DEPARTMENT OF MINES
SOUTH AUSTRALIA

PRELIMINARY REPORT ON THE PRECAMBRIAN STRATIGRAPHY OF THE CARRIETON 1-MILE SHEET

by

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ABSTRACT

The Carrieton 1:63,360 map area lies about 200 miles north of Adelaide, South Australia. It contains folded rocks of the Burra, Umberatana and Wilpena Groups of the Adelaide System, of Upper Precambrian age; total thickness of these rocks exceeds 30,000 feet. Local units in the Burra Group, composed of quartzite, shale and dolomite, can be correlated only tentatively with the type-section. Units of the overlying Umberatana Group, characterised by the presence of tillite, are more readily identified, as are units of the succeeding Wilpena Group.

INTRODUCTION

The Carrieton one-mile Sheet is situated in the mid-north of South Australia, approximately 200 miles north of Adelaide. It is 476 square miles in area and is bounded by longitudes 138°30' and 139° East, and latitudes 32°15' and 32°30' South.

Mapping was carried out in March and April 1965 at a standard suitable for use on the Orroroo four-mile Sheet. Later it was decided that the area should be mapped separately at a scale of one mile to one inch. Detailed mapping was carried out in July and August 1965. Due to lack of time only the south-east and mid-east of the sheet were mapped in detail. It was decided to incorporate this mapping with the more generalised four-mile mapping of the area to produce a provisional one-mile sheet.

The following notes on the stratigraphy of the area

are meant as a guide for any further work that may be done on this sheet.

BURRA GROUP

The oldest Precambrian sedimentary sequence is referred to the Burra Group outcropping in the cores of anticlinal structures which occur near Carrieton, 2 miles west of Johnburgh, west of Minburra Station. The general sequence in the south-east of the sheet consists of feldspathic quartzite, silty shale with interbedded dolomitic bands, whitequartzite and grey dolomite with intercalated shaly bands at the top. The Yudnamutana Sub-group is of variable thickness and its base marks the upper limit of the Burra Group.

? Undalya Quartzite

In the south-east corner of the area a pale pink feldspathic quartzite exceeding 6,500 feet in thickness is thought to be equivalent to this formation. The massive to crudely bedded quartzite has discrete layers of fine- and medium-sized grains with heavy mineral banding. Silty interbeds and hard dolomitic bands, averaging a few feet thick, occasionally occur in the quartzite formation. Feldspar, generally kaolinised, occurs at some horizons. The lower portion of the Undalya Quartzite that crops out beyond the southern limits of the sheet has not been investigated. This unit may also be equivalent to the Undalya Quartzite. One and a half miles E.S.E. of Claddie Homestead there is a pink, medium-grained feldspathic sandstone which contains heavy mineral banding. It is suggested that this sandstone should also be correlated with the Undalya Quartzite.

? Lower Auburn Dolomite

In the same locality a monotonous sequence of hard grey dolomitic bands alternating with layers of laminated carbonate-rich siltstone conformably overlies the Undalya Quartzite. These sediments occupy areas of low relief where the outcrops are sporadic. The dominant feature of this sequence is the repeated occurrence of the hard dolomitic bands. On the weathered surface of the dolomitic siltstone and shale the lamination is quite conspicuous. Cleavage is poorly developed in the siltstone. White, thin, quartz bands occur occasionally in the siltstone. Brown iron oxide inclusions are common in the siltstone and shale and probably represent former pyrite. The carbonate-rich siltstone weathers to yellow soft silt, occasionally with liesegang rings.

One and a half miles east-southeast of Oladdie Homestead a sequence of fine-grained, bluish grey sandstone, banded grey silty limestone with interbedded green shale and light buff limestone was observed overlying the pink medium-grained sandstone described earlier. The sandstone unit in the upper portion of the sequence has interbeds of siltstone and a thin zone of breccias with bluish-grey, shaly angular fragments in a quartzitic matrix. This sandy unit is a dominant feature in this sequence suggesting that the correlation with the tentative Lower Auburn Formation of the south-east corner is uncertain. However, this sandy unit may be a lateral facies variant of the repeated dolomitic bands mentioned above. More detailed mapping is required to establish a reliable relationship between these two sequences.

? Watervale Sandstone Member

In the south-east corner of the area a strike ridge of quartzite trending 70° forms a prominent topographic feature.

This bedded feldspathic quartzite, which is 500 feet thick, overlies the monotonous sequence of dolomitic siltstone, is fine- to medium-grained and quite friable in parts. In some horizons dark micaceous flakes are associated with heavy mineral banding. Sedimentary facings obtained by using small scale cross bedding at a locality 3 miles S.E. of Minburra Station indicate that the quartzite is not overturned. The quartzite steepens in dip from 20° to 50° along the ridge in a south-west direction. Laminated yellow siltstone bands are occasionally developed in the quartzite.

To the west of the Minburra Station a seemingly thicker, pink, bedded quartzite forms the central part of the Bendleby Hills. Large-scale cross bedding is strongly developed. There are several sets of well developed joints, the more conspicuous being perpendicular to the bedding. The jointing has given the quartzite a blocky appearance. The small amount of feldspar in the quartzite is usually altered to white powdery kaolin. Lithologically this quartzite and the one to the south-east are quite similar and are equated by the writer. The apparent discrepancy in thickness between the two quartzites is readily explained by the flat dip of the quartzite in the Bendleby Hills.

A 300 feet thick fine-grained white quartzite crops out as a strong ridge 1 mile east of Oladdie Homestead. The limited work done on the quartzite does not provide adequate information to correlate the rock unit with the other two quartzites.

P.J. Binks recorded the occurrence of a brown quartzite with rounded quartz grains 2 miles north of Carrieton. Three miles south-west of the township he noted a white ripple marked feldspathic sandstone with interbeds of silt and shale. This unit is considerably thicker than the other quartzites.

? Upper Auburn Dolomite

In the south-east corner of the sheet the bold? Watervale Sandstone Member is sharply overlain by a thin zone of green silt and hard, thickly-bedded blue dolomite. Fine lamination occurs in the dark blue dolomite, which is pyritic. Thin lenses or stringers of chert have been observed in some horizons of the dolomitic unit. Thin interbeds of calcareous siltstone occur occasionally throughout the dolomitic unit. Estimated thickness is 800 feet.

Two miles west of Baltimore Hut near the north end of the Bendleby Hills the rock sequence overlying the feldspathic quartzite consists of grey laminated dolomite, calcareous siltstone and interbedded silty bands. At this locality the rock type immediately underlying the glacial deposit is a calcareous, laminated pale yellow shale. However, at the southern end of the Bendleby Hills, 9 miles away, P.J. Binks observed that a white fine-grained quartzite was overlain by gritty, cross-bedded sandstone and tillite. It would appear that the dolomite lenses out completely towards the south. Careful investigation of the tillite - dolomite contact is essential to establish whether it represents a disconformity.

About 1½ miles east of Oladdie Homestead the dolomitic sequence is absent and is replaced by a thin zone of greenish grey shale which overlies the bold ridge-forming quartzite. The absence of the dark blue dolomite marker bed makes stratigraphic correlation difficult. More work needs to be done in this locality.

UMBERATANA GROUP

As defined by Coats (1964) this rock unit represents the formations between the top of the "upper glacial sequence" and the base of the "lower glacial sequence". The Umberatana Group is developed in the Carrieton area with minor variations from the type area. The lowest unit of the Umberatana Group is known as the Yudnamutana Sub-Group representing the "lower glacial sequence". The only units that can be identified with certainty are the Elatina Formation, Tapley Hill Formation, and Yudnamutana Sub-Group.

Yudnamutana Sub-Group

The characteristic feature of the Yudnamutana Sub-Group is the recurrence of faceted and striated boulders of variable size and rock type. The origin of these ill-sorted sediments is believed to be glacial although slump action appeals to some American geologists. The extension of the boulder beds over vast distances favours glacial origin.

From a general investigation of the area two distinct formations are recognised within the group. The lower unit contains erratics of variable composition and size set in an argillaceous to sandy matrix, whilst the upper unit is characterised by bedded, green and partly gritty siltstone. In general the tillite appears to be conformable with the underlying dolomite of the Burra Group but detailed mapping may reveal a disconformable contact along the southwest side of the Bendleby Hills.

The tillite, which contains abundant cobbles and boulders of quartzite, granite and arkose embedded in a shaly to silty matrix, is an excellent marker. Erratics of quartzite, granite and granitic gneisses are generally rounded whereas those of shaly composition are more angular. Some granitic erratics

measure up to 2 feet in diameter. In some horizons the matrix of the tillite is calcareous. Thin felspathic sandstone with distinct cross-bedding occasionally occurs in the tillite. Fine-grained white quartzite bands are common as thin interbeds.

The massive tillite is overlain by hard, bedded green siltstone which is gritty in parts. Rounded pits resulting from grit grains from the siltstone are sometimes the only indication that therock is a tillite. The general lack of rock fragments might suggest that the sedimentation was at the closing phase of the glaciation. The grits, usually quartz, are irregularly distributed.

Systematic mapping is required to draw a boundary between the two formations. The base of a dark, well laminated shaly dolomite (Tindelpina Shale Member) defines the upper limit of the bedded gritty siltstone.

The Yudnamutana Sub-Group varies appreciably in thickness, ranging from 2,000 feet in the south-eastern corner to 300 feet one mile east of Oladdie Homestead. On the western limb of the Bendleby anticline the tillite thickens towards the south.

Tapley Hill Formation

A section near Gum Creek at the northern end of Bendleby Hills affords a continuous sequence ranging from the Burra to the Wilpena Group. A lower member of finely laminated shale and laminated slate equivalent to the Tindelpina Shale Member can be distinguished in the Tapley Hill Formation.

This unit consists of finely laminated shale, partly carbonaceous, with grey dolomitic interbeds. It is relatively easy to recognise this unit in the sequence because of the distinctive fine lamination, bedded pyrite and the appreciable carbon content which is absent in the underlying green gritty siltstone. The dark shale weathers readily to a pale yellow

colour. In a weathered specimen the rows of pyritic or limonitic cubes are parallel to the bedding. Near the base of the unit thin dolomitic bands, 3 to 5 feet thick, alternate with weathered yellow laminated shale. On the western slope of the Bendleby Hills the thin basal dolomitic band becomes gritty in parts, usually with associated quartzitic cobbles. The grits and cobbles in the lenticular dolomitic band might be derived by non-glacial erosion of the underlying glacials.

Three miles due west of Baltimore Hut, a ten-feet-thick band of shiny micaceous haematite cuts across the bedding of the Tindelpina Shale Member. The development of the haematitic veins near the base of the Tindelpina Member has been seen at a number of localities.

Well laminated, dark blue, blocky slates of the Tapley Hill Formation overlie the Tindelpina Shale Member. The blocky nature of the slate is produced by joints. On weathering the dark slate becomes a pale purple shale. In the Gum Creek section the slate is observed to be highly calcareous in the middle and the upper part of the formation. In this respect it is difficult to distinguish a carbonate sequence comparable with the Pekina Formation.

One and a half miles east of Oladdie Homestead several bands of fine-grained sandstone or sandy siltstone occur in the sequence of black laminated slate.

Willochra Formation

Owing to the lenticularity of the rock units in the mid-Umberatana Group the use of the Willochra Formation on a broad basis to include all the rock units between the Tapley Hill Formation and the Wilpena Group may reduce the difficulty of stratigraphic correlation. However, if the three topmost formations, viz. Enorama Shale, Trezona and Elatina Formations, are recognisable, then the embracing Willochra Formation may be

employed to include the monotonous siltstone and sandy siltstone together with the lenticular Etina Formation.

? Tarcowie Siltstone Member

The disappearance of the fine, even lamination typical of the Tapley Hill Formation is gradational. Consequently, the upper limit of the Tapley Hill laminated shale is subjective as the overlying grey siltstone possesses some form of inferior lamination. Towards the top of the Tapley Hill Formation the rock develops sandy lenses which pinch and swell laterally. This hard, resistant unit develops cross-lamination from which the correct facing of the rock is determined. The resistant character of the unit is indicated by the formation of a bold ridge 6 miles bearing 290°E. from Beltimore hut. Throughout the sequence the sandy siltstone is well bedded and flaggy.

To the east of Oladdie Homestead the rock unit overlying the well-laminated Tapley Hill Formation is a yellow fine-grained sandstone with strongly developed, liesegang rings. Fine, even lamination occurs in certain horizons. The unit is moderately calcareous, judging from the pitted, weathered, surface. Towards the upper portion of the unit thin layers of grits, 1 cm. in thickness, have been observed. The transition of the Tapley Hill Formation to the yellow sandstone up the sequence, appears to indicate that the succession of grey siltstone and sandy siltstone described above is missing. This may be due to non-deposition.

The pinching and swelling lenses of sand are characteristic of the Tarcowie siltstone.

Six miles bearing 290°E. from Beltimore hut the sequence of monotonous sandy siltstones is overlain by yellow fine-grained sandstone, with interbedded limestone, siltstone, and pinkish-brown medium-grained sandstone bands. The sandstone

becomes gritty towards the top. The colour of the sandstone is contributed by the weathered feldspar content of the rock. According to a petrological examination by AMDEL, the rock is a porous sandstone with sericitised feldspar and limonitic staining and no bedding features.

? Etina Formation

Overlying this yellow sandstone is a dark blue, massive, oolitic limestone, partly gritty, with white calcite crystals strongly developed near the base. This limestone is approximately 100 feet thick and forms a prominent ridge which is limited in lateral extent because of its lenticular nature. The limestone is overlain by orange, laminated shale with liesegang rings. This thin shale is overlain by greenish-grey, silty shale and pale pink sandy siltstone which has distinct lamination and forms a jagged ridge. This 200-feet sequence of shale and siltstone is dominated at the top by a pink medium-grained sandstone which forms a prominent rounded ridge. Lithology and stratigraphic position suggest that this sequence of limestone, shale and sandstone may be equivalent to the Etina Formation.

A thicker unit of grey, hard, bedded, partly gritty limestone occurs east of Oladdie Homestead. There are some thin interbeds of limy siltstone. Towards the top of the unit the limestone becomes oolitic and contains several brown calcite veins.

Enorama Shale

At Oladdie Homestead the bluish-grey oolitic limestone is overlain by fine and evenly-laminated green shales. The boundary is obscured by soil cover. Good partings along the bedding and cleavages are common. This unit is remarkably consistent in lithology at this locality. Six miles bearing 290°E. from Beltimore hut the green laminated shale overlies the sandstone ridge-former. Occasionally a lenticular bluish-grey 30-feet-thick oolitic limestone and yellow shaly band lie between the sandstone and the overlying green shale. In this locality the shale becomes siltier towards the upper portion and forms a bold ridge. The silty and partly sandy character of the green shale is due to quartzitic lenses. The characteristic lithology equates this unit with the Enorama Shale. The Enorama Shale persists throughout the entire area.

Trezona Formation

Six and a half miles bearing 290°E. from Beltimore hut, a 40-feet-thick, hard, pale pink limestone occurs at the top of the green shale. This limestone is characterised by numerous dark brown flakes which produce the hieroglyphic effect. The limestone occurs as lenses of limited lateral extent in this horizon, interbedded with grey shaly bands. This limestone with the characteristic 'hieroglyphic' markings is correlated with the Trezona Formation. At this locality, the 'hieroglyphic' limestone is overlain by a pink medium-grained sandstone one quarter of a mile west of Oladdie Homestead. No such development of limestone was observed above the Enorama Shale. The latter is sharply overlain by a purple medium-grained sandstone which forms prominent ridges. This 100-feet-thick sandstone is a good marker because it defines the topmost formation of the Umberatana Group. Grits occasionally occur

at the base of this unit. South of Oladdie Creek the west-dipping sandstone unit is cut by shears. This sandstone is considered to be the Elatina Formation.

WILPENA GROUP

The Wilpena Group consists of a characteristic sequence of rocks corresponding in time interval to the upper portion of the Marinoan Series in the Adelaide System. It is well established in the Flinders Ranges and its formations are recognizable in the Carrieton area.

Field investigation was concentrated on the upper part forming the Price's Range Syncline 8 miles north of Carrieton and the elongate syncline 10 miles north-north-west of Johnburgh.

Nuccaleena Formation

The basal rock unit of the Wilpena Group is the Nuccaleena Formation which is a characteristically thin, pink-yellow-weathering dolomite (4 - 6 feet thick) with overlying purple laminated shale. This formation overlies the topmost rock unit, the Elatina Formation, of the Umberatana Group. However, the pink dolomite is very lenticular but the more persistent purple shale is generally present. The pink dolomite occurs 1 mile bearing 250°E. from Oladdie Homestead. At this locality the dolomite is 4 feet thick and limited in lateral extent. In the Price's Range and elongate synclines investigated, the Nuccaleena Formation is recognised by the good development of the purple, thinly bedded shale above the Elatina Sandstone, although the pink dolomite is absent. It should be noted that lenses of pink dolomite occur below and within the Elatina

Sandstone. The dolomites below were observed 1½ miles south of Oladdie Creek while those within the formation were seen 3 miles bearing 80° from Carrieton. In the latter case the dolomite with a thin zone ofoverlying purple shale is overlain by pink gritty sandstones which resemble the Elatina Sandstone.

Ulupa Siltstone

In the Prices' Range syncline the shaly Nuccaleena Formation grades upwards into a sequence of outcropping green shale and siltstone with strongly developed lamination. Ripple marks occur near the top of the green shaly sequence. One mile bearing 290° from Sandil Park the olive green evenly-laminated shale has interbedded purple sandstone and yellow siltstone. The hard banded sandstone with fine- to medium grains is strongly marked by liesegang rings. Distinct cross-bedding is well developed in the sandstone.

A.B.C. Range Quartzite

The green shaly sequence in the Prices' Range syncline is overlain by a medium-grained, banded pale purple orthoquartzite. The A.B.C. Range Quartzite forms a bold ridge with a scarp-like outer wall. Near the contact the brownish-grey, drab and fine-grained sandstone with irregular banding is regarded as the topmost member of the underlying Ulupa Siltstone. Heavy mineral bandings occur occasionally in the unit. The small amount of feldspar present in the quartzite has been weathered to a white powder. The quartzite measures 300 feet in thickness on the eastern limb of the syncline.

In the elongate syncline 3 miles east of Carrieton the quartzite is absent; it was probably eroded prior to the

deposition of the Wonoka Formation.

Bunyeroo Formation

The contact between the A.D.C. Range Quartzite and the overlying purple shale of the Bunyeroo Formation is well defined. Steeply west-dipping cleavages are strongly developed. Consequently, good partings parallel to cleavages predominate over the poorly-developed partings along the bedding plane. However, with the occurrence of interbedded olive green shale the bedding plane becomes better defined. This purple shale is readily susceptible to weathering resulting in a bleached pale yellow shale. The fresh shale is highly friable or brittle. The formation is approximately 2,000 feet thick.

The absence of the shale in the syncline 3 miles east of Carrieton is attributed to erosion prior to deposition of the Wonoka Formation.

Wonoka Formation

A conglomeratic zone with elongated pebbles and cobbles of quartz and shaly fragments set in a limy matrix occurs 1½ miles bearing 290°E. from Sandil Park. This 50 feet band of conglomerate is overlain by pale blue, well-bedded fine-grained calcareous sandstone. There are thin shaly interbeds in the conglomerate. On the western side of the syncline the conglomerate is noticeably thicker, about 200 feet. Light blue, clean, micaceous fine-grained sandstone occurs as interbeds in the conglomerate. From photo interpretation, this unit appears to lie disconformably on top of the Ulupa Siltstone sequences and the boundary is apparently an erosional surface. However,

further detailed mapping is vital for the confirmation of the disconformity between the Wonoka Formation and the Ulupa Siltstone.

CONCLUSIONS

Sediments referable to the Burra, Umberatana and Wilpena Groups of the Adelaide System outcrop over 60% of the area contained within the Carrieton 1:63,360 Sheet. The total thickness of this sequence of rocks, measured from the aerial photographs, is estimated at more than 30,000 feet in the north eastern corner of the area. The rock units are tentatively correlated with those established in the Central Flinders Ranges and Burra regions. Because of the absence of marker beds and mappable contacts within the middle to upper Umberatana Group it may be necessary to represent this sequence as an undifferentiated unit.

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EXPLANATION OF MAP LEGEND

Carrieton 1:63,360 area

Pww	WONOKA FORMATION: (?)	Brecciola limestone with shaly fragments, quartz pebbles and associated bluish-grey fine grained sandstone.
Pwb	BUNYEROO FORMATION:	Reddish purple, heavily cleaved shale, poorly bedded, weathered to pale yellow.
Pwa	A.B.C. RANGE QUARTZITE:	Pale purple, clean banded quartzite, generally medium-grained with powdery felspar.
Pwr	BRACHINA FORMATION:	Olive grey shale and siltstone, laminated with some sandy lenses.
Pwn	NUCCALEENA FORMATION:	Purple, well laminated shale with basal lenticular, pink dolomite band.
Puo	ELATINA FORMATION:	Purplish pink, medium grained, felspathic sandstone partly gritty, with dark mineral bands.
Puz	TRINDONA FORMATION:(?)	Dense purplish limestone, no hieroglyphic marking observed.
Puo	ENORAMA SHALE:	Green well-laminated shale and siltstone.
		Yellow laminated shale, grey silt and pink fine to medium grained S.S., overlying dark bluish grey, massive gritty limestone; pink medium grained felspathic S.S.
Put	TAPLEY HILL F:	Finely and evenly laminated, dark grey shale and slate.
	TINDELPINA SHALE MEMBER:	Finely laminated, black partly carbonaceous shale with bedded pyrite crystals, weathered to pale purple.
Pug	YUDNAMUTANA SUBGROUP (Undifferentiated)	Greenish grey, flaggy siltstone, partly gritty and bedded; massive boulder tillite with intercalated white quartzite bands.
$Pba_{a_1}^{2}$	AUBURN DOLOMITE:	Dark bluish grey, dense dolomite with cherty blebs in parts, greenish-grey shale; a felspathic quartzite member underlain by a sequence of dolomitic bands alternating with calcareous sil
Pbw	WATERVALE SANDSTONE MEMBER:	Bedded, white felspathic fine-to medium-grained quartzite.
Pbu	UNDALYA QUARTZITE:	Pale pink felspathic quartzite, fine to coarse grained with interbedded silt and thin dark mineral banding.
Pc	DIAPHIC ROCKS	Contorted phyllite, dolomite and siltstone.

S.A. DEPT. OF MINES

CARRIETON

SCALE 60 CHAINS TO 1 INCH

64-574
Ff+jk

YEDNALUE

ORRORDO

PRICE HILL

MARCHANT HILL

CARRIETON EAST

CARRIETON WEST

CARRIETON

Wirra Dowis HS

Wood Vale HS

Sandhill Dam HS

Grotto HS

Warna Plain

Wilkatoo Creek

Qr Recent alluvium and recent alluvial plains

Qrt Slope deposits

T Tertiary duricrust

CAINOZOIC — TERTIARY QUATERNARY — RECENT

PROTEROZOIC — ADELAIDE SYSTEM

MARINOAN — WILPENA GROUP

- Pww Yondoka Formation
- Pwb Bunyeroo Formation
- Pwa A B C Range Quartzite
- Pwr Brachina Formation
- Pwn Nooalleena Formation
- Pue Elatina Formation
- Puz Rezona Formation
- Puo Rhynie Sandstone Formation
- Puw Willoochra Formation

UMBERATANA GROUP

STURTIAN

- Put Appley Hill Formation
  - Tapalpina Member
- Pug Yudnamutana Sub-Group [Undifferentiated]

TORRENSIAN — WILLOURAN — CALLANNA BEDS

- Pba3 Auburn Dolomite
- Pbw Watervale Sandstone Member
- Pba1
- Pbu Undalya Sandstone

- Pc Cadnia Rocks

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