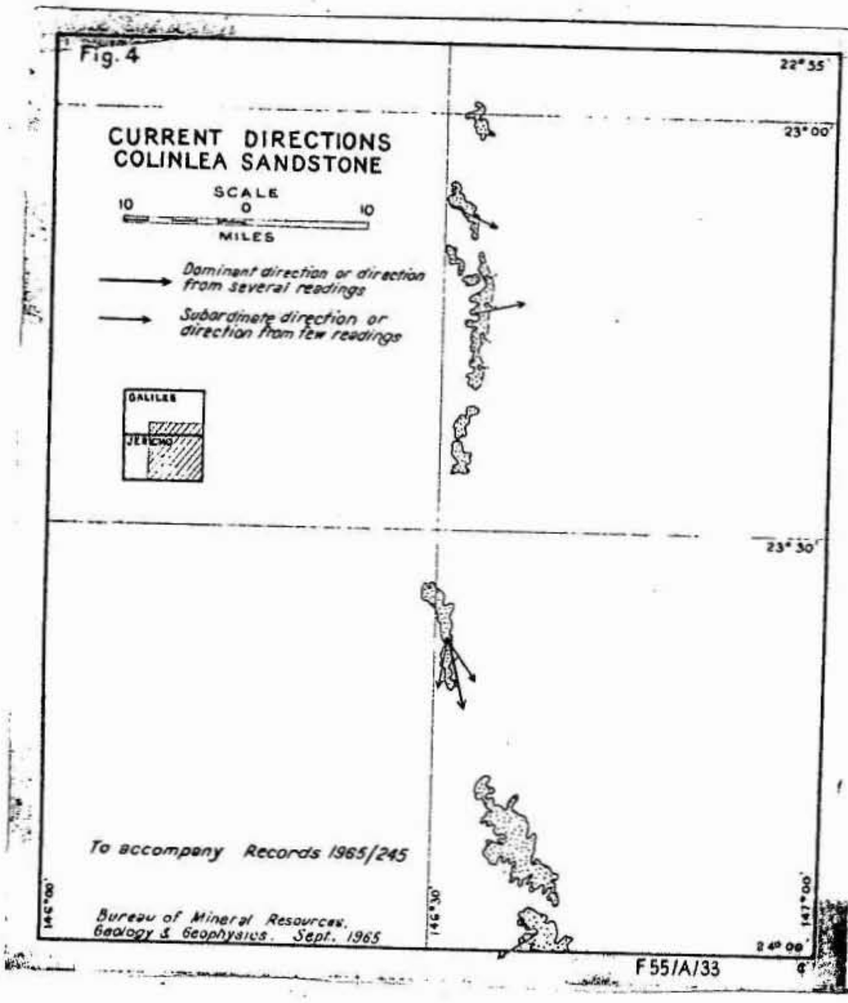
the Colinlea Sandstone forms a range of low rounded hills separated by flat-bottomed, dry valleys. Near the railway it forms a low, rounded rise contrasting with the surrounding plain of Cainozoic sediments, and with one good exposure in a railway quarry. Further north, outcrops are in rubble covered slopes mainly less than 30 feet high in a range of very low rounded hills.

Rock types: Dominantly sandstone, comprising both quartzose and sub-labile sandstone with minor labile sandstone. Thin-section examination of four samples (Galloway, in prep) showed matrix-free composition in ranges: quartz 70-80%, rock fragments 20-25%, feldspar 0-7%. Sandstones commonly argillaceous and, in part, micaceous. White, buff, pale grey, yellow. Occur in two modes: fine-grained (even-grained and sub-rounded), and medium to coarse-grained (poorly sorted, sub-angular to angular) with bands of grit and beds of pebble conglomerate. Conglomerate mainly quartzose, except for basal conglomerate at Grid Reference 461090, which contains many labile pebbles, including sediments derived from underlying Joe Joe Formation.

Mudstone and siltstone in subordinate amounts, most common in northern outcrops. Thin to thick interbeds in sandstone sequence. White to pale grey, yellow, buff; somewhat micaceous particularly along micaceous laminae in siltstone. Rare bands rich in plant fragments.

Coal, brown, dirty. Single locality only, at base of sequence near fossil locality GAB1755 (Grid Reference 474023).

Bedding: Thin to thick, commonly strongly trough cross-stratified with thick to very thick sets in sandstone; very thin to laminate in siltstone; poorly laminated or massive in mudstone. Current directions, derived from a limited number of cross-bedding measurements are shown on Fig 4.



Thickness: Not measured. Only nearly complete sequence is in south, where thickness estimated from photo-interpretation, is less than 200 feet. Exon and Kirkegaard (1965) record 450 feet in TAMBO, but note that thickness decreases towards JERICHO.

Fossils and age: Plant fragments are widespread and fairly common in argillaceous beds, but well-preserved leaves are uncommon. Four collections made; determinations are by White (1965). GAB1755 (from the base of the formation in the southern outcrops) Glossopteris mitchelli, G. communis, G. indica, G. sp., Noeggerathiopsis hislopi, Sphenopteris polymorpha; of Upper Permian age.

GAB1464 (from a railway quarry, 8 miles west of Alpha) Glossopteris indica, G. angustifolia, G. mitchelli, G. longicaulis, G. sp. Sphenopteris polymorpha, Samaropsis dawsoni, Noeggerathiopsis hislopi, Annularia sp., of Upper Permian age.

GAB1463 (from one of the northern outcrops, near the base of the formation). Glossopteris communis, G. indica, G. angustifolia, of Permian age, but not diagnostic of any part of the Permian. GAB1462 (from one of the northern outcrops near the base of the formation). Indeterminate stem impressions.

At Grid Reference 461090, the Colinlea sandstone rests disconformably on labile sandstone of the Joe Joe Formation. In the southern outcrops the actual contact with the underlying Joe Joe formation is obscured by debris. However, photo interpretation indicates that the Joe Joe Formation dips gently westwards, but at appreciably greater angles than the almost flat-lying Colinlea Sandstone. The relationship is probably unconformable. In other outcrops the base of the Colinlea Sandstone was not seen.

The top of the Colinlea Sandstone is everywhere obscured by Cainozoic sediments. The relationship with the Bandanna Formation is discussed below.

Mollan, Exon and Kirkegaard (op. cit.) correlate the Colinlea Formation on the Springsure Shelf with the Aldebaran Sandstone, Ingelara Formation and Catherine Sandstone of the Denison Trough. Marine faunas in the Denison Trough sequence indicate an upper Lower Permian age. By contrast, White (op. cit.) assigns an Upper Permian age to the floras of the Colinlea Formation in JERICHO apparently based mainly on the occurrence of the Upper Permian form Glossopteris mitchelli. The Colinlea Sandstone in JERICHO is equated with that in SPRINGSURE by lithological similarity and physical continuity across TAMBO (Exon & Kirkegaard, op. cit.).

Of possible significance is the fact that the Colinlea Formation of JERICHO contains labile beds with appreciable proportions of lithic grains. This is not typical of the Colinlea Formation of the type section; however a higher part of the formation in SPRINGSURE contains labile beds, but these are feldspathic. Mollan et al (op cit) suggests that this upper part should be equated with the Catherine Sandstone. Possibly, therefore, only the uppermost part of the Colinlea Sandstone is present in JERICHO, a possibility borne out by the appreciable thinning of the unit westwards and northwards.

There are three possibilities for the differences in the assigned ages of the formation in JERICHO and SPRINGSURE

(a) that a younger sandstone has been confused with the Colinlea Sandstone as mapping progressed westwards; the quality and continuity of outcrop renders this unlikely,

(b) that the Colinlea Sandstone is diachronous; but the evidence for this depends solely on the quality of the floral evidence,

(c) that Glossopteris mitchelli is not restricted to the Upper Permian but ranges from uppermost Lower Permian. In this regard, it must be remembered that the Glossopteris flora is an endemic one, not wholly suitable for precise correlation with the European time-scale.

Alternative (c) is regarded as most likely. However, the discrepancy in assigned ages is only real if the correlation between sediments of the Springsure Shelf and the Denison Trough suggested by Mollan et al (op. cit.) is valid.

The flora recorded in the Colinlea Sandstone in JERICHO is comparable with that of the Betts Creek Beds in HUGHENDEN. The two units also have a similar range of rock types, but the Betts Creek beds contains a larger proportion of argillaceous beds, as well as a coal measure sequence comparable with the Bandanna Formation. However, the northern outcrops of the Colinlea Sandstone of JERICHO seem to have more argillaceous beds than those to the south, and this may reflect a general lithological change northwards.

Absence of marine fossils, presence of plant fossils and coal, indicate that the Colinlea Sandstone was deposited in a terrestrial environment. The well developed cross stratification indicates strong current action and, with the abundance of argillaceous matrix, suggests dominantly fluviatile deposition. The large areal extent of the Colinlea Formation is indicative of coalescing alluvial deposits of many streams. Only a few current direction measurements were made (Fig. 4) but they indicate currents from a northerly or westerly source.

BANDANNA FORMATION

The Bandanna Formation (Hill, 1957) was originally named the "Bandanna Series" by Shell (Queensland) Development Pty Ltd. (SQD, 1962). The name was first published, without definition, by Maxwell (1954). Occurrences in SPRINGSURE, which include the type area, are described by Mollan, Exon and Kirkegaard, (1964).

Distribution:	Restricted to a narrow belt about 1 mile wide and 4 miles long on the southern boundary of JERICHO, extending NNW along the road from Tambo to Alpha. Very poorly exposed in gullies, but forming a very low, rounded, soil-covered ridge.
Rock types:	Mainly mudstone, grey or greenish-grey, blocky, with abundant pieces of fossil wood. Two small hillocks of deeply weathered, brown, fine-grained labile sandstone, also with abundant wood fragments. Calcareous labile sandstone also weathers out as large concretions on the surface of the soil. Abundant angular blocks of silicified fossil wood which occur in the walls of an earth tank at Grid Reference 457026 are probably derived from the Bandanna Formation. This is shown as a small outcrop of undifferentiated Permian in the Preliminary edition of the JERICHO Geological Sheet.
Thickness:	Not measurable in JERICHO. Exon and Kirkegaard (1965) estimate the thickness at 400 feet in adjacent TAMBO.
Fossils and age:	Only fossil wood found. The age is assumed to be Upper Permian by lateral continuity of the formation to SPRINGSURE, where it contains Upper Permian plants (Mollan et al. op. cit.).

Both the top and bottom of the Bandanna Formation are concealed in JERICHO by Cainozoic sediments. In SPRINGSURE, Mollan et al (op. cit.) noted that the Bandanna Formation is lithologically divisible into a lower part, consisting dominantly of mudstone, and an upper coal measure sequence. No such distinction is evident in the few poor exposures in JERICHO. Rock types there seem to correspond closely to the lower part of Bandanna Formation; no evidence of coal seams was found in this area. Exon & Kirkegaard (op. cit.) also noted that no coal seams were found in TAMBO. In the northern half of JERICHO several water bores intersected coal seams (and commonly obtained an adequate supply of water in a sandstone bed immediately underlying the coal). These possibly indicate the subsurface presence of the upper part of the Bandanna Formation west of the belt of Colinlea Sandstone.

Relationships with the underlying and overlying formations are obscure. Mollan et al (op. cit.) stated that the Bandanna Formation is apparently conformable on the Peawaddy Formation, but that the sharp lithological change at the contact may indicate a disconformity. Exon & Kirkegaard (op. cit.) stated that the Peawaddy thins westwards in TAMBO and changes lithologically so that it cannot be distinguished from the Colinlea Sandstone. Thus, the Colinlea Sandstone of JERICHO may include the time correlate of the Peawaddy Formation; the absence of the Peawaddy Formation in northern TAMBO and southern JERICHO is not necessarily evidence of a regional unconformity at the base of the Bandanna Formation.

Mollan et al (op. cit.) stated that the Bandanna Formation is apparently transitional into the overlying Rewan Formation, but is overlain disconformably in some structurally high areas. The boundary is at a change from a carbonaceous sequence to one containing red beds.

SUBSURFACE

Subsurface intersections of sediments corresponding to Evans' palynological division P3-4 are shown on Plate 1. Known intersections are all east of the Hulton-Rand and Tara Structures. Sediments of P3-4 age have also been recorded from Exoil Brookwood No. 1 Well (Evans, 1964b) and AAO Beryl No. 1 Well (Evans, Appendix 2 <u>in</u> MAP, 1964) to the north.

Intersections:	Lake Galilee No. 1	(2810' - 3476')
	Maranda No. 1	(2396' - 2900')
	Alice River No. 1	(2507' - 2822')
	Saltern Creek No. 1	(2386' - approx. 2700')
	Marchmont No. 1	(3110' - approx. 3450')

Rock types: (Generalized lithology of each intersection is shown on Plate 1)

<u>Mudstone</u> (including <u>shale</u>) comprising more than 50% of the sequences. Grey, green, black; commonly carbonaceous, particularly in lower part, somewhat micaceous throughout, calcareous in Marchmont No. 1 and Saltern Creek No. 1. Grades to <u>siltstone</u>.

<u>Sandstone</u> occurring as two modes:

(a) interbeds in argillaceous sequences; consisting of fine, very fine and medium-grained sandstone; grey to white; quartzose to lithic, argillaceous, micaceous, carbonaceous; generally fairly well sorted.

(b) thick intervals with interbeds of mudstone and coal; consisting of fine to coarse-grained sandstone; pebbly at the base of the sequences in Maranda No. 1 and Alice River No. 1; white to grey; quartzose; friable; poorly sorted, variable amounts of argillaceous matrix.

Coal, brown to black and hard; in seams varying from 16 feet thick to thin partings in argillaceous sediments. Thickest known seams in Lake Galilee No. 1 and Maranda No. 1, although abundant coal cuttings reported in lower parts of intervals in Saltern Creek No. 1 and Marchmont No. 1.

Thickness: 656 feet in Lake Galilee No. 1
504 feet in Maranda No. 1
315 feet (top probably eroded) in Alice River No. 1
300 feet approximately (top possibly eroded) in Saltern Creek No. 1 and Marchmont No. 1.

Fossils and age: Well-preserved plant remains recorded in Lake Galilee No. 1, but no determinations made. On palynological evidence interval identified as Upper Permian (Evans Appendix 1(b) in Pemberton, 1965, De Jersey, App 2c, d in Le Blanc, op. cit; Hodgson App 3 in Hare and Associates, 1963).

Sediments of P3-4 age are overlain with apparent conformity by the Rewan Formation in Lake Galilee No. 1 and Maranda No. 1, disconformably by the Clematis Sandstone in Alice River No. 1, and disconformably by the Hutton Sandstone correlate in Saltern Creek No. 1 and Marchmont No. 1. The base of the sequence is a regional unconformity, widespread in the eastern part of the northern Eromanga Basin.

These sediments are the time correlates of the interval Colinlea Sandstone to Bandanna Formation of the Springsure Shelf, but only the broadest lithological comparisons can be made. In Maranda No. 1 and Alice River No. 1, the basal arenaceous and conglomeratic part of the interval is comparable with the Colinlea Sandstone; however the intervals in both wells contain coal seams, which are not typical of the Colinlea Sandstone of the Springsure Shelf.

The sequences in the other wells, and that above the lower sandstone in Maranda No. 1 are possibly comparable with part of the Bandanna Formation as both are coal bearing; however, coal seams are lacking in Alice River No. 1. The twofold division of the Bandanna Formation on the Springsure Shelf into an upper coal measure sequence and a lower argillaceous and tuffaceous sequence is not evident in any of these wells.

The wide extent of sediments of P3-4 age containing coal seams in the northern Eromanga Basin indicates that the surface upon which they were deposited was extremely flat. Possibly sedimentation overlapped the Hulton-Rand and Tara Structures, but deposits to the west were subsequently eroded. Coarse basal sandstone in Maranda No. 1 and Alice River No. 1 is possibly derived from local sources, but the generally fine-grained sediments of the coal-bearing sequence are probably the deposits of sluggish rivers, lakes and swamps. Deposition was probably mainly on extensive plains marginal to the transgressing and regressing Permian sea of the Bowen Basin. The main source of the sediments was possibly an old mountain range to the west, now represented by the Silurian or older granite of the Longreach area and the early Palaeozoic metamorphics of MANEROO.

TRIASSIC

REWAN FORMATION

The name 'Rewan' was first published without definition by Isbell (1955) as 'Rewan Series' when referring to unpublished work by Shell (Queensland) Development Pty Ltd. geologists. Hill (1957) described the sequence in SPRINGSURE as the 'Rewan Formation'. Mollan, Exon and Kirkegaard (1964) nominated a type section several miles north of Rewan Homestead in SPRINGSURE.

Distribution: Isolated outcrops in creek beds and forming rubbly mounds within a belt west of Alpha Creek and bordering the Great Dividing Range in JERICHO. Probably continuing northwards but concealed by Cainozoic sediments in a near-meridional belt in JERICHO and GALILEE. Subsurface in Lake Galilee No.1 (1770 to 2828 feet) and Maranda No. 1 (1764 to 2396 feet).

Measured sections: None, due to extremely poor outcrop.

Rock types: In outcrop: labile and sub-labile sandstone, commonly micaceous, generally brown and weathered; very fine to fine grained, generally well sorted. Poverty of exposure suggests that much of the sequence mapped as Rewan Formation is argillaceous.

Subsurface: mudstone (including shale) and siltstone, with some interbedded labile sandstone; minor quartz sandstone in Maranda No. 1. Argillaceous sediments green, grey and brown, and rarely red; siltstone commonly sandy. Labile sandstone grey, green-grey and white, mainly fine-grained but grading to coarse-grained; argillaceous, some beds calcareous. Quartz sandstone, grey, fine to medium-grained and pebbly, commonly porous, kaolinitic in part.

Driller's logs of water bores record "blue shale"; spoil at bore heads is blue-grey micaceous siltstone and mudstone.

Thickness: Not measurable in outcrop.
1058 feet in Lake Galilee No. 1.
632 feet in Maranda No. 1
Approximately 1000 feet in abandoned water bore at Grid Reference 424085 in JERICHO inferred from driller's log.

Fossils and age: None found in outcrop. Some plant remains recorded in Maranda No. 1 but no determinations made. Interval barren of spores in Lake Galilee No. 1 (Evans, App 1(b) in Pemberton, 1965) but identified as Lower Triassic in Maranda No. 1 (Evans, app 2(a) in Le Blanc, 1963).

The areas shown as Rewan Formation on the Jericho Preliminary edition contain only a few isolated or rubbly outcrops of labile to sub-labile sandstone. However, the marked contrast with the generally fairly well-exposed yet similar sandstone of the Dunda Beds immediately west of these outcrops suggests that a dominantly argillaceous sequence is present, but not exposed. Northwards the presence of an argillaceous sequence overlying coal measures recorded in water bores east of the outcrop belt of the Dunda Beds tends to confirm this inference. Similarly, in Lake Galilee No. 1, approximately 1000 feet of a dominantly argillaceous sequence overlies the Upper Permian coal measures and underlies the Dunda Beds.

These sediments are regarded as Rewan Formation even though the characteristic red colouration of the type area is almost non-existant in this area. However, Mollan et al (op cit) note that green argillaceous beds also occur and appear to be transitional from the red beds. For regional mapping purposes it is considered that a dominantly argillaceous sequence containing green and/or red beds, which occupies the same stratigraphic position and is continuous with the Rewan Formation of the type area, can reasonably be mapped as Rewan Formation.

Contacts of the Rewan Formation with underlying and overlying sediments are not exposed in the area mapped. On the Springsure Shelf, Mollan et al (1964) regard the Rewan Formation as possibly transitional from the underlying Bandanna Formation. The boundary is placed at a marked lithological change from a coal-bearing sequence to one bearing red-coloured beds, and this corresponds to a sharp microfloral change which Evans (1964) suggests is due to a climatic change. The limited subsurface information in the area mapped in 1964 contributes little to this discussion, although marked character change in some of the wireline logs (particularly the micrologs) suggests that there is a significant lithological change at the boundary.

The Dunda Beds are regarded as conformable with the Rewan Formation and a correlate of the upper part of the unit. The relationships are discussed below under 'Dunda Beds'.

An abandoned water bore 16 miles NNE of Jericho (Grid reference 424085), which intersected approximately 1000 feet of argillaceous sediments regarded as Rewan Formation, was drilled close to outcrops of Clematis Sandstone. Here the apparent absence of Dunda Beds is probably due to pre-Clematis erosion over the eastern extension of the Barcaldine Ridge (see 'Structure'). In Maranda No. 1 Dunda Beds cannot be identified, and the Rewan is much thinner than in Lake Galilee No. 1; the Clematis Sandstone probably overlies the Rewan Formation with regional unconformity. Close to the Hulton-Rand and Tara Structures, the Rewan Formation has been completely eroded; underlying Upper Permian sediments are overlain unconformably by the Clematis Sandstone in Alice River No. 1 and by Lower Jurassic sandstone in Saltern Creek No. 1 and Marchmont No. 1.

Thicknesses are generally greater than on the Springsure Shelf but less than in the Denison Trough. Possibly the JERICHO-GALILEE area was a distinct structural basin in Lower Triassic times in which gentle subsidence allowed the accummulation of a greater thickness of sediments than on the Springsure Shelf. Sedimentation was dominantly argillaceous, possibly derived from strong chemical weathering of nearby uplands but with only periodic oxidising conditions in this depositional area. Sandstone was possibly deposited mainly by streams, although a thick porous quartzose sandstone interval in Maranda No. 1 and several calcareous sandstone beds in both Lake Galilee No. 1 and Maranda No. 1 are not typically fluviatile sediments, and may have been deposited in a marine or deltaic environment.

DUNDA BEDS

'Dunda Beds' is a new name proposed for a dominantly sandstone sequence, which rests conformably on the Rewan Formation on the north-eastern margin of the Eromanga Basin, and is probably a facies variant of the upper part of the Rewan Formation of the Denison Trough. The name is derived from Dunda Creek, a tributary of the Belyando River. The type section is in a gorge of an unnamed tributary of Dunda Creek in GALILEE, at Grid Reference 436200, Lat 22° 27'S, Long 146° 19'E.

Distribution: Forming a near-meridional belt of sandstone hills extending from southern BUCHANAN through the centres of GALILEE and JERICHO. Outcrops mainly in steep but rounded hills with some scarps, commonly with discontinuous rubble cover; also forms scattered outcrops as low rises in sand plains.

Subsurface only in Lake Galilee No. 1 (1520'-1770')

Measured sections: X33, X35, X36 (Type Section), X37, X38, X39 (Fig. 5)

Rock types: Lithic to quartzose sandstone, with subordinate thick intervals of mudstone and siltstone. Proportion of sandstone highest (greater than 85%) in northern JERICHO and southern GALILEE; in Lake Galilee No. 1 sandstone content (estimated from wireline logs) about 65%.

Sandstone: white to buff, and pale grey; predominantly fine to very fine-grained, even grained, with variable amounts of kaolinitic matrix. Minor amounts of coarser sandstone, generally quartzose; some pebbly beds and beds with mud pebbles. Sand-size fraction of labile arenites generally contain less than 10% feldspar, and between 15 and 60% lithic grains (Galloway, in prep.)

Bedding mainly thick to very thick, common trough cross-stratification, some planar cross-stratification, lesser thinly to very thinly-bedded sandstone.

Lutites: Red, red-brown, white and grey; mainly mudstone, lesser siltstone; commonly micaceous. Mainly massive or poorly bedded; some micaceous beds thin-bedded or poorly laminated. In Lake Galilee No. 1 lutites are varicoloured and commonly micaceous.

Thickness: Maximum measured in outcrop 152 feet (X33). Thickest exposed sequence estimated from air-photo interpretation between 200 and 300 feet (northern JERICHO). 250 feet in Lake Galilee No. 1.

Fossils and age: Plant fossils include Thinnfeldia acuta, ?Taeniopteris spatulata, Dicroidium odontopteroides, Sphenopteris cf superba, Ginkgo antarctica, Araucarites sp ?Cladophlebis australis, and ?Coniopteris delicatula; the age range of the assemblage is Triassic to Lower Jurassic (White, 1965). No palynological determinations have been made. A Lower Triassic age is inferred from the stratigraphic position below the Clematis Sandstone, and by correlation with the Warang Sandstone of the Hughenden area and the upper part of the Rewan Formation of the Denison Trough.

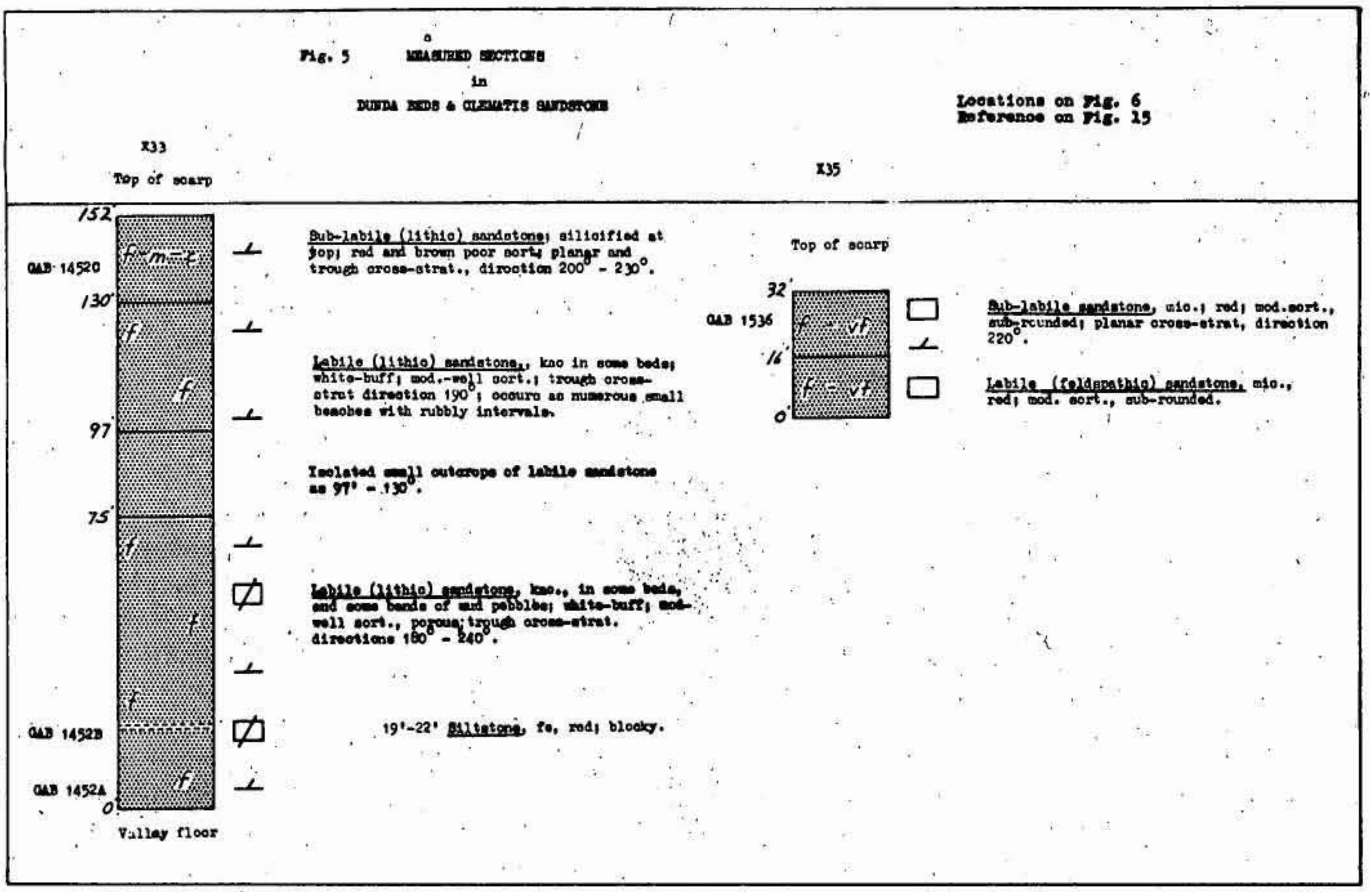
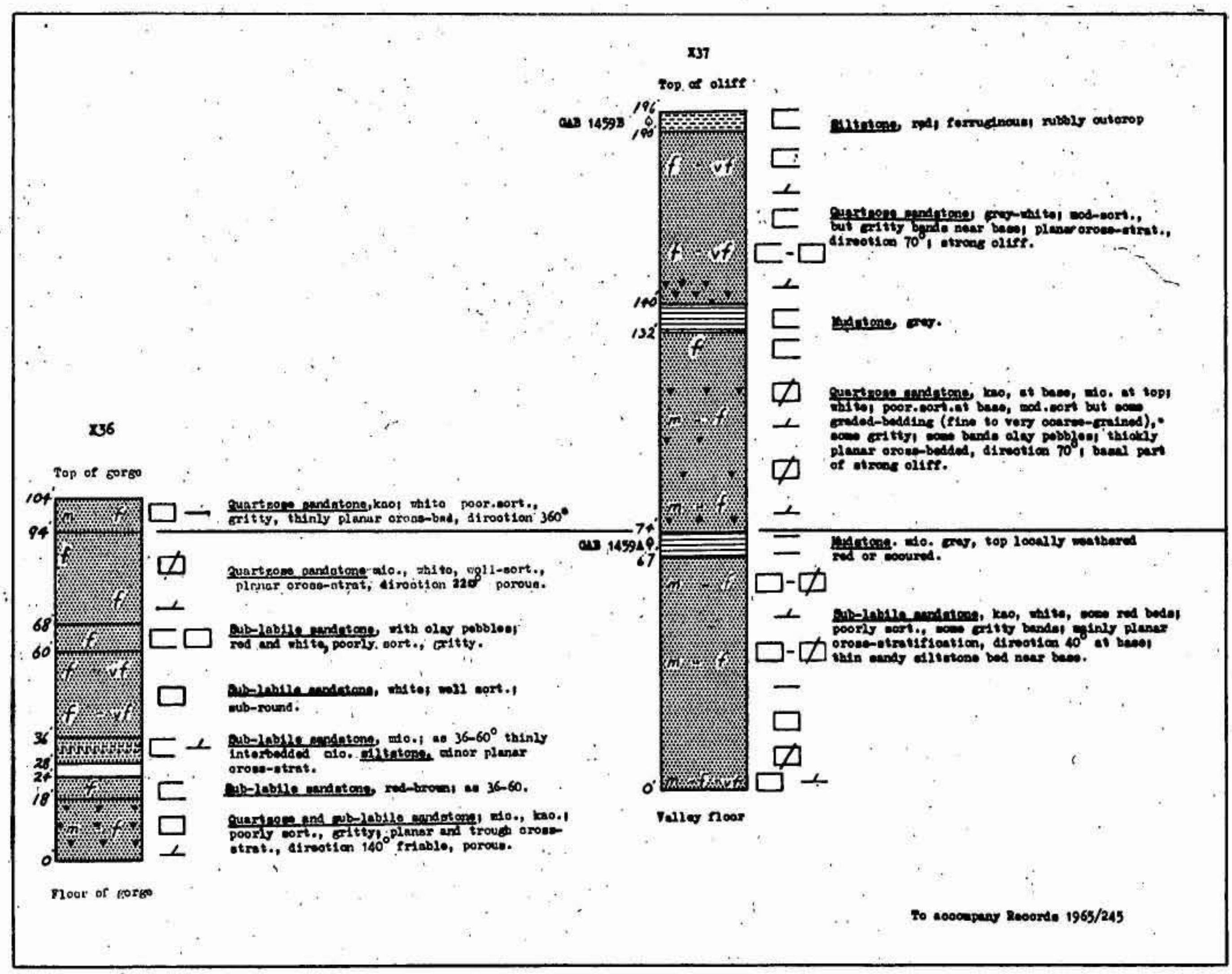


Fig. 5 MEASURED SECTIONS in DUNDA BEDS & CLEMATIS SANDSTONE



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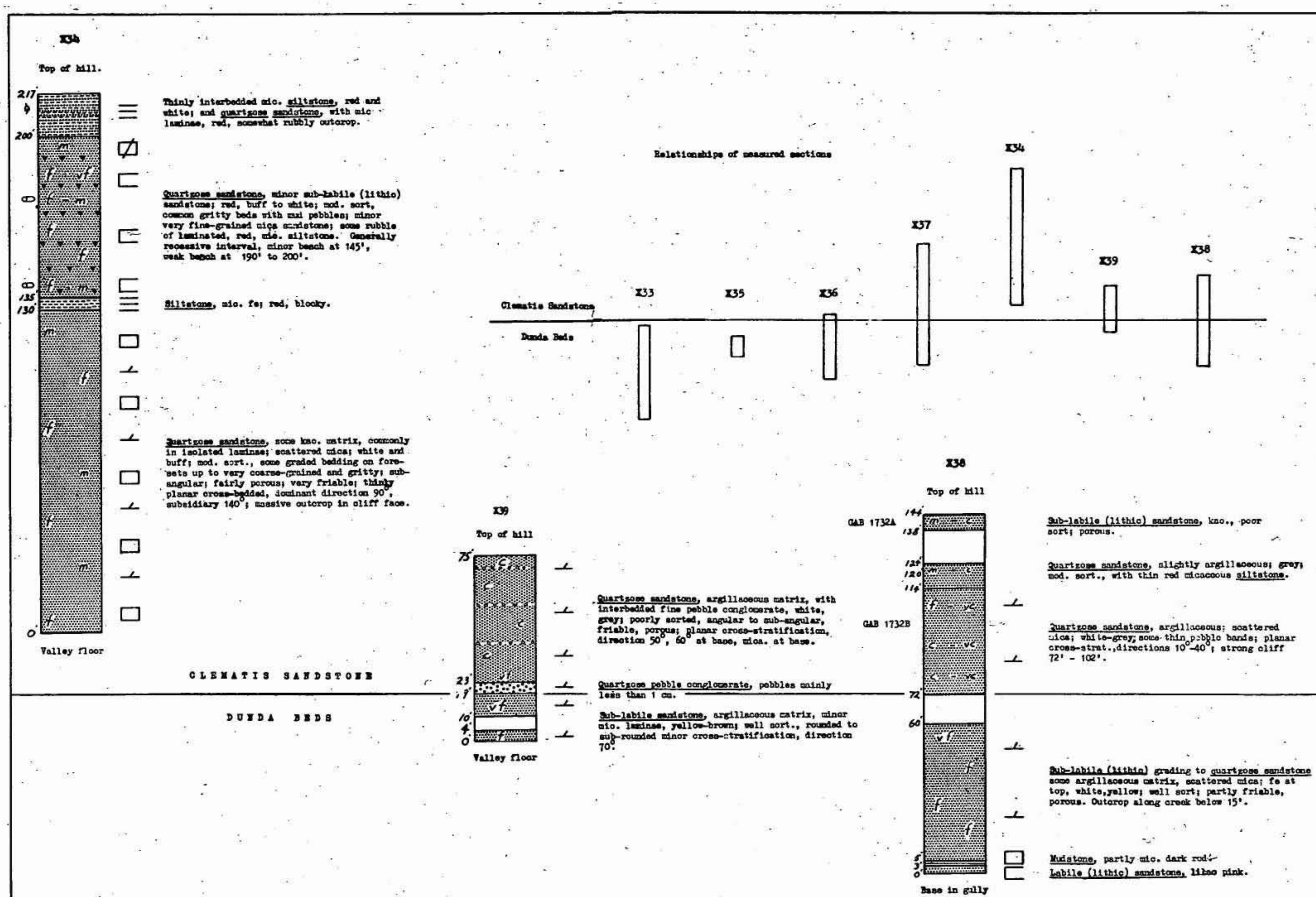

X34
Top of hill.
217
200
135
130
0
Valley floor
Thinly interbedded mic. siltstone, red and white; and quartzose sandstone, with mic laminae, red, somewhat rubbly outcrop.
Quartzose sandstone, minor sub-labile (lithic) sandstone; red, buff to white; mod. sort, common gritty beds with mud pebbles; minor very fine-grained mica sandstone; some rubble of laminated, red, mic. siltstone. Generally recessive interval, minor beach at 145', weak bench at 190' to 200'.
Siltstone, mic. fe; red, blocky.
Quartzose sandstone, some kao. matrix, commonly in isolated laminae; scattered mica; white and buff; mod. sort., some graded bedding on foresets up to very coarse-grained and gritty; subangular; fairly porous; very friable; thinly planar cross-bedded, dominant direction 90°, subsidiary 140°; massive outcrop in cliff face.
CLEMATIS SANDSTONE
DUNDA BEDS
Relationships of measured sections
Clematis Sandstone
Dunda Beds
X33
X35
X36
X37
X34
X39
X38
X39
Top of hill
75
23
17
10
4
0
Valley floor
Quartzose sandstone, argillaceous matrix, with interbedded fine pebble conglomerate, white, grey; poorly sorted, angular to sub-angular, friable, porous; planar cross-stratification, direction 50°, 60° at base, mica. at base.
Quartzose pebble conglomerate, pebbles mainly less than 1 cm.
Sub-labile sandstone, argillaceous matrix, minor mic. laminae, yellow-brown; well sort., rounded to sub-rounded minor cross-stratification, direction 70°.
X38
Top of hill
GAB 1732A
GAB 1732B
144
138
124
120
114
72
60
5
3
0
Base in gully
Sub-labile (lithic) sandstone, kao., poor sort; porous.
Quartzose sandstone, slightly argillaceous; grey; mod. sort., with thin red micaceous siltstone.
Quartzose sandstone, argillaceous; scattered mica; white-grey, some thin pebble bands; planar cross-strat., directions 10°-40°; strong cliff 72' - 102'.
Sub-labile (lithic) grading to quartzose sandstone some argillaceous matrix, scattered mica; fe at top, white, yellow; well sort; partly friable, porous. Outcrop along creek below 15'.
Mudstone, partly mic. dark red.
Labile (lithic) sandstone, lilac pink.

Distinguishing features of the Dunda Beds are the large proportion of labile to sub-labile sandstone, the fine-grain size, and the generally fairly good sorting. By contrast, the underlying Rewan Formation both in Lake Galilee No. 1 and in the Denison Trough, is dominantly argillaceous. The overlying Clematis Sandstone is dominantly quartzose, coarser than the Dunda Beds and mainly poorly sorted or has graded bedding.

The base of the Dunda Beds is concealed by Cainozoic sediments. In southern JERICHO, the lower boundary was taken as the division between the sandstone hills of the Dunda Beds and the sand plain on the Rewan Formation. In Lake Galilee No. 1 the boundary is taken at a marked change in the proportion of lutite in the sequence; the change is well shown by the electric logs.

The top of the Dunda Beds is a disconformity, and probably a regional unconformity. Where seen the contact with the overlying Clematis Sandstone commonly shows scouring or local erosion. Rarely, the top of the Dunda Beds appears to have been weathered before deposition of the Clematis Sandstone (e.g. X37). Dunda Beds have apparently been eroded north of the Central Railway (discussed under Rewan Formation). In Maranda No. 1 and Alice River No. 1 the Clematis Sandstone rests directly on older than the Dunda Beds sediments. The absence of the Dunda Beds in these well sections is presumed to be due to erosion before deposition of the Clematis Sandstone.

The Dunda Beds are regarded as the correlates of the Warang Sandstone (although possibly only the lower part) because of lateral continuity to the north in BUCHANAN. To the SE they are regarded as the correlate of the upper part of the Rewan Formation (Exon, pers. comm.).

Common labile grains in the Dunda Beds indicate rapid transport from the source area. The presence of some red argillaceous beds indicates local development of mud flats in a strongly oxidizing environment. Current directions, indicated by measurments of cross-bedding, are somewhat variable (Fig. 6) but suggest that the sediment was derived mainly from the east. Possibly the source of the sediment was mainly volcanics and sediments of the Drummond Basin sequence. No marine fossils have yet been found; presence of plant fossils, abundance of kaolinitic matrix and trough cross-stratification indicate fluviatile deposition, possibly confined to a belt flanking fold mountains composed of the Drummond Basin sequence. The different lithologies of the correlates, the Warang Sandstone to the north and the Rewan Formation of the Denison Trough to the south-east, possibly reflect different source areas and different rates of transport.

CLEMATIS SANDSTONE

This unit was originally named by Jensen (1926); the type area is in the Bowen Basin in BARALABA.

Distribution: Crops out along a near-meridional belt of sandstone hills in JERICHO and GALILEE. Deeply dissected, steep scarps and bluffs in south, commonly forms a steep cliff overlooking foothills of Dunda Beds; lower hills with gentler slopes in north.

Subsurface intersections in Lake Galilee No. 1 (1100'-1520')
Maranda No. 1 (1367'-1764')
Alice River No. 1 (1890'-2507')

Measured sections: X34, X36, X37, X38, X39 (Fig. 5)

Rock types: Described in measured sections, particularly X34, X38. Predominantly quartzose sandstone with minor interbeds of mudstone and siltstone.

Sandstone: white and grey, commonly with kaolinitic matrix, moderately sorted, beds commonly graded from very coarse-grained to fine-grained, some pebbly beds and beds of conglomerate, thin to very thick-bedded, commonly thinly planar cross-stratified in thick to very thick sets.

Argillaceous sediments in thick intervals: grey to white, some red and ferruginous, commonly micaceous, mainly thin-bedded to laminated. Some green and rare red colouration reported in Alice River No. 1.

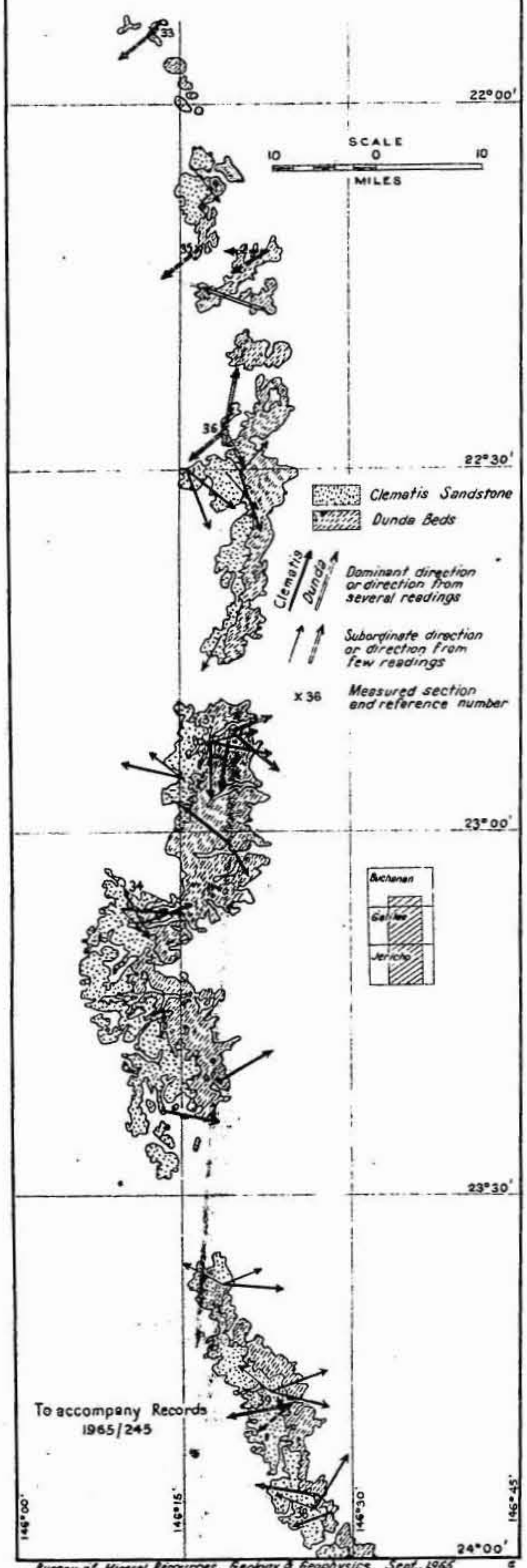
Thickness: Maximum measured thickness in outcrop 200 feet (X34). Total thickness in outcrop variable; estimated at approximately 350 feet in southern JERICHO, thinning to approximately 100 feet about 5 miles south of the Central Railway, thickening to approximately 300 feet in northern JERICHO and southern GALILEE.

420 feet in Lake Galilee No. 1
397 feet in Maranda No. 1
617 feet in Alice River No. 1

Fossils and age: Plant fragments occur in argillaceous beds, but preservation generally poor. Collection 1459B (190 feet above base of Section X37) includes Cladophlebis australis, Ginkgo cf. magnifolia and Dicroidium odontopteroides; the flora has the range Triassic to Lower Jurassic (White, 1965). Palynological results from the wells are somewhat inconclusive, but the existing determinations (Evans, in Le Blanc, 1963; Hodgson, in Hare and Associates, 1963) indicate that the Clematis Sandstone is probably of Middle Triassic age, but sedimentation may have started in Lower Triassic time.

Fig. 6

CURRENT DIRECTIONS
DUNDA BEDS AND CLEMATIS SANDSTONE



Bureau of Mineral Resources, Geology & Geophysics. Sept., 1965

F55/A/34

The base of the Clematis Sandstone is probably a regional unconformity, although only disconformable relationships are evident in any area. Throughout most of GALILEE and JERICHO and in Lake Galilee No. 1, the Clematis Sandstone rests disconformably on the Dunda Beds, but just north of the Central Railway in JERICHO it probably overlies the Rewan Formation unconformably (discussed under Rewan Formation). In Maranda No. 1 the Clematis Sandstone rests directly on the Rewan Formation, and in Alice River No. 1 on Upper Permian sediments.

Locally in outcrop, weathering or scouring is evident where the uppermost preserved beds of the Dunda Beds are argillaceous. The boundary between the two units is difficult to pick where basal sandstone of the Clematis rests on a sandstone of the Dunda. However, the difference in composition of sandstones of the two units is reflected by weathering characteristics - the quartzose Clematis sandstone commonly forms a near-vertical cliff, whereas the labile Dunda Beds form gentler slopes and foothills. The break in slope is a close approximation to the boundary.

The Clematis Sandstone is overlain with apparent conformity by the Moolayember Formation. In the present mapping the boundary has been taken at the top of the sequence of massive quartzose sandstones. The overlying beds are mainly thinly interbedded fine-grained sandstone and mudstone or siltstone. In some places the uppermost massive sandstone is directly overlain by an argillaceous sequence, and the boundary is sharp.

Absence of marine fossils, poor sorting, common kaolinitic matrix, and strong cross stratification indicate that deposition of the Clematis Sandstone was mainly fluviatile. Graded bedding, particularly in foresets may indicate deposition from frequent floods. Argillaceous sediments represent local mud flats probably bordering the main channels; the presence of red beds indicates periods of non-inundation and non-deposition.when oxidizing conditions prevailed in the depositional area.

Current ~~directions,~~ indicated by measurements of cross-stratification are consistently from the west (Fig. 6). These, together with the lack of labile material, indicate derivation from a source area west of the Hulton-Rand Structure.

MOOLAYEMBER FORMATION

'Moolayember Shale' was first used by Reeves (1947); Whitehouse (1954) nominated a type section along the road from Injune to Rolleston in TAROOM. The unit was renamed Moolayember Formation by Phillips (in Hill and Denmead, 1960).

Distribution: Scattered outcrops within a wide, near-medional belt in BUCHANAN, GALILEE and JERICHO. Most extensive exposures are in the scarp of duricrust-capped hills in the Carmichael Embayment (see Physiography), but sediments are deeply weathered. Basal beds exposed along the west flank of the belt of sandstone hills of the Clematis and Warang Sandstones as rubble or only a few feet of section in creeks. Lakes Buchanan and Galilee are within the outcrop belt of the Moolayember Formation.

Subsurface intersections:

Lake Galilee No. 1	(175'-1100')
Maranda No. 1	(858' -1367')
Alice River No. 1	(1672'-1890')
B.M.R. Jericho* S.H. 3A	(180' - T.D. of 213'6")
B.M.R. Galilee* S.H. 1	(110' - T.D. of 210')

Rock types: Dominantly an argillaceous sequence, mudstone and siltstone with interbeds of labile sandstone and lesser quartz sandstone. Roughly equal amounts of sandstone and lutites reported in Lake Galilee No. 1.

Mudstone and siltstone: green, grey, lesser brown, purple, red, yellow; in part carbonaceous, variably micaceous; top of unit intersected in B.M.R. Scout holes Jericho 3A and Galilee 1 weathered to varicoloured puggy clay.

Sandstone: green, grey, white; both labile and quartzose; labile sandstone contains rock fragments and feldspar and is commonly calcareous; quartzose sandstone is mainly very thinly interbedded with argillaceous sediments at base of unit, mainly fine to very fine-grained, but reported as grading to coarse-grained in Lake Galilee No. 1. In outcrop, sandstone and lutite thickly to very thickly interbedded, individual rock types thickly to thinly bedded, some laminated.

* Shallow stratigraphic holes drilled by the BMR in 1964 (Vine & Galloway, 1965).

Thickness: Total thickness not measurable in outcrop.
925 feet in Lake Galilee No. 1
509 feet in Maranda No. 1
218 feet in Alice River No. 1
Lake Galilee No. 1 is near the middle of the outcrop belt of the Moolayember Formation so possible maximum thickness in GALILEE is approximately twice the thickness in the well, i.e. nearly 2000 feet.
Maximum thickness probably less than 1000 feet in JERICHO.

Fossils and age: Poorly preserved plants in base of unit include: Sphenopteris(?) sp., Neocalamites(?) or Equisetites(?), Thinnfeldia(?) cf. T.talbragarensis, and Podozamites lanceolatus; the presence of Podozamites indicates Jurassic or Upper Triassic age (White, 1965); but a pre-Jurassic age is indicated by stratigraphic relationships (discussed below). Spores from Lake Galilee No. 1, Maranda No. 1 and Alice River No. 1 and from seismic shot hole B51 (13 miles west of Jericho) are from Evans' palynological division R3 of Middle to Upper Triassic age (Evans, 1964, in prep., and in Pemberton 1965).

The Moolayember Formation rests on the Clematis Sandstone with apparent conformity. The boundary, though locally sharp, is essentially gradational. It is marked primarily by a change from massive cross-stratified quartzose sandstone with a few thick interbeds of lutites to a very thinly interbedded sequence of fine quartzose sandstone and lutites (Fig. 7). Quartzose sandstone dominates the Moolayember Formation only

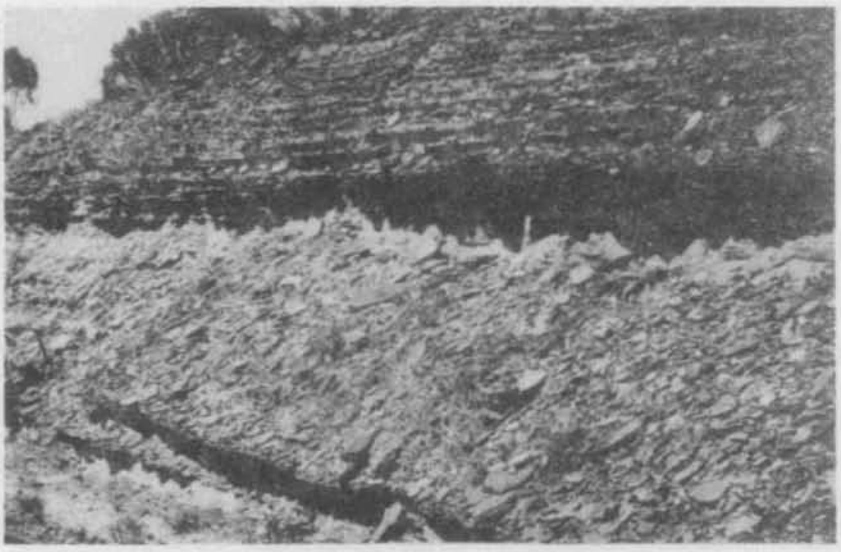


Fig. 7. Very thinly interbedded sandstone and lutites at base of Moolayember Formation, 9 miles east of Jericho on Central Railway.

BMR Neg.

at the base, the higher beds are mainly labile, but the change appears to be gradual.

Variations in thickness of the unit are mainly due to subsequent erosion, although the higher proportion of sandstone in the sequence noted in Lake Galilee No. 1 may indicate facies variation. The Moolayember Formation is overlian disconformably by Lower Jurassic sandstone in the south of JERICHO and in Maranda No. 1. Northwards the Moolayember Formation is overlain with regional unconformity by the Upper(?) Jurassic to Lower Cretaceous Ronlo Beds, which in northern BUCHANAN apparently overlap on to the Lower Triassic Warang Sandstone.

No marine fossils have yet been found in the Moolayember Formation in the Galilee Basin. Immaturity of the sediments and the frequent interbedding of sedimentary types indicate that deposition took place fairly rapidly in an irregularly subsiding terrestrial basin. The apparently greater proportion of sandstone in Lake Galilee No. 1 may indicate proximity to source area.

WARANG SANDSTONE

(Unpublished name, first used by Vine, Casey and Johnson (1964) for a Triassic sandstone sequence in the White Mountains in HUGHENDEN).

Distribution: Forming the Great Dividing Range in BUCHANAN.

Measured sections: X32 (Fig. 8), which is typical of the Formation.

Rock types: Kaolinitic quartz sandstone, minor lenticular ferruginous siltstone.

Sandstone: pure white; sand fraction almost entirely quartz but some beds somewhat feldspathic; rare micaceous beds; some beds contain pebbles of quartz, quartzite, jasper, some of rhyolite; matrix (20-30%) almost entirely kaolinite. Fine and medium grained, but poorly sorted or poorly bimodal and commonly gritty, some pebbly beds; fine grains sub-rounded, coarser grains sub-angular to angular, pebbles sub-rounded to rounded.

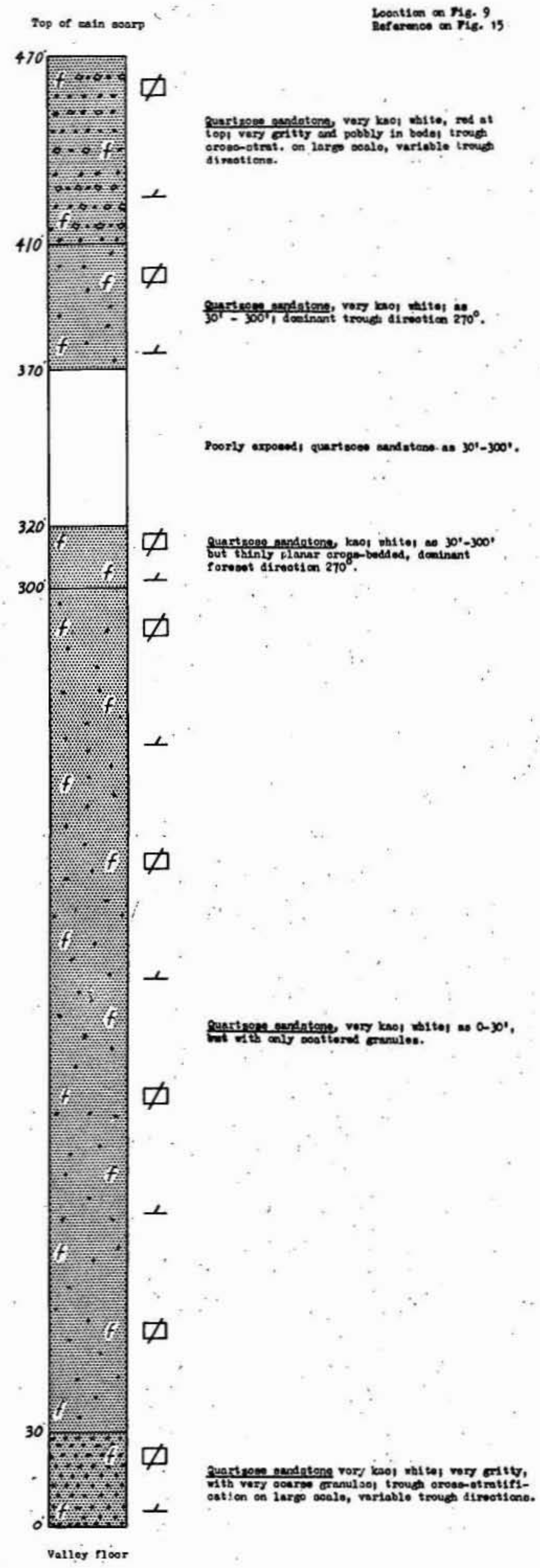
Siltstone: mainly red, some green, white where leached; commonly micaceous.

Bedding: Strongly trough cross-stratified, commonly on a very large scale; most sets are very thick. Trough directions commonly very variable, dominant directions shown in Fig. 9.

Thickness: Probably about 600 feet. 470 feet measured in Section X32, but this is incomplete.

Fossils and age: No fossils found in BUCHANAN. Evans (1964) recorded spores of Triassic (probably Lower Triassic) age from one water bore in HUGHENDEN.

Fig. 8 MEASURED SECTION K32 in the WARANO SANDSTONE



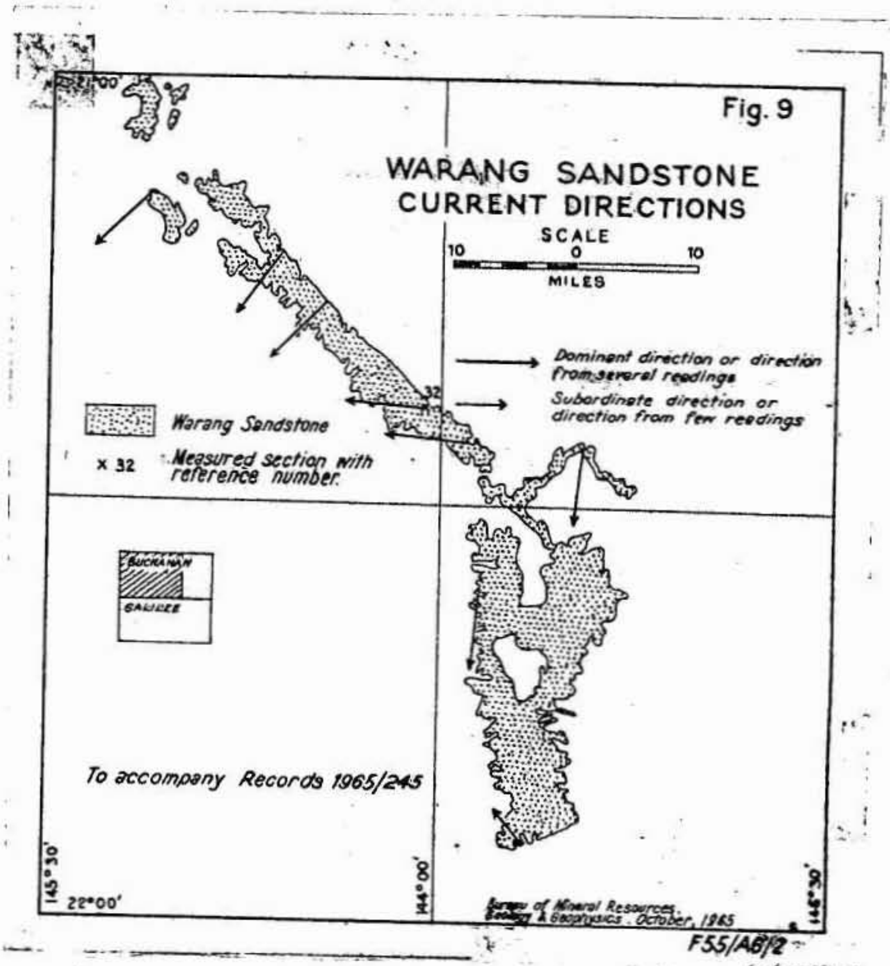
The actual contact of the Warang Sandstone with the underlying Upper Permian Betts Creek Beds is concealed by rubble in the outcrops examined. The Betts Creek Beds dip to the south-west at angles up to 26^{o} whereas the Warang Sandstone dips gently at angles less than 5^{o}. On the map the boundary between the two units is straight and parallel to the strike of the Betts Creek Beds. It is possibly a structurally-controlled margin due to folding or faulting of the Mingobar Structure prior to deposition of the Warang Sandstone.

East of the main outcrop area of the Betts Creek Beds, the Warang Sandstone overlies sediments apparently older than the Betts Creek Beds and tentatively correlated with the Joe Joe Formation. A regional unconformity at the base of the Warang Sandstone is, therefore, inferred in north BUCHANAN. In HUGHENDEN and CHARTERS TOWERS the Warang Sandstone overlies the Betts Creek Beds with regional and, locally, angular unconformity.

In southern BUCHANAN photo-interpretation indicates that the base of the Warang Sandstone is not exposed.

Sediments overlying the Warang Sandstone are exposed only in southern BUCHANAN. The boundary with the overlying Moolayember Formation appears to be conformable and gradational, with the development of several siltstone or mudstone interbeds in the top of the Warang Sandstone. However, some beds of fine conglomerate or breccia are associated with the lutite interbeds and may indicate local uplift and a break in sedimentation. These sediments are overlain by sediments of the Moolayember Formation comprising an interbedded sequence of lutites and sandstone. Moolayember sandstone in this area is fine-grained and even-grained, quartzose at the base but becomes labile upwards.

The abundance of kaolinite in an otherwise mature quartz sandstone indicates that sediments of the Warang Sandstone were originally feldspathic and/or micaceous, but were subject to strong weathering during deposition. Confirmitory evidence of weathering is the almost complete absence of organic matter and the indication of strongly oxidising conditions given by the presence of red siltstone. The source of the sediment was probably mainly metamorphics similar to the mica schist and quartzite of the Cape River Metamorphics in HUGHENDEN. The few current directions indicated by the cross-stratification (Fig. 9) are consistent with this interpretation. However, the much better rounding of the fine fraction than the coarse fraction of the sandstone possibly indicates derivation in part from older sandstone, such as that in the Drummond Basin sequence



Strong weathering during deposition and well developed trough cross-stratification are consistent with fluviatile deposition during periodic floods in a climate of alternating wet and dry seasons. Torrential deposition (suggested by the strong cross-stratification) was probably infrequent and the rate of sedimentation was slow. Deposition probably took place on extensive flood plains flanking a mountainous belt of metamorphics with foothills of folded Drummond Group sediments.

The Warang Sandstone is probably the correlate of both the Clematis Sandstone and the Dunda Beds, and thus of the upper part, at least, of the Rewan Formation. Both the Clematis and the Warang Sandstones are overlain, apparently conformably, by the Moolayember Formation and the three sandstone units form a belt of hills extending from north-east of Hughenden to south of the area mapped in 1964.

An arbitrary southern limit of the Warang Sandstone has been taken in BUCHANAN at the southern end of a large area of sandstone hills. Only the western margin of this area was visited because the initial photo-interpretation did not indicate any stratigraphic problems. Within these sandstone hills sandstone beds of the Warang, Clematis and Dunda will probably be found to interfinger. Certainly, more recent photo-interpretation shows the presence of a major sandstone scarp within the area mapped as Warang Sandstone, similar to that commonly formed by the Clematis Sandstone.

The Warang Sandstone differs from the Clematis Sandstone in its generally poorer sorting, larger proportion of kaolinite, and its characteristic large-scale trough cross-stratification. It differs from the Dunda Beds in its poorer sorting and more quartzose composition.

Current directions, indicated by cross-stratification, suggest that the Dunda Beds and the Warang Sandstone were derived from eastern sources whereas the Clematis Sandstone was derived mainly from the west. The three sandstone units are discrete sandstone bodies deposited by separate river systems. Lithological differences reflect different provenances, and differences of sorting and bedding probably reflect differences of land slope and water supply.

LOWER JURASSIC

A sandstone sequence of Lower Jurassic age occurs widely in the sub-surface of LONGREACH and western JERICHO. Until mapping in TAMBO, to the south, has been completed the relationship of the sequence with the formally named units of the Surat Basin is uncertain. The sequence is described here as a whole, and possible relationships are discussed separately.

Distribution: Forms a north-north-west-trending belt of sandstone hills in southern JERICHO, crossing the Blackall Branch Railway near Joycedale Siding. In the south, the sandstone hills terminate in a strong east-facing scarp; hills become less prominent and more rounded northwards.

Subsurface Intersections:

Alice River No. 1	(1262'-1672')
Maranda No. 1	(356'-858')
Saltern Creek No. 1	(2083'-2386')
Hulton No. 1	(1500'-1830')
Marchmont No. 1	(2845'-3110') approx.

Measured sections: X45, X46, in southern JERICHO (Fig. 10).

Rock types: Quartzose and sub-labile sandstone, brown to white in outcrop, pale grey to white sub-surface; described as quartzose in the sub-surface, but lithic sub-labile in outcrop; medium to fine-grained, in part coarse-grained or gritty; moderately to poorly sorted; kaolinitic in outcrop, variably argillaceous and porous sub-surface; sub-surface commonly slightly calcareous and in part carbonaceous. Minor interbedded mudstone and micaceous siltstone.

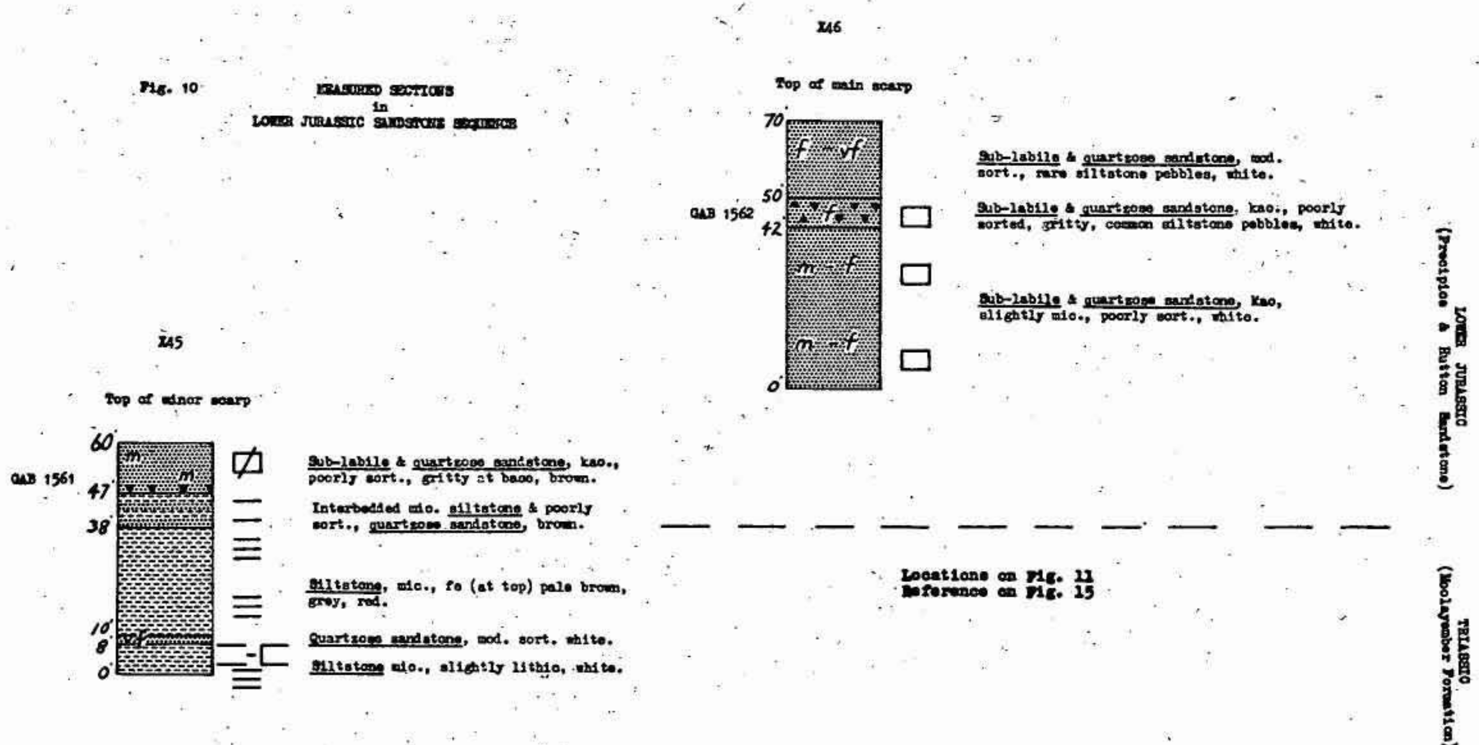


Fig. 10 MEASURED SECTIONS in LOWER JURASSIC SANDSTONE SEQUENCE

Bedding mainly thick to very thick, with most outcrops massive; planar cross-stratification common.

Thickness: Estimated 300 feet maximum in southern JERICHO, wedging-out northwards on Barcaldine Ridge (see Structure) in JERICHO. and to north in GALILEE and BUCHANAN.

Subsurface (feet)

410 in Alice River No. 1

502 in Maranda No. 1

303 in Saltern Creek No. 1

330 in Hulton No. 1

265 approx. in Marchmont No. 1

Not present to west in Longreach area and MANEROO.

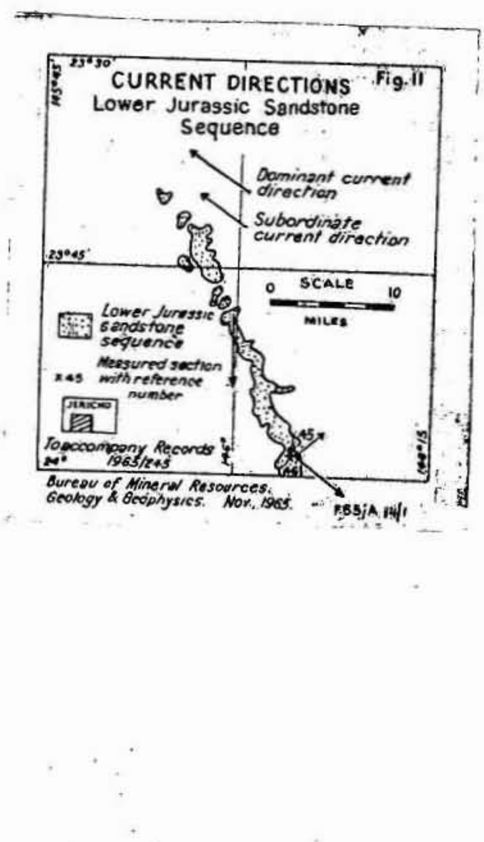
Fossils and age: No macrofossils reported. Palynological studies of bottom hole samples from shot holes.

A66 and A67 from near Joycedale Siding indicates a Lower Jurassic age of Evans' palynological division J1 (Evans, in prep., i.e., comparable with the Precipice Sandstone. A Lower Jurassic age for the whole sequence is inferred from stratigraphic relationships.

The Lower Jurassic sediments rest disconformably on a weathered surface of the Moolayember Formation in southern JERICHO and eastern LONGREACH. Near the Hulton-Rand Structure they overlie Permian sediments, and westwards overlap on to crystalline basement. In LONGREACH and southern JERICHO the Lower Jurassic sequence is overlain, with apparent conformity, by the Injune Creek Beds. Both the Lower Jurassic sequence and the Injune Creek Beds thin westwards and are overlapped by the Upper Jurassic sandstone sequence in MANEROO. In GALILEE and BUCHANAN, the Moolayember Formation is overlain directly by the Upper(?) Jurassic-Lower Cretaceous Rondo Beds.

In the Surat Basin, the Lower Jurassic is represented by the Precipice Sandstone, the Evergreen Formation (including the Boxvale Sandstone Member), and the Hutton Sandstone. The two lower units (Precipice and Evergreen) wedge out northwards and westwards. There is no evidence of the Evergreen Formation within the area mapped during 1964, but the presence of the Precipice Sandstone, or a correlate of it, is inferred in southern JERICHO from palynological evidence (Evans, in prep.). The effective northern limit of the Precipice Sandstone is probably the Barcaldine Ridge (see Structure).

Throughout most of the northern Eromanga Basin, Lower Jurassic sediments form a sandstone unit generally referred to as the Hutton Sandstone. Correlation with the Hutton Sandstone is supported by palynological evidence and by electric log characteristics in the widely-spaced oil exploration bores. Preliminary correlation of recent gamma-ray logs of more closely spaced water bores also supports the validity of the identification at least in the Longreach area. The Hutton Sandstone of the Springsure Shelf contains significant amounts of feldspar, regarded as diagnostic of the unit. By contrast, Lower Jurassic sandstone in the oil exploration wells in LONGREACH is described as quartzose. In southern Jericho outcropping sandstone is commonly sub-labile, but lithic grains are present as well as feldspar (Galloway, in prep.).



The Hutton Sandstone is a thick blanket sandstone, probably deposited in fresh water in a gently subsiding basin. Current directions indicated by the very few cross-stratification measurements (Fig. 11), and the small proportion of labile grains, do not indicate the source of the material. However, it is possible that north-western JERICHO and western GALILEE were elevated areas during Lower Jurassic time, and may have provided sediment.

MIDDLE JURASSIC

INJUNE CREEK BEDS

The term 'Injune Creek Beds', together with many variations of the name, was originally used by H.I. Jensen (1921). Subsequent use of the name and of several others for the same stratigraphic interval was discussed by A.R. Jensen et al (1964) who suggested that the term 'Injune Creek Beds' be used informally for 'that section of the Jurassic sequence between the Hutton Sandstone and the Gubberamunda Sandstone in the Injune-Roma area'. The term was, therefore, used primarily for a stratigraphic interval rather than a specific rock unit; this usage is particularly useful at the present stage of mapping of areas west of Roma.

Subsequent mapping in the Mitchell and Tambo areas (Exon, per. comm.) indicates that two lithological units are mappable at the top of the Injune Creek Beds: the Westbourne Formation (Gerrard, 1964, App. 9), overlying the Adori Sandstone (name originally used by Woolley, 1941; published by Hill & Denmead, 1960). Preliminary interpretation of gamma-ray logs of water bores indicates that at least the upper, (the Westbourne Formation) of these two formations is recognizable sub-surface in LONGREACH. Neither was identified in outcrop in JERICHO where apparently only the lower part of the Injune Creek Beds crop out. Until detailed correlation and interpretation of the gamma-ray logs is attempted the informal term Injune Creek Beds is retained for the whole stratigraphic interval, although the Westbourne Formation is described separately where it is possible to do so.

Distribution: Underlying a sand plain in S.W. JERICHO, with isolated rubbly rises and small scarps of deeply weathered sediments. Sub-surface throughout most of LONGREACH; not identifiable in Maranda No. 1, on the Barcaldine Ridge.

Subsurface intersections:

		(Westbourne Formation)
Alice River No. 1	908'-1262'	(908'-982')
Saltern Creek No. 1	1660'-2083'	(1660'-1750')
Hulton No. 1	1175'-1500'	(1175'-1230')
Marchmont No. 1	2464'-2845'	(2464'-2564')
L.O.L. No. 1 (Cleeve)	2750'-3056'	(2750'-2870')
L.O.L. No. 4 (Longreach)	3010'-3275'	(3010'-3100')

Measured sections: Nil. Precluded by poverty of outcrop.

Rock types: In outcrop: Labile Sandstone, brown and white (but weathered), fine and very fine-grained, even-grained, argillaceous.

Subsurface: WESTBOURNE FORMATION: Dominantly grey siltstone with interbedded shale; rare to common carbonaceous material, variably calcareous and micaceous. Lesser interbedded fine-grained argillaceous sandstone. Easily identifiable in gamma-ray logs as an interval with uniformly high radioactivity.

REST OF INJUNE CREEK BEDS: Interbedded sequence of labile(?) sandstone, shale and siltstone. Sandstone commonly argillaceous, but cleaner, friable, and more quartzose at top; commonly carbonaceous, some calcareous; grey to light brown; mainly fine to medium grained; some to very coarse-grained at top; Argillaceous beds grey to light brown and black, commonly carbonaceous with minor coal; some calcareous, micaceous.

			(Westbourne Formation)
Thickness:	Alice River No. 1	354'	(74')
	Saltern Creek No. 1	423'	(90')
	Hulton No. 1	325'	(55')
	Marchmont No. 1	381'	(100')
	L.O.L. No. 1 (Cleeve)	306'	(120')
	L.O.L. No. 4 (Longreach)	265'	(90')

Probably not deposited in area of Penrith No. 1, Fermoy No. 1 and Mayneside No. 1; probably eroded in area of Maranda No. 1.

Fossils and age: Only microspores and pollens found. They provide a correlation with the Middle Jurassic Walloon Coal Measures of the Ipswich Basin (Evans, in prep.).

The Injune Creek Beds rest unconformably on granite basement in the wells in Longreach and at Cleeve. (Mott, 1955, etc.) refers a thin basal sandstone, which he describes as a base-levelling deposit, in these wells to the Hutton Sandstone. This basal sandstone is better regarded as a member or unit within the Injune Creek Beds rather than a part of the widespread and generally thick blanket sand of the Hutton Sandstone. (Spores from the basal sandstone are of Middle Jurassic age).

Eastwards, the unit rests on the Hutton Sandstone with apparent conformity, and, locally, apparently gradationally. It is overlain with apparent conformity by the Ronlo Beds and correlates. However, the basal bed of the overlying sequence is commonly a porous sandstone and the lithological differences with the top unit of the Injune Creek Beds, the Westbourne Formation, is marked.

Deposition of the Injune Creek Beds probably took place very slowly in freshwater environments. Some of the sediments appear to be lacustrine, with local development of coal in swamps. Coarser quartzose sandstone deposition immediately preceeding the Westbourne Formation possibly reflects the effect of local uplift of source areas and the development of vigorous streams. Preliminary correlation of gamma-ray logs of water-bores in the north-eastern Eromanga Basin indicates that the Westbourne Formation is an extensive, fairly uniform argillaceous unit characterized by anomalously high radioactivity. These features are consistent with an interpretation that the formation was deposited following a marine transgression.

UPPER JURASSIC TO LOWER CRETACEOUS

RONLO BEDS

The term 'Ronlo Beds' is here proposed for a sequence of dominantly arenaceous sediments underlying the Wilgunya Formation and overlying the Moolayember Formation in the north and the Injune Creek Beds in the south. Outcrops are generally poor and widely scattered. The name is derived from Ronlo Park Station, the homestead of which is approximately 10 miles S.W. of the southern end of Lake Buchanan.

Distribution: Forms a near-meridional belt extending through western BUCHANAN, GALILEE and JERICHO. Exposures generally confined to isolated, small and discontinuous, very low scarps; these are mainly either at the base or the top of the unit. Most exposures are deeply weathered. The most continuous scarps are in southern BUCHANAN, south of Ronlo Park Homestead. The type section is approximately 6 miles south of the homestead.

Measured sections: X31, X40 (Type Section), X41, X42, X43, X44, X47, X48. (Fig. 11). The top of the Ronlo Beds was also interesected in B.M.R. Scout Holes Longreach No. 3 and Jericho No. 1.

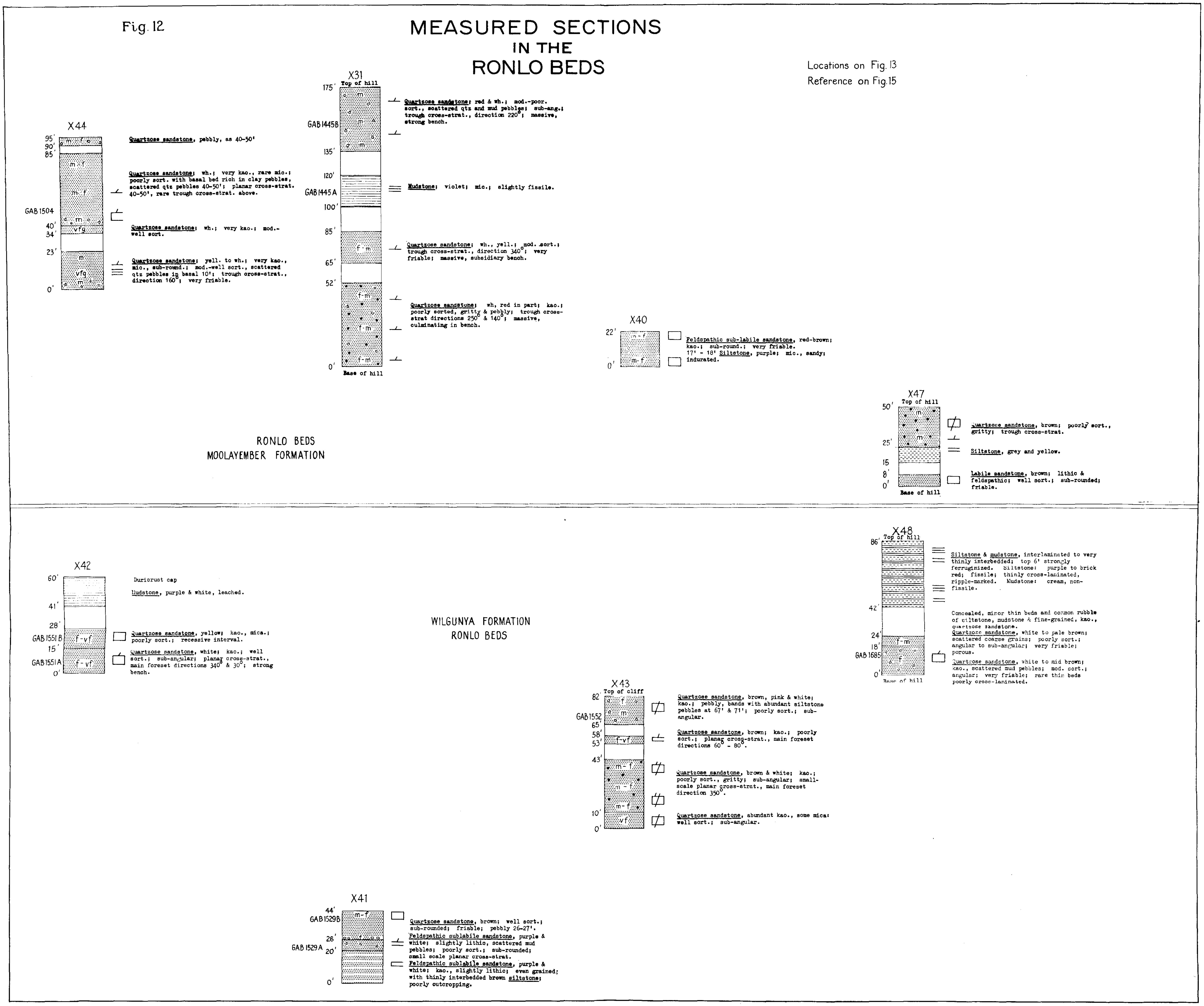


Fig. 12

MEASURED SECTIONS IN THE RONLO BEDS

Rock Types: mainly sandstone, dominantly quartzose, but commonly labile or sub-labile, particularly in GALILEE and JERICHO; fine to coarse-grained, moderately to well-sorted, but commonly argillaceous; locally pebbly, or containing mud pebbles. Minor amounts of interbedded mudstone, carbonaceous in scout holes.

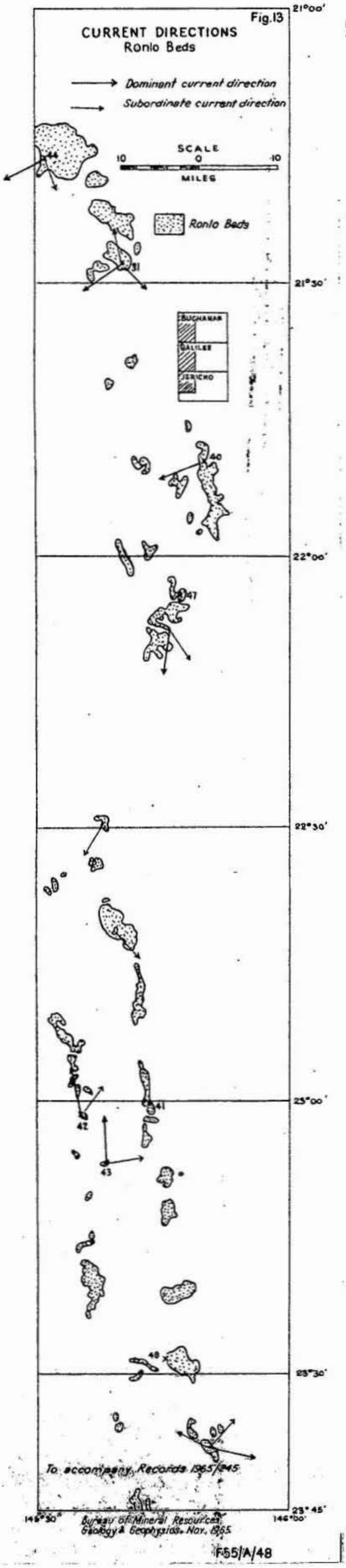
Thickness: Maximum measured thickness 175 feet in X31. The Ronlo Beds are estimated to be between 200 and 300 feet thick, but thinning to less than 100 feet over the Barcaldine Ridge.

Fossils and age: Only silicified wood and indeterminable plant debris found in outcrop. Outcrops too weathered for palynological determinations. A mudstone stringer at the top of the Unit in B.M.R. Longreach S.H. No. 3 yielded microspores and pollens (but only rare microplankton) of Lower Cretaceous age. A core approximately 50 feet lower yielded only spores of probable Upper Jurassic age (Evans, in prep).

Poverty of outcrop makes it difficult to be sure of the stratigraphic relationships of the Ronlo Beds. They occur in a belt between the Moolayember Formation and the Wilgunya Formation in BUCHANAN, GALILEE and northern JERICHO. In southern JERICHO outcrops are west of those of the Injune Creek Beds.

Where seen the boundary with the Moolayember Formation is a disconformity, but the base of the Ronlo Beds is inferred to be a regional unconformity. South of the Barcaldine Ridge, the Ronlo Beds apparently overlie the Injune Creek Beds (and possibly overlap the Hutton Sandstone). On the Barcaldine Ridge, the Wilgunya Formation appears to be less than 100 feet stratigraphically above the Moolayember Formation near Alice Siding; the inference is that the interval contains only Upper Jurassic Ronlo Beds, the Hutton Sandstone and Injune Creek Beds having been eroded. Northwards the entire sequence between the Moolayember Formation and the Wilgunya Formation is assigned to the Ronlo Beds. It is possible that either the Hutton Sandstone or a sandy facies of the Injune Creek Beds has been included; this can only be checked by shallow drilling and detailed palynological studies.

Westwards in the subsurface, the Ronlo Beds or their correlates are regarded as resting on successively younger sediments (Lower Jurassic sandstone in Maranda No. 1, Injune Creek Beds at the Hulton-Rand Structure. Thus the Upper Jurassic sandstone sequence overlaps progressively older units towards the present eastern margin of the basin. A similar relationship is inferred in the Hughenden area on the north-eastern margin (Vine et al, 1964).



Where seen the contact between the Ronlo Beds and the overlying Doncaster Member of the Wilgunya Formation is extremely sharp (Fig. 14). The boundary is possibly a disconformity, corresponding to the marine transgression of the Wilgunya Formation. A marked environmental change at this boundary is indicated by the palynological studies on B.M.R. Longreach S.H. No. 3. Abundant microplankton occur at the base of the Wilgunya Formation, but are rare in the top of the Ronlo Beds. The palynological evidence is, as yet, inconclusive with regard to any age differences between the two units. The top part of the Ronlo Beds is tentatively regarded as a correlate of the Lower Cretaceous Gilbert River Formation of the Hughenden area, where it was mapped as a basal sandstone and conglomerate of the Wilgunya Formation. Upper Jurassic spores from approximately 50 feet below the top of the Ronlo Beds suggest that some of the unit can also be correlated with the Upper Jurassic Blantyre Sandstone (Vine et al, 1964) of the Hughenden area.

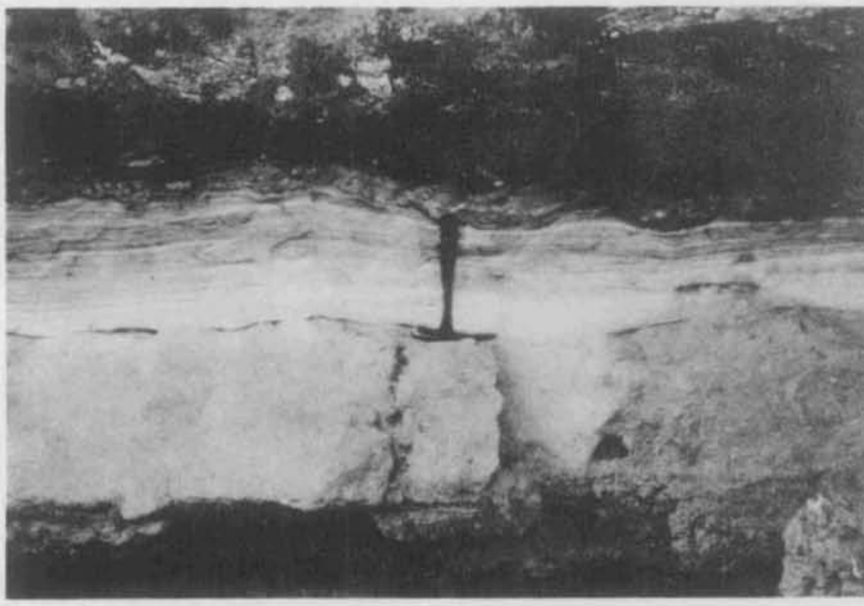


Fig. 14. Contact of the Ronlo Beds with the overlying Wilgunya Formation, 22 miles east of Aramac.

The Ronlo Beds occupy a similar stratigraphic position to the Hooray Sandstone in TAMBO, and thus are a correlate of part or all of the sequence Gubberamunda Sandstone to Blythesdale Formation of the Roma area.

Deposition of the Ronlo Beds probably took place mainly as fluviatile sands, with mud flats on flood plains and local lakes. The land surface was probably extremely flat, but almost everywhere above sea level prior to the great marine transgression of the Wilgunya Formation. Current directions, interpreted from cross-stratification measurements are shown in Fig. 13; they are too variable to enable any interpretation to be made of source areas of sediments.

SUBSURFACE CORRELATES

Sediments occupying the stratigraphic interval between the Westbourne Formation (Injune Creek Beds) and the Wilgunya Formation are not described with the Ronlo Beds, although they are correlated with them. There are marked differences in both lithology and thickness which are probably only partly due to the limited exposure and therefore restricted knowledge of the Ronlo Beds. In addition the Ronlo Beds may possibly include correlates of the Hutton Sandstone and Injune Creek Beds, so while the restricted stratigraphic interval can be readily identified in the subsurface a separate discussion is preferred.

		Intersections:
Distribution:	Maranda No. 1	180' - 356'
	Alice River No. 1	767' - 908'
	Saltern Creek No. 1	1405' - 1660'
	Hulton No. 1	930' - 1175'
	Marchmont No. 1	2097' - 2460'
	L.O.L. No. 1 (Cleeve)	2130' - 2750'
	L.O.L. No. 4 (Longreach)	2332' - 2945'
	Penrith No. 1	2578' - 3787'
	Fermoy No. 1	3375' - 5040'
	Mayneside No. 1	3713' - 5105'

Rock types: Dominantly a sandstone sequence with interbedded mudstone and siltstone.
Sandstone varies from fine to coarse, and labile to quartzose. Labile sandstone most common in Maranda No. 1 (described as arkose) and in Fermoy No. 1 and Mayneside No. 1 (described as greywacke). Some intervals of coarse quartzose sandstone have thin interbeds of conglomerate.
Argillaceous sediments mainly dark coloured, commonly micaceous and carbonaceous, some coal.

Thickness (feet)	Maranda No. 1	176
	Alice River No. 1	141
	Saltern Creek No. 1	255
	Hulton No. 1	245
	Marchmont No. 1	363
	L.O.L. No. 1 (Cleeve)	620
	L.O.L. No. 4 (Longreach)	613
	Penrith No. 1	1209
	Fermoy No. 1	1665
	Mayneside No. 1	1392

Fossils and age: Only microspores and pollens recovered; age determinations given in completion reports indicate Upper Jurassic to Lower Cretaceous.

The limits of the unit are defined by the easily identifiable argillaceous sequences of the overlying Wilgunya Formation and the underlying Westbourne Formation. The unit therefore represents the time interval during which the sequence Gubberamunda Sandstone to Blythesdale Formation were deposited in the Surat Basin. A very marked thickening of the unit westwards implies prolonged subsidence in a previously stable area, but may additionally indicate deposition close to a western source area due to uplift of the Cloncurry massif. Some support for this hypothesis is given by the large amounts of labile material in the sandstones of Fermoy No. 1 and Mayneside No. 1. Evidence of marine deposition is lacking. Sedimentation probably was mainly fluviatile with local or temporary developments of lakes and swamps

Fig. 15 *Reference for Measured Sections*

LITHOLOGY

Grain Size (mm)		
2		*Conglomerate*
1–2	vc	*Sandstone:*
0·5–1	c	*Quartzose > 90% clasts quartz*
0·25–0·5	m	*Sublabile (feldspathic) 75%–90% clasts quartz*
0·125–0·25	f	*Labile (feldspathic, lithic) < 75% clasts quartz*
0·063–0·125	vf	

Siltstone

Mudstone (includes fine siltstone, claystone, silty claystone)

Gaps in Sections are concealed area

STRATIFICATION

- *Very thick > 120 cms*
- *Thick 60–120 cms*
- *Thin 5–60 cms*
- *Very thin 1–5 cms*
- *Laminate < 1 cm.*
- *Cross-stratified (tick may be placed on top of appropriated stratification symbol)*

SYMBOLS

- *Plant fossils*
- *Fossil wood*
- 6AB 1459A *Specimen*

ABBREVIATIONS

calc – calcareous	*kao – kaolinitic*
carb – carbonaceous	*si – siliceous*
fe – ferruginous	*sort – sorted*
feld – feldspathic	*strat – stratification*

LOWER-UPPER(?) CRETACEOUS

Rolling Downs Group

The Rolling Downs Group, first referred to as the Rolling Downs Formation by Jack (1886), was named and defined by Whitehouse (1954). It is essentially a marine argillaceous sequence gradational upwards into a freshwater sequence of interbedded argillaceous and fine-grained arenaceous sediments, with coal. Whitehouse divided the group into three formations - Roma, Tambo and Winton - but noted that there was no lithological difference between the Roma and Tambo Formation (op.cit., p.10). The division between these two formations was regarded as a faunal break, or period of non-deposition. Subsequently, systematic mapping in the northern Eromanga Basin showed that there was continuous sedimentation from Roma to Tambo time, and it has been found to be more useful to regard Roma and Tambo as essentially stages. Vine and Day (1965) proposed an alternative nomenclature for the northern Eromanga Basin comprising lithological divisions which had proved to be mappable units. Briefly, these are the Wilgunya Formation (Casey, 1959), of dominantly argillaceous sediments deposited in a mainly shallow, epicontinental sea; the Mackunda Formation, of interbedded argillaceous and fine-grained labile arenaceous sediments deposited in a paralic environment; and the Winton Formation (Dunstan, 1916, Whitehouse, 1954) of sediments similar to the Mackunda Formation but containing coal seams, deposited in freshwater environments. The Wilgunya Formation was further divided into members, based on more subtle lithological differences. Names of five of these members have already been published; Toolebuc Member (Casey, op. cit.), Doncaster, Jones Valley, Ranmoor, and Allaru Members (Vine and Day, op. cit.). The Coreena Member was recognized as a result of the 1964 mapping and is defined below.

In general, the subtle differences between members of the Wilgunya Formation have not been noted in lithological descriptions of cores and cutting from oil exploration wells. Most of the differences do not affect electrical characteristics; the only member consistently identifiable from wire-logs is the Toolebuc Member which is characterized by a strong peak on the gamma-ray logs. Accordingly, in the following descriptions reference to sub-surface intersections of the members is only made where some distinctive feature has been recorded.

DONCASTER MEMBER OF THE WILGUNYA FORMATION

Distribution: Forms only scattered poor outcrops in small areas of grassland in north-eastern LONGREACH and south-western JERICHO, and in deeply weathered exposures in duricrust-capped scarps in western GALILEE and JERICHO. Intersected in B.M.R. Scout Holes Longreach 3 and Jericho 1.

Rock Types: Dominantly mudstone, blue-grey, blocky, only poorly micaceous; some calcareous. A few bands green and richly glauconitic, with some thin beds of glauconitic siltstone. Some nodular limestone. Gypsum, in small amounts, occurs both at the surface and in fresh cores. On the northern margin of the Eromanga Basin beds rich in glauconite are diagnostic of the unit; but within the area mapped in 1964 the exposures are too poor and scattered to ensure that this criterion is valid.

Thickness: Nowhere measurable in outcrop. Estimated thickness between 250 and 350 feet. Probably thickening westwards.

Fossils and age: No good fossil collections made from the poor outcrops within area mapped. Northwards the member contains a rich fauna of pelecypods and ammonites of Aptian (Lower Cretaceous) age (Appendix 1).

Mapping during 1964 added little to knowledge of the Doncaster Member, except for further information on its distribution. It is regarded as the deposit of a shallow epicontinental sea, probably one with only periodic good access to the open ocean, and surrounded by an extremely flat land surface which was unable to contribute much sand-size debris. Common occurrence of gypsum probably due to concentration of salts by evaporation.

In Mayneside No. 1 and Fermoy No. 1 several beds or intervals of richly glauconitic very fine-grained sandstone or coarse-grained siltstone are reported from the Wilgunya Formation. They are mainly in the basal 500 feet of the formation, in the interval which probably corresponds to the Doncaster Member. These beds seem to be comparable with the richly glauconitic siltstone common in the member in the Hughenden area. A thick interval of glauconitic very fine-grained sandstone in the two wells (2900-2972 feet in Fermoy No. 1; 3290-3358 feet in Mayneside No. 1) is comparable with the Jones Valley Member which immediately overlies the Doncaster Member in the Hughenden-Richmond area.

CORENA MEMBER OF THE WILGUNYA FORMATION

The Coreena Member is a sequence of coarse-grained siltstone grading to very fine-grained sandstone interbedded with mudstone. It overlies the Doncaster Member and is overlain conformably by the Toolebuc Member of the Wilgunya Formation. No type section is measurable; the type area is along the western boundary of Coreena Station.

Distribution: As scattered rubbly outcrops within a belt of rolling downs extending from Barcaldine in eastern LONGREACH to the Aramac area in south-eastern MUTTABURRA. The western limit subsurface is not known.

Rock types: Siltstone, coarse-grained and grading to very fine-grained sandstone; blue-grey, buff where weathered; labile, commonly calcareous, glauconitic, argillaceous. With interbedded mudstone, blue-grey, buff where weathered. Minor coquinite and intraformational conglomerate. Locally richly fossiliferous.

Thickness: In outcrop estimated at 300', probably thickening southwards.

Fossils and age: A rich fauna of pelecypods and ammonites of Albian (Lower Cretaceous) age (App. 1).

The Coreena Member, below the Toolebuc Member and above the Doncaster Member occupies the same stratigraphic position, as the Ranmoor Member on the northern margin of the basin. However, the Ranmoor Member is almost entirely a mudstone or shale unit, whereas the Coreena Member contains many beds of sandstone or coarse siltstone. In addition, the Coreena Member becomes sandier southwards in the Tambo area.

Day (App. 1) correlates the fauna with that of the Ranmoor Member, but notes the absence of Lower Albian fauna which occurs at the base of the Ranmoor Member.

The Coreena Member is regarded as a facies variant of the Ranmoor Member, deposited in a very shallow epicontinental sea with a local supply of sand-sized detritus.

Subsurface information on the Coreena Member is mainly lacking. In Alice River No. 1, fine-grained sandstone was drilled immediately below the Toolebuc Member in the interval 148-183 feet, and thin interbeds of sandstone or siltstone continue to about 350 feet. This interval is comparable with the Coreena Member. Westwards, logs of oil exploration wells record almost no sandstone or siltstone for about 300 feet below the Toolebuc Member apart from rare beds in Fermoy No. 1 and Mayneside No. 1. This sequence is perhpas better regarded tentatively as the argillaceous Ranmoor Member.

TOOLEBUC MEMBER OF THE WILGUNYA FORMATION

Distribution: Forms a narrow belt of rubbly outcrops within extensive rolling downs, extending from Aramac southwards to near Barcaldine. Best exposures are in road-metal pits. Near Barcaldine outcrop of the Member swings sharply westwards round the nose of a west-plunging faulted anticline on the Barcaldine Ridge. A single large limestone floater from the Toolebuc Member limestone was found in creek debris in south-west JERICHO at Grid Reference 357013. Some outcrops occur on TAMBO. Identifiable in oil exploration wells in LONGREACH and MANEROO by a very strong deflection of the gamma-ray log and less well-defined deflections of electric logs. Drilled in B.M.R. Scout Hole Longreach 5.

Rock types: Platy, white, coarsely crystalline limestone and interbedded grey calcareous shale; minor white and pink, finely crystalline to earthy, concretionary limestone.

Thickness: Estimated less than 10' in outcrop. 8 feet in B.M.R. Longreach Scout Hole 5. Gamma-ray peak extends over intervals ranging from 15 feet in the Barcaldine area to 120 feet at Fermoy No. 1.

Fossils and age: Richly fossiliferous, but a very restricted fauna consisting almost entirely of the pelecypods *Inoceramus* and *Aucellina hughendenensis*. (Appendix 1).

The widespread occurrence of limestone in the Toolebuc Member, throughout almost the entire northern Eromanga Basin reflects a major regional tectonic event or climatic change. The restricted fauna indicates development of an environment unsuitable for most of the macrofauna present in the underlying and overlying sediments. Possibly a sudden warming of the whole area coupled with limited access to the open ocean would be sufficient to increase the salinity by increased evaporation, and also produce conditions favourable to precipitation of calcium carbonate.

ALLARU MEMBER OF THE WILGUNYA FORMATION

Distribution: Forms a belt of rubbly outcrops within rolling downs extending from west of Aramac to near Barcaldine, with a large lobe extending north-west almost to the Thomson River on the upthrown side of the Hulton-Rand Structure. Identifiable in logs of oil exploration wells in

LONGREACH and MANEROO as an argillaceous interval between the Toolebuc Member and the Mackunda Formation. Drilled in B.M.R. Scout Holes Longreach 2 and 4.

Rock types: Dominantly mudstone, blue-grey where fresh, buff where weathered, non-fissile, poorly laminated in part, poorly micaceous. Some calcareous mudstone, uncommon siltstone and calcareous siltstone, particularly in the upper part of the Member. Some seams of cone-in-cone limestone.

Thickness: 700 to 1000 feet; thickest in MANEROO.

Fossils and age: A rich marine macrofauna, including many ammonites and pelecypods. Day (Appendix 1) regards the fauna as of Albian (Lower Cretaceous), probably Upper Albian, age.

The Allaru Member is the deposit of an extremely shallow epicontinental sea, surrounded by a flat land surface capable of supplying only clay or silt-sized debris.

MACKUNDA FORMATION

Distribution: Forms numerous rubbly outcrops in extensive rolling downs in LONGREACH, and in fault inliers in south-eastern MANEROO. Identifiable in oil exploration wells in MANEROO and western LONGREACH as a sequence of interbedded sandstone and mudstone, with marine fossils.

Rock types: Interbedded labile sandstone and mudstone. Sandstone mainly very fine-grained, but grading from coarse-grained siltstone to fine-grained sandstone. Grains well-sorted, but mainly with argillaceous matrix or abundant calcareous cement; calcareous sandstone grades to sandy limestone. Sand-size fraction mainly volcanic rock fragments and angular plagioclase feldspar, with minor amounts of quartz (Galloway, in prep.). Mudstone similar to Allaru Member. Fossiliferous, some coquinite. However coquinites are not as common as in the north, and the fossils seem generally more fragmentary.

Thickness: 600 to 800 feet, apparently thinning westwards.

Fossils and age: Rich fauna, dominated by pelecypods. Day (Appendix 1) regards the fauna as Upper Albian (Lower Cretaceous) age.

The abundance of volcanic rock fragments and plagioclase, with very low proportion of quartz, indicates derivation almost exclusively from contemporaneous volcanics, i.e. that no older quartzose sediments provided significant amounts of detritus. This implies that the areas of the Tasman Geosyncline, and the Bowen, Drummond and Galilee Basins were precluded from supplying sediment either because erosion had produced a senile land surface or that they were covered by the Cretaceous sea.

Angularity of the fragments in the Mackunda arenites indicates rapid deposition and lack of significant reworking; even grain-size suggest long transport. The Cretaceous vulcanicity implied by the composition of the arenites may, therefore, have been far removed from the Eromanga Basin. Cretaceous vulcanicity is otherwise unknown in eastern Australia, but is recorded in Papua-New Guinea (APC, 1961). However, the authors believe that there was no direct hydraulic gradient between Papua and the Eromanga Basin during the Cretaceous; this requires separate discussion. Alternative possible areas are;

(a) the Coral Sea Plateau, an extensive present day shelf about which virtually nothing is known geologically. However, the limited amount of aeromagnetic work in areas closer to the mainland indicates abundant volcanics in the sedimentary section.

(b) near southern Victoria, where thick piles of Cretaceous sediments derived from volcanics occur in the Otway and Gippsland Basins.

WINTON FORMATION

Distribution: Forms numerous rubbly outcrops in extensive rolling downs in western and southern LONGREACH and eastern MANEROO; some deeply weathered exposures in the slopes of duricrust-capped hills in western MANEROO; sub-surface in oil exploration wells in these areas.

Rock types: Interbedded mudstone and labile sandstone, with some seams of coal; fairly common intraformational conglomerate. Mudstone similar to Allaru Member. Sandstone similar to Mackunda Formation, but tends to be slightly coarser (but still mainly fine-grained) and seems to have more argillaceous matrix. Presence of coal and carbonaceous mudstone help to distinguish the Winton Formation from the Mackunda Formation. In addition, the bedding in the Winton Formation is generally thicker than the Mackunda, and intervals of sandstone or mudstone are commonly tens of feet thick. Interpretation of logs of oil exploration wells and surface examination suggest that the unit contains less sandstone and intraformational conglomerate in LONGREACH and MANEROO than in the type area near Winton and to the north in MANUKA.

Thickness: Top eroded, up to 1275' (in Mayneside No. 1).

Fossils and age: Abundant plant fragments and fossil wood, mainly indeterminate. Rare shelly fossils are freshwater pelecypods. From regional mapping in areas to the north and identifications by M.E. White of a few plant fossils, Vine and Day (1965) suggest that the lower part of the Winton Formation was deposited late in Lower Cretaceous time, but that sedimentation continued into Upper Cretaceous time.

The Winton Formation represents the continuation of Mackunda-type sedimentation in exclusively fresh-water environments. The larger proportion of lutites in the LONGREACH-MANEROO area may indicate either waning vulcanicity or else diversion of the main supplies of coarser sediments.

TERTIARY

By convention, but without any positive evidence, lithified superficial sediments in the interior of Queensland are regarded as Tertiary in age. Certainly their distribution, with relation to the Winton Formation, indicates a considerable period of erosion between deposition of the two sequences. In addition, apparently younger and non-lithified sediments north of Aramac contain a Pleistocene vertebrate fauna (Vine et al, 1964).

GLENDOWER FORMATION

Glendower Formation (Whitehouse, 1954) was originally named the Glendower Series by Whitehouse (1940). A more precise use of the name was suggested by Vine et al (1964).

Distribution:	Forms isolated hill cappings in a belt extending through N.W. LONGREACH, south-westwards to southern MANEROO, roughly following the course of the Thomson River. Continuation of a belt of outcrops extending from north of Hughenden.
Rock types:	Mainly sandstone, grading to sandy siltstone. Sandstone illsorted, pebbly, angular, poorly bedded; some bands and lenses of conglomerate ranging up to cobble size. Small amounts of mudstone, mainly sandy.
Thickness:	Variable, partly due to Quaternary erosion; mainly of the order of 50 feet.
Fossils and age:	No fossils found. Regarded as Tertiary by stratigraphic relationships.

Outcrops of the Glendower Formation mapped in 1964 are the southern continuation of others extending nearly 300 miles from north of Hughenden. Distribution of the unit shows quite clearly that it contains the deposits of an ancient river system, with a source north of Hughenden but with tributaries joining from east and west. One such tributary, the ancestral Aramac Creek is now represented by isolated outcrops in the northern margin of LONGREACH, including Mt. Rodney. Most of the Glendower Formation represents the ancestral drainage system of the Thomson River and, to the north, Landsborough Creek and the headwaters of the Flinders River.

Abundance of arenites in the Longreach area indicate derivation from older coarse quartzose sediments, probably mainly the

Jurassic sandstone sequences east of Barcaldine and Aramac.

WERITE BEDS

Named by Vine (1964) from outcrops in the Forsyth Range in southern WINTON.

Distribution: Isolated hill-capping in northern MANEROO.

Rock types: Mainly grey mudstone, with thin interbeds of poorly sorted fine-grained quartzose sandstone and sandy mudstone.

Thickness: Occur as erosional remnants, maximum thickness seen: 58 feet.

Fossils and age: No fossils found. Regarded as Tertiary from stratigraphic relationships.

Outcrops of the Werite Beds in MANEROO are only the southern extension of a large area in southern WINTON. The Werite Beds are probably the deposit of another river system which drained south-eastwards into the old Glendower river. Mudstone in the unit was probably derived by erosion of the quartz-poor Cretaceous sequence, and the quartzose sandstone from crystalline rocks of the Mt. Isa-Cloncurry mineralized belt.

UNDIFFERENTIATED TERTIARY SEDIMENTS

(a) Central MANEROO. Isolated hill-cappings in central MANEROO include both mudstone, similar to the Werite Beds, and sandstone, similar to the Glendower Formation. Thicknesses of nearly 200 feet were seen. They possibly represent sedimentation at the confluence of the Werite river and an anabranch of the Glendower river.

(b) Alice River area. Poorly sorted sediments (mainly sandy mudstone and argillaceous sandstone) occur as extensive low plateaus in a belt adjacent to the present Alice River and Jordan Creek, some at levels not far above young river terraces. Most of the plateaus have a cover of superficial sediments and outcrops are confined to the plateau margins. The sediments are mainly leached, and most have resistant silicified caps, locally ferruginous.

By analogy with the Glendower Formation and Werite Beds, these sediments are regarded as old fluviatile deposits of the Alice River and Jordan Creek.

(c) Piedmonts. Sheets of lithified, poorly sorted, superficial sediments slope gently down from many of the ranges of sandstone hills but are now themselves being dissected. The surfaces of most of these sheets are cloaked by younger unconsolidated sediments and the Tertiary sediments are only exposed where the sheets are themselves being eroded. These deposits are clearly the old outwash deposited as piedmonts during earlier erosion of the sandstone hills.

Many of these sheets of Tertiary sediments have thin protective cappings of ferricrete (pisolitic ironstone) developed within the sandstone. The ferricrete is interpreted as a surface enrichment of an originally ferruginous sediment which derived iron from erosion of older lateritized sediments.

Large areas of JERICHO, GALILEE and BUCHANAN are covered by unconsolidated superficial sediments with scattered rubble of ferricrete. Probably a large part of these areas is underlain at shallow depth by Tertiary sediments which are continuous with those of the piedmonts.

STRUCTURE

REGIONAL SETTING

Within, and adjacent to, the area mapped are three named sedimentary basins: the Drummond, Galilee and Eromanga Basins. The oldest, the Drummond Basin, containing Devonian and Lower Carboniferous sediments and volcanics, is exposed to the east of the area mapped. The extent of the Drummond Basin westwards below younger sediments is unknown. Devonian sediments were drilled in Lake Galilee No. 1, but a western limit of the basin is implied by the occurrence of crystalline basement directly overlain by Lower Permian or Upper Carboniferous sediments in Exoil Brookwood No. 1 in MUTTABURRA and A.O.D. Maranda No. 1 in LONGREACH.

Whitehouse (1954, Fig. 37) named the Galilee Basin in passing, and presumably derived the name from Lake Galilee. This description merely noted it as a Permian and early Mesozoic basin. However, further on (op.cit, p.15), he referred to the development in late Permian time of a meridional depression west of the Drummond Ranges. Drilling of Exoil Lake Galilee No. 1 subsequently proved the existence in the Lake Galilee area of nearly 3000 feet of Upper Permian and Triassic sediments, disconformably overlying approximately 6500 feet of Upper Carboniferous to Lower Permian sediments. This indicates that the development of the Galilee Basin started much earlier than Whitehouse conceived, and that sedimentation took place over a comparable period to the Bowen Basin. The Galilee and Bowen Basins may be best regarded as complimentary basins developed on the west and east flanks respectively of the Anakie Inlier and the Nebine-Nogoa Axis. Exposed parts of the Galilee Basin are confined to a near-meridional belt through BUCHANAN, GALILEE and JERICHO; westwards the basin is overlapped by Jurassic sediments of the Eromanga Basin.

The youngest basin, the Eromanga Basin, can be defined by the limits of Jurassic and Cretaceous sedimentation. The area mapped is mainly on the present north-eastern margin of the Eromanga Basin, but in MANEROO and LONGREACH includes some of the central parts.

STRUCTURES

Major folding is confined to the Drummond Basin, and this is not discussed further. Most of the folds of the Galilee and Eromanga Basin are drape folds over older elevated areas; the amplitudes are greater in the Galilee Basin. Within these two basins the most prominent structures are linear features - probably faults at depth, but grading upwards into monoclines.

Plate 2 shows the major structural features of the area deduced from the surface mapping (supplemented by photo interpretation) and seismic surveys. Plate 3 shows contours on the base of the Wilgunya Formation, interpreted mainly from drillers' logs of water bores. Structure indicated by this interpretation corresponds well with that indicated by seismic work in LONGREACH. Preliminary interpretation of gamma-ray logs of water bores indicates that the drillers' logs generally give a reliable pick of the base of the Wilgunya Formation.

The <u>Hulton-Rand Structure</u> (called Hulton-Rand Monocline by Mott & Associates, 1964a,b,c) is evident on air photos as a belt of lineated trend lines, which are presumed to reflect dipping beds. No direct evidence of dips was seen on the ground. However, the boundary between the Mackunda and Wilgunya Formations follows the belt along most of its length. The structural interpretation based on drillers' logs does not give any clear indication of the Hulton-Rand Structure. It had previously been recognized and interpreted as a monocline by seismic surveys (GAL, 1963; UGC, 1964). Confirmation of the presence of the structure was provided by the drilling of three oil exploration wells, Saltern Creek No. 1, Hulton No. 1 and Marchmont No. 1; the first two are only 3 miles apart and on opposite sides of the structure. They showed:

(a) that there is displacement of approximately 500 feet at the base of the Wilgunya Formation between the Saltern Creek and Hulton wells;

(b) that the Hulton-Rand Structure is an ancient feature, which periodically acted as a barrier to sedimentation during late Palaeozoic and Mesozoic time. The sedimentary succession is much thicker on the north-eastern (downthrown) side of the structure; Mott et al. (op.cit.) suggested that it formed the effective south-western limit of the Galilee Basin, and we agree with this interpretation.

The <u>Tara Structure</u> (here named after Tara Homestead, 17 miles west of Barcaldine) has a similar expression to the Hulton-Rand Structure. It is marked by a belt of lineated trend lines but, by contrast, southerly dips up to 26^{o} were measured. The Tara Structure is also clearly evident in the structure contour map (Plate 3). There is, as yet, no seismic evidence of this structure, although a possible eastern continuation was indicated by seismic work (GGC, 1963a) preceeding the drilling of Alice River No. 1. (This well was drilled to test the petroleum possibilities of sedimentary units which wedge out northwards). The Tara Structure is interpreted to be similar to the Hulton-Rand Structure: a basement fault which has been intermittently active during Palaeozoic and Mesozoic sedimentation in the area. By analogy with the Hulton-Rand Structure, it may also have been the effective N.W. limit of Palaeozoic sedimentation of the area south of Barcaldine.

Structures in the area west of the Hulton-Rand and Tara Structures are a series of faults or monoclines with mainly northerly trends. The Yarraman Fault*, the Westland Structure and the Stormhill Fault are all indicated by lineated trend lines which correspond to boundaries between the Winton and Mackunda Formations. All three have displacements at the base of the Wilgunya Formation in excess of 1000 feet; the Yarraman Fault evidenced by correlation of gamma-ray logs of water bores in MUTTABURRA, the other two by seismic survey (Harwood and Vind, 1963).

The other faults (or monoclines) mapped in western Longreach are inferred from lineated trend lines, some of which correspond to geological boundaries. At the present state of knowledge it is not considered necessary to name any of them; the structural contour map (Plate 3) indicates that the displacement at the base of the Wilgunya Formation is small, with the possible exception of the structure N.W. of Ilfracombe.

Seismic surveys (Harwood and Vind, op.cit; AGP, 1962; GSI, 1964) show that the Westland Structure and Stormhill Fault form part of a series of step-faults, downthrown to the west, extending across the southern part of MANEROO. Each fault block is tilted to the east, but the cumulative result is a regional depression to the west. Similar block faulting is also evident from seismic surveys to the north in MANEROO, in the headwaters of Vergemont Creek (CGG, 1964a, b). Surface evidence for these western faults is generally lacking, although some seem to be aligned with lineaments evident on air photos, or with straight sections of watercourses.

This step-faulting of an inclined platform is at variance with the concept of the "Longreach Spur" (Hill and Denmead, 1960, p.16) extending south-westwards into the Eromanga Basin. It will be noticed that the Mackunda/Winton boundary of the Longreach and Maneroo Preliminary Editions differs markedly from the position of the comparable "Tambo"/Winton boundary shown on the 1953 Geological Map of Queensland. In particular, a faulted inlier of Mackunda Formation replaces a lobe of Tambo Formation, which previously had seemed to

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*The Yarraman Fault is named from Yarraman Homestead in S.W. MUTTABURRA; it is not named on the Preliminary Edition of the Longreach Sheet. The Westland Structure and Stormhill Fault are named from Westland and Stormhill Homesteads respectively, in S.E. MANEROO.

provide a clear indication of a major buried ridge.

West of the Tara Structure, the sub-surface structural map (Plate 3) shows two parallel S.W. plunging anticlines. Crowding of the contours possibly indicates faulted margins to these structures. Most of the basement occurrences recorded in water-bore drillers' logs are along the two structures, which are interpreted as drape folds over shallow, block-faulted basement.

On the easterly anticline a small dome (shown on the Longreach Preliminary Edition) is inferred from photo interpretation. No dips were seen on the ground, but the surface expression of the dome is a roughly oval, very low, gravel-covered, ridge. By size and appearance it could be interpreted as a salt dome, but the basement occurrences nearby make this interpretation doubtful.

The anticlines shown near the Penrith, Hulton, Jericho (and one 10 miles N.W.) Lake Galilee and Balmoral wells are all very gentle structures indicated by seismic surveys. Most are small, although the Balmoral structure (Mott, 1958) is the largest, and of sufficient extent to be identifiable on the structure contour map. By contrast, the Barcaldine Ridge is reflected at the surface by the distribution of rock units, and is also evident on the structure contour map as a plunging anticline. The subsurface extent of the Barcaldine Ridge is discussed further below.

The Mingobar Structure (name derived from the Parish of Mingobar) is evidenced by a linear belt of moderately dipping Upper Permian sediments overlain by more gently dipping Lower Triassic sediments. Dips up to 27° to the S.W. were measured in the Permian sequence. Although only the steep limb is exposed, the structure is interpreted as a monocline. It probably reflects a deeper fault which has been intermittently active, and was active at least during the time interval between deposition of the Permian and Triassic sediments. The possible fault to the south-east of the Mingobar Structure was detected on a single traverse of Lake Galilee - Lake Buchanan Seismic survey (A.G.P., 1963). The relation of these two structures to an inferred major lineament is discussed further below.

STRUCTURAL INTERPRETATION

Plates 4 and 5 show the available gravity and magnetic data; available interpretations of depths to magnetic basement are collated in Plate 6. These, together with the structural information discussed above have been used in compiling the structural interpretation shown on Plate 7. The individual features are discussed in succeeding sections.

The Maneroo Platform (named from Maneroo Creek in eastern MANEROO) is an area of crystalline basement, directly overlain by Jurassic sediments. It is step-faulted, with cumulative depression westwards. The stratigraphic sequence has been determined from wells drilled in the area, coupled with seismic work. Step-faulting is evident from surface mapping, photo-interpretation and seismic work.

Eastwards the Maneroo Platform narrows sharply between the Tara and Hulton-Rand Structures to become the BARCALDINE RIDGE. This is a shallow buried ridge, probably of crystalline basement in the west and possibly of the Drummond Basin sequence in the east, over which younger sediments have been drape-folded, and faulted on the margins. It is evident from the surface mapping as a broad anticline N.W. of Barcaldine, from the apparent marked thinning of the Ronlo Beds N.E. of Barcaldine, and from the apparent sub-Clematis erosion of the Dunda Beds N.E. of Jericho. The Lagoon Creek seismic survey indicates a strong basement "high" north of Barcaldine (GGC, 1963a), and the Alpha refraction survey (GGC, 1963b) indicates a marked northwards rise of basement between Barcaldine and Jericho. Additional support for the presence of the Barcaldine Ridge is given by the gravity values (Plate 4), and magnetic basement configuration (Plate 6). The magnetic interpretation also indicates a major E-trending fault corresponding to the basement rise inferred from the Alpha refraction survey. Possibly the Barcaldine Ridge is a major tilted basement horst; the southern fault having the most displacement. Thinning of stratigraphic units indicated by the surface mapping and by seismic work in the vicinity of the Alice River and Jericho wells, indicates that the Barcaldine Ridge is a ancient structure which may have influenced sedimentation from Devonian time.

Outcrops of the Drummond Basin sequence lie east of the area mapped in the Drummond Fold Belt, which is a zone of robust folding. The geophysical maps (Plates 4,5 and 6) show that it is characterized by positive Bouguer anomalies, mainly smooth isogals, and generally deep magnetic basement.

The western limit of the exposed Drummond Basin sequence is a major lineament here named the Belyando Feature (from the Belyando River). In GALILEE it corresponds to a sharp gravity gradient. The large negative Bouguer anomaly on the western side of the gradient indicates a thick development of light rocks, probably sediments. This is also the area of the deepest magnetic basement. Northwards the Belyando Feature is represented by the Mingobar Structure in BUCHANAN. Further north-westwards, in HUGHENDEN it is the White Mountains Structure (Vine et al, 1964), which separates crystalline basement on the north-eastern side from Permian and Triassic sediments to the south-west. Another steep gravity gradient corresponds with the White Mountains Structure. The Belyando Feature is interpreted as a major regional structural discontinuity, which probably developed during the period of folding of the Drummond Basin sequence. It possibly initiated the development of the Galilee Basin, and may have formed the effective eastern margin of the basin during at least part of the sedimentation.

The Bowie Platform (named from Bowie Station, in southern BUCHANAN), west of the Belyando Feature, is an area of positive Bouguer anomalies, deep magnetic basement, and smooth isogals: an association characterising the Drummond Fold Belt. A single seismic traverse across the Bowie Platform indicates a marked thinning east of the Great Dividing Range between the 'B' reflector (within the Galilee Basin sequence) and the 'C' reflector (within the Drummond Basin sequence) compared with the Lake Buchanan area. The positive Bouguer anomaly is interpreted as due to a thick development of fairly dense Drummond Basin sequence below the Galilee Basin sequence. The single seismic traverse crosses the line of the Belyando Feature, and records in the 'C' and 'D' reflectors a fault or monocline downthrown to the east. This throw is in the opposite sense to all others indicated along the Belyando Feature, possibly due to local 'scissors' faulting.

The total magnetic intensity map shows a N.W. trending belt through central JERICHO and western GALILEE which is magnetically much more irregular than the areas to the north-east. It is shown on Plate 7 as the Lake Dunn Belt. In part it corresponds to areas of gravity maxima, and to some of the more elevated areas of magnetic basement. It may represent the western part of the Drummond Basin, possibly with strong development of volcanics and associated sediments. Alternatively, it may represent a major swell of crystalline basement on the western margin of the Drummond Basin, but buried below the Galilee Basin sequence. On the western side of the Lake Dunn Belt, Maranda No. 1 intersected crystalline basement immediately below the Galilee sequence. Lake Galilee No. 1 was drilled on the north-east margin of the Lake Dunn Belt and intersected Upper Devonian sediments below a thick Galilee Basin sequence.

To the west of the Lake Dunn Belt, two depressions north and south of the Barcaldine Ridge are portrayed by the structural contours (Plate 3). It is also an area of generally strongly negative Bouguer anomalies, but with a N.E.-trending gravity maximum in S.E. LONGREACH. This gravity maximum seems to correspond to a south-westerly deepening of magnetic basement, and may reflect a lobe of the Drummond Basin extending southwards towards the Adavale Basin.

GEOLOGICAL HISTORY

Prior to the development of the Galilee Basin the land surface showed considerable diversity. In MANEROO and western LONGREACH tightly folded metamorphics and granite of the Maneroo Platform formed a mountainous area. Block faulting had probably already taken place, but is doubtful if the Hulton-Rand and Tara Structures were well-defined at that stage. The Barcaldine Ridge was probably already in existence as a tilted horst extending east from the Maneroo Platform. Further east the Drummond Basin sequence had already been folded and was being actively eroded. Possibly the Belyando Feature was in existence as a structural discontinuity.

Initial sagging of the Galilee Basin probably coincided with major movements on the Belyando Feature. The early Galilee Basin, during Carboniferous time, was a narrow, near-meridional trough, generally west of the Belyando Feature but with sedimentation extending east of it in areas of least movement (e.g. Bowie Platform). The western margin was possibly at about the present meridian of $145^{\circ}30'$E. During Lower Permian time the area of sedimentation spread further west, to the margins of the Maneroo Platform and the Barcaldine Ridge. The basin was receiving sediments from both sides.

During this period the Galilee Basin was essentially a continental intermontain basin, although it was well drained and some parts probably subjected to marine incursions. The surrounding elevated areas were being glaciated for at least part of the time, and during P1b time varved sediments were deposited in widespread glacial lakes.

This phase of deposition in the Galilee Basin closed with paludal and lacustrine sedimentation in P1c time, after the close of the glacial epoch, and lowering of the source areas by erosion.

A period of slight warping and erosion followed, corresponding to the main phase of marine sedimentation in the Bowen Basin.

Slight uplift in the marginal areas resulted in a renewal of continental sedimentation, both fluviatile and paludal, during Upper Permian time. The area of deposition probably spread widely beyond the limits of Lower Permian sedimentation, although much of the marginal sediment was later eroded.

The start of Triassic time is marked by a sharp climatic change. To the south it corresponds to the strongly oxidised red-beds of the Rewan Formation of the Denison Trough and Springsure Shelf. In the Galilee Basin sediments are mainly green and grey, indicating reducing conditions, but the dominantly fine grain of the sediments suggests rapid chemical weathering of source areas, while the thickness indicates continual subsidence of the basin, possibly with marine incursions. Renewed uplift of the marginal areas resulted in widespread deposition of fluviatile sands, with source areas on both flanks of the basin. The final Triassic sedimentation was again mainly fine-grained, resulting from lowering of the marginal areas by erosion. This reduction of source areas marks the final stage of the sedimentary history of the Galilee Basin.

During Upper Permian and Triassic time the Hulton-Rand and Tara Structures were probably hinge lines. In nearby areas, in particular on the Barcaldine Ridge, erosion only locally kept pace with sedimentation, resulting in thin or interrupted sequences, but with complete absence near the hinge-lines in the Saltern Creek-Marchmont area. The western part of the Maneroo Platform was probably a major source of detritus during this period.

During Jurassic time the area of sedimentation increased greatly, but intermittently, forming the Eromanga Basin. Lower Jurassic fluviatile sands encroached upon the margins of the Maneroo Platform, which by then had been reduced to a flat land surface. Middle Jurassic lacustrine and paludal sediments spread further west over this land surface.

In Upper Jurassic time a thick sequence of fluviatile and lacustrine sediments were deposited in MANEROO due to uplift of source areas (probably to the west) and downfaulting of the depositional area. During this time only thin fluviatile sediments were deposited in the east of the area, and local uplift resulted in attenuated sequences, particularly on the Barcaldine Ridge.

Paralic sedimentation probably preceeded the marine transgression of the Lower Cretaceous Wilgunya Formation only in the west of the area (western MANEROO) where sedimentation may have been nearly continuous from the Upper Jurassic. In the east, however, the lower boundary of the Wilgunya Formation is extremely sharp.

Lower Cretaceous sedimentation took place in a shallow epicontinental sea, which transgressed rapidly onto an extremely flat land surface. The surrounding source areas were of such low relief that drainage was sluggish and mainly only able to contribute fine sediment. The slightly coarser sediment in the Coreena Member probably reflects the effect of local uplift in nearby areas.

Late in Lower Cretaceous time the onset of vulcanicity in a distant area marginal to the basin resulted in the influx of coarser labile sediment, and produced the Mackunda Formation. This coincided with the development of paralic conditions, due to the rate of sedimentation intermittently exceeding the rate of subsidence, and finally to continental lacustrine, fluviatile and paludal conditions (the Winton Formation).

Rate of erosion though very slow, exceeded deposition during late Cretaceous and Tertiary time, and resulted in a flat land surface bevelling the Cretaceous and older sediments. Strong chemical weathering on the flat land surface produced a duricrust.

Block faulting of the Maneroo platform and margins was renewed during Tertiary time, and further erosion took place before deposition of the Glendower Formation and Werite Beds.

Tertiary deposits were almost entirely fluviatile. Some of the original alluvial deposits are now preserved as hill cappings, although they were originally incised into the older deeply weathered land surface.

The youngest deposits are the present day alluvia and outwash sediments.

ECONOMIC GEOLOGY

UNDERGROUND WATER

Some underground water is obtained from most of the sedimentary units in the area mapped, but the supplies and quality are very variable. A considerable amount of further work is required for a complete appraisal of the potential use of all aquifers. The underground water potential of each stratigraphic unit is discussed separately below.

Upper Carboniferous to Lower Permian sequence

Exposed sequence of mainly argillaceous or fine-grained argillaceous arenites seems to have little prospect for good supplies of water. However, the electrical logs of the sequence in oil exploration wells indicate several thick permeable intervals, and in Maranda No. 1 some of the SP log is reversed, indicating very fresh water.

Upper Permian sequence

The Colinlea Sandstone is generally permeable, but water bores in south-east JERICHO and north-east TAMBO generally produce brackish to saline water. However, the SP log of the basal sandstone interval of the Upper Permian sequence in Maranda No. 1 is reversed, indicating fresh water. Electrical logs of all wells penetrating the Upper Permian sequence indicate several permeable intervals. Several water bores in northern JERICHO obtain potable to brackish water from sandstone beds immediately below coal seams of probably Upper Permian age. In the same area other bores have been abandoned because the water was too saline for stock.

Rewan Formation

This is dominantly an argillaceous sequence, but electric logs of Lake Galilee and Maranda No. 1 indicate many permeable sandstones, some with reversed SP log.

Dunda Beds

Much of the Dunda Beds is sandstone, and fairly good permeability is indicated by electrical logs in Lake Galilee No. 1. However the position of the unit, immediately below the Clematis Sandstone, and usually in rough country has meant that no attempts have been made to drill the Dunda Beds for water supplies.

Clematis Sandstone

A thick friable sandstone sequence, with good permeability indicated by electrical logs. The large spring at Doongmabulla Homestead in northern CALILEE (Whitehouse, 1954, p.14) is at the boundary between the Clemátis Sandstone and the overlying Moolayember Formation.

Many shallow bores have been drilled into the Clematis Sandstone, and almost all have obtained water suitable for stock. Some water is used for domestic purposes.

Moolayember Formation

The Moolayember Formation is dominantly an argillaceous sequence, but contains many sandstone beds. Good permeability is indicated for some of these by electrical logs of Maranda No. 1. The water supply (brackish) for the drilling of Lake Galilee No. 1 was obtained from an aquifer below 520 feet depth after higher salt water aquifers had been cemented off (Pemberton , 1965, p.4).

Throughout large areas of JERICHO, GALILEE and BUCHANAN many bores have been drilled in the Moolayember Formation, and most are still used. The water seems to be generally brackish, and few homesteads rely upon it for domestic supplies. The majority of abandoned bores were drilled in the upper part of the formation, and may indicate that supplies and/or quality deteriorate upwards in the Moolayember Formation.

Warang Sandstone

In outcrop the Warang Sandstone is very argillaceous, and it is doubtful if most of the formation would provide good aquifers, but some permeable beds probably exist. There is no record of drilling into the Warang Sandstone in BUCHANAN.

Lower Jurassic sequence

Preliminary interpretation of gamma-ray logs indicates that the Hutton Sandstone (or its subsurface correlates in the northern Eromanga Basin) contains the main aquifer system of the north-eastern Eromanga Basin. Most of the artesian bores still flowing in LONGREACH obtain abundant supplies of potable water from this aquifer system.

Injune Creek Beds

Very little water is obtained from the Middle Jurassic sequence, because most bores are drilled deeper to the Lower Jurassic high-pressure aquifer system. However, in the Longreach area water is produced from permeable sandstone at the base of the unit.

Upper Jurassic to Lower Cretaceous sequence

In eastern LONGREACH, and western JERICHO and GALILEE good supplies of potable water are obtained from the Ronlo Beds and its subsurface correlates, but it is doubtful if any bores which are still flowing draw water exclusively from this aquifer system.

Westwards, where the sequence thickens, the Upper Jurassic sandstone system is the main artesian acquifer used and provides abundant supplies of potable water including the Longreach town supply. Many of the artesian bores are still flowing.

Wilgunya Formation

In general the Wilgunya Formation is a major aquiclude. However, in south-eastern LONGREACH, several bores appear to be obtaining water from an aquifer about 400 feet above the base of the Wilgunya Formation, presumably from the Coreena Member. At least 3 bores, Reg. Nos. 1384 (G.R. 322034) 1385 (334034) and 2399 (340027) are flowing bores.

Mackunda and Winton Formations

Sandstone beds in the Mackunda and Winton Formations contain aquifers which are tapped extensively in southern and western LONGREACH and in MANEROO. Bores are shallow, mostly less than 1000 feet deep. No artesian aquifers have been reported although the water usually rises to within a few hundred feet of the surface. Water quality is variable, although mainly brackish; several bores have been abandoned because the water is too saline for stock. In other abandoned bores insufficient supply was obtained or the supply has decreased.

Cainozoic Sediments

The Glendower Formation and Werite Beds mainly form hill-cappings, and are therefore unlikely to contain good aquifers. However, there are small permanent springs issuing from the Glendower Formation in the Herbert Range, 16 miles north of Longreach.

In the areas of extensive superficial cover several bores obtain water from very shallow depths (less than 100 feet) presumably from Cainozoic sediments. Water is also obtainable within a few feet of the surface in the beds of the largest sandy creeks and rivers.

PETROLEUM

Information on most of the petroleum occurrences in the area mapped was summarized by the Geological Survey of Queensland (G.S.Q., 1960). Briefly, several shows of oil and/or gas have been reported from water bores and oil exploration wells in the Longreach and Barcaldine area, and several have been confirmed by analysis. The only significant addition since then was the recovery of 10 feet of approximately 44° API gravity oil and a small flow of gas from a drill stem test of Exoil Lake Galilee No. 1.

Most of the shows in the Longreach and Barcaldine areas are in the Upper Jurassic to Lower Cretaceous sandstone sequence, although some may be from Lower Jurassic sandstone. The show in Lake Galilee No. 1 is from a sandstone in the basal arenitic part of the Upper Carboniferous to Lower Permian sequence of the Galilee Basin. Where tested each occurrence was found to be in sediments of poor permeability.

The petroleum prospects of the area are considered to be fairly good because -

(a) Occurrence of small amounts of oil indicates that source beds are present, even though not immediately definable.

(b) Porous and permeable beds suitable as reservoirs are indicated by the aquifers present throughout most of the sequence.

(c) Numerous folds suitable as structural traps are present.

(d) The geological history of the region favours the development of stratigraphic traps, particularly on the flanks of basement ridges.

CONSTRUCTION MATERIALS

Cainozoic sediments provide good supplies of sand and gravel, although most of it is argillaceous and requires treatment for construction work other than road foundations. Elsewhere there are only inferior quality road construction materials and this creates a considerable problem in the construction and maintenance of roads. The possibility of using sub-standard materials, such as sandy loams, for the pavement is now being considered. The Australian Road Research Board is at present carrying out a research project on part of the Landsborough Highway between Barcaldine and Longreach. One of the aims of this experiment is to find ways of utilizing locally available inferior materials in road construction. Morris and Scala (1962) have described the project, which could have far-reaching effects on road construction over vast areas of western Queensland.

Sand

Sand in beds of creeks which drain the Mesozoic arenites is suitable as fine aggregates in concrete.

Sandstone.

Lenses of tough, calcareous sandstone, common in the Cretaceous sediments, are not usually large enough to be an economic source of paving material. Sandy loam deposits appear to be related to these sandstone beds.

Gravel

Gravel deposits near the Thomson River and Patrick Creek have been worked although the material is of poor quality. "Gidyea gravel", an ironstained siliceous gravel, is quite common in the area as a thin surface layer. This gravel has been used for road construction purposes by grading large surface areas, sieving out the soil and remixing with a transported loam.

Limestone

Limestone in the Toolebuc Member, occurs as very thin beds with interbedded calcareous shale. This material has been successfully used as a paving material on roads formed in soil areas, but is unsuitable for other construction work or lime manufacture.

OPAL

At the end of the 19th century, Opalton, in the north-west of MANEROO, was one of the largest opal mining centres in Queensland having a population of about 600. Shortage of water and horse feed restricted mining (or activities) and a prolonged drought caused the field to be virtually abandoned by 1901. While the field was operating opal worth about £40,000 was produced.

Jackson (1902) reported that the opal occurred at the contact between soft sandstones and clays; these sediments are overlain by a hard siliceous cap. The host rock of the opal is the Winton Formation. A less important opal occurrence was worked on Horse Creek, a tributary of the Mayne River.

SALINE DEPOSITS

For most of the year Lake Buchanan is a salt pan. Small supplies of coarse salt are shovelled from the surface by local pastoralists or their employees for use or sale locally, but no attempt has been made to work the salt systematically.

Several hand auger holes were drilled to about 4 feet in the lake bed after all water evaporated in 1964. Each hole intersected only 1 or 2 inches of salt overlying fetid black mud. Thicker salt beds possibly occur in the lake but detailed investigation would be required to check this.

Sediments on the bed of Lake Galilee are silt, clay and sand. They are locally salty, but there is no record of beds of salt.

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APPENDIX I

PALAEONTOLOGICAL REPORT

by

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In LONGREACH marine Cretaceous macrofossils were collected from the Coreena, Toolebuc and Allaru Members of the Wilgunya Formation, and from the Mackunda Formation. Collections were also made from a faulted inlier of Mackunda Formation in MANEROO. Faunally, all these units belong the the "Tambo Series" of Whitehouse (1926). All units are assigned a Lower Cretaceous (Albian) age.

The nearest known outcrop with an Aptian fauna lies to the north at GAB 1384, near the eastern margin of adjacent MUTTABURRA to the north. The fauna from this locality includes Maccoyella barklyi and Mytilus rugocostatus. In the subsurface the oldest marine fauna occurs from 534' - 554' in Farmout Drillers Alice River No. 1. This interval yielded an ammonite doubtfully referred to the Aptian-Lower Albian genus Sanmartinoceras.

Coreena Member

The area of outcrop of this member is shown on the Queensland 40 mile geological map as Roma Formation. However, the fauna has very little in common with that formation.

The Coreena Member is quite fossiliferous, the fossils mainly occurring in coquinite bands. The occurrences of the ammonite Myloceras sp., and the pelecypods Aucellina hughendenensis, Inoceramus constrictus and Pseudavicula papyracea indicate an Albian age. Other pelecypods in the fauna are Barcoona trigonalis, Thracia cf. primula, Camptonectes sp., Nuculana sp., indeterminate Nucula and Maccoyella species, and forms very tentatively referred to the genera Tancredia, Tatella and Fissilunula. Other species are the gastropods Euspira reflecta, a form like "Vanikoropsis" decussatus, a clavate belemnite Dimitobelus sp., and a smooth scaphopod Laevidentalium sp.. There are also a few crustacean remains, shark teeth and fish scales.

Several species are long-ranging. Pseudavicula papyracea, Camptonectes sp. and "Vanikoropsis" decussatus also occur in the overlying Allaru Member and Mackunda Formation. Euspira reflecta and Laevidentalium sp. range through the entire Aptian-Albian sequence.

The fauna correlates closely with that collected from the unit shown as Ranmoor Member (but now regarded as Coreena Member) in adjacent MUTTABURRA to the north. To the south, a somewhat similar fauna was described by Etheridge Jnr. (1907) from the sources of the Barcoo, Ward and Nive Rivers.

The relationship of the predominantly sandy Coreena Member to the predominantly mudstone Ranmoor Member of the Hughenden area to the north is a problem heightened by faunal dissimilarity and by the presence of Cainozoic cover in the intervening area. Both units immediately underlie sediment which lithologically and faunally correspond to the Toolebuc Member. The association of the ammonites Aconeceras, Beudanticeras and Brewericeras indicates that the base of the Ranmoor Member is Lower Albian, while the top is no younger than early Middle Albian. The sole ammonite found in the Coreena Member is a large, undescribed species of Myloceras, a genus apparently not found below the Toolebuc Member in the north. As discussed below, the range of Myloceras can only be inferred from its overseas occurrences. In Madagascar the genus ranges from uppermost Middle Albian to lower Upper Albian. If the new species of Myloceras is also of this age, then the Coreena Member is younger than the Ranmoor Member. The only species common to both members are the pelecypods Inoceramus constrictus which is restricted to these members, and the rather long-ranging (Ranmoor to Allaru Member) Aucellina hughendenensis. Whether the faunal differences are due to age or to facies cannot be determined at present.

Toolebuc Member

Collections from this member contained only large numbers of Aucellina hughendenensis and fragmentary Inoceramus shells. These indicate an Albian age.

Allaru Member

A rich fauna has been collected from this member. The fossils occasionally occur in coquinite bands, but are mainly found in concretionary limestones. Ammonites are particularly well represented. Several species of the heteromorphs genera Myloceras, Aleteceras, Flindersites and labeceras are present, together with Beudanticeras ingente. Pelecypod species in this fauna are Aucellina hughendenensis, A. cf. gryphaeoides, Inoceramus carsoni, I. sutherlandi, I. aff. sutherlandi, Syncyclonema gradata, Camptonectes sp., Nucula sp., Pseudavicula papyracea, a new species of this genus, and a new species of Maccoyella. Other species are Dimitobelus sp., Laevidentalium sp., the gastropod Cancellaria terraereginensis, the nautiloid Eutrephoceras hendersoni, and the crab Homolopsis etheridgei.

A very similar rich fauna occurs in the Allaru Member of MUTTABURRA. By contrast, the fauna of the Allaru Member in its type area in RICHMOND, though similar, is much poorer in species.

Correlation with the standard Albian sequence, the Gault of Europe, is extremely difficult, owing to the absence of Hoplitids which are the basis of zonation in the lower part of the Gault, and the rarity of Mortoniceras-like forms on which the upper part of the Gault is zoned.

However, occurrences of the characteristic ammonites of this fauna, Labeceras and Myloceras, in Madagascar and East Africa, allow indirect reference to the European standard. In Madagascar these genera occur with a remarkably cosmopolitan fauna, and they range from the Dipoloceras cristatum subzone (uppermost Middle Albian) to the Mortoniceras inflatum zone (lower Upper Albian) (Collignon, 1963). If the same range can be inferred for Australian occurrences of Myloceras and Labeceras then the fauna of the Allaru Member is also of this age. The occurrence of an Aucellina very similar to the worldwide Upper Albian - Lower Cenomanian species A. gryphaeoides is perhaps additional evidence for an Upper Albian age.

Thus Whitehouse's (1926) low Upper Albian age for the "Tambo Series" seems valid in so far as it applies to the Allaru Member. This is not entirely unexpected as localities with Prohysteroceras (the ammonite on which the correlation was largely based) are near the top of the Albian sequence in the Eromanga Basin.

Mackunda Formation

Collections from the Mackunda Formation in LONGREACH and MANEROO are characterized by an abundance of fragmentary Inoceramus and Aucellina shells, most of which can only be determined generically. Many of the fossils occur in coquinite bands. Despite the large number of species reported here the fauna does not seem as rich as that in MUTTABURRA to the north nor that in MANUKA to the north west.

Gastropods are more abundant than in the underlying Allaru Member, while the sole ammonite is a form doubtfully referred to the genus Labeceras. Gastropod species identified are Euspira reflecta, Cancellaria terraereginensis, Anchura aff. wilkinsoni, Caveola sp., and a form like "Vanikoropsis" decussatus. Pelecypod species in this fauna are Aucellina cf. gryphaeoides, Inoceramus carsoni, I. aff. sutherlandi, Nototrigonia minima Panopea aramacensis, Nuculana aff. randsi, Nucula aff. cooperi, Nucula sp., Yoldia? sp., Chlamys? sp., Maccoyella rockwoodensis, and a second new species of Maccoyella. There are also numerous smooth scaphopods designated Laevidentalium sp., clavate Dimitobelid belemnites, and a few shark teeth. In addition Teredo bored wood was found in collections from MANEROO.

The numerous species common to both the Allaru Member and the Mackunda Formation suggest that the difference in age between the two units is slight.

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002112

PLATE 1

To accompany Records 1965/245

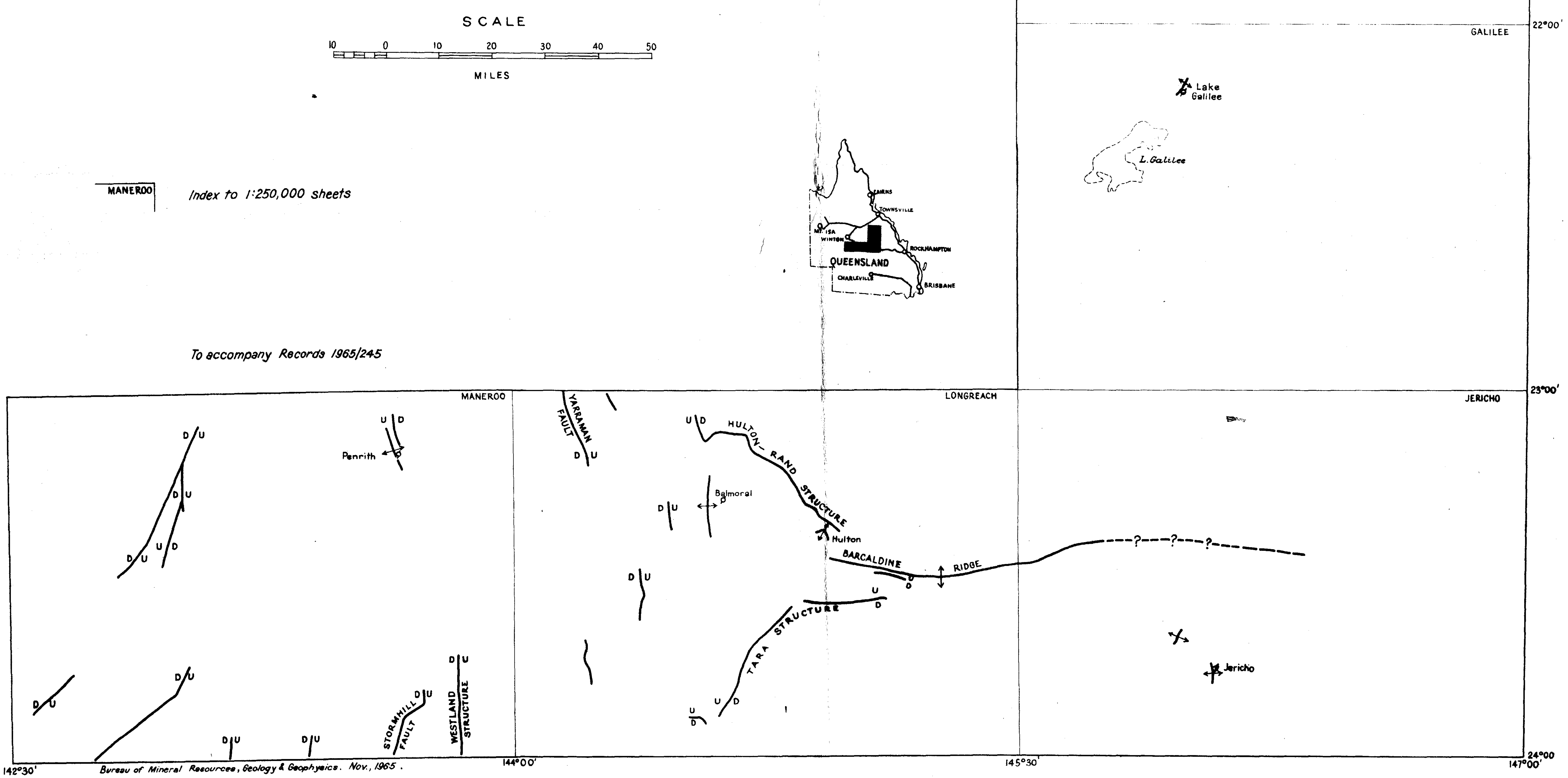
Bureau of Mineral Resources, Geology & Geophysics. August, 1965

E55/A1/41

002112

PLATE 2

STRUCTURAL FEATURES



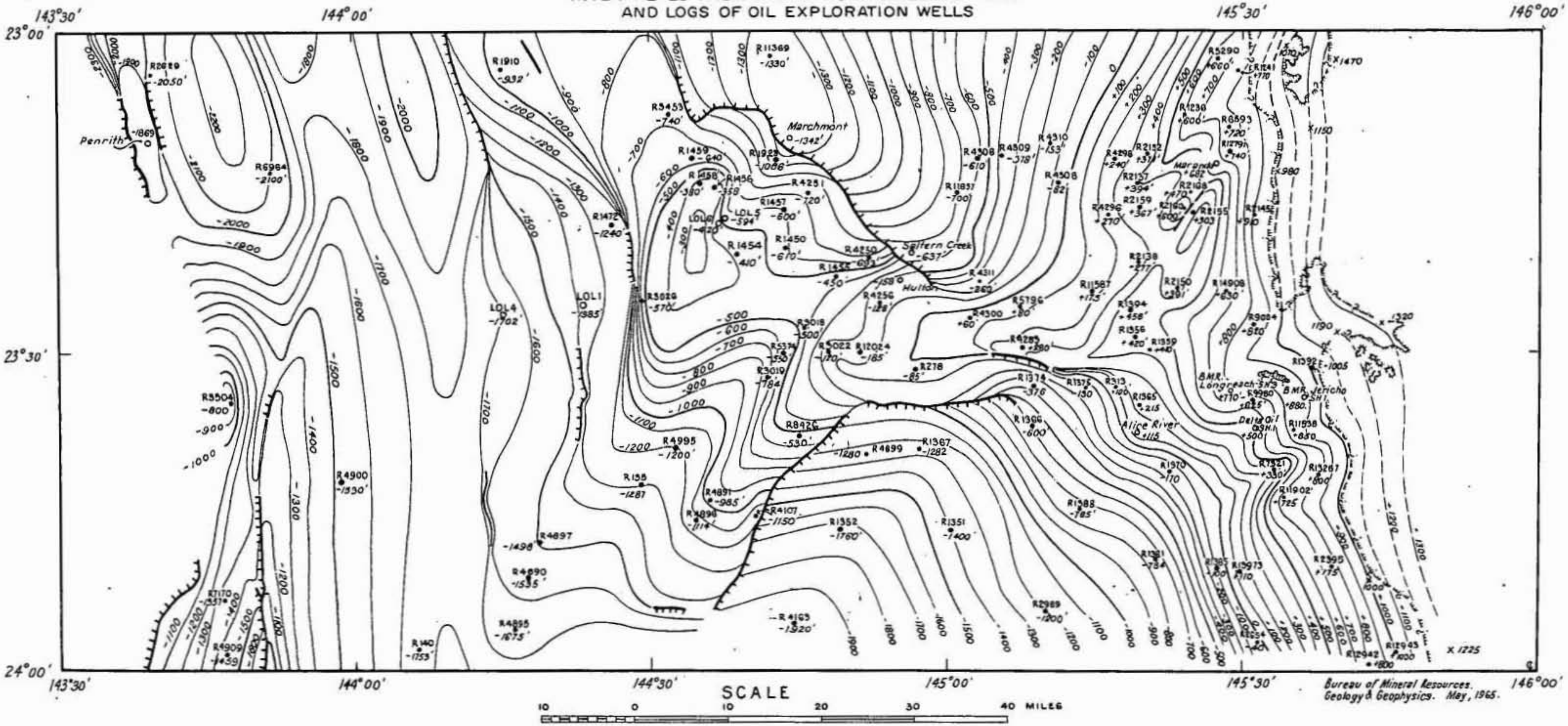
F55/A/46

002112

Plate 3

CONTOURS ON THE BASE OF THE WILGUNYA FORMATION

INTERPRETED FROM WATER-BORE DRILLERS' LOGS AND LOGS OF OIL EXPLORATION WELLS



R.4900 Hulton. *Registered number of bore, oil exploration well*

• o *Bore position, oil exploration well*

-1530' *Elevation on the base of Wilgunya Formation*

Fault or monocline; hachures on downthrown side where evident from surface mapping or seismic surveys

Outcrop margin of Wilgunya Formation

× *Spot height*

Datum - Mean sea level.

Contour interval 100 feet.

To accompany Records 1965/245

F55/A/35

002112

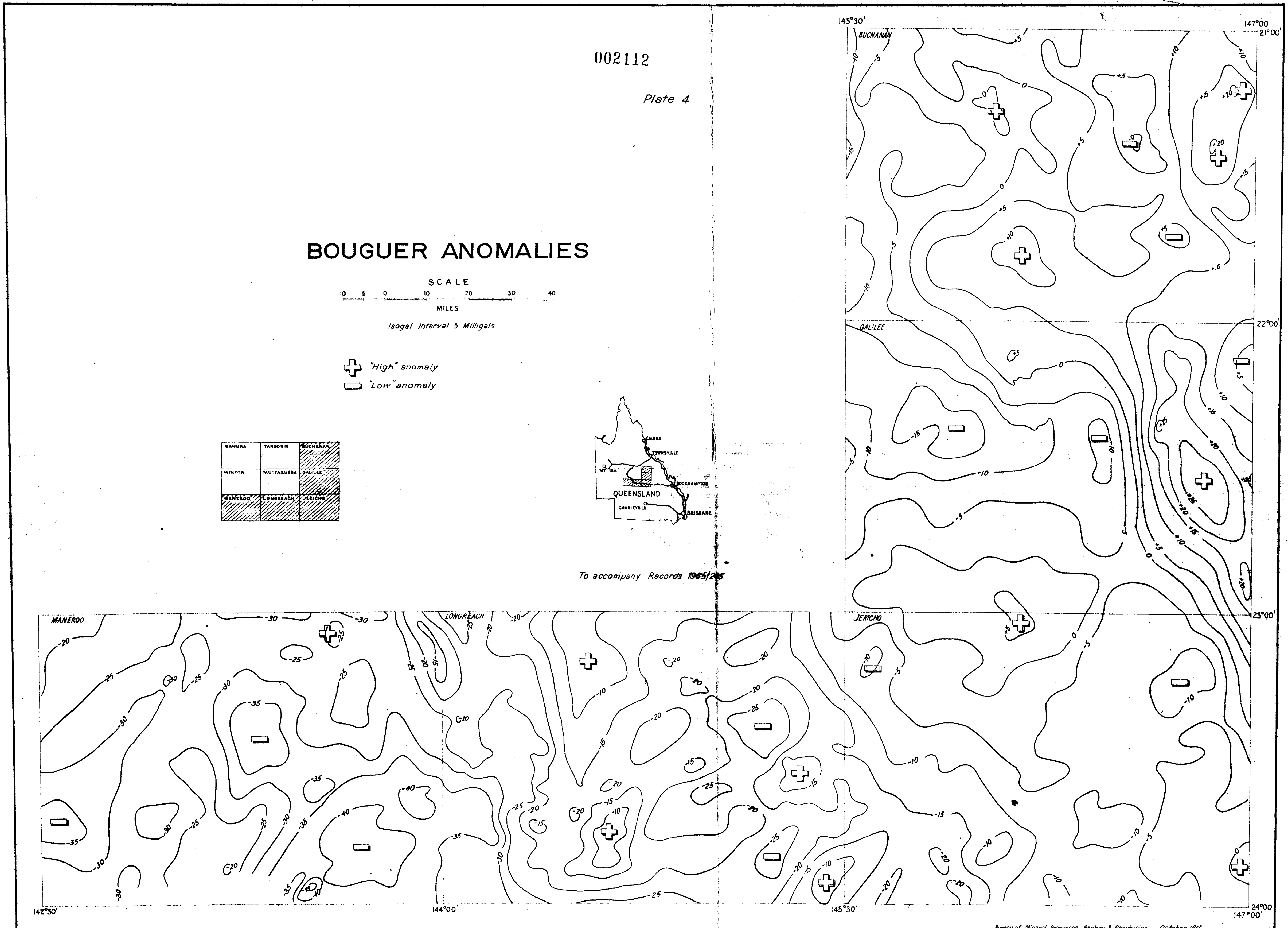


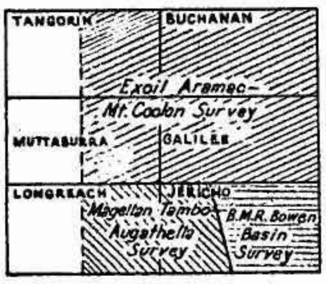
Plate 4
BOUGUER ANOMALIES
SCALE
10 5 0 10 20 30 40
MILES
Isogal interval 5 Milligals
"High" anomaly
"Low" anomaly
MANUKA
TANGORIN
BUCHANAN
WINTON
MUTTABURRA
GALILEE
MANEROO
LONGREACH
JERICHO
CAIRNS
TOWNSVILLE
MT. ISA
ROCKHAMPTON
QUEENSLAND
CHARLEVILLE
BRISBANE
To accompany Records 1965/215
145°30'
147°00'
21°00'
22°00'
23°00'
24°00'
142°30'
144°00'
Bureau of Mineral Resources, Geology & Geophysics. October, 1965

Q/A86

002112

Plate 5

TOTAL MAGNETIC INTENSITY
(Gammas)

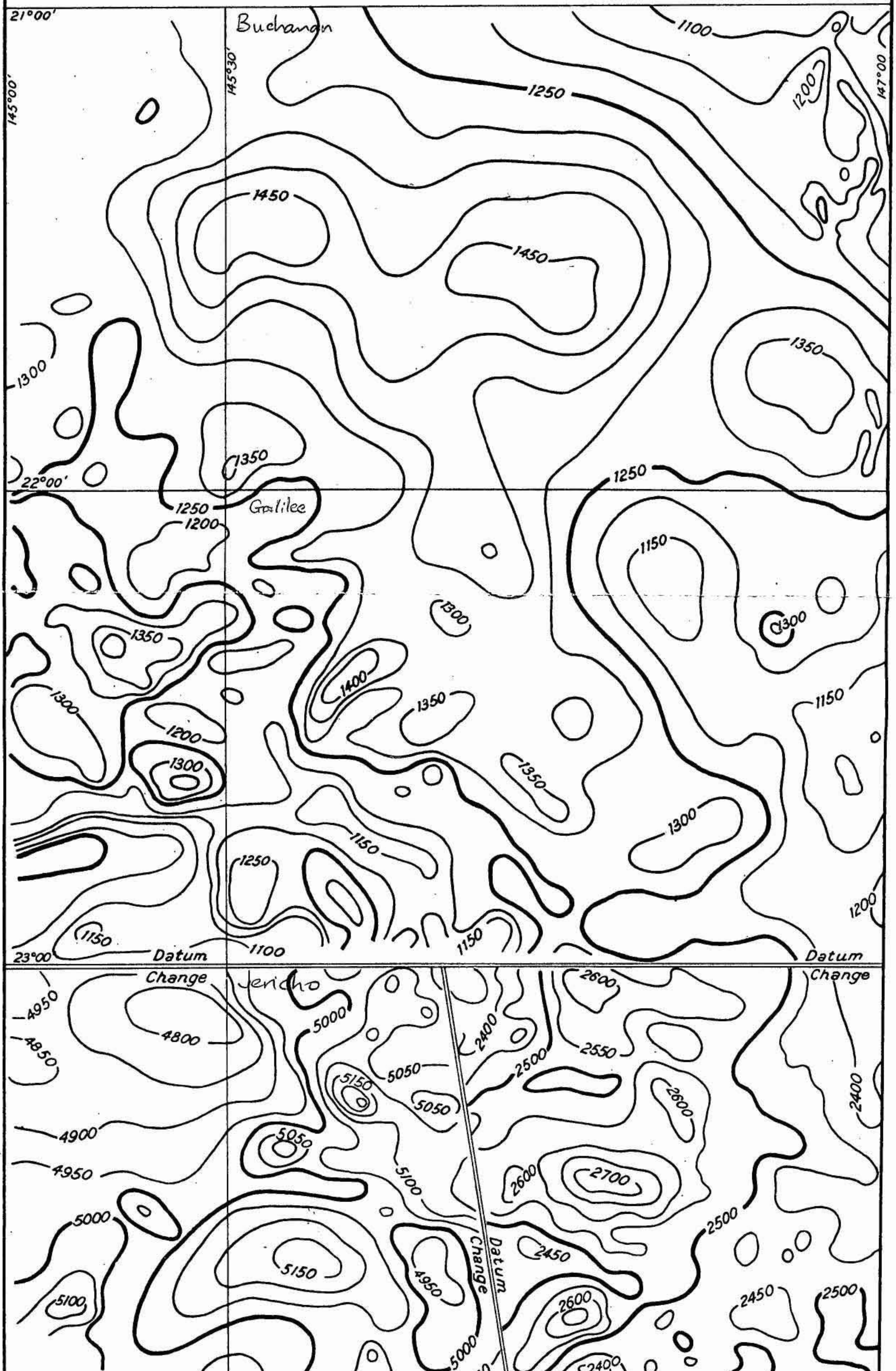


Approximate Scale

10 5 0 10 20 30 40

Miles

To accompany Records 1965/245



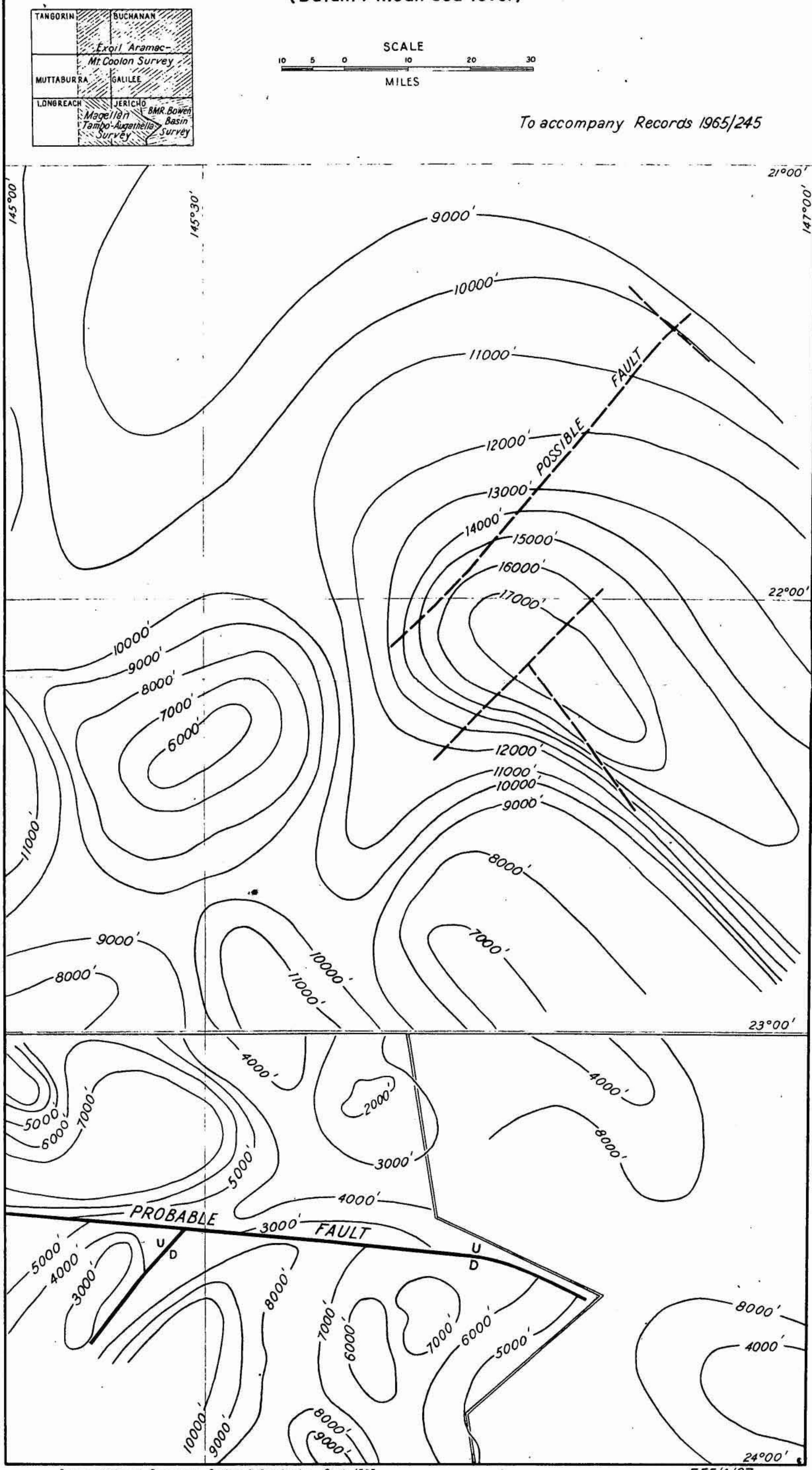
Bureau of Mineral Resources, Geology & Geophysics. Sept., 1965.

F55/A/36

002112 *Plate 6*

MAGNETIC BASEMENT DEPTH CONTOURS

(Datum : mean sea level)



To accompany Records 1965/245

Bureau of Mineral Resources, Geology & Geophysics. Sept, 1965.

F55/A/37

002112

PLATE 7

STRUCTURAL INTERPRETATION

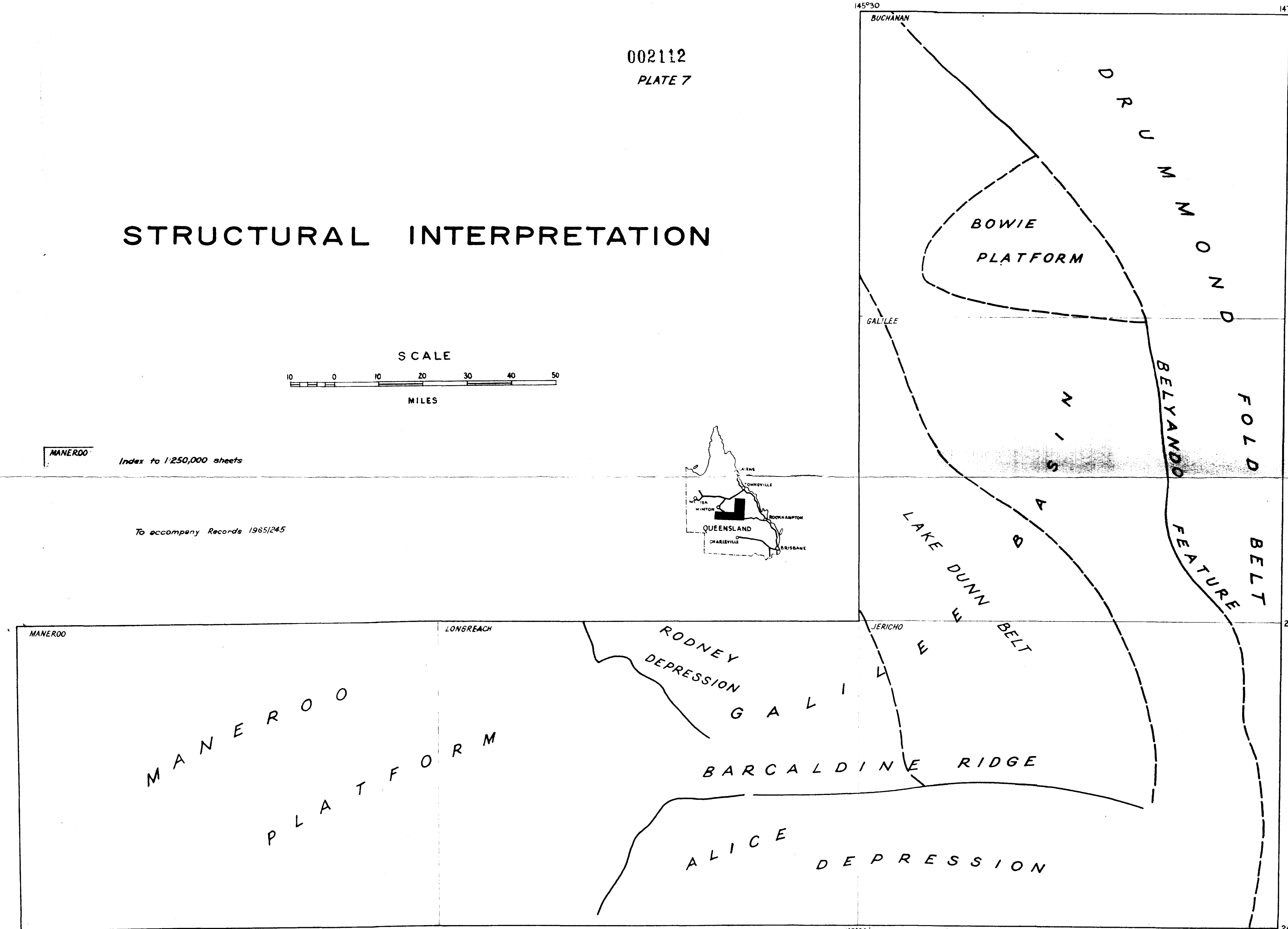
SCALE

10 0 10 20 30 40 50

MILES

MANEROO Index to 1:250,000 sheets

To accompany Records 1965/245



Bureau of Mineral Resources, Geology & Geophysics. Nov., 1965.

F55/A/47

PRELIMINARY EDITION, 1965

SUBJECT TO AMENDMENT

AUSTRALIA 1:250,000

MANEROO
QUEENSLAND

1:250,000 GEOLOGICAL SERIES SHEET SF 54-16

Reference

CAINOZOIC	QUATERNARY		Qa	Alluvium
			Qs	Sand, gravel, rubble, soil
	UNDIFFERENTIATED		Czd	Duricrust (laterite, silcrete)
	TERTIARY	Undifferentiated	T	Mudstone, quartz sandstone, quartz conglomerate
		Werite Beds	Tw	Mudstone, quartz sandstone
		Glendower Formation	Tg	Quartz sandstone, quartz conglomerate
MESOZOIC	LOWER – UPPER(?)CRETACEOUS	Winton Formation	Kw	Lithic sandstone, calcareous lithic sandstone, mudstone, coal.
	LOWER CRETACEOUS	Mackunda Beds	Klm	Lithic sandstone, calcareous lithic sandstone, mudstone, coquinite
		Wilgunya Formation	Klw	Mudstone, calcareous lithic siltstone, limestone
	UPPER JURASSIC – LOWER CRETACEOUS		J-K	Sandstone, siltstone, shale, silty shale, lignite
PALAEOZOIC(?)	UNDIFFERENTIATED		Pz	Phyllite, slate, quartzite

Klw, J-K, Pz: Section only

Geological boundary

Fault, grading to monocline (D,U indicate relative movement down, up.)

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

Lineament (Photo-interpreted)

50 Measured Section and section number

Trend lines

Macrofossil

G1706 Locality reference number

Opal mines, abandoned

Abandoned dry oil exploration well

Artesian bore, flowing

Artesian bore, ceased flowing

Sub-artesian bore

(from artesian aquifer system)

Sub-artesian bore or well, from non-artesian aquifer system

Abandoned bore or well.

R 4900 Refers to bore registered number of Queensland Irrigation and Water Supply Commission's records.

Waterhole

Dam

E Earth tank

Road

Vehicle track

Railway with siding

Fence

"Iandra" Homestead

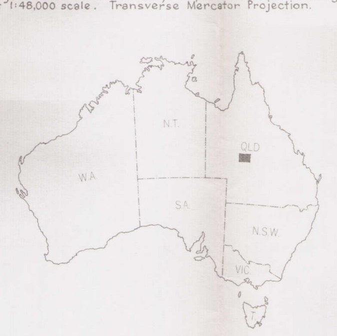
Landing ground

· 663 Height in feet; datum mean sea level

Astronomical station

PD Position doubtful

Compiled and issued by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Topographic base compiled by the Division of National Mapping, and the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Aerial photography by the Royal Australian Air Force; Complete vertical coverage at 1:48,000 scale. Transverse Mercator Projection.



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MACHATTIE SG 54-2	CONNEMARA SG 54-3	JUNDAH SG 54-4	BLACKALL SG 55-1	TAMBO SG 55-2
BETOOTA SG 54-6	CANTERBURY SG 54-7	WINDORAH SG 54-8	ADAVALE SG 55-5	AUGATHELLA SG 55-6

ANNUAL CHANGE 2'E

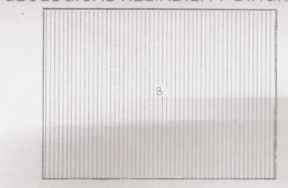
Scale 1:250,000

Miles

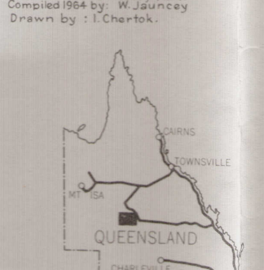
Kilometres

Geology by: W. Jauncey, M.C. Galloway (B.M.R.)
D.J. Casey (G.S.Q.)
Compiled 1964 by: W. Jauncey
Drawn by: I. Chertok.

GEOLOGICAL RELIABILITY DIAGRAM

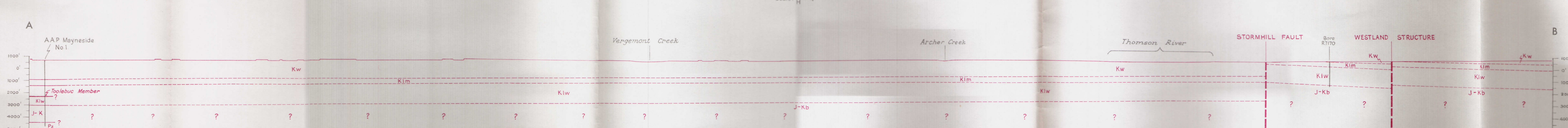


B. Reconnaissance-traverses and air-photo interpretation



Section

Cainozoic sediments omitted from section



MANEROO
Sheet SF 54-16

PRELIMINARY EDITION, 1965

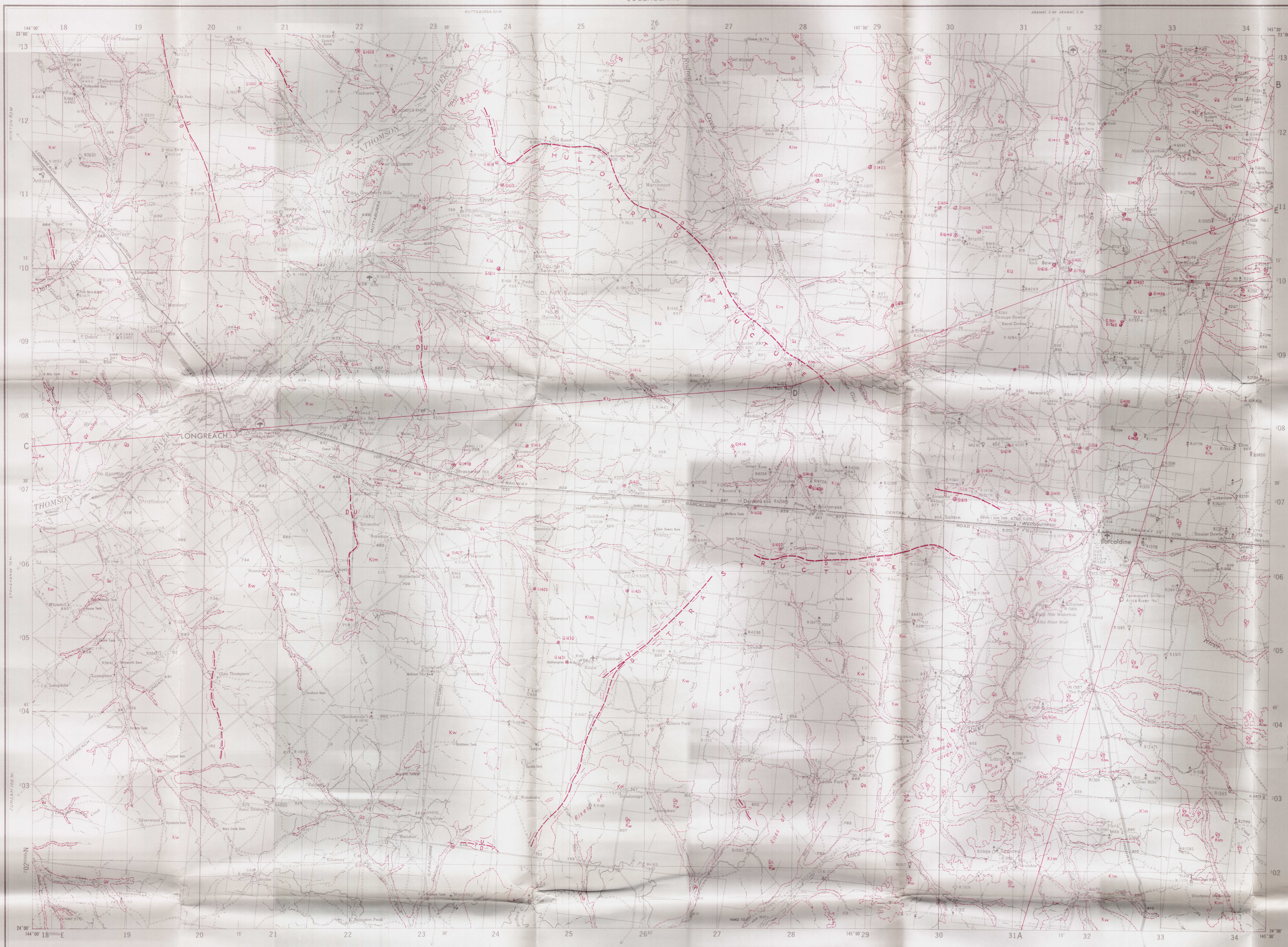
SUBJECT TO AMENDMENT

AUSTRALIA 1:250,000

LONGREACH

QUEENSLAND

1:250,000 GEOLOGICAL SERIES SHEET SF 55-13



Reference

CAINOZOIC	QUATERNARY		Qa	Alluvium
			Qs	Sand, gravel, rubble, soil
	TERTIARY	Undifferentiated	T	Sandy mudstone, muddy sandstone, conglomerate.
		Glendower Formation	Tg	Quartz sandstone, quartz conglomerate
MESOZOIC	LOWER TO UPPER (?) CRETACEOUS	Winton Formation	Kw	Lithic sandstone, calcareous lithic sandstone, mudstone, coal.
	LOWER CRETACEOUS	Mackunda Beds	Klm	Lithic sandstone, calcareous, mudstone, coquinite.
		Wilgunya Formation	Klw	
		Allaru Member	Kla	Mudstone, calcareous mudstone, siltstone.
		Toolebuc Member	Klo	Limestone, calcareous shale
		Coreena Member	Klc	Siltstone, very fine grained sandstone, calcareous siltstone, mudstone.
		Doncaster Member	Kld	Mudstone, glauconitic mudstone, limestone
	JURASSIC TO LOWER CRETACEOUS		J-K	Sandstone, conglomerate, mudstone
	TRIASSIC	Moolayember Formation.	Rm	Mudstone, siltstone, sandstone
		Clematis Sandstone	Re	Quartz sandstone, pebbly sandstone, micaceous mudstone and siltstone
		Rewan Formation	Rr	Mudstone, siltstone, sandstone
PALAEOZOIC	PERMIAN	upper division	Pu	Siltstone, mudstone, coal, pebbly sandstone
		lower division	Pl	Sandstone, siltstone, mudstone, conglomerate, coal
	UPPER CARBONIFEROUS		Cu	Siltstone, sandstone, conglomerate, mudstone
	?		Pz	Indurated mudstone, siltstone, pebbly sandstone
			Pzg	Granite

Section only (J-K to Pzg)

Geological boundary

Fault grading to monocline (D,U indicate relative movement down, up)
Where location of boundaries and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries are dotted, faults are shown by short dashes.

26 Strike and dip of strata

Trend lines, Dome — Air-photo interpretation

Macrofossil

Microfossil

G1408 Locality reference number

Abandoned dry oil exploration well

Abandoned oil exploration well with show of oil

S.H. Abandoned scout hole

Artesian bore, flowing; Artesian bore, ceased flowing; Sub-artesian bore — from artesian aquifer system

Sub-artesian bore or well from non-artesian aquifer system

Abandoned bore or well

R1386 Refers to bore registered number of Queensland Irrigation and Water Supply Commission's records.

Spring

W.H. Waterhole

Dam

E Earth tank

Road

Vehicle track

Railway with station

Fence

"Ramona" Homestead

Airfield

Landing ground

Astronomical station

·914 Height in feet; datum mean sea level

PD Position doubtful

Compiled and issued by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Topographic base compiled by the Division of National Mapping and the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Aerial photography by the Royal Australian Air Force; Complete vertical coverage at 1:48,000 scale. Transverse Mercator Projection.

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MACKUNDA SF 54-11	WINTON SF 54-12	MUTTABURRA SF 55-9	GALILEE SF 55-10	CLERMONT SF 55-11
BRIGHTON DOWNS SF 54-15	MANEROO SF 54-16	LONGREACH SF 55-13	JERICHO SF 55-14	EMERALD SF 55-15
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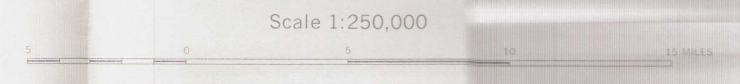
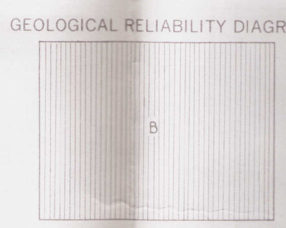
CANTERBURY SG 54-7	WINDORAH SG 54-8	ADAVALE SG 55-5	AUGATHELLA SG 55-6	EDDYSTONE SG 55-7

ANNUAL CHANGE 2′E

Scale 1:250,000



GEOLOGICAL RELIABILITY DIAGRAM



B. Reconnaissance traverses and air-photo interpretation

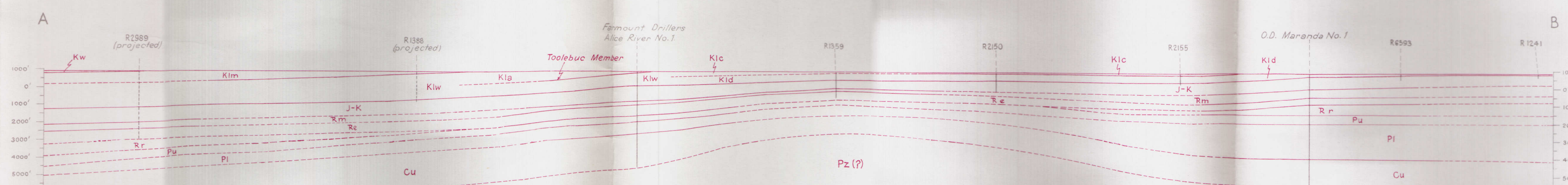
Geology and compilation 1964 by: R.R. Vine, W. Jeuncey, M.C. Galloway (B.M.R.) D.J. Casey (G.S.Q.)

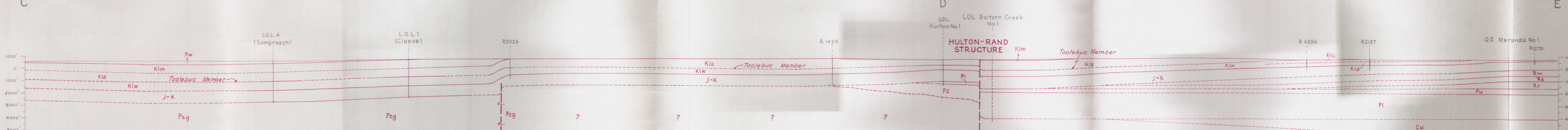
Drawn by: I. Chertok.

Sections

Cainozoic sediments omitted

Scale $\frac{V}{H} = 4$





LONGREACH

Sheet SF 55-13

PRELIMINARY EDITION, 1965

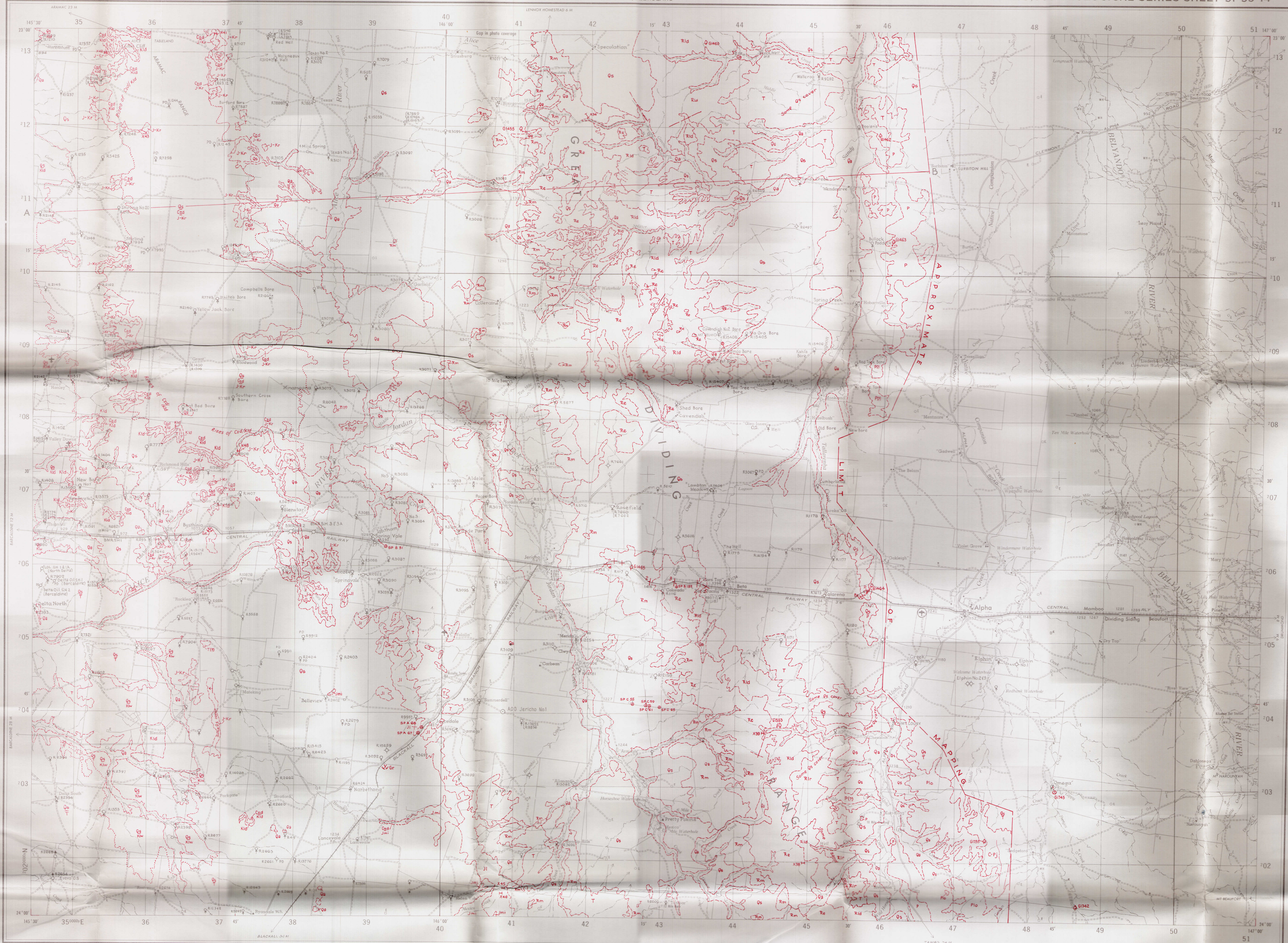
SUBJECT TO AMENDMENT

AUSTRALIA 1:250,000

JERICHO

QUEENSLAND

1:250,000 GEOLOGICAL SERIES SHEET SF 55-14



Reference

CAINOZOIC	QUATERNARY		Qa	Alluvium
			Qs	Sand, gravel, rubble, soil.
	UNDIFFERENTIATED		Czd	Duricrust
	TERTIARY(?)		T	Argillaceous sandstone, sandy mudstone, limestone.
			Tb	Basalt
MESOZOIC	LOWER CRETACEOUS	Wilgunya Formation	Klw	Mudstone, siltstone, limestone, calcareous shale
		Doncaster Member	Kld	Mudstone, glauconitic mudstone and siltstone, limestone.
	JURASSIC—LOWER CRETACEOUS	Ronlo Beds	J-Kr	Quartz and lithic sandstone, mudstone, minor coal
	MIDDLE JURASSIC	Injune Creek Beds	Jmi	Lithic sandstone, mudstone
	LOWER JURASSIC	Undifferentiated	Jl	Quartz sandstone
	MIDDLE—UPPER TRIASSIC	Moolayember Formation	Rm	Mudstone, sandstone, siltstone, shale, clay
	LOWER—MIDDLE TRIASSIC	Clematis Sandstone	Re	Quartz sandstone, minor siltstone and mudstone
	LOWER TRIASSIC	Dunda Beds	Rld	Lithic sandstone, siltstone, mudstone
		Rewan Formation	Rlr	Mudstone, siltstone, lithic sandstone
	LOWER(?)—UPPER PERMIAN	Undifferentiated	P	Lithic and quartz sandstone, siltstone, mudstone, carbonaceous shale, coal, conglomerate.
		Colinlea Sandstone	Plo	Lithic and quartz sandstone, minor siltstone and coal.
	CARBONIFEROUS—LOWER PERMIAN	Joe Joe Formation	c-Pj	Mudstone, lithic sandstone, siltstone, shale.

------- *Geological boundary*

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

- *Strike and dip of strata*
- *Horizontal strata*
- *Dip less than 15°* (air-photo interpretation)
- *Lineament* (air-photo interpretation)
- *Joint pattern* (air-photo interpretation)
- *Plant fossil*
- *Spores*
- G1755 *Locality reference number*
- SP C 55 *Locality reference number of bottom-hole samples of seismic shot-holes*
- *Oil exploration well being drilled*
- *Abandoned scout hole*
- *Artesian bore ceased flowing*
- *Sub-artesian bore or well*
- *Abandoned bore or well*

R 1179 Refers to bore registered number of Queensland Irrigation and Water Supply Commissions records.

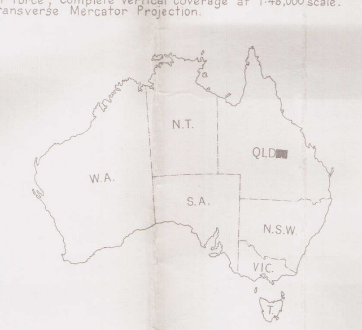
- *Spring*
- WH *Waterhole*
- *Dam*
- E *Earth tank*
- *Quarry*
- Gr *Gravel*
- Bs *Building stone*
- *Road*
- *Vehicle track*
- *Railway with station*
- *Fence*
- "Merida" *Homestead*
- *Airfield*
- *Landing ground*
- *Astronomical station*
- ·1129 *Height in feet; datum mean sea level.*
- PD *Position doubtful*

Compiled and issued by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Topographic base compiled by the Division of National Mapping and the Bureau of Mineral Resources, Geology and Geophysics Department of National Development. Aerial photography by the Royal Australian Air Force; Complete vertical coverage at 1:48,000 scale.
Transverse Mercator Projection.

Scale 1:250,000

25 Statute Miles

Geology and compilation 1964 by: R.R. Vine, W. Jauncey, M.C. Galloway (B.M.R.) D.J. Casey (G.S.Q.)
Drawn by: I. Chertok



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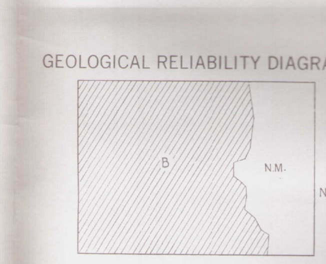
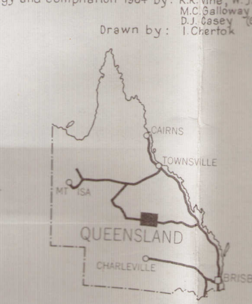
MANEROO SF 54-16	LONGREACH SF 55-13	JERICHO SF 55-14	EMERALD SF 55-15	DUARINGA SF 55-16
JUNDAH SG 54-4	BLACKALL SG 55-1	TAMBO SG 55-2	SPRINGSURE SG 55-3	BARALABA SG 55-4
WINDORAH SG 54-8	ADAVALE SG 55-5	AUGATHELLA SG 55-6	EDDYSTONE SG 55-7	TAROOM SG 55-8

ANNUAL CHANGE 2′E

GEOLOGICAL RELIABILITY DIAGRAM

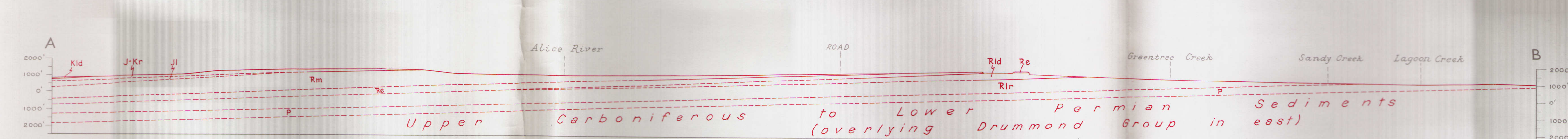


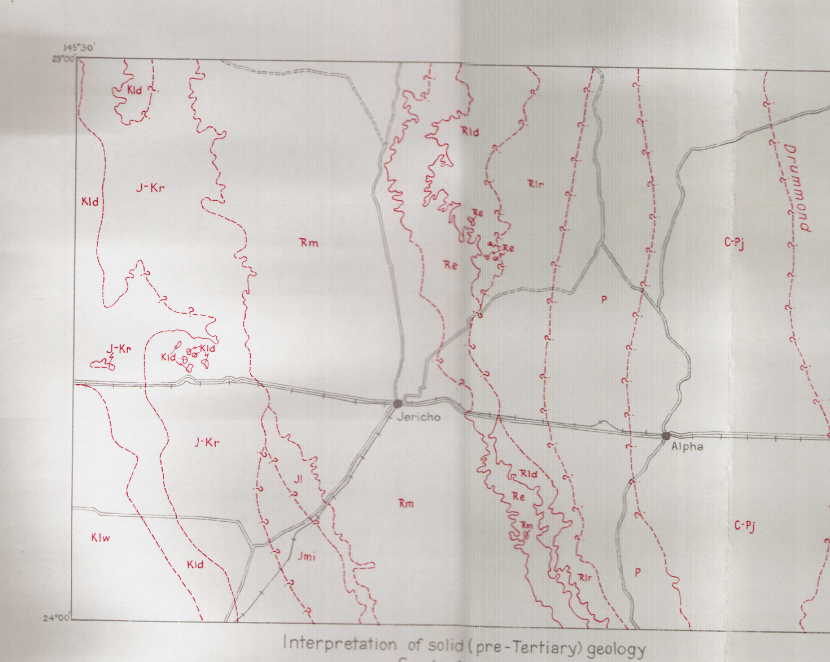
B. *Reconnaissance-traverses and air-photo interpretation*
N.M. *Area not mapped.*



Section

Cainozoic sediments omitted from section





Interpretation of solid (pre-Tertiary) geology

Scale 1:1,000,000

JERICHO
Sheet SF 55-14

002112

PRELIMINARY EDITION, 1965

SUBJECT TO AMENDMENT

AUSTRALIA 1:250,000

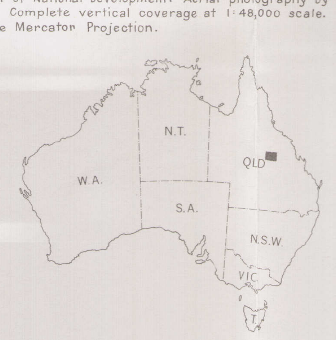
GALILEE

1:250,000 GEOLOGICAL SERIES SHEET SF 55-10

Compiled and issued by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Topographic base compiled by the Division of National Mapping and the Bureau of Mineral Resources, Geology and Geophysics Department of National Development. Aerial photography by the Royal Australian Air Force; Complete vertical coverage at 1:48,000 scale.
Transverse Mercator Projection.

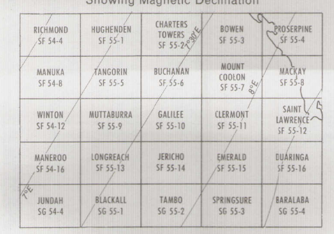
Scale 1:250,000

Geology and compilation 1964 by: D.J. Casey (G.S.Q.)
R.R. Vine (B.M.R.)
Drawn by: I. Chertok

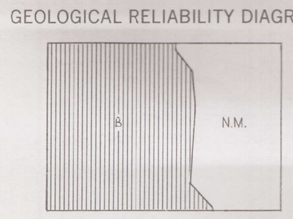


INDEX TO ADJOINING SHEETS

Showing Magnetic Declination



GEOLOGICAL RELIABILITY DIAGRAM



B. Reconnaissance-traverses and air-photo interpretation.

N.M. Area not mapped

Reference

CAINOZOIC	QUATERNARY		Qa	*Alluvium*
			Qs	*Sand, gravel, rubble, soil*
	UNDIFFERENTIATED		Czd	*Duricrust*
	TERTIARY (?)		T	*Argillaceous sandstone, sandy mudstone, clay*
MESOZOIC	LOWER CRETACEOUS	Wilgunya Formation Doncaster Member	Kld	*Mudstone, glauconitic mudstone, siltstone, limestone*
	JURASSIC–LOWER CRETACEOUS	Ronlo Beds	J-Kr	*Quartz and labile sandstone, mudstone, coal*
	MIDDLE-UPPER TRIASSIC	Moolayember Formation	Rm	*Mudstone, labile and quartz sandstone, siltstone, shale, clay*
	LOWER-MIDDLE TRIASSIC	Clematis Sandstone	Re	*Quartz sandstone, conglomerate minor siltstone and mudstone*
	LOWER TRIASSIC	Dunda Beds	Rld	*Labile and quartz sandstone, siltstone, mudstone*
		Rewan Formation	Rlr	*Mudstone, labile sandstone, siltstone* (Section only)
PALAEOZOIC	LOWER (?)– UPPER PERMIAN		Pu	*Mudstone, coal, carbonaceous shale labile and quartz sandstone, siltstone* (Section only)
	PERMIAN	Undifferentiated	P	*Labile sandstone, mudstone, siltstone, conglomerate*
	CARBONIFEROUS– LOWER PERMIAN		C-P	*Mudstone, siltstone, labile and quartz sandstone minor coal, calcareous siltstone, greywacke* (Section only)
	UPPER DEVONIAN		Du	*Quartz and labile sandstone, mudstone, shale, siltstone, minor calcareous siltstone* (Section only)

Geological boundary

Fault

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

Seismic reflectors interpreted from Lake Galilee Seismic Survey for Exoil No Liability 1962

Magnetic basement interpreted from Aramac–Mt. Coolon Aeromagnetic Survey for Exoil No Liability 1962

Type section

Measured section

X36 *Section reference number*

Plant fossil locality with reference number

Abandoned oil exploration well with show of oil

Abandoned scout hole

Sub-artesian bore or well

Abandoned bore or well

WH. *Waterhole*

Dam

E *Earth tank*

Road

Vehicle track

"Dunrobin" *Fence*

Homestead

Landing ground

• 1025 *Height in feet; datum mean sea level*

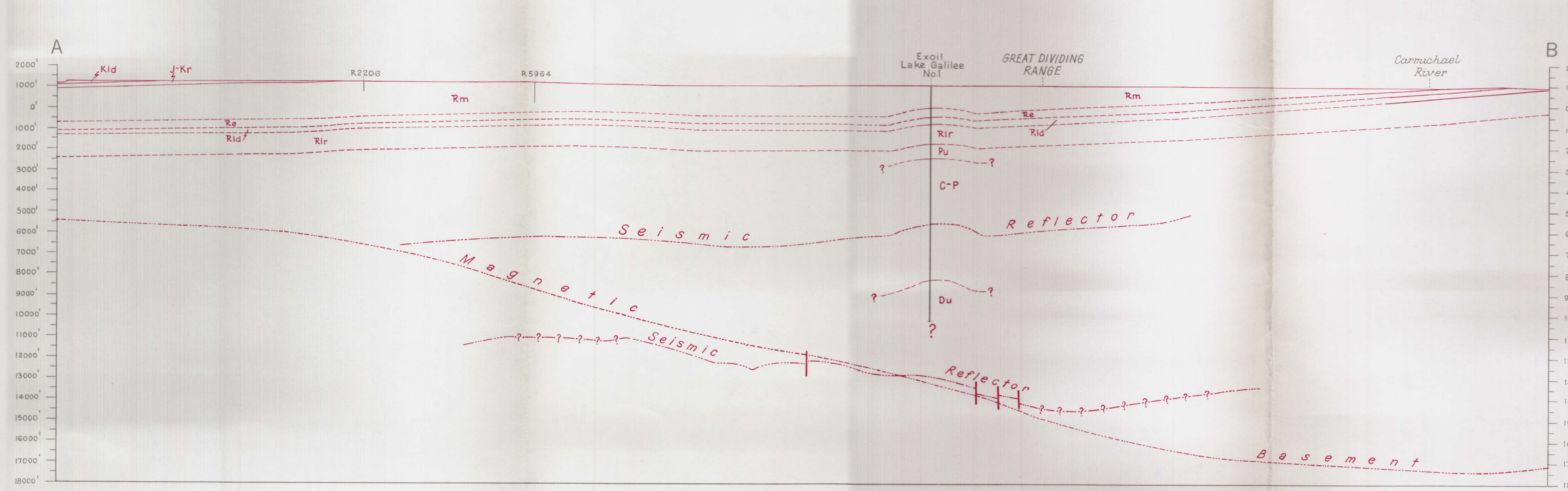
Astronomical station

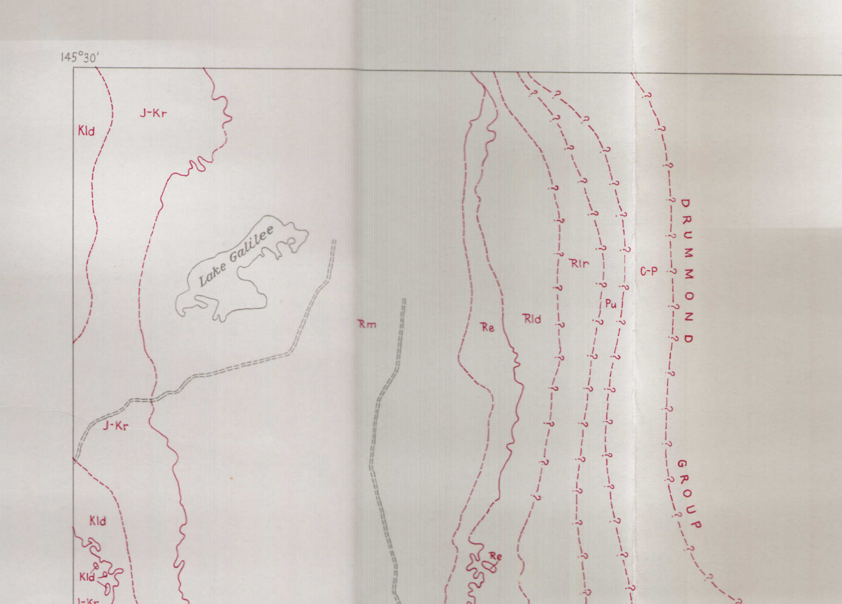
PD *Position doubtful*

Section

Cainozoic sediments omitted from section

Scale: V/H = 4

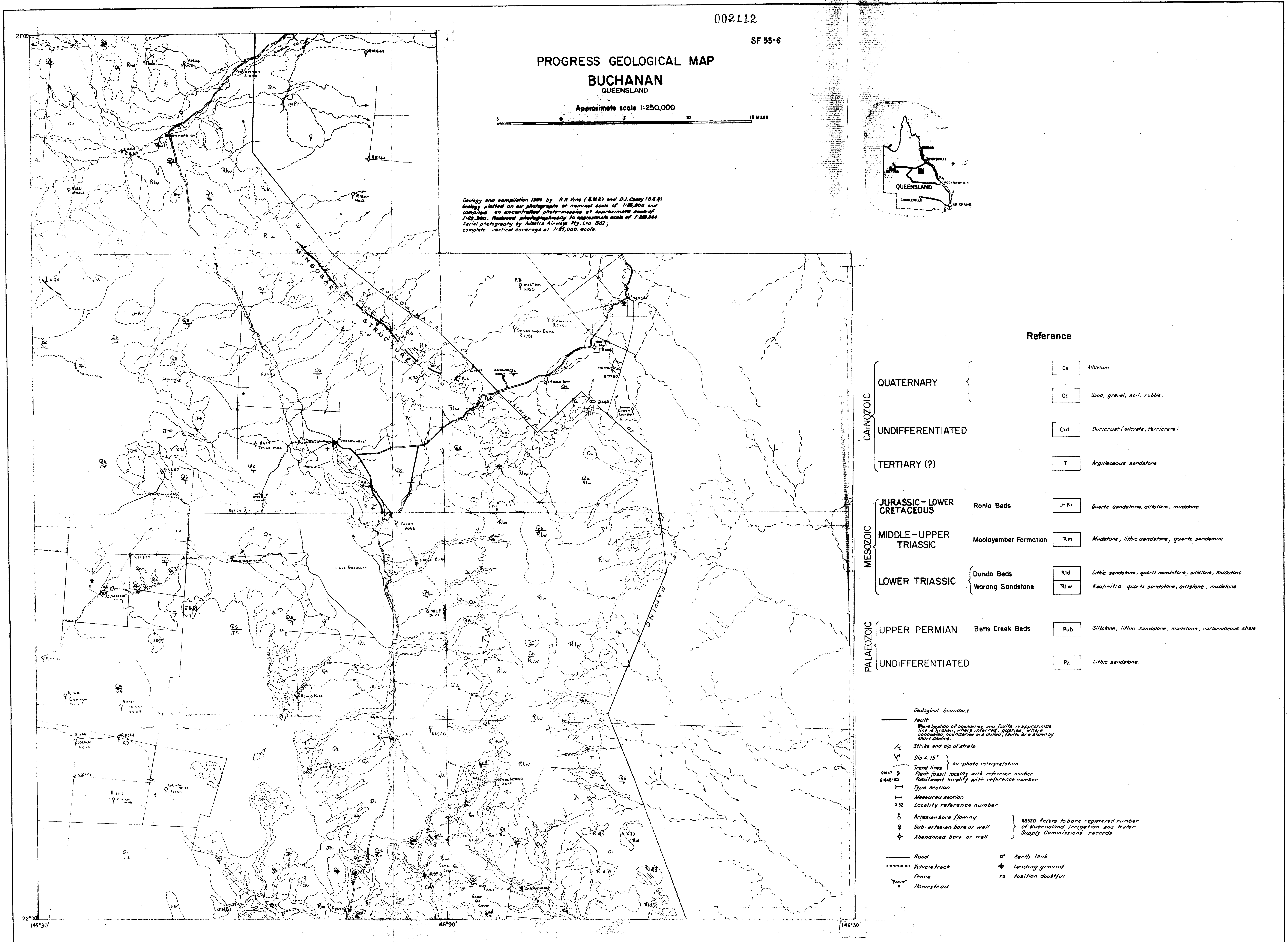




Interpretation of solid (pre-Tertiary) geology

Scale 1:1,000,000

002112


SF 55-6
PROGRESS GEOLOGICAL MAP
BUCHANAN
QUEENSLAND
Approximate scale 1:250,000
15 MILES
Geology and compilation 1964 by R.R. Vine (B.M.R.) and D.J. Casey (G.S.Q.)
Geology plotted on air photographs at nominal scale of 1:85,000 and compiled on uncontrolled photo-mosaics at approximate scale of 1:63,360. Reduced photographically to approximate scale of 1:250,000.
Aerial photography by Adastra Airways Pty. Ltd. 1962;
complete vertical coverage at 1:85,000 scale.
QUEENSLAND
ROCKHAMPTON
CHARLEVILLE
BRISBANE
MINGOBAR STRUCTURE
APPROXIMATE LIMIT OF MAPPING
Lake Buchanan
Reference
CAINOZOIC
QUATERNARY
Qa Alluvium
Qs Sand, gravel, soil, rubble.
UNDIFFERENTIATED
Czd Duricrust (silcrete, ferricrete)
TERTIARY (?)
T Argillaceous sandstone
MESOZOIC
JURASSIC-LOWER CRETACEOUS
Ronlo Beds
J-Kr Quartz sandstone, siltstone, mudstone
MIDDLE-UPPER TRIASSIC
Moolayember Formation
Rm Mudstone, lithic sandstone, quartz sandstone
LOWER TRIASSIC
Dunda Beds
Rld Lithic sandstone, quartz sandstone, siltstone, mudstone
Warang Sandstone
Rlw Kaolinitic quartz sandstone, siltstone, mudstone
PALAEOZOIC
UPPER PERMIAN
Betts Creek Beds
Pub Siltstone, lithic sandstone, mudstone, carbonaceous shale
UNDIFFERENTIATED
Pz Lithic sandstone.
Geological boundary
Fault
Where location of boundaries and faults is approximate line is broken, where inferred, queried; where concealed, boundaries are dotted, faults are shown by short dashes.
Strike and dip of strata
Dip < 15°
Trend lines
air-photo interpretation
G1447 Plant fossil locality with reference number
G1448 Fossilwood locality with reference number
Type section
Measured section
X32 Locality reference number
Artesian bore flowing
Sub-artesian bore or well
Abandoned bore or well
R8520 Refers to bore registered number of Queensland Irrigation and Water Supply Commissions' records.
Road
Vehicle track
fence
"Bowie" Homestead
Earth tank
Landing ground
PD Position doubtful
21°00'
22°00'
145°30'
146°00'
146°30'