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EXPLANATORY NOTES

GLENBURGH, W.A.

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COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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Compiled by M. A. Condon

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DEPARTMENT OF NATIONAL DEVELOPMENT

Minister: SENATOR THE HON. W. H. SPOONER, M.M.
Secretary: H. G. RAGGATT, C.B.E.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS.

Director: J. M. RAYNER.

These notes were prepared in the Geological Branch.
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Explanatory Notes on the Glenburgh Geological Sheet

Compiled by M. A. Condon

The Glenburgh Sheet lies between latitudes 25° and 26°S, and longitudes 115°30' and 117°E.

Unpublished data from original field work by the compiler are included in these notes.

Geological Investigations

A. Gibb Maitland carried out a reconnaissance survey of the country between Northampton and Peak Hill in 1897. The results were reported briefly in 1898 and in more detail in 1909. Brief references were made in other publications (1907, 1912; and Maitland & Montgomery, 1924). The limestone at Wyndham River (Callytharra Formation) was described and some of its fossils listed; a boulder bed of glacial origin in the Wyndham River and Wooramel River was named 'Lyons Conglomerate' and the Precambrian rocks between Coordewandy and K-32 were described.

Woolnough (1928) examined the Wooramel River area and recommended further investigation. Talbot carried out a rapid geological survey in 1928 and reported this in 1929. Feldtmann (1930) reported on a joint visit with Woolnough and Talbot. Hobson (1936) surveyed 'Talbot's Dome'.

Hossfeld (1931) after a joint visit with Talbot and Hobson recommended a semi-detailed investigation. In 1932 Dee and Rudd carried out a survey for Oil Search Ltd. This work was reported by Condit (1935) and Condit, Raggatt, & Rudd (1936). Raggatt (1936) described the sequence in the Wyndham River area.

Waterford, about 1937, carried out a reconnaissance survey between Byro Plains and Mount Sandiman. His collection of fossils was reported by Crespin (1937).

McWhae, Parry, & Stanley (1954) did a reconnaissance survey of the area surrounding the Carrandibby Range.

Konecki, Condon, Dickins, & Quinlan defined new rock units in the Wooramel River area in McWhae et al. (1958). Konecki, Dickins, & Quinlan (1958) described the geology of the Sheet as part of a larger area.

Fossils from the Lyons Group in the Sheet area have not been described. Dickins (1957) described molluscs from, and Dickins & Thomas (1960) listed the fauna of, the Carrandibby Formation (incorrectly included by them in the Lyons Group). Bretnall (1926) described bryozoa from Daurie Creek, and Fossil Hill. Glauert (1926) listed fossils from Byro Station. Etheridge (1903), Hosking

(1931, 1932, 1933), Prendergast (1943), Coleman (1957), and Crespin (1958) have described fossils from the Callytharra Formation. Glauert (1910) listed fossils from the 'Carboniferous' of Wooramel River. Hosking (1931), Prendergast (1943), Coleman (1957), and Crespin (1958) have described fossils from the Byro Group of the Sheet area.

The age of the Permian formations has been discussed by Raggatt & Fletcher (1937), Teichert (1951, 1952), Thomas & Dickins (1954), Konecki, Dickins, & Quinlan (1958), and Dickins & Thomas (1960).

Thyer (1951) and Chamberlain, Dooley, & Vale (1954) reported the Burueau of Mineral Resources geophysical work in the Carnarvon Basin; this included a reconnaissance gravity survey of the western part of the Glenburgh Sheet.

Geologists of the Bureau mapped the Glenburgh Sheet in 1953 and 1955 (Konecki, Dickins, & Quinlan, 1958). Condon did some additional mapping in 1959.

The Bureau has completed an aeromagnetic survey over the northern part of the Sheet area : total magnetic intensity contour maps have been prepared but no report has been produced.

The Bureau carried out stratigraphic drilling at Mount Madeline and Daurie Creek (Mercer, 1959).

PHYSIOGRAPHY

The area consists of three main physiographic divisions : the eastern area of undulating lateritic plateau up to about 1,700 feet above sea level; a central strongly dissected area; and the western area generally of low relief over the sedimentary rocks, but including the strongly dissected Carrandibby Range.

The area is drained by the Wooramel River and the Gascoyne River; the drainage divide between them runs east-west near the middle of the Sheet. The Murchison River drains the south-eastern corner of the Sheet.

STRATIGRAPHY

(Tables 1 & 2)

PRECAMBRIAN

No detailed work has been done on the Precambrian rocks of the area. The distribution of rock types shown on the map results from photo-interpretation based on a few traverses by Bureau geologists and on the reconnaissance of Johnson (1950).

Precambrian rocks crop out in a central north-south belt and in the Carrandibby Range; they probably form the floor of the Palaeozoic sedimentary basin. Crystalline schists cover the greater part of the outcrop area : quartz schist, biotite schist, quartz-feldspar-biotite schist (or micro-gneiss), amphibolite schist, tremolite schist, and sericite schist are among the types represented. Discordant granite crops out north-west and south-east of Erong Homestead. Dykes of basic igneous rock and of quartz are numerous.

Johnson (1950, p. 5) divides the Precambrian of the eastern Glenburgh Sheet into Talbot Gneiss, sedimentary series, and granite. The 'sedimentary

TABLE 1.

ROCK UNITS, GLENBURGH SHEET

Age	Group	Formation and Map Symbol.	Lithology	Fossils	Thickness (feet)	Structure	Topography	Economic Geology (u–undeveloped; ?–not proved).	Principal References.
Recent		Alluvium (Qra)	Sand, silt, clay, gravel.		to 20	Lenticular	Flats in valley floor	Shallow ground water.	Konecki, Dickins & Quinlan, 1959.
		Wash (Qrw)	Sand, gravel		to 5	Sheet ..	Plain		
		Sand (Qrs)	Brown sand		to 10	Residual ..	Hummocky plain		
		Scree (Qrb)	Gravel, rubble, clay ..		to 20	Scarp slopes and base			
Pleistocene		Joolabroo Fm. (Qpj)	Sand, silt, gravel ..		10–50	Lenticular	Terraces in valleys	Shallow ground water (u) ..	Condon, 1954.
		Sand (Qps)	Red aeolian sand ..		to 50		Seif and braided dunes ..		
		Nadarra Fm. (Qpn)	White chalcedonic limestone, sandstone with detrital laterite ..		10–30	Lenticular	Mesa or stream rock-bar ..	Road aggregate (u)	Condon, 1958. Konecki et al.,1958,p.57
Upper Tertiary		Lateritic soil (Tus)	Red, loamy soil ..		to 10	Sheet ..	Gently undulating		
		Billy (Tub)	Hard grey siliceous billy		to 6	Sheet ..	Mesa cap ..		Condon, 1954 p.133.
		Laterite (Tul)	Pisolitic ironstone and leached rock		10–200	Irregular sheet ..	Gently undulating, strongly dissected	Shallow grond water (u) ..	Condon, 1954 p.131
Eocene		Pindilya Fm. (Tep)	Quartz greywacke, siltstone, conglomerate	Corals, bryozoa	10–90	Irregular sheet ..	Plain; scarp top; mesa top ..		Konecki et al., 1958, p.55
Artinskian (Permian)	Byro	Warrawarringa Fm. (Pap)	Siltstone, shale, fine-grained quartz greywacke	Few foraminifera, bryozoa, molluscs	to 200	Gentle syncline ..	Plain	Brick shale (u)..	Konecki et al., 1958, p.48.
		Bogadi Greywacke (Paf)	Fine- to medium-grained quartz greywacke	*Neospirifer*, pectinids, worms	120–350	Synclines; low dips	Plain or mesa ..		Konecki et al., 1958, p.46.
		Madeline Fm. (Pal)	Fossiliferous siltstone and fine quartz greywacke, evaporite gypsum	Foraminifera, bryozoa, crinoids, brachiopods, molluscs, plants	110–500	Synclines; low dips; monoclines	Plain	Brick shale (u) ? Salts; ? Petroleum cap, source	Konecki et al., 1958, p. 43.
		Coyrie Fm. (Paj)	Fossiliferous siltstone & fine & medium quartz greywacke, some calcareous	Bryozoa, crinoids, brachiopods, pelecypods.	700	Gently dipping homocline ..	Plain	Brick shale (u)	Condon, 1962
	Woor-amel	Keogh Fm. (Pah)	Fine-grained quartz greywacke, siltstone, minor coarse quartz greywacke ..	Plants, pelecypods	to 240	Synclines & anticlines; low dips ; monoclines	Dissected; mesas		Konecki et al., 1958, p.35.
		One Gum Fm. (Pao)	Quartz greywacke, quartz sandstone, siltstone, minor conglomerate.	Plants, bryozoa, brachiopods, pectinids ..	45–235	Gentle homocline; monoclines	Dissected; mesas		Konecki et al., 1958, p. 31.
		Nunnery Sandstone (Pay)	Quartz sandstone, minor conglomerate ..	Invertebrate trails	545–580	Gentle homoclines; monoclines	Dissected; mesas	Potable water (u) ? Petroleum reservoir ..	Konecki et al., 1958, p.29.
		Billidee Fm. (Pae)	Quartz greywacke (some calc.) and siltstone ..	Plants, brachiopods, pelecypods	150–300 ..	Synclines & homoclines; low dips	Dissected; mesas		Condon, 1962
		Moogooloo Sandstone (Paw) ..	Quartz sandstone ..		70–120	Synclines & homoclines; low dips	Dissected; mesas	Portable water (u) ? Petroleum reservoir ..	Condon, 1958 Condon, 1962 p. 66.
		Congo Fm. .. (Paz)	Quartz greywacke, siltstone, minor conglomerate	Plants, bryozoa, brachiopods, molluscs ..	to 200	Syncline ..	Dip slopes; .. dissected ..		Konecki et al., 1958, p. 37.
		Monument Fm. (Pat)	Quartz greywacke, quartz sandstone, minor siltstone	Plants, invertebrate trails ..	270–700	Synclines & homoclines; low dips	Dissected; some mesas	Stock water ? Petroleum reservoir ..	Konecki et al.. 1958, p. 34.
		Callytharra Fm (Pac)	Fossiliferous calcarenite, calcilutite, siltstone, and fine quartz greywacke	Plants, foraminifera, bryozoa, crinoids, brachiopods, molluscs	to 380	Synclines & homoclines; low dips	Plains	Limestone (u) ? Petroleum source and cap	Konecki et al., 1958, p. 23. Condit et al., 1936.
?		Carrandibby Fm (P(a)a)	Shale, calcilutite and sandstone	Pelecypods, gastropods, brachiopods, foraminifera	to 320	Homoclines; low dip	Shallow dissection	Brick shale (u) ? Petroleum source ..	Konecki et al., 1958, p. 22.
Sakmarian (Permian)	Lyons	Weedarra Shale (Psw) ..	Sandy shale, tillitic siltstone, boulder beds ; quartz greywacke member		to 900	Synclines..	Plain	Brick shale (u) ? Petroleum source. Stock water in sandstone (u) ..	Condon, 1962
		Thambrong Fm. (Pst) ..	Quartz greywacke and tillitic siltstone; minor varves & boulder beds		360–800	Homoclines; low dip ..	Plain; low hills ..	Stock water (u)..	Condon, 1962
		Mundarie Siltstone (Psm)	Tillitic siltstone; boulder beds		430–580	Homoclines; low dip ..	Plain	Brick shale (u) ? Petroleum source and cap. ..	Condon, 1962
		Koomberan Greywacke (Psk) ..	Quartz grewacke; boulder beds; minor siltstone		185–650	Homoclines; low dip ..	Plain; low hills ..	Stock water (u) ? Petroleum reservoir ..	Condon, 1962
		Dumbardo Siltstone (Psd) ..	Tillitic siltstone; boulder beds ..		1300–1600	Homoclines; synclines; anticlines	Plain	Brick shale (u) ? Petroleum source and cap	Condon, 1962
		Coyango Greywacke (Psc) ..	Quartz greywacke; boulder beds; minor siltstone		320–1200	Homocline, synclines	Low hills ..	Stock water (u)	Condon, 1962
		Austin Fm. (Psa) ..	Quartz greywacke and tillitic siltstone; boulder beds ..		1000— 1200+	Homocline	Low hills ..	Stock water (u) ? Petroleum source and reservoir ..	Condon, 1962
Precambrian		(pCe) ..	Sandstone, slate ..			Steep dips	High hills ..		
		(pCg) ..	Granite			Discordant	Dissected ..		
		(pCs) ..	Schists, quartzite, gneiss			Strongly folded and faulted.	Dissected		

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TABLE 2

STRATIGRAPHY: GLENBURGH SHEET

Era	System	Gascoyne River	Daurie Creek	Wooramel River	Extensions and Correlations	Stage
Cainozoic	Quaternary	Alluvium, wash, sand				Recent.
		Joolabroo wwwwwwwwwww		Joolabroo wwwwwwwwwww	In Merlinleigh Basin	Pleistocene.
			Aeolian Sand	Aeolian Sand	cf. Aeolian red sand throughout W.A.	
	Tertiary	Nadarra oooooooooooooooo	Nadarra oooooooooooooooooooo		In Merlinleigh Basin cf. Oakover Beds.	?Upper Tertiary
		Laterite	Laterite	Laterite	Throughout northern Australia	
			Pindilya wwwwwwwwwwwwwww	Pindilya wwwwwwwwwww	cf. Merlinleigh Sandstone.	? Eocene
Palaeozoic	Permian			Warrawarringa	cf. Bulgadoo or Coyrie.	Artinskian
			Bogadi	Bogadi	cf. Mallens or Coyrie.	
		Coyrie	Madeline	Madeline	cf. all or part Coyrie.	
		Billidee	Congo — Keogh	Keogh	cf. High Cliff and Poole Sandstones	
			Congo — One Gum	Monument — One Gum		
		Moogooloo wwwwwwwwwwww	Congo — Monument wwwwwwww wwwwwwww	Nunnery wwwwwwwwwwww		
		Callytharra wwwwwwwwwww	Callytharra oooooooooo oooooooo	Callytharra oooooooo oooooooo	cf. Fossil Cliff and Nura Nura.	
			Carrandibby wwwwwwwwwwwwwww	Carrandibby wwwwwwwwwww	cf. upper part Holmwood Shale	?Artinskian
		Weedarra	Weedarra		cf. lower part of Holmwood. Shale and Nangetty Formation	Sakmarian
		Thambrong	Thambrong	Thambrong		
		Mundarie	Mundarie	Mundarie	cf. Grant Formation.	
		Koomberan	Koomberan	? ? ?		
		Dumbardo	Dumbardo	? ? ?		
		Coyango Austin wwwwwwwwwwww	Coyango ? ? ? wwwwwwwwwwwwwwww	Coyango ? ? ? wwwwwwwwwww		
Pre-cambrian		Strongly folded sediments, schist and micro-gneiss intruded by basic dykes and by granite.				

oooooooooo = Disconformity wwwwwwwww = Unconformity ? ? ? Not outcropping but probably present.

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series' includes 'quartzite, jaspilite, andalusite and kyanite-bearing quartzites, sillimanite-garnet gneiss, quartz mylonite gneiss, muscovite quartzite, hornblende-felspar quartzite, epidote-diopside hornfels, calcite-felspar-chlorite hornfels, quartz-mica schist, chert, knotenschiefer, graphite schist and phyllite'. This series grades into the Talbot Gneiss. As Johnson's boundaries are very indefinite and cannot be related to any photo-pattern the whole of the metamorphic rocks has been mapped as a single unit.

Sedimentary rocks at Earilier Hill were regarded by Konecki, Dickins, & Quinlan (1958, p. 10) as similar to the Badgeradda Beds. Condon examined them in 1959 and found them to belong to the Coyango Greywacke of the Lyons Group.

PERMIAN

Maitland (1900, p. 15) called all the Permian strata of the Carnarvon Basin 'the Gascoyne Beds' and 'the Gascoyne River beds'. The name has not been used in this sense since. As there are several unconformities and disconformities in the sequence no single rock body term is applicable and Maitland's name therefore is invalid.

Sakmarian

The *Lyons Group* (Maitland, 1912; Raggatt, 1936; Condon, 1954) rests unconformably on the Precambrian schist and gneiss. Its formations can be mapped near Wyndham River and Daurie Creek but elsewhere because of poor exposure they cannot be distinguished with certainty. All the known formations crop out in the Sheet area.

The *Austin Formation* (Condon, 1961) consists of alternating members of quartz greywacke and sandy (tillitic) siltstone with few boulder beds. It rests unconformably on Precambrian schist and gneiss and is conformably overlain by the Coyango Greywacke. It crops out in the north-western part of the Sheet between Wyndham River and Bush Creek and was penetrated in BMR 8 Bore, Mount Madeline, between 1,805 feet and total depth 3,004 feet. No fossils have been found in outcrop, but marine fossils were found in the Austin Formation in BMR 8 : J. M. Dickins (personal communication) identified crinoid fragments and *Neospirifer* sp. ind. from Core 30 (2,790 feet), and *Astartila* (?) sp., *Pseudosyrinx* (?) sp. and a rhynchonellacean from Core 32 (3,000 ft.).

The Austin Formation is about 1,000 feet thick 7 miles north-north-west of K-33 (near the northern margin of the Sheet) and more than 1,200 feet thick in Bore BMR 8. These are the only thicknesses of the formation known on the Glenburgh Sheet; in both sections the characteristic alternation of arenaceous and shaly members is evident. In the northern area the Austin Formation abuts unconformably on Precambrian schist and gneiss and is overlain conformably by the Coyango Greywacke or unconformably by the Koomberan Greywacke. In Bore BMR 8 the base is not reached; the Austin Formation is overlain by the Carrandibby Formation.

The rhynchonellacean brachiopod at 3,000 feet in BMR 8 has ribbing like that of one from the Dumbardo Siltstone near Moogooree Homestead (Condon, 1962). This tends to confirm the Sakmarian age of the Austin Formation, previously included in the Sakmarian Stage because of its conformity with the Sakmarian Dumbardo Siltstone and its strong unconformity on Lower Carboniferous and older rocks.

The *Coyango Greywacke* (Condon, 1962) is the formation of quartz greywacke with minor boulder beds and siltstone beds and members conformable between the Austin Formation below and the Dumbardo Siltstone above. On the Glenburgh Sheet it is identified between the north margin and the Gascoyne River, in the embayment 3 to 6 miles east of Coordewandy Homestead, 4 to 5 miles north-east of Mount Madeline, and at Earilier Hill. It probably approaches the surface in the Wooramel River embayment, but its outcrop is hidden by strongly developed laterite.

In the Wyndham River area the Coyango Greywacke is truncated by a depositional unconformity developed at a hingeline : only about 500 feet of the lower part of the formation is exposed. In the Daurie Creek embayment the Coyango Greywacke is unconformable on a surface of strong relief on the Precambrian schist and gneiss : only 320 feet of the upper part of the formation is exposed. North-east of Mount Madeline about 1,200 feet of pebbly quartz greywacke with boulder beds and thin tillitic siltstone beds rests unconformably on Precambrian schist and gneiss and is overlain unconformably by Monument Formation, Keogh Formation, and Madeline Formation. This was mapped by Konecki, Dickins, & Quinlan (1958, p. 2) as Monument Formation, but Condon identified it in 1959. Earilier Hill is formed of silicified quartz greywacke with thin beds of tillitic siltstone and thin boulder beds. The exposed thickness in Earilier Hill is about 2,500 feet : this thickness, predominantly of quartz greywacke, and the stratigraphic position low in the Lyons Group identify the sequence as Coyango Greywacke.

No fossils have been found in the Coyango Greywacke on Glenburgh Sheet, but as part of the Lyons Group it is Sakmarian.

The *Dumbardo Siltstone* (Condon, 1962) consists dominantly of tillitic siltstone with tillitic boulder beds, conformable between the Coyango Greywacke and the Koomberan Greywacke. On the Glenburgh Sheet it crops out in a small area on the northern margin south of the Arthur River, and $\frac{3}{4}$ mile to $5\frac{1}{2}$ miles east of Coordewandy Homestead, where it is 1,300 to 1,600 feet thick : it rests conformably on Coyango Greywacke and unconformably on Precambrian schist and gneiss and is conformably overlain by Koomberan Greywacke. Elsewhere on the Sheet its outcrop is masked by laterite or Quaternary sediments.

No fossils have been found in the Dumbardo Siltstone on this Sheet, but its age is established by marine fossils farther north in the Carnarvon Basin as Sakmarian.

The *Koomberan Greywacke* (Condon, 1962) consists mainly of quartz greywacke, with several tillitic boulder beds and few siltstone beds. It is conformable

between the Dumbardo Siltstone and Mundarie Siltstone. On the Glenburgh Sheet it crops out near the north-western corner in a belt about 4 miles long between the Arthur and Wyndham Rivers, and in another belt from the northern Sheet margin to the Gascoyne River : in this belt it is 650 feet thick. In a north-trending belt ½ mile east of Coordewandy Homestead the Koomberan Greywacke is 185 feet thick. It may crop out in Bilung Creek downstream from Bilung Pool, but its identity there is not certain. Farther south laterite covers the area where it might crop out.

No fossils have been found in the Koomberan Greywacke on this Sheet, but by its position in the Lyons Group it is Sakmarian.

The *Mundarie Siltstone* (Condon, 1962) is the formation of tillitic siltstone with tillitic boulder beds conformable between the Koomberan Greywacke below and the Thambrong Formation above. On this Sheet it crops out south-eastward from the north-west corner to the Wyndham River; the belt is about 530 feet thick. In another outcrop belt from the north edge of the Sheet across the Wyndham River to the Gascoyne River the Mundarie Siltstone is 500 feet thick, and at the south end is truncated and unconformably overlain by the Callytharra Formation. In the north-south belt passing Coordewandy Homestead the Mundarie Siltstone is 430 feet thick; it includes 110 feet of varved siltstone/shale and siltstone/sandstone in the middle part of the formation. The Mundarie Siltstone crops out in the valley of the Wooramel River and Bilung Creek, where it is 580 feet thick, including a varved member 60 feet thick. Farther south the Mundarie Siltstone does not crop out because of the thick laterite.

No fossils have been found in the Mundarie Siltstone on the Glenburgh Sheet.. By reference to the fossils in the Mundarie Siltstone on the Kennedy Range Sheet, its age is Sakmarian.

The *Thambrong Formation* (Condon, 1962) consists of alternating members of quartz greywacke and tillitic siltstone with minor varved sediments and tillitic boulder beds. It rests unconformably between the Mundarie Siltstone and the Weedarra Shale and is commonly overlain unconformably by the Callytharra Formation. On this Sheet the Thambrong Formation crops out in the north-western corner, between the Arthur River and Wyndham River : there it is 360 feet thick and unconformably overlain by the Callytharra. Six miles to the east, where another outcrop belt crosses the Wyndham River, the Thambrong is 800 feet thick; at the south end it is truncated by an unconformity, with the Callytharra Formation above. In a north-trending belt ¼ mile to 1½ miles west of Coordewandy Homestead the Thambrong Formation is overlain unconformably by the Callytharra Formation; it is 690 feet thick. In the valleys of Bilung Creek and Wooramel River it is 400 feet thick and overlain unconformably by the Carrandibby Formation. It does not crop out south of the Wooramel River : deep laterite masks the area where it might be expected.

No fossils have been found in the Thambrong Formation on this Sheet, but it is Sakmarian in age by reference to fossils found farther north.

The *Weedarra Shale* (Condon, 1962) consists of sandy shale, tillitic siltstone and tillitic boulder beds with a quartz greywacke member in the middle part of the formation. It rests conformably on the Thambrong Formation and is unconformably overlain by the Carrandibby Formation or Callytharra Formation.

On this Sheet it crops out in a belt crossing the Wyndham River. At the north end it rests unconformably on Mundarie Siltstone and Thambrong Formation and at the south end is truncated by the unconformity beneath the Callytharra Formation : its maximum thickness in this area is 850 feet. It does not crop out south of the Gascoyne River but was penetrated for 894 feet in Bore BMR 9 (Daurie Creek) from 1,405 feet to total depth (2,299 feet).

No fossils have been found in the Weedarra Shale on this Sheet. By reference to the fossiliferous Weedarra Shale farther north in the Carnarvon Basin its age is Sakmarian.

Raggatt (1936, p. 105, 110) used the name 'Gascoyne Series' for the Permian sequence above the 'Lyons Series' in the Carnarvon Basin. He ignored Maitland's use of the name (1900) for the whole Permian sequence. As Raggatt's sequence is broken by an unconformity and several disconformities it cannot be named as a rock unit.

Sakmarian or Artinskian

The *Carrandibby Formation* (Konecki, Condon, Dickins, & Quinlan, in McWhae et al., 1958, p. 72) consists of shale, calcilutite, and sandstone. It is unconformable on the Lyons Group and overlain, possibly disconformably, by the Callytharra Formation. The type locality is on the Wooramel River just west of the western margin of the Glenburgh Sheet.

It crops out on the south side of the Wooramel River 1,000 yards northeast of Callytharra Spring : it is only 25 feet thick. In a small outcrop $\frac{3}{4}$ mile north of Gap Pool, Wooramel River, the Carrandibby Formation is 33 feet thick. In Bore BMR 8 (Mount Madeline) the Carrandibby Formation is 320 feet thick (1,485 to 1,805 feet depth) and in BMR 9 (Daurie Creek) it is 315 feet thick (1,090 to 1,405 feet depth). In BMR 8 it overlies the Austin Formation and in BMR 9 the Weedarra Shale.

Few fossils have been found in the Carrandibby Formation on this Sheet except in the bores. The fauna so far determined in the type locality includes a few species at present restricted to the Carrandibby Formation — *Astartila? obscura* Dickins, *Pachymyonia occidentalis* Dickins, and *Leiopteria? carrandibbiensis* Dickins; some that range downwards into the Lyons Group — *Eurydesma playfordi* Dickins, *Deltopecten lyonsensis* Dickins, *Aviculopecten tenuicollis* (Dana), *Keeneia carnarvonensis* Dickins, *Peruvispira umariensis* (Reed), and *Trigonotreta* sp. nov.; and some that range upwards into higher formations — *Nuculana darwini* (de Koninck) and *Stutchburia variabilis* Dickins. The fauna is transitional between the Sakmarian Lyons Group and the Artinskian Callytharra Formation. Dickins & Thomas (1960) include the Carrandibby Formation in the Lyons Group and do not discuss its fauna or age separately. A larger number

of species ranges down into the Lyons Group than up into the Callytharra Formation, but this may be in part controlled by environment : the Lyons Group and Carrandibby Formation faunas are dominated by molluscs, which are a minor part of the Callytharra fauna. There is a very large unconformity between the Lyons Group and Carrandibby Formation; there is a sharp change in lithology between the Carrandibby and Callytharra Formations and, in Bilung Creek, some suggestion of a disconformity. At present the evidence is insufficient to decide whether the Carrandibby Formation should be referred to the Sakmarian or Artinskian Stage. Because of the nature of its two boundaries it is more likely to be closer in age to the Callytharra Formation than to the Lyons Group and therefore is referred to as possibly Artinskian.

Artinskian

Fairbridge (1953, p. v11/13) 'restricted' Maitland's (1900) and Raggatt's (1936) use of the name Gascoyne to a 'Gascoyne Group' consisting of the Callytharra Formation and the present Wooramel Group. This is invalid as there is an unconformity in this sequence.

The *Callytharra Formation* (Condit, 1935; Condon, 1954, 1962) consists of fossiliferous hard and friable sandy and silty calcarenite and calcilutite, siltstone, and quartz greywacke overlying the Carrandibby Formation probably disconformably or formations of the Lyons Group and Precambrian schist unconformably, and overlain unconformably by formations of the Wooramel Group. The type locality on the south bank of Wooramel River ½ mile west of Callytharra Spring is on the western margin of the Sheet. The Callytharra Formation crops out in the following areas on the Glenburgh Sheet : from near the north-west corner of the Sheet south-east to the Gascoyne River; westward along the north side of that river and across the river at Pells Creek in the north end of Pells Range. In this area the Callytharra Formation is unconformable on a truncated surface of Lyons Groups formations and is overlain unconformably by Moogooloo Sandstone; it is 150 to 200 feet thick. At the northern margin of the Sheet, north of the Wyndham River, an outlier of Callytharra Formation 210 feet thick is unconformable between Lyons Group and Moogooloo Sandstone. South of the Gascoyne Rievr, between Daurie Creek and Congo Creek, is an outcrop belt of Callytharra Formation, interrupted in places by Quaternary deposits : this ends at an unconformity. The outcrop is offset southward to the east of the unconformity and extends eastward for about 4 miles. In both of these outcrop belts the Callytharra rests unconformably on Lyons Group and is unconformably overlain by Moogooloo Sandstone. The Callytharra Formation crops out around the north, west, and south sides of the Bush Creek syncline, unconformable between the Congo Formation above and the Lyons Group below; it is 85 feet thick three miles east of Dairy Creek Homestead. On the east side of Bush Creek syncline the Callytharra Formation appears as steeply dipp' g lenses between the Precambrian schist and the Congo Formation. South of Congo Creek there are two outcrop belts around the north end of two synclines. The western one ends four miles south at an unconformity, the eastern one continues to 3 miles south-west of

Coordewandy Homestead, where it is masked by laterite. West of Coordewandy in this belt the Callytharra is 235 feet thick, unconformable on Thambrong Formation and unconformably overlain by Monument Formation. In the area north and south of the Wooramel River near the junction with Bilung Creek the Callytharra is 200 feet thick, probably disconformably overlying the Carrandibby Formation and disconformably overlain by Monument Formation. Near Plant Well on Daurie Creek a poorly exposed area of Callytharra Formation with some structural complications continues into a western narrow belt and a wider eastern belt on the flanks of the Plant Well syncline. The Callytharra is unconformable on Lyons Group and Precambrian schist, disconformably overlain by Monument Formation, and in the eastern belt is about 180 feet thick. East of this, the Callytharra crops out at the north end of a small syncline. Small lenses of Callytharra Formation, unconformable on Precambrian schist and unconformably overlain by Wooramel Group or Madeline Formation, crop out 5 to 7 miles north-east of Mount Madeline. One and a half miles north-west of Gap Pool, Wooramel River, the Callytharra rests on Carrandibby Formation and is disconformably overlain by Nunnery Sandstone; it is 380 feet thick. There are two small lenses, steeply dipping, between Lyons Group or Carrandibby Formation and Nunnery Sandstone on the south side of Wooramel River between Nunnery Pool and the mouth of One Gum Creek. Lateral equivalents of the Callytharra Formation have been penetrated in BMR 8 Bore (1,110 to 1,485 feet depth), BMR 9 Bore (825 to 1,090 feet depth) and Deep Bore (1,236 to 1,956 feet depth, approximately); in all three bores the lateral equivalent is finer grained than the Callytharra Formation and more carbonaceous.

The Callytharra Formation is richly fossiliferous, including many species of foraminifera (Crespin, 1958), bryozoa (Crockford, 1944a and b), corals (Hill, 1937, 1942, 1957), crinoids (Teichert, 1949), blastoids, brachiopods (Coleman, 1957; Thomas, 1958), pelecypods, gastropods, nautiloids (Teichert, 1951, p. 83), and an ammonoid (Thomas & Dickins, 1954). Algae and *Gangamopteris* (Teichert, 1942) are also present.

The ammonoid, brachiopods, and pelecypods have strong affinities with those of the Artinskian Lower Productus Limestone of the Salt Range, India, and Bitauni Beds of Timor. A minor element of the fauna ranges down into the Sakmarian. The age of the Callytharra Formation is low in the Artinskian.

The *Wooramel Group* (Condit, 1935; Konecki, Condon, Dickins, & Quinlan, 1958, p. 72) consists in the type locality of the Nunnery Sandstone (at base), One Gum Formation, and Keogh Formation. It rests unconformably on the Callytharra Formation and is conformably overlain by the Madeline Formation of the Byro Group. Elsewhere on the Glenburgh Sheet the Wooramel Group includes as lateral variants of the type formations the Monument Formation, Congo Formation, Moogooloo Sandstone, and Billidee Formation.

The *Nunnery Sandstone* (Konecki, Condon, Dickins, & Quinlan, 1958, p. 72) is the formation predominantly of quartz sandstone unconformable on the Callytharra Formation and conformably overlain by One Gum Formation. The type section 545 feet thick is three miles north-east of Nunnery Pool, Wooramel River.

It is known only in the area 8 miles downstream from Gap Pool, Wooramel River, and in Bore BMR 8, Mount Madeline, where it is 580 feet thick (530 to 1,110 feet depth). It contains no fossils, but its age is determined as Artinskian by its position between the Artinskian Callytharra and Madeline Formations.

The *One Gum Formation* (Konecki, Condon, Dickins, & Quinlan, 1958, p. 73) consists of quartz greywacke, quartz sandstone and minor conglomerate and siltstone. In the type section 5 miles east-north-east of the mouth of One Gum Creek the formation is 180 feet thick; four miles west of that section it is 135 feet thick. It is known only to the south of the Nunnery Sandstone outcrop, in Bore BMR 8, where it is 235 feet thick (235 to 470 feet depth), in the Daurie Creek area where it is 45 feet thick, and in Bore BMR 9 Daurie Creek where it is 75 feet thick (390 to 465 feet depth). Marine fossils have been found in the basal siltstone member at several localities; they include hexagonellidae, fenestellids, polyporids, *Strophalosia* sp., *Neospirifer* sp., *Cleiothyridina* sp., *Pseudosyrinx* sp., *Permorthotetes* sp., and *Deltopecten* sp. Plant stems are found in a siltstone bed about the middle of the formation. The fauna has closer relationships to that of the Callytharra Formation than the Madeline Formation. The age of the One Gum Formation is Artinskian.

In Bore BMR 8 the basal siltstone member is absent and coaly shale beds take the place of siltstone higher in the formation. Between the One Gum Formation and the Nunnery Sandstone is 60 feet of fossiliferous calcarenite not observed in outcrop on this Sheet. It is almost certainly the equivalent of the calcarenite formation between the Moogooloo Sandstone and Billidee Formation, 9½ miles west of Jimba Homestead (Wooramel Sheet).

The *Keogh Formation* (Konecki, Condon, Dickins, & Quinlan, 1958, p. 73) consists of interlaminated fine-grained quartz greywacke and siltstone with few thin beds of coarse quartz greywacke. It is 145 feet thick in the type locality 2½ miles east of Nunnery Pool, Wooramel River. The outcrop continues from there southward to the southern margin of the Sheet and northward beyond the Wooramel River. Keogh Formation crops out 1½ and 4 miles north-east of Gap Pool, Wooramel River, around Mount Madeline, where in outcrop and Bore BMR 8 it is 240 feet thick (surface to 235 feet depth), and 3½ and 8 to 10 miles north-east of Mount Madeline. In these outcrops the Keogh Formation rests conformably on Monument Formation or unconformably on Precambrian schist and is conformably overlain by Madeline Formation. It overlies Monument Formation in the Plant Well syncline and One Gum Formation in Monument Syncline. In outcrop there it is 110 feet thick, but in Bore BMR 9 in the axial part of the syncline it is absent, having changed laterally into siltstone. It crops out on the eastern flank of the Bogadi Syncline from the Wooramel River to the southern margin of the Sheet; at Wooramel River it is about 200 feet thick.

The Keogh Formation contains *Glossopteris* sp. and many invertebrate burrows and trails. In a few places marine fossils are found near the top; they include *Astartila blatchfordi* (Hosking), *Praeundulomya* cf. *concentrica* Dickins, *Aviculopecten* sp. ind., *? Atomodesma mytiloides* Beyrich (Dickins, 1956). The

Keogh Formation is Artinskian because of its position between the Callytharra and Madeline Formations.

The *Monument Formation* (Konecki, Dickins, & Quinlan, 1958 p. 34) is the dominantly arenaceous formation unconformably overlying the Callytharra Formation and overlain conformably by the One Gum Formation or Keogh Formation. It is the lateral equivalent of the Nunnery Sandstone and all or part of the One Gum Formation. In the type locality in Daurie Creek it is 400 feet thick, in Bore BMR 9 Daurie Creek it is 360 feet thick, between One Gum Formation and Callytharra equivalent. It crops out in the Daurie Syncline (700 feet thick on northern end, 400 feet thick on eastern flank), in the Monument Syncline (310 to 490 feet thick on eastern flank), in the Plant Well Syncline, in the Wooramel River 1½ miles downstream from the mouth of Bilung Creek (270 feet thick), and 4 and 5 miles north-east and 6 miles south-west of Mount Madeline. No marine fossils have been found in the formation; invertebrate trails and burrows and plant stems are fairly common.

The age of the Monument Formation, determined by its position between the Artinskian Callytharra and Madeline Formations, is Artinskian.

The *Congo Formation* (Konecki, Dickins, & Quinlan, 1958, p. 37) consists of quartz greywacke, thin beds of conglomerate and thin to thick beds of siltstone. It is unconformable on the Callytharra Formation, Lyons Group, or Precambrian schist; it is conformably overlain by the Madeline Formation. It crops out only in the Bush Creek Syncline and is 175 feet to 200 feet thick. Fossil wood has been found in several places and marine fossils in four localities: forms include fenestellid bryozoa, brachiopods, pelecypods, gastropods, and a nautiloid. The species have not been determined, but the assemblage and the lithology of the fossil bed at the top of the formation are very like the bed at the top of the Billidee Formation (Condon, 1962). Because of its position between the Callytharra and Madeline Formations the Congo Formation is Artinskian in age. It is a stratigraphic equivalent of the Monument and Keogh Formations and of the Moogooloo Sandstone and Billidee Formation.

The *Moogooloo Sandstone* (Craig, 1950; Condon, 1958) is the formation consisting predominantly of medium-grained quartz sandstone resting unconformably on the Callytharra Formation and conformably below the Billidee Formation.

The Moogooloo Sandstone is the unit incorrectly called 'Wooramel Sandstone' by Raggatt (1936) and Condon (1954).

On the Glenburgh Sheet it crops out southward from the northern margin near the north-west corner, where it is unconformable on Callytharra Formation and Koomberan Greywacke and overlain by Billidee Formation; it is 85 feet thick. The Moogooloo Sandstone crops out in the area between Wyndham River and Gascoyne River; it rests unconformably on a rock-stack surface of the Callytharra Formation with local relief of about 50 feet, and is overlain by Billidee Formation; it is 70 to 120 feet thick. In the area between Bush Creek and Daurie Creek south of Red Hill the Moogooloo Sandstone is 80 to 100 feet thick.

No fossils have been found in the Moogooloo Sandstone on the Glenburgh Sheet. Its stratigraphic position between the Artinskian Callytharra and Coyrie Formations fixes its age as Artinskian. Konecki, Dickins, & Quinlan (1958, pp. 31 and 34) regard the Moogooloo Sandstone as being equivalent to both the Nunnery Sandstone and One Gum Formation or to the Monument Formation, but the compiler considers, on the basis of comparison of siltstone members in the Wooramel Group, that the Moogooloo Sandstone is the equivalent of the Nunnery Sandstone.

The *Billidee Formation* (Condon, 1962) consists of quartz greywacke (calcareous in places) with beds and members of siltstone, conformable between the Moogooloo Sandstone below and Coyrie Formation above. On the Glenburgh Sheet it crops out only in the north-western part. Near the northern margin the Billidee Formation crops out in a syncline; it is 250 feet thick. Between the Wyndham and Gascoyne Rivers the Billidee is about 200 to 300 feet thick : the upper boundary is not well exposed. The lower part only of the Billidee Formation, with a maximum thickness of about 150 feet, is exposed in the area east and south of Congo Well on Congo Creek.

Marine fossils (brachiopods and pelecypods) and fossil wood have been found in the northern outcrop and fossil wood between Wyndham River and Gascoyne River.

The age of the Billidee Formation, based on the Artinskian age of the Callytharra Formation and Coyrie Formation, is Artinskian.

The Billidee Formation is the equivalent in the Bidgemia Basin of the One Gum and Keogh Formations of the Byro Basin.

The *Byro Group* (Condit, 1935, p. 870; Konecki, Dickins, & Quinlan, 1958, p. 43) is the sequence of siltstone, shale, and quartz greywacke that, in the type locality, rests on and grades laterally into the Wooramel Group and consists of the Madeline Formation (at base), Bogadi Greywacke, and Warrawarringa Formation. Raggatt (1936) and Condon (1954) included the whole sequence between the Wooramel Group and Kennedy Group in the Byro Group. The Byro Group contains many fossils which establish its Artinskian age.

The *Madeline Formation* (Konecki, Condon, Dickins, & Quinlan, 1958, p. 73) consists of carbonaceous siltstone and fine-grained quartz greywacke, calcareous in places. It is conformable between the Keogh Formation and Bogadi Greywacke and in places grades laterally into the Keogh Formation and the One Gum Formation.

In the type locality west of Madeline Creek the Madeline Formation is 395 feet thick. Its lower part consists of siltstone, shale and evaporites, and its upper part of interbedded quartz greywacke and siltstone. The outcrop of the Madeline Formation extends from the northern part of the Daurie and Monument Synclines to the southern margin of the Sheet. There is also an area of outcrop in the Bush Creek Syncline, where the Madeline Formation is 110 feet thick. In the Daurie Syncline it is 160 feet thick. On Daurie Creek, in the Monument Syncline, the Madeline Formation is 285 feet thick; the lower part is a lateral variant of

the Keogh Formation. In Bore BMR 9, Daurie Creek, the Madeline Formation is 320 feet thick (70 to 390 feet depth). At the Wooramel River 3 miles northward from Dilba Bore the Madeline is about 280 feet thick, and east-south-east of Bogadi outcamp it is about 500 feet thick. No thickness could be obtained in the south-western part of the Bogadi Syncline because of poor outcrop and irregular structure.

Fossils are common in the Madeline Formation, including foraminifera, bryozoa, crinoids (*Calceolispongia*), brachiopods — *Neospirifer* spp., *Linoproductus* (*Cancrinella*) sp., *Strophalosia prideri* Coleman, *Permorthotetes* sp., *Aulosteges ingens* Hosking, *Kiangsiella condoni* Thomas, *Pseudosyrinx* sp., *'Chonetes'* spp., *Cleiothyridina* sp., *'Martiniopsis'* sp., *Streptorhynchus* sp., *'Dielasma'* sp.; pelecypods — *Astartila blatchfordi* (Hosking), *Glyptoleda* sp., *Aviculopecten* cf. *subquinquelineatus* (McCoy), *Pseudomyalina* sp., *Praeundulomya concentrica* Dickins, *Atomodesma mytiloides* Beyrich, *Streblochondria* sp., *Chaenomya* sp., *Heteropecten* sp., *Stutchburia* sp., and *Schizodus* sp.; gastropods *Baylea?* sp., *Mourlonia?* sp., *Ptychomphalina maitlandi* Etheridge, *Stachella?* sp., *Warthia* sp., *Macrocheilus?* sp., *Bellerophon* sp.; nautiloids, *Conularia* sp., and *Glossopteris* sp. and *Equisetales* stems (Dickins, 1956). The Madeline Formation is assigned to the Artinskian because of the affinities of the brachiopods and pelecypods with those of the Artinskian Lower Productus Limestone of the Salt Range, India and Bitauni Beds of Timor. The faunal assemblage has sufficient specific differences clearly to distinguish it from the Callytharra assemblage and from the Wandagee-Cundlego assemblage of the Merlinleigh Basin.

The Madeline Formation correlates with all or part of the Coyrie Formation and perhaps with the lower part of the Mallens Greywacke (Konecki, Dickins, & Quinlan, 1958, p. 46).

The *Coyrie Formation* (Condon, 1954, revised Condon, 1962) consists of fossiliferous siltstone and fine-grained quartz greywacke, both calcareous in places, conformable between the Billidee Formation and the Mallens Greywacke. It is the upper part of the sequence originally called Coyrie Formation (Condon, 1954).

On the Glenburgh Sheet it crops out only in the area between Wyndham and Gascoyne Rivers, where it is about 700 feet thick. In that area two beds low in the formation contain marine fossils (bryozoa, *Calceolispongia* sp., *Neospirifer* sp., *Aulosteges* sp., *Strophalosia* sp., and pelecypods).

The age of the Coyrie Formation, based on the affinities of its brachiopods and pelecypods, is Artinskian. It correlates with the Madeline Formation of the Byro Basin.

The *Bogadi Greywacke* (Konecki, Condon, Dickins, & Quinlan, 1958, p. 74) is the formation, consisting predominantly of fine- to medium-grained quartz greywacke with few calcareous beds and few beds of carbonaceous siltstone, conformable between the Madeline Formation below and the Warrawarringa Formation above. It crops out as an outlier in the Bush Creek Syncline, where it is 240 feet thick with an erosion surface at the top. Outliers in the Daurie Syncline have a maximum thickness, up to the erosion surface, of about 50 feet.

In the Monument Syncline the maximum thickness, eroded, is about 200 feet. The main outcrop area is in the Bogadi Syncline for 8 miles east-north-east of Mount Madeline around both flanks to 3 miles south-south-west of Bogadi Outcamp. This outcrop includes the type section in Madeline Creek and Wooramel River, where the Bogadi Greywacke is 200 feet thick. On the northern plunge the thickness is about 300 feet ± 50 feet (exposures are poor and dip determination difficult). On the north-east flank the Bogadi Greywacke is 120 feet thick, on the north-west flank 350 feet. It is 300 feet thick on the south-western flank, 250 feet thick on the southern plunge, and 200 feet at Bogadi Outcamp.

Marine fossils are found sporadically; *Neospirifer* sp. is most abundant; *Conularia* sp., pectinids, gastropods, and fish remains are rare; abundant conical mounds with festoon striations are probably worm burrows. The few species are similar to those found in the Madeline Formation. The Bogadi Greywacke is placed in the Artinskian because of its faunal similarity to the Madeline. It may possibly correlate with the Mallens Greywacke (Condon, 1954) of the Merlinleigh Basin, although there is a possibility also that it is equivalent to part of the Coyrie Formation (Condon, 1962).

The *Warrawarringa Formation* (Konecki, Condon, Dickins, & Quinlan, 1958, p. 74) consists of siltstone, shale, and fine-grained quartz greywacke, conformable on the Bogadi Greywacke. The top of the formation is an erosion surface. The Warrawarringa Formation crops out only in the central part of the Bogadi Syncline, from the Wooramel River to 1 mile south-west of Bogadi Outcamp. Exposures generally are poor and reliable dips hard to determine; therefore reliable thickness measurements have not been obtained. The thickness of the type section (120 feet) is almost certainly less than the maximum thickness as younger beds occur farther north.

A few marine fossils, including foraminifera, bryozoa, pelecypods, and gastropods, have been found but not described. As there is no break in sedimentation between the Madeline Formation and the Warrawarringa Formation the latter is almost certainly Artinskian. It may possibly be correlated with the Bulgadoo Shale of the Merlinleigh Basin, or with the upper part of the Coyrie Formation.

Mesozoic

No Mesozoic rocks crop out in the Glenburgh Sheet.

Tertiary

Eocene

The *Pindilya Formation* (Konecki, Condon, Dickins, & Quinlan, 1958, p. 130) consists of quartz greywacke, siltstone, and conglomerate, overlying Permian formations unconformably, and has a lateritized erosion surface at its top. Its thickness depends on the relief of the basal unconformity; the greatest measured thickness (90 feet) is in the type locality two miles south-west of Callytharra Spring. No fossils have been found in the formation, but chalcedonic fossils

found loose on the surface of the One Gum Formation not far from a mesa capped by Pindilya Formation are of the same preservation and similar type to fossils found in the Eocene Merlinleigh Sandstone of the Merlinleigh Basin. On this basis the Pindilya Formation probably correlates with the Merlinleigh Sandstone and is Eocene in age.

Upper Tertiary

Laterite profiles are developed over Precambrian schist, gneiss, and basic dykes, and Permian and ?Eocene sediments. On the Glenburgh Sheet all stages in the dissection of the laterite are evident. The undissected laterite covers large areas of the eastern part of the Sheet and is commonly covered by lateritic red soil (Tus); its surface is gently undulating, but has a major relief of about 300 feet from the drainage divide to the bed of the Wooramel River and the alluvium of the Gascoyne River. In the upper reaches of the Wooramel River the stream has not cut through the laterite and a continuous unbroken laterite surface extends from the valley floor over the drainage divide. In the area between Congo Creek and the western southern margin of the Sheet, the laterite is dissected or entirely removed In places siliceous 'billy' is developed near the top of the laterite profile and forms resistant mesa caps and, on dissection, rough gibber plains.

Quaternary

There are several small outcrops of lacustrine sediments of the *Nadarra Formation* (Condon, 1958, p. 129) between Dalgety Brook and Daurie Creek. White or pale green chalcedonic limestone with sandstone containing detrital laterite pisolites at the base is found in hollows in the laterite surface. It obviously post-dates the main development of the laterite profile, but the lime and silica of this formation may have been derived from groundwater leaching of the laterite profile, perhaps at a late stage in its development. No fossils have been found in the Nadarra Formation, but as dissection of the laterite had begun before its deposition it is probably Quaternary.

High-level terraces of river deposits along the valleys of some of the larger rivers are referred to the *Joolabroo Formation* (Condon, 1954). As well as the areas shown, there are narrow but thick deposits in the gorge of the Wooramel River near Pandara Pool and in Nyarra Creek.

In areas where the lateritic soil had a large sand content, the sand has been wind-blown into long dunes, probably during an arid period in the Pleistocene. This wind-blown sand is regarded as Pleistocene (Qps) although it originated in the upper part of the laterite profile.

Recent deposits, related to the present climate and drainage system, include alluvium (Qra) in the valley floors, wash (Qrw) — a thin layer of sand and gravel overlying bedrock — sand (Qrs) from the weathering of sandy formations, and scree (Qrb) from the dissection of duricrust.

STRUCTURE

The main structural elements of the Glenburgh Sheet and the Bouguer gravity anomaly contours from a Bureau of Mineral Resources unpublished map No. G. 98-38 are shown in Figure 1.

The Precambrian schist trends generally east-west except in the Carrandibby Range, south from Mount Dalgety and south of Wooramel River, where the trend is northward. Folds are apparent in several places and probably are more plentiful than shown. Major faulting is suggested in several places by displacement of trends or by sharp divergence in trend. Granite intrudes the schist in the central part of the Sheet : the granite margin transgresses the trends of the schist, but the trends continue into the granite, suggesting 'granitization' or lit-par-lit intrusion. Dykes of basic rock have two main trends — east and south-east — and a minor, north-east, trend. The margin of the Carnarvon Basin appears to be controlled more by these trends than by the structure of the schist.

Parts of three basins — Merlinleigh, Bidgemia, and Byro — and their separating basement ridges — Weedarra and Carrandibby Ridges — are included on the Glenburgh Sheet.

Sediments of the Lyons Group are anticlinal over the Weedarra Ridge between Gascoyne River and Carrandibby Range and over the Carrandibby Ridge north of the Gascoyne River.

Anticlines in Permian sediments include the Madeline and Ballythanna Hill Anticlines (Konecki, Dickins, & Quinlan, 1958, p. 66-68); the Ballythanna Hill Anticline extends much farther north than shown by Konecki et al. (pl. 2) to about two miles south of the Wooramel River. There are two small asymmetrical north-plunging anticlines 5 and 6 miles east-south-east of Callytharra Spring and gentle undulations including small anticlines in the Bogadi Greywacke in Wooramel River near Middle Camp.

The Permian sediments form synclines in the area north of the Gascoyne River as well as those named by Konecki, Dickins, & Quinlan (1958, p. 67). It is very likely that the Plant Well and Bogadi Synclines are continuous one with the other.

The nature of many of the linear stratigraphic and structural discontinuities is in doubt. Condon (1956) considers almost all of them unconformities whereas Konecki et al. (1958) regard most of them as faults. Bore BMR 8, Mount Madeline, was drilled 3,600 feet east of the outcrop contact of Permian sediments with the Precambrian schist to total depth 3,004 feet without reaching the schist : the contact therefore has an average slope at this place steeper than 40°.

Pre-Permian sediments are shown, in the section, within the Byro Basin. The only evidence for these is the large negative gravity anomaly in the Bogadi Syncline area, which is not accounted for by the known thickness and density of Permian sediments. The age of the suggested pre-Permian sediments is quite unknown; as Carboniferous, Devonian, Silurian, ? Ordovician and ? Proterozoic sediments are known elsewhere in the Carnarvon Basin they may be of any of these ages.

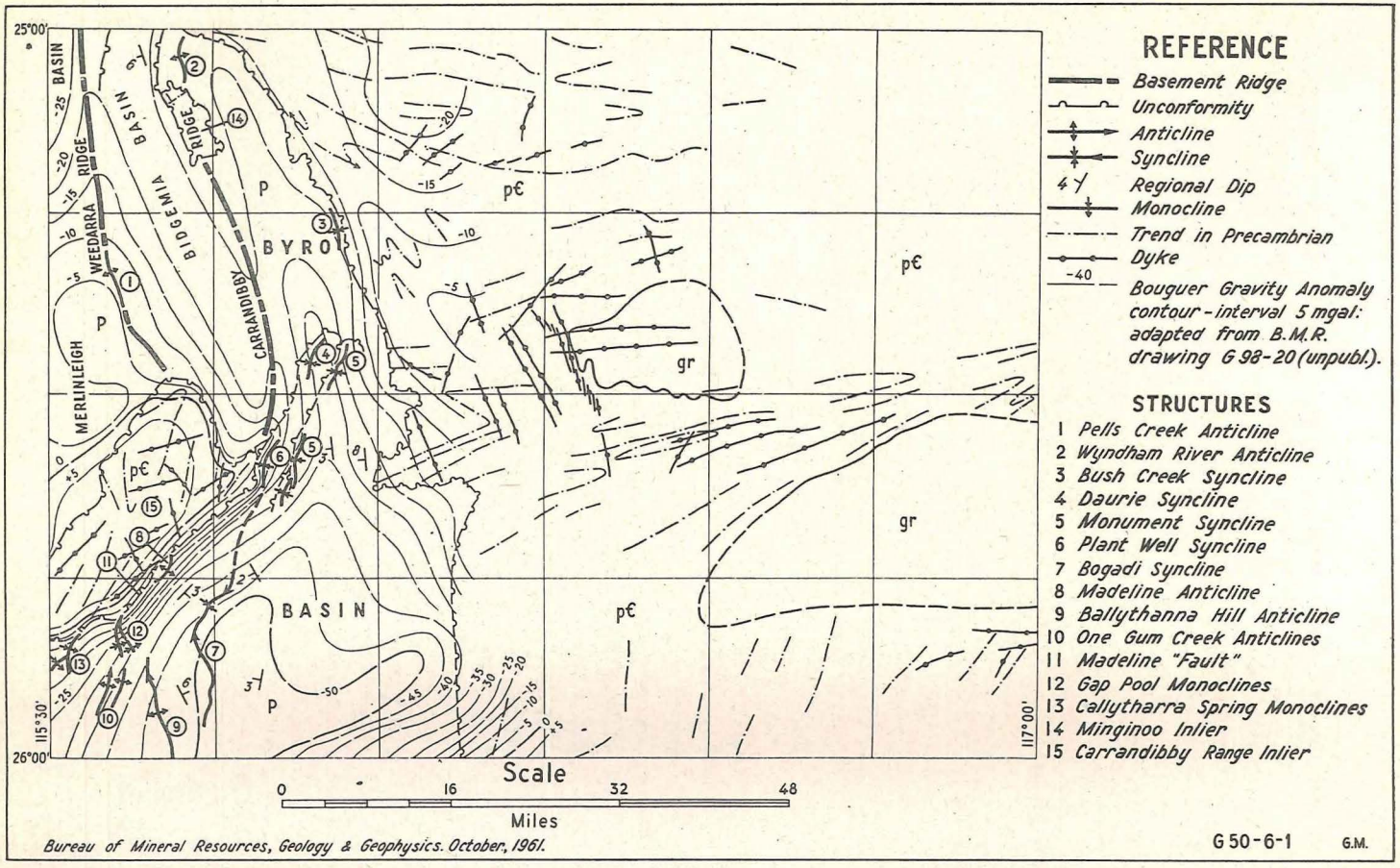
25°00'
26°00'
115°30'
117°00'
BASIN
RIDGE
BIDGEMIA
BYRO
WEEDARRA
MERLINLEIGH
CARRANDIBBY
BASIN
P
pC
gr
-25
-20
-15
-10
-5
0
+5
-50
-45
-40
-35
-30
Scale
0
16
32
48
Miles
REFERENCE
Basement Ridge
Unconformity
Anticline
Syncline
Regional Dip
Monocline
Trend in Precambrian
Dyke
-40
Bouguer Gravity Anomaly contour-interval 5 mgal: adapted from B.M.R. drawing G 98-20 (unpubl.).
STRUCTURES
1 Pells Creek Anticline
2 Wyndham River Anticline
3 Bush Creek Syncline
4 Daurie Syncline
5 Monument Syncline
6 Plant Well Syncline
7 Bogadi Syncline
8 Madeline Anticline
9 Ballythanna Hill Anticline
10 One Gum Creek Anticlines
11 Madeline "Fault"
12 Gap Pool Monoclines
13 Callytharra Spring Monoclines
14 Minginoo Inlier
15 Carrandibby Range Inlier
Bureau of Mineral Resources, Geology & Geophysics. October, 1961.
G 50-6-1
G.M.

FIG. 1

ECONOMIC GEOLOGY

Water

The only mineral of economic importance produced on the Glenburgh Sheet is underground water for sheep and cattle. Ground-water is contained in the more permeable Permian formations, in the laterite, and in dykes and fracture zones in the Precambrian schists. The Permian formations are Austin Formation (good to brackish, generally small supplies), Coyango Greywacke (good stock water, good to small supplies, e.g. Mums Bore, Coordewandy), Koomberan Greywacke (stock water, small supplies), Thambrong Formation (good stock water, fair to small supplies), sandstone member of Weedarra Shale (good water, good supplies, e.g. Bore BMR 9), Nunnery Sandstone (good water and supply, e.g. Bore BMR 8), Monument Formation (good stock water, small supply; e.g. Monument Bore, Bogadi Bore), Moogooloo Sandstone (good water and supply, e.g. Congo Well).

Other Minerals

The following rocks and minerals of possible future economic significance have been found : *limestone* (for road surfacing, concrete aggregate, cement and lime manufacture, agricultural lime) in the Callytharra Formation and Nadarra Formation; *gypsum* and possibly other evaporites in the basal part of the Madeline Formation 2½ miles north-east of Gap Pool, Wooramel River; *shale* (for brick-making, portland cement manufacture) in the Dumbardo Siltstone, Mundarie Siltstone, Madeline Formation, and Warrawarringa Formation.

The following have not been found in the area but geological evidence suggests that they may be found : *Salts* — the presence of outcropping evaporite gypsum at the base of the Madeline Formation and of salt efflorescence on the outcrop of Bogadi Greywacke suggests the possibility of evaporite salts in the Byro Group below the water table.

No metallic minerals have been reported from this area.

Petroleum

The Permian sequence is about 10,000 feet thick and includes formations of both source-bed and reservoir type. Capped reservoir formations likely to be in contact with source-bed formations include Koomberan Greywacke, Thambrong Formation, sandstone member in Weedarra Shale, and Wooramel Group. One or more of these should be present in the Ballythanna Hill and Mount Madeline Anticlines and the Weedarra Ridge Anticline. Stratigraphic traps may be formed against abutment unconformities to the east of Carrandibby Range and along the eastern margin of the basin.

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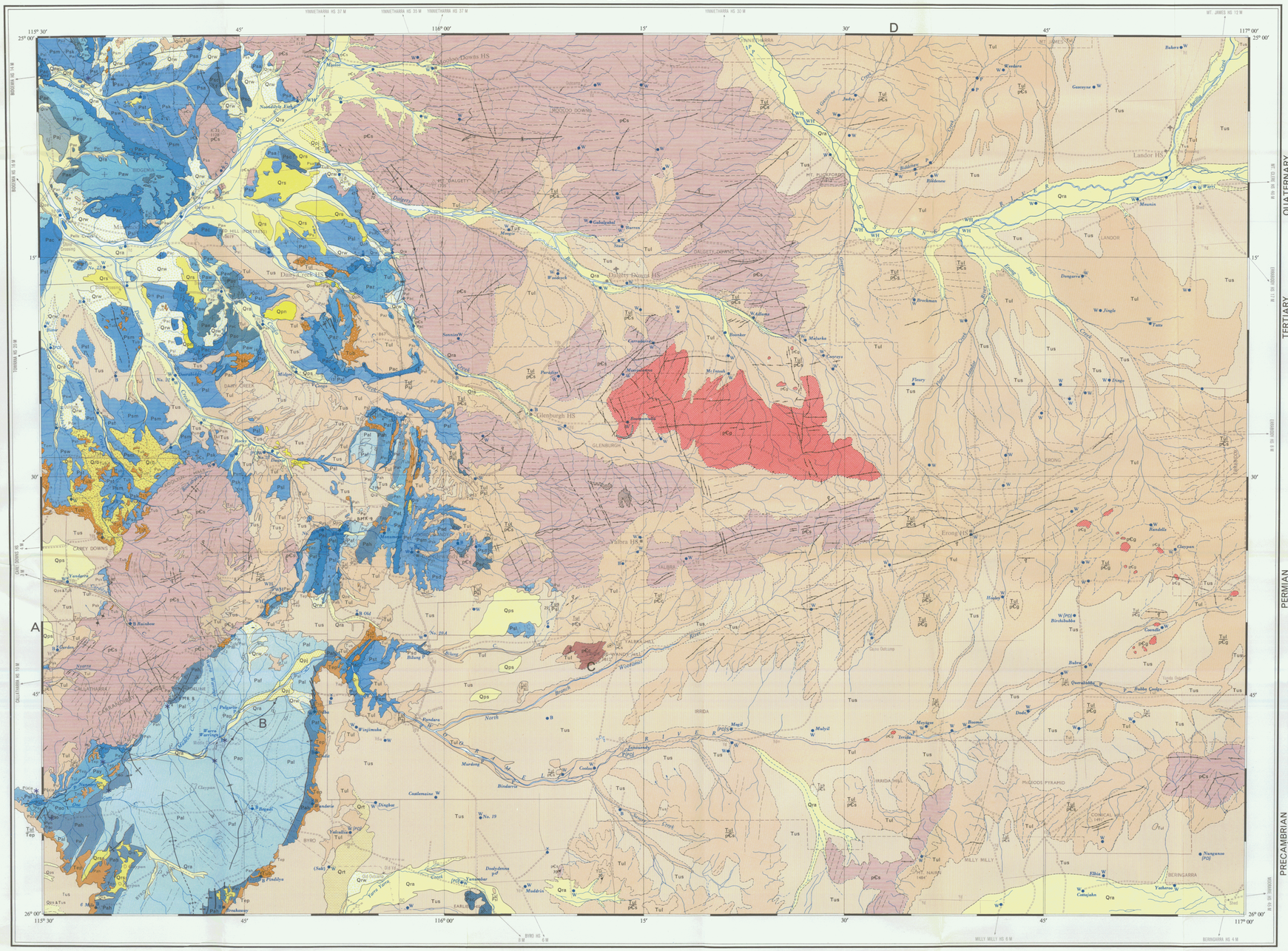

Reference

- Established geological boundary, position accurate
- Established geological boundary, position approximate
- Doubtful boundary, photo interpretation
- Unconformity, position accurate (∪–opens towards younger formation); shown only where necessary
- Strike and dip, inclined strata
- Horizontal strata
- Trend lines, photo interpretation
- Established anticlinal crest, showing plunge, position accurate
- Established anticlinal crest, showing plunge, position approximate
- Established synclinal trough, showing plunge, position accurate
- Established synclinal trough, showing plunge, position approximate
- Fold axis, position inferred, under younger formations
- Monocline
- Established fault, position accurate
- Strike and dip of foliation
- Vertical foliation
- Pac — Significant small outcrop (not to scale)
- Dyke; b = basic, q = quartz
- Type section
- BMR 8 — Stratigraphic bore
- B — Water bore
- W — Water well
- Bore or well with windpump
- S — Spring
- P — Pool, semi-permanent
- WH — Water hole
- Watercourse (all streams intermittent)
- Road
- Vehicle track
- Fence
- Station boundary, fenced
- Station boundary, unfenced
- LANDOR — Station name
- Telephone line
- Telephone line along fence
- Homestead
- Outcamp
- Yard
- Landing ground
- 1128' — Trig. station
- 929' — Spot height
- (Pcs) — Position doubtful

Reference

QUATERNARY

RECENT
- Qra — Alluvium
- Qrw — Wash
- Qrs — Sand
- Qrb — Scree
- Qrt — Travertine

PLEISTOCENE
- Joolabroo Formation — Qpj — Sand, gravel, travertine (old river deposits)
- Qps — Aeolian sand
- Nadarra Formation — Qpn — Limestone, chert, sandstone

TERTIARY
- Tus — Lateritic soil
- Tub — Billy
- Tul — Laterite

EOCENE
- Pindilya Formation — Tep — Silty sandstone, siltstone
- Merlinleigh Sandstone — Tem — Quartz sandstone

PERMIAN

ARTINSKIAN

Byro Group
- Warra Warringa Formation — Pap — Siltstone, shale, quartz greywacke
- Bogadi Greywacke — Pat — Quartz greywacke, marine fossils
- Madeline Formation — Pal — Siltstone, shale, quartz greywacke, evaporites, fossils
- Coyrie Formation — Paj — Siltstone, quartz greywacke, fossils

Wooramel Group
- Keogh Formation — Pah — Quartz greywacke, siltstone, conglomerate
- Congo Formation — Paz — Quartz greywacke, conglomerate, siltstone, fossils
- One Gum Formation — Pao — Quartz greywacke, siltstone, conglomerate
- Billidee Formation — Pae — Quartz greywacke, siltstone, plant and marine fossils
- Monument Formation — Pat — Quartz greywacke, quartz sandstone, siltstone
- Nunnery Sandstone — Pay — Quartz sandstone
- Moogooloo Sandstone — Paw — Quartz sandstone
- Callytharra Formation — Pac — Fossiliferous calcarenite, calciludite, siltstone
- Carrandibby Formation — P(a)a — Shale, siltstone, calciludite, fossils

SAKMARIAN

Lyons Group
- Weedarra Shale — Psw — Quartz greywacke, tillitic siltstone, boulder beds
- Thambrong Formation — Pst — Quartz greywacke, tillitic siltstone, boulder beds
- Mundarie Siltstone — Psm — Sandy siltstone, varved siltstone/shale/sand, boulder beds
- Koomberan Greywacke — Psk — Quartz greywacke
- Dumbardo Siltstone — Psd — Sandy siltstone, boulder beds, quartz greywacke
- Coyango Greywacke — Psc — Quartz greywacke, boulder beds
- Austin Formation — Psa — Quartz greywacke, boulder beds, siltstone
- Undifferentiated — Psl — Sandy siltstone, quartz greywacke, boulder beds

PRECAMBRIAN
- pCs — Sediments: sandstone, slate
- pCg — Granite
- pCs — Schist, gneiss

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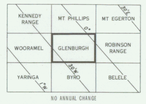

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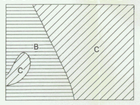
GEOLOGICAL RELIABILITY DIAGRAM



B *Detailed reconnaissance — numerous traverses with air-photo interpretation*

C *Air-photo interpretation*

Section

Scale

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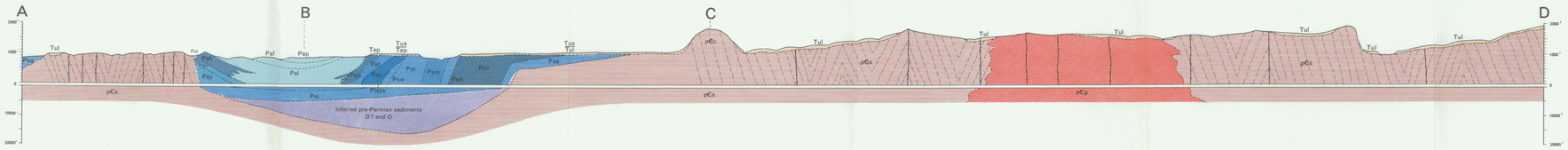
Below sea-level V/H = 1

Pleistocene and Recent formations omitted from section



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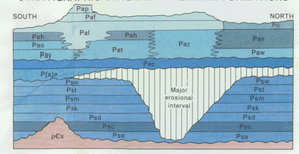

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