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BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

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EXPLANATORY NOTES ON THE MOUNT WHELAN GEOLOGICAL SHEET

Compiled by

M.A. Reynolds

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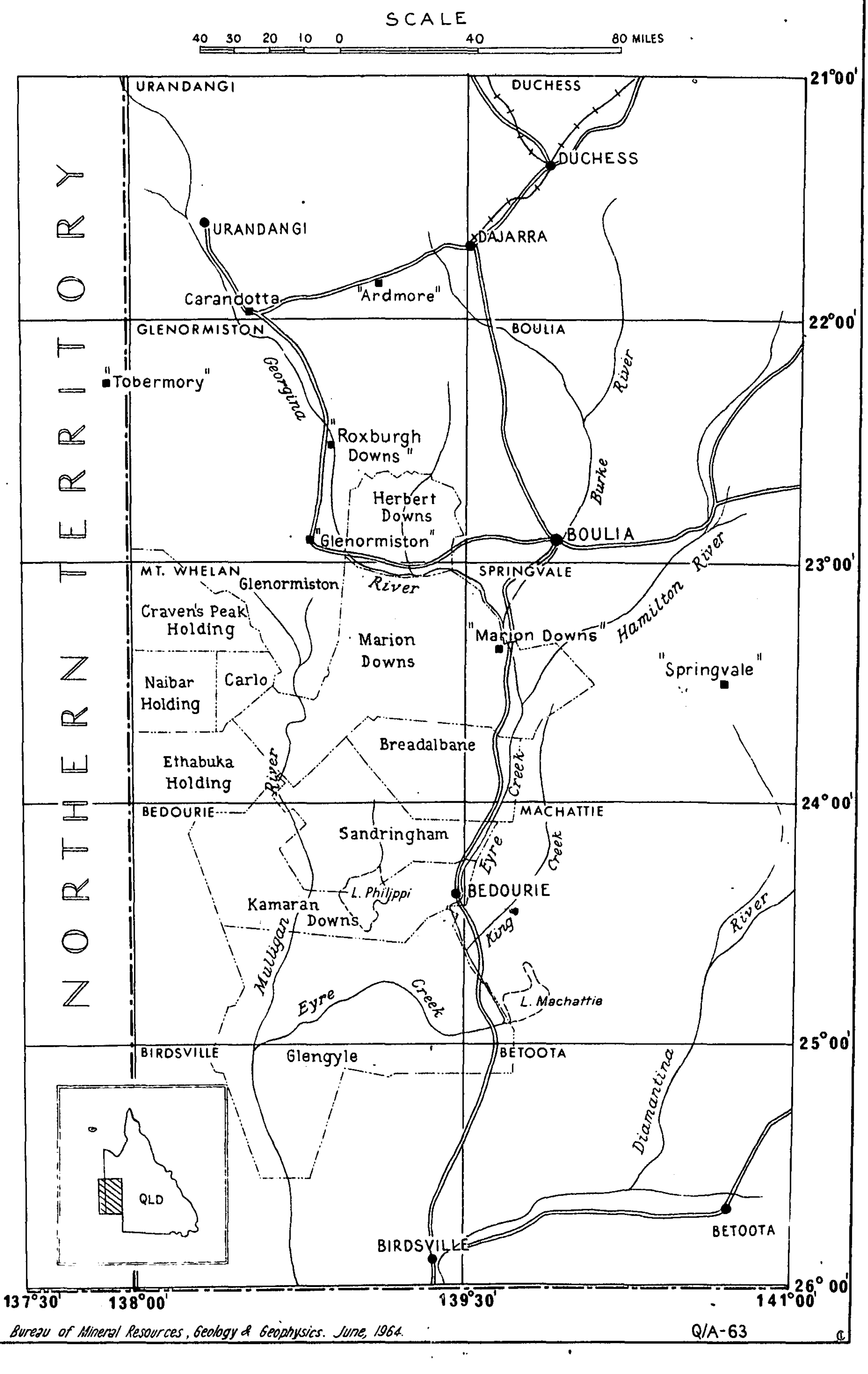
Fig.1

LOCALITY SKETCH MAP

Showing 1:250,000 Sheets and Station Boundaries



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EXPLANATORY NOTES ON THE MOUNT WHELAN GEOLOGICAL SHEET.

Compiled by

M.A. Reynolds

The Mount Whelan Sheet area marks the north-eastern limit of the Simpson Desert and almost half is covered by sand. Nevertheless, the area is geologically interesting because it is here that the north-western margin of the Great Artesian Basin transgresses the southernmost outcrops of the south-eastern plunging Toko Syncline, a southerly extension of the Georgina Basin. The Mount Whelan area extends from the Northern Territory - Queensland border at 138° East to 139°30' East Longitude, and between Latitudes 23° and 24° South.

Except for the Simpson Desert, most of the Mount Whelan Sheet area is used for cattle grazing. The biggest holding, comprising Herbert Downs, Marion Downs and Breadalbane Stations, is leased by the Marion Downs Pastoral Company; this holding is mostly in the Mount Whelan area, but extends on to adjoining areas, see Figure 1. Two other big stations, Glenormiston (Glenormiston Pastoral Company) in the north-west, and Sandringham (Kidman Estates) in the south, adjoin the Marion Downs Company properties. Smaller properties in the country within and around the Toko Range such as Carlo Station, and Craven Peak's Holdings, have not shown much development because of feed and water shortages. The Badalia sheep station extends into the north-east of the Mount Whelan area, north of the Georgina River.

The climate is typical of central Australia with hot summer and mild winter conditions, marked daily temperature variations, and sparse rainfall - mainly from storms in the summer and annually less than 6 inches. A few sand and dust-storms occur each year. The region is well-known for its mirage effects, particularly at daybreak, and these may give quite deceptive impressions of the topography in some places.

Access into the eastern half of the Mount Whelan area is possible along station tracks which are easily reached from the main Boulia-Bedourie road, (Figure 1). Although the tracks are generally well-maintained, high-low range, 4-wheel drive vehicles are the most convenient for use in the area. The northern and north-western edges may be reached from station tracks via the Boulia-Glenormiston road, and more distant parts by cross-country traverses. Rain may impede access because of the clayey surface in some parts, by wash-outs, or because streams may become impassable, (the Georgina River, in particular, may become impassable for up to two or three months). The Simpson Desert is accessible by helicopter, or by suitably equipped vehicles, and with good organization, as shown by Geosurveys Ltd (Sprigg, 1963), and by the French Petroleum Company (C.G.G., 1964), who have recently crossed the central and southern parts of the Desert.

Water supplies are available from bores, springs and soaks, and some of the earth tanks in the eastern half of the area, but the quality is not everywhere dependable. Waterholes along the Georgina and Mulligan Rivers may contain good supplies; Paravituari Waterhole on the Georgina (see Figure 2) is the most reliable. Evidence seen during helicopter traverses suggests that soak or spring supplies are available from the interdune areas at the eastern side of the Desert, west of Duck Point Waterhole on Marion Downs.

Planimetric maps of the Mount Whelan Sheet area at 4-mile scale are available from the Department of National Mapping, Canberra, and planimetric maps at 1:250,000 scale are also being prepared. Photomaps at 1-mile scale can be obtained; they were prepared from aerial photographs at 1:48,500 scale, taken by the Royal Australian Air Force during 1951.

PREVIOUS INVESTIGATIONS

A detailed account of early investigations in the Western Queensland region was given by Casey, et al (1960) and a more recent summary of reports affecting the Glenormiston Sheet area (and parts of Mount Whelan) is in Reynolds and Pritchard (1964). Another useful guide to work done in the Georgina Basin, as a whole, is a bibliography of published and unpublished reports and maps of the Basin (up to February 1964), by K.G. Smith of the Bureau of Mineral Resources.

Some of the more important of early references to the Mount Whelan region include the publications of Whitehouse (1930-1940), and his main paper on the Great Artesian Basin (1954) is also pertinent. Öpik's studies (1956-1961) on the Cambrian and Ordovician of western Queensland also refer to the Glenormiston and Mount Whelan areas; he has recently described the early Upper Cambrian fossils from these areas, (Öpik, 1963). Palaeontological work on Cretaceous samples has been done by Dickins (1960) who identified the macrofossils, and Crespin (1960, 1961) who listed the microfossils and later (1963) described some of the Foraminifera.

Specific references to that part of the Simpson Desert which is in the Mount Whelan Sheet area are given by Madigan (1938, 1945). Jack and Etheridge (1892) and Jack (1895) referred to water boring in the area, and Dunstan (1920) gives a fossil location, some hydrological information, and notes on coal, gypsum and salt occurrences.

Surveys in the Mount Whelan area since 1957 may be summarised as follows:

(1) Reports were prepared by Leslie (1959 - general geology) and Taylor (1959 - palaeontology) on field mapping in the Boulia-Toko Range-Glenormiston area for Frome-Broken Hill in 1958.

(2) Reconnaissance traverses were also made into the area during 1958 by members of the joint Bureau of Mineral Resources (B.M.R.) - Geological Survey of Queensland (G.S.Q.) Georgina Basin Party under J.N. Casey; some detailed work was done in the Toko Ranges and from Sun Hill to the Mulligan River.

(3) The B.M.R. aeromagnetic survey in 1958 made two reconnaissance flights across the area (Jewell, 1960).

(4) During 1959, Mines Administration Pty Ltd conducted a semi-detailed gravity survey in the Toko Range area for The Papuan Apinaipi Petroleum Co. Ltd (Starkey, 1960), and some field mapping was done by Laing (1960). Austral Geoprospectors carried out a seismic reflection survey in the same area for Papuan Apinaipi and Phillips Petroleum Company during 1960-61 (P.P.C.,1961).

(5) Mulder (1961), in a report on the Georgina Basin prepared for Shell, refers to the Mount Whelan Sheet area; this is a study based on photo-geology, published and unpublished reports, and a short field trip.

(6) During 1960, several traverses were made in the eastern half of the area by the B.M.R. Great Artesian Basin Party, under M.A. Reynolds; a helicopter traverse was made to visit outcrops in the Simpson Desert, and a section was measured in the southern part of the Toomba Range. A gravity survey was also done at this time by the B.M.R. Helicopter Party, (Barlow, in prep.).

(7) The South-eastern Georgina Basin Seismic Survey started in 1963 and is being continued in 1964, mainly in the north-eastern and south-central parts of the

Mount Whelan Sheet area (Robertson, 1964). A preview report on the 1964 programme by P. Jones and J. Stanley (B.M.R.) gives a useful summary of the results of previous geophysical work in the area.

(8) The current (1964) Georgina Basin aeromagnetic survey covers the Mount Whelan area, at 2-mile north-south spacing.

The Mount Whelan Sheet area falls within Authority to Prospect 54P which is held by The Papuan Apinaipi Petroleum Co. Ltd.

PHYSIOGRAPHY

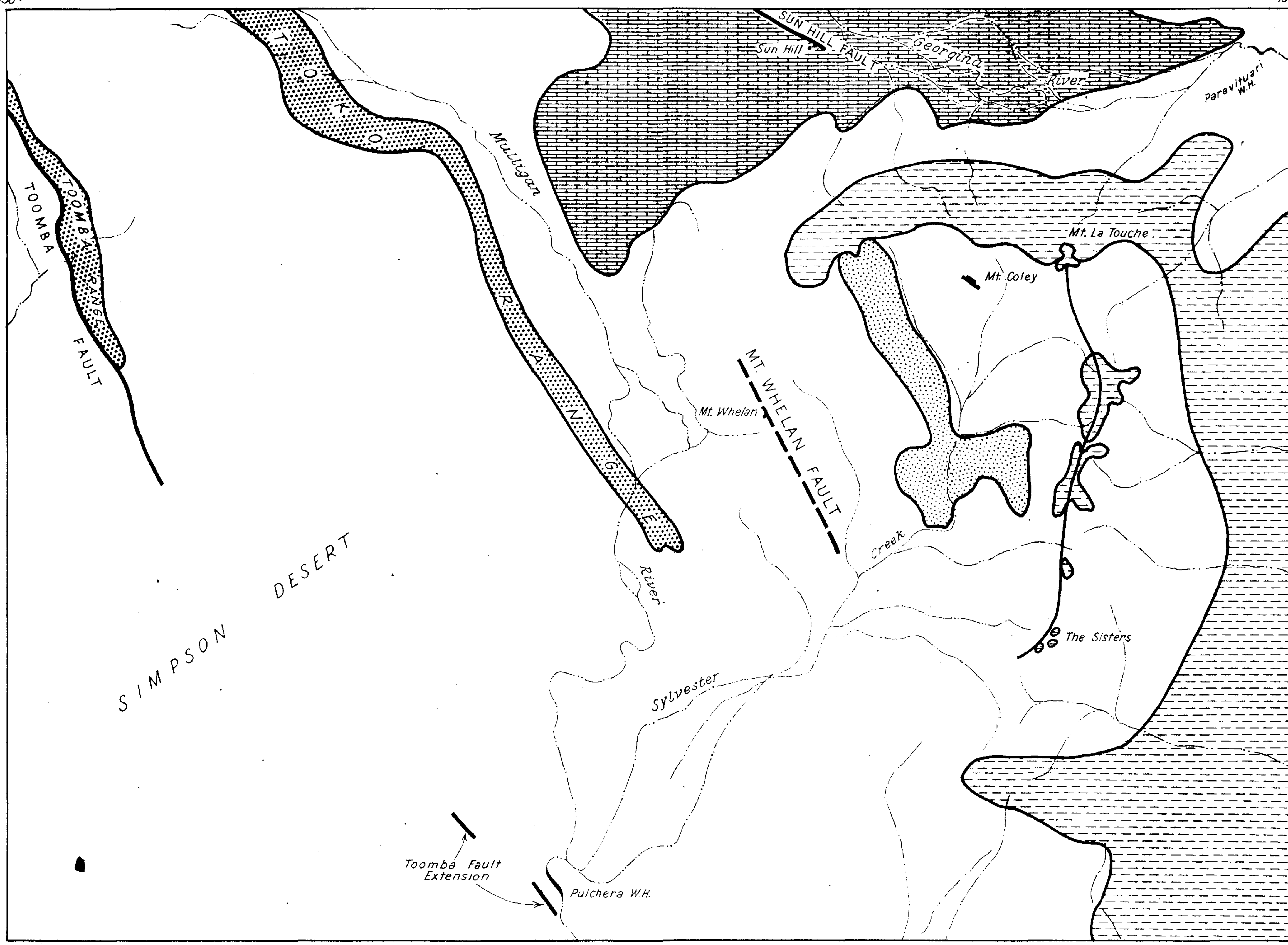
The drainage of the Mount Whelan Sheet area is controlled by two major stream systems, that of the Georgina River in the north-east corner, and that of the Mulligan River in the central part (Figure 2). The Georgina River, mainly a system of braided channels with a low gradient less than one foot per mile, flows to the east and across the overall regional gradient to the south. It appears to have been diverted to the east by topographic features associated with the Sun Hill Fault, and continued east along the strike valley of the Cretaceous Longsight Sandstone. East of the Mount Whelan area, the Georgina River turns to the south and flows through the western edge of the Springvale Sheet area. This river is more likely to flow than others in the area because its head waters are 250 miles to the north in a region of generally higher rainfall, and because of its large catchment area.

The Mulligan River begins in the northern part of the Mount Whelan Sheet area in the Toko Range and its course is controlled by the strike valleys of soft rocks in the Toko Syncline sequence. Where the Toko Range disappears below younger sediments to the south the River meanders to Pulchera Waterhole, where it is joined by Sylvester Creek. At Pulchera Waterhole, the Mulligan River resumes a south-south-east course apparently following along the south-eastern extension of the Toomba Fault.

The highest part of the Mount Whelan Sheet area - 700 to 800 feet above sea level - is in hills in the north-western corner. The hills are cuestas of Palaeozoic sandstone, capped by lateritized Cretaceous rocks, south-west of the Toko Range. The main part of the Range is composed mainly of the silicified Carlo Sandstone which forms a plateau in the axial part of the Toko Syncline, and a cuesta with a strong eastern scarp along

Fig.2

MOUNT WHELAN – Physiography



REFERENCE

- Toomba and Toko Ranges
- Sylvester Creek Plateau
- Palaeozoic Carbonate rocks
- Hills of Cretaceous - Tertiary rocks

SCALE

5 0 5 10 15 20 MILES

Bureau of Mineral Resources, Geology & Geophysics. June, 1964.

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the eastern limb. Where the Range dips below younger sediments to the south, elevations have dropped to about 400 feet.

Another strong topographic feature in the north-western corner is formed by the western limb of the Toko Syncline. The rocks have been up-turned against the Toomba Fault to form the Toomba Range. It has a trend parallel to the Toko Range, and is composed of strike ridges of steeply dipping to vertical and overturned rocks, mainly carbonate rocks on the western side and silicified sandstones to the east. Elevations vary from over 650 feet above sea level near the Toomba Gorge to about 500 feet where the Range merges with the Simpson Desert to the south. West and south of the Toomba Range, inliers of Upper Proterozoic rocks protrude through the sand of the Desert; they are in part mesas capped by lateritized Mesozoic rocks.

Cretaceous and Tertiary rocks form the dominant topography of the eastern half of the Mount Whelan Sheet area. The highest parts are plateaux and mesas of lateritized rocks with a duricrust (siliceous) cap, are generally flat, and have elevations up to 550 feet above sea level. High ridges (Mount Coley) and peaks (Mount Whelan) formed of silicified spring deposits are locally prominent in this terrain. The main range of hills extends from south of the Georgina River, along the eastern edge, to the south-eastern corner of the area. A subsidiary belt of buttes and narrow mesas is also prominent to the west of the main range; the trend is arcuate from Mount La Touche in the north to The Sisters in the south. It was probably part of an extensive plateau which originally included the range to the east, but is now a residual belt forming the main drainage divide between the Georgina River and Sylvester Creek. Apparent lineations are shown by ridges in this belt and it may reflect structures in underlying rocks.

The country falls gradually to the west towards the Mulligan River from the belt of ridges but is locally interrupted by a low rocky plateau of Lower Cambrian basement which protrudes through the Cretaceous. This plateau trends south-south-east and is formed of dense silicified Sylvester Sandstone. The Sylvester Creek and some of its tributaries have dissected the eastern side of the plateau and cut through the southern part to join the Mulligan River to the south-west. A low (but strong,) scarp marks the central western side, but in the south-west the plateau merges into a low rise of Sun Hill Arkose rocks.

At Sun Hill in the north, Lower Cambrian rocks crop out along the southern side of the Sun Hill Fault through hard and soft layered carbonate rocks of the Georgina Limestone. South-west of the fault the carbonate rocks have been buckled or have a low south-west dip and occur as low terraced rises or as strike ridges, (in many parts, as lines of limestone plates on the surface). East of the fault the carbonate rocks are generally subhorizontal and crop out along the course and in the channels of the Georgina River; they are covered south of the River by south-dipping Cretaceous rocks. The fault has obviously caused the diversion of the Georgina River from a southerly course in the Glenormiston area to an easterly one, and the River has continued on this course through the strike valley of the soft sandy basal beds of the Cretaceous rocks.

Apart from the Toomba and Toko Ranges in the north, the western half of the Mount Whelan Sheet area is covered by sand of the Simpson Desert. The sand is mainly in ridges with a dominant north-north-westerly trend. The ridges are never more than about 50 feet high, and are asymmetrical with a steeper eastern side. Interdune areas are drift sand or claypan; subhorizontal to low dipping rocks of the Toko Syncline may crop out in claypans in the northern part.

Except for the trees along streams and in areas of carbonate outcrop, the area is generally barren. Most of the larger trees (Coolibahs, and other eucalpyts) are concentrated along the main streams. Other trees along watercourses may include Minnaritchie and Gidyea, although the latter are found in the areas of carbonate outcrop as well. Drought conditions generally prevail and stock feed is usually scarce; however, grass and herbage become abundant in most parts after rain, and the stock seem to regain good condition quickly. The sandy parts of the Desert are covered by spinifex, but may yield herbage after heavy rain.

Table 1: Stratigraphy of the Mount Whelan and Bedourie Sheet areas, Western Queensland

AGE		FORMATION	THICKNESS (feet)	LITHOLOGY	FOSSILS	STRATIGRAPHIC RELATIONSHIPS	DISTRIBUTION and TYPE of OUTCROP
CAINOZOIC	Undifferentiated	Alluvium and soil (Cza)	60 in bore	White sands and generally grey soils;			Major streams and alluvial flats
		Sand (Czs)	Dunes up to 50	Red-brown, orange aeolian sands.			Simpson Desert and other areas; mainly sand ridges - interdune sand flats, claypans.
		Duricrust gravel (Czg)	< 1	Gravel of mainly brown-coated rounded siliceous sandy pebbles ('gibbers')			Residual gravel from eroded duricrust - widespread in east of region.
		Gypsiferous deposits (Czy)	12+	White, bedded gypsiferous deposits.	Vertebrate remains		Low plateaux around alluvial flats at junction of Sylvester Creek and Mulligan River; edges of some Simpson Desert claypans.
	Tertiary	Silicification and formation of Duricrust (Czd)					
		Undifferentiated (T)	<10 in outcrop; up to 80 in bores	Limestone and chalcedony	Gastropods, ?ostracods	Probably equivalent to Austral Downs Limestone.	In Bedourie area, as elongated belts east-west along Eyre Creek and south-south-westerly from south edge into Birdsville Sheet area; in Mount Whelan area, small patches west of Toomba Range.
		Austral Downs Limestone (Ta)	<10 in outcrop	Limestone and chalcedony		Unconformable on Ninmaroo Formation	Along course of Georgina River in northeastern part of Mount Whelan area.
		Mount Coley Sinter (Tc)	170 (Casey, 1959)	Chalcedony and siliceous sinter over fine-grained sandstone.	Silicified fossil wood.	Overlies Cretaceous rocks; equivalent to Austral Downs Limestone.	Capping Mount Coley, Mount Whelan, Sugarloaf Hill and small deposits elsewhere (Mount Whelan area).
		Lateritization and Deep Weathering					
		Marion Formation (Tm)	55 (Bedourie area)	Quartz sandstone, quartz chert grit; sandy siltstone.		Disconformable on Cretaceous rocks; covered by sand in parts of Bedourie area.	Most common in eastern parts of both areas, in the duricrust cap over Cretaceous rocks.
MESOZOIC	Cretaceous	Winton Formation (Kw) -Bedourie Sheet only.	20 in outcrop	Leached argillaceous sandstone and mudstone with ironstone concretions.	Silicified wood, carbonized woody fragments.	Base not seen in outcrop; apparently conformable in bores; disconformably overlain by Marion Formation.	Low plateau and hilly country south of Eyre Creek (south-eastern part of Bedourie Sheet area).
		?Mackunda Beds (?Klm) -Bedourie Sheet only	Not known	Ferruginized sandy rocks, calcareous sandstone.	none found	Generally conformable above and below, but covered by Marion Formation in Bedourie Sheet area.	Possibly in buttes south of Kamaran Homestead, and scattered outcrop between dunes south of Lake Philippi (eastern central Bedourie area).
		Wilgunya Formation: upper beds (Klw_2)	500 increasing to over 1000 to south.	Grey mudstone (lateritised in outcrop), fossiliferous calcareous siltstone.	Ammonites, pelecypods (*Inoceramus*, etc.), arenaceous Foraminifera.	Conformable above and below	Mainly plateaux and hilly country, or rolling downs where calcareous beds crop out, (south-eastern Mount Whelan to north-eastern Bedourie area).
		Toolebuc Member (Klo)	up to 10	Fossiliferous pink platy limestone with green shale interbeds, ferruginized in part.	Pelecypods (*Aucellina*, *Inoceramus*), Foraminifera (*Globigerina*), fish scales.	Possible disconformity at base.	Ironstone-covered outcrops in mesa slopes in central eastern edge of Mount Whelan area, and at Bellevue Tank; around alluvial flats west and north of Sandringham at join of Sheet areas.
		Lower beds (Klw_1)	450-550	Sandy glauconitic gypsiferous grey mudstone (lateritised in part) with calcareous concretions.	Abundant arenaceous Foraminifera with with well-formed tests.	Apparently conformable on Longsight Sandstone.	Hilly country in east of Mount Whelan area; small area at north edge of Bedourie.

The underlying formations crop out in Mount Whelan Sheet area only - but may extend subsurface into the Bedourie area

ERA	AGE	FORMATION	THICKNESS (feet)	LITHOLOGY	FOSSILS	STRATIGRAPHIC RELATIONSHIPS	DISTRIBUTION and TYPE of OUTCROP
MESOZOIC	Cretaceous	Longsight Sandstone (Kll)	Up to 550 in bores	Poorly sorted silty sandstone, conglomerate, and silicified brown sandstone, glauconitic in part; minor fontainbleau sandstone; shale and lignite in bores.	Lower beds with fossil wood, plant remains, Rhizocorallium; upper-pelecypods, gastropods, belemnites, cidaroid remains, starfish, arenaceous Foraminifera.	Unconformable on Precambrian and Palaeozoic rocks; disconformable on ?Lower Jurassic.	In valleys along Georgina River and east of Toko Range; in Toomba Range area and north-west parts of Mount Whelan, mainly lateritized and capping mesas.
MESOZOIC	?Lower Jurassic (Jl)		380+	Red claystone, partly calcareous; minor sandstone.	None found.		Subsurface only - Montara Bore on Sandringham Station; below Lower Cretaceous in trough of Toko Syncline
PALAEOZOIC	?Permian (P)		Unknown	Unconsolidated fluvioglacial (?) boulders, cobbles and pebbles of silicified sandstone mainly.		Apparently unconformable over older Palaeozoic and below Mesozoic rocks.	Loose gravel on flanks of Toomba Range, low hilly mounds in trough of Toko Syncline, scattered gravel patches elsewhere.
PALAEOZOIC	Upper Silurian to Lower Devonian	Craven's Peak Beds (S-Dc)	456+	Brown ferruginized fine to medium-grained quartz sandstone with clay pellets and basal conglomerate in part.	Fish scales	Basal erosional disconformity over lower Palaeozoic and Precambrian rocks.	As strike ridges or steep cuestas along Toomba Range; low dip slopes in claypans of Simpson Desert.
PALAEOZOIC	Ordovician – Middle (Toko Group)	Mithaka Formation (Omm)	200-400	Brown gypsiferous siltstone and sandstone; minor pellet beds.	Nautiloids, trilobites, sponges (Receptaculites), conodonts; some pelecypods, brachiopods; tracks.	Conformable on Carlo Sandstone.	Hard beds may form dip slopes or strike ridges in scattered outcrops through sand north-east of Toomba Range and west of Toko Range.
PALAEOZOIC	Ordovician – Middle (Toko Group)	Carlo Sandstone (Omc)	200+	Red, brown thick-bedded sandstone, clay pellet beds and some siltstone; cross-bedded.	Nautiloids, brachiopods, pelecypods, trilobite casts and tracks; U-tube structures thought to be organic.	Conformable with overlying and underlying formations.	Prominent steeply dipping beds of east side of Toomba Range, top of scarp and plateau of Toko Range.
PALAEOZOIC	Ordovician – Middle (Toko Group)	Nora Formation (Omn)	165-?500	Green, brown, purple gypsiferous siltstone, and brown sandstone; calcarenite and coquinite beds; clay pellets common.	Nautiloids, brachiopods, pelecypods, trilobites, gastropods, bryozoa, tracks and trails, tubular structures.	Conformable above and below.	Exposed in Toomba Range, and in basal part of and valley to east of Toko Range scarp.
PALAEOZOIC	Ordovician – Lower	Coolibah Formation (Olc)	50-520	Grey calcilutite, some oolitic, and green-white marl; chert lenses, minor calcarenite, dolarenite.	Nautiloids, gastropods, ribeirioids, corals(?), sponges.	Fossil evidence suggests a time break between the Coolibah and Kelly Creek Formations.	As low hills and strike ridges parallel to and north-east of Toko Range; part of deformed sequence in Toomba Range.
PALAEOZOIC	Ordovician – Lower	Kelly Creek Formation (Olk)	250	Lower part mainly sandstone and some siltstone overlain by dolomite with marl and chert; laminated to thin-bedded.	Brachiopods, nautiloids, trilobites, ribeirioids, tubular structures (U-tubes), tracks.	Basal relationship with Ninmaroo Formation uncertain, but probably disconformable.	Generally poor exposures along north-east side of Toko Range and central valley of Toomba Range.
PALAEOZOIC	Cambrian to Ordovician	Undifferentiated (Є-O)	Estimated 3000 to 4,000	Calcilutite, calcarenite, dolomite, sandstone - units ranging in age from Cambrian (?Middle) to Lower Ordovician - which could not be differentiated in the mapping of the northern part of the Toomba Range in the Mount Whelan Sheet area.			
PALAEOZOIC	Cambrian to Ordovician	Ninmaroo Formation (Є-On)	Up to 2400 ±	Calcilutite, calcarenite, and dolarenite; sandy in part; sandstone and siltstone inter-beds; algae, intraformational breccia, oolitic limestone.	Algae (stromatoliths), nautiloids, brachiopods, ribeirioids, 'mandibles'.	Disconformable on Georgina Limestone; overlain by Kelly Creek Formation.	Along northern edge in plains, low rises with terraces, strike ridges and in Georgina River alluvial flats; hard beds prominent along west side of Toomba Range.
PALAEOZOIC	Cambrian – Upper	Georgina Limestone (Єug)	100 (outcrop) probably more than 1100 in Tyson's Bore.	Thinly interbedded hard grey and soft white calcilutite, some sandy, with chert; calcareous sandstone, oolitic limestone, breccia, two-coloured blue grey and brown limestone.	Trilobites, brachiopods, hyolithids.	Basal contact not seen but beds have same general attitude as small Middle Cambrian inliers to east.	Low terraced rises in plains with poor outcrop - usually occur as scattered lines of limestone plates along strike.

AGE			FORMATION	THICKNESS (feet)	LITHOLOGY	FOSSILS	STRATIGRAPHIC RELATIONSHIPS	DISTRIBUTION and TYPE of OUTCROP
PALAEOZOIC	Cambrian	Middle	Undifferentiated (Ꞓm)	Not known but apparently thin in outcrop.	Laminated calcilutite, some sandy, and minor calcareous sandstone.	Trilobites	Low westerly dip, contacts not seen.	Small inliers in sand west of Polly's Lookout and in Cretaceous sediments west and north-east of the low plateau between Mount Coley and Rocky Yard.
		Lower	Sylvester Sandstone (Ꞓls)	1200 (Casey, 1959)	Silicified dense brown sandstone and green siltstone.	tracks	Probably conformable on Sun Hill Arkose; Middle Cambrian and younger rocks apparently unconformably above.	Low elongate plateau, mainly west of Sylvester Creek, from west of Mount Coley to south-east of Rocky Yard; also as small inlier south-west of Sun Hill Fault.
			Sun Hill Arkose (Ꞓlh)	150+ (Casey, 1959)	Arkose, arkosic sandstone conglomerate, siltstone dolomite, greywacke.	Worm trails and trilobite tracks.	Base not seen; unconformably overlain by ?Permian and by Lower Cretaceous.	Low rounded hills (Sun Hill) and rises (south-west of Rocky Yard); small inliers north of Mount Coley Tank.
UPPER PROTEROZOIC			Field River Beds (Buf)	1,000+ (inliers in Simpson Desert)	Interbedded green siltstone and boulder beds - some tillitic texture; arkose, dolomite, siltstone and sandstone.	None	Unconformably overlain by Carlo Sandstone, Craven's Peak Beds, and Lower Cretaceous Longsight Sandstone.	West of Toomba Fault in north-western part of Sheet area, in low rises and strike ridges protruding through sand.
ARCHAEAN (A)				unknown	Granite, schist, pegmatite.	None	Field River Beds thought to be unconformable above although contact not seen.	A small inlier in the Simpson Desert 16 miles north-west of Mirrica Bore.

STRATIGRAPHY

The stratigraphy of the Mount Whelan Sheet area, and also that of Bedourie which joins Mount Whelan to the south, is shown in Table 1.

PRECAMBRIAN

Rocks which may be Archaean in age were found in the Simpson Desert during the helicopter survey in 1960. They occur in vertically dipping outcrops with north-south strike. Granite, finely crystalline quartz-mica-feldspar pegmatite, and schist were noted; they have been correlated with the Archaean Arunta Complex rocks which crop out in the Hay River Sheet area to the west. It is possible, however, that the granite and pegmatite have intruded the schist, and events were similar to those in the Hay River area where Lower Proterozoic intrusions into the Arunta Complex are recorded (Smith, 1963). White quartz veins are associated with the Simpson Desert inlier and have been observed also with the folded and faulted younger rocks to the west - i.e. with the Field River and Palaeozoic rocks at the southern end of the Toomba Range.

The thickness of the Field River Beds in the western part of the Mount Whelan Sheet area has not been determined because the sediments are difficult to trace due to the scattered nature of the outcrops, they have been folded and faulted, and they have been partly altered by lateritization and silicification. Outcrops along the western edge of the Sheet area, south of the Wonapituri Claypans, are estimated to include over 1000 feet of sediments: mainly steeply dipping boulder beds, and green to dark grey siltstone and fine-grained sandstone. The conglomeratic beds are polymict; granite boulders and pebbles, some with prominent tourmaline, were noted as well as schist and quartzite. Outcrops of the Field River Beds occur along the Toomba Fault adjacent to Lower Palaeozoic beds, and at the southern end of the Toomba Range appear to be overlain directly (but unconformably) by the Carlo Sandstone and Craven's Peak Beds. Elsewhere Mesozoic and younger sediments may lie unconformably over the Field River Beds. The Field River Beds were named by Smith (op.cit.) from the Hay River area.

PALAEOZOIC

Lower Cambrian

The Sun Hill Arkose and Sylvester Sandstone may be a continuous sequence but a complete section has not been seen in outcrop. A thin section of about 20 feet of polymict conglomerate and dark grey coarse sandy siltstone to fine-grained greywacke overlying tough red micaceous siltstone and green-grey mudstone with dark and light varve-like lamination occurs under Cretaceous sediments at the head of Kangaroo Creek. The outcrop is below the western scarp of indurated Sylvester Sandstone and may represent the transition from Sun Hill Arkose to Sylvester Sandstone (J.N. Casey, pers. comm.).

The units were named by Casey (1959) and are thought to be equivalent to the Mount Birnie Beds in the Duchess Sheet area to the north-east (and Lower Cambrian in age, Öpik in Hill & Denmead, 1960). Some of the rocks mapped as Field River Beds in the western part of the Sheet area could also be equivalent, but were not mapped in enough detail to be shown as separate formations; the arkose at the western edge of the section measured across the Toomba Range at GAB 95 locality, for example, contained white quartz pebbles and was very similar to the coarse arkose at the base of the Sun Hill Arkose.

At Sun Hill, about 50 feet of massive conglomeratic arkose forms a prominent monolith; in a small butte to the north, arkose (20 feet thick) is interbedded with shaly purple siltstone (10 feet) above 40 feet of red greywacke in a steeply folded section near the Sun Hill Fault. A composite section of 125 feet of pink, buff and chocolate arkose, in part dolomitic, and minor white feldspathic pebbly grit was measured north of Dingo Hill in the central part of the Mount Whelan area; and small inliers north of Mount Coley Tank contain about 50 feet of micaceous and pebbly arkosic sandstone, green shaly mudstone, and brown to grey dolomite over massive pink granitic arkose with white quartz pebbles. These rocks form the Sun Hill Arkose, and Casey (op. cit.) estimates an overall thickness of 150 + feet. Trilobite tracks (Protichnites) were found at W257 in the Dingo Hill area, and together with "coffee bean" tracks (Öpik, op. cit.) at W256 near Mount Coley Tank.

The Sylvester Sandstone is mainly green siltstone and massive brown silicified to white fine to medium-grained micaceous quartz sandstone; slump structures, ripple marks, and tracks are common. Casey (op. cit.) estimates a thickness of 1200 feet, but no more than 150 feet has been seen in any one outcrop.

Middle Cambrian

The small pockets of undifferentiated Middle Cambrian which occur north-east of Mount Whelan generally contain very sandy limestone overlying dense calcareous sandstone; the limestone is commonly pyritic, or is associated with ironstone pseudomorphs of pyrites nodules. Some small cross-bedding occurs in sandy beds. The undifferentiated Cambrian to Ordovician section adjacent to the Toomba Fault in the western part of the Mount Whelan Sheet area probably contains rocks equivalent to the Middle Cambrian; K.G. Smith (pers. comm.) estimated a thickness of 300 feet of blue limestone in the undifferentiated section which might be equivalent to the Marqua Beds (in the Hay River and Tobermory areas to the west and north-west), and Middle Cambrian in age.

Upper Cambrian

The predominant lithology of the Georgina Limestone is dark and light grey calcilutite with chert. The best outcrops are between Sun Hill and Twenty Mile Bore in the central northern part of the area. The beds are buckled, however and the true thickness cannot be measured; 100 feet of outcrop has been estimated. The log of Tyson's No.4 Bore, which spudded into the Georgina Limestone, shows a thickness of 1810 feet of limestone. Date of drilling is shown as about 1909. However, Jack (1895) refers to "drillings" from a bore on Glenormiston between the Mulligan and Georgina River which showed limestone and shale from depths of 520 and 1100 feet, dark hard shale, compact grey limestone with shale, dark grey sandy limestone, and hard quartzose rock from deeper in the hole, and granite from 1900 feet. This could have been Tyson's bore, the only bore of comparable depth known in that area, or an old bore which was reopened about 1909. This information suggests that the Georgina Limestone is probably over 1100 feet thick, and possibly Middle, and also Lower Cambrian rocks are continuous at depth.

Öpik (1963) has distinguished between a lower part of the Georgina Limestone with dark beds with shale partings and light grey aphanitic beds north of the 23rd parallel, and flaggy, sandy limestone beds with breccia interbeds to the south (Mount Whelan area). It is possible that this litho-facies distinction exists within the Mount Whelan Sheet area as well - a rough plot of sandy and non-sandy limestone at localities within the Sun Hill - Mount Idamea - Twenty Mile Bore area has shown the following features:

(1) the older beds of the Georgina Limestone (Glyptagnostus stolidotus, G. reticulatus zones) which occur in an apparent belt north-east of localities W15, W6 and through W40a are mainly non-sandy calcilutite;

(2) sandy beds between locality W6 and the inferred faults to the south-west, and to the north-west at Mount Idamea are younger and belong to the Corynexochus plumula, Erixanium sentum zones of Öpik (op. cit.);

(3) the few localities within the sandy belt reported as non-sandy limestone appear to coincide with anticlinal axes;

(4) immediately south-west of the inferred faults, non-sandy calcilutites recur and are overlain to the south-west by sandy-beds - the only localities with fossils determined are at W46 (C. plumula) and W47 (E. sentum), the latter at the junction of the non-sandy and the sandy beds.

The W168 locality to the south-east, mainly banded and two coloured calcilutite and probably in the G. reticulatus zone (Öpik, pers. comm.), could be on the up-thrown, south-western side of a south-easterly extension of the inferred faults.

Among the rocks of the Georgina Limestone are dark grey foetid limestone, coquinoid laminae, and, in a creek bed north-east of Mount Whelan (and between W38 and W150 localities), light and dark brown laminated calcareous siltstone.

Rocks of Upper Cambrian age which occur in the Toomba Range are discussed later under 'Undifferentiated Cambrian to Ordovician'.

Cambrian to Ordovician

The Ninmaroo Formation was first recognized as the 'Ninmaroo Limestone', by Whitehouse (1936), was redefined by Casey (1959), and has been described by Öpik, and Pritchard (in Hill and Denmead, op. cit.). Pritchard has divided the Ninmaroo Formation into five informal units (Єu-2 to Ol-6) but these are not differentiated in the mapping of the Mount Whelan Sheet area. His uppermost unit (Ol-6) is now regarded as separate from the Ninmaroo Formation, and called the 'Kelly

Creek Formation' (Casey, in Smith, in prep.). Thin-bedded to laminated calcareous sandstone and siltstone (in parts red-brown to white, leached) appear to be more common in the Mount Whelan Sheet area than elsewhere, particularly along the Georgina River. Black, and dark to light-coloured cherts were noted in some outcrops. The thickest section measured east of the Toko Range is at W307 locality, east of 14-mile Bore on Glenormiston Station; it is 135 feet thick and contains poor outcrops of calcilutite and calcarenite. Calcilutite and calcarenite are also the main lithologies in the section at W309 to the south-west. Dolomite and sandstone appear to be most common in the sparse outcrops between the sections.

A section across the Toomba Range east of Cravens Peak includes 545 feet of fossiliferous Ninmaroo Formation, faulted on the west side against Field River Beds:-

Top	
20 feet	No outcrop
30 feet	Intraformational conglomerate and algal limestone
55 feet	Grey, yellow thick-bedded limestone with sandy beds, crinoidal limestone, green micaceous sandy shale, and massive white dolomite
30 feet	Grey and dark grey two coloured limestone and massive oolitic dolomite beds
30 feet	No outcrop
10 feet	Medium-bedded flaggy sandstone
20 feet	No outcrop
10 feet	Massive white and yellow oolitic limestone
100 feet	No outcrop
40 feet	Grey and yellow massive limestone with algae and brown dolomite
200 feet	(Estimated) Grey Limestone with very steep dip
545	FAULT

A similar section to the south-west of GAB95 locality is much thicker (estimated 2400 feet) but no fossils have been found; the beds are overturned and have steep westerly dip.

Top	Contact with Kelly Creek Formation not seen; formations separated by 1000 foot interval of no outcrop
205 feet	Dolarenite to calcarenite, sandy in part; dolomitized beds include intraformational conglomerate
340 feet	Fine sandy calcarenite, laminated to thin-bedded and showing cross-bedding, dolomitized in part

95 feet	Poor outcrop; some laminated sandy calcarenite, and grey and red-brown two-coloured limestone
10 feet	Massive grey sandy calcarenite
720 feet	No outcrop
185 feet	Massive grey calcilutite with brown siliceous patches, some sandy beds, and with thick inter-beds of two coloured brown dolomitic and grey limestone
230 feet	Poor outcrop - a few scattered outcrops of massive calcilutite, as above, but with different strike
185 feet	Massive grey calcilutite, as above with similar strike; minor two coloured limestone and dolomite beds
30 feet	Medium to thick-bedded grey oolitic limestone with scattered silica blebs
15 feet	Brown-grey calcarenite with very sandy laminae, cross-bedded
35 feet	Thick-bedded grey and light grey mottled "blotchy" calcilutite
45 feet	Brown-grey sandy calcarenite
125 feet	"Blotchy" calcilutite and calcarenite in scattered outcrops
45 feet	Grey fine-grained laminated calcarenite - vertical dip
135 feet	No outcrop except for thin bed of grey calcarenite at the base; covered by aeolian sand.
	Faulted against Field River Beds - red medium-grained micaceous arkose with large angular quartz pebbles.
2400 feet	

The estimated thickness of the Ninmaroo Formation in this section may be exaggerated by repetition from minor faulting, and by inclusion of older formations in the lower 400 feet (although the lithologies appear to be more like the Ninmaroo Formation than the Georgina Limestone.)

The disconformity at the base of the Ninmaroo Formation is visible in small mesas west of Sun Hill (W4, W204 area) where leached sandstone with moulds of trilobite fragments transgresses the basal beds of the Georgina Limestone.

Undifferentiated Cambrian to Ordovician

An undifferentiated Cambrian to Ordovician unit has been mapped in the Toomba Range to cover ?Middle Cambrian to Lower Ordovician rocks which were not separated in the field, and could not be differentiated by air-photo interpretation. Lithologies similar to the Middle Cambrian Marqua Beds and Upper Cambrian Arrinthrunga Formation were identified by K.G. Smith (pers. comm.) and fossils (including G. stolidotus), which suggest a zone low in the Georgina Limestone, occur at W283 locality. As an estimate, the thickness of the unit would be 3,000 to 4,000 feet thick, but only a small percentage would be present in outcrop, the rest covered by sand and alluvium.

Lower Ordovician

The Kelly Creek Formation was first described from the Tobermory Sheet area in an unpublished report by Smith and Vine (1960) and later defined by Casey (in Smith, in prep.). Its lithology: a lower thin-bedded to laminated sandstone with siltstone interbeds and an upper dolomite, is fairly constant; minor lithologies include sandy limestone, red intraformational conglomerate, crinoidal and pink oolitic, glauconitic limestone. In the Mulligan River area (Mount Whelan) the thickness was estimated to be 250 feet; in the Toomba Range it varies from 230 feet across W270 and W274 localities to an estimated 270 feet near GAB95 where it adjoins an interval of no outcrop in which about 1000 feet of section could be concealed.

The contact between the Kelly Creek Formation and the Ninmaroo Formation appears to be conformable in the main outcrop areas. However small scattered outliers which have been or could be correlated with the Kelly Creek Formation (on lithological or palaeontological evidence) occur east of Glenormiston No. 18 Bore and south-east of Polly's Lookout(and elsewhere in the Glenormiston and Boulia Sheet areas). They appear to transgress an old Ninmaroo Formation surface, and the boundary between the Formations has therefore been considered a disconformity. A disconformity is also shown between the Kelly Creek Formation and overlying Coolibah Formation; J. Gilbert-Tomlinson (pers. comm.) has suggested a marked time break between these Formations based on palaeontological evidence.

Lower to Middle Ordovician

The Toko Group comprises the Coolibah and Nora Formations, Carlo Sandstone and Mithaka Formation (Casey, in Smith, op. cit). The Coolibah Formation, (Unit O1-7 of Pritchard in Hill and Denmead, op. cit), is a distinctive lithological unit, and its fauna is not closely related to either of the adjacent formations (J. Gilbert-Tomlinson, pers. comm.). In the Mount Whelan Sheet area, a maximum of 520 feet was measured at W271, 271a in the Toomba Range. At GAB95 to the south, only about 50 feet is present, and at W58 in the Toko Range to the north-east an incomplete section of 90 feet was measured.

The Nora Formation is defined by Casey (in Smith, 1963). Its thickness in the Toomba Range sections varies from 400 feet at W272, where it has a prominent basal coquinite, and overlying sandstone to siltstone units, to 165 feet at GAB95 to the south. At GAB95 the basal bed is also 15 feet of prominent coquinoid limestone lens, overlain by 10 feet of grey sandy limestone, and 140 feet of platy silty sandstone with thin coquinite bands. A partial section measured in the Toko Range area, at W73, south Illanama Swamp was 45 feet thick; the estimated thickness at W12 (further south) assuming a constant 5^{o}dip, is at least 500 feet.

The Carlo Sandstone (Casey, op. cit.) forms a prominent plateau surface and scarp in the Toko Range where it occurs in the axial part of the Toko Syncline, and strike ridges along the limbs of the Syncline. It is a prominent steeply dipping ridge along the eastern side of the Toomba Range, and, in the south-eastern part of the Toko Range south-west of Carlo Homestead, it breaks up into four low strike ridges with shallow dip slopes. The thickness in the Mount Whelan Sheet area is 200 feet in the type area two miles south-west of Carlo homestead, and 200 feet (top not seen) in the Toomba Range east of GAB95.

The Mithaka Formation (Casey, op. cit.) is not well-exposed in the Mount Whelan Sheet area and is best seen to the north in the Tobermory and Glenormiston Sheet areas where it is 200-400 feet thick.

Upper Silurian to Lower Devonian

The Craven's Peak Beds are defined by Reynolds (in Smith, in prep.) and the type area is in the south-western corner of the Glenormiston Sheet area. The thickest known section is in the Toomba Range near the junction of the Hay River and Mount Whelan Sheet areas. A section, 455+ feet of red-brown, coarse to medium-grained, thin-bedded and cross-bedded quartz sandstone with clay pellets, is recorded by Smith, Vine and Milligan (1961). 120 feet of pebbly fine-grained quartz sandstone and conglomerate in vertically dipping beds which wedge out the Carlo Sandstone against the Toomba Fault (south end of Toomba Range west of Two Hills) are thought to be at the base of the Craven's Peak Beds; the pebbles are mainly subangular to subrounded quartz and probably derived from erosion of the Field River Beds. Another small inlier to the south, also interbedded pebbly sandstone and conglomerate, is 300+ feet thick. The stratigraphic relationship between the three sections is not known.

? Permian

The widespread pebble deposits, mostly unconsolidated, which occur in hollows in the Toomba Range and over its eastern slopes, as surface scree over low rounded hills in the western trough area of the Toko Syncline, and scattered in the area between Sun Hill and Polly's Lookout, have been mapped as ?Permian. The pebbles are mainly silicified fine-grained quartz sandstones and appear to be locally derived from the older Palaeozoic rocks in the Toomba Range area. Leslie (1959) records their occurrence in unconsolidated boulder clay. Markings on some of the erratics suggest a glacial or fluvio-glacial origin for the deposits, and shiny grooved surfaces which could be of glacial origin have been noted on outcrops of Field River Beds south of the Toomba Range and on Sylvester Sandstone in the Sylvester Creek area. On this and other evidence given in Reynolds and Pritchard (1964) the deposits have been mapped as ?Permian. They have probably been winnowed of matrix and reworked to some extent during Lower Cretaceous or earlier Mesozoic freshwater transgressions.

MESOZOIC

?Lower Jurassic

The red beds which occur below the Lower Cretaceous mudstone and sandstone in Montara Bore on Sandringham Station are unfossiliferous, but are thought to be younger than the ?Permian glacial or fluvioglacial deposits, and older than Lower Cretaceous in age. Red beds are not widespread in the western part of the Eromanga Basin but have been penetrated in wells drilled for oil: Conorada Ooroonoo No.1 (east of the Mount Whelan Sheet area) between 3649 and 3840 feet where they are at least in part Jurassic in age, (C.P.C., 1963), probably Lower Jurassic; and Delhi-Frome-Santos Innamincka No.1 in north-eastern South Australia in which two red bed units were identified between 5938 and 6723 feet - these occurred between Lower or Middle Jurassic and Upper Permian (Ryan, 1961). The only known occurrences of Triassic or Jurassic rocks in the areas adjacent to the Mount Whelan Sheet area are in the Tobermory and Hay River Sheet areas - the Triassic Tarlton Formation (see Smith, 1963) - but these sediments are unlike the Montara Bore red beds. On all of the available evidence, the red beds have been given a ?Lower Jurassic age.

Lower Cretaceous

The Lower Cretaceous sediments of the Mount Whelan Sheet area are the Longsight Sandstone and Wilgunya Formation. They form part of the Great Artesian Basin and thicken to the south and east, although the Longsight Sandstone may thin or pinch out over buried highs.

Plant fossils and fossil wood, worm burrows, and Rhizocorallium are mostly associated with poorly sorted silty sandstone in the lower part of the Longsight Sandstone; glauconitic sandstone with marine fossils and arenaceous Foraminifera occurs in the upper part. The age of these beds is Lower Cretaceous (Reynolds, in Hill and Denmead op. cit.). The fossiliferous fontainbleau sandstone outcrops occur mainly with the small Cambrian inliers north-east of Mount Whelan, and to the south at GAB55 locality. Outcrops along strike valleys in the north-eastern part of the area are partly altered by weathering, but fresh rock is not uncommon. In the north-western part, however, the outcrops have been lateritized and generally have a duricrust cap. Most outcrop sections are less than 100 feet thick. At W57, Mount Idamea, there is 70 feet of section consisting mainly of poorly sorted quartz and silty sandstone, thin siltstone with plant remains, and some conglomerate.

The main details of the Wilgunya Formation are shown in Table 1. The lower beds have a fauna which can be correlated with that of the Roma Formation of Whitehouse (1954); the Toolebuc Member and upper beds correspond to his coquinite bed and Tambo Formation. The overlying ?Mackunda Beds do not extend on to the Mount Whelan Sheet area.

CAINOZOIC

The Tertiary history of western Queensland is covered in a recent publication by Paten (1964 - geological and palaeontological aspects), and in a paper by Reynolds (in prep.) on the lateritization and silicification. The Marion Formation, which has been lateritized and occurs mainly as duricrust (billy), is confined to the eastern half of the Mount Whelan Sheet area. It may extend as less altered sediments (into the Simpson Desert area) below Tertiary limestones.

The Tertiary limestone and chalcedony deposits west of the Toomba Range in the north-west, and west of Mirrica Springs in the south (very small inlier in sand), are similar lithologically to the Austral Downs Limestone along the Georgina River; they were probably formed at the same time in the late Tertiary. The thickness in outcrop is less than 10 feet, but may be up to 80 feet in bores. Drillers' logs for Ethabuka and Mirrica Bores, which are thought to have spudded in Tertiary limestone below top soil, show up to 80 feet of intermixed 'red and white rock and clay' which could possibly be correlated with the Tertiary limestone. Lower sediments: sandy mudstone, 'red and yellow clay', 'porous sandstone and quartz' (opal or chalcedony), 'brown and grey shale' (no microfossils present) may be in part Marion Formation and grading downwards into Cretaceous sediments.

Fossils found in the gypsiferous deposits near Pulchera Waterhole by Mr R. Larter of No.1 B.M.R. Seismic Party in 1963 were identified by the Queensland Museum as a reptilian tooth referable to the Varanidae (goanna group), and diprotodon bones. The age is Upper Cainozoic. These deposits are shown in Plate 9 (Reynolds, et al, 1961).

STRUCTURE

The predominant structural trend in the Mount Whelan Sheet area is south-south-easterly, a trend common to western Queensland and possibly a relict of Precambrian structures affected to some extent by a moderate ?Carboniferous orogeny.

The Archaean outcrop in the Simpson Desert has vertically dipping rocks with north-south strike, different from the regional trend; however, this is only a very small outcrop and the trend might be quite local. The quartz veins which occur with this inlier have the same north-south trend but could be a later intrusion associated with the ?Carboniferous movement along the Toomba Fault.

The Field River Beds in the west also dip steeply in many of the outcrops, but the trend here is mainly westerly. Smith (1963) attributes their deformation to tectonic activity (with faulting dominant) in the Upper Proterozoic. Quartz veins, where associated with these outcrops, trend north-north-westerly across the strike of the beds; these also are probably a later ?Carboniferous intrusion.

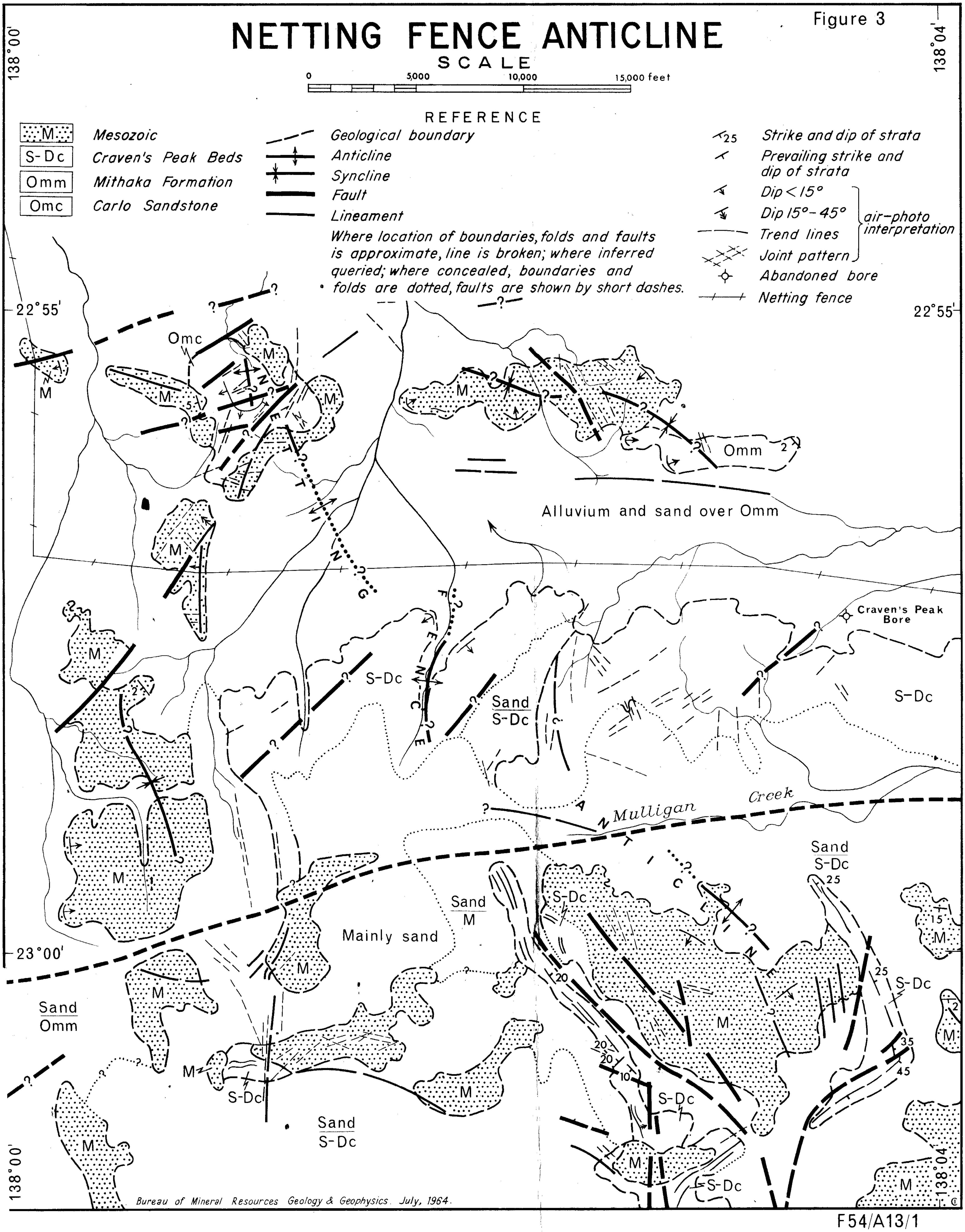
Lower Cambrian rocks in the central part of the Mount Whelan area are not deformed to any marked degree. They show a diversity of dips, probably partly depositional and partly in response to post-depositional orogenic movements, but their overall altitude suggests that they form part of a fairly stable horst block.

Towards the end of Lower Cambrian time, (or early Middle Cambrian), subsidence began which led to formation of the Georgina Basin, and left some areas of Lower Cambrian and older rocks as land. Minor tectonic activity probably initiated and accompanied the subsidence, and fault movements controlling the development of the Toko trough (later Syncline) at the southern end of the Basin are envisaged. Evidence of possible tectonic instability in late Lower Cambrian time is shown by slump structures in the Sylvester Sandstone, and it is believed that the Toomba Fault was an extensive linear crustal weakness before faulting occurred during the ?Carboniferous orogeny.

During Middle Cambrian to Lower Ordovician times, seas covered the Georgina Basin and Toko trough area, and limestone-dolomite deposition began; the process was mostly continuous, but some breaks have been noted. Evidence of sedimentation in Kelly Creek Formation time is confined mainly to the Toko trough area; however, minor transgressions to the east and north-east occurred. Later sedimentation in Lower to Middle Ordovician time was not continuous, but appears to have been confined throughout to the Toko trough. No further deposition occurred in that part of the Toko trough which falls within the Mount Whelan Sheet area (and in adjacent sheet corners to the north-west) until Upper Silurian - Lower Devonian time. These sediments were laid down, with slight erosional disconformity, on older rocks in the central part of the trough.

A major thrust from the south-west during the ?Carboniferous (Reynolds & Pritchard, 1964) caused extensive faulting, mostly steep and some reverse, along the western edge of the Toko trough. The main fault line, the Toomba Fault, is irregular and disrupted by cross-faults some of which show

Figure 3



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transverse movement. It can be traced from the Toomba Range in the Hay River Sheet area, and through the Mount Whelan area to the south-east into the Bedourie Sheet area (Reynolds, Olgers & Jauncey, 1961). The Middle Cambrian to Devonian succession in the western part of the Toko trough was up-turned and overturned against the fault, and an asymmetrical structure with steep western limb and low-dipping eastern limb, the Toko Syncline, was formed. Quartz veins, parallel to the main fault line, have been intruded into Precambrian and Palaeozoic rocks during the orogeny, and some silicification of sediments may have occurred at the same time.

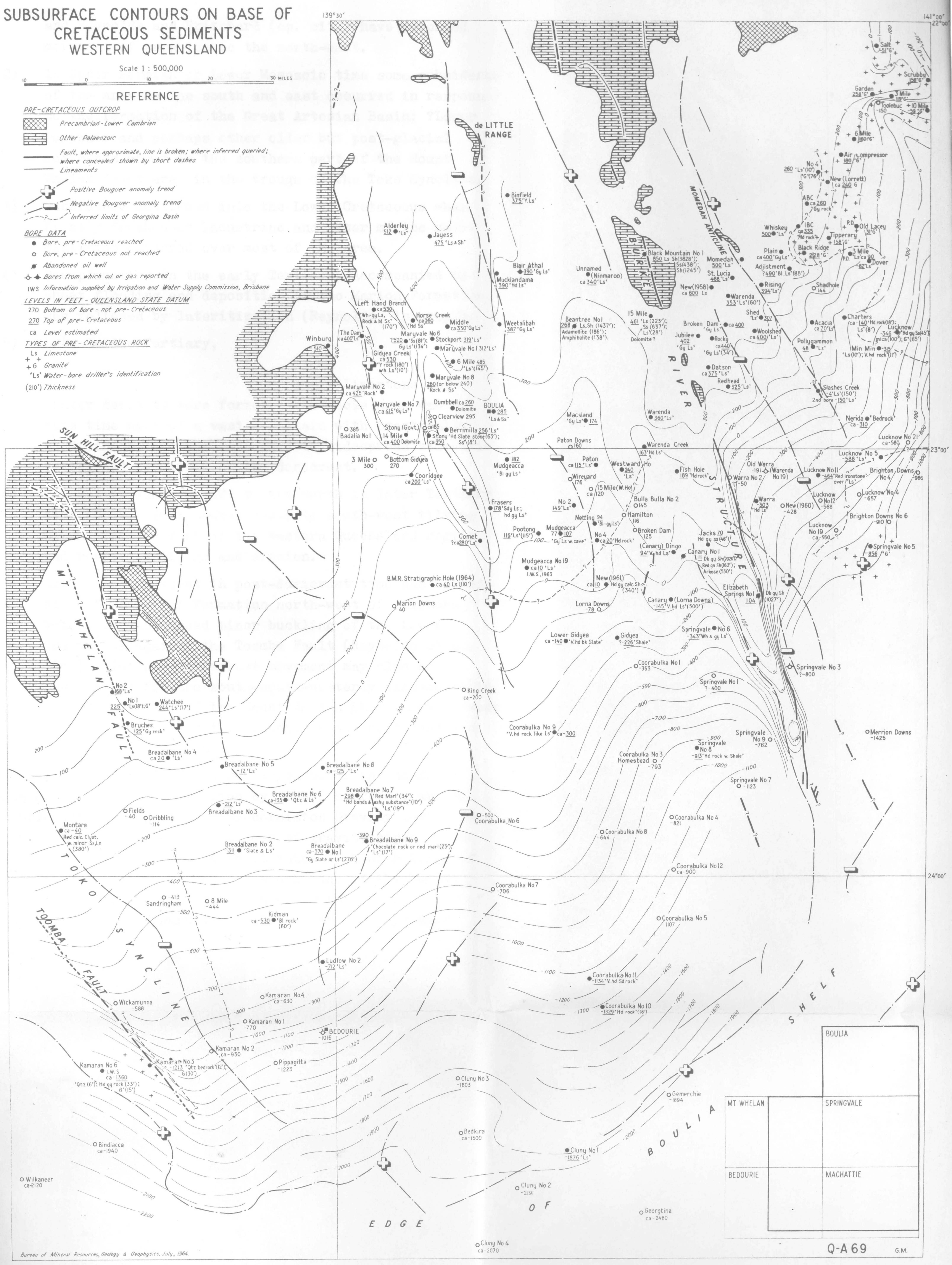
The force of the thrust movement was not as strong to the east of the Toomba Fault, but minor buckling and faulting have occurred. One folded structure in the north-western corner of the Mount Whelan Sheet area appears to be a north-west plunging anticline continuing into the Glenormiston area, and is called the Netting Fence Anticline (Figure 3). It has been disrupted by cross-faulting and the discontinuous anti-clinal axes, as shown in the figure, are mostly conjectural. The only possible closure occurs in the north-western segment of the structure where a small inlier of Carlo Sandstone protrudes through the Mithaka Formation; the closure is shown by the seismic survey of Austral Geoprospectors (P.P.C., 1961) in ?Cambrian and ?Ordovician horizons but with north-easterly axes in contrast to the north-westerly axis suggested by out-crop and airphoto interpretation.

Two small surface faults to the east of the Toomba Fault, and which may be of regional significance, are the Sun Hill Fault and Mount Whelan Fault (Figure 4). The Sun Hill Fault follows the south-easterly trend of the strong Pituri Creek lineament in the Glenormiston Sheet area to the north. Any extension to the south-east from Sun Hill is concealed by Cainozoic and Mesozoic sediments. The other fault is exposed at Mount Whelan and is inferred from subsurface contours drawn on the base of Cretaceous rocks (prepared mainly from water bore drillers' logs); it parallels a line of positive Bouguer anomalies.

The ? Carboniferous orogeny was the last major tectonic event in the region. Subsequent events in the structural and geological history of the Mount Whelan Sheet area may be summarised as follows:-

(1) The area was little changed in the late Palaeozoic; effects of early Permian glaciation have been noted

Fig. 4



SUBSURFACE CONTOURS ON BASE OF CRETACEOUS SEDIMENTS
WESTERN QUEENSLAND
Scale 1 : 500,000
10 0 10 20 30 MILES
REFERENCE
PRE-CRETACEOUS OUTCROP
Precambrian-Lower Cambrian
Other Palaeozoic
Fault, where approximate, line is broken; where inferred queried; where concealed shown by short dashes
Lineaments
Positive Bouguer anomaly trend
Negative Bouguer anomaly trend
Inferred limits of Georgina Basin
BORE DATA
Bore, pre-Cretaceous reached
Bore, pre-Cretaceous not reached
Abandoned oil well
Bores from which oil or gas reported
IWS Information supplied by Irrigation and Water Supply Commission, Brisbane
LEVELS IN FEET - QUEENSLAND STATE DATUM
270 Bottom of bore - not pre-Cretaceous
270 Top of pre-Cretaceous
ca Level estimated
TYPES OF PRE-CRETACEOUS ROCK
Ls Limestone
G Granite
'Ls' Water-bore driller's identification
(210') Thickness
139°30'
141°00'
22°00'
23°00'
24°00'
de LITTLE RANGE
SUN HILL FAULT
MT WHELAN FAULT
TOKO SYNCLINE
TOOMBA FAULT
BURKE RIVER STRUCTURE
MOMEDAH ANTICLINE
BOULIA SHELF
EDGE OF
BOULIA
Binfield
Alderley
Jayess
Blair Athal
Mucklandama
Left Hand Branch
Horse Creek
Middle
Weetalibah
Winburg
The Dam
Maryvale No 6
Stockport
Gidyea Creek
Maryvale No 1
6 Mile
Maryvale No 8
Maryvale No 2
Maryvale No 7
Dumbbell
Clearview 295
Stony (Govt)
Badalia No 1
14 Mile
Berrimilla
3 Mile
Bottom Gidyea
Cooridgee
Mudgeacca
Frasers
Comet
Pootong
Mudgeacca No 19
B.M.R. Stratigraphic Hole (1964)
Marion Downs
Macsland
Paton Downs
Paton
Wireyard
Westward Ho
15 Mile (W.Ho)
No 2
Netting
Hamilton
Bulla Bulla No 2
Broken Dam
Mudgeacca No 4
New (1961)
Lorna Downs
Lower Gidyea
Gidyea
Unnamed (Ninmaroo)
Beantree No 1
15 Mile
Black Mountain No 1
Momedah
St. Lucia
New (1958)
Warenda
Jubilee
Broken Dam
Rocky
Shed
Woolshed
Datson
Redhead
Warenda
Warenda Creek
Fish Hole
Jacks
(Canary) Dingo
Canary No 1
Canary (Lorna Downs)
Elizabeth Springs No 1
Springvale No 6
Coorabulka No 1
Springvale No 1
Springvale No 3
Old Warra
Warra No 2
Warra
New (1960)
Lucknow No 11
Lucknow No 12
Lucknow
Lucknow No 19
Lucknow No 4
Lucknow No 5
Lucknow No 21
Brighton Downs No 4
Brighton Downs No 6
Springvale No 5
Nerida
Slashes Creek
Charters
Acacia
Pollygammon
Min Min
Shadhole
Rising
Adjustment
Plain
Black Ridge
Whiskey
IBC
Tipperary
Old Lacey
3 Mile
Dover
ABC
New (Lorrett)
No 4
Air Compressor
6 Mile
Garden
Toolebuc
10 Mile
3 Mile
Scrubby
Salt
King Creek
Coorabulka No 9
Coorabulka No 3 Homestead
Springvale No 8
Springvale No 9
Springvale No 7
Merrion Downs
No 2
No 1
Watchee
Bruches
Breadalbane No 4
Breadalbane No 5
Breadalbane No 8
Breadalbane No 6
Breadalbane No 7
Breadalbane No 3
Fields
Dribbling
Montara
Breadalbane No 2
Breadalbane No 1
Breadalbane No 9
Coorabulka No 6
Coorabulka No 4
Coorabulka No 8
Coorabulka No 12
Coorabulka No 7
Coorabulka No 5
Sandringham
8 Mile
Kidman
Ludlow No 2
Coorabulka No 11
Coorabulka No 10
Wickamunna
Kamaran No 4
Kamaran No 1
BEDOURIE
Kamaran No 2
Kamaran No 6
Kamaran No 3
Pippagitta
Cluny No 3
Gemerchie
Bedkira
Bindiacca
Cluny No 1
Wilkaneer
Cluny No 2
Georgtina
Cluny No 4
MT WHELAN
SPRINGVALE
BEDOURIE
MACHATTIE
Q-A 69
G.M.
Bureau of Mineral Resources, Geology & Geophysics. July, 1964.

and Reynolds and Pritchard (op. cit.) have recorded movement of erratics to the north-east.

(2) In Upper Permian or Lower Mesozoic time some subsidence of the area to the south and east occurred in response to the formation of the Great Artesian Basin; ?Lower Jurassic and perhaps other older but post-glacial sediments occur in the southern part of the Mount Whelan Sheet area in the trough of the Toko Syncline.

(3) Subsidence continued into the Lower Cretaceous when firstly freshwater lacustrine and later marine sedimentation occurred over most of the area.

(4) Peneplanation in the early Tertiary, accompanied by sheet flooding and deposition of the Marion Formation, was followed by lateritization (Reynolds, in prep.).

(5) Late in the Tertiary,

small limestone and sinter deposits were formed. The whole area was by this time part of a vast peneplain with practically no drainage, and was subjected to widespread silicification and formation of the duricrust.

(6) The Selwyn Range Uplift to the north in later Tertiary time (Öpik, 1961) caused south to south-west tilting which affected most of the western Queensland region and revived drainage and erosion.

(7) Some minor movement in post-duricrust time has folded silicified Marion Formation north-west of Pulchera Waterhole and caused minor buckling of the Lower Cretaceous against the Toomba Fault (Reynolds et al, 1961). The post-duricrust movement may also be responsible for the south-south-westerly lineaments in the eastern part of the Mount Whelan Sheet area between Mount Coley and Mount La Touche in the north and The Sisters in the south.

Two other gravity features which occur in the Mount Whelan area, and have been named by Gibb (in prep.), are the 'Bedourie Gravity Ridge' and 'Glenormiston Gravity Low'. The 'Bedourie Gravity Ridge' is a series of gravity highs on the south-west side of the Toomba Fault which link with highs of similar Bouguer values around the south edge of the Boulia Shelf (Figure 4). A prominent high along this ridge (west of the area covered by Figure 4) coincides with the presumed

Archaean rock inlier in the Simpson Desert. The 'Glenormiston Gravity Low' extends from Smoky Creek in the north of the Glenormiston Sheet area into the north-eastern corner of the Mount Whelan area. It may mark an area of lower Palaeozoic rocks preserved east of the stable block formed by the Sun Hill Arkose-Sylvester Sandstone rocks, either in a graben or a southerly embayment of the Georgina Basin.

ECONOMIC GEOLOGY

Underground Water

Useful to good supplies of potable water and water suitable for stock may be obtained from boring in many parts of the Mount Whelan Sheet area. The best supplies are from the Lower Cretaceous Longsight Sandstone, the main aquifer of the Great Artesian Basin in this region. However, good supplies have been obtained and could be expected from older sandstones in the limbs of the Toko Syncline: Fairview Bore at the south end of the Toko Range, and Toomba Bore in the Toomba Range in the Hay River Sheet area (Smith, 1963) are examples of successful bores in this category. Wells and bores in the eastern edge of the Simpson Desert on Carlo, Ethabuka and Sandringham holdings have shown that useful water may also be obtained from Cainozoic sediments.

Although the most useful supplies are from the Longsight Sandstone, they are not always dependable. Where the unit pinches out against or thins over Lower Palaeozoic to Precambrian basement, such as below Breadalbane Station at the south end of the Sun Hill Arkose-Sylvester Sandstone horst, or at Mirrica Springs against the Toomba Fault, very salty water unsuitable for stock (or only useful as emergency supplies) is obtained. Elsewhere near basement highs, the quality of the water may be satisfactory, but water level or the hydrostatic pressure may be too low to give sufficient supplies.

It is difficult to obtain good water in the northern belt of carbonate rocks. Dolomite or limestone with dolomite and/or sandstone interbeds (Twenty Mile Bore), may yield good supplies of water, but some may be hard, or contain too much magnesium sulphate and cause scouring. Limestone rocks mainly yield salt water.

Surface Water

The only permanent supply of good water occurs at Paravituari Waterhole in the Georgina River. Good supplies are also held for several months by other waterholes in the main streams after they have flowed, (Pulchera Waterhole on the

Mulligan, Duck Hole on Sylvester Creek, etc.). Soaks occur along some of the Georgina channels and other streams in the area but are not reliable sources either in quality or quantity. Most spring supplies have dried up, but stock still use the water at Carlo Springs (and at Mirrica Springs when other supplies are unavailable). The source of most spring supplies is the Longsight Sandstone, and increased drainage of this source by artesian water bores has depleted the spring supplies.

Earth dams and tanks hold useful supplies of water for limited periods after rain; the gypsiferous and salty nature of unweathered Lower Cretaceous mudstones used in these constructions generally causes fairly rapid deterioration in the quality of the water.

Minerals

Small quantities of lead occur in quartz veins in the Sun Hill Arkose between Watchie Hut and Rocky Yard. X-ray spectrographic analysis No.147 by the B.M.R. Laboratory showed traces of bismuth, copper and ?chromium. Some silver was also detected by assays.

Superficial deposits of gypsum are available in the area around Pulchera Waterhole but transport costs would make mining uneconomical; thickness observed in outcrop was about 5 feet, but greater thicknesses may be present in the area.

Dunstan (1920) refers to brown coal up to six feet thick in bores on Sandringham Station; the beds are probably of only local extent and they contain a lot of pyrites.

Pellet beds in the Mithaka Formation have been shown by analysis to be phosphatic; up to 13% was recorded from samples taken in the Toko Range, just north of the Mount Whelan Sheet area, (see Appendix I).

Petroleum prospects

The best prospects for petroleum accumulation in the Mount Whelan Sheet area are confined to the Toko Syncline. The sedimentary rock sequence is thick (at least 11,000 feet in the Pulchera Waterhole section, Robertson, op. cit.) and contains possible source, reservoir and cap rocks. Oil traces have been reported from the Georgina Limestone in Glenormiston No.4 bore and a strong kerosene smell was reported from the same unit in Tyson's No.2 bore (though to be near Tyson's No.1).

Suitable structures which would allow oil accumulation include overthrust (reverse) faults and minor folding shown by the B.M.R. Seismic survey (Robertson 1964). Some stratigraphic traps may occur in the limbs of the Syncline.

REFERENCES

BARLOW, B.C., in prep - Georgina Basin reconnaissance gravity surveys using helicopters, Northern Territory and Queensland 1960-61. Bur. Min.Resour.Aust.Rec., (unpubl.).

CASEY, J.N., 1959 - New names in Queensland stratigraphy. North-west Queensland. Aust.Oil Gas J., 5(12), 31-36.

CASEY, J.N., REYNOLDS, M.A., DOW, D.B., PRITCHARD, P.W., VINE, R.R., and PATEN, R.J., 1960 - The geology of the Boulia area, western Queensland. Bur.Min.Resour.Aust. Rec. 1960/12 (unpubl.).

C.G.G., 1964 - Geophysical report on Pedirka-Annandale seismic survey, for French Petroleum Company (Aust.) Pty Ltd, by Compagnie Generale de Geophysique (unpubl.).

C.P.C., 1963 - Conorada Ooroonoo No.1, Queensland of Conorada Petroleum Corporation. Bur. Min.Resour.Aust. Petrol.Search Subs. Acts Publ. 23.

CRESPIN, I., 1960 - Micropalaeontology of samples of sediments from the Great Artesian Basin Queensland. Bur.Min.Resour.Aust.Rec. 1960/25 (unpubl.).

CRESPIN, I., 1961 - Micropalaeontology of further rock samples from the Great Artesian Basin, Queensland. Ibid., 1961/35 (unpubl.).

CRESPIN, I., 1963 - Lower Cretaceous arenaceous Foraminifera of Australia. Bur.Min.Resour.Aust. Bull. 66.

DICKINS, J.M., 1960 - Cretaceous marine macrofossils from the Great Artesian Basin in Queensland. Bur.Min.Resour.Aust.Rec. 1960/69 (unpubl.).

DUNSTAN, B., 1920 - North-western Queensland. Geological notes on the Cloncurry-Camooweal-Burketown-Boulia area. Geol.Surv.Qld. Publ. 265.

GIBB, R.A., in prep. - Reconnaissance gravity surveys 1957-61, Western Queensland. Bur.Min.Resour.Aust. Rec. (unpubl.).

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

JACK, R.L., 1895 - Stratigraphical notes on the Georgina Basin, with reference to the question of artesian water. Proc.Roy.Soc.Qld, 11(1), 70-74.

JACK, R.L., and ETHERIDGE, R., 1892 - Geology and palaeontology of Queensland and New Guinea. Geol.Surv. Qld Publ. 92, 2 vols.

JEWELL, F., 1960 - Great Artesian Basin, Aeromagnetic reconnaissance survey 1958. Bur.Min. Resour.Aust.Rec. 1960/14 (unpubl.).

LAING, A.C.M., 1960 - Geology and oil prospects of Boulia, Authority to Prospect 54P. Mines Administration Pty Ltd Rep. Q/54P/76, Confidential (unpubl.).

LESLIE, R.B., 1959 - The geology of the southern Georgina area, Queensland - Northern Territory. Frome-Broken Hill Pty Ltd Rep. 4400-G-13 (unpubl.).

MADIGAN, C.T., 1938 - The Simpson Desert and its borders. Proc.Roy.Soc. N.S.W., 71, 503-535.

MADIGAN, C.T., 1945 - Simpson Desert Expedition 1939. Scientific reports. Trans.Roy.Soc.S. Aust., 69(1), 118-139.

MULDER, C.J., 1961 - Geology of the Georgina Basin (North-western Queensland and Northern Territory, Australia). Bataafse Internationale Petroleum Maatschappij N.V. - The Hague, Exploration and Production, April, 1961 (unpubl.).

ÖPIK, A.A., 1956 - Cambrian geology of Queensland; in El Sistema Cambrico, su Paleogeografia y el Problema de su Base. 20th Int.geol. Congr., Mexico, 2, 1-24. Reprinted in the Cambrian Geology of Australia. Bur. Min.Resour.Aust. Bull. 49, 1957.

ÖPIK, A.A., 1956 - Cambrian palaeogeography of Australia. Ibid., 239-284.

ÖPIK, A.A., 1957 - Cambrian succession in Queensland, south of the 22nd Parallel (Preliminary Report, Revised Edition). Bur.Min. Resour.Aust.Rec. 1957/95 (unpubl.).

ÖPIK, A.A., 1959 - Correlation chart of Cambrian and Ordovician in Australia. Ibid. 1959/52 (unpubl.).

ÖPIK, A.A., 1961 - The geology and palaeontology of the headwaters of the Burke River, Queensland. Bur.Min.Resour.Aust.Bull.53.

ÖPIK, A.A., 1963 - Early Upper Cambrian fossils from Queensland. Ibid. 64.

PATEN, R.J., 1964 - Tertiary geology of the Boulia region, western Queensland. Bur.Min.Resour.Aust. Rep. 77.

P.P.C., 1961 - Seismic survey report. Authority to Prospect 54P. (Boulia-Springvale-Marion Downs and Glenormiston areas Queensland), by Austral Geo-Prospectors Pty Ltd for Phillips Petroleum Co., and Sunray Mid-Continent Oil Co. (unpubl.).

REYNOLDS, M.A. in prep. - Some observations on lateritization and silicification in western Queensland. (unpubl.).

REYNOLDS, M.A., OLGERS, F., and JAUNCEY, W., 1961 - Geology of the Bedourie, Machattie, Birdsville, Betoota 4-mile Sheet areas in western Queensland. Bur.Min.Resour.Aust.Rec. 1961/54 (unpubl.).

REYNOLDS, M.A., and PRITCHARD, P.W., 1964 - The geology of the Glenormiston 1:250,000 Sheet area. Ibid. 1964/28 (unpubl.).

ROBERTSON, C.S., 1964 - South-eastern Georgina Basin seismic survey, Qld 1963. Bur.Min.Resour.Aust. geoph. Progress Rep. 1964/2 (unpubl.).

RYAN, J.C., 1961 - Innamincka No.1 Well, South Australia of Delhi-Frome-Santos. Bur.Min.Resour. Aust.Petrol. Search Subs.Acts Publ. 9.

SMITH, K.G., 1963 - Explanatory notes on the Hay River geological sheet. Bur.Min.Resour.Aust. explan. Notes SF53-16.

SMITH, K.G., 1964 - Progress report on the geology of the Huckitta Four-Mile Sheet, Northern Territory. Bur.Min.Resour.Aust.Rep. 67.

SMITH, K.G., in prep. - Explanatory notes on the Tobermory geological sheet. Bur.Min.Resour.Aust. explan. Notes SF53-12.

SMITH, K.G., and VINE, R.R., 1960 - Summary of the geology of the Tobermory 4-mile geological sheet. Bur.Min.Resour.Aust.Rec. 1960/71 (unpubl.).

SMITH, K.G., VINE, R.R., and MILLIGAN, E.N., 1961 - Revision to stratigraphy of Hay River, Huckitta and Tobermory 4-mile Sheets, Northern Territory. Ibid. 1961/65 (unpubl.).

SPRIGG, R.C., 1963 - Geology and petroleum prospects of the Simpson Desert. Trans.Roy.Soc.S. Aust., 86, 35-65.

STARKEY, L.J., 1960 - Report on gravity survey in Authority to Prospect 54P Queensland. Mines Administration Pty Ltd Rep. Q/54P/77, Confidential (unpubl.).

TAYLOR, D.J., 1959 - Report on the examination of fossils collected in the Georgina Basin 1958. Frome-Broken Hill Pty Ltd Rep. 4400-G-12. (unpubl.).

WHITEHOUSE, F.W., 1930 - The geology of Queensland in Handbook for Queensland. Aust.Ass.Adv.Sci., 23-29.

WHITEHOUSE, F.W., 1931 - Report of the Palaeontologist. Ann. Rep.Dep.Min.Qld, 1930, 141-142.

WHITEHOUSE, F.W., 1936 - The Cambrian faunas of north-eastern Australia. Mem. Qld Mus., 11, 59-112.

WHITEHOUSE, F.W., 1940 - Studies in the late geological history of Queensland. Pap.Univ.Qld Dep. Geol., 2(N.S.) (1).

WHITEHOUSE, F.W., 1954 - The geology of the Queensland portion of the Great Australian Artesian Basin. Appendix G in Artesian Water supplies in Queensland. Dep.Co-ord.Gen. Public Works, Qld parl.Pap. A, 1955.

APPENDIX I.

Phosphate analysis of samples from the Glenormiston Sheet area, Queensland.

by

S.C. Goadby

Report No.10 1/9/64

1. Four samples from Oodatra Point, south-western corner of Glenormiston Sheet area. Collected by J.N. Casey from the Nora Formation.

Sample No.	% P_2O_5
1	0.3
2	0.5
3	0.3
4	0.8

2. Three samples from two miles west of G273 locality, Toko Range. Collected by J.N. Casey from Mithaka Formation.

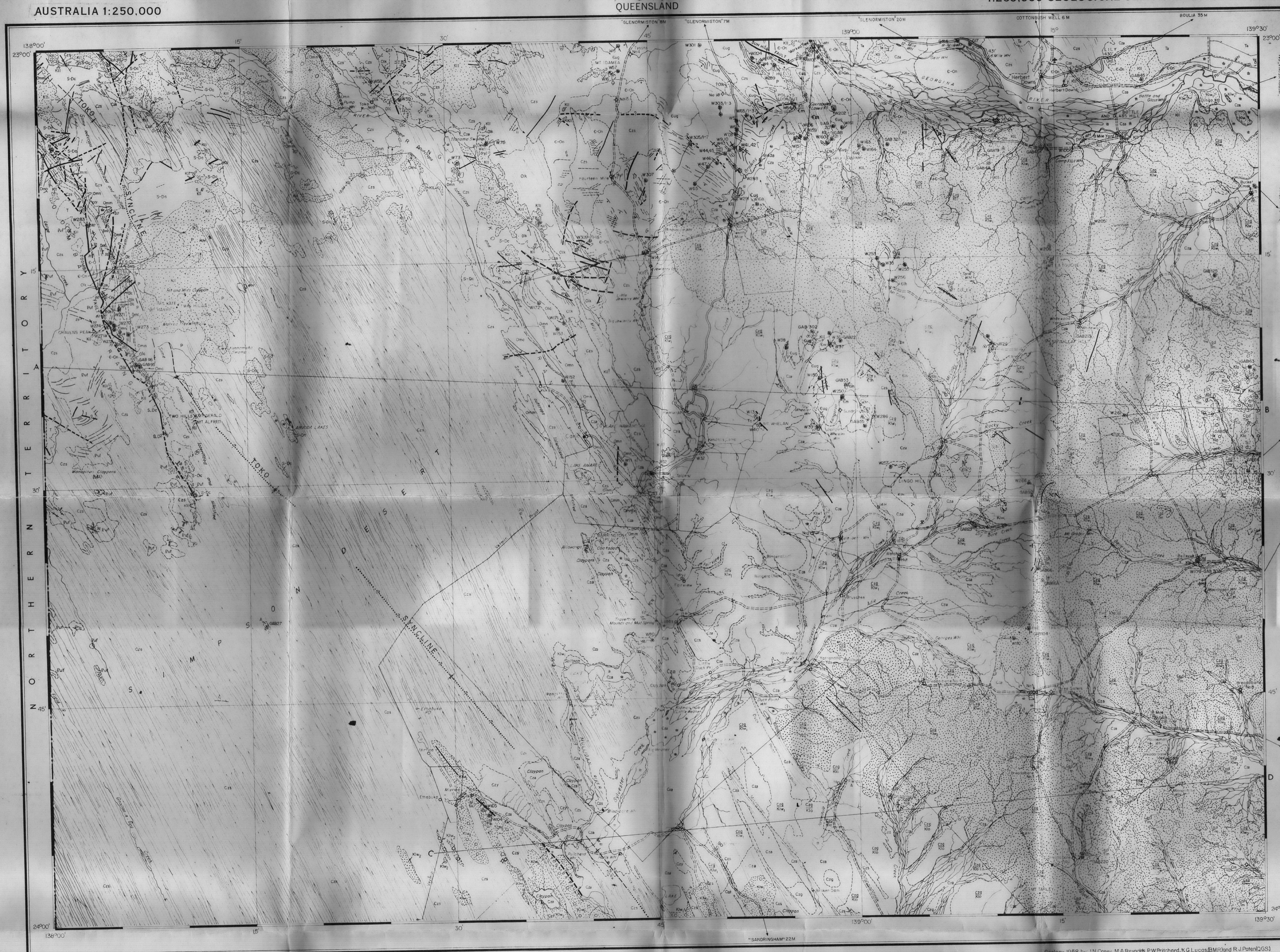
Sample No.	% P_2O_5
1	10.6
2	4.4
3	12.7

PRELIMINARY EDITION, 1964
SUBJECT TO AMENDMENT

AUSTRALIA 1:250,000

MOUNT WHELAN
QUEENSLAND

1:250,000 GEOLOGICAL SERIES SHEET SF 54-13



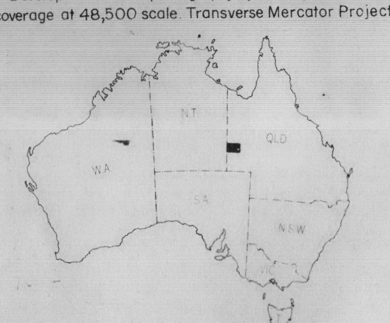
Reference

CAINOZOIC	UNDIFFERENTIATED		Cza	Soil, alluvium
			Czs	Sand
			Czy	Gypsiferous deposits
			Czg	Gibbers — duricrust gravel
			Czd	Duricrust — mainly silcrete
				Ironstone gravel; Leached and ferruginized (? lateritized) rock
	TERTIARY		T	Limestone, chalcedony
		Austral Downs Limestone	Ta	Limestone, chalcedony
		Mt. Coley Sinter	Tc	Chalcedony, sinter, sandstone
		Marion Formation	Tm	Silicified sandstone, sandy siltstone
MESOZOIC	LOWER CRETACEOUS	Wilgunya Formation	Klw_2	Upper beds: mudstone with calcareous lenses
		Wilgunya Formation: Toolebuc Member	Klo	Fossiliferous limestone, ferruginized in part
		Wilgunya Formation	Klw_1	Lower beds: mudstone with sandy bands
		Longsight Sandstone	Kll	Poorly sorted sandstone, conglomerate
	?LOWER JURASSIC		Jl	Red claystone, marl and sandstone (section only)
PALAEOZOIC	? PERMIAN		P	Unconsolidated pebble beds, pebbly sandstone
	UPPER SILURIAN TO LOWER DEVONIAN	Craven's Peak Beds	S-Dc	Sandstone with clay pellets, conglomerate
	ORDOVICIAN	Toko Group: Mithaka Formation	Omm	Gypsiferous siltstone and sandstone
		Toko Group: Carlo Sandstone	Omc	Thick-bedded sandstone with clay pellets
		Toko Group: Nora Formation	Omn	Siltstone, fine sandstone, coquinite
		Toko Group: Coolibah Formation	Olc	Calcilutite, marl, calcarenite, chert
		Kelly Creek Formation	Olk	Thin-bedded sandstone and dolomite, chert
	CAMBRIAN TO ORDOVICIAN	Undifferentiated	€-O	Calcilutite, calcarenite, dolomite, sandstone
		Ninmaroo Formation	€-On	Calcilutite, calcarenite and dolarenite with algae, sandstone
	CAMBRIAN — UPPER	Georgina Limestone	€ug	Flaggy calcilutite and sandy calcilutite with chert, sandstone
	CAMBRIAN — MIDDLE		€m	Laminated sandy calcilutite
	CAMBRIAN — LOWER	Sylvester Sandstone	€ls	Silicified sandstone, green siltstone
		Sun Hill Arkose	€lh	Arkose, arkosic sandstone, conglomerate, siltstone, dolomite
PRECAMBRIAN	UPPER PROTEROZOIC	Field River Beds	Puf	Boulder beds, green siltstone with tillitic texture, arkose, dolomite, siltstone, sandstone
	ARCHAEAN		A	Granite, schist, pegmatite

- Geological boundary
- Anticline, showing plunge
- Syncline
- Fault, showing relative horizontal movement
- Lineament
- Where location of boundaries, folds and faults is approximate, line is broken; where inferred queried; where concealed, boundaries and folds are dotted, faults are shown by short dashes
- Strike and dip of strata
- Vertical strata
- Horizontal strata
- Overturned strata
- Dip < 15° (air-photo interpretation)
- Dip 15° — 45° (air-photo interpretation)
- Dip > 45° (air-photo interpretation)
- Trend lines (air-photo interpretation)
- Joint pattern (air-photo interpretation)
- Macrofossil locality
- Microfossil locality
- Plant fossil locality
- Fossil wood
- xW36 Text reference to specimen locality
- Sections with fossil collections
- Quartz vein
- Mine
- Spring
- Bore with windpump
- Abandoned bore
- Well
- Tank
- Dam on stream
- Waterhole
- Swamp
- Sand dunes
- PD Position doubtful
- Road
- Vehicle track
- Fence
- "Carlo" Homestead
- Landing ground
- Astronomical station
- 430 Height in feet, instrument levelled; datum: mean sea level

Compiled and issued by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development, in conjunction with the Geological Survey of Queensland. Slotted template control supplied by the Division of National Mapping, Department of National Development. Aerial photography by the Royal Australian Air Force; complete vertical coverage at 48,500 scale. Transverse Mercator Projection

Geology, 1958, by: J.N. Casey, M.A. Reynolds, P.W. Pritchard, K.G. Lucas (B.M.R.) and R.J. Paten (Q.G.S.)
1960, by: M.A. Reynolds, F. Olgers and W. Jauncey (B.M.R.)
Compiled, 1963, by: M.A. Reynolds
Drawn by R.J. Molloy and J. Pasman



INDEX TO ADJOINING SHEETS
Showing Magnetic Declination

ELKEDRA SF 53-7	SANDOVER RIVER SF 53-8	URANDANGI SF 54-5	DUCHESS SF 54-6	McKINLAY SF 54-7
HUCKITTA SF 53-11	TOBERMORY SF 53-12	GLENORMISTON SF 54-9	BOULIA SF 54-10	MACKUNDA SF 54-11
ILLOGWA CREEK SF 53-15	HAY RIVER SF 53-16	MOUNT WHELAN SF 54-13	SPRINGVALE SF 54-14	BRIGHTON DOWNS SF 54-15
HALE RIVER SG 53-3	SIMPSON DESERT NORTH SG 53-4	BEDOURIE SG 54-1	MACHATTIE SG 54-2	CONNEMARA SG 54-3
MC DILLS SG 53-7	SIMPSON DESERT SOUTH SG 53-8	BIRDSVILLE SG 54-5	BETOOTA SG 54-6	CANTERBURY SG 54-7

5°E; 5°30'E; 6°E; 6°30'E; 7°E

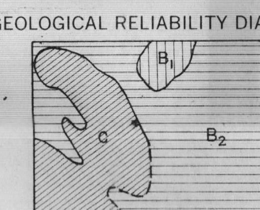
ANNUAL CHANGE 1'45"E

Scale 1 : 250,000

5 0 5 10 15 MILES

5 0 5 10 15 20 25 KILOMETRES

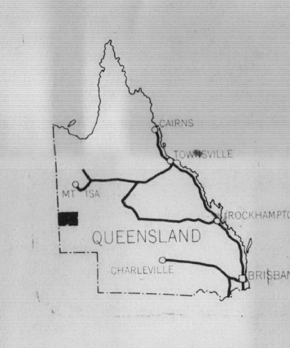
GEOLOGICAL RELIABILITY DIAGRAM



B_1 Detailed reconnaissance-numerous traverses and air-photo interpretation

B_2 General reconnaissance-traverses and air-photo interpretation

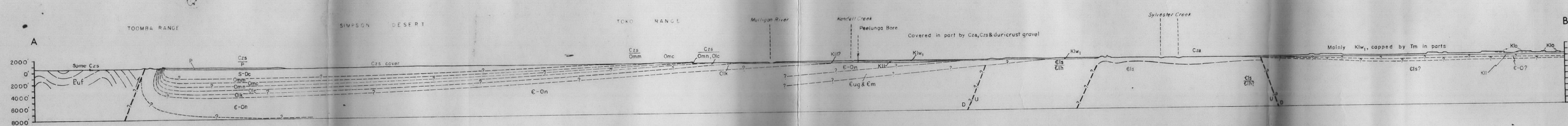
C Air-photo interpretation

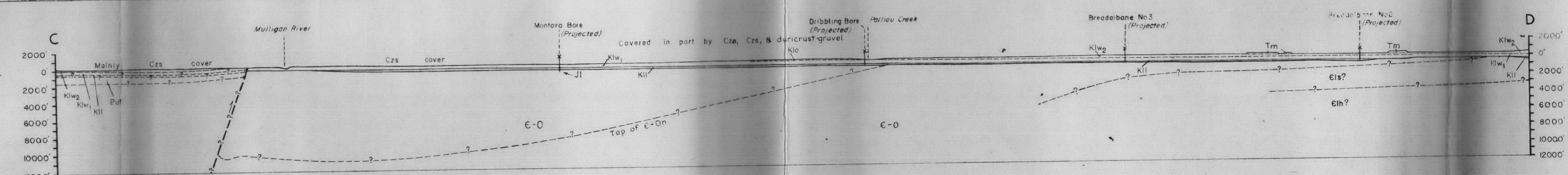


Sections

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

(Cainozoic sediments shown by letter symbols only)





MOUNT WHELAN
SHEET SF 54-13