THE UNIVERSITY OF ADELAIDE

DEPARTMENT OF GEOLOGY AND MINERALOGY

GEOLOGY OF THE MT. CHAMBERS GORGE REGION, FLINDERS RANGES, SOUTH AUSTRALIA

Report on Geological Investigations
Submitted in Partial Fulfilment of the
Course Requirements of
Honours Geology

by

Trevor J. Mount, B.Sc.

October, 1970

Supervisor: B Daily


MT CHAMBERS GORGE
GEOLOGICAL MAPPING
JUNE 1970
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2

Note by Dr Trev. J. Mount on his Honours Thesis on the Geology of the Mt. Chambers Gorge Region, Flinders Ranges, South Australia.

The work was completed in 1970 at the School of Geology, Adelaide University., South Australia.

The thesis was presented, late 1970, to the school in three parts: (i) the report, with plates and field notes etc, in a black Fortis three-ring folder (this volume), *together with* (ii) a large (A2 to A1 size?) folder bound in 'mission brown' cloth with a name plate in gold lettering ('Geology of the Mt Chambers Gorge Region' ?), that held the original hand-coloured geological map, other diagrams (such as a 3D representation of the mega-breccia channel), and coloured stratigraphic sections (including the measured Type Section of the Moorowie Formation) etc., and (iii) a tray of rock specimens from the map area.

In August 2011, the University was unable to locate either the thesis text or the map folder, but did find the rock specimens in the geology department's basement.

Although the original thesis appears to be lost, the geology school says they will retain the specimen tray (Aug. 2011).

However, the author had retained a personal copy of the thesis, until about 1996 when the large map folder (above) was passed to Alan Tasker (02 9273 1429 in Aug. 2011), Field Officer for the Original Materials Section of the Mitchell Library, State Library of NSW, for evaluation.

It had been assumed that the SLNSW had retained the map folder, until in August 2011 a possible reference to it was found in the National Library's Trove database which pointed to item "PRG 1429/5, Geology of Mount Chamber Gorge region, tracings and maps", as held at the State Library of *South Australia* (SLSA).

In August 2011, Tonia Eldridge at the SLSA archive (eldridge.tonia@slsa.sa.gov.au 08 8207 7260) was asked to 'confirm that the library holds a copy of the missing map folder'.

If the archive confirms it holds the map folder, then the 'black folder' bearing this note will be sent to Adelaide for permanent storage under (?) PRG 1429/5.

Sydney,
25 August, 2011
trev.mount@gmail.com

SMS: 0410 647366

June 11, 1982

Dr. Colin H.H. Conor,
Programme Secretary
Geological Society of Australia
Seltrust Mining Corp. Pty. Ltd.
P.O. Box 219,
EASTWOOD, S.A. 5063

Dear Colin,

GSA Meeting, July 15th 1982

Following our lunchtime meeting I can now provide details on my contributions to the presentation 'Reefs through the Ages'. In 1970 while mapping the geology of the Moorowie area at the eastern end of Mt. Chambers Gorge, Flinders Ranges, some unusual lithologies were found in the Early Cambrian Hawker Group that recalled certain features of modern reef complexes.

Apart from an abundance of massive archaeocyathid-algal limestone there were found spectacular mega-breccias and slump brecciolas suggestive of fore-reef talus environments, as well as ôôlites and thick clastic carbonate banks such as occur around modern reefs. The archaeocyathid limestones seem to be localized in a band along the upthrown edge of a major fault-scarp. On the downthrown block were deposited dark hemi-pelagic 'Parara'-type limestones with the talus mega breccias while on the upthrown shelf were found carbonate facies such as birdseye limestones and ôôlites formed in a shallow hypersaline backreef to sabkka environment.

The Moorowie area is structurally and stratigraphically complex and exposures of dig facies very limited. The existence of an Early Cambrian Arch-algal reef is not proven but a series of 35 mm slides will be shown that show some intriguing parallels with later Palaeozoic 'reefs' and modern complexes.

As for lithographic information:-

- BSc Hons (Adel) Geology of the Mt. Chambers Gorge Region with emphasis on Cambrian carbonates and 'diapirs'
- PhD (Adel.) Diapirism in the Adelaide "Geosyncline'
- now at Delhi Petroleum (Adel.) - looking for hydrocarbons in the Arrowie and Eromanga Basins

Yours very truly,

Dr. Trev H. Mount

CONTENTS

NOTE: FOLDER, 22 by 30 inches, is presented separately to the thesis and contains:

1. Geological Map, Mt. Chambers Gorge Region (1,2)
2. Geological Map, Mt. John Syncline (3)
3. Overlay 1, showing
   a) Mineralization
   b) Dolerites
   c) Diapirs
   d) Faults, including Fault Rose
   e) Main Folds
4. Overlay 2, with
   a) Stratigraphic section Lines
   b) Key Trilobite Localities
   c) Reference Stations
   d) Suggested Place Names
5. Combined fence diagram and stratigraphic column giving an interpretation of vertical and lateral variation in Cambrian sediments as inferred from measured stratigraphic sections. Includes suggested stratigraphic nomenclature and gives average thicknesses of all Cambrian units
6,7,8 Graphic stratigraphic columns compiled from measured sections (A to Z) and coloured to approximate fresh rock. 10,000 feet represented, plotted at 100' to inch vertical scale.
9. PLATE 6: Panoramic photographs, retouched, to show nature and extent of Cambrian outcrop in Map Areas 1 & 2 (Mt. Chambers Gorge) presented in accompanying folder under 'Cambrian outcrop'.

ABSTRACT

Mapping and section measuring South of Mt. Chambers Gorge has detailed 2,900 feet of Lower Cambrian carbonates, ranging from the massive carbonates of the Wilkawillina Limestone to the purple shales of the Billy Creek Formation. Carbonates include thinly laminated, oolitic and pelletal limestones and previously unreported mega-breccias. An autochthonous sedimentary pattern, typical of deposition in epeiric seas has been imprinted on the vertical sequence by a marine regression. This tends to be masked by allochthonous sediments, dominantly silts, clay and a coarse quartz sand, possibly eroded from diapirs. Brecciolas (slumps) with archaeocyathid limestone megaclasts (to 70ft.) occur locally in the upper beds of the Parara Formation and may help to date diapiric movements. Late phase dolerites intrude diapirs and cut related faults; mineralization is also diapir associated and includes copper and lead sulphides.

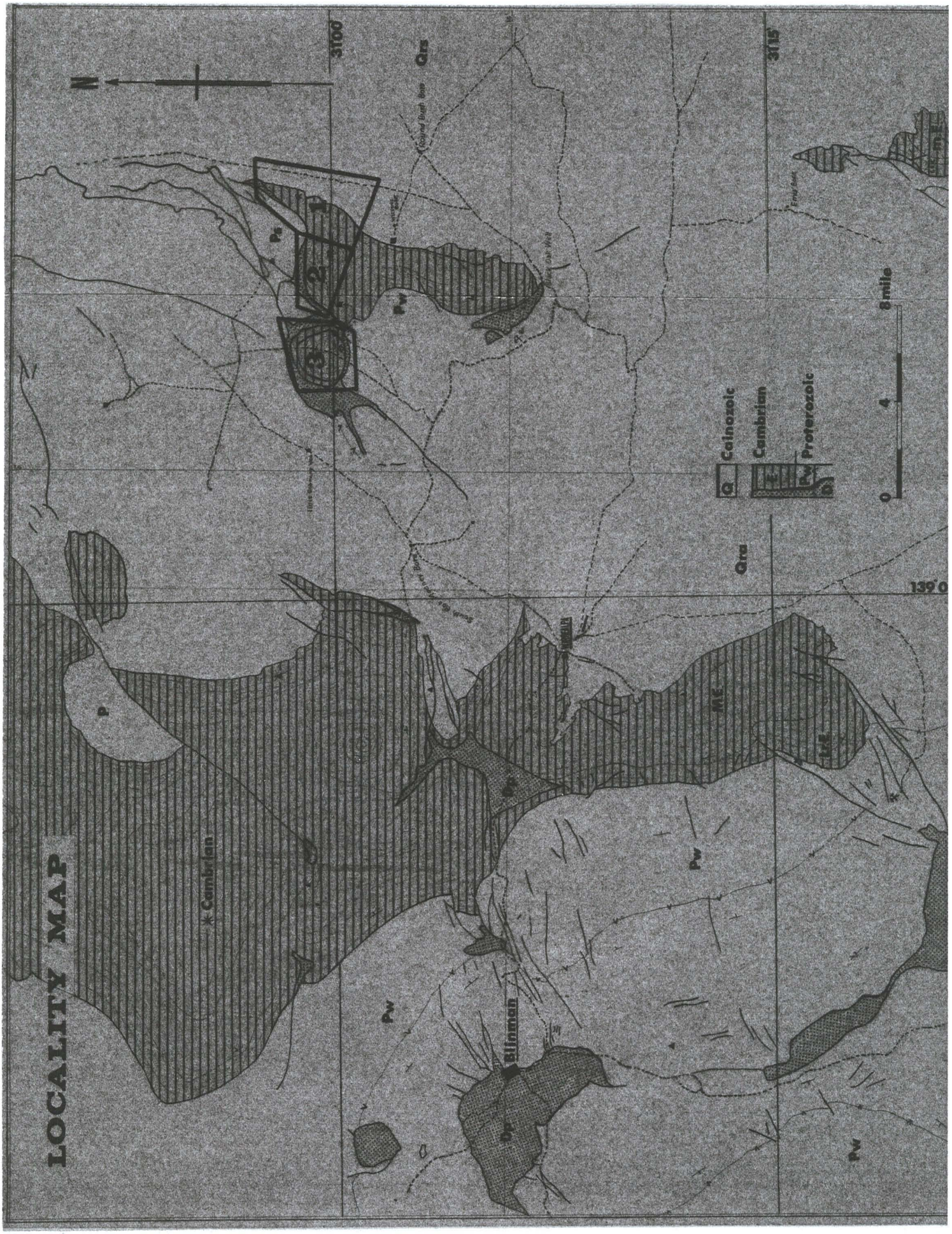
INTRODUCTION

Mt. Chambers Gorge is situated in east-central South Australia, 35 to 38 miles N73°E of Blinman. The area studied resembles a 10 by 4 mile rectangle with Chambers Gorge as the northern length and the 31°00' line of latitude bisecting the area to the south.

Cambrian rocks form the southern extension of a low range between Mt. Frome and Mt. Chambers to the north. The plains and salt flats of Lake Frome lie to the east, the range rising in marked topographic contrast to over 400ft. above them.

Outwash fans radiate from the foot of the scarp and merge into the playa environments (Plate 6, in folder). Low rounded hills mark the Cambrian in the north east of the map area and grade south over a series of stepped fault blocks into a more rugged terrain deeply dissected by spectacular gorges in which almost complete stratigraphic sections are exposed. Vegetation is of two types: (1) the low grasses and sparse bush of the plains, with heavier growth on the distributaries of the alluvial fans (including quondong thickets), and bare gibber and bulldust patches, (2) the hill-type with very sparse native pine and scrub on the flanks of the gorges. Hilltops are frequently barren and ti-tree eucalypt growths are restricted to Mt. Chambers Gorge. The climate is continental and marginal-arid type with a low rainfall and long, hot dry summers. Streams are ephemeral. Drinking water is a problem and unless brought to the area can only be obtained from one of 7 bores (in 260 sq. mls) or from pools in the Gorge. The quality of the water and distance to the bores varies and the map area was divided into three zones.

Zone 1 (see Locality Map) was mapped in March and April, 1970, from a camp located 0.6 miles due west of Wilsons Bore, just south of the map area, and was shared with geologists Hatcher and Wigglesworth who were involved in mapping the southerly adjoining area. Detailed stratigraphic sections, 10,000ft. in all, were measured in Map Zone 1 and chip samples taken at least every 10ft. The descriptions appear, with Plates A to E, in Appendix I and three sheets of graphic columns, coloured to approximate the fresh rock, appear in the folder accompanying this report. An August camp was


LOCALITY MAP
N
3100'
3115'
139°0
Qra
Cainozoic
Cambrian
Proterozoic
Q
Pw
0
4
8mile
Cambrian
Blinman
P
Pw
Pe

located at the Mt. Chambers copper mine in the south west of Map Zone 2 from which this and Zone 3 (Mt. John Syncline) were mapped. Only two days were spent in the Mt. John area on reconnaissance mapping, considered incomplete. Two geological maps are presented in the accompanying folder. The "Mt. Chambers Gorge" map, hereafter referred to as Zones 1 and 2, and the smaller separate map, with less detail, of the Mt. John Syncline, Zone 3. (A single detailed section was run in this area and rock and fossil specimens can be obtained from the author).

Initial access to the map area was by 4-wheel drive vehicles along bulldust tracks to a base camp at the foot of the range and from there daily excursions were made into individual map areas using 90c.c. trail-geared motor bikes. These proved indispensable in terms of mobility, time saved, and as a means of retreat to Wirrealpa Station, 28 road miles to the south west. Mapping and section measuring were done on foot and geological fact marked directly onto air-photo enlargements. (SVY. 952, S.A., 11, 12, 13 and SVY. 803, S.A., 62 to 67). Hand specimens for later analysis were taken and photographs supplemented field notes. Station locations are shown on a map overlay in the accompanying folder. Details of section measuring techniques are given in Appendix I.

Careful attention was given to the palaeontology of the area and faunal collections were presented to Dr. B. Daily for identification. Key trilobite localities are shown on an accompanying overlay and faunal horizons are marked on the graphic columns with their supporting descriptions in Appendix I.

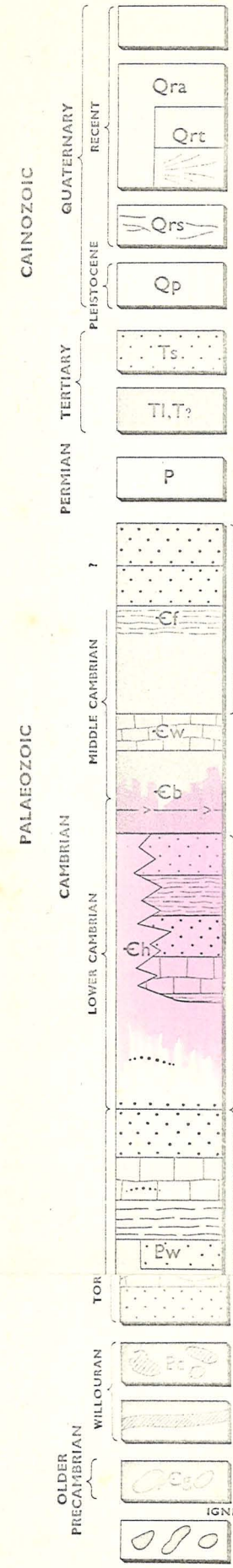
Laboratory work concentrated on the rock specimens, especially those from the measured stratigraphic sections, which were cut, moistened and subjected to binocular examination under low magnification, the information being used to upgrade the column descriptions. Thin sections of certain representative or problematical lithologies were prepared, and some stained with an Alazarin-Red S, Potassium Ferricyanide solution to differentiate between calcite, ferro carbonates and dolomite. Thin sections and techniques are fully described and listed in Appendix IIb and are presented with a single tray of representative hand specimens to be held by the Geology Department of Adelaide University under the accession number A343.

The rocks presented represent two groups: (1) Those from the measured sections (see Overlay 2) described and listed in Appendix I; Code, A343/ followed by the section designation and a position in it in feet - e.g. A343/ J260ft. and 'T.S.' if thin sectioned, the slide bearing the same designation but with a black triangle to the right, above the code letters, (2) rocks collected at the stations (see Overlay 2). A list and descriptions are given in Appendix IIa. The prefix A343 is followed by the station designation and occasionally a specific sample letter - e.g. A343/C.G.40.a. with 'T.S.' if thin sectioned.

A fence diagram and combined stratigraphic column summarizing the laboratory work and incorporating all other data is presented in the accompanying folder. It shows the interpreted vertical and lateral association of Cambrian lithofacies in the map area, Zones 1 and 2. It is stressed that this is a rock-unit diagram only and contacts shown are almost certainly diachronous. Standard unit numbers, from 1 to 12 are used throughout this work. The South Australian Mines Department have included parts of the map area on their 4 mile to the inch 'Parachilna' sheet and on the Arrowie 1 mile to the inch geological map but have failed to subdivide the Cambrian succession mapping it as one formation when in fact 12 clearly defined units including both carbonates and clastics are present. The geological map presented with this thesis is to be incorporated in their Copley 4 mile to the inch map. Geochemical data is available from the Electrolytic Zinc Company who hold a lease over the area.

1. REGIONAL GEOLOGY

Before describing in detail the stratigraphy of the Mt. Chambers Gorge area, its regional history must be reviewed. The crystalline "Archaean" basement rocks and their response to major crustal stresses have largely determined the magnitude, nature and timing of geological events and include patterns of subsequent deformation and intrusion. This area of crustal weakness, the Adelaide Geosyncline, extends along a north-south (to north-west) axis from the Mt. Lofty Ranges to the north of the state. The tectonic setting of the geosyncline during the late Proterozoic can be considered as an area of gentle platform downwarp adjacent to rising basement flanks; the



Lake deposits. Gypseous clays, saline silts and quartz sands.

Alluvium of drainage channels and flood plains.

Low-angle slope deposits.

Scree deposits and well-defined outwash fans.

Sand of ridges and dune spreads.

High-level dissected piedmont gravels, often kunkarised. Lacustrine sediments, gypsite and limestone. Jasper breccia east of Mt. Frome.

Duricrust developed on Tertiary sands marginal to Pirie-Torrens Basin.

Grey shales with basal polished pebble conglomerate. Case-hardened pebbly calcareous sands and silts near Grindstone Range.

Glacial boulder clays and sandy conglomerates south of Blinman.

GRINDSTONE RANGE SANDSTONE: Crossbedded sandstones with well-rounded white quartzite pebbles in upper part.

PANTAPINNA SANDSTONE: Pink argillaceous sandstone with large scale crossbedding and heavy mineral banding.

BALCORACANA FORMATION: Red-brown and green micaceous siltstones and thin grey dolomitic limestones, repetitively bedded.

MOODLATANA FORMATION: Friable red-brown arkosic sandstone. Crossbedding common. Thin dolomitic limestone near the base.

WIRREALPA LIMESTONE: Grey nodular and shaly limestone with brachiopods and trilobite fragments. Massive bed at base.

BILLY CREEK FORMATION: Red-brown micaceous sandstones and shales with halite pseudomorphs. Basal flaggy limestone followed by red and green shales with tuffaceous interbeds.

NARINA GREYWACKE: Grey-green calcareous siltstones and chloritic sandstones.

ORAPARINNA SHALE: Green carbonaceous siltstones with trilobites, brachiopods, hyolithids and rarely archaeocyathids.

BUNKERS SANDSTONE: Crossbedded sandstone with calcareous interbeds.

PARARA LIMESTONE: Dark, flaggy and silty limestones with interbedded shales.

WILKAWILLINA LIMESTONE: Massive biostromal archaeocyathid limestones with brachiopods. Dolomitic and sandy near the base with algal and oolitic beds. Local conglomerates near Frome and Wirrealpa Diapirs. Biohermal bank south of Ten Mile Creek.

PARACHILNA FORMATION: Argillaceous sandstones with vertical burrows. Oolitic and shaly lenses.

POUND QUARTZITE: Resistant white quartzite with minor shale bands above red crossbedded feldspathic sandstone.

WONOKA FORMATION: Grey calcareous shale with flaggy limestone interbeds. Becoming increasingly silty to the south-west. Pebble beds west of the Frome Diapir.

BUNYEROO FORMATION: Grey-green and red dolomitic shales.

A.B.C. RANGE QUARTZITE: Ripple-marked and cross-bedded feldspathic sandstone with heavy mineral laminae. dolomites. Thin beds with magnesite pellets.

EMEROO QUARTZITE: Crossbedded feldspathic sandstones, interbedded siltstones.

Dolomites, siltstones, and sandstones of inferred Willouran age included as rafts in diapiric breccia.

Melaphyres, amygdaloidal in part, interbedded with tuffs and siltstones in diapiric rafts.

Blocks of granite basement incorporated in Blinman Diapir.

Dolerites intruding the core of the Blinman Diapir.

subsequent marine incursion resulting in the deposition of up to 80,000ft. of sediments in the trough. This is the type area for the Adelaide System and four series are recognized: The Willouran (from diapiric exposures), the Torrensian, Sturtian (with glacials) and the Marinoan at the close of Proterozoic time. (The relationships are summarized in the enclosed stratigraphic column from the Parachilna 4 mile to the inch geological map published by the Geological Survey of South Australia). Scattered diapirs often domed the Proterozoic sediments, sometimes piercing them to shed debris into the adjoining epeiric seas. The major sources of sediment were the Gawler Platform to the west of the trough, and locally, the marginal basement blocks of the Willyama complex and other land exposed to the east. (These crystalline and substable eastern blocks were tectonically positive during the Lower Cambrian).

Within the Adelaide Geosyncline the Cambrian to Ordovician(?) sediments are thought to represent the last depositional event before the final deformati of this mobile trough in early Palaeozoic time. Cambrian transgression and deposition followed a late Adelaidian regression and led to thick carbonate sequences (Hawker Group) being deposited on the floor of the gently subsiding basin. Stabilization of this basin towards the end of the Lower Cambrian led to a regression of the sea, which began in the Mt. Scott area and extended south, with progressively more saline members of the autochthonous epeiric series being deposited in a given area. It is this transgression and regression (penultimate to the Palaeozoic orogeny) that the rocks mapped at Mt. Chambers Gorge represent. Upper Cambrian to Ordovician deformation resulted in broad arch folds with diapiric piercements by Willouran rock. Cambrian sediments have survived as cores to the broad, shallow synclines in the older rocks. Later deformation and deposition is restricted to Tertiary deposits and Pleistocene lacustrine and residual accumulations with broad arching and reactivation of older lines of weakness.

2. STRATIGRAPHY [1]

A. PROTEROZOIC DEPOSITS:

The oldest rocks in the area are of inferred Willouran age and occur

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1 For details of vertical and lateral facies variation within the Cambrian units and for average thickness determinations refer to the fence diagram in the accompanying folder.

only in diapirs.

Two rock units from the Umberatana Group are recognized:

(a) TAPLEY HILL FORMATION: Extensive outcrop of blue-grey to pale green, thinly laminated shales, probably at least several hundreds of feet in thickness and forming the spectacular cliffs and deep ravines of the Mt. Chambers Gorge area are faulted against younger Cambrian rocks in the north of Zones 1 and 2. In mapping of the Arrowie 1 mile sheet (Horwitz, 1962) extensive shear zones along the fault have been confused with diapiric material. Locally, in the shear zone hydrothermal alteration of rocks on both sides of the fault is extensive and again this has been confused with diapiric material. Diapiric dykes up to 2ft. thick and filled with a carbonate-sandstone breccia cut the formation in the Gorge. *

(b) WOCKERAWIRRA DOLOMITE: (?) A yellow weathering unit observed above the Tapley Hill shales, generally high up on the hills of the flat lying sequences of the Mt. Chambers Gorge area may be the Wockerawirra dolomite. Erosion of this unit from outcrop or blocks in an exposed diapir suggests possible sources for certain yellowish and dolomitic clasts which are curiously ubiquitous in Cambrian rocks.

B. CAMBRIAN DEPOSITS:

(a) Hawker Group:

The basal Parachilna Formation is not exposed in map Zones 1 and 2 and the sequence begins with the upper WILKAWILLINA LIMESTONE (Unit 1): outcrop is believed to occur in central Zone 2, Stations (ii) and (k) and was seen in the west near the Mt. Chambers Mine. The exposure examined in detail (Section P, Appendix I) is limited to the core of a large north plunging anticline (Fold 3) in the south east corner of the map area (Zone 1). The eastern limb of this fold has been downthrown by at least 1,900ft. along a major fault that runs along the edge of the range. Numerous splinter faults of lesser magnitude, often with calcite, pyrolusite or jasper veins cut the western limb. Breccia zones, transecting the bedding, are shown in Figure 2, Plate 5. Figure 6, Plate 5 shows an outcrop of possible diapiric material that could be associated with the faulting and lies in a major crush

zone in Unit 1, just west of Station 2 (North Boundary Creek).

Lithologically, the unit is a massive, 2 to 6ft. bedded, silty yellow to buff limestone (Figure 5, Plate 5) with the internal colour grading from pink, light grey in patches, to a limonitic buff-brown (siderite?). Sandy and oolitic to pelletal limestone beds crop out near Station 1 and suggest shallow marine conditions with well agitated and well oxygenated waters. The light colour of the limestones supports these conclusions and suggests complete oxidation of any organic compounds which could have darkened the unit or given rise to reducing conditions with the formation of disseminated sulphides. Both conclusions are supported by palaeoecological reasoning based on the fauna present in the rock (Faunal assemblage 2, Daily, 1956). Archaeocyathids and brachiopods (Huenella etheridgei) have been recognized in large numbers and "the enigmatic phosphatic fossil incorrectly referred by Walcott (1912) to Micromitra (Paterina) etheridgei." (B. Daily, pers. comm.).

The presence of Huenella sp., a sessile benthonic organism (filter feeder) suggests shallow marine conditions with currents to supply food and oxygen and remove wastes; however the fossils could be members of an allochthonous thanatocoenosis and the inference is better supported by the archaeocyathids. These members of the benthos are believed to be true biostromal organisms, occasionally reef forming, and could have existed in shallow marine epeiric seas away from the palaeoshorelines and in the less restricted environments of the shelf margins. Assuming a similar ecological niche within the photic zone for the archaeocyathids as for modern corals and allowing for the clouding effect of suspended clay and silt, a water depth of less than 100ft. is probable for the depositional environment of the Wilkawillina Limestone. It may correspond to the least restricted zone of the autochthonous sedimentary pattern for epeiric seas proposed by Shaw (1964).

Overlying the Wilkawillina Limestone in the map area, excluding the north east, are extensive outcrops of the PARARA LIMESTONE. For descriptive purposes it is divided into five units, 2 to 6, which genetically are better considered as one unit with two tongues or interbeds - namely the Bendieuta

Member (Unit 3), the unit above the Lower Parara Limestone (Unit 2) and the 'Middle Lens' (Unit 5), the middle unit of the Upper Parara Limestone. The Bendieuta Member is lenticular and thins from over 380ft. to tens of feet in the west. Section M (Appendix I) includes the Lower Parara Limestone but it was only in the south east of the map area that the unit was examined in detail.

THE LOWER PARARA LIMESTONE (Unit 2): vertically and laterally this unit is rather variable but in the south east of the map area can be described as a medium (base) to dark (top) grey rubbly to laminated or flaggy limestone with pencil thin, greenish, argillaceous partings between the beds. The contact with Unit 1 is not well exposed but lack of obvious transition beds may indicate a disconformity. The upper contact with Unit 3, however, (Plate D, Appendix I) is clearly visible and has 1ft. thick transitional beds of mixed facies over a thickness 10 to 15ft. A silicified fossil fauna (Daily's Faunal assemblage 3 to 4?) can be collected from the top beds of the unit and includes a large trilobite, almost 3 inches wide, "the cranidia of which are typical of species belonging to the Redlichiacea" (B. Daily, pers. comm.). Long occipital trilobite spines are also present in the debris with hyolithids, brachiopods, rare archaeocyathids and Helcionella (B. Daily, pers. comm.). Current action was probably weak but variable and periodic, occasionally strong enough to sort and align fossil debris. Suspended clay may have restricted light penetration into the water. The inferred environment of deposition is deep-water marine, beyond the shelf environment of Unit 1

BENDIEUTA MEMBER (Unit 3): again the best exposures of this unit are in the south east of the area where nearly 400ft. thickness have been measured (Section M, Appendix I). To the west the unit thins to tens of feet within a mile and these were not studied in detail.

A marine regression beginning with Unit 2 implies that progressively higher units in the sequence should bear evidence of increasingly restricted circulation and more saline, shallower conditions. Fine grained limestones and perhaps dolomites, with a sparse biota and little evidence of mechanical energy could be expected from model considerations (Shaw, 1964). Grain

size increase of terriginous elements would be probable with no local sources such as diapiric islands. The Bendieuta Member satisfies most of these criteria but appears to contradict the requirement of low energy. Ripple marks are common (Figure 3, Plate 2) with a wavelength of about 3 inches. Dolomitic clasts have been swept into the depositional environment, some up to 6 by 3 inches (Plate D, Appendix I), and the 'fine-grained limestone' occurs as 0.5 to 2mm. subspherical to ellipsoidal well rounded pellets. Some are dolomitic and the matrix is a clear grey to silty yellow limestone. Silt influx has occurred in cycles, giving a mottled appearance to the unit and is associated with an almost ubiquitous coarse to very coarse quartz sand. A petrological study of the quartz granules shows that over 80% occur as single grains; about 0.5 to 3mm. in diameter depending on the bed, are well rounded (0.8), spherical (0.7), xenomorphic, irregular subequant, sometimes with re-entrant angles, contain numerous inclusions and over 95% have none-undulose (straight) extinction. A plutonic origin is suggested, but an intermediate source such as a diapir is likely for the area; authigenic quartz is present.

The rock is buff-coloured in the silty pelletal beds and light grey in the wholly pelletal horizons. Beds are up to 15ft. thick and very massive. Biota is sparse, and apart from brachiopods near the base, is limited to rare archaeocyathid fragments, probably derived laterally. Karren type weathering is common and well developed (Figure 4, Plate 4). The top of the unit is marked by a darkening of Unit 3 with quartz grains up to 3mm. in places, then a very persistent bed of dolomitic clasts (A343/C40ft.) with a marked imbrication (C63, Plate A, Appendix I). The contact itself is usually sharp (top and bottom left, Plate B, Appendix I) with little evidence of transitional beds; a hiatus may be indicated.

UPPER PARARA LIMESTONE (Lower horizon) (Unit 4): although typical outcrop[1] is restricted to the south east of the map area, Stations 6 and 18, a thin unit near Station 25 may be its westerly equivalent. The unit has been closely examined and summarized in Appendix I, Sections A, C, E and N, and lithologically is a dark grey limestone with 2 to 3 inch flags separated by

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1 (Bottom left, Plate B, top left, Plate A, Appendix I)

thin, 1 inch argillaceous partings. The basal few feet are rather more shaley and grade up into silty beds with quartz sand, often coarse, and associated imbricated dolomitic clasts up to 4 inches long. The environment of deposition is, however, interpreted as off-shore marine with restricted circulation, dominantly quiet conditions and spasmodic currents which introduced an allochthonous content and sorted faunal debris. Fossils are numerous, especially in certain siliceous beds (chert nodules, Figure A192ft., Plate A, Appendix I) and include hyolithids (H. planoconvexa?), rare archaeocyathids, the brachiopod 'Linqulella' (B. Daily, pers. comm.) and a large trilobite with axial segments up to 1.4cm. wide. Affinities may be with Daily's Faunal assemblage 4(?).

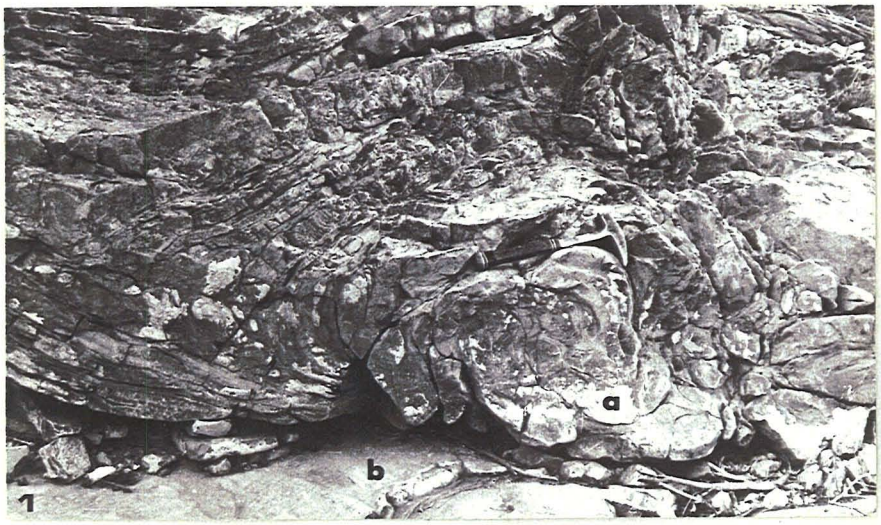
UPPER PARARA LIMESTONE, MIDDLE LENS (Unit 5): the unit varies in both lithology and extent and detailed descriptions are included in Appendix I (Sections A, B, C, E, N, Q and S). Typical outcrop occurs in the south eastern corner of the map, the unit being unrecognized in the west due to lensing out (to 10ft(?) at Station 28) or to facies change. It may also thin to the east (top left, Plate D, Appendix I), but in all areas both contacts are obscured due to extensive intertonguing and grading into the enclosing Parara-type flaggy units (Plate D). (At Station 7 there is a laterally discontinuous lens of very dark, almost black, mauve mottled (weathered) and finely laminated limestone. Trilobites from this lens have been collected by B. Daily and are code numbered C.G.7 - Delta).

Typical exposure of the unit is a very massive (3 to 4ft. beds) cliff forming and blocky limestone, usually light in colour with buff to (rare) pink-grey and pale yellow patches; (bottom left, Plate B, Appendix I). Except for a highly irregular whitish mottling (C285ft., Plate B, C255ft., Plate C, Appendix I), the unit resembles a mottled, medium grey Parara-like limestone. The white lithology is often restricted to certain (1ft.) beds but with digitate to dendritic mottling extending into the darker units below. In other beds only patches of grey, mottled limestone remain, suspended in a matrix of white 'limestone'. Preliminary thin sectioning and staining techniques suggest that the white material is a pelletal dolostone (T.S.A343/C265ft.); however the unit has a high percentage of light coloured silt in certain beds and this, combined with post depositional pressure-solution

EXPLANATION TO PLATE 1

Figure

1. Ball and pillow (slump) structure, Parara Limestone.
2. Tuff band, (a), Unit 6.
3. Typical Parara Limestone (Unit 6) with minor folding.
4,5. Typical outcrop of Unit 6; Upper Parara Limestone.
6. Main syncline, North Boundary Creek, looking south.



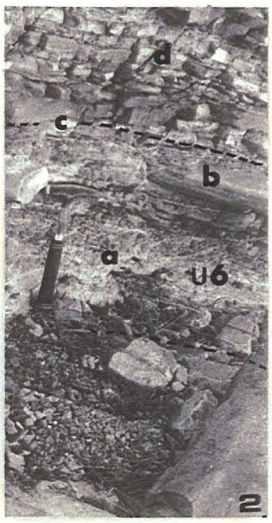
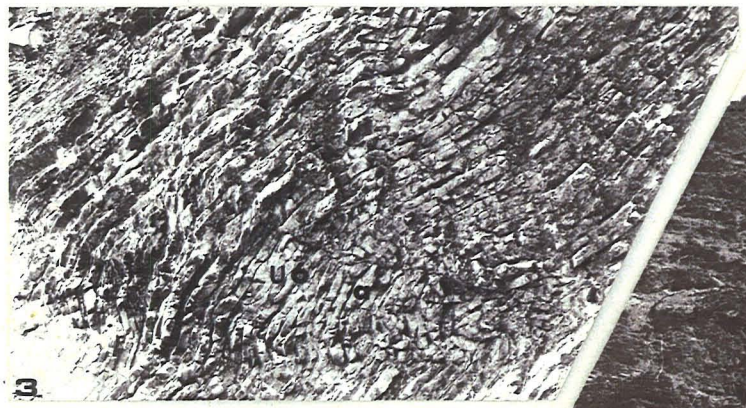
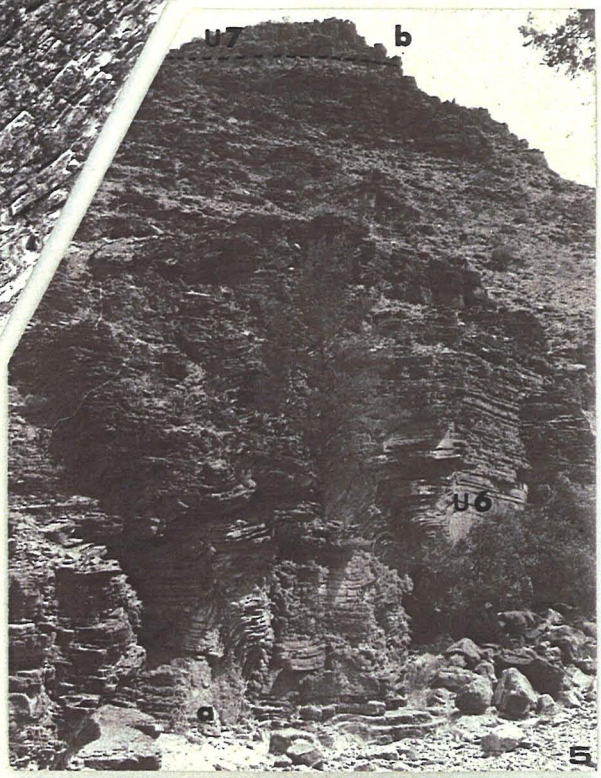
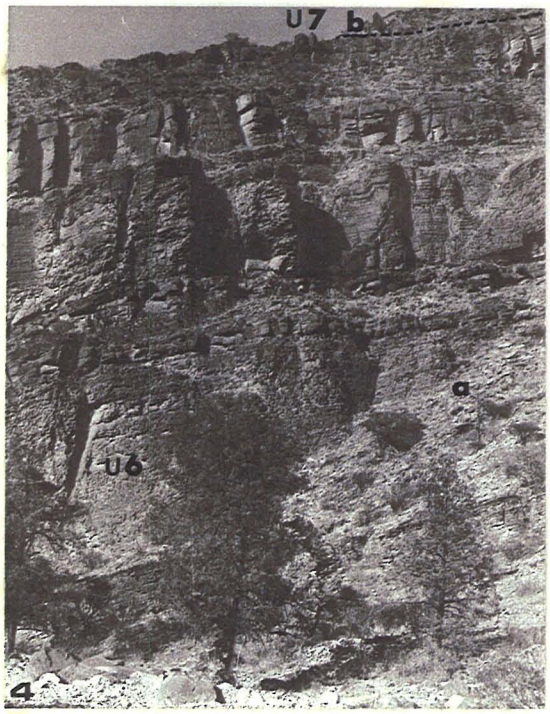
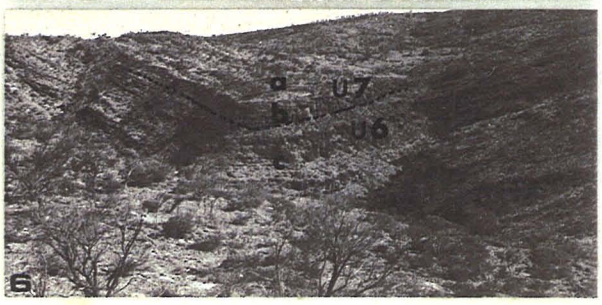


PLATE 1









phenomena (stylolitization) may also explain some of the mottling. (Stylolites, both vertical and horizontal, are shown in Figures C243ft.a,b, Plate B, Appendix I). Quartz sand and rare beds of fine pebbles (5.5mm.) are associated with finely pelletal, rarely coarse, and dolomitic limestone interbeds. Dolomitic clasts up to 3cm. are ubiquitous. Fossil fauna is sparse but includes rare brachiopods and archaeocyathid fragments, probably allochthonous. A 'marker-horizon' at the top of the unit is often covered with archaeocyathids including many complete, silicified specimens, representing several categories and may include the genus Syringocnema (Walter, pers. comm.). Limonitic infills are common. Other features of Unit 5 include prominent karren weathering, authigenic quartz crystals (3mm.) and pyrolusite dendrites.

UPPER PARARA LIMESTONE, UPPER UNIT (Unit 6): detailed descriptions of this interval are contained in Appendix I, Sections B, D, E, L, N, O, Q and S. It was found to be of rather uniform character extending over most of the map area, but modified by brecciolas near the Eagle's Nest and North Boundary Creeks. These grade northward into thin intraclastic and quartz granule rich interbeds near Section O. Apparent thinning, by 75%, in Sections E and S could be due to faulting out (see map) of the (less competent) unit between the more massive beds of Units 5 and 7. Penecontemporaneous faulting with deposition is also suggested. Typical outcrop (Figure 2, Plate 4, Plate 6 and Figures 3, 4 and 5, Plate 1) suggests the unit to be a dark grey, rarely mauve, aphanitic (A343/D175ft.) to rubbly and flaggy limestone with thin greenish, argillaceous partings between the lamellae. In 2ft. thick beds and towards the top of the interval the lamination has been modified by silt and quartz sand influxes to give a mottled limestone. Ripple marks, parallel to N48°E are common in middle zones near Station 8. Beds with dolomitic clasts up to 2cm. in length are ubiquitous. A 2ft. 'marker-bed' of epidote to glauconitic green siltstone is a persistent and unusual feature near the base of Unit 6 (Figure 2, Plate 1 and Stations 22, 30, 37 and 96). Quartz sandstone lenses and grey 'Parara-formation' cobbles occur within the silts. Possible explanations for the 'green mineral', as yet unidentified, involve epidote from altered dolerite plugs, tuffs and diapirs. "Ball and pillow" structures (flow rolls) (Pepper, de Witt and Demarest, 1954) are well exposed near Station 21N (Figure 1, Plate 1). Within the parallelogram defined by Stations 12, (20), 38, 44 and 96 and in the upper 40ft. of Unit 6 there is

EXPLANATION TO PLATE 2

1,2. Megaclasts in brecciola horizon, Unit 6, above Station 21.

3. Ripple marks in Unit 3.

4. Graded bedding and brecciola, Unit 6.

5. Graded bedding, Unit 7.

6. Large scale cross bedding, Unit 7.

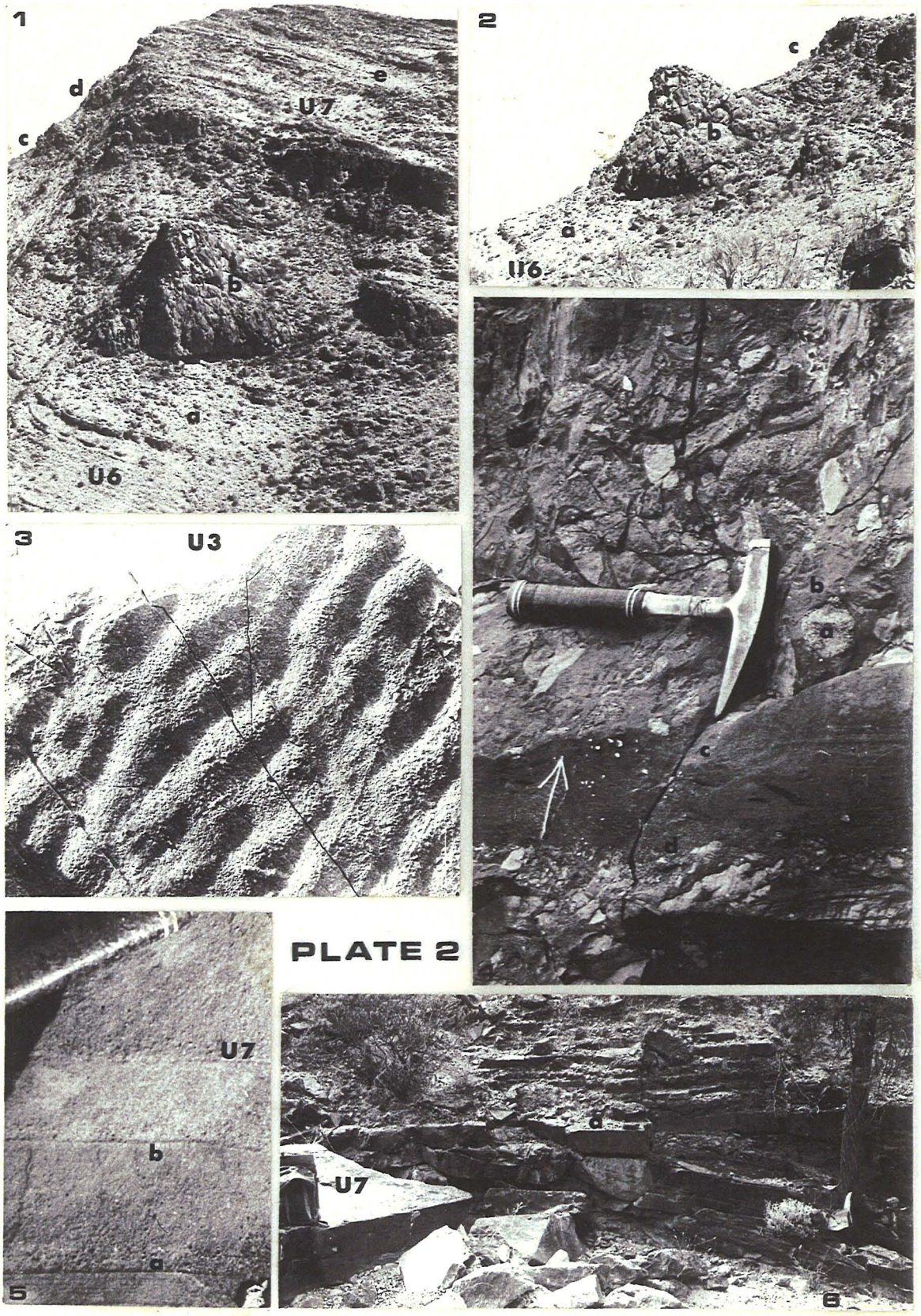

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PLATE 2
U7
b
a
5
d
U7
6

evidence of major disruption of the sediments by slumping. Semi-lithified beds of limestone up to 2ft. thick have been thrown into sinuous folds (Figure 3, Plate 3) or have been ripped up and broken into clasts up to 1ft. long and incorporated with marked imbrication, in a sandy, silty limestone matrix (top right and Figure W, Plate C, Appendix I). The matrix often has graded bedding, in cycles (Figures X and W, Plate C, Appendix I) alternating with the intraclastic horizons (Figure 4, Plate 2). Subrounded blocks of intraclastic facies (reworked by subsequent flows), 2, Figure Y, and dark archaeocyathid limestone, 1, Figure Y (Plate C, Appendix I) occur with irregular orientations in this zone. Masses of archaeocyathid limestone up to 70ft. or more mark the brecciola horizon away from the area just described (near Station 21) and occur above Stations 21 (Figures 1 and 2, Plate 2, Figure 2, Plate 6) and 42 (Figure 6, Plate 3).

Discordant bedding relationships with Unit 7 in the block below Mt. Daily (Figure 5, Plate 3) offer proof that these blocks are not simply in situ archaeocyathid bioherms. The distance travelled by these blocks is uncertain but it is worth noting that a series of elongate diapirs, extending from Stations 2 to 99 has risen on an axis that bisects the brecciola zone coincident with the line of maximum disruption. Archaeocyathid limestones may have formed in locally shallow water over the domed sediments of an incipient diapiric axis or on the flanks of exposed diapirs. The associated earth tremors may have triggered off slumps of unstable limestone into the adjacent basin. Diapirism, however, may not be essential to the argument and the inherent gravitational instability of the ridge/trough system may be all that is required. Arguments about relative water depths for the deposition of the archaeocyathid and the dark Parara-type limestones may be supported by the presence of megaclasts of the archaeocyathid facies in beds of the latter and is prima facie evidence for the Parara being of deeper water origin. Fossils from Unit 6 include trilobites, sponge spicules, hyolithids, brachiopods, rare archaeocyathids and annelid trace fossils. A cause and effect relationship may be implicit in the association of silt influxes with beds of silicified and sorted fossils.

A significant change in rock type occurs from the top of Unit 6 and continues to the top of the Hawker Group - i.e. the base of Unit 12, the

Billy Creek Formation. The interval is characterized by light coloured limestones, often with archaeocyathids and stromatolites, an abundance of coarse quartz sand, oolite lenses and mega-breccias indicative of very shallow marine conditions. Interbedded red siltstones probably indicate deposition under oxidizing conditions. The sequence is thought to represent the final phases of a Lower Cambrian marine regression. The name Moorowie Formation is here proposed. Five members are recognized and have been named accordingly:

THE PINYATTA MEMBER (Unit 7): although spatially variable, good exposures of this unit are extensive on the northern closures of the main anticlines (Folds 1 and 3) and in the core of the 'main syncline' (Fold 2). Consequently many sections have been measured across the unit and include Sections B, E, G, H, (L), N, O. Q, R, S and T (Appendix I). Typical outcrop can be seen in Figures 3, 6 and 10, Plate 6 (in folder) and at the top of Plate D, Appendix I. It is a massive, thick-bedded silty to sandy archaeocyathid limestone with reliable evidence for often strong current action including ripple marks, large scale low amplitude crossbedding (Figure 6, Plate 2) and graded bedding (Figure 5, Plate 2). A coarse quartz-sand fraction, of 0.5 to 2mm., well rounded spherical grains is very common in the upper beds of the northern limestones of Unit 7 (Sections G and H) but decreases and is only a 'rare' fine sand in the south (Section E), although here the uppermost beds may be faulted out. This gradient is paralleled by pelletal limestone, intraclastic (reworked) and oolitic lenses that only occur below the sandy beds in the north. A pink colouration, at the top of the generally buff sandy beds in the north, grades south and west to Sections B and N, into a massive, red, possibly biohermal limestone with abundant and complete, large (white) archaeocyathids (B250ft., Plate A, Appendix I). The coarse-sandy limestone facies is still present but is red coloured and contains lenses of reworked material. Basal beds in the south, Sections B, E and N are a massive poorly bedded, grey to buff and silty limestone with only a 'moderate' archaeocyathid content. Thin, Parara-type grey laminated limestone interbeds occur at the base of the red units in Section B and at the base of Section H, under the oolitic beds. A feature of Unit 7 is the large number and size (to 4 inches) of dolomitic clasts that occur in certain beds and lenses, especially in the sandy and red limestone horizons.

EXPLANATION TO PLATE 3

1. Typical mega-breccia, Unit 9.
   a. Megaclasts of light grey archaeocyathid limestone
   b. Clasts of quartz granule rich limestone
2. Large archaeocyathid, lying in bedding, Unit 9.
3. Brecciola horizon, Unit 6, showing slumped bed.
4. Silicified archaeocyathids weathering out of limestone.
5. Contact between megaclast and beds of Unit 6, Mt. Daily, showing discordant relationships.
6. Megaclast, brecciola horizon, Unit 6.

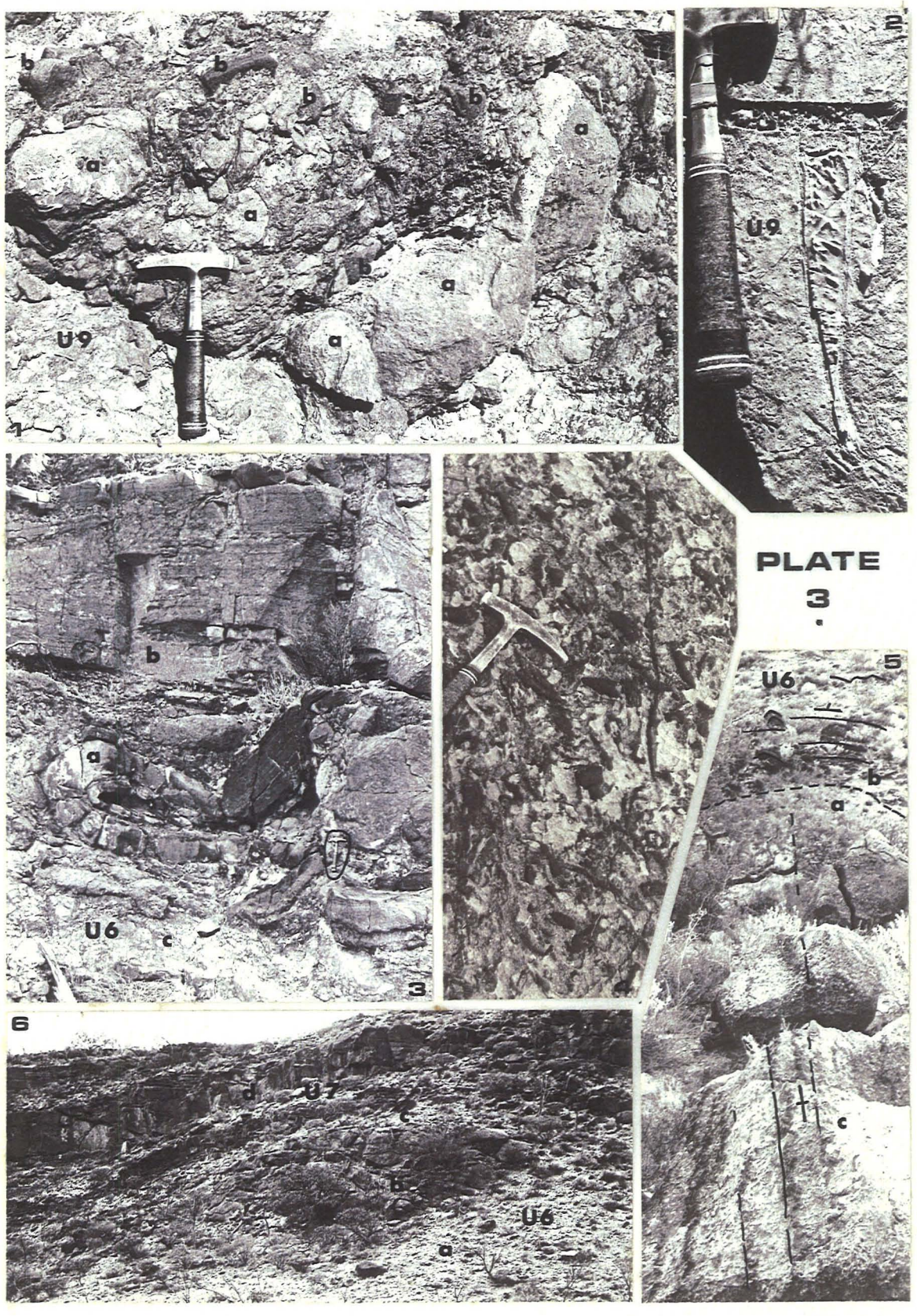
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PLATE
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U6
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U7
c
b
U6
a

THE WOOKATA MEMBER (Unit 8): a major north-south pivotal fault (Stations 15 to 37 and 72) bisects outcrop of this and higher units making it impossible to trace individual beds from the north east of the map area to their equivalents south, in the core of the main syncline (Fold 2). The north eastern beds are a 'typical' red-brown to purplish, finely micaceous shale, well laminated and with ripple marks, suggesting shallow nearshore marine and oxidizing conditions. Exposure is thickest in the north (Sections G, I, K, U, V and Z) with facies changes to the south and towards the base, through purple and green shales in the contact zone to green siltstones with thin 1 to 2 inch light grey limestone interbeds near Stations I and Z. These dark weathering and protruding interbeds often contain small, 1cm. intraclasts of green siltstone as well as a fine (pelletal) carbonate sand, rare dolomitic clasts, some quartz granules, red (feldspar?) and green granules, and possible siderite lenses (Section Z). Linguoid sole markings and ripple marks are common suggesting that currents have been associated with the limestone interbeds and were responsible for the reworking of the underlying green siltstones.

An unidentified, possibly new trilobite from Daily's Faunal assemblage No. 9 (Oraparinna time?) was collected by Daily and the author from a green-shale near Station 104. Apparent thinning of the unit south towards Section G (cannot be found in Section H) is interpreted as the shearing out of the less competent shales, parallel to the strike and between two massive limestones, Units 8 and 9. A single 70ft. exposure of highly contorted Wookata facies, purple shales occurs at the base of Section F and is interpreted as a remnant block in that fault zone (F0ft., Plate D, Appendix I).

South, across the pivotal fault and at the top of Section R (Station 11) the unit is represented by green calcareous siltstones that alternate with quartz, red, green and carbonate granule-rich interbeds, up to 1ft. thick and with the green calc-siltstone as the matrix (Specimen A343/R150ft.). Sub-rounded megaclasts 6 to 8ft., of a light grey archaeocyathid and algal lime-stone (A343/R140ft.) lie slumped into the green silts with the sedimentary structures of the granule rich beds draped around them (Figure 1, Plate 4). These blocks may mark the base of Unit 9. In the north this contact is well exposed at Station 130 and shows a passage from the purple shales through a

EXPLANATION TO PLATE 4

1. Archaeocyathid limestone megaclasts (a) with granule rich limestone beds draped around them, Station 11.

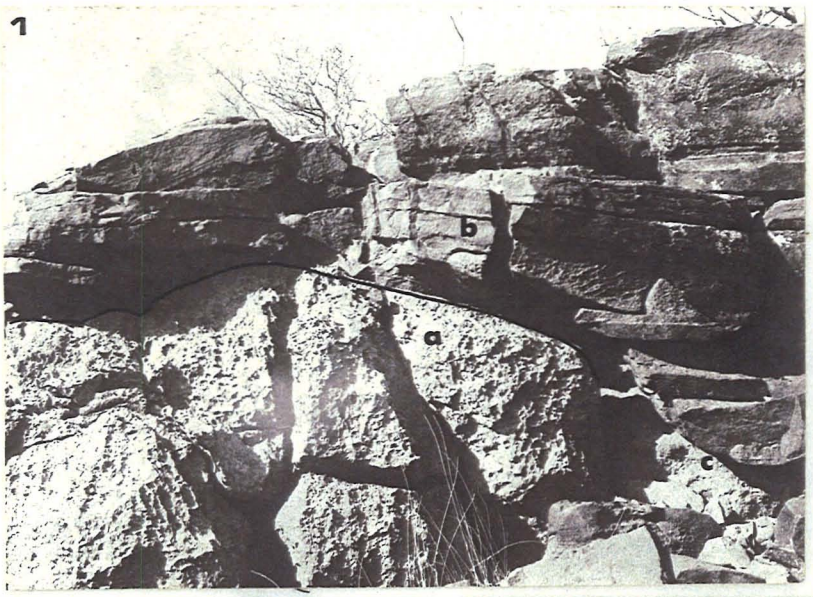
2. Typical outcrop of Unit 6, Section D.

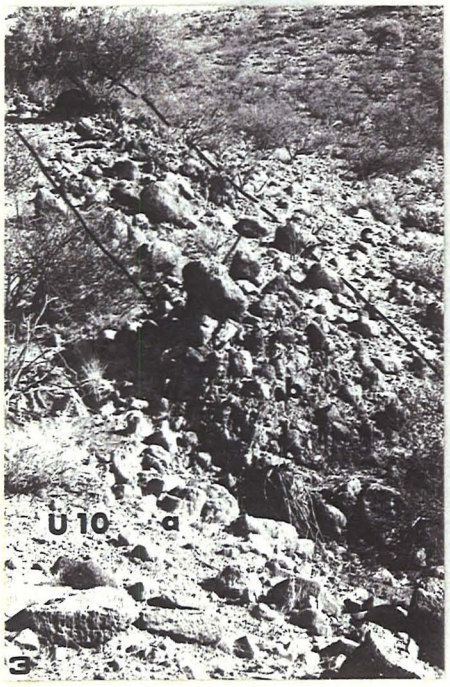
3. Conglomerate bed at base of Unit 10.

4. Karren weathering, Unit 3.

5. Chert nodules, Unit 2, near Station 26.

6. Diapiric shale south of Central Diapir ("Microdiapir").





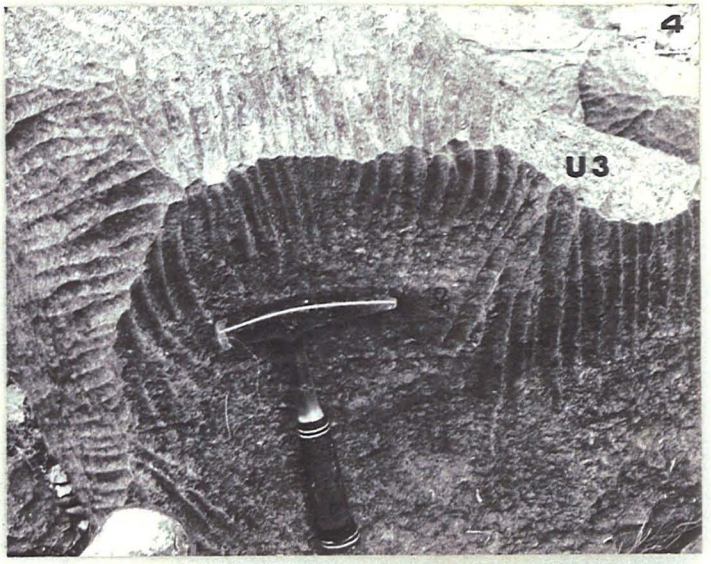
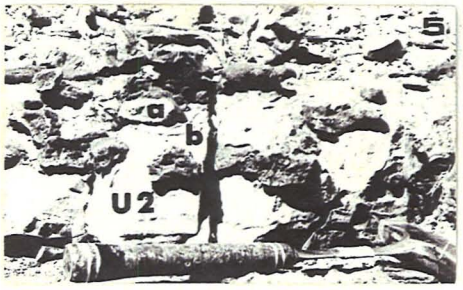
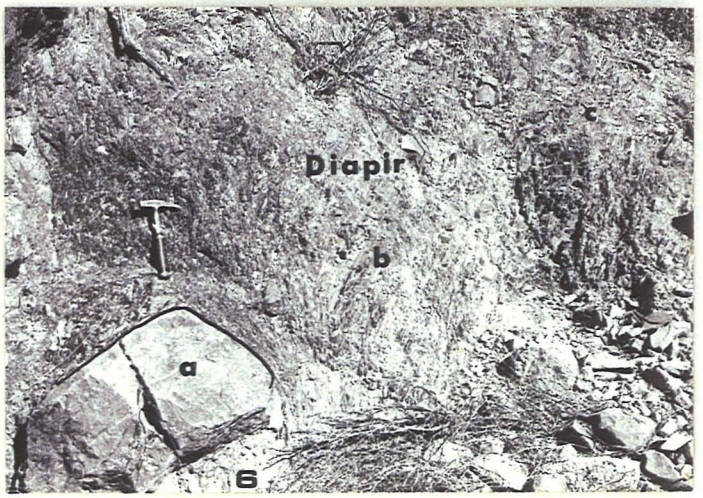


PLATE 4 •





zone with scour and fill structures to the crossbedded limestones and calcirudites of the base of Unit 9 (Figures 1, 2 and 3, Plate 5).

THE KANDRAMOOKA MEMBER (Unit 9): although one of the most complex units, it is potentially the most interesting and is described in detail in Sections E, F, G, H, I, J, K, U, V, X, Y and Z, Appendix I. Outcrop is extensive in the north east of the map area (Zone 1) and can be traced from north of Mt. Chambers Gorge to Section F in the south. To aid description the unit is divided into four 'facies subunits' that bear an intertonguing relationship or the various parameters of which define regional clines. The first of these, Subfacies A, extends from Section F in the south to about Section H and is characterized by massive, buff to light grey or white, archaeocyathid limestones (F120ft., Plate D, Appendix I). In the middle to upper beds the archaeocyathids are often large (to 14 inches in length, Station 40, Figure 2, Plate 3), abundant, commonly complete and with associated stromatolites may represent an autochthonous thanatocoenosis. Dolomitic clasts (2cm.) are common in the lower beds and highly spherical quartz granules to 5mm. in diameter with clastic limestones dominate the beds above the archaeocyathid bioherms. Subfacies B is the northern extension of A and continues to about the south Moorowie Mine area (Station 84). It is a massive light coloured, archaeocyathid limestone similar to facies A but with a high percentage of coarse quartz sand ('granules') and ochre-yellow silt that colours the unit buff, often with reddish beds, and dark brown weathering surfaces. The granules become increasingly abundant to the north; Subfacies C and D. A few 8 by 5ft., subrounded archaeocyathid limestone megaclasts occur in this division and become numerous northward to Subfacies D. Subfacies C extends in outcrop from the Moorowie Mine area, to the east (Section Y) and to the north of Mt. Chambers Gorge. The basal beds(?) are strongly oolitic but grade upward into pelletal limestones then into very thick and regularly bedded, massive, buff to pinkish limestones with abundant quartz granules and silt. Granules and archaeocyathids are rare in the vicinity of the Gorge and an ochre-yellow silt colours the (massive) limestones (Subfacies E?). Intertonguing with or grading into C, and to the south, with the northern extension of B is the mega-breccia zone; Subfacies D (Sections I, K, U, V and Z, Appendix I). The complex nature of this unit is well illustrated in

Figure 1, Plate 3. A calcirudite or mega-breccia are the best overall terms for the subunit, however these obscure its diverse nature and origin. Individual clasts range from fine clay to very large boulders (2048mm.); from angular to well rounded; spherical to elongate and lithologies include:

1. A clean, light grey, massive archaeocyathid limestone. Archaeocyathids are commonly large, complete, and are associated with algal structures (Subfacies A?). The rock occurs as pebbles to the largest boulders and may account for up to 90% of the rock.

2. Pebbles to large cobbles, generally elongate, of dark brown weathering, buff, quartz-granule rich limestone (Subfacies B?). Beds and lenses, up to 6ft. thick, of this lithology alternate with the breccia horizons and individual quartz granules may occur in the silty matrixes of the latter; i.e. not only could these blocks have been derived, but reworking of in situ granule beds is inferred.

3. Rare megaclasts, up to 10ft. long, but generally small pebbles of yellowish dolostone.

4. Boulders containing, as a lithified mass, all or some of the above facies and in a silty yellow limestone matrix.

5. Boulders of the silty yellow limestone.

The matrix to the whole unit tends to be a silty, clay-rich, ochre yellow limestone or, less commonly, the granule-rich limestone and thus may reflect a basic depositional pattern with a cycle unrelated in time to influxes of archaeocyathid limestone debris that accompanied the extensive reworking of all lithologies, including earlier breccias. The silty limestone matrix-rock is reddish, and almost a 'Wookata Shale' lithology towards the base in some areas (Sections U, V and Z) as if the breccia episode had begun before 'completion' of the underlying member. Certain of the reworked blocks in this zone - the granule and the silty-limestone facies, are red rather than yellow in colour and include rare stromatolites (A343/U187ft.), indicating marine shorelines possibly subject to exposure. In Sections K and X the archaeocyathid limestone megaclasts change slightly in character towards the top of the unit and become sparsely fossiliferous and darker in colour. A general absence of granules in the uppermost beds allows recognition of an

'Upper unit' of clean, mottled, light grey archaeocyathid limestone in all subareas.

THE PACK CREEK MEMBER (Unit 10): a purple friable and micaceous shale with thin grey limestone interbeds in the basal ten feet. Outcrop is restricted to the east of Map Zone 1 (Stations 57 to 79, 105 to 114 and 133 to 155, Sections G, J, H and W, Appendix I). Typical outcrop of this and the overlying unit, No. 11, is shown in Figure 7, Plate 6 and in the accompanying folder. A polymict conglomerate lens near the base (Section H), contains poorly sorted, angular to subrounded clasts of the following lithologies:

1. A light grey limestone (with rare archaeocyathids) as cobbles to 260mm. in diameter.
2. Quartz granule-rich limestone pebbles similar to lower units but with a red matrix, and
3. Purplish-red massive limestone with abundant (white) archaeocyathids, rare cobbles.

A passage may be indicated into the overlying unit.

THE BRILLIG CATCH MEMBER (Unit 11): (Outcrop pattern and descriptive sections are as for Unit 10). Lithologically the unit is remarkably homogeneous in nearly all respects, consisting of thick lamellae, 6 to 12 inches, of medium grey, aphanitic limestone; very clean but with thin argillaceous partings. Very fine clay and some silt, probably related to very minor reworking, is present with dolomitic and darker limestones in the upper beds of some areas. Excellent karren structures (Specimen A343/J140ft.) and stylolites (A343/J210ft.) are a feature of this unit.

(b) Rocks younger than the Hawker Group:

THE BILLY CREEK FORMATION (Unit 12): outcrop of this unit is restricted to the eastern margin of the main range, generally sheared against older Cambrian units by a major north-south fault and exposed as highly irregular patches through the local Cainozoic cover. The base of the unit as recognized in apparently conformable sequences (Sections (G), H, J and (W)), is defined as the base of a very persistent, 10 to 20ft. marker horizon known locally

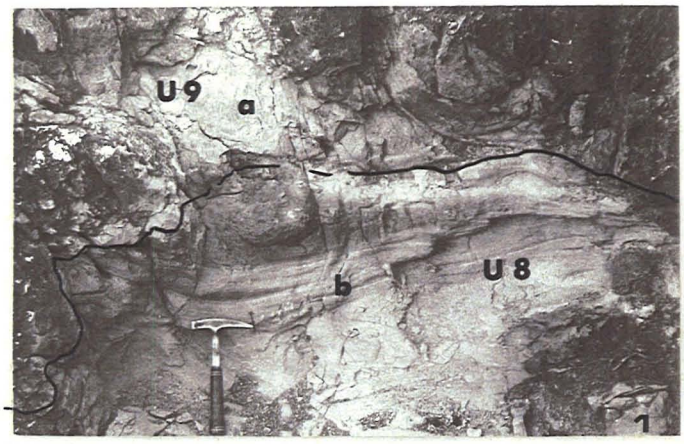
EXPLANATION TO PLATE 5

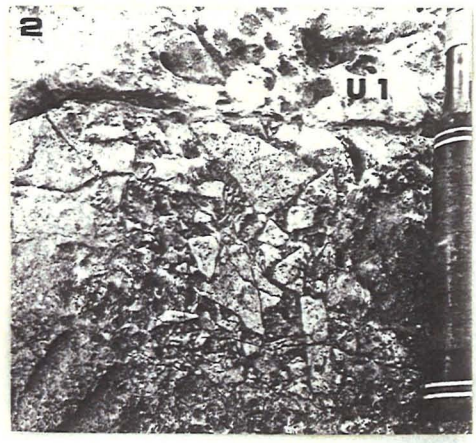
1,3,4. Contact between Units 8 and 9, north of map area.

2. Tectonic breccia, Unit 1.

5. Typical Wilkawillina Limestone, Unit 1, near Station 1.

6. Possible diapiric zone with fault breccia, North Boundary Creek.





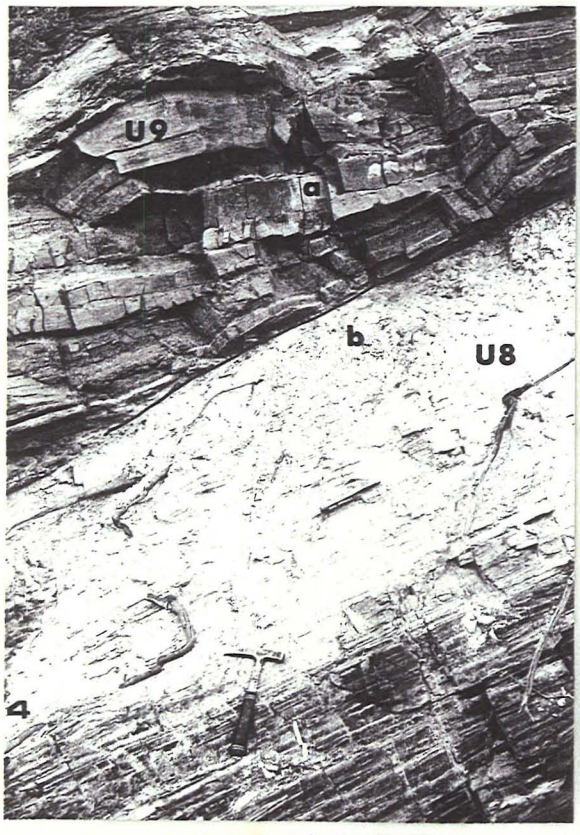
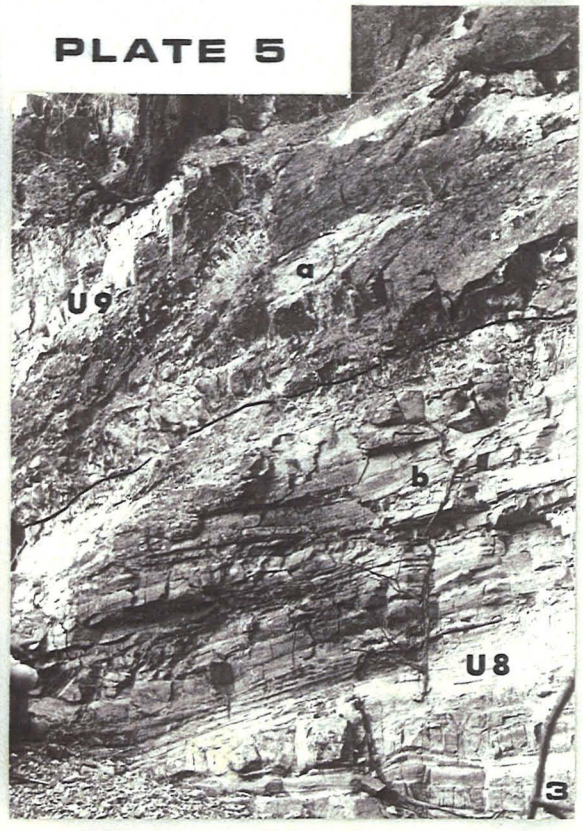
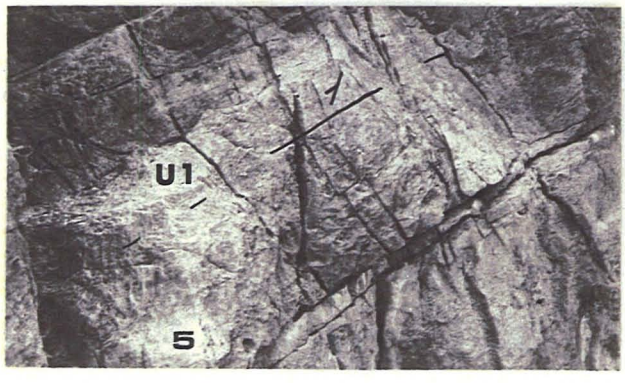


PLATE 5





cf Edeowie Ls. (Pierce, 1969) or Unit 11?? See Moore, 1979

as the BOOK-LIMESTONE. The name reflects its outcrop appearance with thin, 2mm., sheets of a fine grey limestone interleaved with equally thin, khaki and argillaceous partings. Above this zone is a laterally variable unit of massive to rubbly, grey to yellow limestones or dolostones, often pelletal (0.7mm.), with 'red granules' (a coarse sand), minor chert, shales and evidence of gentle reworking of the dolomitic beds. Green shales with pseudomorphs after halite are next in sequence followed by purple and green shales, thin yellow dolostones and finally all purple shales with imbricated mica flakes, ripple marks, flute casts, halite pseudomorphs and trilobite tracks. Red sandstones occur at Station 152.

Style

C. CAINOZOIC DEPOSITS:

These extend from the foot of main range, east to Lake Frome and beyond, and include high level dissected piedmont fanglomerates, lacustrine deposits and more recent accumulations with well defined outwash fans and aeolianites of diverse origin. Lithologies include brick red, dark grey and white clays, often gypsiferous, red jasper breccias, silcrete masses (including silicified iron and manganese oxides) and polished-pebble palaeoshoreline conglomerates as gibber plains. The map indicates a Tertiary age for the deposits (B. Daily, pers. comm.) yet similar lithologies of Pleistocene age occur in the Mt. Frome area.

3. POSTDEPOSITIONAL DEVELOPMENT[1]

(a) DIAGENESIS, NEOMORPHISM & HYDROTHERMAL ALTERATION:

Secondary minerals observed in the map area include epidote, chlorite and actinolite in the hydrothermally altered dolerite plugs; authigenic quartz, sparry calcite, travertine, pyrolusite, dolomite, siderite and limonite in the carbonates; authigenic pyrite in the dark limestones of Unit 6 and (hydrothermal) silica replacing calcitic limestones in Unit 9. Understanding of neomorphism of carbonates in the sequence has been the subject of only preliminary petrological study. Their complexity suggests that years of effort is required.

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1 Overlay 1 in the accompanying folder summarizes this discussion.

(b) FAULTING:

The dominant fault set of the map area is parallel to the axial plane of the major folds, and with a well developed set conjugate to the fold axes, cuts the area into blocks, commonly downthrown to the east and with pivot (especially of wedge shaped grabens) about dominantly southern fulcrums. The main development has occurred after the deposition of the Billy Creek Formation although minor penecontemporaneous faulting is suggested (Unit 6). Minor faulting, possibly along old trends is evidenced by low scarps and * dissected Cainozoic deposits on the eastern plains. The loss of sequence through shearing out along strike of less competent flaggy limestone or red-shale unite ((2), (4), 6, 8, 10 and 12) where the limbs of the main folds parallel major fault-trends is a feature of the area. Regional considerations suggest that the area may lie over the intersection of two major basement faults; a Blinman - Mt. John - Moorowie Mine east-west lineation and a Reap-hook Hill - Moorowie Mine - Mt. Painter (?) or Italowie line.

≡ Paralana Fault. *

(c) FOLDING (Overlay 1):

Three broad, north plunging (15°) arch-type folds dominate the structure of the Cambrian in the map area. Fold style has been concentric with minor bedding slip and more intense deformation in the cores with good joint development, especially in the more massive carbonates. Axial planes are vertical to steeply dipping (east) giving the main syncline, Fold 2, a slight asymmetry. Superimposed on this main trend are the later and minor east-west cylindrical drag folds (Folds 5 to 9) associated with vertical movements (Cambrian down) along the major east-west fault with the Proterozoic in the Wya Creek area (central north of map). A broad upwarp truncates the nose of Fold 1, the western anticline, and is associated with minor southerly thrusting and upward drag of the Cambrian at Bellaringa Gap, Stations i and k.

(d) DIAPIRISM:

Diapirs in the map area vary in form from elongate dyke-like masses that appear to breach the core of the main syncline, to wider elongate forms that re place the western limb at the northern closure of the main easterly anticline (Fold 3) and in the Chambers Gorge region occupy a major fault zone. Diapir trends tend to parallel the trace of the axial planes of the main folds and thus

the major faults in the area. Lithologies include pastel coloured silts and sandstones; purple, mauve, pink, pale green, yellow and blue with abundant pseudomorphs after halite. Heavy mineral, crossbedded and ripple marked quartzites also occur with coarse arkosic sandstones with angular, pink, feldspar grains and rounded, 2mm. quartz granules, very similar to those found in the Cambrian limestones. Typical lithologies are included with the accompanying hand specimens.

(e) DOLERITES:

Ten plugs, up to 500ft. long occupy and cut fault zones and are associated with diapirs in the east of the map area. Structural relationships suggest that they intruded late in the deformation of the area, possibly using faults and diapirs as conduits. It is improbable that they originated as blocks in the diapirs. Hydrothermal alteration to an epidote-actinolite (magnetite) rock is common, especially in plugs close to the major fault with the Proterozoic.

(f) MINERALIZATION:

Copper minerals, usually associated with hydrothermal silicification and replacement of the Cambrian limestones, are very common in the map area, particularly around major faults and include malachite, azurite, cuprite and chalcopyrite (Station 148). Associated minerals include vein quartz, siderite galena (Central Diapir only) and possibly cerussite. Calcite veins and masses up to 12ft. wide are associated with the Central Diapir, Stations 38, 41, 97 and 98. A symmetrical colloform texture is a feature of veins near Station 38 (Specimen A343/C.G.38) and a vein at Station 126 contains rhombs of carbonate up to 7 inches long. Siliceous plugs and masses are common in the Moorowie area where selective alteration of non-dolomitic blocks in the mega-breccia (Unit 9) has proceeded along joints in the rock and is associated with disseminations of chalcopyrite, a mineral apparently undetected in a survey by the Electrolytic Zinc Company. This area, extending from Station 131 through the Moorowie Mine and to Station 79 in the south should be further explored with the structure and composition of the Cambrian below Unit 8 in mind. The Bendleuta Member could extend out under the eastern plains and a non-recrystallized equivalent with a high porosity and permeability may have

been suitable for hydrocarbon accumulation.

4. SUMMARY AND CONCLUSIONS

The Cambrian sequence of the Mt. Chambers Gorge area records a period of extensive carbonate deposition under epeiric, marine conditions. The vertical sequence is believed to reflect the lateral sequence during the regression of the seas in the Lower Cambrian. The basal Wilkawillina Limestone shows evidence of a well oxygenated, clean environment with good circulation. The younger Parara Formation is of a deeper water, less well oxygenated, generally quieter environment, but the Bendieuta intertongue of pelletal limestone records a period of intense current activity which may be related to local sea-floor highs or to islands associated with diapiric uplift. Breccioles and the general presence of quartz sand in the sequence may also be related to the diapirs, but source areas in the substable basement blocks to the east cannot be excluded.

The Moorowie Formation records the onset of marked shallowing and increased salinity of the seas with massive light coloured, often oolitic, limestones and purplish shales prevailing in outcrop. Mega-breccias mark the middle beds of this formation and demonstrate the necessity for the lateral juxtaposition of the various lithologies and thus the diachroneity of lithological contacts in the area. They bear a remarkable similarity to carbonate breccias in the Cow Head region of Newfoundland (Kindle and Wittington, 1958). The final phases of the marine regression are evidenced in the red beds of the Billy Creek Formation with the development of halite, dolomite and red, oxidized siltstones under restricted saline and marine conditions.

Hydrothermal copper mineralization is extensive, particularly in the east of the map area, and is associated with faults and, generally, diapirs. It must be emphasized that without very detailed mapping and petrological study, perhaps on single beds alone, the true significance of geological history as recorded in these limestone sequences will never be realized.

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October, 1970

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MT. CHAMBERS GORGE

GEOLOGICAL MAPPING

APPENDIX
I

"DESCRIPTIONS OF MEASURED STRATIGRAPHIC SECTIONS"

(INCLUDING SOME PALAEONTOLOGICAL DATA)

After completion of preliminary geological mapping the Mt. Chambers Gorge area was re-examined and detailed section measuring was carried out over suitable outcrop.

Section locations were chosen to examine in detail the lateral and vertical variations of rock units in the upper part of the sequence (Moorowie Fm.); however, some work was done over all Cambrian lithologies represented in the map area.

Measuring technique: a five foot tape was held perpendicular to the bedding at a given station and sighted to the next station upslope. This method proved to be fast and accurate to about 7ft. in 150ft. A 10% accuracy is claimed overall. In gently sloping terrain trigonometric methods proved more accurate.

A Fence diagram is included in the map folder. Problems encountered in its construction included representing sections measured over sloping erosional surfaces as vertical columns on paper. For example, two sections may have a common base in the core of a fold but the upper units, if measured in opposite directions will have a geologically finite and increasing horizontal distance between them.

In the final solution a horizon common to most areas and sections (the top of Unit 8 in this case), was selected and the points located on the section lines and on the geological map. These points then formed the fulcrums about which the columns were rotated to the vertical - i.e., assuming the top of Unit 8 to be planar.

The evidence of the measured columns and general field evidence was then used to interpret the lithologies represented. The folder presented with this thesis.

apart from containing the fence diagram, has an overlay-map showing the locations of the measured sections and also three pages of stratigraphic columns drawn to scale and coloured as in the fresh rock face.

About 10,000ft. of section is detailed. All lithologies in all sections were sampled; however, only a single tray of selected hand specimens and thin sections is presented with this thesis and will be stored in the Geology Department of Adelaide University. The relevant specimens bear the prefix A343/ followed by the section designation and the position, in feet, above the base of that section - e.g. A343/H261'.

LIST OF ROCK SPECIMENS PRESENTED WITH THE THESIS AND DESCRIBED IN THE FOLLOWING PAGES UNDER THE APPROPRIATE SECTION LETTER AND POSITION IN ROCK SEQUENCE, AS DESIGNATED BY THE SPECIMEN CODE NUMBER

(THIN SECTIONS MAY BE DESCRIBED ELSEWHERE)

1.	A343/B267	Typical white Archaeocyathid in red limestone matrix
2.	A343/C40	Dolomitic clasts
3.	A343/C265	Dolomitization (?) of grey limestone. ? Unit 5
4.	A343/D175	Classic dark Parara-type limestone
5.	A343/E175	Fragmental limestone
6.	A343/E390	Calcirudite. Red matrix
7.	A343/F70	Algal structures (?) in dolomitic (?) limestone
8.	A343/G220	Contact, matrix and breccia limestone block
9.	A343/H305	Silty limestone matrix with granule rich limestone clasts
10.	A343/J140	Karren ridges on typical Unit 11
11.	A343/J210	Stylolites (?) in typical Unit 11
12.	A343/J525	Halite pseudomorph, Unit 12
13.	A343/J760	Billy Creek Fm.?
14.	A343/J900	Trilobite markings, Unit 12
15.	A343/K5a	Mega-breccia limestone with granules and Cu
16.	A343/K5b	Limestone from Unit 9. Calcirudite
17.	A343/K25a	Granule rich limestone pebbles, grey limestone pebbles in silty yellow limestone matrix. Typical Mega-breccia (small scale)
18.	A343/K25b	

19.	A343/K220a	Silicified Archaeocyathid
20.	A343/K220b	Silicified limestone with chalcopyrite
21.	A343/L367	Hyolithid
22.	A343/M0	Micromitra ?
23.	A343/M107	Mottled limestone. Unit 4
24.	A343/M160	Pelletal limestone (large)
25.	A343/M165	Typical, Unit 3, Pelletal limestone
26.	A343/N127	Phosphatic or Mn contact ?
27.	A343/N245	Brachiopod
28.	A343/N317	Redlichiacian (?) Trilobite
29.	A343/P4	Wilkawillina limestone
30.	A343/P140a	Travertine vein fill
31.	A343/P140b	
32.	A343/Q317	Dark, pelletal limestone
33.	A343/R60	Dolomitic and grey limestone, pebbles in red limestone matrix
34.	A343/R134	Green calc. Siltstone
35.	A343/R138	Feldspathic and quartz granules in limestone
36.	A343/R139	Graded bedding. Granule influx
37.	A343/R140	Archaeocyathid limestone. Breccia boulder facies
38.	A343/R150	Granule influx, graded, into green calc-siltstone
39.	A343/S10	Travertine
40.	A343/S130	Limonitic fill in Archaeocyathid limestone
41.	A343/U187	Stromatolites in red limestone matrix
42.	A343/U200a	Filled Archaeocyathid
43.	A343/U200b	Granule rich limestone
44.	A343/Z85a	Large Archaeocyathid. Red matrix
45.	A343/Z85b	Archaeocyathid in red limestone

Descriptions of rock units based on field observation, binocular examination under low magnification of hand specimens and on data obtained from thin section examination under high magnification and with the aid of carbonate staining techniques.

SECTION A (Plate A)

Feet	
-3 to 0	Clastic Limestone: (probably Bendieuta Member); massive, somewhat mottled.
0 to 20	UPPER PARARA LIMESTONE (Unit 4): slate grey, thinly laminated limestone ('Parara facies'). Good mottled texture in places.
20 to 21	Grey limestones as below but with abundant clasts, up to 2cm. in length, of laminated dolostone, other limestones and abundant quartz granules.
21 to 26	As for 0 to 20.
At 26	Trilobite debris (Redlichiacia?). Silicified occipital spine in medium grey 'Parara type' limestone.
26 to 190	No reliable outcrop. Inferred 'Parara-type' limestones.
190 to 200	'Parara-type' limestone - i.e. 2-3" laminated to rubbly slate grey limestones with thin, 1cm., shaley partings. Limestone is fine grained, usually clean and homogeneous within laminae. Bed of chert nodules at about 192ft. (Plate A).
————	MIDDLE LENS, UPPER PARARA LIMESTONE (Unit 5)
200 to 313	Massive buff-brown purplish bedded dolomitic (?) limestone. Light grey limestone with lighter dolomitic (?) mottling. Quartz granules increase near 313ft. Some silt.

SECTION B
(Continuous above Section C., 50ft. West)

Feet	
0 to 1	Top of MIDDLE LENS (Unit 5): Dark mottled, massive limestone with Archaeocyathids well preserved.

SECTION B (Cont)

Feet	
1 to 5	'Parara-type' limestone. Fine, homogeneous, (light) grey, laminated, (slightly silty).
At 5	Trilobite debris very abundant. Silicified 2 inch zone although occurring sparsely in overlying beds. Collected by Dr. Daily (B.D.20). Includes a small complete. Blocks removed.
5 to 30	'Parara-type' limestone. Silty and with few Trilobites.
30 to 31	Bed of dark limestone, massive with abundant dolomitic clasts up to 5cm.
31 to 42	'Parara-type' Limestone with silt increasing to 42ft. (esp. at 40ft. a 3", dark weathering, "marker bed").
42 to 55	One inch silty bands persist with some graded bedding.
At 55	Archaeocyathid in some flaggy, slate grey limestone. Trilobites in float.
55 to 60	Less silt.
At 60	Few Trilobite remains.
60 to 89	'Parara-type' Limestone as below. Fewer Trilobites in float.
At 80	Trilobite fragment.
89 to 90	Silty bed in lighter, mauve grey limestone. Trilobites.
90 to 120	'Parara-type' Limestone. (100 to 101) more massive bed with Archaeocyathids and rare Trilobites. (102 to 105 to 110) abundant silicified Trilobite remains (110ft.). Whole silicified Archaeocyathids.
120 to 128	Silty unit with some dolomitic (?) clasts and graded bedding. Dark weathering.
128 to 130	No outcrop.

EXPLANATION TO PLATE A

Top left : Section A

Top right : Dolomitic clasts, C 63ft.

Middle right: Archaeocyathid, B 250ft.

Middle left : Chert nodules, A 192ft.

Bottom left : Clasts, C 50ft.

Bottom right: Base of Section C in Unit 3.

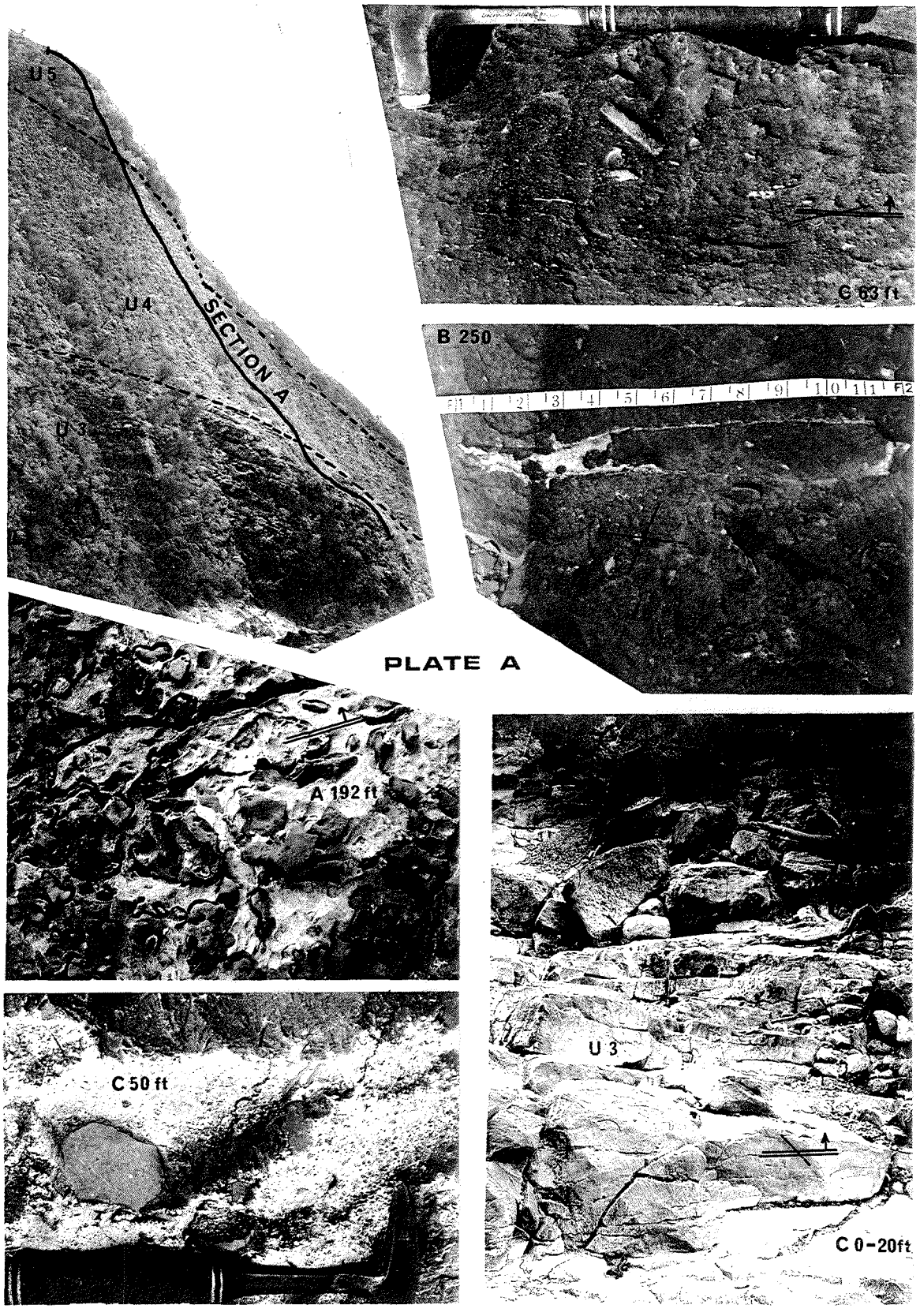


PLATE A

SECTION B (Cont)

Feet	
130 to 140	Possibly mottled grey limestone with Trilobites (?). Parara-type (?).
140 to 150	'Parara-type' Limestone. A little silty and rubbly in outcrop. No fossils?
150 to 155	Silty beds.
155 to 160	No reliable outcrop. Probably silty Parara facies.
160 to 162	Calc-Siltstone bed. Massive, yellowish. Autochthonous elements probably Parara Limestone with (allochthonous) influx of yellow clays and fine quartz silts.
162 to 165	No outcrop. Irregular contact zone ?
165 to 238	PINYATTA MEMBER (Unit 7): Archaeocyathid Limestone: very massive, medium grey to pink grey, white matrix limestone with well preserved fossils. Mesoscopic bedding indistinct. Rare dolomitic (?) debris may define bedding. 2-3% silt present gives brown weathered surface with karren textures. Possible Brachiopods (?). At 180ft. Archaeocyathids especially common in pink, white, grey mottled limestone with some silt and reddish grains. Recrystallization of carbonate evident. At 220ft. fossils less common and silty yellow dolomitic (?) clasts become very common (230ft.).
238 to 248	Outcrop poor. Data unreliable. 3ft. bed of Silty Parara type Limestone at 238ft.?
248 to 267	Purple Archaeocyathid Limestone. Very fossilferous with white Archaeocyathids up to 12 inches long by 4 inches in diameter, in a reddish limestone matrix (Plate A). Dolomitic (?) clasts, up to 4", abundant in beds. Fossils commonly intact and lie parallel to bedding plane. (Upset from growth position by periodic (?) currents associated with clast influxes ?).
At 267	One inch diameter goethite pyritohedral pseudomorphs (after pyrite) in fissure in limestone.

SECTION C (Photo 63 to 229ft., Plate B)

Feet	
0 to 20	BENDIEUTA MEMBER (Unit 3): Pelletal Limestone: massive, 2-3ft. beds, pink-orange to buff limestone with buff rounded clasts (0.5mm.) in a lighter matrix with some silt and very few quartz granules (1.2mm. max. diam., well rounded, highly spherical). No obvious fossils. Some stylolites (Plate A). Becoming mottled at 10ft. increasing to 20ft. with pinkish silty mottles around grey cores. At 10ft., 2.4mm. red granules occur. Rare dolomitic (?) clasts up to 4 inches long.
20 to 23	Rather homogeneous, medium to light grey bed 2'6" thick with a few granules of milky quartz (av. 2mm. diam., sphericity .5, rounding .7), topped by a 6" bed of light grey to orange pelletal limestone (av. diam. 1.0mm., max. 1.0mm.). Stylolites and rare dolomitic clasts.
23 to 63	Mottled pelletal limestone; generally as below, very massive 6ft. beds of medium grey limestone, 2mm. quartz granules in places (well rounded, high sphericity) but less than 1%. Rare dolomitic clasts except at 40ft. - i.e. a 5ft. bed of very fine grained pelletal limestone, granule rich with angular to
At 50	subangular clasts up to 5cm. long (specimen) (Plate A). Beds show vague partings at 6ft. intervals and mottled limestones alternate with more homogeneous beds. Possible large scale cross bedding. Carbonate clasts are round to elliptical, about 1mm. in diameter and poorly sorted. Mottling less distinct in last 20ft.
At 63	A 6 inch bed rich in quartz granules (10%), sand, silt and dolomitic (?) clasts up to 3cm. long which may be aligned (S.S.E.-N.N.W.) (Plate A). Matrix is dark grey pelletal limestone.
----------	Photo of contact, Plate B.
	UPPER PARARA LIMESTONE (Unit 4): very sharp contact with Unit 3.
63 to 70	Weathered zone, rather shaley, khaki to grey laminated limestone.

EXPLANATION TO PLATE B

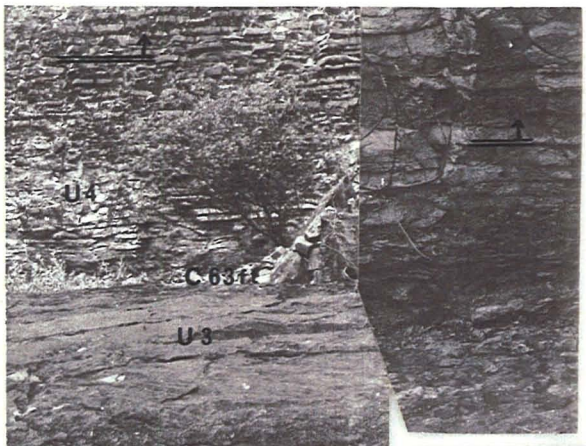
Top left : Contact, Units 3, 4, Section C

Bottom left : Section C, Units 3, 4, 5.

Top right : Annelid (?) burrows, Unit 4, C 200ft.

Middle right: Stylolites, C 243ft.

Bottom right: Dolomitization (?) or patches of pelletal dolmicrite in grey Parara-type limestone, C 295ft.


U 4
C 63 ft
U 3


C 200 ft
U 4

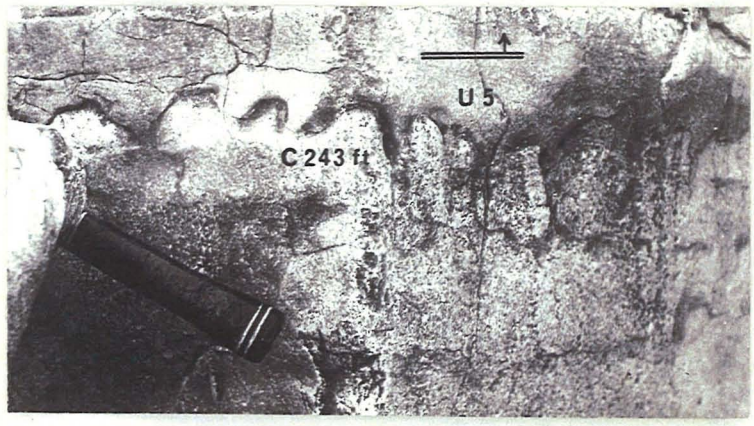
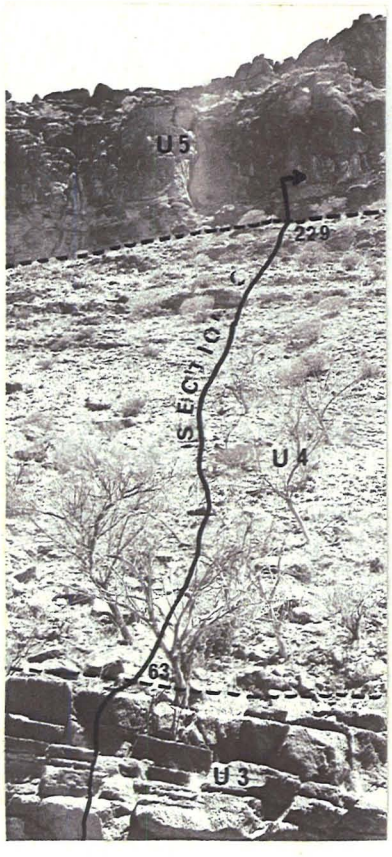
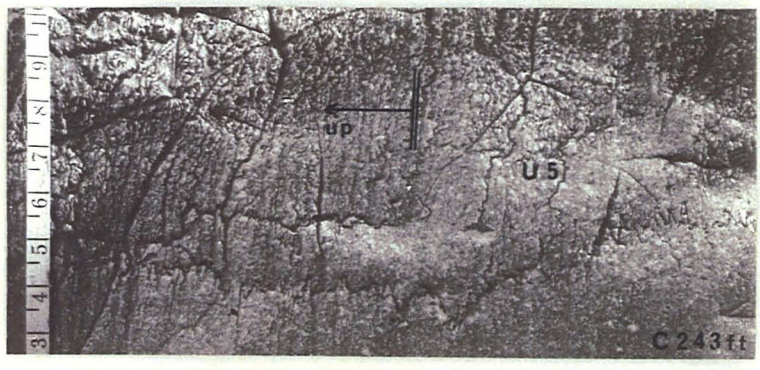

U 5
C 243 ft

PLATE B


U 5
229
IS EIGHT IO
U 4
63
U 3


UP
U 5
C 243 ft


285
U 5
DOL?
FAEY LS.

SECTION C (Cont)

Feet	
70 to 110	Good 'Parara-type' Limestones. 3 inch laminae of clean grey limestone with thin khaki, silty interbeds. Any silt in the limestone causes light brown colour from grey, on weathering surfaces. Some sand at 94ft. and Trilobite fragment? Siliceous debris and granules coming in at 95ft. (as a 3 inch bed at 97ft.). Cleaner at 100 to 110ft.
110 to 136	Loss of outcrop. Measurements unreliable (±5ft. in 30ft.).
136 to 179	As below with minor cross bedding in any silts and conchoidal fracturing of limestones. Less and less silt from 100ft.
179 to 180	Mottled limestone bed, more massive than below with up to 10% dolomitic (?) intraclasts and small gravel size debris in a very sandy (quartz) poorly sorted limestone matrix. Some quartz granules. Silicified Trilobite remains. Mainly spines. Interpret as a change in conditions with a sediment influx that killed the Trilobites (?) and/or sorted their remains and provided the silica for their preservation.
180 to 216	'Parara-type' Limestone as below. Some gritty beds. At 195ft. a 1 inch siliceous debris bed with Trilobites. At 200ft. a large doublure recovered (Redlichiacia?). 200-217ft. abundant Trilobite remains. At 213ft. and 215ft. Hyolithids. At 214ft. a large free cheek collected.
216 to 220	Sudden loss of fauna. Not preserved? More massive 2ft. beds of dark grey mottled khaki limestone with some quartz granules and sand (10%) patches. At 219ft. some dolomitic clasts. Higher energy conditions inferred? At 200ft. burrows? (Plate B).
220 to 229	Laminated 'Parara-type' Limestone as below with minor Trilobite debris (rare at 225ft.). At 225ft. Brachiopods common.
———————	MIDDLE LENS
229 to 237	Very massive, cliff forming, mottled, buff limestone. Mottling could be due to secondary dolomitization of mottled, grey

SECTION C (Cont)

Feet	
	'Parara-type' Limestones.
237 to 243	1 inch laminated, dark grey 'Parara-type' Limestone with khaki-silty partings. Could be lenticular.
243 to 255	Very massive, cliff forming member. Dolomitic (?) limestone. Numerous stylolites. Thick bedded and often pelletal. At 255ft., 6 inch buff silty dolomite (?). (Photo of stylolites, Plate B).
255 to 338	As below but mottling is more obvious with grey cores in buff to white matrix (Photo, Plate C, 255ft.). At 285ft. a 2 foot band with a deeper grey colour and less mottling (Photo, Plate B, 285ft.). 0.8mm. quartz granules and silt coming in above about 300ft. At 310ft. becoming more a massive, grey mottled 'Parara-type' Limestone. At 320ft., Archaeocyathid fragment. At 330ft. grit at a maximum but becoming less sandy and less dolomitic.
338 to 360	Massive medium to dark grey thick bedded limestone with dolomitic (?) mottling on 2 inch beds. At 338ft. a 4 inch buff bed. Above 338ft. almost an altered pelletal limestone. Some (2cm.) coarse dolomitic pebbles observed (to 360ft.) (moderate currents inferred?) and an Archaeocyathid fragment. Sand increases to 360ft. Top of cliff at 250ft. Granules are quartz. Poorly rounded but generally spherical, av. 0.5mm. diam., max. 1mm., poorly sorted. 360ft. bedding plane covered with complete and silicified Archaeocyathids, about 3 inches long and of cup as well as cylindrical forms. Pycnoidocyathus and Syringocnema-like forms present (photos). This bed extensive over map area and may be a good marker.
360 to 370	Mottled to laminated khaki to dark grey limestone.

SECTION C (Cont)

Feet	
370 to 380	Finely mottled limestone with clean, medium grey cores in a buff matrix. Very sharp karren structures. Minor silt. At 377-380ft., a crumbly bed. At 375ft. a 6 inch dolomitic clast bed. (few at 378ft.).
380 to 401	Massive bed. Fine grained, slightly silty limestone. At 387-395ft. a good mottled, grey limestone. Thin mottling from 395ft.
401 to 404	Massive mottled, medium grey, khaki, silty limestone with fine sand and rare quartz granules. Some intraclastic pebbles.
————	Base of Unit 6 at 404ft?

SECTION D

Feet	
0	Taken as base of massive bed just above brecciolas.
Measuring up...Top of Unit 6	
0 to 6	Massive cliff forming band of very silty mottled 'Parara-type' Limestone. Silty Parara-facies, laminated with 1-2inch dark grey limestone beds with ½ inch yellow brown weathering silty, dark limestone beds (Photo X, Plate C). At 10ft. a few Archaeocyathids (derived). Graded bedding common and may represent turbidite flows. At 18ft. a 2 inch bed of nodular chert.
18 to 25	Slightly silty 'Parara-type' Limestone.
25 to 50	Foreign block of massive grey limestone with some Archaeocyathids. Brachiopods (?), and dolomitic (?) clasts (10%). Similar to 8170ft.
————	Major Fault. Returned to 0ft. and measured down sequence.
0 to -2	Normal, dark grey, light weathering, slightly silty, flaggy (2 inches) 'Parara-type' Limestone.
-2 to -20	Brecciola or intraformational slump zone with allochthonous elements: 1. Medium grey, Archaeocyathid rich bichermal(?)

EXPLANATION TO PLATE C

Y : Brecciola, Station 21, Section D, showing megaclasts (1,2) in brecciated matrix.

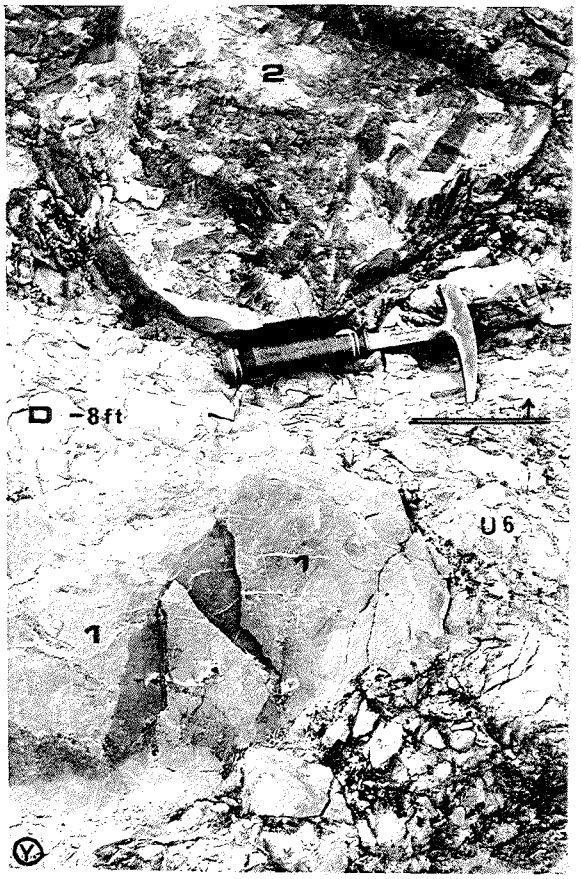
Z : Brecciola horizon, Station 21, showing slumped bedding.

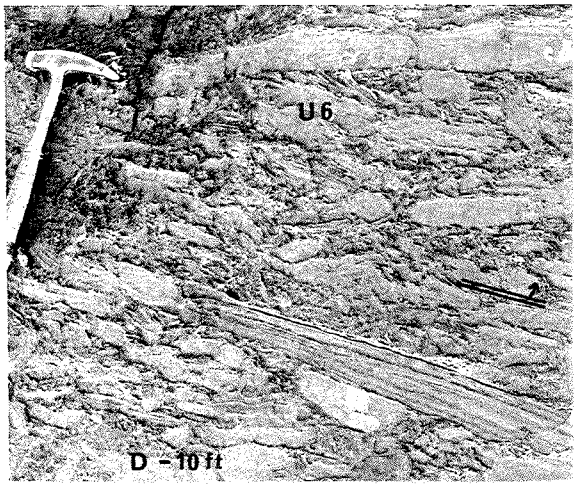
X : D 10ft., graded bedding in granule rich limestone.

W : Imbricated intraclasts, brecciola horizon, D -5ft.

Top right : D -10ft. Imbricated clasts showing reworking of beds.

Middle right: Typical Unit 5 showing mottling.





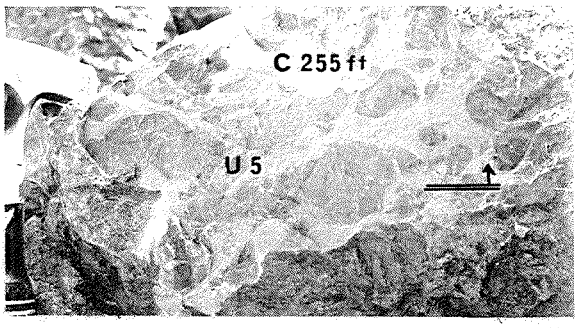
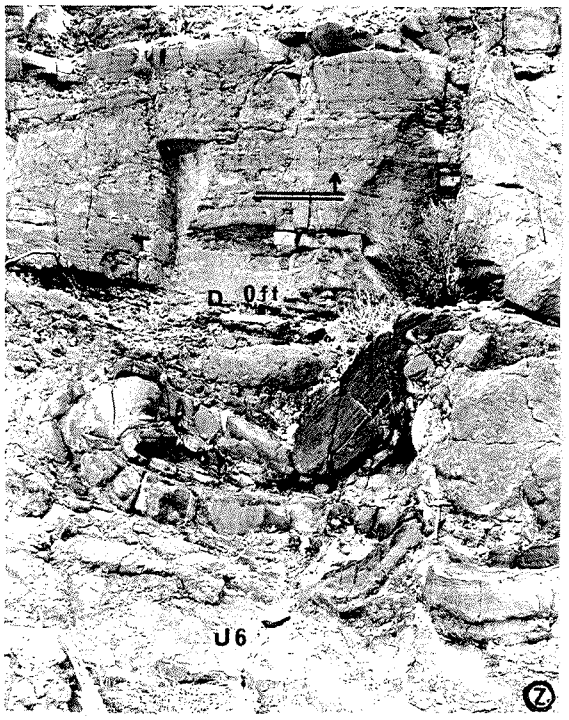
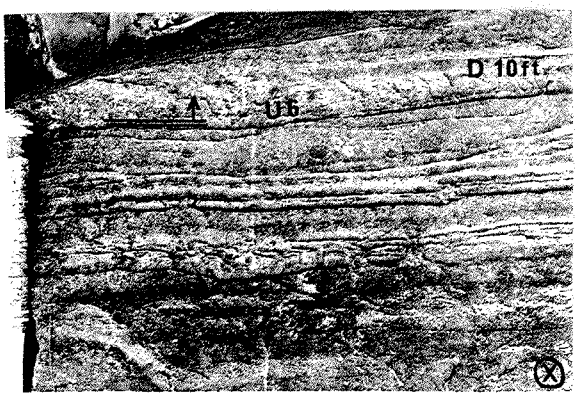


PLATE C





SECTION D (Cont)

Feet

limestone as a subrounded 4ft. boulder. Similar to B248ft. but is grey, not red.

2. A 3ft. boulder of grey-silty limestone with abundant silty clasts (-8 to -13ft.). Similar to B230ft.

3. Other carbonate facies (Photo Y, Plate C).

Matrix of zone is silty Parara-type grey limestones although thoroughly disrupted in places, reworked and in one place a 12 inch bed has been contorted into a 15 x 5ft. sinusoidal slump structure (-2 to -7ft.) (Photo Z, Plate C). One exotic block extends from -5 to -24ft.

Moving 30ft. East.....

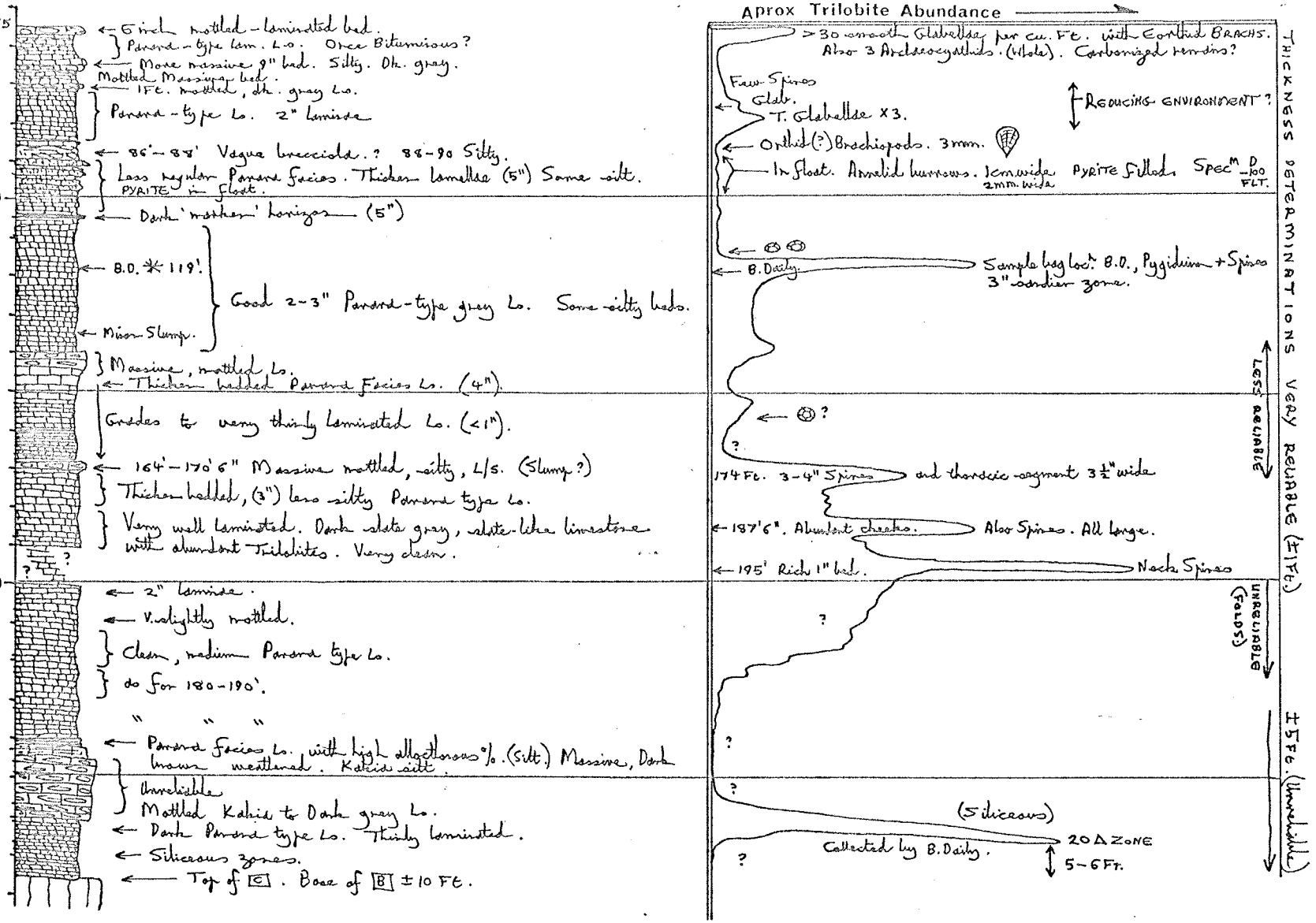
0 to -2	As above
-2 to -7	Brecciola. Many clasts (Photo W, Plate C).
-7 to -28	Usual laminated grey limestone.
-28 to -31	Rather more massive silty laminated bed (3ft. ledge).
At -29	Thin darker, 2 inch grey bed with Archaeocyathid debris similar to boulder in brecciola zone.
-31 to -32	Laminated greenish siltstone limestone. Dark grey internally.
-32 to -50	Typical dark grey (mottled) khaki 'Parara-type' Limestone. From -40ft. becoming silty (1ft. ledge). At -45ft. dark weathering limestone 'marker bed'. At -48ft. 6 inch greenish bed.
-50 to -54	More massive with thin laminae in top 1 foot. Laterally variable.
-54 to -55	Good 2 inch laminated 'Parara-type' Limestone. Dark grey. Minor silt. Abundant Trilobites. Well preserved glabellae, black and in a fine dark grey limestone. Complete head found.

Section continued in some detail with much attention to fossil content.

See Appendix, Figure I.

SECTION D (continued)

Figure I.



SECTION E (Photo, Plate D)

Feet	
0 to 4	BENDIEUTA MEMBER. Clastic Limestone: light grey spherical to elliptical, well rounded carbonate grains up to 0.5mm. in a carbonate matrix. Larger (20mm.) intraclasts and a few quartz granules present.
4 to 106	UPPER PARARA LIMESTONE (Unit 4): Flaggy grey limestones. Medium to dark grey with 3 inch limestone lamellae and up to 1 inch greenish shaley partings. At 20ft. some silt. At 30ft. minor silt influx, laminae become thinner, minor small scale cross beds. At 93ft. some red siliceous granules weathering out. Becoming less well laminated at 100ft.
Lateral Shift about 100ft. South	
106 to 134	Dark grey mottled limestone with abundant red brown siliceous debris including Trilobites and rare quartz granules, (2mm.), often graded. Silt fraction encircles grey limestone cores. Some dolomitic (?) clasts. Collections at 190 to 118ft. Archaeocyathids very rare (118ft.). 130ft. a Trilobite trash zone in dark grey mottled limestone. Grit nodules. 134ft. a bedding plane with nodular chert and Trilobite spines. Axial segment 1.5cm. across. 3 inch genal spines.
134 to 140	Obscured
140 to 170	MIDDLE LENS (Unit 5). Massive buff limestone. Possibly dolomitic. Very fine grains, rounded, 0.2mm., with some silt. Generally clean, buff to pale grey or whitish, massive and scarp forming. No fossils (?) but rare siliceous "clumps" 1 inch diam. At 170ft. becoming pinkish, mottled light grey in places with minor dendritic manganese oxides.
170 to 172	Negative relief. Possible Parara-type interbed.
172 to 184	Buff limestone as below.
184 to 204	UPPER PARARA LIMESTONE? (Unit 6): light grey bedded, almost

SECTION E (Cont)

Feet

flaggy limestone with some silt. Orange weathered siliceous nodules prominent. Some Trilobite occipital spines. Rare Archaeocyathid and intraclasts.

204 to 280 PINYATTA MEMBER? Massive buff limestones (Unit 7?): Pinkish orange in patches. Some dendrites. Grains less than 0.2mm. diam. Rare quartz grains, <1%, 1mm. diam. Silty, especially at 210ft., with a 2% fine sand fraction (0.6-0.1mm.) of medium sphericity and well rounded. Poorly sorted. Silt is yellow to buff with whitish flexks. Less sandy at 220ft., becoming clean, with 6 inch light grey limestone patches. Karren weathering. At 240ft. a 6 inch zone of light grey, clean, Archaeocyathid limestone with 1cm. dolomitic (?) clasts and darker grey limestone breccias in a 6 inch pod (Photo, Plate D). Archaeocyathids complete and up to 3 inches long. No quartz granules at 250ft., only fine yellow silt fraction. Smooth weathering, with pods of light grey Archaeocyathid limestone. At 270ft. a 6 inch bed of buff silty dolomite (?). Very finely crystalline, karren textures.

280 to 348 Clean, white to buff and yellow Archaeocyathid limestones with possible Brachiopods (280ft.) and rectangular, 3cm. silty limestone intraclasts. Karren weathering, thick bedded. At 310ft. pinkish and yellow limestone. At 314ft. influx of silt, ½% quartz granules and rectangular intraclasts. Colour is buff to light grey. At 320ft. more massively bedded, relatively homogeneous with a fine silt or sand fraction marking the bedding. A few intraclasts at 330ft. (of buff to brown silty dolomite?).

348 to 383 Minor change from below. Recrystallized limestone with some lighter grey patches and rare Archaeocyathid fragments. Minor silt and quartz granules. Authigenic quartz crystals and possible Brachiopods define the bedding. Upward trend to

SECTION E (Cont)

Feet	
	increasing light grey, mottled orange, clean Archaeocyathid limestones. Intraclasts (as described) persist. Sand is 0.3mm. quartz, some quartz is authigenic (0.4mm. crystals). Some limestone may be clastic. Overall, 'a massive, buff, silty limestone". At 380ft. a lens of very fine grained yellow buff dolostone (?).
383 to 392	Lighter grey, smooth weathering limestone, mottled limonitic yellow in places with clean lenses of a carbonate breccia rock of limestone and dolomitic clasts with Archaeocyathids in a sandy yellowish limestone matrix. Matrix is red in patches. At 391ft. limestone is brecciated, rare malachite is present in the rock and a fault is suspected on other evidence.
392 to 404	Honey coloured, fine grained, homogeneous dolostone (?) with rare silt, no fossils (?), buff weathered and with dendritic manganese. Second fault suspected at 404ft. However above 404ft. there is a vague, 30ft., purplish shaley zone which if not diapiric could well be the WOOKATA SHALE MEMBER (Unit 8) of the Moorowie Formation. Section F is begun in this shale but 100 yards to the North.

SECTION F

Feet	
0 to 34	WOOKATA SHALE MEMBER (?). Red-brown shale, weathered, strongly deformed (Photo, Plate D).
34 to 70	No outcrop, shale inferred.
70 to 100	KANDRAMOOKA MEMBER (Unit 9): light grey to buff massive limestones with silt and rare granules. May be dolomitized in patches. Often well recrystallized. At 70ft. stromatolites, at 80ft. dolomite rhombs and Archaeocyathids. The latter also at 90ft. and 106ft. Some dolomitic clasts.

EXPLANATION TO PLATE D

Top left : Section E

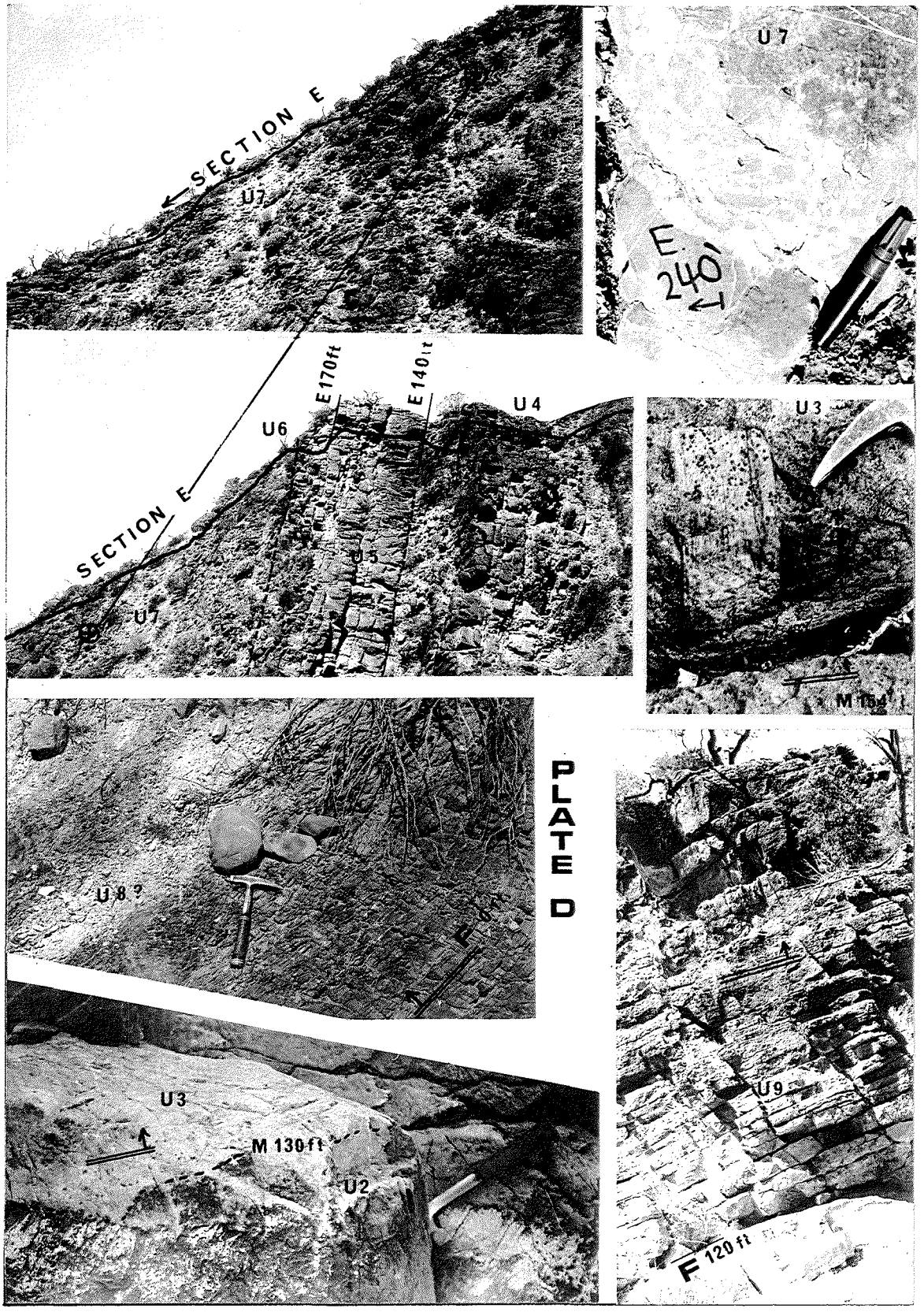
Middle left : Unit 8 at Section F, 0ft.

Bottom left : Contact, Unit 3, Unit 2, Section M 130ft.

Top right : Unit 7 at Section E 240ft.

Middle right: Clast in Unit 3, Section M154ft.

Bottom right: Typical exposure of Unit 9, Section F, 120ft.


SECTION E
U7
U7
E. 240'
E 170ft
E 140 ft
U6
U4
U5
SECTION E
U7
U3
M 134 ft
U8 ?
F 90 ft
PLATE D
U3
M 130 ft
U2
U9
F 120 ft

SECTION F (Cont)

Feet	
100 to 106	Undolomitized, light grey Archaeocyathid limestone.
106 to 120	Dolomitized limestone as below. Less silt at 120ft.
Minor Fault suspected	
120 (equivalent bed) to 195	(Photo, Plate D). Pale buff, rather massive, almost flaggy (12 inches) dolostone. Dolomitic clasts, subangular, up to 3cm. long. Some silt, clean, no granules. Archaeocyathid fragments including irregular forms. Grains are less than 0.2mm. diam. Few stylolites. Very reliable thicknesses, 120 to 170ft. At 135ft. a 3 inch bed of elongate, 4cm., dolomitic clasts in a limestone matrix. Some fragmental Archaeocyathids. Very little silt, no granules, crystalline well bedded. At 140ft. another 3 inch clast bed. At 170ft. Archaeocyathids become abundant, lying in the bedding. Possible Trilobite. 3 to 6 inch alternating beds of (1) light grey limestone with allochthonous Archaeocyathids and (2) 3 inch beds of homogeneous, buff, silty dolomitic limestone with Archaeocyathids. Both with rare dolomitic clasts. (Specimen F170ft. shows both facies). Becoming massively bedded (3ft.), cleaner and fossiliferous. From 175 to 185ft. a massive reef-like block exists with stromatolites and large, complete Archaeocyathids (8 inch by 4 inch) in a clean light grey limestone. From 185 to 190ft. a similar facies to below but more a thick bed than a block. Archaeocyathids lie in the bedding, are unbroken and may be preferentially orientated. Buff interbeds may be selective dolomitization or silt influx or both. Some stylolites. Karren ridges. Rare dolomitic clasts up to 3 inches long.
————	Possible loss of about 5ft. of sequence due to minor faulting?
195 to 197	Sudden influx of quartz granules (1%) (Upper Unit 9?) Loss of Archaeocyathids. Passage into granule rich pelletal limestones. Pellets are well rounded and up to 1.3mm. in diameter, averaging

SECTION F (Cont)

Feet	
	0.6mm. Granules are yellow, pink and grey.
197 to 236	Very granular (1-2%) massive (6ft. beds) limestone with quartz spheres up to 5mm. (av. 2mm.) in diameter and of intermediate rounding and sphericity. One dolomitic clast. Carbonate clasts up to 2mm., well rounded, moderate sphericity and are pink, grey, yellowish, orange, white and a few green. At 200ft. granules becoming scarce (1/4%) and are buff to white, 1mm. in diameter, well rounded, of moderate sphericity and poorly sorted. At 210ft. granules absent. Some silt remains and the limestone clasts are smaller (less than 0.4mm.) and may be oolitic. At 220ft. recrystallization is marked, fossils are absent and the silt fraction falls below 1%. Pale buff at 230ft. with less than 0.2mm. clasts. Very clean at 236ft. with small pods of clean, light grey limestone.
236 to 250	Yellow Dolomitic Limestone: (may correlate with sections to the North, just under Unit 10). Massive with 2mm. clasts and rare irregular Archaeocyathids.
250 to 300	Pelletal limestone: grey to buff with some Archaeocyathids. Rare quartz granules and silt. Some light grey patches. Yellowish at 260ft. and 290ft. At 270ft. with Archaeocyathids and pinkish colour. Possible Trilobites at 280ft. and 300ft. However recrystallized and pelletal (0.3mm.) at 300ft.

SECTION G

Note: The proximity of diapiric structures, the possibility of diapiric dykes, observed 2ft. wide calcite veins, obvious minor faulting, suspected major faulting, some anomalous dips and other factors make this section one to be regarded with caution. Suspected faulting is mentioned in the description and in the

SECTION G (Cont)

Feet	
	case of uncertain dip the regional dip has been adopted and measurements continued to the next reliable outcrop.
-11 to 0	(UPPER) PINYATTA MEMBER (Unit 7): massive, slightly pelletal, silty, orange to pink, 2ft. bedded Limestone with minor quartz granule fraction.
0 to 8	Massive, reworked, 3ft. bedded, silty, minor granule limestone but with medium grey limestone clasts, elongate, up to 10cm. by 2cm. with rare dolomitic clasts in a silty, pink and yellowish matrix, giving a vague mottled effect. Small Archaeocyathid and Brachiopods found in matrix. Strongly reworked at 5 to 8ft. (rubbly zone).
8 to 10	Poorly exposed. Highly weathered whitish shale debris.
10 to 15	Thin, 2 inch beds of sparsely pelletal, medium grey limestone with very rare and small Archaeocyathid fragments. Pellets are less than 0.6mm. diam., light to medium grey and rarely reddish (not jasperiod). Possible 1ft. silty bed at about 14ft. Only minor quartz granules.
15 to 20	'Typical', clean light grey, mottled orange-yellow (silt or dolomite?) Archaeocyathid rich limestone. No granules.
20 to 62	Very dark brown-black weathering, granule rich limestone (correlate of H200ft.+). Granules are quartz, medium sphericity and roundness, of 2mm. maximum diameter (average about 1mm.), and in a pinkish yellow to buff silty matrix. Slope concavity, 34 to 36ft., another, slightly higher, granule ridge at 36 to 46ft. Concavity from 46 to 50ft. with some granular limestones then another granule bed. (Quartz is 0.9mm. average diameter, 1.2mm. maximum).
	Major break in slope. Small valley. (Lateral shift South 50ft.)
62 to 127	UOOKATA SHALE MEMBER (Unit 8): purple, friable, micaceous and laminated siltstones or shales. Laterally thins southward.

SECTION G (Cont)

Feet	
127 to 149	KANDRAMOOKA MEMBER (MEGA-BRECCIA HORIZON) (Unit 9): light grey, clean, Archaeocyathid rich limestones as blocks (?) in a silty yellow matrix (?).
149 to 154	Dark brown weathering, 'typical', quartz granule rich limestone (Correlates with sections I, U, V, X and K?).
154 to 165	Light grey Archaeocyathid limestone as below. Mega-breccia features are not obvious and this may be a transition zone for a lateral passage into true breccias in the North from more massive (source area?) limestones in the South.
165 to 170	As for 149ft. Granule rich limestone bed. Buff, weathering brown.
170 to 260	Silty, orange mottled, clean, light grey Archaeocyathid limestones as below but with granule patches suggesting that the limestones are grading upward into true mega-breccias. Granules decline after 200ft. and matrix becomes a buff siltstone; however rare, 6 inch, large cobbles of granule limestone are present and are obviously derived. The grey Archaeocyathid limestone blocks are very irregular in form, indistinct in outline from the matrix and are perhaps about 1ft. wide. Bedding (within the blocks) is very difficult to establish. Note that the limestone blocks are 'clean' and the silt and granules are confined to the matrix.
260 to 262	Granule rich lens.
262 to 330	As below (Calcirudites). Granule rich zone at 275 to 284ft. Buff. Exposure poor above 260ft. Vague red colour at 320 to 325ft.
330 to 334	Buff, brown weathering granule bed.

SECTION G (Cont)

Feet	
334 to 360	Poor outcrop. Probably mega-breccias.
360 to 385	APPROX. UPPER UNIT 9: massive, clean, pink, grey mottled limestone with very few Archaeocyathids (grey limestone is probably reworked). Also very prominent grass-green and brick red granule band (marker bed - relates to top of Section H). At 370ft. a 1 foot granule limestone bed. Some silty mottling at 371ft. No Archaeocyathids? Fault zone at 384ft? Exposure poor from 380ft.
385 to 450	Massive, ridge forming, silty dolomite (?) with odd patches of quartz granules (2-3% overall) in what may be a "matrix" with 6 inch limestone cobbles, granule free. Pink colour internally, some mottled buff (silt) and with white crystalline calcite. Reworked? Relate to H400ft?
450 to 456	Massive limestone with black and red granular chert nodules, otherwise a relatively clean light grey to buff limestone with yellow-buff silty matrix. Rather massive 3ft. beds, karren ridges and some smooth pavements.
456 to 471	PACK CREEK MEMBER (Unit 10): Purple shale friable, deeply weathered silty shales. Whitish at base. At 459ft. a 6 inch pale yellow, silty dolostone with purplish and light grey pebbles.
471 to 475	Very distinct Limonitic (calc) siltstone: bright limonite yellow with odd patches of haematitic red material. Fine wavy banding observed. Some small, black cherty nodules. Could be a weathered Sideritic limestone (silty).

Suspect zone of MAJOR FAULTING. 471ft. upward. Main fault at 475ft?
Section moved 100ft. South across creek and becomes highly speculative.
Begin at top of first purple shale - i.e. G471ft.....

SECTION G (Cont)

Feet	
471 to 487	Massive purplish to grey, 1ft. bedded, very thick laminated, slightly silty limestone. Weathers brown to light grey and with silty yellowish clasts, some purple, in a light grey limestone matrix. Thinner laminae, 3 inches, towards 487ft.
487 to 503	Probable purple shale (faulted?) (Unit 10?).
503 to 520 Approx.	BRILLIG CATCH MEMBER EQUIVALENT (?) (Unit 11): Ridge of Sideritic Limestone with black granular cherts, a few haematitic red patches and a little limonite. Moderately well bedded.
520 to 523	Massive medium to light grey limestone with black cherty granules, no fossils and with light grey grains or patches with limonitic and silty (sideritic?) matrix. Main limestone, Unit 11, probably faulted out.
523 to 540	BILLY CREEK FORMATION (Unit 12): Basal "BOOK-LIMESTONE" marker horizon. 0.1 to 1mm. laminae of grey limestone and yellowish silts to give an excellent shaley parting.

SECTION H

Feet	
-10 to 0	PINYATTA MEMBER (Unit 7): massive silty (or dolomitic?) buff to pale yellowish Limestone, no obvious fossils, pale purplish in patches and with only minor silt.
0 to 5	Yellowish (mustard) to greenish highly weathered shaley member at contact (typical of basal Parara limestone contacts). Exposure very poor.
5 to 10	Grades up into buff, light grey to pinkish 'Parara-type' laminated limestone (3 to 6 inch beds) (Relate to T57ft?).
10 to 20	Very poorly exposed, suspect a semi massive unit. Massive grey bed at 20 to 21ft.
21 to 25	Good slate grey 'Parara-type' Limestone. Fine laminae, clean with thin shaley interbeds.

SECTION H (Cont)

Feet	
25 to 52	Massive unit, well bedded (6 to 12 inches), pelletal limestone with quartz granules up to 2mm. diam. Pellets are light to medium grey, 0.6mm. average diameter and some are red (but not jasperoid). At 30 to 40ft. colour grades to pinkish purple and granules persist. Some 1 inch silty beds. Rare dolomitic (?) clasts up to 5cm. long at 25 and 40ft. Rare, dark granular chert nodules. Grey at 51ft. Granules large (2mm.). Pellets are 1mm. and light grey, dark, orange, pinkish and dolomitic (?).

Slope concave for 20ft.

52 to 57	Poorly exposed but suspect pelletal limestone or perhaps a very light grey, clean Parara-type facies with 1ft. pelletal beds.
57 to 73	Pelletal limestone, perhaps oolitic. Light to medium grey grains that are very spherical and may have radial (spherulitic) structures. Spherulites? All very even light grey and of uniform size (0.7mm. av.). Some 3 to 30mm. (av. 10mm.), elongate yellowish limestone clasts, poorly rounded, low sphericity. At 60 to 65ft. poorly exposed but strongly OOLITIC, saccharoidal limestone with yellowish clasts. From 57ft. more pelletal limestone. At 67ft., thinly laminated, medium grey oolitic or pelletal limestone. (Outcrop resembles thinly laminated Parara Limestone). Some granules.
73 to 76	More massive, bedded, silty, yellow-brown, dark weathering limestone. Some granules, silt and pellets (silt influx?).
76 to 85	(Return to 25 to 52ft. facies). Pelletal limestone. 6 to 12 inch, well bedded, greenish grey weathered.

Shift across creek, South 100ft. Facies change noted. 73ft. equivalent is a pelletal limestone but with abundant quartz sand and granules.

Repeat from 76 to 100	Medium to dark grey, slightly sandy (quartz), 6 inch bedded limestone. Cliff forming and pellstal in part (25 to 52ft. facies). Mottled appearance with silty matrix. Reworking?

SECTION H (Cont)

Feet

Becoming progressively cleaner from 89ft. and Archaeocyathids occurring. (Note the coincidence of silt and Archaeocyathid influx). At 90ft. only minor silt in a medium to light grey, massive, Archaeocyathid rich (well preserved), orange and white mottled limestone.

100 to 110 Massive, 3ft. granule rich unit with medium grey pelletal limestone clasts up to 4 inches. (av. 2 x 1 inch or less). i.e. - reworked bed with a pinkish to buff granular and silty matrix giving a mottled appearance. Shaley interbeds at 103 to 105ft. Some clasts are fine grained, light grey, clean limestone. Rare dolomitic clasts.

110 to 113 Pink, silty and very granule rich limestone or calc sandstone. Some granules are 5mm. in diameter, well rounded, spherical quartz and poorly sorted.

113 to 118 Fewer granules. Pink, pelletal, silty limestone.

Slope concavity. Poor outcrop. 118 to 135ft.

118 to 145 Generally a pink to buff massive limestone with alternating buff silt and grey pelletal bands; few granules. Overall irregularly laminated.

145 to 150 More massive, 1ft., yellow pelletal limestone bed. Clean with round yellow pellets in a clear matrix.

Base of cliff. Passage over 2ft., buff to pink.....

150 to 160 Pink, massive, granule rich and silty pelletal limestone (or calc siltstone?) laterally variable in granule content.

160 to 200 Zone or lens of light grey Archaeocyathid, orange mottled, clean limestone (could be a block?). Grades to buff with some pink (possibly a weathering effect) with 0.4mm. quartz granules. Less granules to 190ft. with a few 5cm. max. length clasts. 4ft. granule unit defines bedding. Weathers yellow. At 190ft. a 3ft. block (?) of light grey, Archaeocyathid rich, clean

SECTION H (Cont)

Feet

limestone. Some orange mottling. (Relate to E, F, G?). From 190ft. 1.2mm. quartz granules, well rounded, highly spherical (none are red), in a pink, silty limestone matrix with odd clasts and Archaeocyathid limestone patches or blocks. Becoming buff and less granule-rich to 200ft.

200 to 233 Pink, to buff granule-rich limestone as below but weathers a dark brown, almost black. (Marker bed, relate to G, Z).

233 to 285 Less obviously dark in colour, but as below. End of really dark weathering limestone at 285ft. Limestone is buff with some pink. Granules all the way but slowly decrease towards 285ft.

285 to 289 Recrystallized (?) pink and white mottled limestones with abundant clasts and blocks (?) of Archaeocyathid limestone. Granules rare (in patches). Local reworking?

289 to 320 Massive buff, dark weathering limestone with some granules and silt, as below 285ft. but with more intraclasts. (Note the coincidence of granules and intraclasts). Pinkish at 294ft. Dark weathering at 330ft. (8ft. light grey Archaeocyathid limestone block at 305ft. At 325ft. a 8 x 5ft. subrounded boulder of light grey Archaeocyathid limestone).

320 to 325 Dark weathering granule rich, massive limestones continue but with a major change in the nature of the granules: brick-red (not jasper?), 60%, quartz (clear to smokey blue, 20%), and grass-green granules, 15%. Matrix is sienna-brown. (Relates to Section G and perhaps R). Green granules lost at 335ft.

335 to 350 Granule rich limestone, almost a calc-arenite at 350ft. Buff to 345ft. then a deep pink-red.
(BASE OF WOOKATA SHALE MEMBER EQUIVALENT at 340ft?).

350 to 351 Archaeocyathid limestone bed with yellow clasts and quartz granules. Colour is grey. 6 inch blocks of granular limestone

SECTION H (Cont)

Feet	
	facies with Archaeocyathid limestone blocks in a silty and granule rich matrix. Reworked or local slump?
351 to 367	(As for 340ft.) Red granule rich limestone with odd blocks of Archaeocyathid limestone. Passage zone? Major contact at 367ft?
367 to 440	KANDRAMOOKA MEMBER, MEGA-BRECCIA HORIZON (Unit 9): clean, light grey, mottled, buff to yellow (silt) and white, Archaeocyathid limestones with possible algal structures and rare cobbles of granule rich limestone facies in the matrix. Overall massive and ridge forming. At 380, 400 and 410ft. beds of granule limestone occur as well as cobbles. Some patches of Archaeocyathid limestone rubble with arenaceous nodules and silty yellow mottling. Less granular material at 410ft., becoming cleaner and grey towards 430ft. Small siliceous, black weathering nodules at 430ft. for 10ft. otherwise a massive poorly bedded limestone. Clean at 440ft. in places with odd silty (yellow) patches.
440 to 455	Interpretation difficult. Basic medium grey limestone with very few Archaeocyathids and silty buff to pink patches. Poorly bedded.
455 to 467	Medium grey, 6 inch laminated limestone with purplish, irregular, silty interbeds. Probable passage zone into overlying unit. White and greenish powdery shales in contact zone with thin interbedded carbonates.
467 to 505	PACK CREEK MEMBER (Unit 10): purple shales or siltstones. Soft, deeply weathered, with minor greenish patches.
505 to 512	Oligomict Conglomerate interbed or lens. Rubbly in outcrop. Well rounded, poorly sorted cobbles of clean, light grey, slightly silty limestone in a silty buff carbonate matrix.

SECTION H (Cont)

Feet

No red in matrix. Some Archaeocyathids in limestone. Loosely consolidated (weathered?). May lens out to the North (1ft. wide, 60ft. North).

512 to 592 Purple shales of (Unit 10). Friable, thinly laminated.

592 to 604 Second interbed of Polymict Conglomerate: irregular boulders up to 2ft. in diameter, subangular to subrounded, very poorly sorted of (1) red quartz granule rich limestone facies, mainly as 6 inch cobbles, (2) clean, light grey massive limestone with rare Archaeocyathids. Resembles G367ft. (3) Purplish mottled white limestone (top of Section B facies?). Matrix is finer equivalents of these lithologies.

604 to 687 Purple shales (Unit 10). 6 inch conglomerate lens at 610ft.

Major contact, unexposed.

687 to 755 BRILLIG CATCH MEMBER (Unit 11): thick bedded, khaki weathered, medium grey, very fine grained, very clean, splintery, homogeneous, 1ft. bedded to laminated limestone. Ridge forming, unfossiliferous (?). Interbed, probably dolomitic, weathers yellowish, khaki internally otherwise similar to bed below, at 744ft. Current activity decreasing upwards?

755 to 760 Massive bed with dark gritty chert nodules, almost black on the 760ft. bed otherwise a reworked limestone with fine grey limestone clasts up to 5cm. long, typically elongate and in a yellow, silty carbonate matrix. No fossils? At 760ft., a 3 inch bed of grey, clean limestone that is the unbrecciated equivalent of the lower bed.

760 to 775 BILLY CREEK FORMATION (Unit 12): "Book-Limestone" basal unit. Very finely laminated silty yellow and light grey, clean limestone. 0.1 to 1mm. laminae. Distinct 'marker bed'. At 770ft. a 1ft. bed of massive grey limestone.

SECTION H (Cont)

Feet	
775 to 785	(BASAL LIMESTONES OF BILLY CREEK FORMATION): massive, rubbly (leached or faulted?) limestone with 3 inch siliceous veins in fractures. At 785ft. a 6 inch yellow limestone on dolostone (?) bed.
785'4" to 792	Very poor outcrop but probably a medium grey, clean and orange mottled limestone.
792 to 797	White powdery shaley zone. Indistinct. Tertiary deposits?
797 to 965	BILLY CREEK FORMATION basal green shales becoming purple towards 965ft.
965 to 966	Thin yellowish Dolostone.
966 to 1075	Purple shales only. Lost under Tertiary Lacustrine deposits at 1075ft. Palaeoshorelines with beach type pebble beds, very well rounded, often highly polished and ellipsoidal in shape. Gypsiferous clays and siliceous Manganese and Iron oxides in patches.

SECTION I

Feet	
0 to 9	(UPPER) PINYATTA MEMBER LITHO-EQUIVALENTS (?) (Unit 7): dark brown to tan weathering (black in bands), laminated (1½ inches to 1mm.) slabstone or a coarsely silty limestone. Colour is light purplish to buff and grey in some beds. Coarse silt size is red, non jasperoid, granules in the thicker beds. Shaley partings as if grey limestone and silt elements were added to an environment of constant shale deposition.
9 to 42	Darker, granule rich beds. Grains are quartz and pink feldspar with rare black grains. Very diverse granule population. Minor ridge. Slope concavity at 15 to 42ft. with more obvious lamination.
42 to 43	Dark ridge of good slabstone facies (tan, calc-siltstone) with 4 inch lamallae with possible current or Trilobite markings on

SECTION I (Cont)

Feet	
	undersides of slabs. Weathering extends deep (1 inch or more) into rock. Internal colour is medium grey. "Silt" is used as a size term only and may include (1) possible clastic carbonate grains, (2) quartz grains and (3) red grains (10%). Slope concavity at 43 to 70ft. with thin laminations. Cycles of deposition evident with 3ft. (max.) limestone beds at 54, 55, 60, 65 and 70ft. with thinly laminated, shaley interbeds. 65 to 70 is almost a purple shale. Transition zone?
70 to 79	WOOKATA SHALE MEMBER (Unit 8): purple shales but gradational change from unit below. Becoming laminated near 79ft.
79 to 80	Dark laminated limestone interbed as below with red granules.
80 to 91	'Interbed zone' with thinly laminated shales.
91 to 92	Dark grey, 4 inch laminae silty limestone (as below).
92 to 93	'Interbed' shale zone.
93 to 94	Ridge with dark weathering, 4 inch laminated facies repeated.
94 to 140	'Interbed' facies but verging to purplish shale at top of interval.
140 to 150	Zone of 1 to 2ft. 'interbed' facies - i.e. almost a shale but with 3 to 4 inch dark weathering, grey limestone interbeds, often quartz granule rich alternating with silty bands.
150 to 222	Approximates to a purple shale; however, with rare, 1 inch or less, grey limestone lamellae.
222 to 256	MEGA-BRECCIA HORIZON (Unit 9): light grey, clean, Archaeocyathid limestone boulders (80%), buff granule rich limestone cobbles (5%) in a silty yellow carbonate matrix. Matrix is red for about 1ft. at the base and some of the basal carbonate blocks have a red colour. Some Archaeocyathids have a Limonitic or Sideritic infilling as at base of Section K.

SECTION J

Feet	
Less than -13 to 1	UPPER KANDRAMOOKA MEMBER (Unit 9): massive, Archaeocyathid, dark grey, mottled light grey and orange (weathered?) limestone with some silt and good karren textures developed. Unexposed from -13 to -8ft. and with no Archaeocyathids observed from -8ft. Beds are 5ft. thick, clean, slate grey and with small, 1cm., flecks of lighter limestone. Slightly lighter from 0 to 1ft. and with some bands of orange weathered siliceous debris. No fossils?
1 to 22	Outcrop very poor: Probably rubbly, very light grey limestone, clean, unfossiliferous (?) and with abundant 5mm. orange siliceous nodules in bands. Slope is convex. Purplish colour in soils from above?
22 to 31	A small ridge of thinly laminated but rubbly, clean, light grey limestone (with some cherty nodules). Very distinct lithology. Resembles an oligomict conglomerate with light grey, 2 to 3 inch max. (av. 1 inch) clasts and limestone pebbles in a pinkish matrix. (correlate with H505ft?). From 1 to 31ft. purple probably is in situ as thin lamellae and in a matrix of conglomeratic units. Some limestone pebbles up to 5 inches in this zone but average ½ to 1 inch in diameter.
31 to 136	Exposure very poor but purple micaceous siltstone inferred. (Checks along strike). 80 to 100ft. a definite crumbly purple shale.
Contact poorly exposed.	
136 to 227	PACK CREEK MEMBER (Unit 10): (very accurate measurements over this unit). Lithology is exactly the same as for Unit 10, Sections G and H. Thin, 1ft., laminated homogeneous, very clean buff to medium grey, splintery, very fine grained limestone. Some very fine clay. Very well bedded with distinctive

SECTION 3 (Cont)

Feet	
	karren and stylolite structures and patterns. At 217 to 220ft. a lighter grey bed, perhaps with more clay, that weathers a lighter buff colour.
227 to 249	(BASAL) BILLY CREEK FORMATION ("BOOK-LIMESTONE") (Unit 12); marker bed as in other areas with 1mm. lamellae of grey limestone with very thin silty interbeds. Parting allows limestone to be cleaved off in thin, flat sheets. At 230ft. and 236ft., 6 inch massive grey limestone interbeds with siliceous debris and black cherty limestone interbeds.
249 to 268	Pelletal and granular limestone. Poorly exposed but pinkish brown weathered with pink to red, not jasperoid, poorly rounded, medium sphericity, 0.7 to 1mm. granules to 25% of rock. Also dolomitic, buff weathered, limestone pellets 0.7 to 1mm. in diameter. Possibly some oolites. Some beds with no granules and these are a buff dolostone, thus perhaps local reworking with granule influxes to give granules and pellets in a light grey limestone matrix. 265 to 268ft. probably represents the 'matrix' alone - i.e. no granule influx. Also rock is grey, suggesting that red colour towards 249ft. may have been derived as such. This interval is a typical light grey, relatively clean but massive and bedded limestone with thin 3 inch or less interbeds of a yellowish lithology, probably dolostone. Very thin and rare granule patches suggest that their source was still exposed, continuous with lower rock units.
268 to 331 to 343	Buff to pinkish-buff, buff weathering, very fine grained, banded (1mm.) Dolostone. Reddish in patches. No granules, 3 inch laminae, no fossils (?), not very massive, with some dendrites and at 315ft., cherty nodules. Dolostone is more buff coloured towards 331ft. and grades into a massive light grey, clean limestone (as for 265ft.). Some silica nodules and buff mottling.

SECTION J (Cont)

Feet	
343 to 365	Semi massive limestones or dolostone. Dense, buff rock with microcrystalline texture. Yellow weathered and with some haematitic patches and pyrolusite.
365 to 520	BILLY CREEK FORMATION SHALES: purple and green near the base
520 to 530	Green shale lens.
530 to 730	Unexposed but purple shales inferred.
730 to 755	Purple shales with thin greens.
755 to 825	Unexposed. Possible faulting.
825 to 828	Dolostone: pale yellow to buff, fine grained with irregular thin lamellae and reddish patches. Not banded.
828 to 830	Massive light grey, yellow mottled, clean limestone with some black cherty granular nodules.
830 to 835	Dense Limonitic yellow dolostone with black, cherty debris.
835 to 839	Massive grey limestone, clean, slightly mottled with some cherty debris.
839 to 857	Massive ridge of dolostone. Khaki to Sideritic buff colour. Not as regular as lower beds.
857 to 860	Massive light grey, orange mottled limestone as below.
860 to 868	As for 839 to 857ft. (Semi massive dolostone; small ridge).

Contact may be faulted.

868 to approx. 1200	Purple shales.

SECTION K

Feet	
-30 to 0	WOOKATA SHALE MEMBER (Unit 8): purple shales, well laminated with subordinate greenish beds and 6ft. buff shale beds at top near contact.
0 to 2	Contact zone, irregular with a passage from whitish and silty shales to the overlying limestones.
2 to 30	KANDRAMOOKA MEMBER, (MEGA-BRECCIA HORIZON) (Unit 9): outcrop is very massive and rubbly with no obvious bedding or very thick beds. 1 to 2ft. (and less) subrounded boulders of 'typical' light grey, clean, Archaeocyathid rich limestone. Some Archaeocyathids up to 6 inches in diameter. Matrix is a yellow, silty, dolomitic (?) limestone with limonite and haematitic patches. Crossbedding in 0 to 10ft. zone with thin, 2 inch, lenses of granule rich calc siltstone - i.e. granule influx into purple shale facies giving a purple, calcareous, silty, arenite. Granules are mainly red and pale green with some quartz, and 0.5mm. max. diameter.

100ft. lateral shift South to avoid fault or isoclinal fold.

Begin at contact.....

0 to 25	MEGA-BRECCIA (unit 9): as before. Interpretation complex. Archaeocyathid limestone is 'classic' light grey, clean, mottled white and orange facies, as in Section I, but with many more Archaeocyathids with their cups siderite filled, the siderite weathering to limonite in places and to red oxides in others. At about 20ft., small exposures of a weathered purplish shale with very rare granules in the shale. Some granule patches as if they and limestone blocks were shed into a purple shale environment. Limestone facies is darker in places and very similar to J.-13ft. (i.e. K.19ft.). Very difficult section to measure. Suspect faults by the dozen, calcite veins and other secondary features. Section continued from contact with an assumed regional dip until reliable outcrop is encountered at

SECTION K (Cont)

Feet	
	about 70ft.
25 to 100	Probably approx. reliable outcrop in places. Purple interbeds lost from 25ft. upwards. Rock is mega-breccia as below. The matrix is silty yellow, dolomitic (?), often banded, with red patches and whole Archaeocyathids lying with their long axes parallel to the bedding (when present). Boulders and cobbles to pebbles to (18 x 6 inches), of purplish granule rich limestone facies (10%) occur in the matrix with the usual Archaeocyathid limestone blocks (80%). The latter are often mottled deep limonitic yellow. Some individual quartz-granules occur in the matrix. A 10ft. block of sandy dolostone at 60 to 66ft. with its bedding vertical and striking North/South, compared with a regional dip for the unit of about 30°West. Faulting is unlikely and the block facies cannot be traced along strike. Some minor dark weathering, internally buff, medium quartz granule limestone lenses and bands at 75 to 100ft.
100 to 103	Quartz sand, granule facies limestone bed with Archaeocyathid limestone rubble coming in above 103ft. to 107ft.
107 to 109	Granule rich limestone bed. Some rubble.
109 to 111	Archaeocyathid rubble bed with granule rich, buff matrix and granule rich limestone facies as pebbles. Granules absent in patches, with minor authigenic quartz crystals at 111 to 116ft. Propose that (1) a buff calcareous and/or dolomitic siltstone is being deposited with (2) alternate quartz granule influxes with silt and moderate currents to form granule limestone beds, then (3) periodic, violent influxes of Archaeocyathid limestone, at times unrelated to peak granule influxes, which involves reworking of silty and granule-rich limestone facies and incorporation of resulting clasts in the matrix. (4) granules predominate over silt in the upper, K100ft. beds. (5) Archaeocyathid limestone facies may have begun to come in before the end of purple shale deposition (i.e. to K25ft.).

SECTION K (Cont)

Feet	
116 to 134	Light grey Archaeocyathid limestone boulders being replaced by a darker grey limestone with boulders up to 2ft. and 6 inch granular limestone facies cobbles all in a silty buff limestone matrix and all very poorly sorted and rounded.
134 to 156	Very dark quartz sand and granule beds. Well bedded, buff and massive, scarp forming. Hydrothermal (metasomatic) alteration and silicification of the limestone with minor CHALCOPYRITE and secondary copper minerals.

Fault at 156ft. Abundant slikenside and mineralization.
Fault zone crossed to the next reliable outcrop to the East and measurements continued as if no fault. Calcite vein in fault.

Fault to 172	Mega-breccia with light grey Archaeocyathid limestone blocks (80%) and buff granule rich limestone cobbles (10%) in a silty yellow limestone matrix. Silicified zones near proposed fault.
172 to 180	Bedded granule rich, sandy, buff limestone with siliceous metasomatites. Some bed as K100ft? (72ft. throw).
180 to 188	Rubbly zone with 'mega-breccia' facies and silty limestone blocks.
188 to 200	Laminated, granule rich zone with 3ft. buff limestone bed at 192ft. and large limestone blocks at 195 to 200ft.
200 to 275	Yellowish silty matrix dominates with darker, clean limestone blocks up to 3ft. by 1ft. as breccia. Rare granules in silt and with granule limestone cobbles as patches. Copper sulphides and carbonates as minor disseminations. Archaeocyathids are rare and silicified. Dark grey limestone at 210ft. is same bed as K130ft. (80ft. throw). Abundant slikensides in silicified zones and very selective replacement of clean grey limestone blocks by mineralizing fluids, leaving the silty matrix unaltered. Much silica at 245ft. Vague purplish limestone K240ft. is K156ft. thus 84ft. of throw on fault. Average throw is 79ft. ± 5ft., West block down.

SECTION K (Cont)

Feet

Much silicified to 275ft. Minor crush zones with Malachite matrix with angular limestone breccia fragments over 6 inches. Limestone is light grey, Archaeocyathid poor and clean at 275ft. However with minor silty-yellow mottling.

SECTION L

Feet

This section has been run across a major fault zone (see map) and lies in an area of general structural complexity. Subsidiary sections may be required to interpret the information presented here.

0 to 49 UPPER PARARA LIMESTONE (Upper Unit 6): slate-grey, splintery, and fine grained, 1 inch laminated 'Parara-type' Limestone with very abundant carbonized (?), black Trilobite remains. Mainly glabellae, however a pygidium was found. Fewer remains in top 5ft. to 15ft. Less 'slatey' and more medium grey from 15 to 46ft. Silty from 46ft.

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49 to 59 Very massive, blocky, 5ft. beds of reworked Parara-type Limestone. Colour is light to medium grey with 2cm. subrounded limestone pebbles. Some blocks, 1 by 5 inches, with rare Archaeocyathids and possible Trilobites in a silty yellowish grey limestone matrix. This horizon probably equivalent to the Brecciola zones to the South and thus may represent the 'tail end' of the slump zone, being further away from the source than the beds to the South?

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59 to 82 Medium grey 'Parara-type' Limestone with a dark weathering, 2ft. and 3ft. silty laminated beds at 77ft. and 79ft. respectively. Minor ridges.

82 to 89 Dark weathering silty laminated limestone with 6 inch interbeds of pelletal limestone with grey and buff irregular, less than 1.2mm. diameter limestone pellets and less than 10% round

SECTION L (Cont)

Feet	
	quartz granules. Graded bedding observed in the 6 inch interbeds with the coarse quartz granules at the base and silty, dark weathering elements at the top.
89 to 108	Resembles 'Parara-type' Limestone but a contrast exists between dark brown weathering silty lamellae, 1 to 3 inches, and 1 to 3ft., incompetent interbeds of greenish shale (relate to top of Section R).
108 to 165	Poorly exposed, concave slope and at base of a major cliff face. Major fault zone? Limestone is rubbly, thinly laminated, very light grey to white, fine grained Parara-like rock with thin shaley interbeds. No fossils? Becomes darker (away from the fault?) to slate grey from 150 to 165ft. and pelletal with minor quartz granule beds at 160ft.
165 to 172	Massive, 2 to 3ft. bedded, medium grey limestone with minor quartz silt and very minor reworking to give a mottled effect.
172 to 176	Medium grey 'Parara-type' Limestone. Some silt.
176 to 181	As for 165 to 172ft. Massive silty, dark grey limestone.
181 to 192	As for 172 to 176ft. Parara-type grey laminated limestones. Poorly exposed.
192 to 206	As for 165 to 172ft. - i.e. this zone from 165ft. to 206ft. shows repetitive influxes of silt into the autochthonous limestone elements. Silt more common from 192ft. with larger scale mottling. Limestone is still medium grey but silts weather out as yellowish-orange.
206 to 223	Return of rubbly, laminated Parara like limestones with some silts.
223 to 308	Base of large cliff with 6 to 10ft. beds of very massive, medium grey limestone with 2ft. cycles of silty mottling.

SECTION L (Cont)

Feet

At 250ft. some 0.2 to 0.3mm. pellets in the limestone which is becoming lighter. Very rare quartz granules (3 to 4mm.). Rubbly 'Parara-type' Limestone, medium grey and slightly silty at 272 to 308ft.

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308 to 318 Massive 1 to 3ft. bedded pelletal limestone. Some beds strongly pelletal (BENDIEUTA MEMBER EQUIVALENT?). Pellets are light grey, clean and 0.4 to 1mm. in diameter. Granules and silt almost absent.

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318 to 370 Rubbly medium grey, thinly laminated 'Parara-type' Limestone, becoming dark grey from 328ft. No obvious fossils. At 366 to 370ft. same lithology but numerous silicified fossils of many diverse phyla. Fauna observed includes:

(1) TRILOBITES: probably Redlichiacia. A large (3 inch wide) organism with a long occipital spine, extended genal spines, and a large, bulbous patterned eye. Hundreds of fragments.

(2) HYOLITHIDS: 15 or 20 specimens. 12mm. long, cones with two parallel longitudinal and dorsal ridges.

(3) ARCHAEOCYATHIDS: small, 2 inch, regular forms.

(4) PORIFERA: represented by triaxon (Hexactinellid) siliceous spicules (3 of).

(5) MOLLUSC (GASTROPOD): a 2cm. long by 1.2cm. wide semi-flattened cone with 5 or 6 circular ribs or plications along its length. Form is represented in the Cambrian limestones of Ardrossan, South Australia (B. Daily, pers. comm.).

(6) p. ARTHROPODA cl. BRANCHIOPODA, cl. CONCHOSTRACA (?): one specimen (B. Daily, pers. comm.).

370 to 441 Parara-like, medium to dark grey, clean laminated limestones. Becoming lighter at 374ft. (silt influx?) and thicker laminated in alternate beds (up to 6 inches). Trilobite remains at 370,

EXPLANATION TO PLATE E

A. Trilobites: YORKELLA Australis (Woodward) from the Ardrossan area, South Australia. Glabellae and free-cheek; photograph supplied by B. Daily.

Compare with

B. Trilobite: YORKELLA Sp. from Mt. Chambers Gorge area; Section L, 476ft., collected and prepared by the author.

C. Hyolithids from Section C, 213ft., Mt. Chambers Gorge.

D. Trilobite free-cheek with well developed genal spine. Section D, 174ft., Mt. Chambers Gorge.

E. Trilobite glabella from Section D, 170ft., Mt. Chambers Gorge.

Specimens B, C, D, E collected and prepared by the author and presented to Dr. B. Daily for further study.

October, 1970

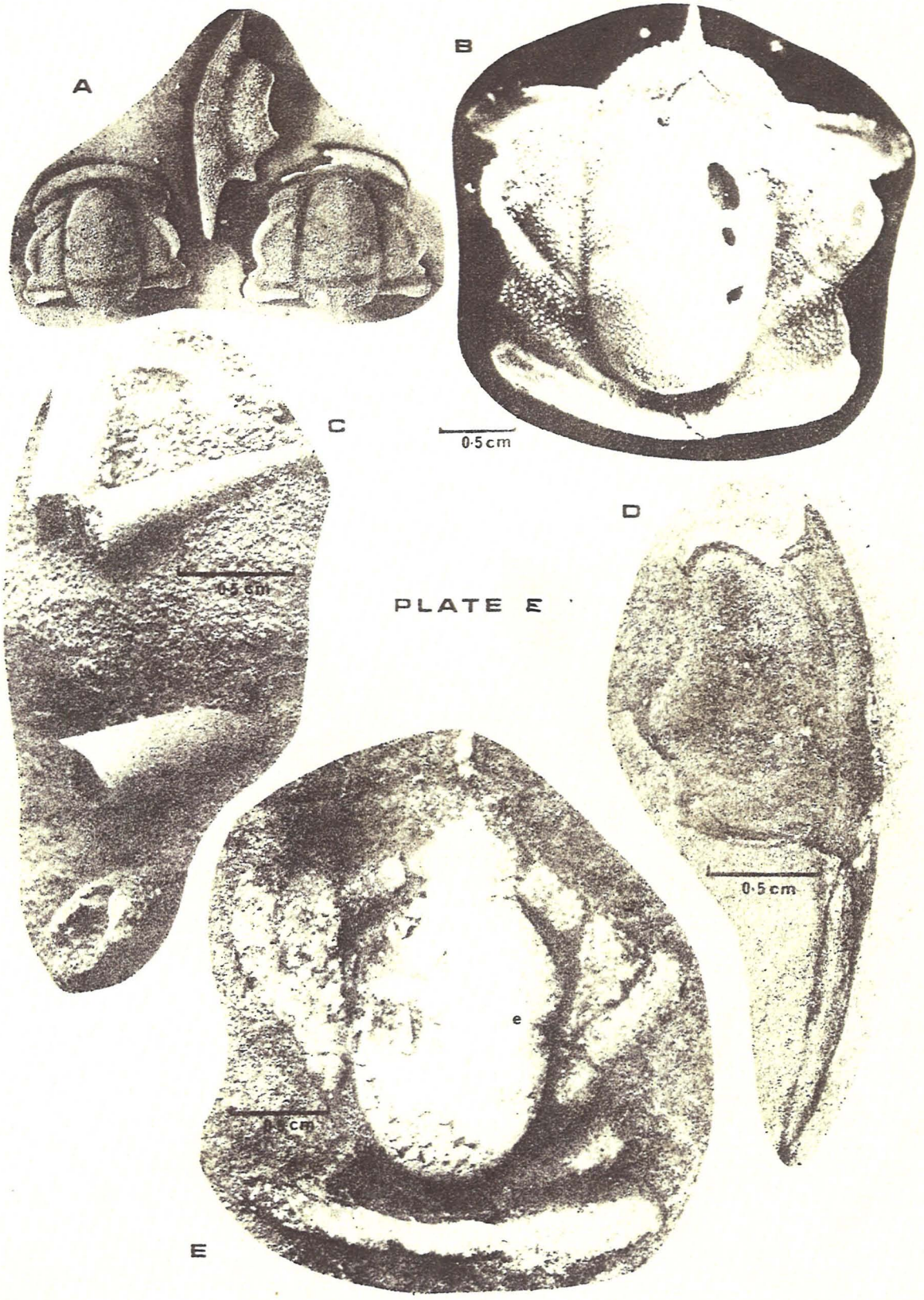

PLATE E

SECTION L (Cont)

Feet	
	410 and 416ft. One massive 3ft. silty, mottled medium grey limestone bed at 421ft. Small Trilobite fragments at 424ft.
441 to 476	Massive, 1ft. laminated, mottled, medium to dark grey, silty limestone interbed, pelletal in part. Rare Trilobite remains. At 475ft. a 2 inch sandy lamella with silicified Archaeocyathid and Trilobite debris. At 476ft. very rich Trilobite horizon. Bedding plane with dozens of almost complete silicified glabellae of YORKELLA (Australis?), with a few Archaeocyathids. (See photo, Plate I).
476 to 480	Partially siliceous 'Parara-type' Limestone with some Trilobites.
480 to 482	Dark, silty bed as at 475ft. but with relatively few Trilobites (fragmental).
482 to 486	Grey laminated, 'Parara-type' Limestone.
486 to 502	Massive, thick bedded, silty, laminated and mottled limestone.
502 to 546	(East lateral shift). Thick, 4 inch laminated 'Parara-type' Limestone, medium to dark grey with graded bedding in silty bands and sponge spicules. Thin, dark, red brown weathered siliceous horizon at 537 to 538ft. Small ridge at 544ft. with yellowish silt influx and laminated rather than mottled limestone (2ft. bed).
546 to 551	Massive, mottled, silty dark grey limestone.
551 to 582	Thick, 3 to 4 inch laminated 'Parara-type' Limestone, slate grey with odd ½inch silty interbeds.
—— Fault——	
582 to 590	Medium grey 'Parara-type' Limestone with calcite veins
—— Fault ——??	

SECTION M

Feet	
0 to 25	WILKAWILLINA LIMESTONE (Unit 1): clean, light grey to white limestone with Archaeocyathids and well preserved, abundant phosphatic Brachiopods (micromitra). Grains are less than 0.2mm. Stylolites common. 2ft. jasper vein in fault, narrowing to 6 inches over 12ft. with two 6 inch throws on the East. Micromitra very abundant above 5ft. Sections elliptical, up to 1.6cm. could be Hyolithids (?). At 22ft. a gradation into dark grey mottled limestone.
25 to 35	Light grey to orange massive, less mottled, pelletal limestone with Archaeocyathids and 6 x 2cm. max. dolomitic clasts and stylolites.
35 to 65	LOWER PARARA LIMESTONE (Unit 2): finely laminated, light grey, rubbly limestone. Slope concavity. Clean limestone with some orange mottling on joint planes. Archaeocyathid fragment. Ridge at 47ft., a more massive unit. Archaeocyathid fragments. 3mm. Brachiopod at 50ft. Limestone becoming less laminated and lighter grey. Concavity at 54ft. Very finely laminated, light grey limestone. Pink and purplish grey patches at 56ft.
65 to 117	More massive, light grey 'Parara-type' Limestone with a few Archaeocyathids and Brachiopods. Darker, medium grey, 1 inch laminated limestone at 66ft. At 75ft., ½ inch purplish lamellae. Dark from 75ft. with a Trilobite spine at 80ft. and a 6 inch bed with 1 inch silty lamellae. Scarp at 85ft. of medium grey 'Parara-type' Limestone with a few 6 inch siltier beds. Light grey from 95ft., finely laminated. Single massive, silty, sandy and pelletal bed at 104 to 107ft. followed by light grey laminated limestone to 117ft. Trilobites at 114 and 115ft., abundant and hard to crack out. Slabs taken and etched with hydrochloric acid then handed to Dr. Daily (Specimens "STN.4."). Hyolithid.
117 to 130	Very massive, mottled limestone, dark grey, pale in part, with

SECTION M (Cont)

Feet

some silt and fine sand. Note that Unit 104 to 107ft. thins to 1ft., 200ft. due North and that the interval 107 to 117ft. is only 3 inches thick at this point.

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130 to 146 BENDIEUTA MEMBER (Unit 3) (Photo of contact, Plate D): very massive, fine calcareous-sandstone or fine sandy limestone (?). Grains less than 0.2mm. diam. of quartz; well sorted, well rounded, spherical and size layered. Colour of rock is pale pink to pale orange and weathers a dark honey-brown. Sandy basal interval grades into pelletal limestone, lighter grey unit then at 137ft. the sandy lithotype is repeated to 146ft.

146 to 232 Light grey, pinkish to pale yellow clastic limestone interbed. Weathers a pale grey. Pellets are very well rounded, spherical or ellipsoidal (long axes 1.6mm.). Archaeocyathid fragments and abundant Brachiopods (?) at 147ft. Some sandy mottling in patches. At 154ft. a 6 x 15cm. laminated Dolostone cobble (Photo, Plate D), and a few 2cm. in diameter. 6ft. beds of massive pelletal (10%) sandy limestone from 147 to 160ft. Specimen M160ft. is typical. Some 3ft. to 6 inch lighter, less sandy pelletal beds followed by ½ to 1 inch very sandy interbeds. Sand is well rounded, frosted (?), highly spherical quartz. Moderately well sorted and 0.5mm. average diameter. Carbonate clasts are light grey to orange, probably dolomitic in some cases, spherical to ellipsoidal and averaging 0.7mm. in diameter (max. 2mm., rare). Rare darker grains; overall colour is purplish-orange to pale pink. Less sand at 170 to 210ft. and is more widely distributed to give a mottled appearance and a grey colour in outcrop. One bed 15ft. thick. At 131ft. pellets average 0.3mm., maximum 0.7mm. in diameter. Colour is purplish-grey. Quartz granule fraction.

232 to 290 Pinkish-buff oolitic to strongly pelletal limestone with very few quartz granules. Grades into a purplish-buff pelletal

SECTION M (Cont)

Feet	
	limestone with abundant quartz granules (1mm. diam.) at 240ft. Colour is honey-brown. Granules are well rounded and spherical and weather out to give a 'sandpaper' texture. Massive and siltier at 273ft. Buff to light grey with fewer quartz granules which are finer above 273ft. Thin silty interbeds give a mottled effect at 277ft. and granules are few. Grey colour at 281ft. with quartz granules. Rather homogeneous rock but with some vague silty interbeds. Pinkish in patches.
290 to 510	Mottled pelletal limestone as for 277 to 281ft. Grey pelletal limestone at 297 to 316ft. and a return to mottled facies at 316 to 320ft. Pellets are grey to pink and round to ellipsoidal. Some stylolites. Quartz granules up to 1.6mm., often poorly rounded but generally spherical. Rarely 3mm. in diameter. Granules persist to 510ft. 'Grey pelletal' type limestone, 320 to 420ft. but with some silt and sand at 406 to 409ft. Mottled pelletal type limestone from 421 to 425ft. and 'grey pelletal' type from 425 to 510ft. but becoming darker towards 510ft. At 510ft. a dark, granule rich pelletal limestone (matrix is dark). Small pale yellow dolomitic clasts up to 5cm. and 3mm. red quartz granules. Passage zone (?) into overlying beds. (Dolomitic clasts relate to top of Unit 3 in Section C).
510 to 537	UPPER PARARA LIMESTONE (Unit 4): partially pelletal near the base, medium grey, finely laminated 'Parara-type' Limestone. Exposure poor. Trilobite fragments and siliceous debris at 515ft.

SECTION N (Measured jointly by M. Hatcher and the author. Descriptions and interpretation is individual).

Feet	
0 to 2	UPPER PARARA LIMESTONE (Unit 4): weathered zone
2 to 35	2 inch laminated, slate grey 'Parara-type' Limestone with khaki, shaley interbeds. Inarticulate Brachiopod (Linguloacean?)

SECTION N (Cont)

Feet	
	at 27ft.
35 to 36	MIDDLE LENS (Unit 5?), massive, medium grey silty pelletal limestone interbed, yellow to grey with or without dolomitic pebbles.
36 to 38	Mottled to laminated medium grey 'Parara-type' Limestone.
38 to 65	Finely pelletal medium grey to yellowish limestone. Cliff forming, very massive, mottled and with 6 inch beds but major partings at 3 to 4ft. Medium grey to sandy orange and mottled at 42ft. (Silty beds are orange to pink inside but weather brown compared to grey limestones without silt that weather grey). Sand weathers cut at 50 to 60ft. Rare quartz granules 5.5mm. in diameter.
65 to 74	Grading into a mottled dolomitized (?) unit with pink to yellow dolomitic or silty (?) mottles with medium grey limestone cores.
74 to 75	Grades into almost 100% dolostone. (Note: poor reaction to acid test may indicate a buff finely silty limestone rather than dolomite. Even staining with Alazarin-Red S is not conclusive and the rock must be quantitatively digested with hydrochloric acid to estimate the percentage of silt. X-ray methods or total rock analyses may be needed to estimate total magnesium). Granules very rare. Silt fraction remains.
75 to 89	Dark 'Parara-type' Limestone with khaki, shaley interthins and abundant Trilobites (at 81ft.). One Archaeocyathid fragment.
89 to 100	Purple to pale pink fine grained pelletal limestone almost 'classic'. Bendleuta facies. Very pelletal (maximum dimensions of pellets 1.1mm., average 0.6mm.), well rounded

SECTION N (Cont)

Feet	
	and in a clean, grey matrix with 3 x 1mm. authigenic quartz crystals. Light pink to buff calc-siltstone from 96ft. Massive with quartz granules and finely pelletal.
100 to 123	Patchy, mottled dolomitized (?), (5%), grey limestone comparable with Unit 5 at Section C 265ft. Rare Archaeocyathid fragments and Brachiopods at 110ft. Some silt and a light buff bed at 117 to 118ft. Contact at 123ft. with stylolites and a dark (pyrolusite?) band.
123 to 140	Grey, light mottled limestone dolomitized (?) along bedding planes, 1 to 2 inches thick with very irregular basal contacts and alternating with 2 to 3 inches of grey limestone. Some rare pellets may be oolites?
140 to 170	Pink to whitish, coarsely silty pelletal limestone, possibly dolomitized. Silt is quartz, some grains to 0.2mm. Archaeocyathid fragments at 138, 142, 148, 150 and 159ft. Is this unit a dolomitized, pelletal, silty and sandy limestone? Granules persist to 160ft. Pelletal, light grey limestone at 158ft. which *may* represent undolomitized equivalent. Light patches *transecting* the bedding is the best evidence for secondary dolomite. Pink at 160 to 167ft., may indicate exposure. Medium grey and mottled at 167 to 170ft. Some rare dolomitic (?) intraclasts.
170 to 182	(INTERLENS) (Unit 5?), very dark, almost *black* Parara-type flaggy limestone. ½ inch silty interbeds are khaki. Minor mauve patches in some of the darkest limestone. Beds are 3 to 4 inches thick but major partings are at 3 to 9 inches. No granules, some silt. *Trilobites* collected by B. Daily at 74ft. and marked '7-Delta'. Passage into overlying unit.

SECTION N (Cont)

Feet

182 to 241 Mottled, dolomitized, medium grey pelletal limestone (as below). Pink at 202 to 205ft. and massive. Massive dolomitic (?) limestone 208 to 212ft. Mottled from 212 to 223ft. Mottled with thin dolomitic (?) bands from 223 to 241ft. and a darker grey with less dolomite (?) in the top 6ft. Few dolomitic pebbles, and a bedding plane with silicified cup-like Archaeocyathids at 241ft. Passage into overlying unit?

Major contact, sudden break in slope although the true base of Unit 6 may be lower if the 182 to 241ft. interval is proved to be a lens or passage zone and only local. Measuring down from Unit 7 with an assumed thickness for Unit 6 suggests that the contact is here at 241ft.

241 to 255 UPPER PARARA LIMESTONE (Unit 6): medium grey, 4 to 5 inch laminated generally 'typical' 'Parara-type' Limestone. Slightly mottled in some beds. Mauve to purplish 2 inch patches. Possible Brachiopods with Hyolithids. Abundant silicified Trilobite fragments especially in a 1 inch gritty bed at 245ft. Species has a long occipital spine, 3 inches, and may be a Redlichian form. Archaeocyathids at 245 to 250ft., usually complete, but probably derived. Very few Trilobites at 250ft. but some Hyolithids of a conical form with two parallel dorsal longitudinal ridges; some specimens 2½ by ½ inch. (Not abundant but large). Dark, black cherty nodules in a 3 inch bed at 255ft., with grit. Some nodules 6 x 1 inch, 2 to 3 only.

255 to 280 Thick laminated 'Parara-type' Limestone as below but with very few fossils. Some mauve silty mottling at 258 to 265ft. and 270 to 275ft. Grades into a darker zone, 260 to 265ft. Rare Trilobite remains at 265ft. (occipital spine) and some Archaeocyathids with cherty nodules and bands. Mauve general in 250 to 275ft. zone but replaced by yellowish, buff silt at 275 to 280ft. resulting in a more massive and mottled

SECTION N (Cont)

Feet	
	outcrop. (Becomes laminated/mottled along strike). Some dolostone intraclasts in 6 inch bed at 280ft.
280 to 286	Sand influx to give a calc-sandstone bed, 8 to 6 inches thick which grades upwards into a mottled unit to 286ft. in which the mottling is silty sand and the limestone is medium grey.
286 to 290	Concave slope; rubbly mottled limestone.
290 to 297	Massive mottled grey limestone with abundant cup-like Archaeocyathids, 295 to 296ft. and in odd patches at 297ft. This may be the "Archaeocyathid-marker horizon" of Section C and elsewhere. Lithologies, 285 to 299ft. may also match especially the sideritic and limonitic mottling at 296 to 297ft. present at the top of Section C.
297 to 298	Mottled khaki to medium grey, rubbly limestone.
298 to 300	Massive mottled limestone with Archaeocyathids at 299ft.
300 to 336	Good Parara Limestone facies, 3 inch laminated, splintery, slate grey limestone with thin silty interbeds as parting planes. Trilobites abundant, especially at 302 to 305ft., with large occipital and genal spines up to 3 inches long (Redlichiacia?). Certain beds resemble the sulphurous Trilobite horizon lithologies of Balcooracana Ck., 40 miles South. Brachiopod (?) at 204ft. Trilobites all the way to 336ft., although not especially common.
336 to 337	Bed of dark weathering (rust brown), dark limestone, which resembles a sandstone in outcrop (good 'marker horizon').
337 to 340	Probably the epidote-green sandstone/shale marker horizon of other sections although rather weathered here from a

SECTION N (Cont)

Feet	
	greenish silt with thin lenses of grey limestone. Rubbly and no obvious fossils from 330 to 340ft.
340 to 357	Parara facies repeated but more massive (not mottled). Finely laminated at 345 to 357ft. At 350 to 357ft. very rich Trilobite horizon. * B. Daily has good collections marked 'C.G.8 Delta'). Black specimens, mainly heads and glabellae (correlates with D57ft?).
357 to 360	Mottled limestone unit, laterally variable.
360 to 365	Finely laminated 'Parara-type' Limestone. Indistinct and partially rubbly. Abundant Trilobites at 362ft. Carbonized? (relate to D60ft?).
365 to 374	Massive Parara facies. Variable interval. Massive 1 inch beds and finely laminated 6 inch beds. Silty.
374 to 380	Finely laminated Parara facies, irregular, some beds 5 inches thick.
380 to 420	Very thick laminated, cliff forming unit. Laminated limestone; grades into more finely laminated unit at 420ft. Light grey. Rare Archaeocyathids at 385ft.
420 to 428	Finely laminated 'Parara-type' Limestone. Light grey with some silty interbeds.
428 to 430	Massive, 2ft. bed of silty, grey limestone; irregular.
430 to 445	Light to medium grey Parara facies limestone.
445 to 452	Silty limestone, medium grey, massive with silty mottling.

SECTION N (Cont)

Feet	
452 to 473	Approx. light grey, sometimes mottled, thinly laminated 'Parara-type' Limestone. Archaeocyathid at 445ft. ('cup' form).
473 to 476	Massive, silty mottled to laminated limestone.
476 to 483	Probable finely laminated 'Parara-type' Limestone. Changes are gradational.
483 to 486	Massive, irregular, mottled-laminated silty limestone.
486 to 506	Undifferentiated; poor exposure but generally a laminated 'Parara-type' Limestone with more silty, mottled interbeds and some thin shaley interbeds. Rare siliceous debris with Trilobite spines (?).
506 to 525	Massive silty limestone bed, not mottled but with a laminite appearance due to thin silty interbeds. Irregular bedding at 515ft. Becoming mottled from 515ft. with rare Trilobite remains (silicified).
525 to 526	Abundant nodular chert in a massive, silty limestone. Dark brown to orange weathering. Trilobite fragment at 526ft.
526 to 554	Usual light to medium grey, finely laminated, shaley (?), Parara-like limestone.
554 to 558	Dark, massive silty limestone especially 557 to 558ft. Weathers very dark; "marker horizon". Relates to Section C.
558 to 564	Probably a laminated to massive Parara facies limestone.
564 to 644	PINYATTA MEMBER (Unit 7): massive, 1 to 5ft. beds of silty and sandy, grey limestone. Pelletal with a grey matrix and

SECTION N (Cont)

Feet

dolomitic clasts up to 2 inches in length near the base, becoming more frequent in given beds. Siltier beds. Quartz sand is angular to subrounded and about 0.2mm. in diameter. At 590ft., less dolomite clasts but still pelletal, sandy, medium grey limestone with silty, 5 inch interbeds and large scale (3ft.) cross beds. No obvious fauna. Abundant dolomitic intraclasts at 601 to 605ft., rare from 605ft. Quartz granules and sand, often to 2mm. in diameter. Colour is light grey towards the top and with far less silt. Still massive and with a definite pelletal limestone content.

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644 to 647 Light to medium grey, clean, Archaeocyathid limestone but with yellow dolomitic intrapebbles. Archaeocyathids are large, well preserved and regular in form.

200ft. North lateral shift.....

647 to 654 Approx. Archaeocyathid limestone (as below).

654 to 660 Pink to red-purple, massive, sandy, Archaeocyathid-poor limestone with 0.1mm. pellets and small jasper sands. (Relate to top of Sections B & C, and to Unit 8 (?) in the North?).

SECTION O

Feet

0 to 40 UPPER PARARA LIMESTONE (Unit 6) (Upper part): (undetailed)... thinly laminated, medium grey 'Parara-like' Limestone with some 3 inch well rounded limestone pebbles at 30 to 40ft. (reworking?)

40 to 43 Brecciola horizon with strongly reworked and slumped Parara facies limestone with a buff to greenish silty matrix. One subrounded boulder of massive dark limestone of an unknown source, 15ft. by 7ft. with differential compaction features in the overlying laminated limestone beds and possible deformation of underbeds.

SECTION O (Cont)

Feet	
43 to 45	Thinly laminated grey limestone.
At 45	An 8 inch breccia lens, about 10ft. long.
46 to 52	Thinly laminated 'Parara-type' Limestone. Medium grey with greenish silts.
52 to 53	Vague, dark weathering 'marker-bed' of silty limestone.
53 to 58	'Parara-type' Limestone.
58 to 63	Brecciola as below. May be lenticular.
63 to 69	Parara limestone.
69 to 75	Brecciola. Less massive, rubbly in outcrop, 72 to 75ft.
75 to 95	Parara limestone, thickly laminated from 78ft. and massive, silty 1 to 3 inch beds at 79ft.

Base of cliff:

95 to 107	Very massive, 12 to 3ft. beds of silty limestone. Silt weathers out buff and in bands with sandy interbeds. Autochthonous base is normal 'Parara-type' Limestone. Some granules in the sandy beds with large scale, low amplitude cross beds.
107 to 114	Small scale Brecciola to mottled limestone bed with granules and silts (95 to 107ft. facies reworked?).
114 to 116	Bed of friable, pale epidote-green to whitish arenaceous siltstone with medium grey, rounded Parara limestone rubble.
116 to 120	As for 95 to 107ft., but 6 inch lamellae - i.e. a medium grey limestone with silt and fine sand.
120 to 122	Brecciola or oligomict conglomerate with 6 inch, elongate slabs of Parara limestone and dolomitic intraclasts (5cm.) in a gritty, silty limestone matrix.
122 to 124	Parara facies limestone.
124 to 126	Brecciola.

SECTION G (Cont)

Feet	
126 to 145	Parara facies laminated grey limestone but with medium to dark brown weathered silty lamellae as resistant layers.
145 to 150	Brecciola facies with pelletal limestone, Parara limestone clasts and a few quartz granules. BASE OF PINYATTA MEMBER? (Unit 7).
150 to 171	Massive, cliff forming limestone with graded bedding and very coarse quartz sand at the base to yellow silts at the top. Brown weathering. Some very granule rich (sandstone?) beds up to 6 inches thick. Quartz is especially coarse at 168 to 171ft. Granule beds are also strongly pelletal with light grey and buff pellets, less than 1mm. in diameter.
171 to 179	About 2ft. beds of massive (brecciola) reworked 'Parara-type' Limestone in a granule and silt rich matrix with some clastic limestone.
179 to 180	Silty, dark weathered grey limestone ("marker horizon" facies).
180 to 185	Massive bed of reworked limestone, sandy grey with elongate limestone clasts in a silty, granule rich matrix.
185 to 192	Massive beds, dark weathered, pelletal-granule limestone. Pellets poorly sorted, less than 1cm., average 9mm. in diameter. Quartz granules are about 20% of rock and are well rounded spheres. Other granules present. Colour is pinkish-grey.
192 to 196	Coarse pelletal limestone, bimodal, average 1cm. but 5% are 3 to 4cm.
196 to 200	Unexposed.
200 to 206	Reworked bed of 'Parara-type'(?) Limestone with a very silty, mottled matrix.
206 to 214	Thickly laminated, 6 inch to 1ft. limestone, medium grey with silty interbeds and some granules (8%).

SECTION P

Subsequent geological evidence suggests that the worth of the data detailed in this section may be almost zero. The sequence may be repeated by faulting from about the middle of the section and bedding is very difficult to establish. Both the top and bottom of the section are faulted off and numerous breccia zones and two big calcite veins cut the area. At best the section may be considered as a random walk over the one outcrop of WILKAWILLINA LIMESTONE in the map area.

0 to 25 — Massive 2 to 6ft. beds of honey-brown limestone. Internal colours are variable from pinkish, yellowish buff to buff grey. Archaeocyathids are abundant but do not weather out. Some manganiferous dendrites. Internal structure is obscure; very fine grained with some rare quartz and minor silt. A rare chert nodule and the Brachiopod 'Micromitra' are present. Perhaps patchy dolomitization in places. Undolomitized (?) or non silty limestone patches up to 1ft; grey. Minor calcite veins (3 inch) and vugs. Patches are 40% and obscure fossils. Phosphatic Brachiopods weather out as tiny white crescents. Archaeocyathids include 'irregular' forms.

25 to 45 — Generally as above but with sand fraction of 0.7mm. quartz grains; well rounded but only moderately spherical. Some silt size quartz. Small red jasper vein. Fewer Archaeocyathids. Colour is buff to yellow. Pelletal or oolitic patches (elliptical, 0.8mm. grains). Dolomite (?) persists. 0.3mm. grains may be clastic limestone while the 0.8mm. spheres are oolites. Pellets to 0.9mm. and ellipsoidal at 30ft. Average 0.5mm. Very few 1mm. quartz granules.

45 to 250 — Massive dolomite-like rock with some Archaeocyathids. Pyrolusite veins in joints, 45 and 50ft. Colour is buff to limonitic yellow. Bedding obscured (6ft?). Sideritic (?) fine sand patches. Brecciated zones parallel to dominant joint directions and cut bedding. Quartz granules increase to 1%, 65 to 70ft. (2mm. maximum diameter). Minor calcite veins. Few, 0.6mm.

SECTION P (Cont)

Feet	
	pellets at 70ft. No obvious fauna. Manganese oxides and colour change at 90ft. to buff-khaki. Rare pellets, massive and with vugs of sparry calcite. Less manganese at 110ft. Becoming brown to khaki or buff. Siderite? Quartz granules persist. Milk-coffee brown limestone. One Archaeocyathid found (2 inch diameter). Fault-breccia zones persist. Travertine veins crosscut at 140ft. Some small caves. Bedding obscure, highly irregular blacky, vertical rock faces. Yellowish from 150ft. (Sequence repeated by faulting?) with loss of quartz granules. Yellow, dolomitic-like facies with patches of grey limestone, becoming lighter and silty with minor calcite veins. Pelletal in part. Silty limestone at 220ft. with some manganese. Massive but brecciated. No fossils?
250 to 280	Unreliable outcrop. 4ft. calcite vein and fault breccias.
280 to 310	Buff limestones with quartz granules and pellets. Probably Bendieuta Member.

SECTION Q

Feet	
0 to 3	UPPER PARARA LIMESTONE (MIDDLE LENS) (Unit 5): massive limestone, with, 3 inch, limonitic and sideritic pods. Small dolomitic clasts at 3ft. (correlates with Sections B & C). Siderite fill in cups of Archaeocyathids. Limestone is clean and light grey with rare silt and silicified Archaeocyathids.
3 to 8	Probably a rubbly, finely laminated, grey, 'Parara-type' Limestone
8 to 9	Massive, siderite (?) mottled, medium grey limestone.
9 to 12	Shaley and rubbly, light epidote-greenish grey silty limestone (probably the 'green-marker' horizon of other sections at this level).

SECTION O (Cont)

Feet	
12 to 14	Massive, sideritic (?), mottled, medium grey limestone.
14 to 16	Rubbly 'Parara-type' Limestone.
16 to 22	As for 12 to 14ft. and again at 21 to 22ft. with a rubbly Parara interbed at 18 to 21ft. Some Archaeocyathids at 21ft.
22 to 60	UPPER PARARA LIMESTONE (unit 6) (contact may be lower). Medium laminated, medium grey, homogeneous, fine limestone with very minor silt weathering out a pale yellow. Grey internally. Typical 'Parara-type' Limestone. At 40 to 43ft. a Trilobite zone with carbonized (?) glabellae weathering out. Includes Redlichiacia and one other family. Very abundant along strike with 6 inch long Archaeocyathids including Syringocnemoid forms. Minor (5ft.) faulting evident. Other silicified remains include Trilobites at 50ft. and a Hyolithid at 40ft.
60 to 92	Silty member, becoming medium laminated above 63ft., generally clean, with some siliceous debris. Trilobites ubiquitous, 63 to 85ft. Well broken and with a few 1cm. dolomitic intraclasts. Rare Archaeocyathids. Siltier, laminated 'Parara-type' Limestone at 85 to 92ft.
92 to 93	Dark 'marker-horizon' (weathered grey limestone).
93 to 130	Clean, light grey 'Parara-type' Limestone with odd Archaeocyathids. Minor silty marker at 97ft. Exposure very poor.
130 to 165 Approx.	May be crossing over a very large block of massive, clean, light grey mottled whitish, Archaeocyathid limestone. Facies very similar to huge (60ft.) exotic block near station 21 which lies in the top of Unit 6, in the Brecciola zone. Dolomitic clasts abundant in certain beds. Block may have discordant bedding dip? Continued measurements assuming the regional dip (± 10ft.).

SECTION Q (Cont)

Feet	
165 to 178	Light grey 'Parara-type' Limestone repeated with minor siliceous, 2mm., nodules and debris. Mottled whitish. Poorly exposed. Darker at top. 'Marker facies' bed at about 171ft.?
178 to 190 Approx.	Mottled dark to medium grey silty limestone (?).
190 to 240	PINYATTA MEMBER (Unit 7) (contact may be lower): very massive, 6 to 8ft. beds of light grey silty Archaeocyathid limestone. Silt is yellowish and causes minor mottling in places. Reddish patches locally. Fossils are very well preserved with the white original (?) calcite in a clear to grey carbonate matrix. (Relates to top of Section B). Silt influx at 230ft. (leaving patches of non silty Archaeocyathid limestone).
240 to 244	Less silt. Grey Archaeocyathid limestone, mottled white, clean and becoming dark grey towards 244ft. Less massive?
Probable fault zone. Sequence may repeat. (Throw on East).	
244 to 270	Exposure poor but massive limestone similar to 240 to 244ft. with white Archaeocyathids in a light grey matrix.
270 to 275	Probably a thin Parara facies interbed (correlates with Section B?). At 275ft. an unusual green, arenaceous and crumbly rock in recent burrow (Q275ft.).
275 to 305	Unexposed but probably silty limestone 245 to 305ft.
305 to 317	Progressively less silt. Granules in at about 300ft. A massive, bedded, dark greenish to dark grey, homogeneous limestone with a few quartz granules and rare Archaeocyathids. Weathers to broad, flat and smooth slabs. Lens reveals pellets of carbonate, dark grey, some buff to orange, 0.4 to 0.5mm. in diameter, 0.8mm. maximum.

SECTION R

Feet	
0 to 30	PINYATTA MEMBER (Unit 7) (Base of member): grey massive limestone with silty interbeds. Medium to dark grey massive limestone from 25ft. Correlates with N644 to 654ft.
30 to 59	Very similar facies to N654ft. Pink, pale purplish pelletal limestone with quartz granule rich bands and some dolomitic intraclasts. Grades into a quartz granule rich (15-20%) pelletal limestone at 40ft. Intraclasts in lenses, almost a conglomerate in places with purplish limestone clasts, granule free, of 1 inch average length with a matrix of similar material but with quartz granules. (Reworking associated with granule influx suggested). Granules define bedding. Some 2 inch silty interbeds. Colour is purplish-pink but weathers a dark-brown. Dolomitic intraclasts at 55 to 57ft. Lighter purplish with only very few granules 57 to 59ft.
59 to 64	Purplish limestone as below but with very large clasts of: (1) clean, light purple limestone, very fine, weathers yellowish, (2) light grey limestone with dolomitic intraclasts within the boulder, (3) other purple limestone fragments (R60ft.), (4) mottled, light grey Archaeocyathid limestone (rare). Boulders are usually rounded but of low sphericity.
64 to 80	Massive, cliff forming, purplish limestone with a gradual loss of large boulders then the smaller intraclasts, paralleled by a loss of granules then the sand fraction such that at 80ft. a silty, purplish, massive limestone with fine, 0.3mm., pellets or intraclasts.
80 to 115	Sandy and purplish at 80ft. with granules and rare intraclasts above 85ft. Colour change at 85ft. to a light to medium grey pelletal limestone (0.8mm. diam.) with granules becoming numerous and increasing in abundance with a colour change to pink such that at 90ft. the rock is a pinkish grey, pelletal (1.0mm.) and granular limestone. Granules a medium sand. More grey

SECTION R (Cont)

Feet

than pink from 90ft. to 96ft. Large intraclasts and abundant 3mm. ('large') quartz granules with large carbonate pellets, grey to pink from 96ft. Granules are smokey blue quartz and jasper red grains. Pellets 0.3mm. from 98ft. and not as abundant. No intraclast facies and colour is progressively grey. Granules continue but a loss of reds from about 85ft. to the contact at 115ft.

WOOKATA SHALE MEMBER (?) (Unit 8) (Based on the first appearance of greenish colour and silts).

115 to 125 Fine grained, silty, khaki to greenish, medium, 3 to 6 inch, bedded limestone that weathers a silty yellow to black. No granules. (Dark, 2cm. elongate markings in rock; fossils?). Silt is quartzose.

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125 to 134 Greenish grey shale or siltstone inferred. Poor outcrop.

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134 to 137 Green siltstone in 3 inch beds, very resistant to weathering the exterior colour being dark brown to black.

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137 to 145 Quartz and red granule influx. Currents have ripped up green siltstone beds and the clasts have been incorporated in a greenish-grey, granule rich limestone matrix. Weathers dark brown. Suggest the term 'Allolith' could be applied to the granules.

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145 to 148 As above but a soft, green shaley member.

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148 to 154 New quartz granule influx as interthins on contact. Excellent specimen, A343/R150. Weathers dark brown to black with the resistant granule bands standing out from the rock face; the 3 inch siltier beds less so. Graded bedding in granules.

SECTION R (Cont)

Feet	
154 to 156	Chocolate siltstones. Some basic lithology as greens but with a colour difference.
156 to 159	Granule influx.
159 to 165	Massive, dark weathering banded limestone (Photo, station 11) with no granules. Colour is buff to whitish. No fossils? A fine grained limestone or calc-siltstone, 6 to 11 inch beds. From 137 to 160ft. a Calcirudite of 6 to 8ft., subrounded blocks of light grey, clean, mottled Archaeocyathid limestone. (A343/R140). Archaeocyathids include both main classes and are very numerous. Some yellowish intraclasts within the boulders. Matrix is greenish, silty granule-rich limestones as below but with large crossbeds (or by compaction?) 'swirling' about the blocks. Limestone blocks include purplish-white mottled facies as found at the top of Section S. Can certain Brecciolas be regarded as approximate isochrons? Archaeocyathid limestones may well be biohermal. Remains are numerous, complete and often preferentially orientated with possible algal columns. Archaeocyathid cups filled with green granule limestone facies rock, proving their derivation as lithified blocks from another area.

SECTION S

Feet	
	Section begins in a probable fault zone; however the near basal 'epidote-green marker horizon' of Unit 6 recognized at the beginning of the section. 'Green marker' is here a conglomerate with rounded 2 inch pebbles of grey 'Parara-type' Limestone in a mustard-yellow siltstone. A few to 6 inches and often very irregular. (Relate to Sections N, O, Q and S?).
Less than 0	MIDDLE LENS (Unit 5): buff to whitish and pale yellow, slightly silty limestone, dark weathering and possibly dolomitic.

SECTION S (Cont)

Feet	
0 to 4	Mottled limestone; dark with some mauve mottling. Buff in patches but exposure is very poor.
Possible fault	zone with some minor folding to S20ft. Laminated, pure white calcitic travertine at 10ft. (A343/S10). Minor throw to the East? Certain beds may strike into this zone.
4 to 31	Good Parara-type grey, laminated limestones (UPPER PARARA LIMESTONE) (Unit 6) with some mauve, siltier beds at 30 to 31ft. and siliceous debris with Trilobites (at 27ft. for 3 inches) and Archaeocyathids.
31 to 125	'Parara-type' Limestone with very abundant siliceous debris at 45 to 46ft. including a large Trilobite (with occipital spine) and Archaeocyathids with Syringocnemoid-like forms (correlate with Q40ft.). 3 inch siliceous bed at 55ft. and becoming darker grey. Laterally, Brecciolas (boulders) from about 40ft. Light grey at 55 to 65ft. with minor siliceous rubble (Relate to Q165 to 178ft.?). At 65ft. a breccia boulder of light grey, massive Archaeocyathid limestone, very similar to Q240 to 244ft.
Complex area -	150ft. North; measured about 115ft. or purple-red, white mottled clean, Archaeocyathid limestone (as at top Section 8?) with some overlying light grey, orange mottled limestone.

SECTION T

Feet	
0 to 5	Exposure very poor. Probable PINYATTA MEMBER (Unit 7). Massive, light grey to buff limestone with sideritic patches and odd Archaeocyathids. Rare dolomitic intraclasts.
5 to 25	Red to purplish, mottled white Archaeocyathid limestone (related to top of Sections 8, Q AND S?). Fossils are white in red matrix and include irregular forms. Dolomitic intraclasts at 8 to 10ft. Some grey limestone patches at 10 to 25ft.

SECTION T (Cont)

Feet	
25 to 57	No longer purple but a light grey, white mottled Archaeocyathid limestone with patches of clean, very light grey limestone while the remainder of the rock is a pale silty yellow limestone (S118ft?). Overall medium massive with white patches weathering out. Resembles top of Section E.

Expect small Fault in valley from evidence in the South; however sequence appears continuous.

57 to 80	Thickly laminated 'Parara-type' Limestone (as at tops, Sections B, Q and base of H). Grey but with pink limestone and some pelletal limestone interbeds. Weathered, shaley zone 57 to 59ft. Some buff beds and darker grey, laminated limestone from 70ft.
80 to 93	Grey pelletal limestone (very similar to Q305ft.). 6 to 12 inch beds with 0.5mm. grey to orange pellets and quartz granules.
93 to 130	Facies similar to 10 to 57ft. Pale pinkish white to buff, recrystallized, slightly silty limestone. Some Archaeocyathids. Very similar to top of Section F (Unit 9). Cleaner with rare Archaeocyathids, light grey to white matrix with a very mottled appearance, especially with buff silty or dolomitic patches, above 120ft.

SECTION U

Resembles Section V.

Feet	
0 to 186	WOOKATA SHALE MEMBER (Unit 8): purple shales, finely micaceous in part with some lighter lamellae. Green and purple from 35 to 45ft., purple with some more resistant beds at 115 to 123ft. All micaceous.
186 to 203	MEGA-BRECCIA HORIZON (Unit 9): Archaeocyathid limestone mega-

SECTION U (Cont)

Feet

breccias, generally purplish matrix at the base, with quartz granules ubiquitous. Facies includes:

(1) Boulders of yellowish silty matrix limestone with dark weathering, buff, granule rich limestone pebbles and light grey Archaeocyathid limestone cobbles.

(2) Boulders of type (1) but with a purplish matrix.

(3) Cobbles of purplish silty limestone.

(4) Quartz and feldspar (red) granules in all matrices.

(5) Free Archaeocyathids in the main matrix but with a purple granule rich limestone fill in the cups.

(6) Archaeocyathids but with yellow silty limestone cup fill in a purple limestone matrix.

(7) Purple, silty limestone with columnar stromatolites (A343/U187), and

(8) Darker grey, clean Archaeocyathid limestone facies cobbles.

203 to 205 Purple, granule-rich limestone lenses and 1ft. bed.

205 to 213 As for above 203ft. but loss of all purple colour in all lithotypes. Typical 'mega-breccia' of Unit 9.

SECTION V (Unexposed below Oft.)

Feet

0 to 16 WOOKATA SHALE MEMBER (Unit 8): purple shales, micaceous in part, with subordinate green interbeds. At 10ft., 1 inch lamellae of grey (pelletal) limestone with red and rare green granules of the type in Section G.

16 to 40 Unexposed but inferred shales.

40 to 132 Massive but laminated limestone with quartz, green and red granules. Dark weathering. Green granules are probably re-worked shale facies. Limestone matrix is poorly pelletal, medium buff and with some 2cm. silty dolomitic (?) intraclasts. Thin, 3 inch, silty beds alternate with thin shaley partings. Reworking of shales by currents associated with granule

SECTION V (Cont)

Feet

influxes is suggested. Granule lamellae at 41 to 50ft. alternating with green shale beds. 6 inch bed of grey pelletal limestone at 45ft. with pellets in a silty yellow matrix with green shale clasts. Purplish from 45ft. with ripple marks at 61ft. and, 1cm., limestone interthins at 61 to 62ft. All purple shales from 62ft. but no reliable outcrop from 98 to 132ft.

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132 to 153 MEGA-BRECCIA HORIZON (unit 9): very massive Archaeocyathid rich limestones. Archaeocyathids commonly whole (90%) and probably lying with their long axes parallel to the bedding and preferentially orientated to N190°E. One specimen 4 inches in diameter with walls $\frac{3}{8}$ inches apart. Beds up to 6ft. thick and not really rubbly. Limestone is light grey and clean and the matrix is a buff, silty yellow limestone (less than 10%) with an overall macroscopic mottled appearance. Bases of Archaeocyathids show a tendency to point to N100°E. in certain limestone beds (?). Some limestone is darker and may reflect a different source. Archaeocyathid cups are empty as voids, calcite filled or infilled with silty yellow limestone.

153 to 188 Dark weathering, reddish, granule rich beds similar to the mineralized horizons of Section K. Silt predominates. Blocks are 6 inches maximum diameter and of light grey Archaeocyathid limestone. Also 4 by 2 inch quartz granule facies cobbles, both in a silty yellow matrix. Becomes darker with fewer (rare) Archaeocyathids from 170ft. Fewer light grey limestone blocks.

SECTION W

Feet

-3 to 0 KANDRAMOOKA MEMBER (Unit 9): massive, light to medium grey limestone with small, less than 2mm., orange cherty nodules (few) good karren ridges developed. Vague mottling (no silt). No fossils(?).

SECTION W (Cont)

Feet	
0 to 97	PACK CREEK MEMBER (Unit 10): purple, micaceous shales.
97 to 161	BRILLIG CATCH MEMBER (Unit 11): thickly laminated (1ft.) clean, homogeneous limestone. Fine grained and splintery with a slight clay content. (Exactly as at Sections G, H and J). Less homogeneous and medium grey to orange-buff limestone from 139 to 160ft. with some mottling and karren structure. Light to medium grey silty limestone, with darker patches at 158ft., from 158 to 161ft. In particular, the interval 145 to 160ft. is yellowish-grey and may contain more silt or even dolomite.
161 to 163	BILLY CREEK FORMATION ('BOOK-LIMESTONE' Unit); marker horizon as for Sections G, H and J.
At 163	A 6 inch medium grey limestone bed with light grey, thinly laminated, rubbly limestone and abundant cherty debris as fine clumps, to 165ft.
165 to 173	Light grey laminated limestone with shaley partings.
Above 173	Diapir or purple shales of Billy Ck. Fm. Clay cover is purple.

SECTION X

Feet	
-40 to 0	WOOKATA SHALE MEMBER (Unit 8): purple micaceous shales.
0 to 15	KANDRAMOOKA MEMBER (Unit 9) MEGA-BRECCIA HORIZON. Breccias with cobbles of brown, granule-rich limestone and boulders of light grey Archaeocyathid limestone in a silty yellow limestone matrix.

Fault suspected in valley leading North from an amphibolite body 0.2 miles South Slickensides and minor calcite veins at 15ft. Section abandoned. Resumed across valley.

SECTION X (Cont)

Feet	
0 to 16	(Unit 9). Massive grey limestone block (?). Light grey, no bedding visible, no purple colour and no Archaeocyathids. Abundant 0.9mm. siliceous, orange nodules. A 6 inch by 2ft. long bed in one block (?). Some irregular karren ridges.
16 to 143	Outcrop unreliable. Calcite vein zone. However, above 20ft. some Archaeocyathids in a light grey limestone, massive to rubbly, with some orange mottling and white patches. Probable 'mega-breccia' facies at 30ft. Light grey limestone is about 90% of rock. Remainder is sitly yellowish limestone matrix. Rare quartz granule patches or lenses (as matrix) and as 2cm. pebbles. Outcrop is semi massive and often rubbly. One granule facies block, 1 cu. ft., at 65ft. Quartz granules often up to 3mm. in diameter and may be associated with pelletal limestone interbeds. Darker slate grey, mottled white but massive limestone blocks (and beds?) at 70ft. Loss of granule facies (Define relation to Sections K and V). Possible fault at 105ft. Sudden loss of darker grey limestone facies. Outcrop poor. Silty yellow bed at 110 to 114ft. (Meso-breccia?). 80% silty limestone with 10% darker grey limestone cobbles and 6 inch clean grey limestone cobbles, and 10% quartz granule facies pebbles to boulders, up to 1ft., containing granules, yellow silty clasts and light grey pellets of carbonate. Silicified (mineralized) beds above 120ft. Weathers dark brown and stained with malachite.

SECTION Y

Thicknesses in this section may be slightly over-estimated following a structural reinterpretation of the area and a recognition of its complexity; however, all units belong to the KANDRAMOOKA MEMBER, except where stated, and the sequence is the right way up.

Feet	
Less than 20 to 0	BILLY CREEK FORMATION (Unit 12): purple shales in a major fault zone (More than 500ft. of throw).

SECTION Y (Cont)

Feet

0 to 8 KANDRAMOOKA MEMBER (Unit 9): exposure very poor. Well bedded, 4 inch laminated, slab colitic limestone. Light grey weathered with highly spherical ooids of light grey carbonate shells about orange nucleii. Fresh rock has purple nucleii to the ooids; thus orange colour may be a weathering effect. Diameter is 0.7mm. Fracture is often around the ooids, the matrix having weathered out or poorly developed initially (3 to 5ft.). Some beds of non-oolitic, fine grey limestone. Purplish grey at 3ft. and a vague orange mottling (quartz silt) at 3ft. (less than 5%). Unexposed, 5 to 8ft.

8 to 125 Good outcrop of 0 to 3ft. lithotype. Ooids less well developed and frequently all orange. Rare, 1mm., carbonate clasts and purplish grey silty bands. Section of Hyolithid(?) at 12ft. Overall colour is grey with purplish patches. Unexposed, 12 to 13ft. Very fine and light grey, pale pink oolite from 13 to 25ft. with 3 to 6 inch lamallae and interthins of light grey limestone clasts (2mm.). Oolites 0.7mm. in diameter, highly spherical and nucleated. Coarser and with quartz sand (10%) above 25ft; less oolitic and often pelletal limestone. Quartz includes smokey blue grains; some are reddish-orange. Average diameter of limestone pellets is 1.6mm. and colour is light buff although weathering honey-brown with black fungii. One irregular Archaeocyathid fragment at 59ft. Coarse quartz sand up to 20% in lenses above 60ft. otherwise a semi massive, light buff, pelletal limestone with minor red grain and silt content. Evidence for moderate current action in rare 2cm. intraclasts. Base of cliff at about 115ft.

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125 to 230 Very massive, 6ft. bedded limestone with pelletal and quartz granule (1.0mm.) rich beds. Some red grains. Silty bands and blocks. Reworking is suggested although the term 'mega-breccia' is not really applicable. Possible Brachiopod section at 170ft? Overall light pinkish to light buff and massive. Pellets

SECTION Y (Cont)

Feet	
	persist in patches beyond 180ft. with silty yellow and pink areas. One Archaeocyathid at 180ft.
230 to 255	Grading to pink at 240ft. and richly pelletal with persistent, 0.5mm., well rounded and spherical quartz sand. Clasts are less than about 1mm. in diameter and lie in a red-orange limestone matrix.
255 to 280	General loss of granules (As in other sections). Probably UPPER UNIT of Unit 9. Archaeocyathids return at 260ft. and become abundant at 280ft. Non pelletal, light grey, clean Archaeocyathid limestone with yellowish, silty mottling. (Facies very similar to that in the mega-breccias). Transitional zone to 280ft?
280 to 358	At 280ft., a massive, poorly bedded, blocky, light grey Archaeocyathid limestone with red-orange, 1cm., very irregular silty mottling. Some Archaeocyathids filled with silt, others with sparry calcite. Chert nodules, 1mm. diameter. No pellets observed. Loss of fauna above 290ft. with purplish patches in the light grey limestone. Silty, micro-mottling and possible algal structures at Y320ft. Outcrop is massive to rubbly. More silt from 351 to 358ft.

SECTION Z

Feet	
0 to 39	WOOKATA SHALE MEMBER (Unit 8) (As for base of Section I): dark weathered, silty, 2 inch lamellae of grey limestone or the 'interbed facies' of Section I; however colour is brown in certain beds and the dark weathering suggests the presence of siderite in the matrix. Minor red and green granules, 7 to 8ft. Rock is dense and yellow powdery. Limonite is common as joint fill. Linguoid sole markings are common. More shaley 'interbed facies' from 8ft. with a thin dark weathering bed at 15ft. Semi purplish silts included from 15ft. 1 inch beds of dark facies from 36 to 39ft.

SECTION Z (Cont)

Feet	
39 to 81	Alternate 'interbed facies', grey limestone and 'dark facies'. Sideritic limestone beds grading into purple shale 55 to 77ft. 'Dark facies' from 77 to 81ft; 6 to ½ inch beds, with a clastic fraction of quartz sand and green and red grains, with a pelletal content. Colour is light to medium grey.
81 to 101	KANDRAMOOKA MEMBER (Unit 9): purple matrix mega-breccias. Passage indicated from Unit 8.
101 to 132	Mega-breccias of grey Archaeocyathid limestone boulders (90%), in a silty yellow matrix and only rare 'granule-facies' limestone pebbles. (May suggest granule source to the North?). No beds or lenses of granule rich limestone although some individual grai occur in matrix and in purplish silty limestone fill of Archaeo-cyathid cups.

Note: Grade sizes modified after Wentworth, K. C. (1933) : "Fundamental limits to the sizes of clastic grains", Science, V.77, pp.633-634.

MT. CHAMBERS GORGE

GEOLOGICAL MAPPING

APPENDIX II

HAND SPECIMEN AND THIN SECTION DESCRIPTIONS

APPENDIX IIa

HAND SPECIMENS:

Rocks listed and described in this section have been collected at the various 'Stations', Map-Zones 1 and 2, and do not include specimens from the measured stratigraphic sections which are listed in Appendix I. Both sets are included in a single tray of specimens presented with this thesis and stored in the Geology Department of Adelaide University under the accession number A343. (The other nine trays of specimens collected may be held by the author). Rocks from this appendix also bear a Station number; e.g. A343/C.G.4., and the superscript 'T.S.' indicated that a thin section has been cut, and described in Appendix IIb.

Only selected, representative and unusual lithologies have been included.

Specimens for which thin sections have been described are listed first:

1. A343/C.G.22, "Green marker" (T.S.)

   Probable rhyolitic vitric TUFF, from the base of Unit 6, the upper unit of the Upper Parara Limestone (Station 22).

2. A343/C.G.34.a (T.S.)

   Dolomitized intraclastic calcarenite. From mid Unit 9 (South).

3. A343/C.G.34.E. (T.S.)

   Concentric growths of fibrous calcite about a dolomitic, archaeocyathid nucleus. Not stromatolitic. Unit 9.

4. A343/C.G.38 (T.S.)

   One half of a symmetrical vein that cuts Unit 6 vertically near Station 38. Central zone weathered (gossan). Diapir associated. Outer zone of large, twinned, calcite crystals.

5. A343/C.G.43.b (T.S.)

   Shows granule influx into green calcareous siltstones, and the weathering out of the central, calcitic, less siliceous layer. Note characteristic brown weathering colour.
   Location: base of Unit 8 in the 'South'.

6. A343/C.G.51.E (T.S.)
   (Compare with A343/C.G.70.D)

   Heavy mineral banded and crossbedded arkosic sandstone from south 'Central-Diapir'. This is typical diapir material for this area.

7. A343/C.G.52.A (T.S.)

Probable diapiric material. ✕

8. A343/C.G.54.A (T.S.)

From top of Unit 7, just west of 'Central Diapir'. Fine calcirudite or pelletal (clastic) limestone. Quartz granules weather out.

9. A343/C.G.70.D (T.S.)

Heavy mineral banded and crossbedded sandstone. Coarse arkosic bands of pink orthoclase. From top of 'Double diapir'.

10. A343/C.G.78 (Float) (T.S.)

Pyrolusite-banded calcite (travertine?). Near major fault zone, Wookata Ck.

11. A343/C.G.94.B (T.S.)

Ferruginous and calcitic siliceous (lithic) greywacke. Base of Unit 9, adjacent to 'Double Diapir'. May evidence exposure of diapir in Oraparinna time (?).

12. A343/C.G.98.A (T.S.)

Partially altered basic intrusive rock. Vesicular weathering surface. From northern end of 'Central Diapir'.

13. A343/C.G.104a(T.S.)

Altered basic intrusive rock from plug near 'Single Diapir'.

14. A343/C.G.107 (T.S.)

Secondary copper mineralization from Moorowie Mine. Malachite, azurite, cuprite and limonite.

15. A343/C.G.132 (T.S.)

Light grey, yellow mottled, archaeocyathid limestone from Unit 9, north of Mt. Chambers Gorge. Note sandy fill in some archaeocyathids and possible preferred orientation of their long axes.

Other specimens:

1. A343/C.G.4

Typical mottled-Parara-type Limestone from Unit 2, the Lower Parara Limestone. Shows grey limestone core with khaki mottling.

2. A343/C.G.10

Archaeocyathid with sideritic infill in a red limestone matrix; base of Unit 9. Few granules in matrix.

3. A343/C.G. '17½ Mine'.A

Chrysocolla (blue) in silicified limestone breccia with minor cuprite(?).

A343/C.G. '17½ Mine'.B

Chrysocolla and malachite in altered limestone

4. A343/C.G.22.B

Rhyolitic, vitric tuff (?) from 2ft. 'green-zone' at base of Unit 6, the upper member of the Upper Parara Limestone.

5. A343/C.G.26.A
A343/C.G.26.B

Enigmatic burrow-like cores of a lighter, buff, limestone in a grey, Parara-type Limestone (Unit 2). Cores may be siliceous and are interpreted by Daily (pers. comm.) as solution phenomena.
(There may be other explanations)

6. A343/C.G.28.A

Silicified archaeocyathid, weathered out from 'marker-bed' at the top of Unit 7. Lay in bedding plane.

A343/C.G.28.B

Part of wall of a silicified, cap shaped archaeocyathid from same bed as 28.A., top of Unit 5.

7. A343/C.G.41.D

A green siltstone from Station 41. Occurs as a highly brecciated, 20ft. pod in the fractured limestones of Unit 7. Lies south of diapiric axis of 'Central Diapir' and classified by Daily (pers. comm.) as "diapiric shale".
(Refer Figure 6, Plate 4, in thesis).

8. A343/C.G.43.A

Archaeocyathid in dark grey, mottled limestone from a megaclast in the brecciola-zone, top of Unit 6, the Upper Parara Limestone. Very similar facies to A343/C.G.102 from the base of Unit 9, to the north east. (Could these zones have been laterally equivalent with derivation of the megaclasts from a more, northerly and shoreward mega-breccia (reef?) zone?).

9. A343/C.G.50.A

Deformed galena from a prospect on a shear just south of Station 50, near the 'Central Diapir'.

A343/C.G.50.B

Possible cerussite with galena in limestone; location as above, C.G.50.A.

10. A343/C.G.51.A

Crossbedded, heavy mineral banded and arkosic sandstone from the 'Central Diapir' with abundant halite pseudomorphs on the bedding planes. Probable Willouran age.

11. A343/C.G.51.C

Sandstone from diapir with possible organic traces (Annelid trace fossils?).

12. A343/C.G.53.A

Typical 'mottled Parara-type' limestone from top of Unit 6. with medium grey cores in a yellowish silty matrix. Note secondary calcite veins.

13. A343/C.G.56.C

Portion of conglomerate lens in Unit 10 showing:

1. Clasts of red-granule rich (sand) facies.
2. Red, archaeocyathid limestone.
3. Secondary calcite.
4. Silty, red and sandy matrix.

14. A343/C.G.57.A

Probably a faulted block. Stratigraphic position probably basal dolomitic units of Billy Creek Formation. Typical of dolostones from near Stations 143 and 117. Note minor granule fraction.

15. A343/C.G.57.B

Archaeocyathid in red limestone matrix. Note core with granule rich fill, a different lithology to the matrix.

16. A343/C.G.57.C
(Relate to C.G.57.D)

Typical red, quartz granule rich, pelletal limestone found at the base of Unit 9 as cobbles in the mega-breccia or in this case as cobbles within the thin conglomerate interbed in Unit 10.

17. A343/C.G.57.D

From a boulder within the conglomerate bed in Unit 10, near Station 57, south of Pack Creek. Large archaeocyathid, complete, in a red, ferruginous limestone matrix. Geopetal structure in core of archaeocyathid indicates fill while in a horizontal (?) position. Core contains reworked, (intraclastic) archaeocyathid limestone fragments, quartz granules and other fragments in a red limestone matrix. Matrix of archaeocyathid can be divided into two types, the upper bed containing more granules of the type that fill the fossil. It is suggested that the archaeocyathid lay on the bedding plane of the lower unit, half buried and then acted as a cup in which part of the coarse fraction of detritus introduced with the overlying bed accumulated.

18. A343/C.G.58.A

Typical buff, brown weathering, quartz-granule rich and pelletal limestone from the top of Unit 7 in 'Subfacies A' area of Unit 9, north of Pinyatta Creek. Beds of this facies persist into Unit 9 and occur as cobbles in the mega-breccias.

19. A343/C.G.60.A

Irregular archaeocyathid from a megaclast at the base of Unit 9, the mega-breccia horizon. Matrix is a red-limestone, typical of the base of this unit. Note calcite and limonitic (geopetal) infill to fossil.

20. A343/C.G.76.B

Silicified iron oxides? (limonite) from the same deposit as 76.C.

A343/C.G.76.C

Silicified manganese oxide? (pyrolusite) associated with Pleistocene silcrete developments and red and yellow jaspers. Very hard.

A343/C.G.76.D

Agate with concentric banding from silcrete developments.

21. A343/C.G.80.A

Stratigraphic position uncertain. Isolated fault block, 30ft. long. Archaeocyathid limestone, typical of megaclasts in upper Unit 9.

22. A343/C.G.89.A

From mineralized zone (just north of 'Mine-Pick Mine'. Shows weathering of carbonate from silicified and mineralized limestone leaving an open boxwork. Traces of copper in unaltered limestone.

22. A343/C.G.89.B
(Cont.)

Siliceous gossan from mineralized zone as for C.G.89.A.

23. A343/C.G.93

Coarse arkose from west of Station 93, in the 'Double Diapir'. Quartz grains are highly spherical and well rounded. Feldspar is orthoclase. Heavy mineral banding (with minor crossbedding). Suggests possible source for 'quartz-granules' that are common in the Cambrian limestones.

24. A343/C.G.93.B

Diapiric material from 'Central Diapir'. Heavy mineral banded, crossbedded and arkosic, coarse sandstone. Pseudomorphs after halite are a feature of this rock. Age probably Willouran.

25. A343/C.G.95 (Float)

Secondary copper minerals with a core of primary ore including chalcopyrite, probably derived from prospects in 'Central Diapir' area.

26. A343/C.G.101.a

Interpreted as hydrothermally altered (ferruginized) Wockerawirra Dolomite (Sturtian) from above the fault zone and on the Proterozoic side at Station 101. Pinkish, dolomitic cores can be seen in rock with sideritic (?) and limonitic matrix.

27. A343/C.G.102

Location: base of Unit 9 north of 'Double Diapir'. Archaeocyathids in a dark to medium grey limestone. Note core of drussy and fibrous calcite.

28. A343/C.G.107.Mm.1

Typical secondary copper minerals from the Moorowie Mine area. Note boxworks in gossan.

A343/C.G.107.Mm.2

Again, typical 'Moorowie' ore with malachite veinlets in an altered limestone matrix.

29. A343/C.G.109.A

Limestone from Moorowie fault area. Shows some silicification and mineralization. Note granule content.

30. A343/C.G.112.a

Thin, local bed at top of Unit 8 near Station 112, Kandramooka Creek. Texture is sedimentary with angular to rounded lithic clasts, very poorly sorted in a limonitic, dolomitic (?) and sideritic (?) matrix. May evidence local exposure of diapir.

31. A343/C.G.113.a

Possible trilobite tracks from top of Unit 8, just west of Station 113, in a coarsely silty ferruginous shale.

32. A343/C.G.123

Specularite in a dolomitic (?) and limonitic matrix from the southern edge of the diapir, due south of Station 123, Brillig Catch Creek.

33. A343/C.G.126.a

Cleavage fragment from 7 inch dolomite or calcite crystals in a 2ft. vein running north west from Station 126.

33. (Cont) A343/C.G.126.b

Pseudomorphs after pyrite (?) in a brecciated matrix of the vein at Station 126.

34. A343/C.G.128

Excellent preservation and exposure by weathering of two archaeocyathids. Spitz well shown on specimen A. Crystalline calcite infill for both. Matrix is a red carbonate. Fossils may be in growth position. Cut from megaclast at base of Unit 9, the mega-breccia horizon, in the Moorowie area.

35. A343/C.G.129.a

Possible (trilobite?) organic trace fossils on bedding plane of Wookata Shale, Unit 8, Kandramooka Creek.

A343/C.G.129.Delta

As above, 129.a

36. A343/C.G.129,B

Shows reworking of green calc. siltstones by currents associated with influx of allochthonous material (quartzitic silt and clay). From Unit 8, 'South-zone'.

37. A343/C.G.135

Fault breccia of limestone from top of Unit 9, north of Mt. Chambers Gorge. Note quartz granules in limestone.

38. A343/C.G.140a

Typical, light grey archaeocyathid limestone, relatively clean, (granule free) but with minor yellow silt or clay. From a megaclast within Unit 9, the mega-breccia horizon.

39. A343/C.G.146

Malachite veins in limestone fault breccia, half way between Stations 146 and 148 and in a small fault.

40. A343/C.G.149

Archaeocyathid, complete, in a light grey limestone matrix. Infill is a ferruginous and silty limestone with a zone of recrystallization extending into it. From upper (?) Unit 9.

41. A343/Chi.1

Haematitic rock from 'Frome Diapir'.

42. A343/Chi.2

Enigmatic rock from a bed within the 'Double Diapir' and south west of Station 94. Concretionary silica or a deformed conglomerate of sedimentary origins. Occurs in 'beds'.

43. A343/Chi.3 (Float)

Typical geopetal infill in archaeocyathid of granule rich limestone while matrix is granule free.

APPENDIX IIb

THIN SECTIONS:

Thin sections listed and described in this section have, with two exceptions marked with the superscript "O", accompanying hand specimens presented with this thesis and are of two groups: (a) sections of rocks from the Stations (see Overlay 2) and (b) from the measured stratigraphic Sections described in Appendix I. Thin sections from the latter bear a black triangle in the upper right hand corner, above the code number and are described first.

Some carbonate sections have been stained with an Alazarin-red S - potassium ferricyanide solution to differentiate between calcite; pink stain, ferro-carbonates; blue and dolomite; no stain. All carbonates have been cut thick to enhance textures and to avoid loss of the section by solution in the acidic staining medium. Conoscopic viewing may accent certain structures, especially in T.S. A343/C.G.107.

A. Thin sections from the Stratigraphic Sections:

1. A343/B.267ft.

Two archaeocyathids from top of Section B, top of Unit 7 (?). Extensive overgrowths around original calcite of skeleton. Matrix is a calcareous, quartzitic and ferruginous siltstone. Sparry calcite void fill common.

2. A343/C.265ft. (stained)

This rock consists of two lithologies:

(1) Calcarenite: well rounded intraclasts, (calcite) in micritic matrix. Some patchy secondary replacement by dolomite.

(2) Dolarenite: well rounded lithiclasts in dominantly dolmicrite matrix. Selective dolomitization of calcitic intraclasts is suggested, however the contact zone contains both types of clast and in a calcitic matrix. The dolomitic clasts in this zone may be confused with secondary, neomorphic dolomite.

3. A343/K.220ft. (C.G.148).

Hydrothermal silica with trace of chalcopyrite from the Moorowie area. Quartz occurs as irregular and interlocking crystals, euhedral into vugs which may be filled with calcite, chalcopyrite, cuprite or malachite. Calcite is colloform and grows into vugs. Texture may indicate replacement of carbonate by silica.

4. A343/M.160ft. (stained) (cc. 60%,dol. 40%,qtz. -)

Intraclast calcimicrite: 1 to 7mm. medium rounded, spherical to elongate and dolomitic clasts ($< 40\%$) in a calcitic matrix.

4. (Cont) Matrix is finely crystalline with 0.1 to 0.2mm. interlocking grains of calcite and occasional euhedral dolomite crystals. Clasts are recrystallized with dolomite (rhombs) replacing calcite. Contacts diffuse.

5. A343/M.165ft. (cc. 98%, dol. 2%, qtz. -)

Calcarenite: finely pelletal calcitic allochems, (lithiclasts), 0.1 to 1mm. in diameter, well rounded and spherical to elongate. Dolomite replaces calcite within the clasts in rare cases. Overall matrix is calcitic micrite. Rare fringing crusts of dolomite.

6. A343/R.138ft. (C.G.10.A) (cc. 60%, dol. 15%, qtz. 25%)

Lithic calcarenite:

Quartz: 0.2 - 1.2mm. Av. 0.6mm. Well rounded, moderately spherical. Some hexagonal (authigenic) sections rimmed with bladed calcite or dolomite.

Dolomite: as fringing crusts or as finely pelletal intraclasts, the matrices of which contain black grains and clay.

Calcite: as 0.6mm. well rounded pellets in a calcite matrix. Matrix may be replaced by dolomite (rhombs).

7. A343/R.150ft. (stained) (qtz. 60%, cc. 15%, dol. 15%, other 10%)

Sandstone: dolomitic (pelletal)

Quartz: well rounded, spherical grains 0.1 to 1.2mm. in diameter. Av. 0.6mm.

Dolomite: as 0.6mm. well rounded grains and as alteration rims to most grains.

Calcite: as interlocking crystals in the matrix. Fringing crusts to allochems extend into matrix and replace micrite.

8. A343/R.150ft.

Quartz sand influx into greenish siltstone environment. Siltstone beds above and below. Granule band with silt as matrix in central band. Quartz is 95% with straight extinction, with abundant (fluid) inclusion,

8. (Cont) re-entrant borders and 5% are composite grains with undulose extinction in individual grains. Mixed source suggested. Grains are 0.2 to 2mm., moderately sorted, and mature to super-mature. Very well rounded and with high sphericity to subrounded and of medium sphericity. Lithic fragments and 0.8mm. grains common. Source for granules may include diapirs on this and other evidence. Compare with (A343/C.G.51,70D).

B. Thin sections from the Stations:

1. A343/C.G.1 (dol. 80%, cc. 15%, qtz. 5%)

Calcimicritic dolmicrite

Dolomite: occurs as finely crystalline replacement of calcitic micrite matrix.

Quartz: 0.1 to 0.2mm., subangular grains. Poorly sorted. Only 5%. Dendritic pyrolusite (rare). Calcite veins cuts rock.

2. A343/'Green zone', Unit 6 (base) Upper Parara Fm. (Station 22)

Probable TUFF.

A rhyolitic vitric tuff with typical vitroclastic texture. Arcuate glass shards, 0.2mm. long, commonly triaxial. Matrix is siliceous dust. Chips with concave borders. Rare haematite crystals, 0.02mm. Secondary calcite as patches.

3. A343/C.G.34.a (stained) (cc. 5%, dol. 95%, qtz. -)

Dolarenite: 0.4 to 0.6mm. (relic) spheres of carbonate replaced by crystalline dolomite (0.1 - 0.2mm. rhombs). Dolomite cuts grain boundaries and has also replaced the matrix. Some calcite remains in matrix ($< 5\%$) as 0.8mm. interlocking crystals. Rare patches of pyrolusite. Progressive dolomitization of intraclastic pelleted limestone.

4. A343/C.G.34.E (stained)

Concentric growths of fibrous calcite (PF_gC), around an archaeocyathid nucleus. "Not stromatolitic" (Walter, pers. comm.). Core is dolomitized with thin stringers of dolomite extending into fractures in the corona. Thin bands of dolmicrite defins concentric layering in some cases; a thin dark line in others. Patchy dolomite is present in corona. Core of archaeocyathid with pelletal dolomite in dolomitic matrix, may be selectively altered or clasts as a source of dolomite for alteration of corona.

5. A343/C.G.38

Section across contact of central 'gossan' core and outer fibrous calcite zone on one side of a symmetrical vein, 2ft. wide near Station 38.
Core: 2mm. long accicular pseudomorphs, now an iron oxide, after an unidentified mineral, in a granular, interlocking, equant calcite matrix. Minor limonite.
Contact: layered with oxide debris in calcite matrix. Secondary pyrolusite band at base of fibrous calcite layer.
Fibrous calcite layer: crystalline calcite, commonly twinned up to 5mm. but to 5 inches in hand specimen.

6. A343/C.G.43.b

Three layers (bedding) can be observed in this rock, cut perpendicular to S1.
Layer 1 (base): calcite, 25%, as matrix, probably recrystallized from carbonate grains. To 0.2mm. Quartz, 70%, 0.1 to 0.3mm., spherical but angular to subrounded. Clay 5%.
Layer 2: Quartz 30%, as angular to subrounded grains. Subspherical to elongate. Poorly sorted. 0.1 to 0.4mm.
Calcite: 50% as 0.04 to 0.1mm. grains, often recrystallized.
Dark grains: less than 15%.
Black grains: less than 2%.

6. (Cont) Layer 3:

Quartz 60%, 0.01 to 1mm. Very poorly sorted, bimodal (?) and probably polygenetic. Larger 1mm. grains tend to be spherical and better rounded than smaller grains which are angular to subrounded and often tabular.

Calcite ∽ 20%, crystalline with relic detrital grains.

Lithic frags. 20%. Poorly sorted and includes feldspar.

7. A343/C.G.51.E

Crossbedded and heavy mineral banded quartzite from southern end of 'Central Diapir', Station 51. Quartz is 'common' plutonic with straight extinction, occasional re-entrant faces and abundant inclusions. Sorting is poor but better in individual layers. $<$0.1 to $>$ 1.0mm. Heavy mineral banding defines bedding. Mica flakes, 0.5mm. very rare. Matrix is quartzose and with abundant clay, inclusions and voids. Porosity low.

Plagioclase: rare, 2%, multiple twinned grains, 0.02mm.

Other:
1. Rounded, quartzitic siltstone clasts, 1.2mm., 2 only
2. Tourmaline grains, 0.2mm., 3 grains
3. Haematite, 5 micron grains, abundant
4. Amphiboles, few 0.2mm. grains
5. Clay

8. A343/C.G.52.A

Quartz: 50%, highly irregular, very poorly sorted, angular to interlocking grains, av. 0.5mm. max. 1.0mm. Some grains with undulose extinction, others composite.

Feldspar: few grains.

Rock fragments: ∽ 30%, includes siltstone clasts

Mica: rare, 0.2mm.

Other: opaques 15%, carbonate

Name: Sub greywacke (?).

9. A343/C.G.54.A (stained) (cc. 97%, dol. trace, qtz. 3%)

Fine calcirudite: 0.1 to 6mm., poorly spherical to elongate, sub-rounded clasts in a calcitic (micrite) matrix. Clasts are re-crystallized calcite. Also 1-2mm., quartz sand. ≤3%. Grains are very well rounded, spherical and commonly with straight extinction and abundant fluid inclusions. Less than 5% of quartz grains are composite and with undulose extinction.

10. A343/C.G.70.D

Crossbedded, heavy mineral banded sandstone with coarse arkosic bands.

Quartz: angular to subrounded, spherical to elongate, 80%, very poorly sorted but sorting improves in individual beds. 0.2 to 1mm. Plutonic.

Feldspar: < 10%, plagioclase, orthoclase, commonly angular, ∽ 0.2mm. More abundant and coarser in bands.

Muscovite: 0.2mm. flakes. < 1%.

Amphibole: very rare, 0.01mm. grains

Dark opaque grains, ∽ 7%, 0.4mm. and less.

Haematite: rare crystals. < 0.01mm.

Clay: rare, in matrix.

Other: (< 2%)

A 2.5mm. rounded, ovoid grain, infraclast of laminated, quartzitic siltstone. Facies identical with A343/C.G.51.E.

11. A343/C.G.78 (float)

Fibrous and colloform calcite with pyrolusite banding. Some bands with calcite crystals to 0.3mm. Pyrolusite may occur as fibrous, occicular crystals (?). Travertine vein cuts one side of section.

12. A343/C.G.94.B

Quartz: 40%, < 0.1 to 1mm. grains, av. 0.4mm., probably bimodal, very poorly sorted but larger grains are often very well rounded and spherical.

12. (Cont) Smaller grains are less so and may be angular and elongate. Feldspar and rock fragments ~ 30%, includes grains of carbonate, plagioclase, amphiboles (rare), mica (rare) and composite, sedimentary, grains, the latter usually well rounded (reworked?). Matrix 15% is dominantly a fine carbonate, probably calcite and includes clay. Opaques account for about 15% of the rock.
Name: lithic greywacke (?).

13. A343/C.G.96

Secondary epidote from dolerite plug. (Hydrothermal alteration). Euhedral to fibrous or columnar crystals to 7mm. long. Minute magnetite (?) inclusions (rare). Forms 98% of rock.
Other minerals:
Actinolite: fibrous to asbestiform and pleochroic aggregates, with inclusions of magnetite. Interstitial with respect to epidote.
Magnetite: rare inclusions, commonly in actinolite.

14. A343/C.G.98.A

Basic igneous intrusive rock, strongly altered. Relic ophitic texture with clinopyroxene (augite) (40%), magnetite (5%) and amphiboles. Accessory apatite, few acicular crystals.

15. A343/C.G.104.a

Altered dolerite from intrusive plug at Station 104. Pyroxene is clinopyroxene, probably pigeonite (40%) and diopsidic augite (60%). Rare haematite grains and about 10% opaques, probably magnetite or ilmenite. Plagioclase is An_{60} (labradorite). Very rare quartz may be present (0.1mm.). Apatite rare. Possible minor chlorite and kaolinite.

16. A343/C.G.107 (use conoscope)

Secondary Copper Minerals (Moorowie Mine)
Azurite:
Malachite: (replaces azurite)

16. (Cont) Cuprite: minor disseminations
Quartz: veinlets and euhedral crystals. Corroded rims.
Calcite: microcrystalline veinlets cut both copper carbonates
Limonite:

17. A343/C.G.132 (stained) (cc. 90%, dol. 10%, qtz. -)

Dolomitic calcimicrite

Rare dolomitic pellets, lithiclasts, in finely crystalline calcitic matrix. Other dolomite is secondary and replaces the matrix. Vugs with drussy calcite fill. Archaeocyathid.

ADDENDUM:

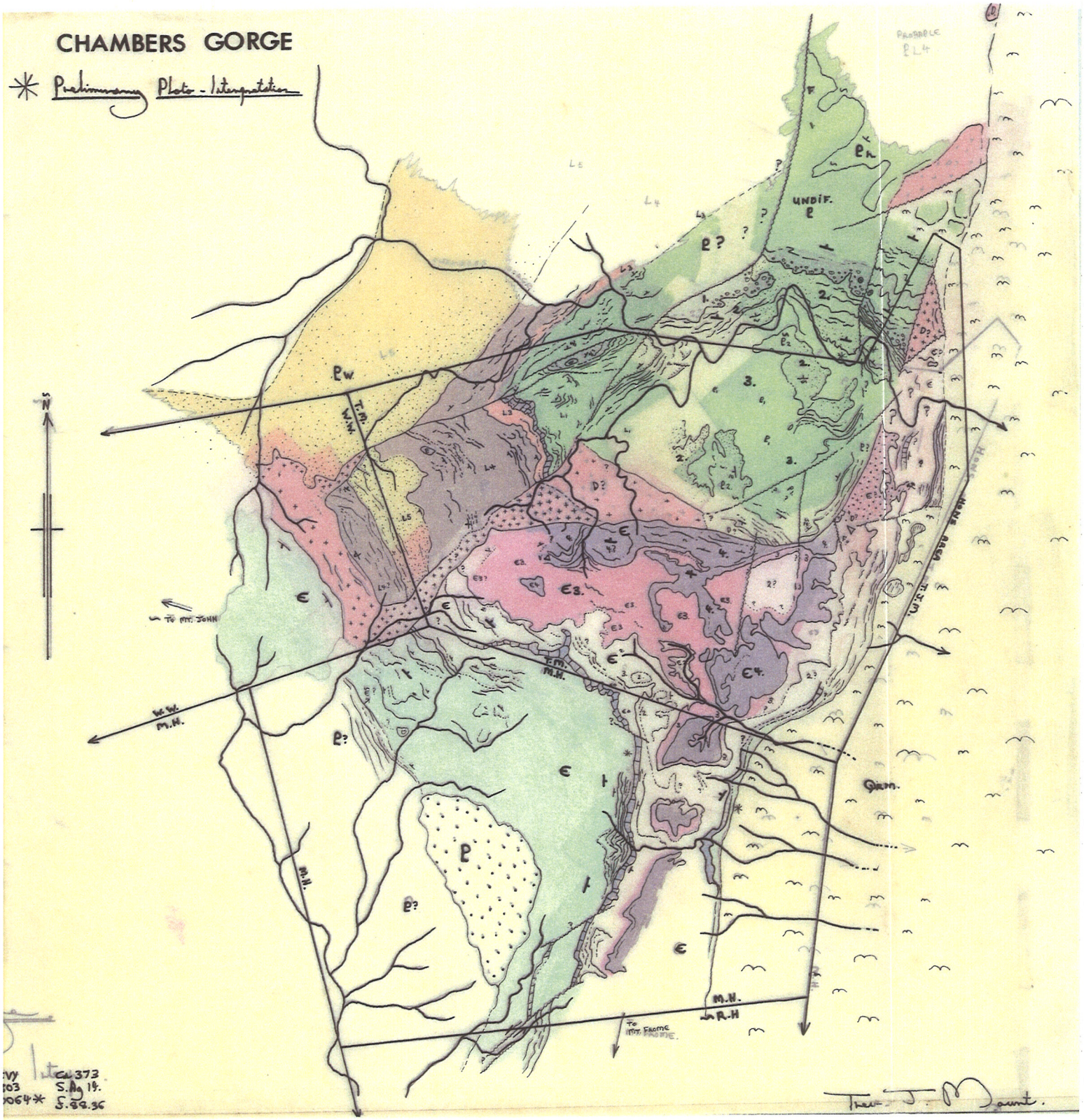
Since the writing of the thesis further work has been done on the heavy minerals from the diapirs and the Cambrian. Five chip samples containing heavy mineral banding were taken from the Central and Double Diapirs, 300g. in all, and were combined, crushed and the heavy minerals extracted using the Frantz Isodynamic separator. (Sample presented in tube "C.G. (D.H.M.)").

An X-ray powder photograph (submitted) taken on the heavy mineral fraction shows it to be ILMENITE (with minor quartz and clay).

The Cambrian limestone A343/R.90ft. was digested with conc. HCl and the magnetic residue (heavy minerals) was found to be ilmenite (Tube C.G. (C.H.M., R.90ft.)).

20/10/70

Miscellaneous maps, stratigraphic sections (remnants of field sketches; see full set of final sections in large folder), and photographs that support the thesis.


CHAMBERS GORGE
Preliminary Plate - Interpretation
UNDIF.
Pw
T.M.
M.H.
W.W.
To Mt. JOHN
Qam.
To Mt. FROME
R.H


FIELD DRAFT MAP
1/2

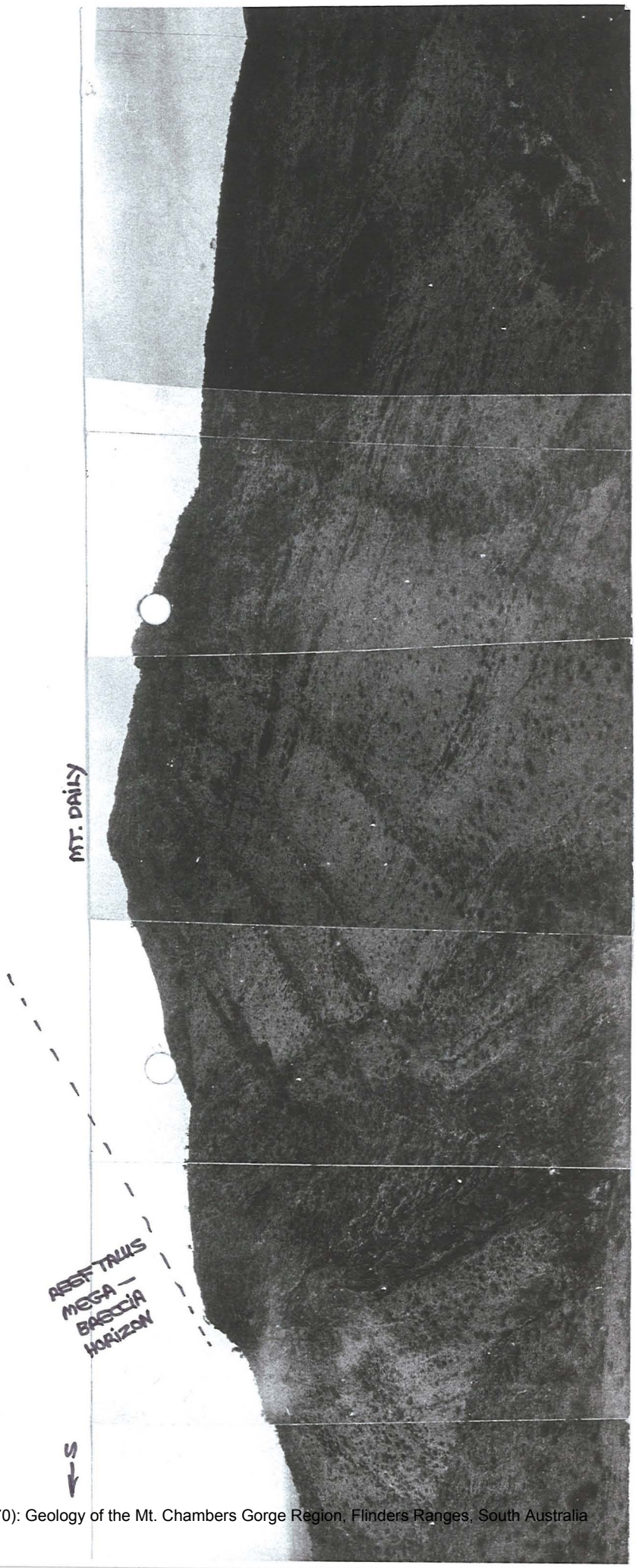
FIELD DRAFT MAP
2/2

FAUNAL LIST.

Note.

Argentine (?) = Ants.
Black ¼" ants.
Red Ants. ½"
Red + Black + White Striped (Abd.) Gum ants.
Spotted Pardalotte. C.C.
White Parrots 5. (Cockatoos)? C.C.
2 Green Rosella type parrots. C.C.
Many Galahs.
Many Pipits. est. ~100-200 Fan-tailed
Tawny Frogmouth 3.
Emus (C.C. Bore). ~5.
Fox. x1.
Yellow Footed rock wallaby. 3.
Wallaby. x ~ 4-5.
Flies. "House" and four larger greenish "March" flies.?
Midges.
"Top-knot" Doves. (Crested Pigeon?)
"Admiral" Butterfly. C.C.
Dingo? tracks??
Crows. ~20.
Eagle ~2. Aquilla Audax?
Red "Xmas"(?) beetles. (Wilsons Bore). (W.B.)
"Basket web spiders".
(Sleep.)
Zebra Finches x 600.
Finches.
Red. Robin x1(?) (W.B. camp)
"Rainbow" Lizards x5.
Skinks (?) <4". Many.
Carpet (?) Snake >x2.
Cricket (camp).
Mosquitoes (C.C.) Bore.
Willy wagtail. (W.B.)
(Nocturnal) Moths (Various).
Centipede.
White ants. (?)
Rabbits.
Brown Beetle
Water Beetle.
~~Red Robin~~.
White Ants.

2
1
1

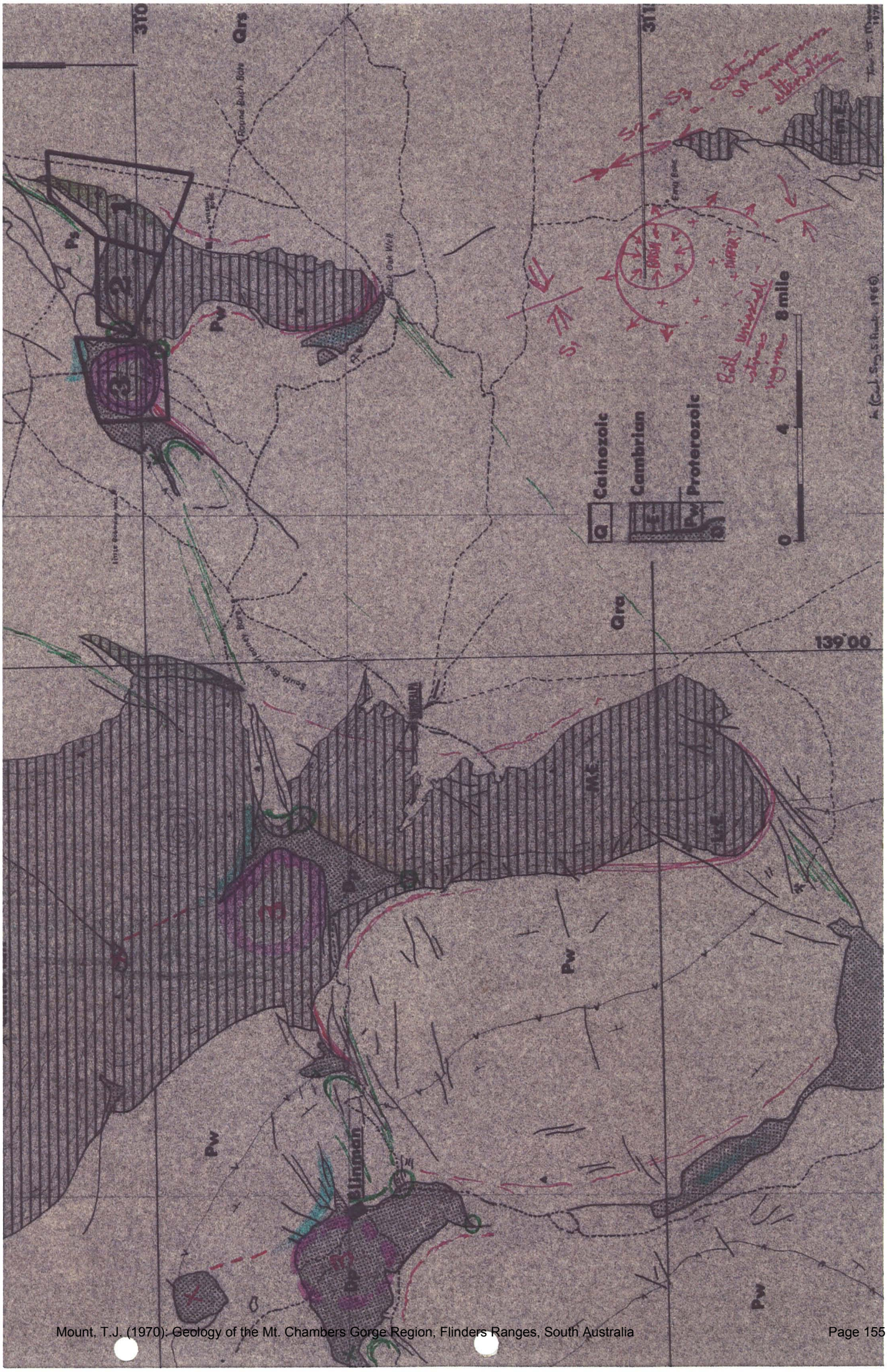

MT. DAILY
REEF TALUS
MEGA-
BRECCIA
HORIZON
S

1/3
LAKE FRAME
MT. CHAMBERS


2/3
MT. CHAMBERS?
SOUTH

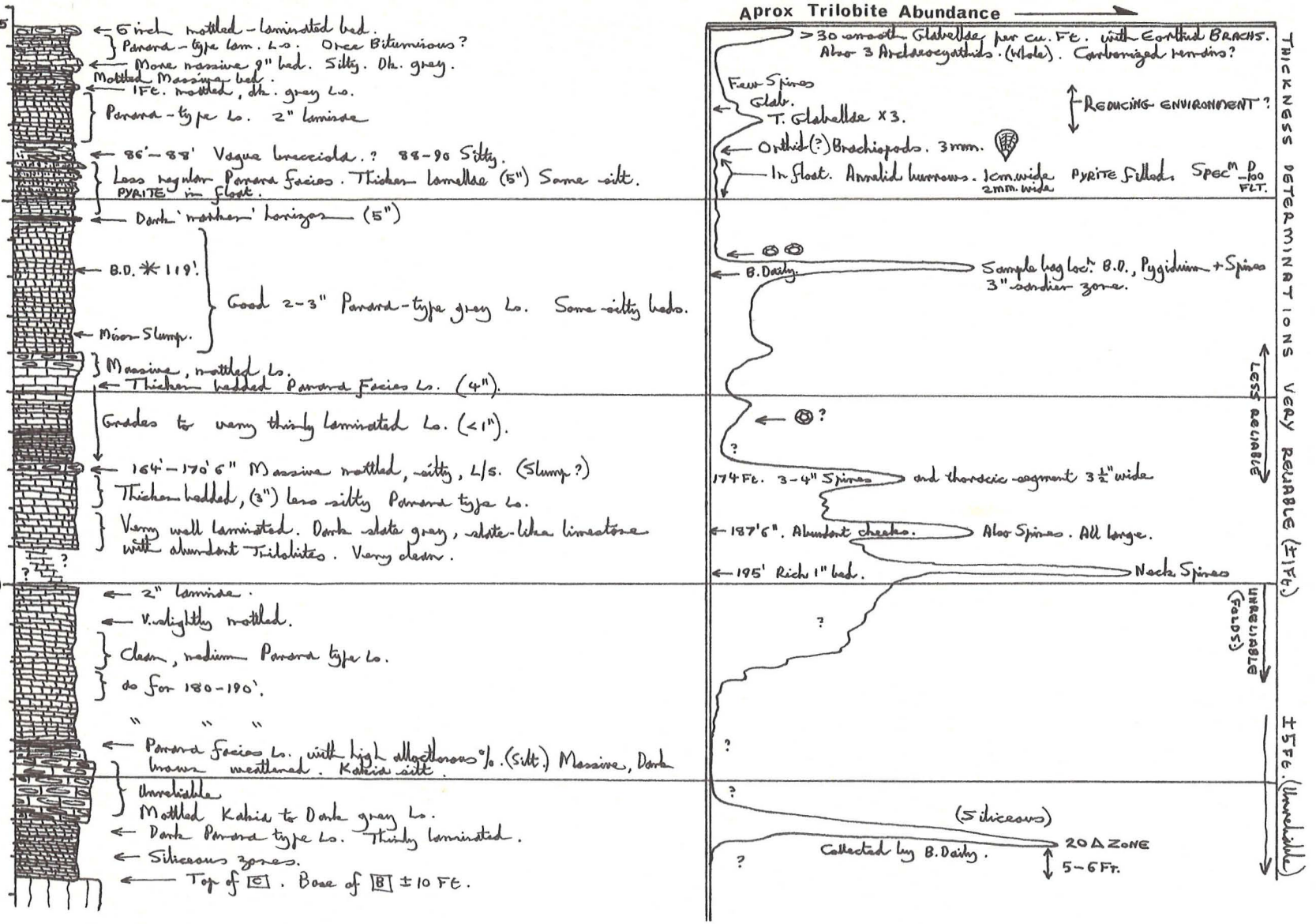

3/3
S

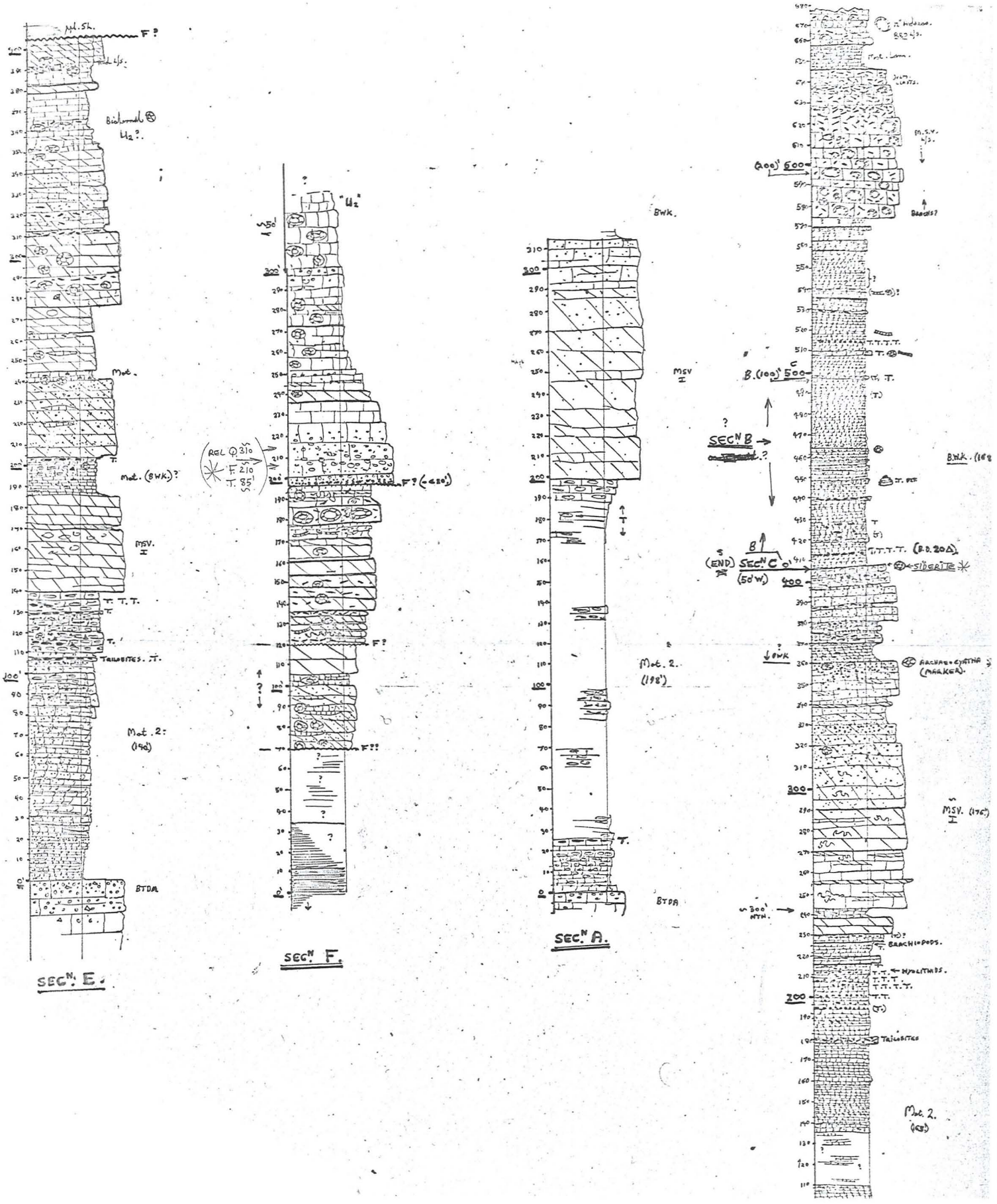
WIRREALPA HILL FROM EREKUNDA
(Sp.:)


NOTES ON STRUCTURE AND TECTONICS
Cainozoic
Cambrian
Proterozoic
Pw
Qra
Blinman
139°00'
8 mile
4
0

← EASTERN MOUTH OF CHAMBERS CREEK, TO LAKE FRAME →

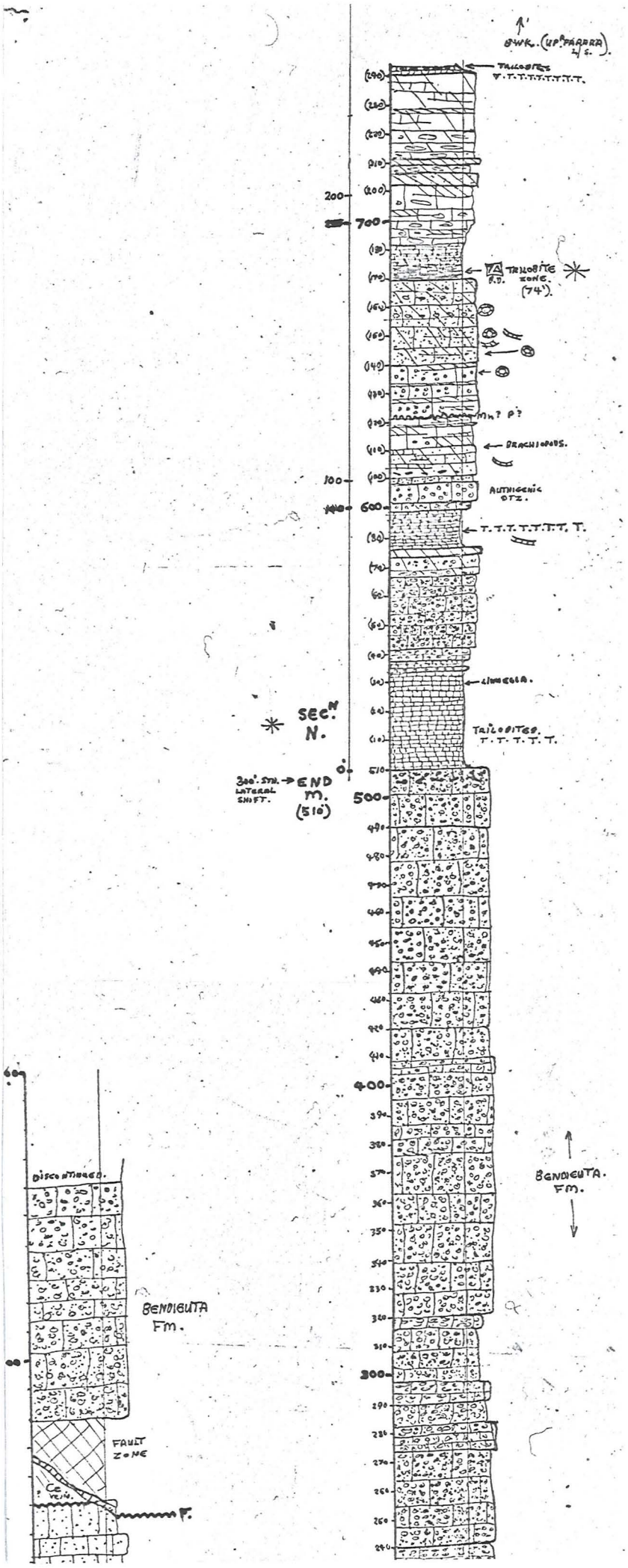
SECTION D (continued)



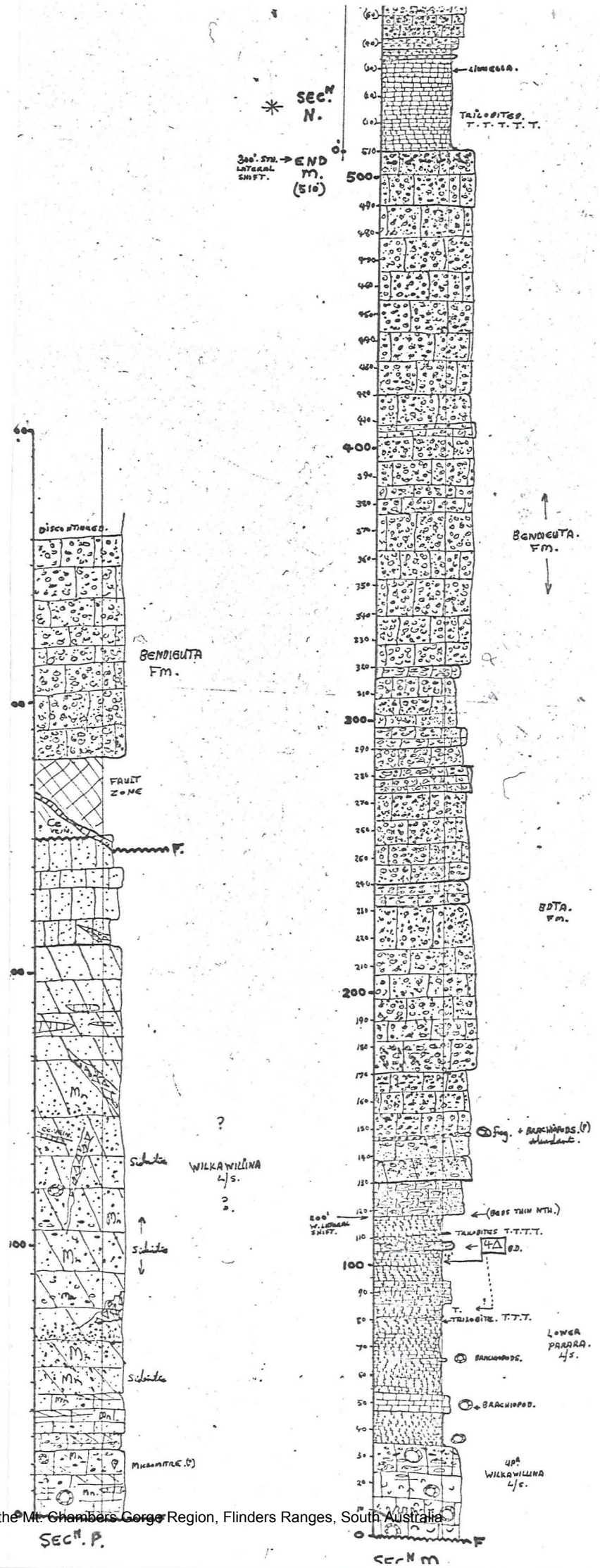


PT. SEC. E, F, A, C 1/2

PT. SEC. E, F, A, C 2/2


BWK. (UP. PARARA Ls.)
TRILOBITES
T.T.T.T.T.T.T.T.T.T.
200
700
TRILOBITE ZONE. (74')
BRACHIOPODS.
100
AUTHIGENIC QTZ.
600
T.T.T.T.T.T.T.T.T.
LIMESTONE.
SEC.N N.
TRILOBITES. T.T.T.T.T.
300' STR. LATERAL SHIFT.
END M. (510')
500
400
BENDIGUTA Fm.
DISCONFORMABLE.
BENDIGUTA Fm.
FAULT ZONE
F.

PT. SEC. M 1/2


SEC^N N.
END
300'. STR. LATERAL SHIFT.
m. (510')
TRILOBITES. T. T. T. T. T.
BENDIGUTA FM.
BDTA. Fm.
DISCONFORMED.
BENDIGUTA FM.
FAULT ZONE
F.
Siltstone
WILKAWILLINA L/S.
Siltstone
Siltstone
MICROMITRE (?)
SEC^N P.
Frag. + BRACHIOPODS. (?) abundant.
(BASS THIN NTH.)
800' W. LATERAL SHIFT.
TRILOBITES T.T.T.T.
4A
B.D.
T. TRILOBITE. T.T.T.
LOWER PARARA. L/S.
BRACHIOPODS.
BRACHIOPOD.
upper WILKAWILLINA L/S.
F
SEC^N M

41

PT. SEC. M

Miscellaneous records relating to the establishment and administration of the thesis.

HONOURS PROJECTS, 1970

Hatcher, M.I.	The geology of the Cambrian south of Moorowie Mine, Central Flinders Ranges.
Mount, T.	The geology of the Mount Chambers Gorge region.
Harris, R.	The geology of the Late Proterozoic and Cambrian of the Mt. Frome Region.
Wigglesworth, K.F.	(1) The geology of the Mount John region. (2) Aerial photo interpretation of the Aroona-Beltana area.
Cobb, M.) Morris, B.)	Geology and petrology of amphibolite body, Weekeroo.
Coin, C.	A study of granulite-amphibolite facies terrain near Amata.
Moriarty, K.	The petrology of some bottom sediment cores from the Southern Ocean.
Hill, V.J.	The atomic structure of scholzite.
Thomas, A.	Joint study and relationship to tin mineralisation of the Stannery Hills Area, Herberton, Qld.
Sibernaler, X.P.	Geochemical project, Tunk Head area.
Smith, P.B.	Geochemical project near Kalgoorlie.
Holt, G.E.	Copper mineralisation Paratoo diaper.
Thompson, R.L.	Kittacoola ores.
Lipple, S.L.	
Drew, G.	Geophysical investigation in the Middlebank Ranges. (Southern Area).
Hone, I.	Geophysical study of the gold bearing magnetite bodies at Tennant Creek.
Kopcheff, J.	Basin study in South Australia.
Price, D.	Geophysical investigation in the Middlebank Ranges (Northern Area).
Pridmore, D.	Investigation of the Edwin Shoot, W.A.
Taylor, R.	

Dr. Nesbitt

Briggs
Davidson
Heraty
Watmuff
P.C. Smith : Petrology and Geochemistry of the granites of the S.E.

THE UNIVERSITY OF ADELAIDE

SCHOOL OF GEOLOGY

Thesis Material

When submitting your thesis you are also required to submit a representative collection of your material (including rock and ore samples, thin and polished sections).

Please observe the following points:

(1) Submit no more than one steel tray of hand-specimen material.

(2) All material (hand specimens and micro-sections) is to be numbered and the numbers must correspond to a list in the appendix of your thesis. All thin sections must also bear your name.

(3) All other specimen material is to be removed from the Department before 1st December, 1970.

Plates and Dyelines for Thesis

The Department will provide sets of up to ten plates or dyelines for 4 copies of the thesis (up to six plates or dyelines if the thesis is over thirty pages long).

The charge for any additional plates, dyelines or extra copies is 10¢ per plate and 5¢ per square foot of dyeline.

Maps and photographs for copying must be submitted to Dr. Gostin or Mr. Both by Monday, 5th October.

MEMORANDUM TO: Postgraduate and Honours Students.

FROM: D.M. Boyd and R.W.R. Rutland.

Various abuses of the facilities of the School of Geology have been reported to us during the past few weeks. If such abuses were to continue they would raise the question as to whether we could continue to open the School to students during the evenings. We would therefore ask all postgraduate and honours students to confine their evening work to their own rooms or to those laboratories which they have had express permission to use in the evenings. It should also be obvious that special care should be taken in the use of facilities in the absence of academic and technical staff and that laboratories should be left in a tidy condition. Any mishaps should be promptly reported.

David Boyd.

Rick Rutland.

To all Honours, M.Sc. and Ph.D. students:

Use of photographic facilities in the School of Geology

1. All postgraduate students (Honours, M.Sc. and Ph.D.) must obtain the approval of their supervisor in order to use the School photographic facilities, and all work so approved must be submitted through the staff member in charge of photographic work.

2. Normally students will be required to develop their own negatives.

3. All photographic prints are to be made by the appropriate photographic technician unless special written permission is obtained from one's supervisor. The quantity and type of paper used should be recorded.

4. For the inclusion of photographs in a thesis, prints have to be submitted to the supervisor for approval. After approval, plates may be prepared by the appropriate photographic technician.

5. The Department will provide the plates for four copies of a Ph.D. or M.Sc. thesis free of charge but only if the four copies are assigned two copies to the University as required by the Board of Research Studies, one to the Department and one to the supervisor. Additional copies can be produced by the photographic technician at the student's expense.

R.W.R. Rutland

GEOLOGY DEPARTMENT

Memo to all staff and research students:

Situation Desperate!

We are rapidly running out of maintenance funds and therefore ask all concerned to co-operate in limiting the use of photographic and copying facilities.

Transparencies for the overhead projector cost at least 25 cents each! So please economize. The maximum number of transparencies allowed for any one seminar shall be 5, or else a strong case needs to be presented to me personally.

V. Gostin.

15/5/70.

University of Adelaide - Department of Geology.

USE OF THE MINERAL SEPARATING ROOM.

Equipment available:

Franz isodynamic separator.

[illegible] funnel.

[illegible]

[illegible]

Whatever procedure is followed it is important to commence with well sized material, ie. with the range of grain size as restricted as the amount of crushed material available will allow. The particular grain sizes chosen are influenced principally by the maximum particle size of the pure mineral concerned that it is possible to obtain.

Mineral separation procedures are empirical. Trial and error are applied to determine the best settings on the Franz. For rough, rapid separation, the Franz may be used vertically. Heavy liquids available are clerici (S.G. 4.3) and tetrabromoethane (S.G. 2.9). Others may be purchased if thought necessary. Note that Clerici is washed with water, and tetrabromoethane with acetone. These liquids, and dimethylsulphoxide which may be used to dilute tetrabromoethane, are poisonous and must be handled with care (see notice on wall of separating room) and with the fan on. Do not use naked flames in the vicinity of acetone fumes.

Material smaller than 200 mesh grain size does not separate easily by gravity in the separating funnel and needs to be centrifuged.

The elutriator is useful for the separation of micas and other flaky minerals from minerals of greater density.

The superpanner is suitable for the separation of heavy ore minerals from each other and from lighter silicates.

Use of the separating room is rostered. See sheet on wall.

Richard Mottershead is available for limited advice and assistance in the separating room.

Further reading:

J. Zussman (Edit). Physical Methods in determinative Mineralogy. 1967, Chapter 1.

R.L. Oliver
13th March, 1969.

University of Adelaide. Department of Geology.

Cutting, grinding and polishing.

Facilities are located in:

1. a "student" area,

2. a "technicians" area.

Honours students are obliged to use the "student" area; others may do so.

Thin sections and polished mounts are prepared for staff and research students by technicians Richard Mottershead and Wayne Hussared. Research students requiring thin sections should provide cut blocks ready for mounting.

Polishing will be done also for Honours students on blocks already mounted.

Staff and research students submitting work to Richard Mottershead should do so with the sanction of Dr. Oliver and to Wayne Hussared with the sanction of Mr. Both.

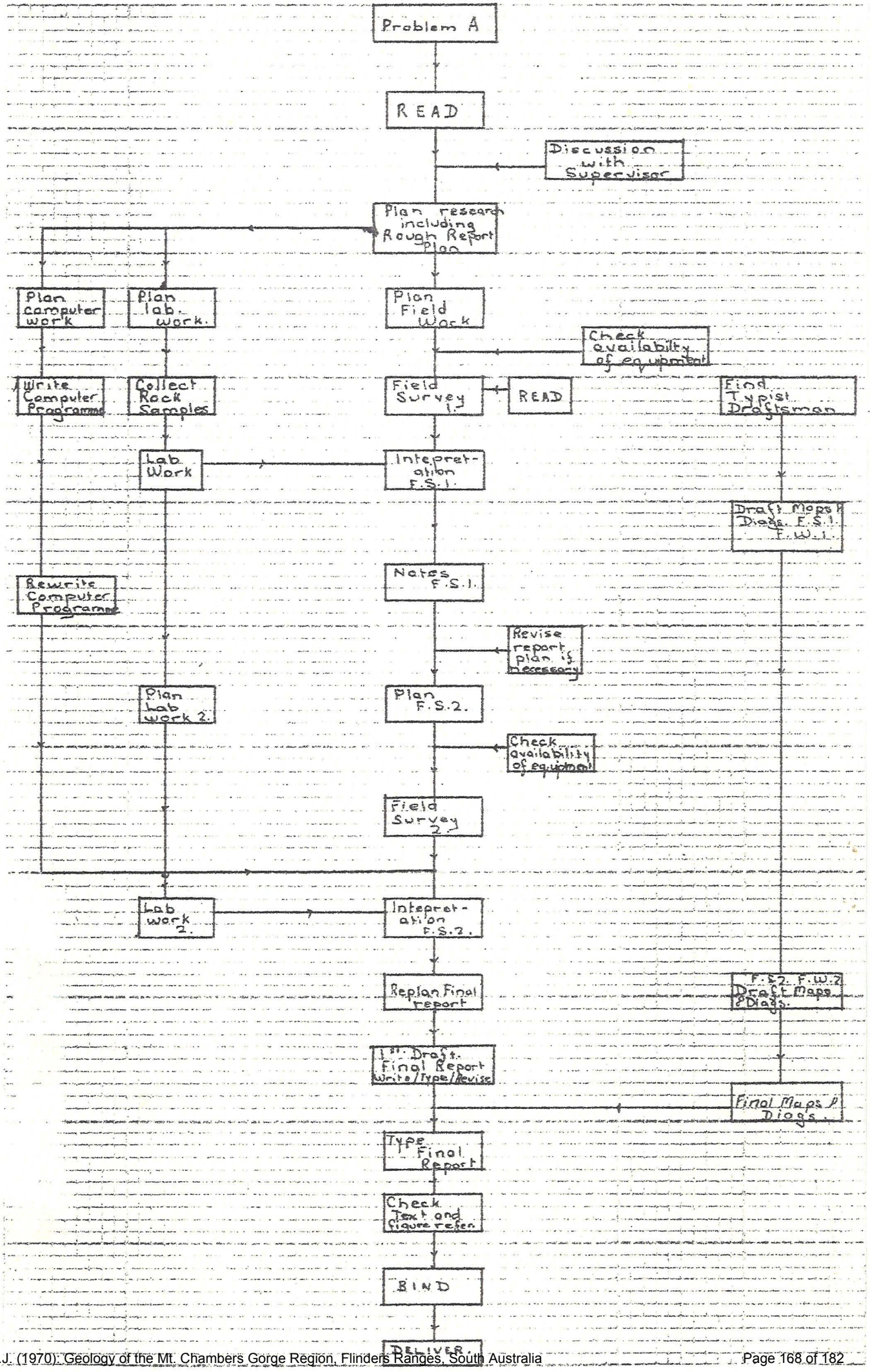
The maximum thin section entitlement for staff and research students is approximately 20 normal size thin sections per three weeks. The ration is smaller for larger thin sections.

Honours students should not use equipment in the "technicians" area. Research students may use the surface grinder or speed fan in the evenings or in the weekends after fully aquainting themselves with the use of these items of equipment, and after signing the book provided.

R.L. Oliver.

R.A. Both.

17th March, 1970.


Problem A
READ
Discussion with Supervisor
Plan research including Rough Report Plan
Plan computer work
Plan lab. work.
Plan Field Work
Check availability of equipment
Write Computer Programme
Collect Rock Samples
Field Survey 1.
READ
Find Typist Draftsman
Lab Work
Interpretation F.S.1.
Draft Maps Diags. F.S.1 F.W.1.
Notes F.S.1.
Rewrite Computer Programme
Revise report plan if necessary
Plan lab work 2.
Plan F.S.2.
Check availability of equipment
Field Survey 2
Lab work 2.
Interpretation F.S.2.
Replan Final report
F.S.2. F.W.2 Draft Maps & Diags.
1st. Draft. Final Report Write/Type/Revise
Final Maps & Diags.
Type Final Report
Check Text and figure refer.
BIND
DELIVER

THE UNIVERSITY OF ADELAIDE
ADELAIDE, SOUTH AUSTRALIA 5001
Telephone: 23 4333

Professor E. A. Rudd, Economic Geology
Professor D. M. Boyd, Geophysics
Mr. R. A. Both, Mineragraphy, Ore Deposits

DEPARTMENT OF
ECONOMIC GEOLOGY

16th June, 1970

Trevor Mount,
Geology Dept.,
University of Adelaide

Typing Fees

40¢ is charged for each page of typescript
This amount includes cost of ribbons,
carbon paper & depreciation on the type-
writer used.

Therefore fee due for 35 pages $14.00

Helen Ball.
Helen Ball

No. 14]

SOUTH AUSTRALIAN RAILWAYS

RECEIVED the undermentioned goo[ds] · livestock for conveyance between the stations shown, subject to the p[rovis]ions of the South Australian Railways Commissioner's Act, 1936-1965, and the Acts [incl]orporated therewith, and all Acts amending the same, and to the By-la[ws] Regulations and Conditions published by the Commissioner and to the terms and condi[tions] of the Consignment Note.

BY AIRSTO

RECEIPT FOR SENDER

Consigned to Mr. T. J. MOUNT. Date 25th Mar.

Station FROM ADELAIDE Station TO

Number and Description of Packages or Livestock	At Whose Risk	Weight
		LB.
Honda 90 Motorbike		
TR-927.		
ACCOM		

$5.42

Name of Sender T. J. MOUNT. Charges Payable by

Address 5 LISKEARD AVE. MITCHAM Signature of Sender or Agent

7:35. 25th March 5063 To

The Railways PROMPTLY deliver Parcels and Goods in Adelaide and Suburbs at Cheap Rates. Railway Employee's Signature

M.27

COMMONWEALTH OF AUSTRALIA

Commonwealth Railways

№ 294788

PORT AUGUSTA

25. 3. 1970.

Received from Mount (W + Hatcher)

the sum of

Six dollars Sixty Six cents,

being

Parachilna

6 Kelly

$ 6.66

Cheque No.

XS COPY

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CASH SALE

NAME T. J. MOUNT

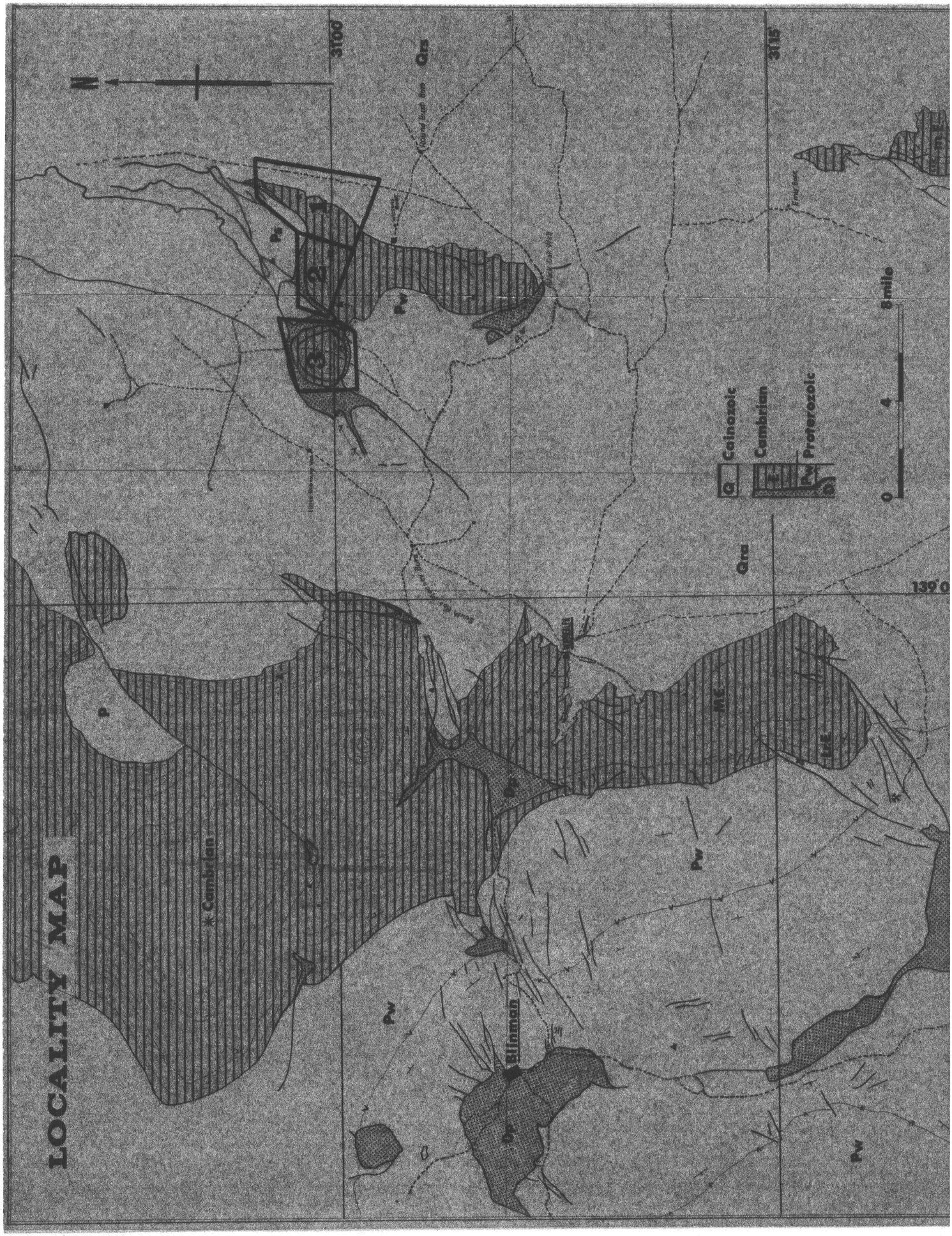
ADDRESS HONS. GEOLOGY No. XS 2811

DATE 14-10-70

Description of Work	No. of Exposures	Cost	
Thesis 3600.	134	6	70
	Total Cost $	6	70

Payment Received By S. Andrews for Copying Service


MT CHAMBERS GORGE
GEOLOGICAL MAPPING
JUNE 1970
1
2
N


LOCALITY MAP
N
3100
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Cainozoic
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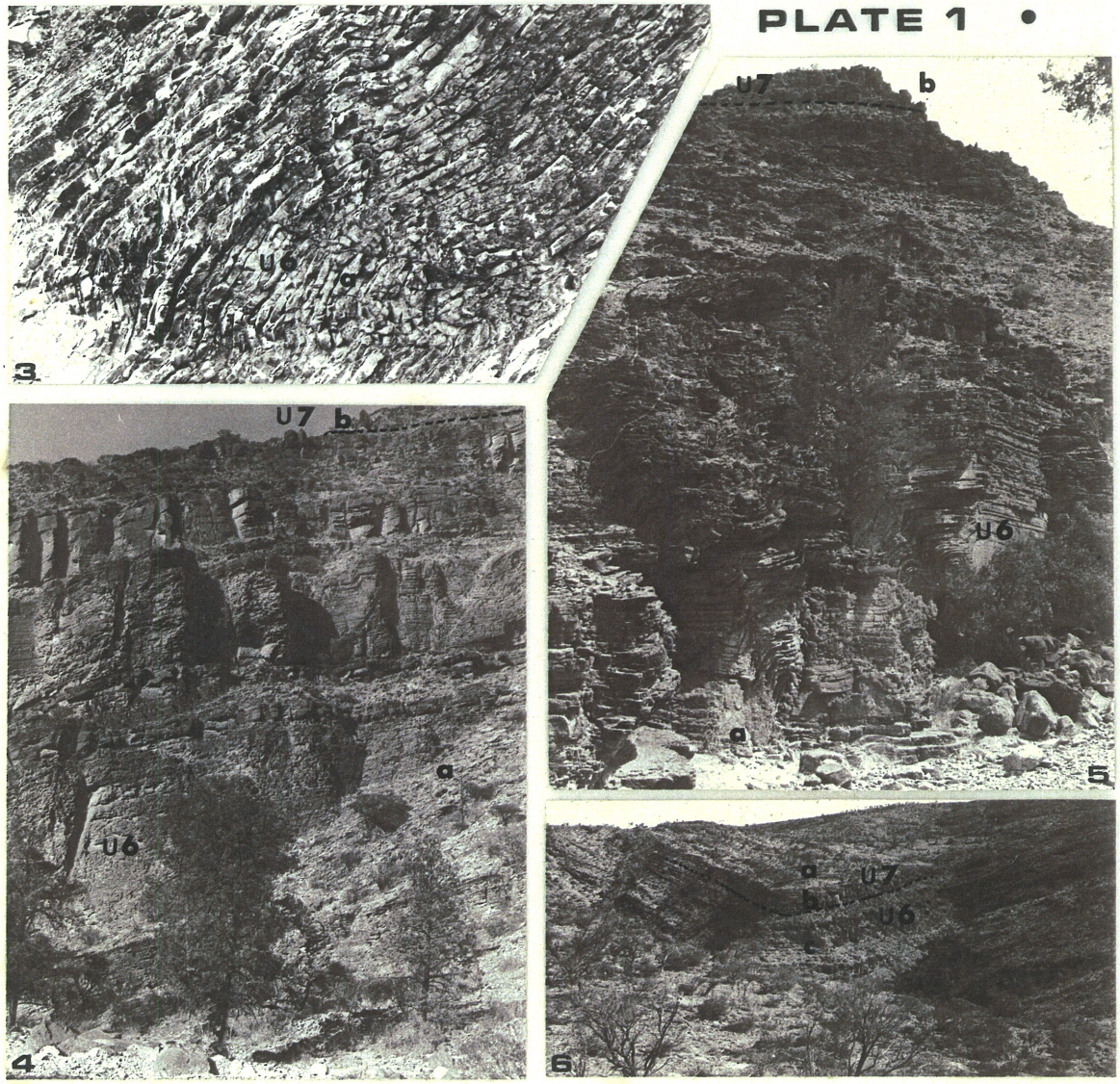
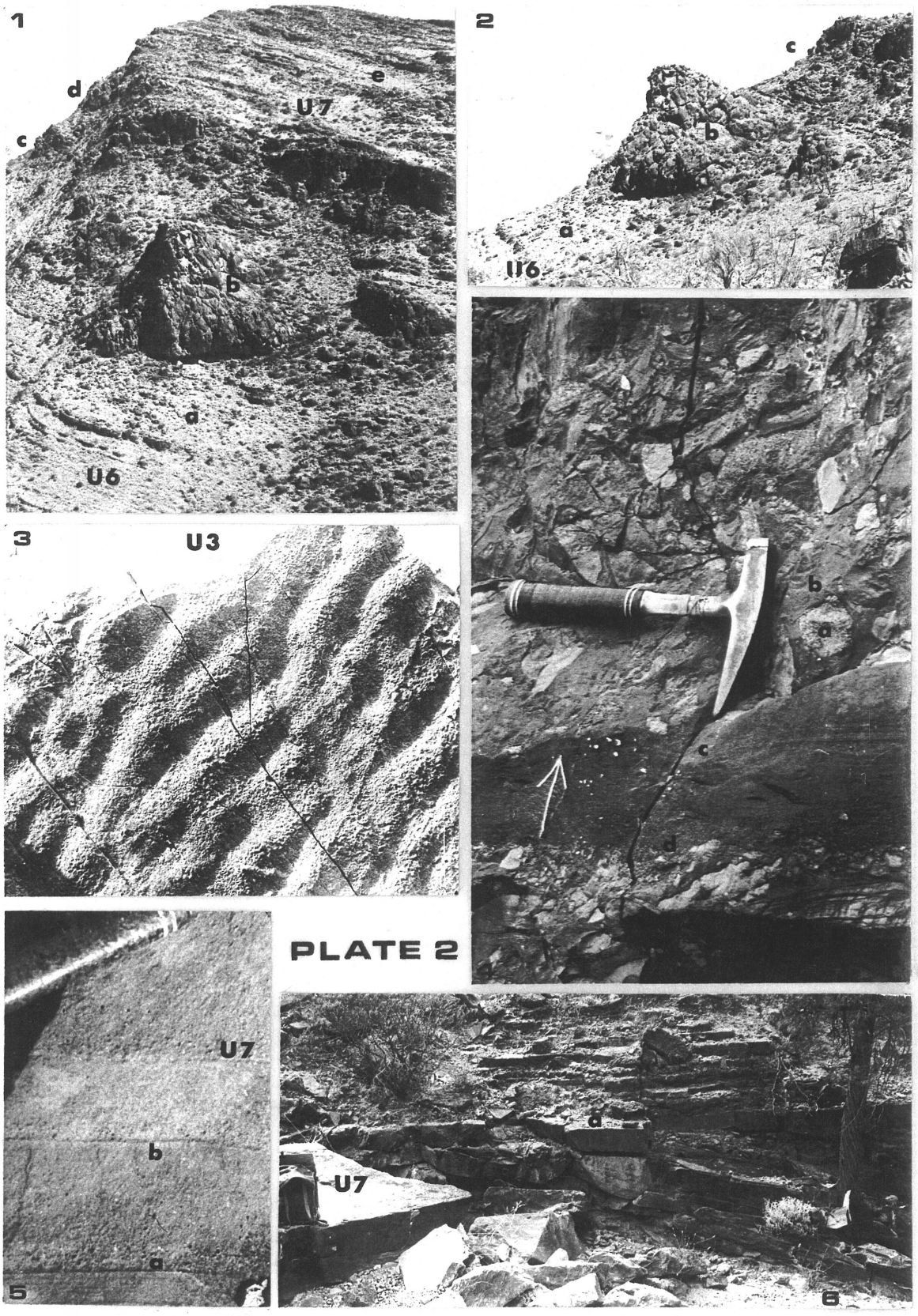
Proterozoic
8mile
4
0

PLATE 1




1
d
e
U7
c
b
d
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2
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U3
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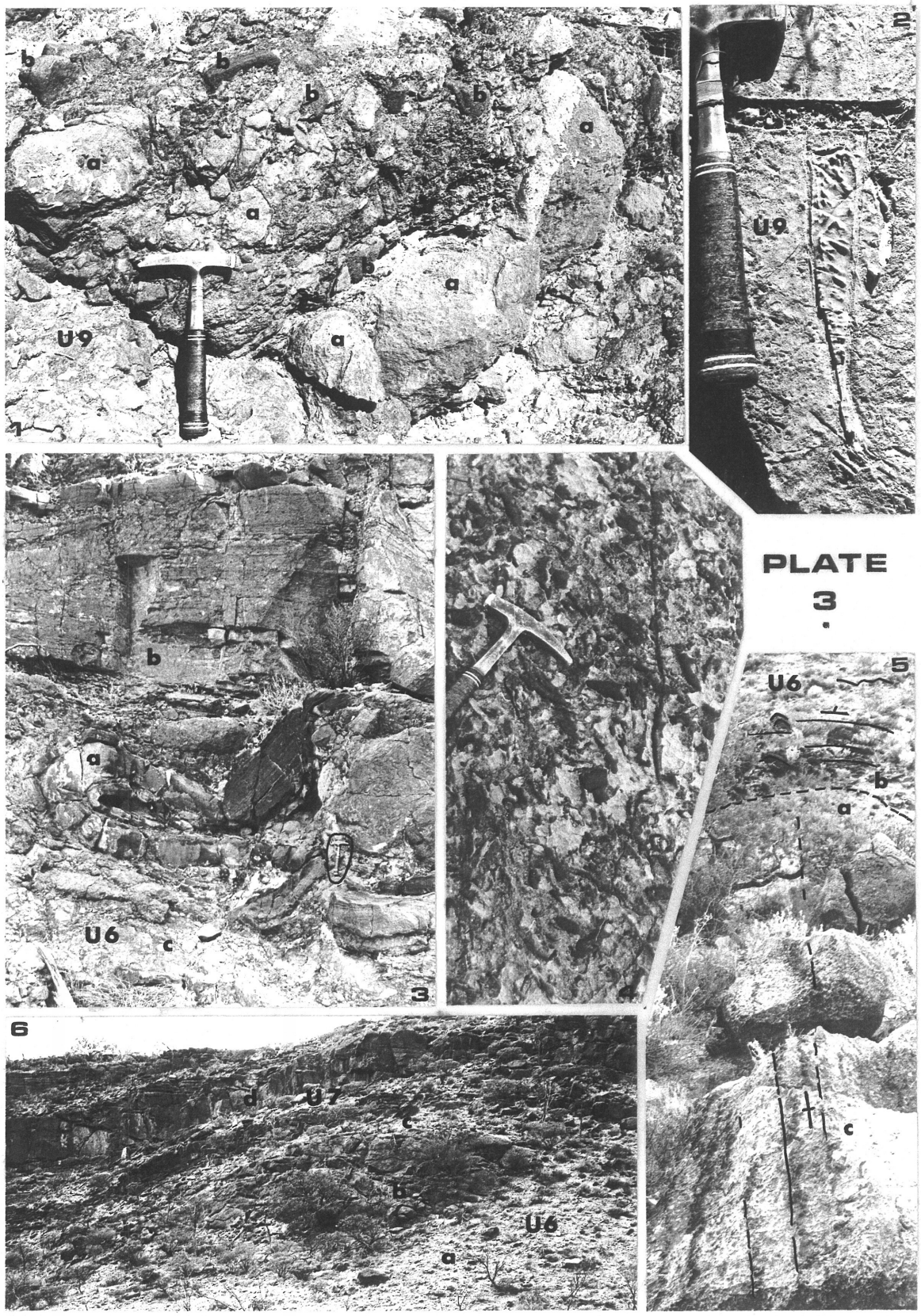
c
d
PLATE 2
U7
b
a
5
d
U7
6


b
b
b
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a
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a
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a
a
U9
1
2
U9
PLATE
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c
6
d
U7
c
b
U6
a

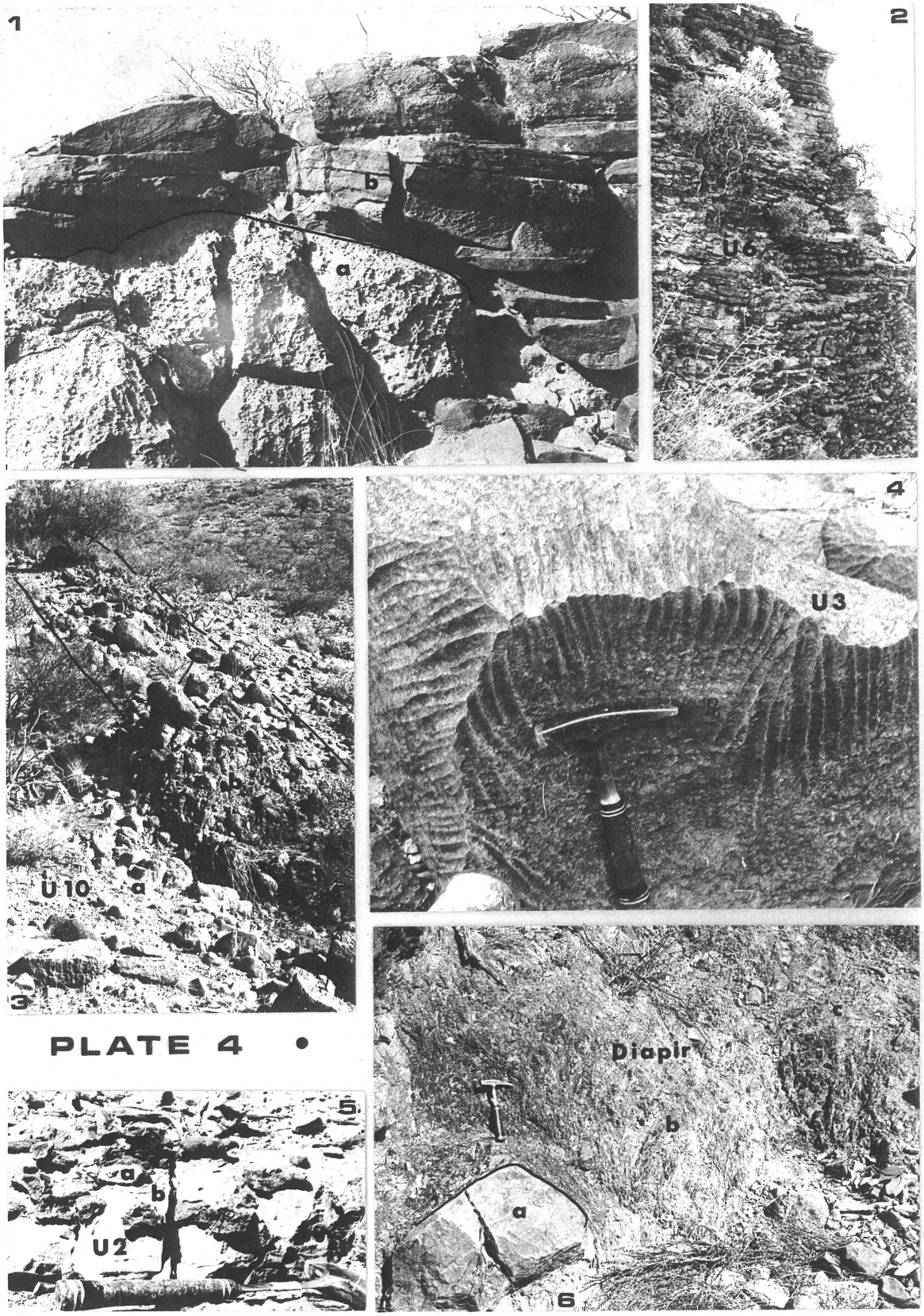
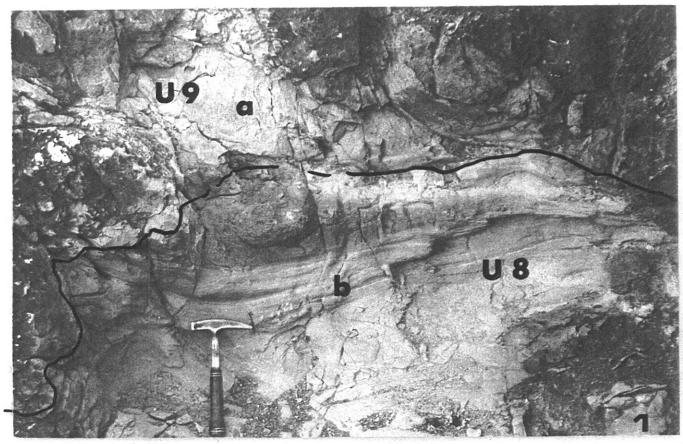
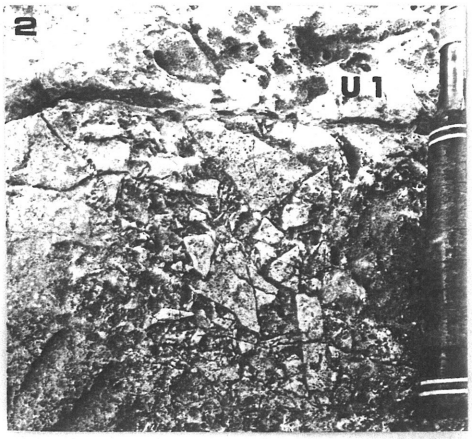
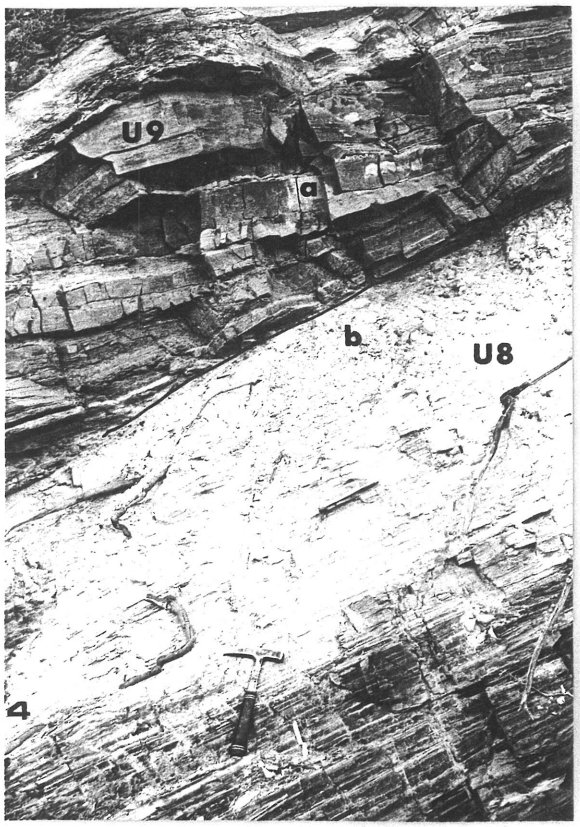


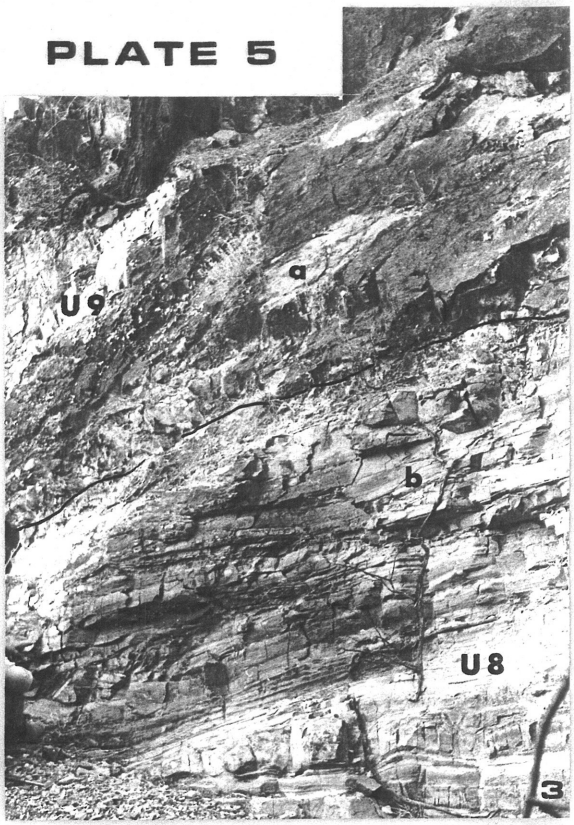
PLATE 4

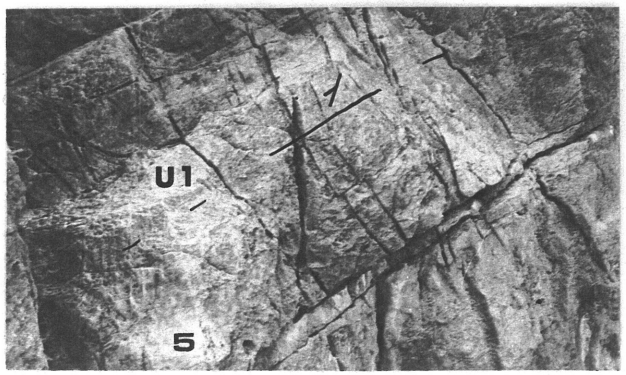
PLATE 5











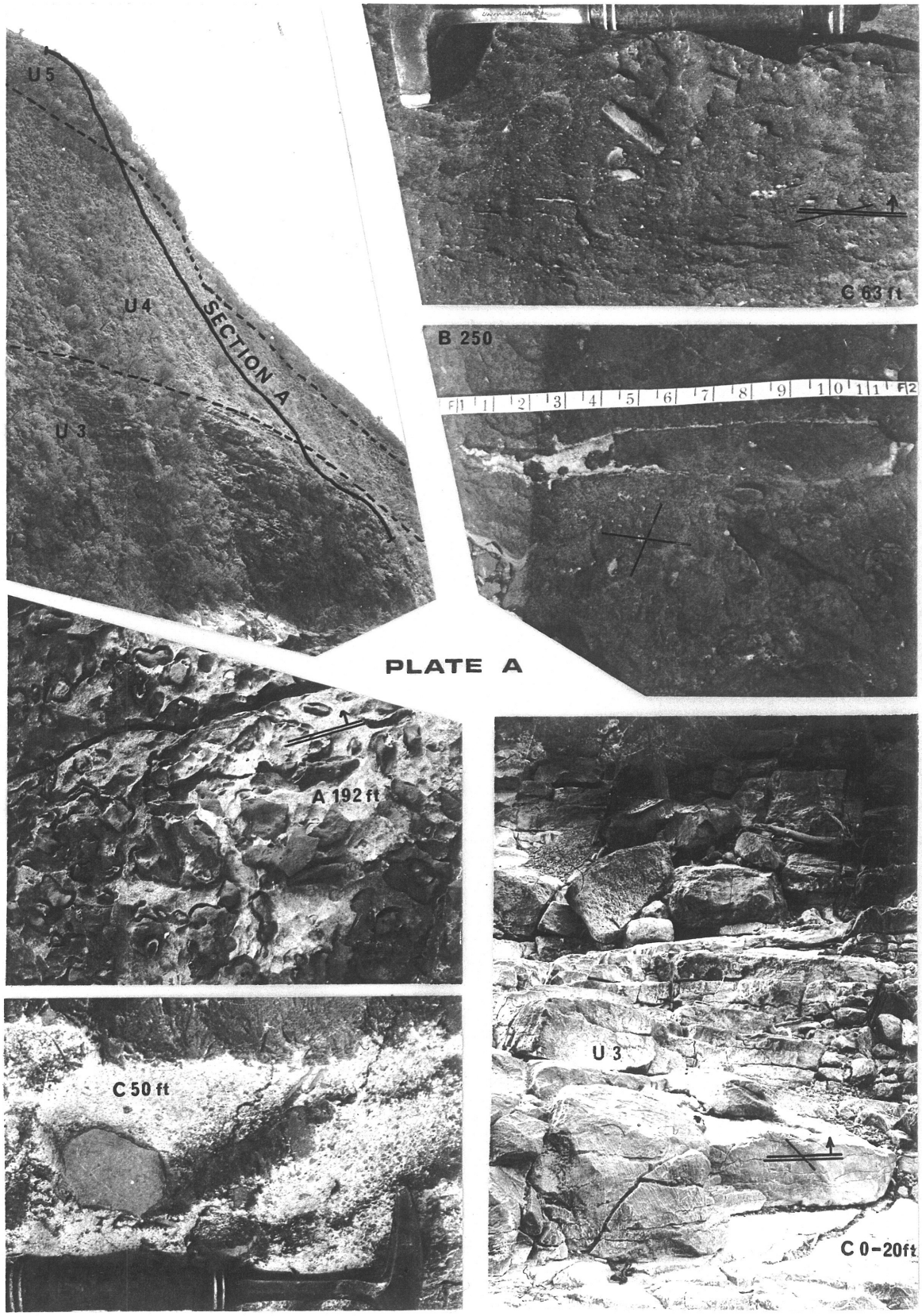
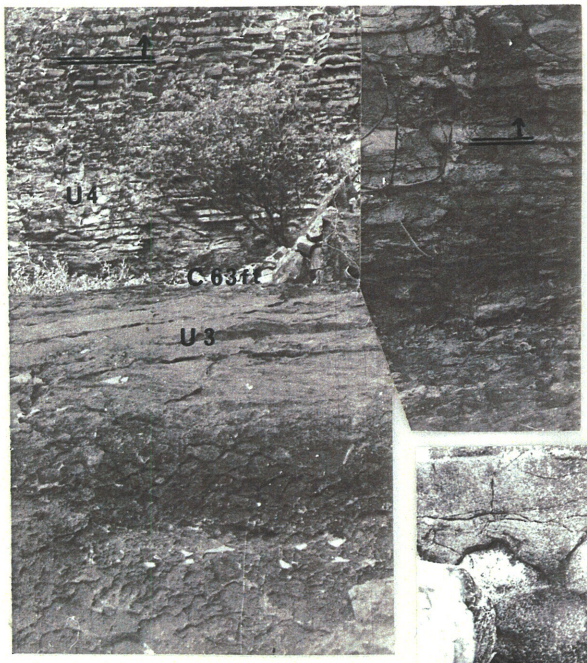


PLATE A


U4
C 63 ft
U3


C 200 ft
U4

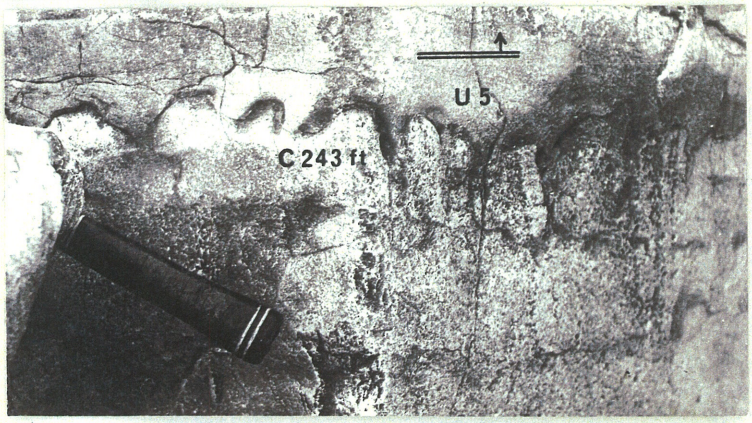
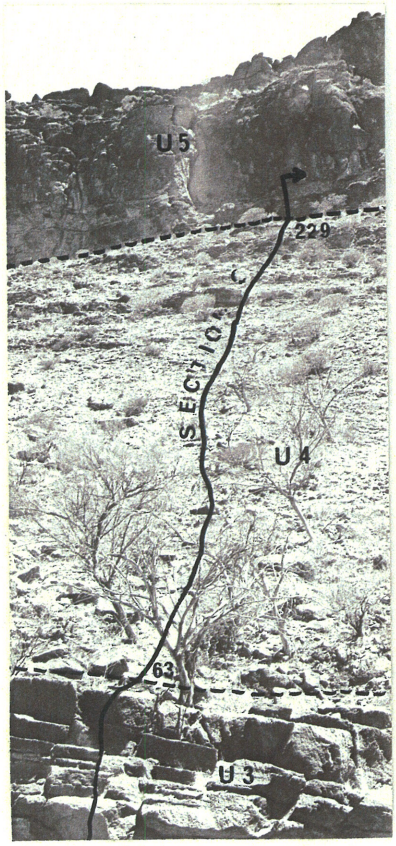
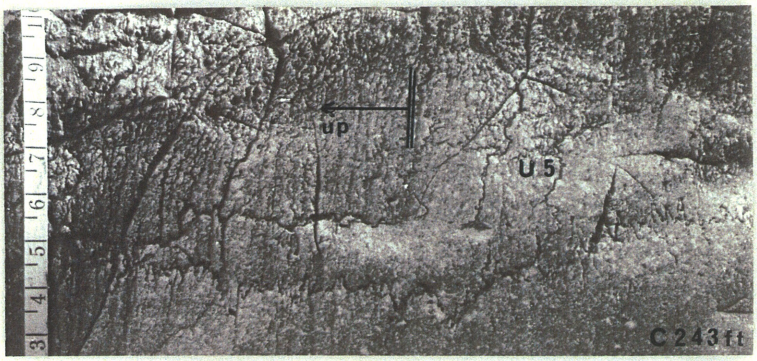
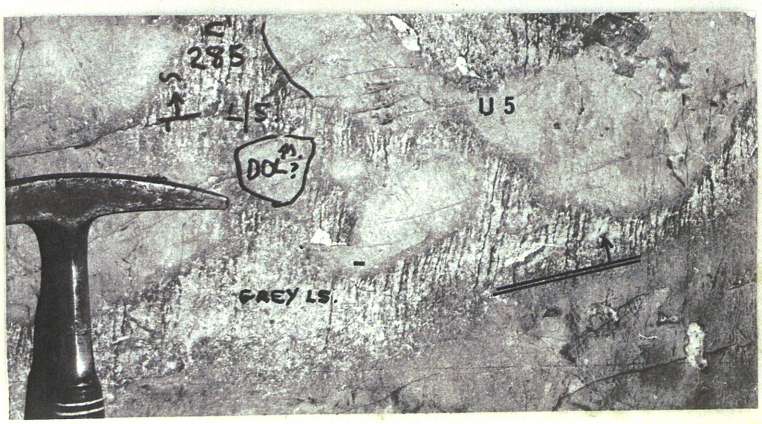
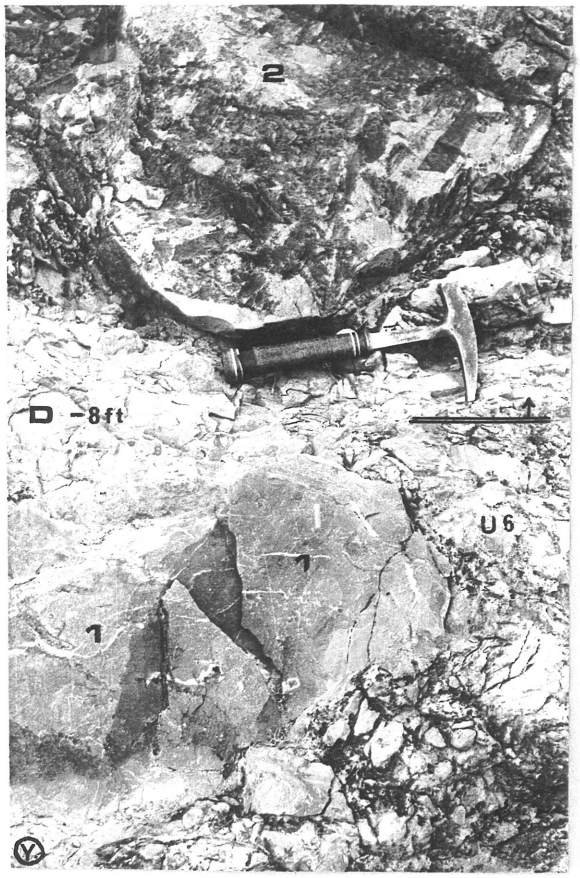

U5
C 243 ft

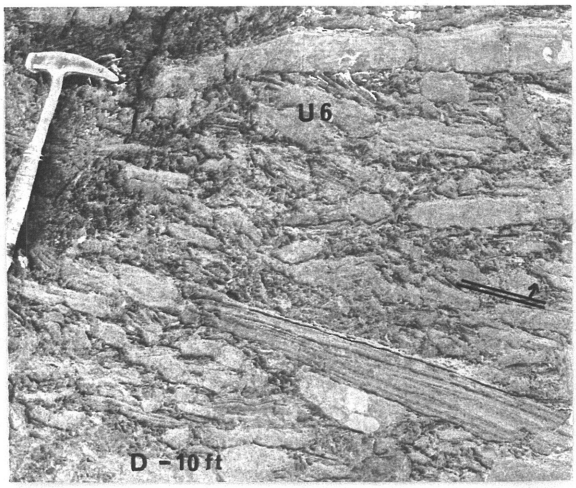
PLATE B


U5
220
IS EICT 10°
U4
63
U3


UP
U5
C 243 ft


285
U5
DOL?
GREY LS.





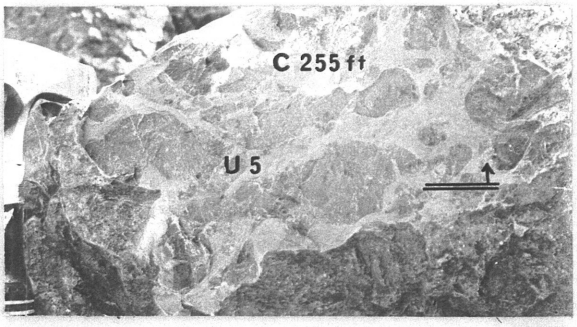
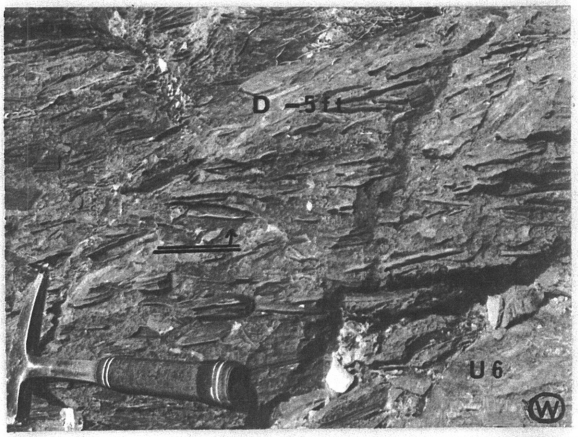
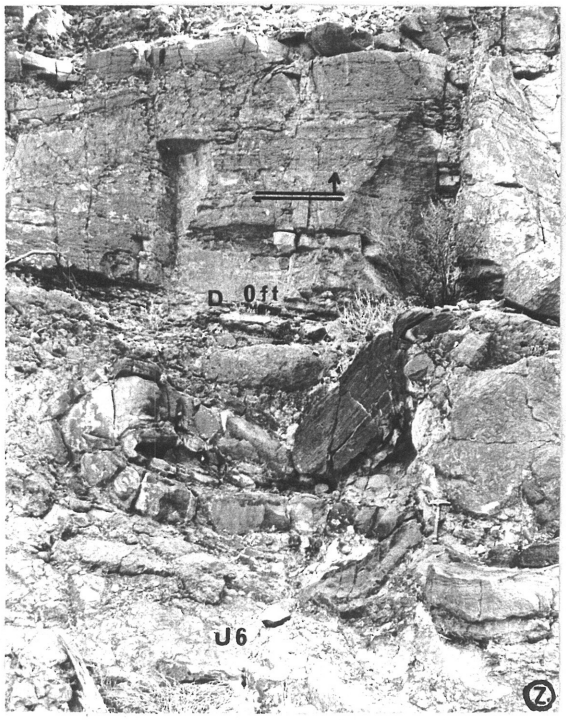
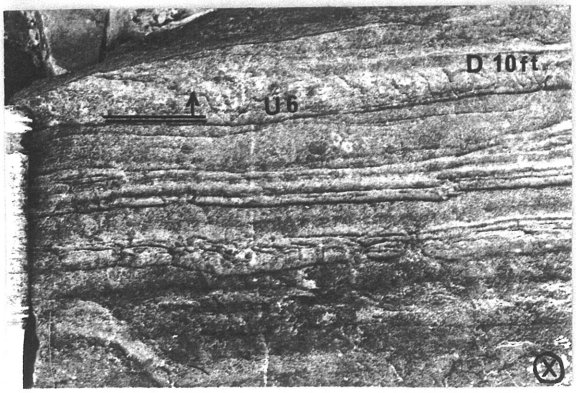


PLATE C •







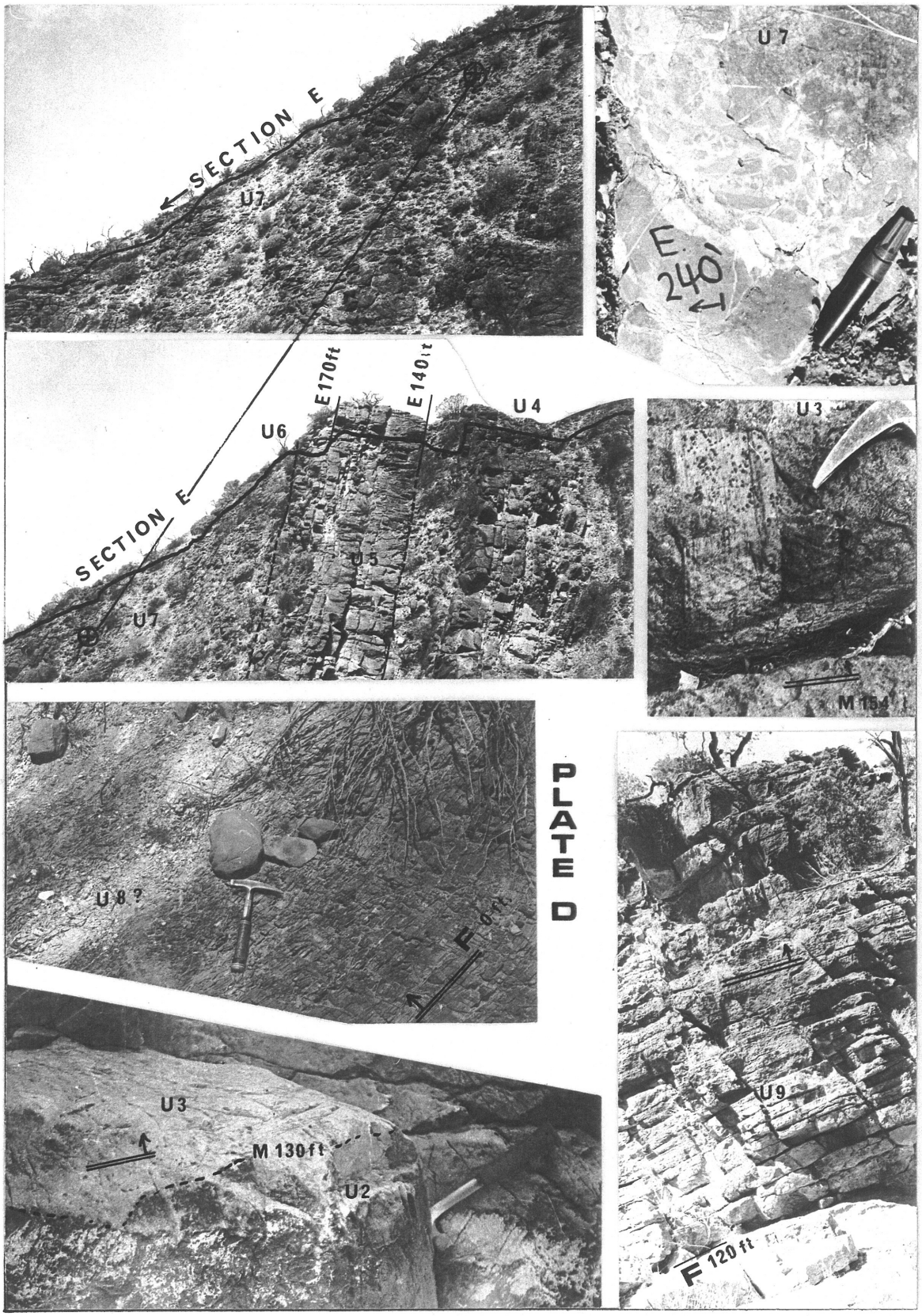

SECTION E
U7
U7
E. 240
E170ft
E140ft
U6
U4
U5
SECTION E
U7
U3
M 154 ft
U8 ?
F 0 ft
PLATE D
U3
M 130 ft
U2
U9
F 120 ft

PLATE D

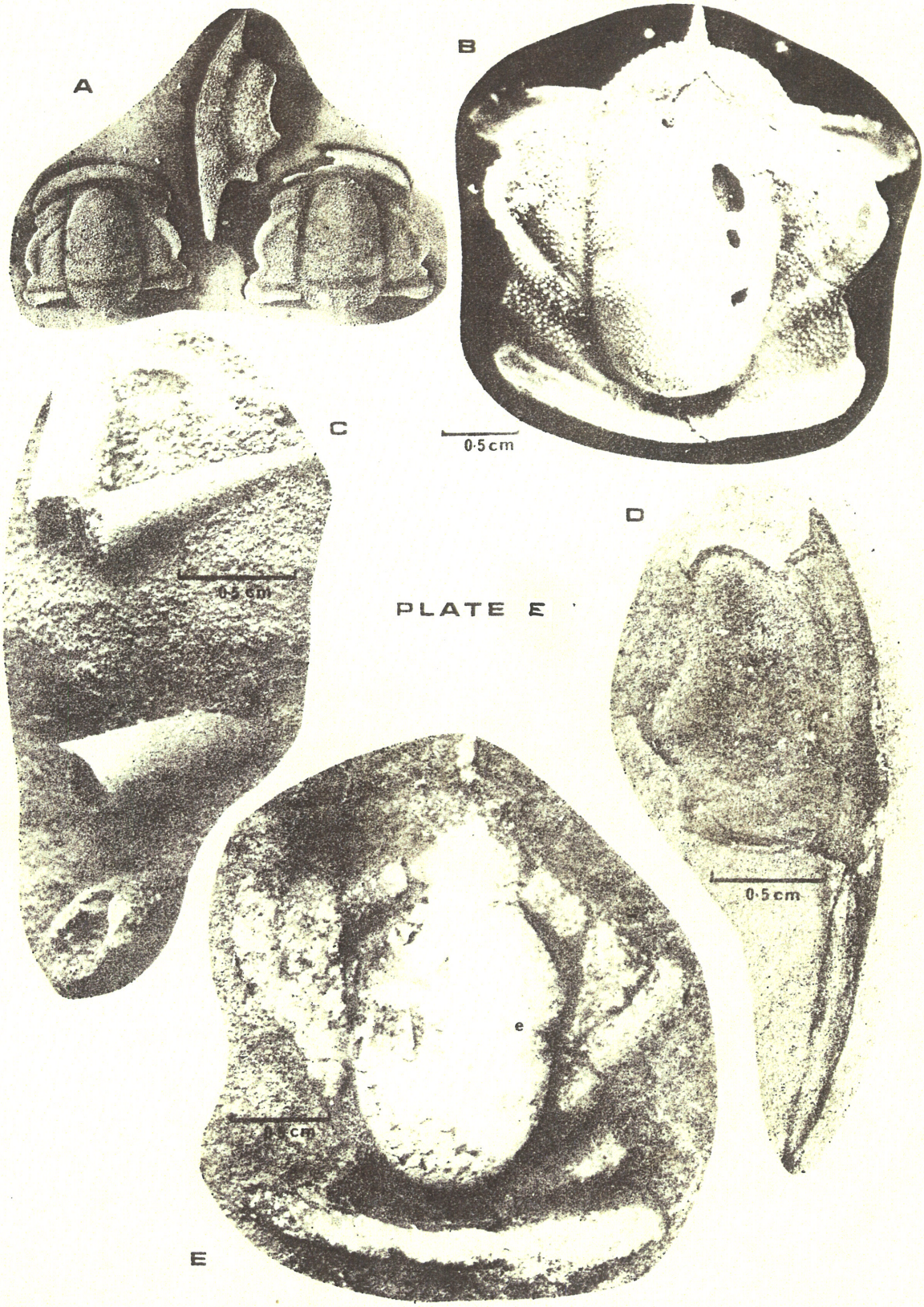


PLATE E