COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

RECORDS.

1961/147

SEDIMENTARY BASINS AND PALAEONTOLOGY SECTIONS

SUMMARY OF ACTIVITIES, 1961.

SEDIMENTARY BASINS AND PALAEONTOLOGY SECTIONS

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Records 1961/147

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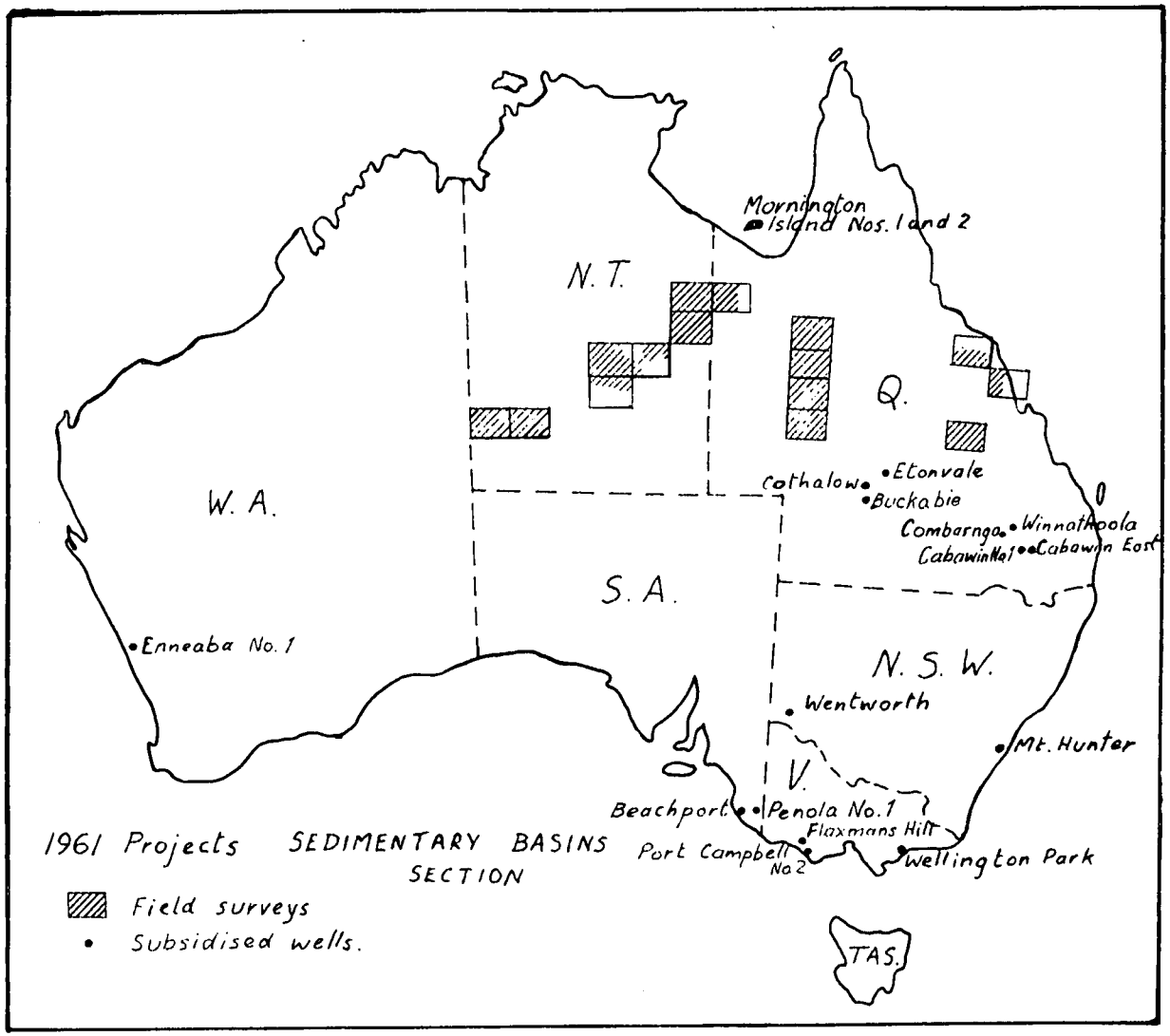

Mornington Island Nos. 1 and 2
N. T.
Q.
W. A.
Cathalow
Etonvale
Buckabie
Combarngo
Winnathoola
Cabawinnal
Cabawin East
S. A.
Enneaba No. 1
N. S. W.
Wentworth
Mt. Hunter
V.
Beachport
Penola No. 1
Flaxmans Hill
Port Campbell No 2
Wellington Park
TAS.
1961 Projects
SEDIMENTARY BASINS SECTION
Field surveys
Subsidised wells.

SUMMARY.

SEDIMENTARY BASINS SECTION.

Six field parties, with 15 geologists from the Bureau of Mineral Resources and 2 from the Queensland Geological Survey, worked in the areas shown in the map of Australia "1961 Projects, Sedimentary Basins Section"; field work continued from June until October 1961. Some of the geologists attended the meetings of A.N.Z.A.A.S. held in Brisbane at the end of May - early June.

Mapping in the Bowen Basin which was started in 1960 was continued in 1961. E.J. Malone, and later A.R. Jensen, led a party in parts of the Bowen and Mackay 4-mile Sheet areas; another party under J.J. Veevers worked in the Emerald 4-mile Sheet area.

The south-west part of the Georgina Basin (in the Northern Territory) was mapped by K.G. Smith and party; their work was in parts of the Alcoota, Barrow Creek and Elkedra 4-mile Sheet areas. Other work in the Georgina Basin was undertaken by M.A. Randal's party who covered the Ranken, Avon Downs areas and re-visited part of the Camooweal 4-mile Sheet area.

The Amadeus Basin party under A.T. Wells continued their 1960 mapping in Western Australia into the Northern Territory in 1961; the 4-mile Sheet areas covered were Mt. Rennie and Mt. Liebig.

SUBSIDY BORES.

Twelve bores have been completed in 1961 :

		total depth
Frome-Broken Hill	Port Campbell No.2	8846 feet
" " "	Flaxmans Hill	11528 "
Oil Development	Penola No.1	4985 "
Union-Kern-Australian Oil & Gas	Cabawin No.1	12035 "
" " " " " "	East No.1	12091 "
Delhi-Australia	Mornington Island No.1	2752 "
" " " "	No.2	3000 "
Phillips Petroleum	Buckabie	9070 "
" "	Cothalow	6010 "
Associated Australian Oilfields	Combarngo	5985 "
" " "	Winnathoola	5342 "
Australian Oil & Gas	Wentworth	2081 "

Wells which are currently being drilled under subsidy are :

		drilling at
Wapet	Eneabba No.1	12900 feet
Oil Development	Beachport No.1	3400 "
Phillips	Etonvale	6400 "
Australian Oil & Gas	Mt. Hunter	500 "
Woodside	Wellington Park	1000 "

NORTH-EAST BOWEN BASIN PARTY

by

E.J.Malone and A.R.Jensen.

The North-east Bowen Basin Party consisted of E.J. Malone, A.R. Jensen and C.M. Gregory of the Bureau of Mineral Resources, and V.R. Forbes of the Geological Survey of Queensland. E.J. Malone was party leader until the 8th September when he returned to Canberra; thereafter A.R. Jensen was party leader.

Field work commenced on 9th June and ceased on 8th October. The party mapped the southern half of the Bowen 4-mile Sheet area and the western third of the Mackay 4-mile Sheet area, so as to complete the map of the northern and north-eastern parts of the Bowen Basin and to establish the tectonic setting and control of the basin. The geology of these areas is shown on the accompanying sketch map and diagramatically illustrated by a series of graphic logs.

The oldest rocks known in the area are the Mt. Wyatt Beds, cropping out in the south-west portion of the Bowen 4-mile Sheet area. Twelve collections of fossils were made and these indicate a Middle Devonian age for this unit. It includes low grade metamorphic rocks, some showing an apparently high grade of structural deformation; these were previously thought to be Anakie Metamorphics.

The Upper Devonian Selheim Formation is a tuffaceous sandstone, sandstone, siltstone unit containing Cyrtospirifer cf. reidi, as well as abundant plant remains. The marine fossils indicate a high Upper Devonian Famennian horizon. The contact between this unit and the Mt. Wyatt Beds was faulted in the few places where observed. The fossils indicate a considerable time break between these two formations and they are probably separated by an unconformity.

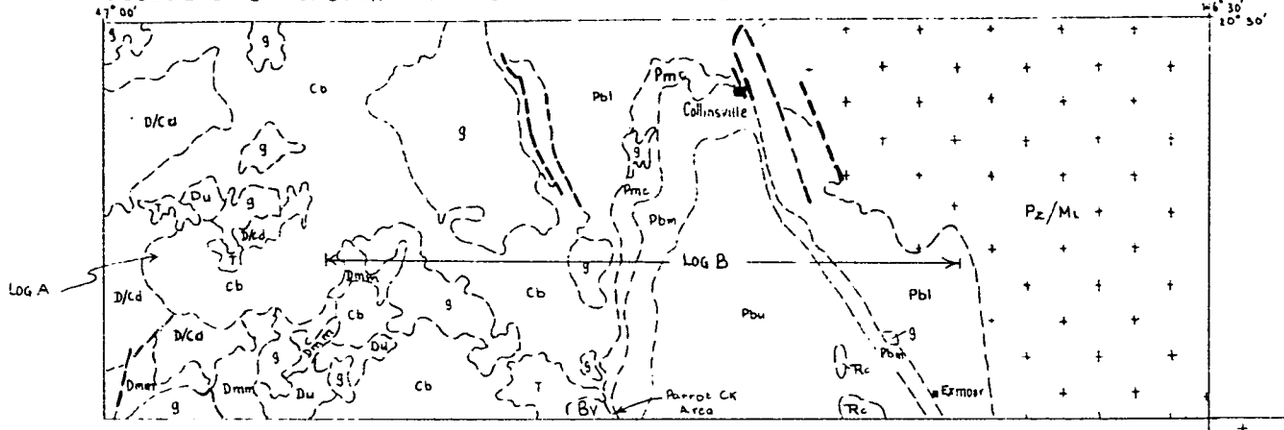
The Devonian-Carboniferous Drummond Beds in the west of the Bowen Sheet are unconformable on, or faulted against the Mt. Wyatt Beds. Their relation to the Selheim Formation is not known. They crop out in well defined, rather tightly folded structures whose axes curve around the Middle Devonian block.

The Bulgonunna Volcanics are unconformable on the Mt. Wyatt Beds, the Drummond Beds and presumably on the Selheim Formation. They form the basement to the western margin of the Bowen Basin and are unconformably overlain by the Permian Bowen Basin sequence.

The Lower Bowen Volcanics, the basal unit in the Bowen Basin, lenses out, or is being overlapped, to the south along the western margin of the basin. North-west of the basin, the volcanics are dominantly basalt and basaltic agglomerate with minor sediments. Around the northern end of the basin the unit includes a great thickness of conglomerate interbedded with sandstone, basic to intermediate flows and some acid flows and breccias. On the eastern margin of the basin it consists mainly of fine-grained sediments interbedded with intermediate volcanics.

Collinsville Coal Measures extend from Parrot Creek, in the south, to Collinsville in the north, on the western side of the basin. In the Parrot Creek area they rest unconformably on Bulgonunna Volcanics.

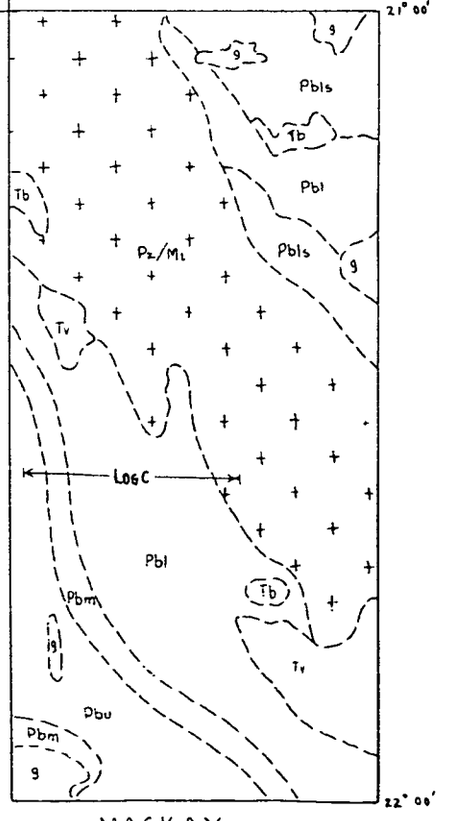
GEOLOGICAL SKETCH MAP OF PARTS OF THE BOWEN AND MACKAY FOUR MILE AREAS



BOWEN

Scale 1 1,000,000

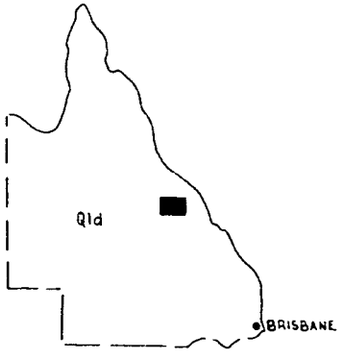
20 0 20 40 Miles



MACKAY

INDEX TO ADJOINING SHEETS

CHARTERS TOWERS	BOWEN	PROSERPINE
BUCHANAN	MT COOLON	MACKAY
GALILEE	CLERMONT	ST LAWRENCE



T Tertiary sediments

Tv Tertiary acid volcanics

Tb Tertiary basalt

Rc Triassic, Carborough Sandstone

Pbu Upper Bowen Sediments

Pbm Middle Bowen Beds

Pbl Lower Bowen Volcanics

Pbls Lower Bowen Sediments

Cb Bulgonunna Volcanics

D/Cd Drummond Beds

Du Saltheim Formation

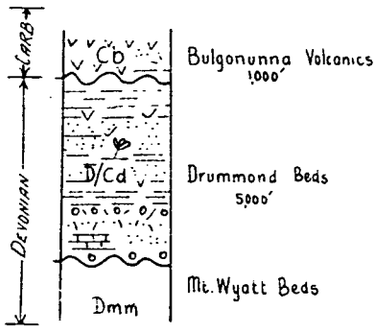
Dmm Mt. Wyatt Beds

Pz/Mt Eungella-Broken River Igneous Complex

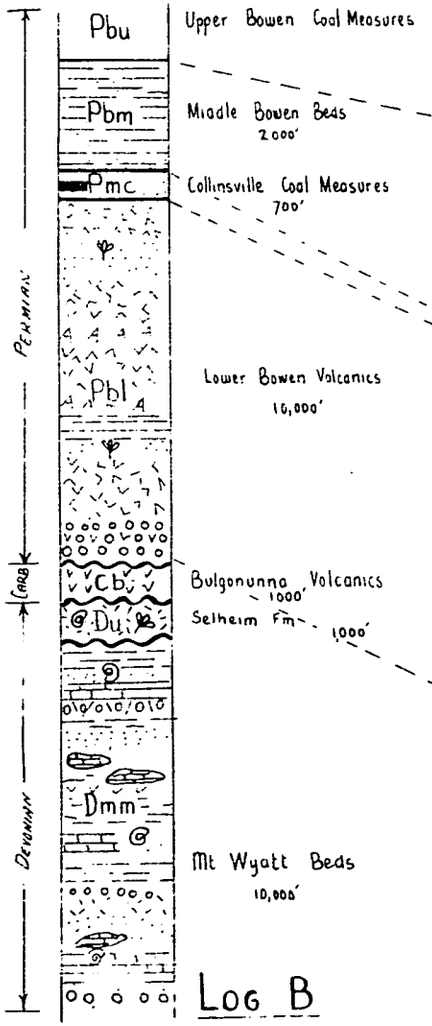
g Igneous intrusive

Graphic Logs for Northern Portion of Bowen Basin

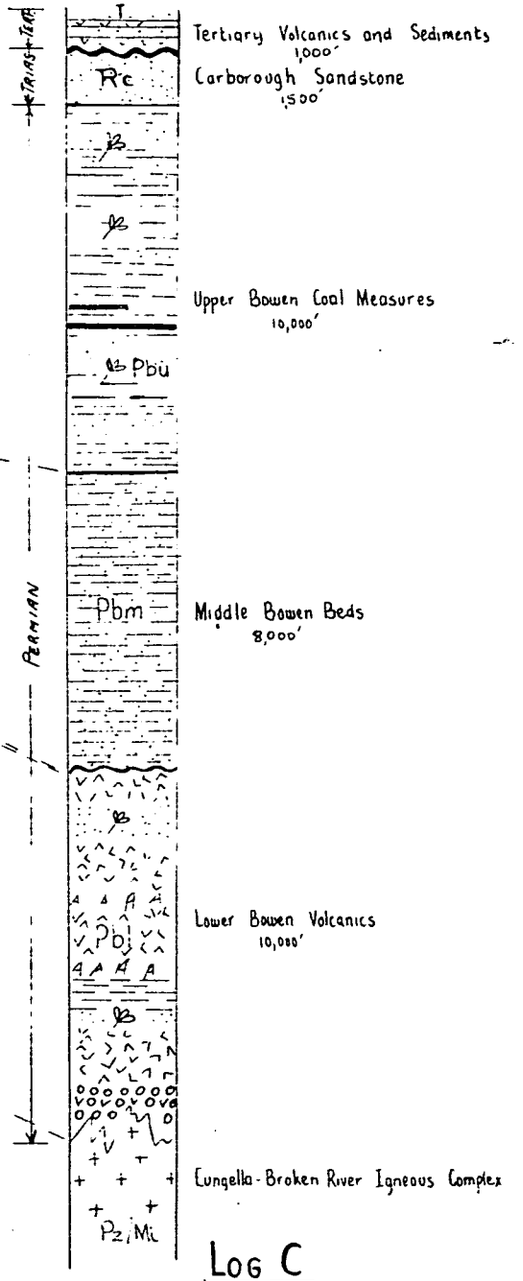
Scale 1" = 5,000 ft.



Log A



Log B



Log C

Middle Bowen Beds thicken from 2,000 feet, in the Exmoor region on the Bowen Sheet, to 8,000 feet on the Mackay Sheet. A stratigraphic section was measured at Exmoor and fossils collected within the section. Fossils were also collected from many other localities in the Middle Bowen Beds.

The Upper Bowen Coal Measures lie conformably on the Middle Bowen Beds. No new estimate of their thickness was made. The Triassic Carborough Sandstone appears to be quite conformable on the Upper Bowen Coal Measures.

The Eugella-Broken River Igneous Complex was traced from the Collinsville area to the southern portion of the Mackay Sheet.

Tertiary sediments and basalt crop out on the Bowen and Mackay Sheets. The Mackay Sheet also has extensive sheets of acid volcanics of Tertiary age.

EMERALD PARTY

by

F. Olgers and R.G. Mollan.

The party consisted of J.J. Veevers (party leader), R.G. Mollan, F. Olgers and G.A. Kirkegaard (Q.G.S.). Mapping of the Emerald 4-mile Sheet area began on 7th June and the party returned to Brisbane on 15th September.

The Anakie Inlier separates the Bowen and Drummond Basins and these three units are the main structural units of the area.

The Anakie Inlier.

The oldest rocks exposed in the area are sheared and folded schists of the Anakie Inlier. A strong unconformity exists between this unit and the adjacent Devonian-Carboniferous rocks in the Drummond Basin, and the Permian rocks in the Bowen Basin. The age of the schists is unknown other than that it is pre-Devonian. Pre-Devonian granitic intrusions (the Tomahawk Granite) also occur in the Anakie Inlier.

The Drummond Basin.

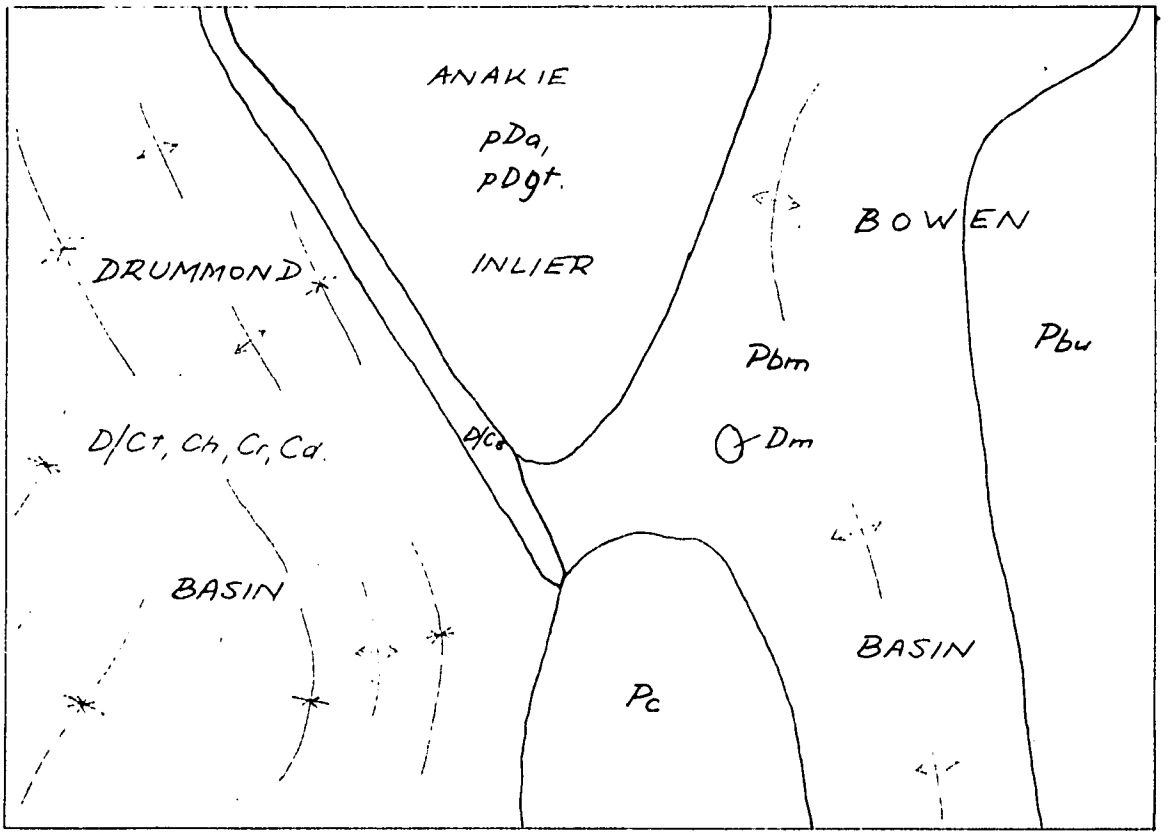
The eastern margin of the Drummond Basin as exposed now is marked by about 2000 feet of mainly acidic volcanic rocks, the Silver Hills Volcanics. Similar volcanic rocks containing a coralline Middle Devonian limestone found near Glendarriwell Homestead overlap on to the Anakie Inlier. Four other formations of mainly shallow freshwater sediments, approximately 13000 feet thick, lie above the Silver Hills Volcanics and overlap them in places. They consist of about 2500 feet of volcanically derived and tuffaceous, often coarse, sediments at the base (Telemon Formation), a lensing quartz conglomerate with a maximum thickness of 2500 feet (Mt. Hall Conglomerate) in the middle, and about 9000 feet of interbedded sandstone and multicoloured siltstone and mudstone in the upper part (Raymond Sandstone and Ducabrook Formation). The upper three formations are placed in the Carboniferous as a slight break in sedimentation was observed in places between the Mt. Hall Conglomerate and the underlying Devonian-Carboniferous Telemon Formation; Lower-Carboniferous plant remains occur in the Ducabrook Formation. Folding of the sediments has formed north-west trending structures, parallel with the basin margin.

In the south, the Drummond Basin Beds are unconformably overlain by a 200 feet thick horizontal sheet of barren pebbly sandstone (Colinlea Formation, equivalent to the Middle Bowen Beds in the Bowen Basin to the east).

The Bowen Basin.

The Permian sediments of the Bowen Basin are poorly exposed. The Middle Bowen Beds rest against the eastern edge of the Anakie Inlier and from seismic evidence are 8000 feet thick at Emerald. They consist of pebbly sandstone, sandstone and siltstone with some coal seams and plants, marine fossils and microfossils. The clarkei bed, which is about 3000 feet above the base of the Middle Bowen Beds, is exposed only in the northern part of the area.

PRE-TERTIARY GEOLOGY OF EMERALD SHEET AREA



Correlation of the sediments in the Middle Bowen Beds with formations of the Springsure Anticline in the Springsure 4-mile Sheet area to the south is difficult because of poor outcrop and lack of fossils. North-west trending structures, notably the Fernlees Anticline, have been produced by folding in the Middle Bowen Beds. The Upper Bowen Coal Measures, several thousand feet thick, cover a large area in the east, but outcrop is poor. The Permian beds have possibly been intruded by a small granitic stock near Capella.

Tertiary Volcanics.

Tertiary lavas cover a large area of the Sheet and trachytic plugs occur in the south-east. Many sapphire-bearing basalt plugs occur in the central part of the Sheet area and intrude the Anakie Inlier and beds of the Drummond Basin.

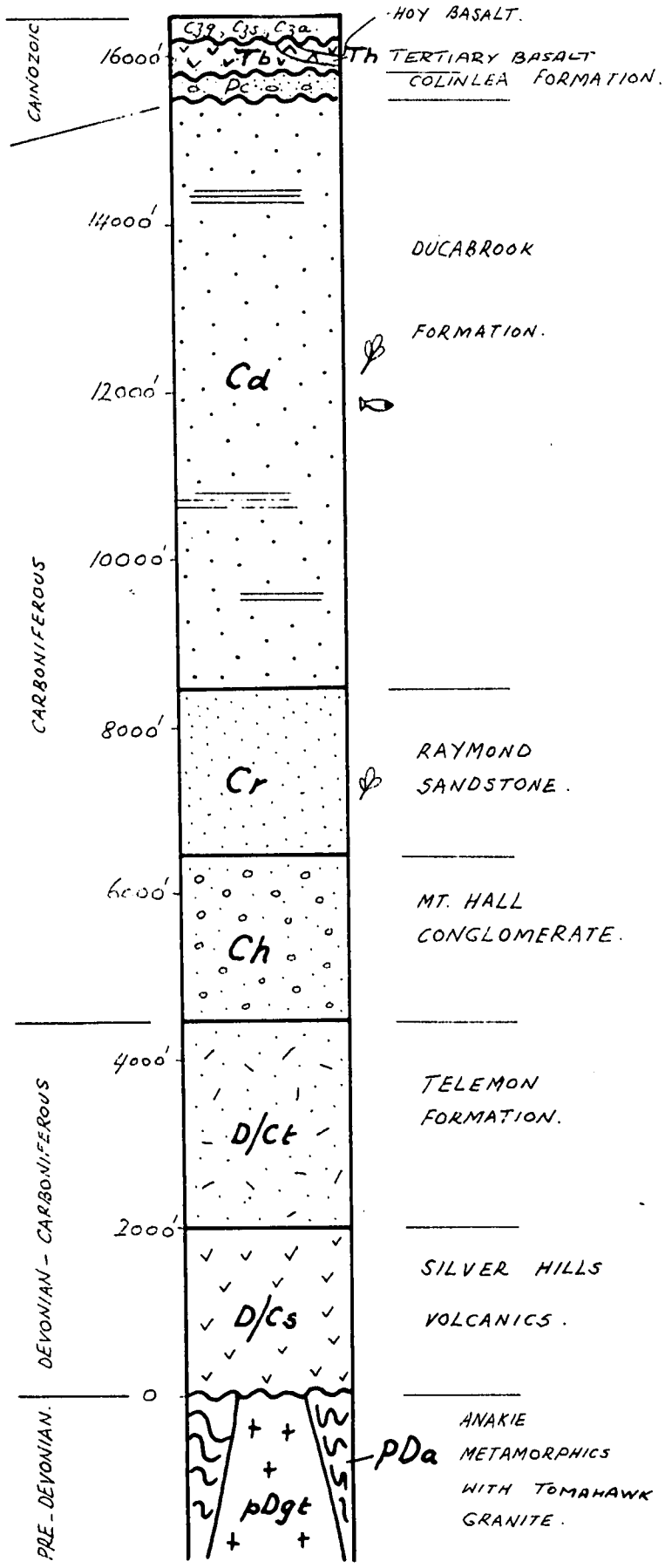
Superficial Deposits.

Cainozoic gravels occur in places especially just east of the Drummond Basin and contain sapphires in the Rubyvale area derived from the plugs and lavas. Black soil covers large areas of the Tertiary lavas, and soil and gravel cover is thick over the Upper Bowen Coal Measures.

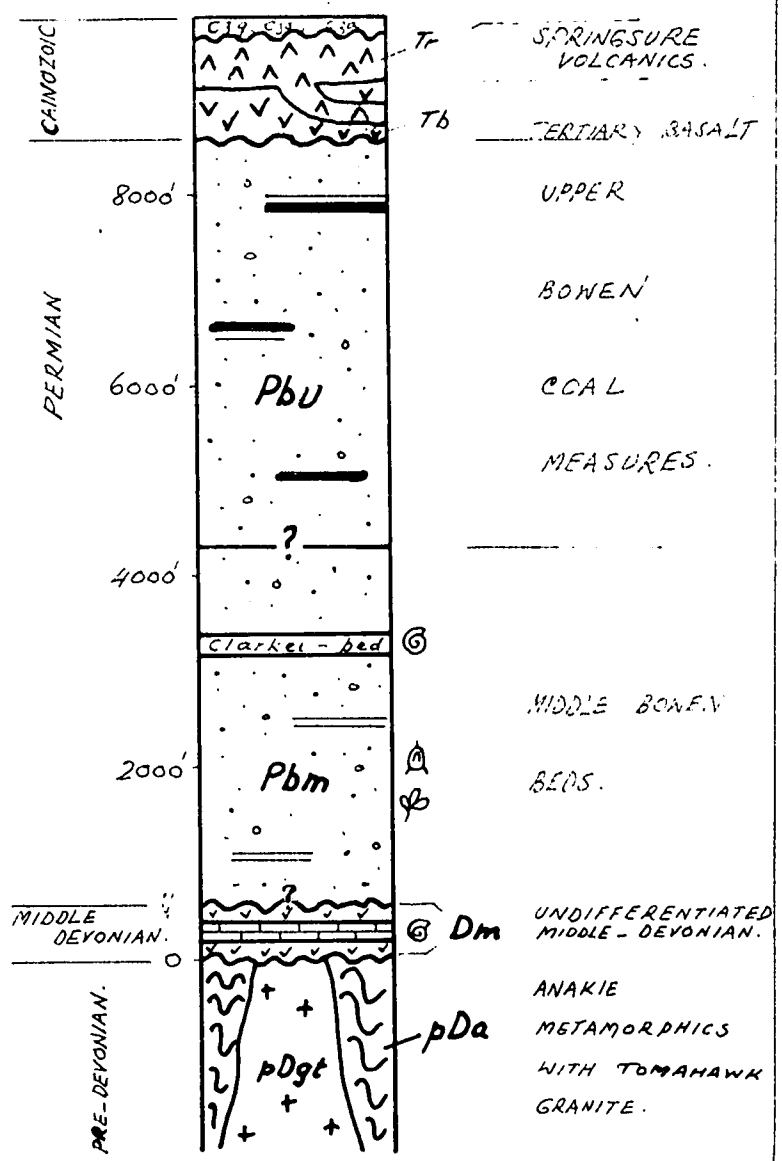
STRATIGRAPHIC COLUMNS.

EMERALD 4-MILE.

DRUMMOND BASIN.



BOWEN BASIN.



SANDOVER RIVER PARTY.

Summary of Activities, 1961 Field Season.

Personnel : K.G. Smith, E.N. Milligan.

Visitors: J.N. Casey (B.M.R.) 2/8/61 - 3/8/61.
K.K. Hughes (New Consolidated Goldfields Aust.Ltd) 19/8/61 - 20/8/61.

Duration of Field Work : 5/6/61 - 6/10/61.

Area Mapped : parts of each of Alcoota, Barrow Creek and Elkedra 1 : 250,000 Sheets. These areas are shown in Fig.1, which shows also the adjoining areas previously mapped by this party, in the Northern Territory part of the Georgina Basin.

The mapping of Barrow Creek and Elkedra Sheets has now been completed and all parts of the Alcoota Sheet relating to the Georgina Basin have been mapped.

Geology : The general geology of the area mapped and that of part of the adjoining Huckitta Sheet, is shown in Fig. 2. Some stratigraphic units continue from Huckitta to the other Sheets and the following Stratigraphic Table shows the units of all four Sheets. (see page 7).

Dr. A.A. Öpik and Miss J. Gilbert-Tomlinson have made a preliminary examination of fossils collected by the party. New information resulting from this examination and from the field mapping is :

(1) Sample B.C.3, obtained about 15 miles south-east of Barrow Creek settlement contains one specimen of the Lower Cambrian fossil, Helcionella. The sample was collected near the top of a sequence of glauconitic, thin bedded quartz sandstone, and siltstone, with numerous worm trails and ?organic markings. This sequence is identical with the Grant Bluff Formation and it conformably overlies a sequence of red arkose, red greywacke and red siltstone which has been deposited unconformably on the surface of Precambrian granite, gneiss and schist. Because the stratigraphical position of this Helcionella in the Lower Cambrian is indefinite, and because no fossils have been found elsewhere in the Grant Bluff Formation, it is unknown whether all of the Grant Bluff Formation may be of Lower Cambrian age, or whether the deposition of sediments similar to those of this formation continued from Upper Proterozoic into Lower Cambrian time.

(2) No sediments of Middle Cambrian age, or of the lower part of the Upper Cambrian, have been mapped on the Alcoota and Barrow Creek Sheets. In the western part of the Huckitta Sheet, a sand-covered area, about four miles wide occurs between the Grant Bluff Formation and Upper Cambrian sandstone of the Tomahawk Beds; this strip of sand cover extends north-west to Utopia Homestead, on the Alcoota Sheet, but

it decreases in width until, at its north-western extremity, the Tomahawk Beds unconformably overlie red Upper Proterozoic sediments which are older than the Grant Bluff Formation.

(3) Upper Cambrian sediments occur in the Tomahawk Beds on each of Alcoota, Barrow Creek and Elkedra Sheets, but Ordovician sediments have been found, in these Beds, only on the Alcoota Sheet. On Alcoota, Barrow Creek and Elkedra, The Tomahawk Beds are predominantly sandstone; in most cases the proportion of dolomite does not exceed 2%.

Information from surface mapping and from examination of bore logs indicates that the Upper Cambrian Sandstone has transgressed the lower Middle Cambrian Sandover Beds and has overlapped on to the Hatches Creek Group (Lower Proterozoic). The party has been unable to find fossils in outcrops of quartz sandstone and siltstone to the south-east of Murray Downs Homestead, but these outcrops are believed to be of Upper Cambrian age because of lithological similarity to fossiliferous Upper Cambrian sediments farther south.

(4) Samples B.C.1 and B.C.7 (Barrow Creek Sheet) from the Dulcie Sandstone contain fossil fish of Middle Devonian age (A.A. Opik, pers. comm.). The samples were obtained from clean, friable cross-bedded quartz sandstone which crops out in small mesas. The maximum thickness measured is 175 feet, but in the main mass of the Dulcie Sandstone a thickness of 1425 feet was measured at a locality about 12 miles west of the Sandover River. The party cannot be certain that the Middle Devonian Sandstone is in continuous sequence with the Upper Devonian sequence of the Dulcie Range, (Upper Devonian fish were located (1958) 1300 feet above the base of a section 2100 feet thick in the Dulcie Range near Huckitta Homestead).

(5) A sequence of carbonate rocks with interbeds of clean quartz sandstone extends for some 40 miles south-west of Annitowa Homestead. This unit is about 300 feet thick, and logs of water bores show up to 360 feet (apparent) of carbonate rocks beneath it. No fossils have been found in outcrops and therefore the age is unknown. For the present the age of the unit is regarded as Upper Cambrian, (Smith, Vine and Milligan in Bur.Min.Resour.Aust.Record 1961/50).

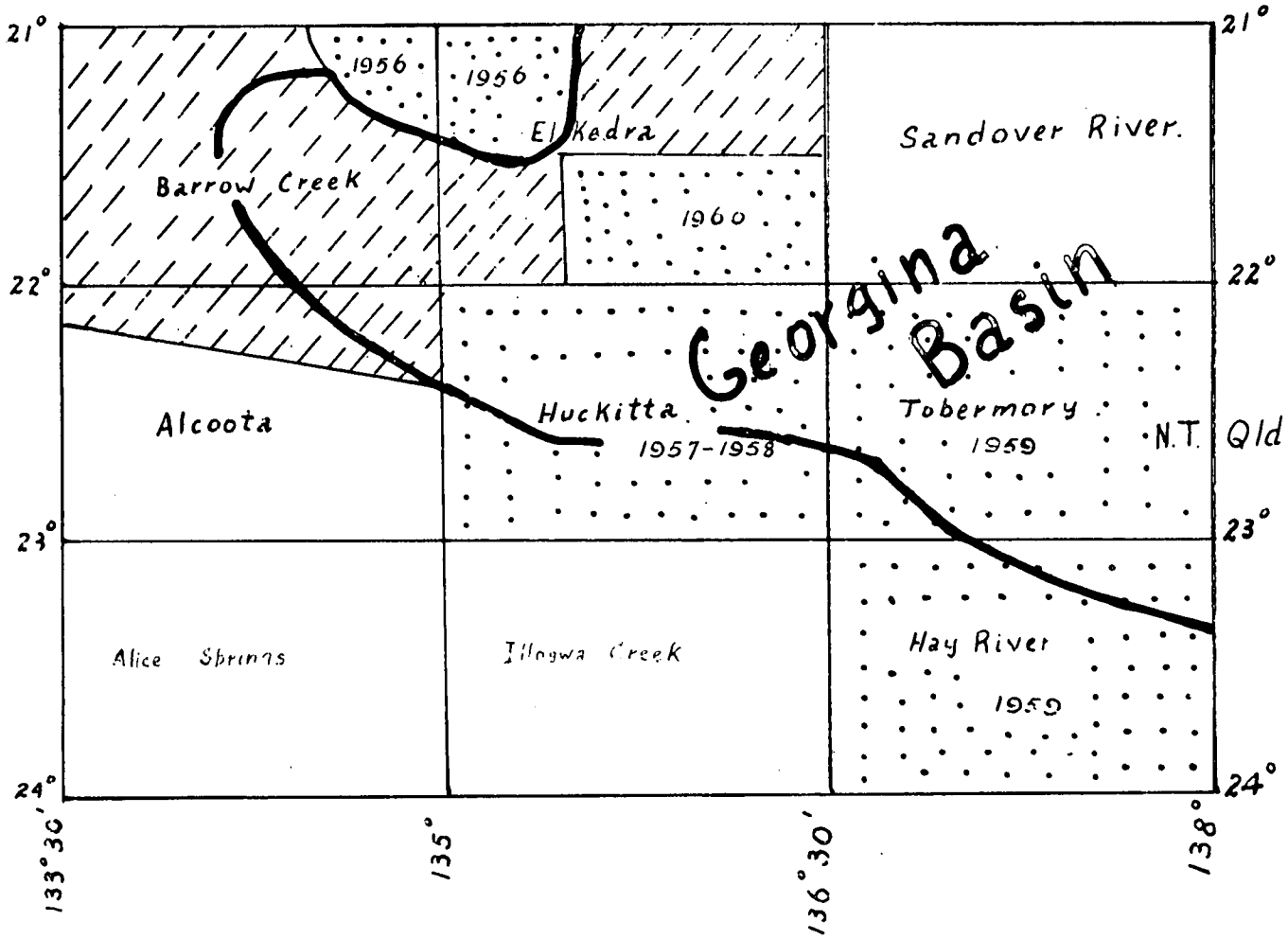
Miscellaneous.

Underground Water - Six bore sites were selected for pastoralists in the party's working area. Five sites selected previously by the party were drilled during 1961 and four of them were successful. At least two more will be drilled before the end of the year and arrangements have been made to obtain logs of them.

Gidyea Survey - K.G. Smith accompanied officers of the Animal Industry Branch, N.T.A., and of Soils Division, C.S.I.R.O., on a sampling programme which was designed to test a theory that all toxic gidyea in Northern Territory grows in areas underlain by carbonate rocks of Upper Cambrian and Lower Ordovician ages. Analyses of the rock, soil and leaf samples collected are not yet available.

Fig 1.

Western Margin of Georgina Basin, and Areas Mapped.



Reference:

Approximate margin of Georgina Basin.

Area mapped 1961.

Area mapped previously.

Fig. 2

Western Marginal Area of Georgina Basin

BARROW CREEK

ELKEDRA

ALCOOTA

HUCKITTA

21°00'

22°00'

23°00'

133°30'

135°00'

135°30'

Qrs
Precambrian metamorphic rocks.

Scattered outcrops of Precambrian metamorphic rocks

Precambrian granite metamorphic rocks.

Precambrian metamorphic rocks.

Barrow Creek
Stirling
Home of Bullion
Murray Downs
Elkedra
Shady Bore
Ammaroo
Dingley Bore
Sandover River
Lake Nash
Annitowa
Bore (405') (in limestone)
Chert
Elkedra River
carbonate rocks
Cherry Ck
?Eu sandstone
?Eu carbonate rocks.
Woolla Downs
Harper Springs
Mt. Skinner
Woodgreen
Utopia
Delmore
Delny
Alice Springs
STUART HIGHWAY
New Bore
Eu glacials
Burdey River
Derry Downs
New Maddonald Downs.
Dud
HBO
Quratibbra
Quratibbra Creek
Tomahawk Creek

Scale 1" = 16 miles (approx)

Reference

- Strike and direction of dip of sediments.
- Homestead
- Road
- Water Bore (with depth where recorded)
- BC1 Fossil Locality.

	Qrs	Sand, soil.
Devonian	Dm-Du	Dulcie Sandstone
Lower Ordovician / Upper Cambrian	€u-Ol	Tomahawk Beds
Upper Cambrian	€ma	Arrinthrunga Formation.
Middle Cambrian	€m	Sandover Beds (€ms); Arthur Creek Beds (€ma)
Lower Cambrian	€lb	Mt Baldwin Formation.
Lower Cambrian	Pu-H	Glauconitic sandstone; siltstone, dolomite [Grant Bluff Formation]
Upper Proterozoic / Upper Proterozoic	Pu	Glacial Sediments (125') and red greywacke, siltstone, sandstone (1000', un-named)
Lower Proterozoic	Plh	Hatches Creek Group (20,000')
	Pgr	Granite
Precambrian Undifferentiated.		Undifferentiated metamorphic rocks.

Note. The numerous outcrops of Tertiary sediments have been omitted, for clarity.

RANKEN PARTY

Summary of Activities, 1961.

by

M.A.Randal and G.A.Brown.

During 1961 M.A. Randal and G.A. Brown mapped the Avon Downs, Ranken, and re-examined a part of the Camooweal 4-mile Sheet areas in the north-eastern part of the Georgina Basin. The area forms the eastern part of the Barkly Tableland and for the most part consists of black soil plains covered by Mitchell grass and containing few rock outcrops. In the Camooweal Sheet area, the dissected edge of the Tableland contains numerous rocky watercourses and steep gorges. The western part of the Avon Downs 4-mile Sheet area consists of a large "desert area" which extends onto the adjacent Sandover, Elkedra and Frew River 4-mile Sheet areas. In this desert, which contains no watercourses and few hills, the mapping was done by means of a helicopter which was attached to the airborne gravity party at Ooratippra. Four north-south traverse lines spaced at fifteen mile intervals were flown over a period of two days. Because of the lack of outcrop and poor aerial photographs available little information was obtained in the desert country.

During the survey the logs for nearly 150 water bores were obtained. However not all logs contain the driller's description of rock types. A number of bores were drilled whilst the party was in the field and chip samples were obtained.

A resume of the geology of the area is given below.

CAMOOWEAL SHEET

An examination of the Lower Palaeozoic carbonate sequence in the Morstone area was undertaken in an attempt to clarify the relationship of both the Camooweal Dolomite and the Mailchange Limestone with the Age Creek Formation, and to obtain additional information on their lithologies.

Camooweal Dolomite: this unit, as shown on the current Camooweal 4-mile geological map, extends from west of Morstone Homestead onto the adjoining Ranken 4-mile Sheet area; to the north it extends onto the Lawn Hill and Mt. Drummond 4-mile Sheet areas and to the south, beyond Camooweal onto the Mt. Isa and Avon Downs 4-mile Sheet areas.

The main lithology of the Camooweal Dolomite is a crystalline dolomite, in part friable and cavernous, with some beds of dense hard brown dolomite. Chert nodules and bands are common. Bedding ranges from medium to very thick. In the vicinity of George Creek and Goonooma Creek interbeds of medium pellet dolomite occur in medium and thick bedded crystalline dolomite.

The total thickness of Camooweal Dolomite is not known; west of New Norfolk, 120 feet has been measured. No fossils have been found in the Camooweal Dolomite; however, a fragment of a trilobite in a piece of chert was found near Frith Creek amongst scree which appears to come from the Camooweal Dolomite. The relationship between the Camooweal Dolomite and the Age Creek Formation is discussed later.

The Camooweal Dolomite is mainly flat-lying, but in sections in Goonooma Creek it dips at shallow angles to the west.

Age Creek Formation: this formation crops out as rugged karst topography consisting mainly of pellet dolomite (dolarenite) with some crystalline dolomite and pellet dolomite containing rounded quartz grains. Oolitic pellet dolomite is also present: chert bands and nodules are rare. Some fossils were found in interbeds in the Age Creek Formation during the present survey, and Öpik (1954) has listed fossils of Middle Cambrian age which were found during the 1953 survey.

Sections measured in Ada Creek and its tributaries show the thickness to be greater than 4,000 feet. In sections elsewhere the prevalence of cross bedding prevents an accurate appraisal of the thickness.

The Age Creek Formation appears to interfinger with rocks which have previously been regarded as Camooweal Dolomite in Ada Creek, west of Marion Bore, in Marion Creek, north of Marion Bore, in Frith Creek and in Labortion Creek, in the Morstone area. The interfingering of sediments along Ada and Marion Creeks involves the upper beds of the Age Creek Formation. It therefore appears that the rocks previously regarded as Camooweal Dolomite in this area are in part younger than Age Creek Formation.

A lithologic boundary can be traced from near Morstone Homestead southwards to Labortion Creek. Its position approximates that of the boundary between the Camooweal Dolomite and the Age Creek Formation as shown on the current geological map. East of the boundary the rocks are pellet dolomite; near the boundary pellet dolomite occurs as lenses within a crystalline dolonite. West of the boundary the rock type is a strongly cross-bedded white or mottled porous crystalline dolomite, and is similar to rocks elsewhere called Camooweal Dolomite.

In the upper reaches of Argus Creek cross beds are developed in pellet dolomite which has low rolls and may dip at low angles to the south and south-west. Between Corkwood Creek and Stoney Creek outcrops of medium-bedded pellet dolomite appear to dip 10° to the east, but the underlying marly limestone of "Mailchange-type" lithology and dolomite dips south-east to south at angles less than 2°. This suggests the strong development of cross beds in the pellet dolomite lithologies of the upper sequence, and, together with the occurrence of collapsed karst-formed outcrops, makes uncertain the validity of measured dips in isolated outcrops of the pellet dolomites.

In Stoney Creek, marly limestone is interbedded with pellet dolomite identical to that of the Age Creek Formation. Similar relationships are seen elsewhere in the Morstone area.

It seems that there is a transition from east to west from limestone to dolomite facies. However, because of lack of outcrop the extent of this relationship is uncertain away from the Morstone area.

RANKEN SHEET

On the Ranken Sheet, stratigraphic information is obtained with difficulty due to the paucity of outcrop and the lack of exposed contacts. Large areas of the Sheet are covered with black soil and sand, with floaters of dolomite, and gravel containing chert, with rare sandstone and pisolitic ironstone pebbles. Many structures which have been photo-interpreted are not visible on the ground.

South of Alexandria Homestead, medium-grained quartz sandstone crops out as a low rubble covered ridge. The rock is similar to the Upper Proterozoic Mittiebah Sandstone which crops out extensively to the north on the Mt. Drummond 4-mile Sheet area. The outcrop appears to be an anticline off which Cambrian sediments are dipping. In this area the Cambrian rocks are fossiliferous shale, mudstone, limestone and chert. Very few original outcrops are preserved - the rocks are mainly found as scattered silicified scree on low rises or as boulders in watercourses.

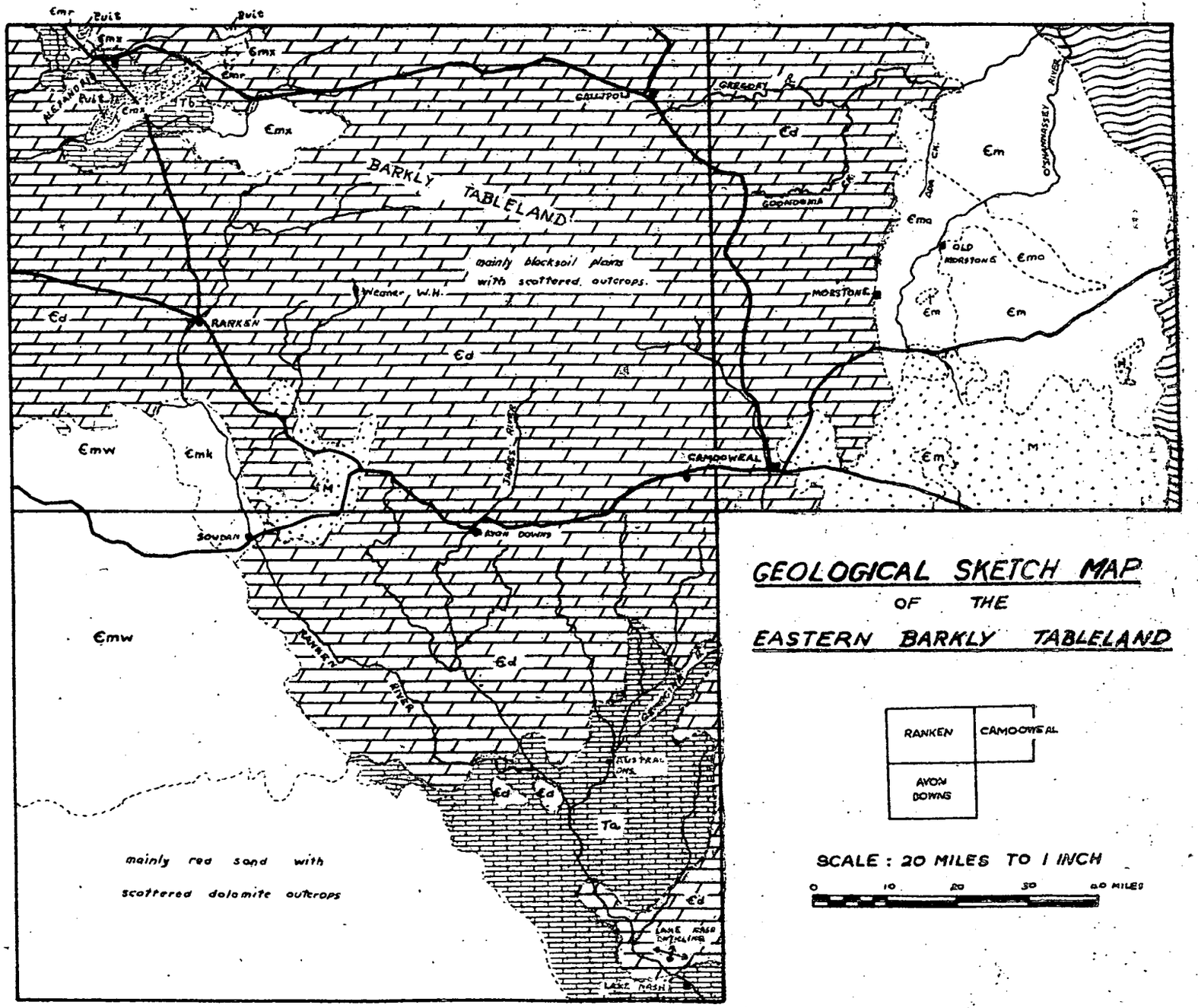
In the south-western part of the Ranken Sheet area low hills are covered by a loose scree of chert, siliceous shale and limestone. The rocks, which are known as the Middle Cambrian Wonarah Beds, are deeply lateritised; a hard capping of billy (silicified mottled zone) has preserved these hills from more complete erosion. No reliable regional dips have been observed in these rocks, and consequently their field relationship with the Ranken Limestone to the east cannot be evaluated with certainty. Fossil evidence, however, suggests that the Ranken Limestone is the older unit.

In the eastern part of the Ranken 4-mile Sheet area outcrops of a white cavernous crystalline dolomite occur as scattered blocks and boulders. The dolomite contains chert nodules and bands and is similar to the dolomite rocks near Camooweal; no fossils have been found in these outcrops. However, on Lorne Creek, chert nodules in a coarsely crystalline speckled dolomite contain abundant remains of hyolithids and fragments of brachiopods and trilobites. Hyolithids have been found in a similar lithology near Weaner Waterhole. The relationship between this outcrop and the surrounding Camooweal Dolomite is obscure. No reliable dips have been measured in the Camooweal Dolomite in this Sheet area, except near Gallipoli Homestead where the rocks are horizontal.

(?)Tertiary limestone and gypsum deposits occur as a thin veneer over much of the western part of the Sheet area. The limestone is similar to the Austral Downs Limestone on the Avon Downs Sheet area, and is probably a continuation of the Brunette Limestone described by Noakes and Traves (1954).

AVON DOWNS SHEET

This area is immediately south of the Ranken Sheet area and contains in the northern parts, outcrops of the Wonarah Beds, the Ranken Limestone and the Camooweal Dolomite. The "Camooweal Dolomite" lithology extends over the entire eastern portion of the Sheet area; it is in places overlain by a white nodular limestone - Austral Downs Limestone - which previous workers consider to be of Tertiary age.



GEOLOGICAL SKETCH MAP
OF THE
EASTERN BARKLY TABLELAND

SCALE : 20 MILES TO 1 INCH

0 10 20 30 40 MILES

Reference.

TERTIARY

Ta — AUSTRAL DOWNS LIMESTONE

Tb — BRUNETTE LIMESTONE

MESOZOIC

M — UNDIFFERENTIATED

MIDDLE CAMBRIAN

Em — UNDIFFERENTIATED

Ema — AGE CREEK FORMATION

Emr — BURTON BEDS

Emx — ALEXANDRIA BEDS

Emw — WONARAH BEDS

Emk — RANKEN LIMESTONE

CAMBRIAN

Ed — CAMOOWEAL DOLOMITE

UPPER PROTEROZOIC

Puit — MITTIEBAH SANDSTONE

PRECAMBRIAN

UNDIFFERENTIATED

In the south-east of the area outcrops of crystalline dolomite, with cherts and minor interbeds of pellet dolomite are folded into a shallow anticline (Lake Nash Anticline) elongated east - west.

The central, western, and south-western parts of the area are covered by sandy desert country with spinifex and mallee type scrub with only occasional outcrops of white hard crystalline dolomite.

REFERENCES

NOAKES, L.C. and TRAVES, D.M., 1954 : Outline of the Geology of the Barkly region, in Survey of the Barkly Region, Northern Territory and Queensland, 1947-48, C.S.I.R.O. Land Research Series No.3.

"
ÖPIK, A.A., 1954 : Cambrian stratigraphy of the Camooweal Region, Bur.Min.Resour.Aust.Rec. 1954/31.

GREAT ARTESIAN BASIN

Summary of Activities - 1961

by
R.R. Vine.

Reports covering the area mapped during 1960 were completed by M.A. Reynolds, F. Olgers and W. Jauncey during the early part of the year.

For the 1961 field season the party consisted of R.R.Vine and W. Jauncey, with I.Chertok (Drafting Assistant). Four months were spent in the field, from 7th June until 13th October. During this time reconnaissance mapping was carried out along the western margin of the Basin on four 4-mile Sheets - Brighton Downs, Mackunda, McKinley and Julia Creek.

The geology of the area mapped is shown on the accompanying sketch map and graphic logs. The main results of the year's mapping are given below.

Cretaceous

The Toolebuc Limestone was traced northwards from the type area on the Boulia 4-mile Sheet across the McKinley and Julia Creek Sheets, roughly parallel to the present western margin of the basin. It also outcrops as a structurally controlled ridge in the north and centre of the Julia Creek area, and over large areas in the north-east of the Sheet. From there it appears to be continuing eastwards and southwards roughly parallel to the eastern margin of the basin.

A major problem of the year's mapping was the boundary between the marine beds of the Upper Wilgunya (=Tambo) Formation, and the non-marine beds of the Winton Formation. This is not a simple and fairly sharp change, but consists of a transition zone of the order of 300 feet thick. The transition beds are very thinly interbedded sandstone and siltstone with some laminae of plant fragments and some shelly horizons.

The Longsight Sandstone and most of the lower Wilgunya (=Roma) Formation were not seen in outcrop. They are probably present, but covered by later sand or alluvium, in the north-east and south-west of the Julia Creek area and in the west of the McKinley area.

Tertiary

Rocks of presumed Tertiary age were mapped in three separate basins. The general successions are shown on the attached graphic logs.

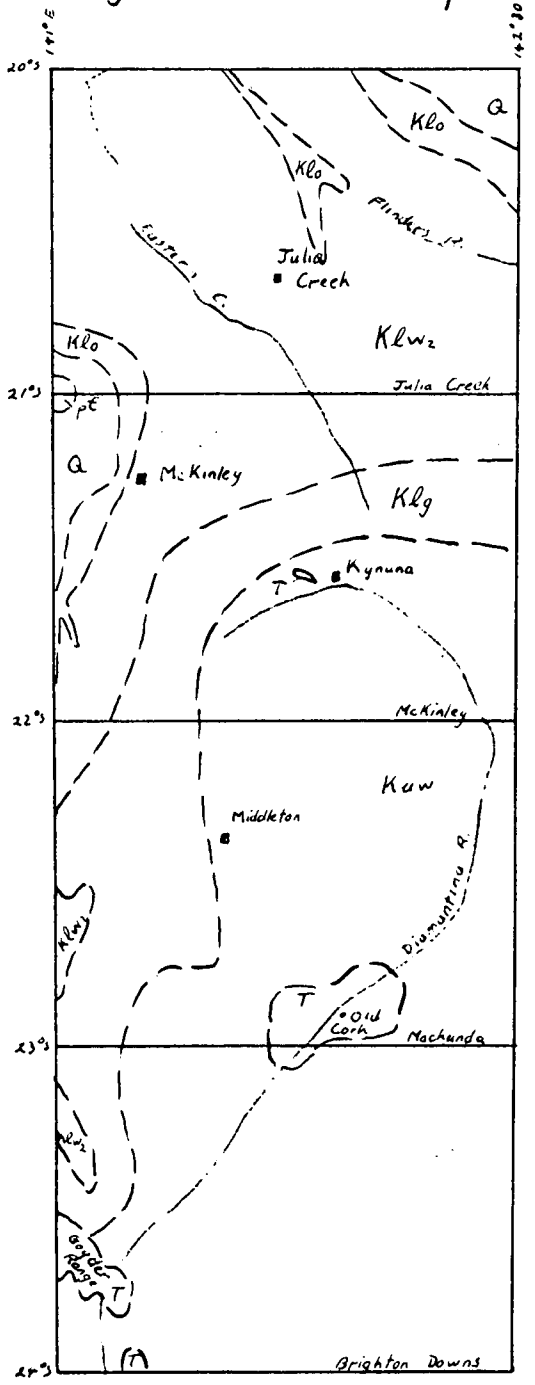
The most southerly, the Springvale Basin, was named and described by Paten after mapping of the Springvale 4-mile Sheet by the Great Artesian Basin Party in 1959. Only the most easterly part of the basin is within the area of the Brighton Downs Sheet. A sandstone unit, not previously recorded in the Springvale Basin, forms the Goyder Range and may be a basal lateral variation of part of the Springvale Formation.

Along the Diamantina River, in the Old Cork area, is a sequence similar to that of the Goyder Range area. There is no evidence of continuity of outcrop or deposition between the two areas, and the deposits of the Old Cork area are regarded as having been laid down in a separate basin. The eastern edge of this basin is at the Mueller Range; there the top limestone unit is missing and a thin sandstone grading laterally into conglomerate overlies the clay unit with slight disconformity.

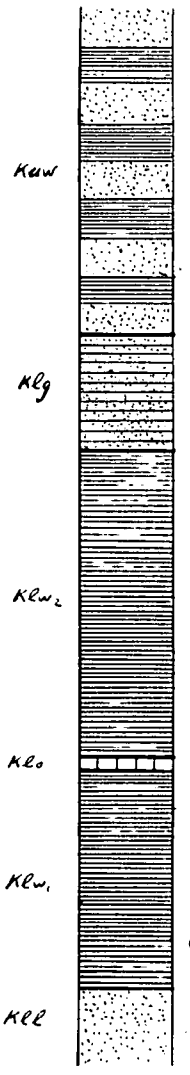
Some hills west of Kynuna are capped by a sequence of conglomerate, sandstone and sandy siltstone, resting unconformably on Winton sediments. This sequence is probably of Tertiary age.

Great Artesian Basin Party - 1961

Geological Sketch Map



Graphic Log of Cretaceous Units



Kuw — Winton Formation — 700'

Klg — Transition Beds — 200' - 400'

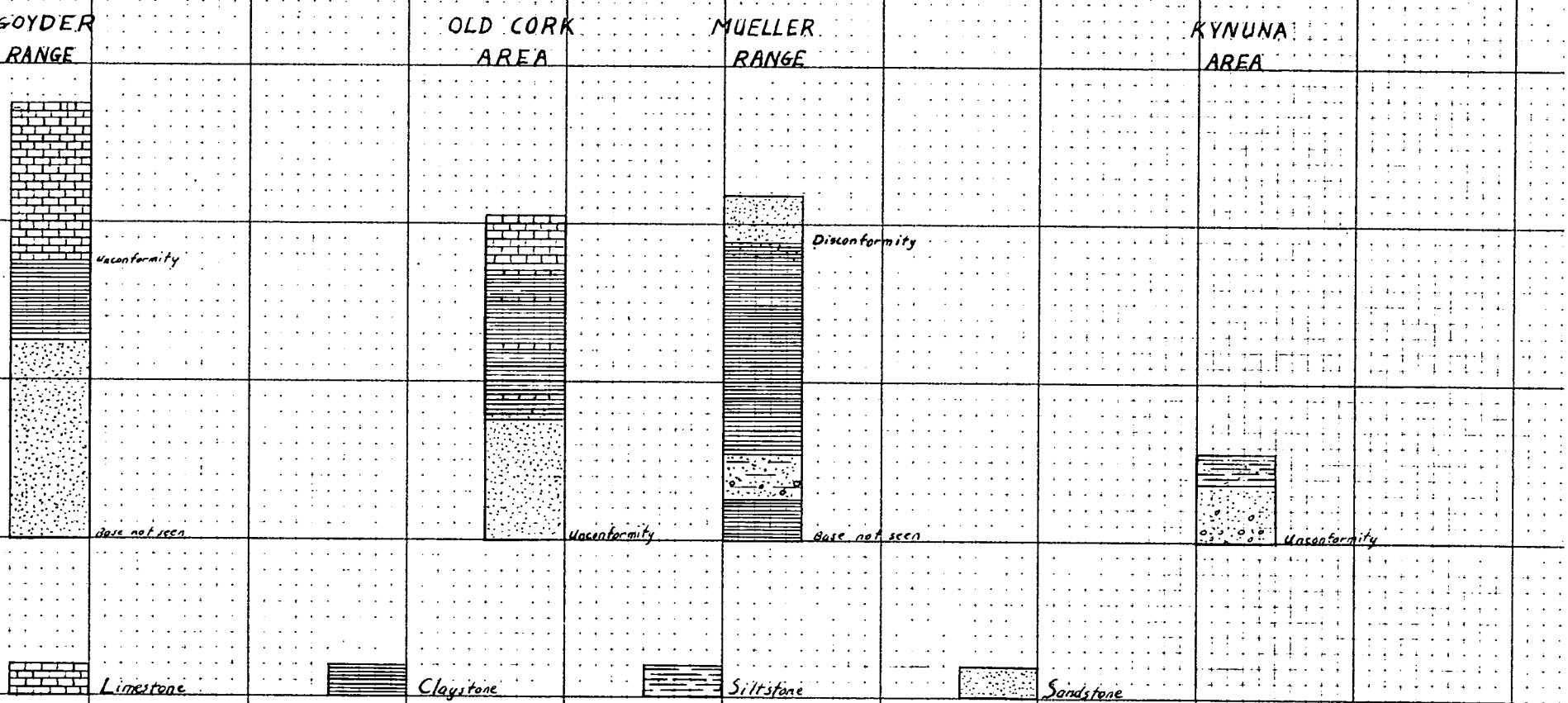
Klw2 — Upper Wilgunya Formation (≡ Tambo Formation) — 600' - 800'

Klo — Tookebuc Limestone — 30'

Klw1 — Lower Wilgunya Formation (≡ Roma Formation) — 400' - 600' (Oily top seen in outcrop)

Kll — Longsight Sandstone (Not seen in outcrop)

Generalised Tertiary Sections



Vertical scale 1" : 40'

Opal

Occurrences of precious opal are widespread throughout the southern half of the area. Opalisation of gem grade appears to be confined to the Winton Formation, as now restricted, and related to the pallid zone of lateritisation.

AMADEUS BASIN

Summary of Activities - 1961

by

A.T. Wells.

The two 1 : 250,000 Sheets covered by the Amadeus Basin party from May to October 1961 are Mt. Rennie (F/52-15) and Mt. Liebig (F/52-16) in the Northern Territory. The party consisted of A.T. Wells, D.J. Forman and L.C. Ranford. The purpose of the geological reconnaissance of the Mt. Liebig and Mt. Rennie Sheet areas was primarily to map the Palaeozoic sediments of the Amadeus Geosyncline and determine the north-western limits of sedimentation.

In 1960, the western limit of the Amadeus Geosyncline was mapped in Western Australia on the Rawlinson and Macdonald Sheet areas. On these two Sheets the only evidence of fossiliferous Palaeozoic sediments are two isolated outcrops of Ordovician limestone which are correlated with the Orthis leviensis beds (Stokes Formation) of the MacDonnell Range area. The bulk of the sediments of the Rawlinson-Macdonald Sheet areas were thought to be probably Precambrian in age but revisions of this concept are now necessary after the mapping carried out this year.

Precambrian sediments and metamorphics crop out on the northern halves of the Mt. Rennie and Mt. Liebig areas. The metamorphics are part of the Archaean Arunta Complex and are made up mainly of quartzite, gneissic granite, granitic gneiss, amphibolite and schists. The Archaean quartzite forms several prominant ridges and ranges on the northern part of the Mt. Liebig area and has been confused by previous authors with equally prominant neighbouring ridges of Upper Proterozoic Heavitree Quartzite. The Archaean quartzite can be distinguished by its prominant lineation and foliation and from the fact that it is intruded by granite and interbedded with schist.

On the northern half of the Mt. Rennie area there are several large outcrops of quartz-feldspar porphyry. The porphyry intrudes Archaean gneisses. Similar porphyries thought to be Lower Proterozoic in age crop out on the northern part of the adjoining Macdonald area (W.A.) and the southern part of the Rawlinson area.

Isolated outcrops of probable Lower Proterozoic volcanic rocks occur unconformably beneath the Heavitree Quartzite at Mt. Leisler.

The succession of Upper Proterozoic and Palaeozoic sediments on the Mt. Liebig area are shown overleaf, (page 16).

Mesozoic			Sandstone and siltstone, deeply weathered.
---------- ANGULAR UNCONFORMITY ----------			
Undifferentiated Palaeozoic		Pertnjara Formation.	Basal white, pink and blue-grey siltstone with calcareous beds, and overlying red-brown cross-bedded quartz greywacke. Pseudomorphs after salt in basal siltstone
---------- ANGULAR UNCONFORMITY ---------- (in places conformable)			
"		Mereenie Sandstone	Basal red-brown fine silty sandstone overlain by white, clean, cross-bedded sandstone.
Ordovician	Larapinta Group	Stokes Formation	Richly fossiliferous limestone composes the basal beds. Upper half of formation mainly siltstone with pseudomorphs after halite.
"	Larapinta Group	Stairway Sandstone	Richly fossiliferous, fine-grained, thin-bedded white sandstone with some thin beds of limestone.
"	Larapinta Group	Horn Valley Formation	Richly fossiliferous limestone composes upper beds, lower beds green-grey and blue-grey siltstone.
Cambrian-Ordovician	Larapinta Group	Pacoota Sandstone	Clean, medium-bedded quartz sandstone with some pebble beds; "pipe rock" and fossils in upper half of formation.
Cambrian	Pertaoorta Group	Goyder Formation	Thin-bedded, yellow, medium and fine sandstone, calcareous sandstone and limestone.
"	Pertaoorta Group	Cleland Sandstone	Purple-brown, micaceous in part, cross-bedded, quartz greywacke. (equivalent of Hugh River Shale).
"	Pertaoorta Group	Arumbera Greywacke	Red-brown, medium and fine-grained, medium & thin-bedded sandstone.
---------- ANGULAR UNCONFORMITY ----------			
Upper Proterozoic		Pertatataka Formation	Chocolate-brown and yellow-brown sandstone and siltstone, grey shale and purple-brown siltstone.
"		Bitter Springs Limestone	Interbedded dark grey dolomite and siltstone with gypsum
"		Heavitree Quartzite	Quartz sandstone and siltstone with basal conglomerate
---------- ANGULAR UNCONFORMITY ----------			
Archaean		Arunta Complex	Quartzite, gneiss, schist and amphibolite

The relationship of the formations on the Mt. Liebig area to those on the Mt. Rennie and Macdonald areas are shown in Fig.2.

The richly fossiliferous formations of the Larapinta Group thin gradually from east to west and were not found west of the Ligertwood Cliffs. The only exception is the presence of Ordovician limestone in Western Australia on the Macdonald area.

The sediments of the Pertaoorta Group change gradually from east to west from limestone, siltstone and shale to quartz greywacke and sandstone. The sediments of the Hugh River Shale pass into quartz greywacke of the Cleland Sandstone; neither the Goyder Formation nor the Arumbera Greywacke and Pertatataka Formation can be traced westward onto the Mr. Rennie area. They may pass laterally into the Cleland Sandstone or Carnegie Formation; alternatively, they decrease in thickness and terminate near the Cleland Hills.

The more important comparisons with the Macdonald and Rawlinson areas mapped in 1960 are :-

1. The identification of the Dover Sandstone with the Heavitree Quartzite.

2. The identification of the Bitter Springs Limestone with the Bonython Dolomite.

3. The correlation of the Maurice Formation, Ellis Sandstone and Sir Frederick Conglomerate with the Pertnjara Formation.

4. The continuation of the Upper Proterozoic Carnegie Formation onto the western edge of the Mt. Rennie area. The formation crops out near Mt. Mein and may terminate here or pass laterally into the Cleland Sandstone or possibly the Pertatataka Formation and Arumbera Greywacke.

5. Small outcrops of a conglomerate with dolomite fragments which crops out south of the Ligertwood Cliffs may be equivalent in part to the Upper Proterozoic Boord Formation of the Macdonald area.

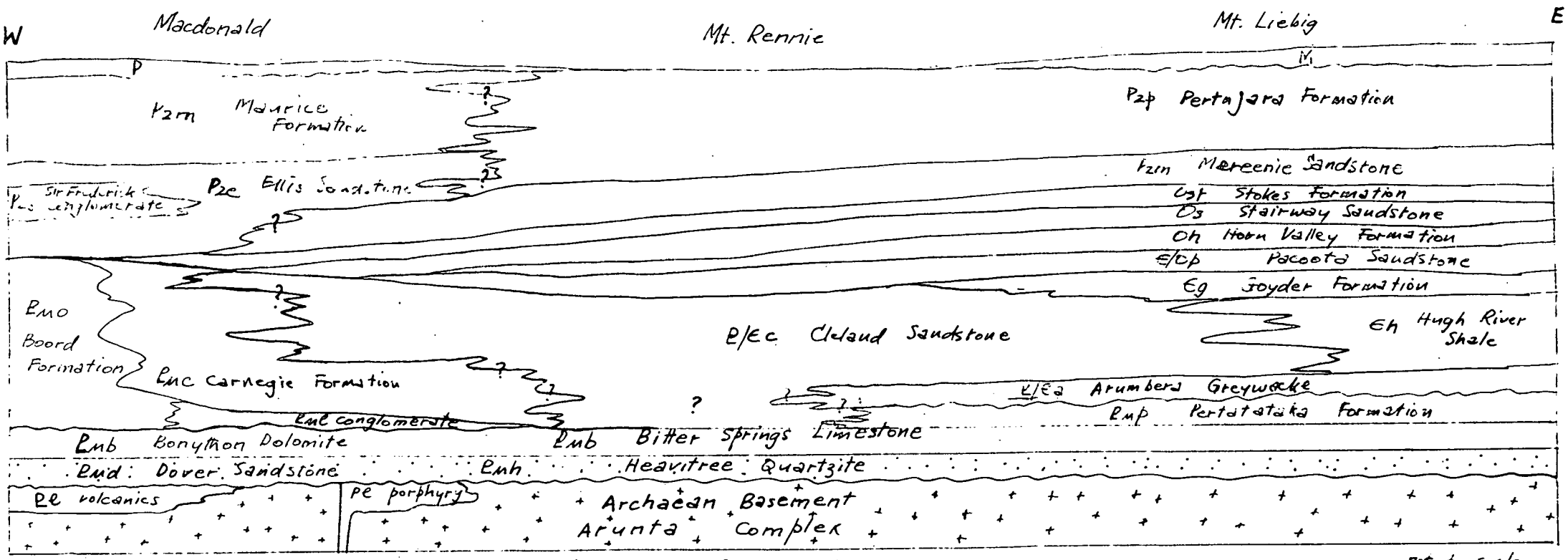
Structurally the area consists of a basement of mostly Archaean Arunta Complex overlain unconformably by the sediments of the Amadeus Geosyncline. On the northern half of the Mt. Liebig area the Heavitree Quartzite and Bitter Springs Limestone have been affected by large thrust faults and in places the basement rocks have been thrust over these formations.

The intensity of folding of the sediments of the Amadeus Geosyncline decreases from east to west. On the western edge of the Mt. Liebig area the sediments have dips generally about 30 to 40°, whereas on the Mt. Rennie Sheet dips are mostly from 10 to 20°.

The bulk of the sediments in the Amadeus Basin show competent folding but a noticeable exception is the Bitter Springs Limestone which invariably shows intense incompetent folding. The reason for this is possibly partly due to the abundance of gypsum and possibly other evaporites in the formation.

A large diapiric structure with a core of sheared gypsum and brecciated and folded dolomite is exposed at Johnstone Hill. The large mass of gypsum is about one mile in diameter and has intruded the younger sediments. Siltstone and sandstone of the Pertnjara Formation crop out on the southern margin of the dome. Similar outcrops of brecciated and folded gypsum and Bitter Springs Limestone occur about 20 miles to the south-east in the core of an anticline. A normal uninterrupted succession of sediments is exposed on the flanks of the fold.

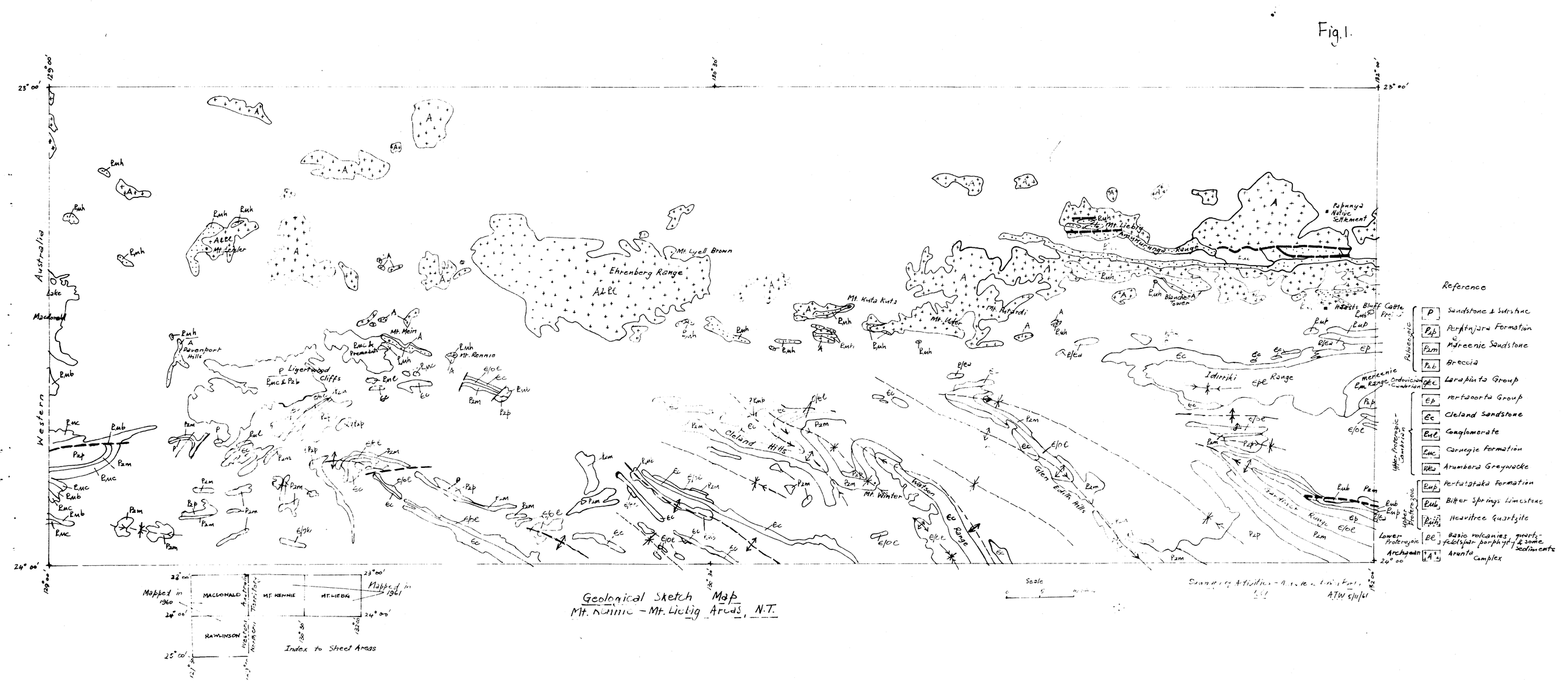
Fig 2.



Probable relationship of formations
Mt. Rennie - Mt. Liebig Areas, N.T. and Macdonald Area W.A.

not to scale.

Fig. 1.



Geological Sketch Map
Mt. Kennie - Mt. Liebig Areas, N.T.

PALAEONTOLOGY

Activities of the Micropalaeontological Group.

by

P.J. Jones and P.R. Evans.

During the year 1961 many changes of staff and staff activities occurred. The head of the micropalaeontological section, Dr. Irene Crespin, retired on 10th November, 1961 after 34 years of distinguished service for the Commonwealth Government. Her contributions to the science of Micropalaeontology are well-known. D.J. Belford was awarded a Public Service Scholarship for two-years full-time research at the Australian National University, where he is studying for the Ph.D. degree. He began his studies on 1st August,1961 and will be on leave until 1st August, 1963. Dr.G.R.P.Terpstra joined the micropalaeontological section on the retirement of Dr. Crespin to continue investigations on foraminifera in the absence of D.J. Belford. P.J. Jones began investigations on conodonts on 1st March. Miss H.M. McKenzie began duty as laboratory assistant to Dr. P.R. Evans on 6th April. J.Rayner assisted Dr. P.R. Evans from November to February, inclusive.

10,060 samples were handled in the section during 1961, some 2,000 less than in the previous year. Bore cores and cuttings came from nineteen subsidized and eleven non-subsidized wells and bores (see Appendix 'A'). Outcrop samples primarily were from collections by Bureau geologists from Queensland and Papua-New Guinea: Timor Oil Ltd. had submitted a large collection of surface samples from Portuguese Timor. All samples have been recorded and stored either in the Bureau Museum or in the basement of the Administrative Building.

2,360 samples were washed for foraminifera, radiolaria, and ostracoda, and 290 thin sections were prepared. 755 samples were processed for microplankton and spores and 165 samples were processed for conodonts.

Registration of slides in the Micropalaeontological Collection continued; 453 individual types and figured specimens of foraminifera and ostracoda were incorporated in the Commonwealth Palaeontological Collection.

A. FORAMINIFERA

Dr. Crespin was engaged mainly on the examination of surface and subsurface samples from the Great Artesian Basin. She examined and reported on outcrop samples collected by Bureau geologists, and subsurface material from Cabawin No.1, Buckabie No.1, and Combarngo No.1. The arenaceous Lower Cretaceous foraminifera recovered from these investigations, together with those from Western Australia, have been described in a monograph to be published shortly as Bureau bulletin 63. Dr. Crespin also examined outcrop samples from the Bowen Basin, Queensland and the Netherlands New Guinea, and subsurface material from New South Wales. A paper on Lacazinella, a new genus of trematophore foraminifera, from New Guinea, was prepared and sent to press.

D.J. Belford examined outcrop and subsurface samples from Portuguese Timor, outcrop samples from New Guinea, and subsurface material from Ooroonoo No.1 and Corfield No.1 in Queensland. His paper on the new Upper Cretaceous genus Spirotecta, and the new Permian species, Giraliarella triloba has been published. A study of the Miocene-Pliocene planktonic foraminifera from Papua-New Guinea has been completed for publication in Bureau bulletin 62, which will be published shortly. D.J. Belford is continuing the study of the smaller foraminifera from the Miocene and Pliocene of Papua-New Guinea, at the Australian National University.

B. OSTRACODA

P.J. Jones completed a systematic study of the ostracod genus Cryptophyllus, in the Upper Devonian and Carboniferous of Western Australia and the results will be published shortly as Bureau bulletin 16. A preliminary palaeontological report on fossils found in WAPET Barlee No.1 was published in Petroleum Search Subsidy Act Report No.16. For similar purposes, preliminary reports on Upper Devonian and Lower Carboniferous ostracoda found in several subsidized wells in the Fitzroy Basin, have been amended.

An alternative to the interpretation of the stratigraphical sequence outlined in the well completion report on Spirit Hill No.1 in the Bonaparte Gulf Basin was proposed.

C. CONODONTS

P.J. Jones began a systematic search for conodonts in Ordovician and Cambrian rocks in order to determine the zonal value of these microfossils. 165 samples have been processed and examined from the Cambrian and Ordovician of the Georgina Basin, and the Ordovician of the Amadeus Basin. Miss J. G. Tomlinson provided Ordovician samples and Dr. A. A. Öpik provided Cambrian samples, all of which are stratigraphically controlled by means of macrofossils. G. A. Brown provided late Upper Cambrian and Lower Ordovician samples from measured sections.

A note on the discovery of conodonts in the Upper Cambrian of Queensland has been published, the first record of conodonts in the Cambrian of Australia. This discovery is important as it provides another fossil group to assist the correlation of Cambrian rocks. Furthermore, as species from the Cambrian are easily distinguishable from those from the Lower Ordovician (Tremadocian), they are a valuable group to distinguish the Cambrian from the Ordovician. Conodonts have been found also in two pilot samples of late Middle Cambrian.

Results so far show that :

(i) conodonts have been recovered from 25% of all Cambrian samples and 60% of all Ordovician samples examined.

(ii) the abundance of conodonts per weight of sample dissolved is high enough for core samples from both the Cambrian and the Ordovician to be usable.

(iii) four conodont faunas in the Ordovician, and three in the Cambrian can be recognized.

All Cambrian residues have been of phosphatic brachiopods, sponge spicules, and radiolaria, as well as conodonts.

D. SPORES AND MICROPLANKTON

Dr. P.R. Evans, with the technical assistance firstly of Mr. Rayner, then of Miss McKenzie, continued palynological studies mainly connected with the search for oil.

The provisional correlations in Upper Palaeozoic and Mesozoic sections of parts of the Artesian Basin which were made in 1959/60, have been confirmed and expanded so that it is now possible to construct a correlation framework for a large proportion of the stratigraphic section of the Artesian Basin. The framework was only suitable initially for subsurface strata and so interest has increased in outcrop sections, particularly to the north of Roma, Queensland. Old well sections which previously have little or no palaeontological control have also been usefully examined. A report on this work is now being compiled.

The Lower Mesozoic of the Artesian Basin has presented many problems and a successful attempt was made to compare it with the better known Triassic of the Sydney Basin. A composite section from wells and outcrop covering the major stratigraphic horizons in that basin has been examined.

The Upper Mesozoic of the Artesian Basin received less attention but the opportunity was taken to examine Conorada Coroonoo No.1 well which was the first adequately cored well in the Cretaceous of the basin, and comparisons in the Lower Cretaceous across the basin were then possible. Additional data on the age of the Artesian Basin Cretaceous was obtained by a study of Lower and Upper Cretaceous of the Otway Basin, Victoria, summarized in a record on F.B.H. Port Campbell Nos. 1 & 2 wells.

Subsequent drilling in the Otway Basin and on its margins in South Australia has formed problems comparable with those which existed for the Artesian Basin last year and provisional attempts at correlations between subsurface and outcrop are being made.

The greater proportion of the work has been based on the distribution of microspores, but microplankton have been valuable for correlation purposes: their potential in this respect has not yet been fully measured. They have been used successfully in the Cretaceous and Permian and certain microplankton-bearing horizons in the Triassic and Jurassic have been discovered. Much attention has been directed to these finds since they will have considerable bearing on any interpretation of the eastern Australian "freshwater" sediments.

Studies were also commenced furing the year of microplankton in Lower Palaeozoic sediments of the Northern Territory in anticipation of stratigraphic drilling in the Georgina Basin next year.

RECORDS BY THE MICROPALAEONTOLOGICAL SECTION.

1960/136 Preliminary note on foraminifera from Ooroonoo No.1 bore, Queensland, by D.J. Belford.

1961/6 Micropalaeontology of samples from Portuguese Timor, by D.J. Belford.

1961/22 Palynological report on Conorada Ooroonoo No.1 well, by P.R. Evans.

1961/30 Preliminary note on the Palynology of Magellan Corfield No.1 well, Queensland, by P.R. Evans.

1961/31 Micropalaeontology of samples from Matai No.1 bore, Portuguese Timor, by D.J. Belford.

1961/35 Micropalaeontology of further rock samples from the Great Artesian Basin, Queensland, by Irene Crespin.

1961/63 A palynological report on F.B.H. Port Campbell No.1 & 2 wells, Victoria, by P.R. Evans.

1961/64 Foraminifera in U,K.A. Cabawin No.1 well,Queensland, by Irene Crespin.

1961/76 A palynological report on Oil Development N.L. Penola No.1 well, South Australia, by P.R. Evans.

1961/90 Micropalaeontology of samples from bore No.9285, "Herwart Downs" via Tibooburra, N.S.W. by Irene Crespin.

1961/100 Foraminifera in A.A.O. Combarngo No.1 well, Queensland, by Irene Crespin.

1961/102 Palynological report on South Pacific Pty.Ltd., No.1 (Birkhead) Well, by P.R. Evans.

1961/104 Foraminiferal rocks from the Nassau Range, Netherlands New Guinea, by Irene Crespin.

PUBLICATIONS

D.J. Belford — *Spirotecta pellicula* n.gen., n.sp., from the Upper Cretaceous and *Giraliarella triloba* n.sp., from the Permian of Western Australia. *Cushman Fdn. Foram. Res.* 12, (3), 81-2, 1961.

P.J. Jones — Discovery of Conodonts in the Upper Cambrian of Queensland. *Austr.J.Sci.* 24, (3), 143. 1961.

P.J. Jones — Preliminary notes on the palaeontological examination of Barlee No.1, Core 2, 2308-2325 feet. Appendix 2, *Bur.Min.Resour. P.S.S.A. Publ.* No.16, 31-32.

PUBLICATIONS (in press)

D.J. Belford	Miocene and Pliocene Planktonic Foraminifera from Papua-New Guinea. Austr.Bur.Min.Resour.Bull. 62, 1962.
Irene Crespin	Arenaceous Foraminifera from the Lower Cretaceous of Australia. Austr.Bur.Min.Resour.Bull. 63, 1962.
	Lacazinella, a new genus of trematophore foraminifera. Cushman Fdn. Foram.Res.
P.R. Evans	Microplankton from BMR 4 and 4A (Wallal) Boreholes. Appendix 5 to Bulletin 60 (Geology of the Canning Basin) by J.J. Veevers and A.T.Wells.
P.J. Jones	Ostracod assemblages near the Upper Devonian-Lower Carboniferous Boundary in the Fitzroy and Bonaparte Gulf Basins. Appendix 3 to Bulletin 60 (Geology of the Canning Basin) by J.J. Veevers and A.T. Wells.
P.J. Jones	The Ostracod Genus Cryptophyllus in the Upper Devonian and Carboniferous of Western Australia. Austr.Bur.Min.Resour. Bull. 62
P.R. Evans	Palaeontological appendices to P.S.S.A. reports on Frome Rocks No.1, Thangoo Nos. 1 & 1A, Betoota No.1.
P.J. Jones	Palaeontological appendices to P.S.S.A. reports on Frome Rocks No.2, Meda No.1.

APPENDIX 'A'

Cores and cuttings were received from :

A. SUBSIDIZED WELLS

Queensland

Phillip's-Sunray Buckabie No.1
U.K.A. Cabawin No.1
" Cabawin East No.1
A.A.O. Combarngo No.1
Phillip's-Sunray Cothalow No.1
" " Etonvale No.1
Delhi-Taylor Mornington Island No.1
" " Mornington Island No.2
A.A.O. Pickinjinnie No.2
" Winnathoola No.1

Victoria

F.B.H. Flaxmans No.1
" Port Campbell No.2

Northern Territory

Oil Dev.N.L. Bathurst Island No.1
" Bathurst Island No.2

South Australia

S.E.O.S. Beachport No.1
Oil Dev.N.L. Penola No.1

Western Australia

WAPET Eneabba No.1

New South Wales

A.O.G. Wentworth No.1

New Guinea

A.P.C. Iehi No.1

B. NON-SUBSIDIZED WELLS

Queensland

S.P.L. Birkhead No.1
W.O.L. No.1 (Warbreccan)
A.A.O. 7 (Arcadia)

Western Australia

Fremantle Traffic Bridge Bore No.2
Jondicot Bore

New South Wales

A.O.G. Baulkham Hills No.1

Portuguese Timor

Timor Oil Matai No.1
" Matai No.1A
" Matai No.2

APPENDIX 'A' contd.

Outcrop samples were received from :-

Queensland

Mt. Whelan	4-mile Sheet	area.	
Clermont	"	"	"
Emerald	"	"	"
Cooktown	"	"	"
Eddystone	"	"	"
Springsure	"	"	"
Taroom	"	"	"
Mt. Coolon	"	"	"
Mundubbera	"	"	"

Victoria

Hamilton	"	"	"

Northern Territory

Bonaparte Gulf Basin Seismic Shot-holes samples

S. Skwarko collection 1960/61.

Tanunbirini

Papua - New Guinea

Docuna Tuff near Port Moresby

Pimi River,

Nipanta Beds, Wario Valley,

Geo Geo, Mailu, Sariba, Drini,

Nassau Range, Netherlands N.G.

Foreign

Portugese Timor

MACROPALAEONTOLOGY - Annual Reports by individual workers.

A. A. Öpik.

Summary

A.A. Öpik published two papers on the palaeontology of the Cambrian of Queensland, including novel aspects of the anatomy of trilobites. A similar paper (Bulletin 64) was prepared and is ready for publication. He identified the Mootwingee Range (N.S.W.) sequence as being of Cambrian to Lower Ordovician age. He discussed with Dr. A.R. Palmer (United States Geological Survey), who paid a prolonged visit to Canberra, aspects of Cambrian stratigraphy and correlation.

Papers Published

1. "Alimentary caeca of agnostids and other trilobites". Palaeontology, 3(4), 410-438. (Anatomy of trilobites; taxonomy of the genus Glyptagnostus and its species).

2. "Mt Isa 4-mile Geological Series". Explanatory Notes No.20 (part author).

3. "Lawn Hill 4-mile Geological Series". Explanatory Notes No.21 (part author).

4. "Cambrian geology and palaeontology of the headwaters of the Burke River, Queensland". B.M.R. Bulletin 53, 1961.

Ready for Publication

"Early Upper Cambrian fossils from Queensland". Bur.Min.Resour.. Bull. 64.

Papers in Preparation

Work is progressing on the taxonomy -

1. of Middle Cambrian trilobites of the family Dolichometopidae, which will also be used in zoning of the sequence;

2. of a rather large fauna that marks the Middle Cambrian / Upper Cambrian passage and the lowermost zones of the Upper Cambrian;

3. of other collections of Cambrian fossils, particularly in respect to novel aspects of their organization and the classification of the class Trilobita.

Study of Cambrian fossils has now reached the stage of presentation of results. This depends largely on the assistance in preparation of illustrations (photographs) given successfully by Mr. C. Gatehouse.

Application of the results of faunal studies of the stratigraphy (zoning, stages, palaeogeography, and correlation) of the Australian Cambrian in general is in good progress.

Geomorphology

Observations collected in the field in previous seasons concerning the geomorphology of the plainlands of northern Australia have been included in published papers.

Lectures

Addressed the Geological Society on : "Exhumed and modern land surfaces and the age of the soil cover in the eastern Barkly Tableland".

Visitors

Dr. A.R. Palmer (U.S.G.S.) stayed in the Bureau for three weeks, studying collections of Cambrian fossils and discussing the correlation of Australian, American, and universal Cambrian faunas and strata. He addressed the Geological Society on the same subjects.

Mr. H.O. Fletcher (Australian Museum) and Mr. L. Hall (N.S.W. Geol. Survey) discussed matters of the Lower Ordovician and Cambrian sequences in the Mootwingee Range, N.S.W.

Dr. M.F. Glaessner (University of Adelaide) visited us several times and discussed matters concerning Precambrian fossils.

Dr. C.R. Twidale (Geography Department, University of Adelaide) on a visit discussed matters of the geomorphology of north-western Queensland and coordination in further studies on the same subject.

Field Work.

By invitation, A.A. Öpik spent a week in the mine and in the field, in company of geologists of the Zinc Corporation, Broken Hill, examining and discussing the sedimentary features of the schists and gneiss sequence of the Willyama Complex.

In company of Mr. L. Hall and party and Mr. H.O. Fletcher studied the sequence of, and collected fossils from, the Mootwingee Range sequence and recognized the presence of Lower Ordovician and Cambrian, and the absence of Silurian and Devonian deposits.

J. GILBERT-TOMLINSON.

Summary

The year 1961 saw notable advances in correlation of the Ordovician formations of northern Australia. Correlations were established at two levels of the Lower Ordovician.-late Tremadocian and late Arenigian. In addition, fossils of the Cambrian - Ordovician transition were discovered in the vicinity of the Dulcie Range, Northern Territory. The known area of fossiliferous Lower Palaeozoic rocks in northern Australia was extended by the discovery of Lower Cambrian and late Upper Cambrian on Barrow Creek Sheet and Lower Ordovician on Mt.Rennie Sheet. The known distribution of Middle Ordovician south of the MacDonnells was extended farther east on Rodinga Sheet and farther south on Ayers Rock Sheet. The presence of a new genus of Upper Cambrian ribeirioids and several new genera of Ordovician trilobites was noted. Palaeontological summaries for the Ordovician sequences penetrated in West Australian Petroleum Company's Subsidized bores Samphire Marsh No.1 and Thangoo Nos. 1 and 1A are in press.

In the Mootwingee Range of western New South Wales a brilliant fauna of early Middle Cambrian molluscs was recorded. It comprises several genera of gastropods and the first Australian record of the monoplacophoran Stenothecoides. Late Upper Cambrian and early Ordovician trilobites from the same area were studied in collaboration with Dr. A.A. Opik, and a Tremadocian pilekiid was identified.

Long-Term Project

Late Upper Cambrian and Ordovician of Northern Australia.

Material.

Collections of 1961 field parties led by K.G. Smith and A.T. Wells, and of Resident Geologists in Alice Springs. Collections of earlier seasons have also been exploited.

1. Correlation.

(a) Cambrian-Ordovician transition.

The passage from Cambrian to Ordovician has been identified in two measured sections on the flanks of the Dulcie Range, N.T. One is near Picton Springs on Huckitta Sheet and the other on Alcoota Sheet. In both sections the transition takes place within the Tomahawk Beds, and no distinction between the Systems can be made from lithological or structural criteria. Diagnostic fossils are ribeirioids and trilobites. The latter include richardsonellids and asaphids in the Cambrian and agnostids, richardsonellids, leiostegiids, and asaphids in the Ordovician. The fauna is partly endemic, and several new genera are present. One of the Ordovician agnostids is comparable with a South American lower Tremadocian species; another resembles a British Columbian genus. They are the first Ordovician agnostids found in the Georgina Basin.

(b) Late Tremadocian.

Late Tremadocian trilobites have been identified (i) in Western Australia in the Pander Greensand of the Cambridge Gulf area and in the Billiluna area, (ii) in the Northern Territory in the Pacoota Sandstone of the Western MacDonnell and Krichauff Ranges, and (iii) in Queensland in the Ninmaroo Formation of the Boulia area. As the late Tremadocian is a known period of widespread transgression, it is not surprising that several described genera can be identified -- Dikelokephalina from north-western Europe and Korea, Leimitzia from central Europe, Psilocephalina from central China, and Koraipsis from Korea.

(c) Late Arenig.

The brachiopod "Orthis" dichotomalis and its associated fauna are widespread in the area of Hermannsburg and Henbury Sheets, N.T., and extend onto the neighboring sheets of Mt Liebig and Rodinga. The age of this fauna has been difficult to establish on the basis of its shelly fossils, because the trilobite genera are either undescribed or long-ranging and the nautiloids give mutually contradictory dating. Moreover, the novelty of the fauna has precluded any direct correlation with Ordovician sequences in other parts of northern Australia. Recently, however, the Henbury area has yielded a trilobite resembling the Swedish genus Borogothus and the Canadian (strat.) brachiopod Tritoechia, which establish the Lower Ordovician (Arenigian) age and confirm the dating given from other localities from graptolites and conodonts. Fossils from Mt Rennie Sheet now for the first time permit a direct correlation of the Dichotomalis fauna with other parts of northern Australia. Here, trilobites and brachiopods from the Western MacDonnell Range are associated with trilobites familiar from the Prices Creek sequence of Western Australia. Part of the Prices Creek sequence, in turn, can be correlated with the Collibah Formation of the Toko Range.

2. New Discoveries.

(a) A new genus of ribeirioids has been noted in the newly discovered late Upper Cambrian sandstone of Barrow Creek Sheet. Fragments were previously known in Upper Cambrian sandstone from Tobermory Sheet, but could not be identified until the well-preserved material from Barrow Creek Sheet was examined. Morphologically the shell displays characters intermediate between Upper Cambrian and Ordovician genera.

(b) The Lower Ordovician sandstone of Mt Rennie Sheet contains a trilobite referable to the genus Bathyuriscops from Kazakhstan and Argentina, where it is recorded from Middle Ordovician rocks. The same fauna contains the first recorded agnostid, dimeropygid, and encrinurid trilobites from the Larapinta region. On the same sheet a sandstone with a different fauna contains an undescribed genus of calymenid trilobites.

(c) The Himalayan cheiruroid trilobite Prosopiscus has been noted at several localities in the Amadeus (Larapinta) region. More widely distributed is a closely related genus (undescribed and apparently indigenous), which is found in the Dulcie and Tarlton Ranges, as well as in the Larapinta region.

(d) A sandstone on Bokhara Station (Rodinga Sheet), thought to be of Upper Palaeozoic age, has yielded Middle Ordovician pelecypods, and a similar fauna has been found in the Curtin Springs area of Ayers Rock Sheet.

3. Conodonts.

Close liaison has been maintained with P.J. Jones, and stratigraphically controlled Ordovician samples have been delivered for conodont analysis. To date, the conodont dating conforms with that established on the basis of other fossils. New collections from the Waterhouse Range (Henbury Sheet) contain shelly fossils that for the first time fix the horizon of the conodonts described by Dr. I. Crespin in 1943 on material supplied by Dr C.T. Madigan.

4. Taxonomy.

Material has been assembled for systematic description of Ordovician trilobites, and some cleaning has been completed.

5. Publications.

Records 1958/90 "Lower Palaeozoic fossils in Samphire Marsh No.1 Bore, W.A." and 1960/94 "Ordovician fossils in Goldwyer No.1, Thangoo No.1, and Thangoo No.1A Bores, W.A." were edited for inclusion in the Palaeontological Appendices to P.S.S.A. Publication No.5 (Samphire Marsh) and P.S.S.A. Publication No.14 (Thangoo Nos. 1 and 1A), which are in press.

Special Project

Cambrian and Ordovician of Mootwingee Range, N.S.W.

Material. Partly supplied by the New South Wales Geological Survey; partly collected by Dr A.A. Opik in 1961.

1. LOWER AND MIDDLE CAMBRIAN MOLLUSCS.

(a) Lower Cambrian. A Lower Cambrian limestone contains rare fragments of a gastropod resembling a North American Lower Cambrian species - Helcionella buttsi Resser. It is distinct from any Lower Cambrian gastropod known in South or central Australia.

(b) Middle Cambrian. Residues from a silicified limestone have yielded a remarkable fauna of well-preserved molluscs. They include one genus of monoplacophorans, about seven genera of gastropods, and the hyolithid Biconulites. The monoplacophoran is Stenothecoides, a new record for Australia, which displays structures not previously recorded for the genus. The gastropods include Coreospira, Latouchella, and several undescribed genera familiar from early Middle Cambrian rocks of the Northern Territory and Queensland. Most of the New South Wales species are distinct from those in northern Australia. In variety of species, number of individuals, and excellence of preservation, this is the world's most brilliant Middle Cambrian gastropod fauna. A siliceous shale a little higher in the same sequence has yielded Stenotheca. It is probably specifically related to a Northern Territory form.

2. LATE UPPER CAMBRIAN AND EARLY ORDOVICIAN TRILOBITES.

A greywacke sequence has yielded trilobites, including asaphids and pilekiids. The pilekiid most nearly resembles "Pilekia" anxia Sdzuy from the Tremadocian Leimitz Shale of Bavaria. These fossils are being studied in collaboration with Dr. Öpik.

Organization of Collections

Space allotted to Macropalaeontologists in the Administrative Building Sub-Basement has been exploited to the full. Working collections have been sorted and arranged systematically, so that samples can be found without delay. The project has been carried out with assistance from C.G. Gatehouse and T. Nicholas.

Visitors

Dr M. N. Chougaeva, Academy of Sciences, Moscow, and Dr June Phillips Ross, University of Illinois, discussed questions of Ordovician taxonomy and correlation.

C.G. GATEHOUSE.

Summary

Proampyx, a ptychopariid trilobite is being described. The Middle Cambrian fauna from the Daly River Area is being examined and described. One week was spent at Captains Flat collecting fossils; fossils have also been collected from the Canberra district. Photography of Cambrian fossils for Dr. A.A. Öpik has proceeded regularly.

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1. Work was started on the description of the general morphology of ptychopariid trilobites as evidenced by Proampyx. Proampyx is a lower Upper Cambrian trilobite from Tasmania. All parts, including the hypostome and rostral shield are available and present in the one specimen. When complete, the description will give the organisation of ptychopariid trilobites and Proampyx in particular.

2. The Middle Cambrian fauna from the Daly River Area of the Northern Territory is being examined. No formal descriptive work has been carried out in this area in recent years.

Field Work

1. One week (May 22nd to May 26th, 1961) was spent in the Captains Flat area. Fossils of Ordovician age (Gisbornian) and Silurian age were collected. Due to bad preservation and fragmentation few Silurian fossils were identifiable.

2. Excavations have been made from time to time in the Canberra district. From these, collections of fossils have been made before the sites became unavailable permanently.

Incidentals

Photography of Cambrian fossils selected by Dr. A.A. Öpik has proceeded regularly.

Burnt material from the "Illaenus Band" and from Argdargada has been sorted out. A total of 23 type specimens were recovered, a list was prepared and the specimens were transferred to the museum for safe keeping.

F.W. Chapmans' type specimens from Beetle Creek have been sorted out; only five of his illustrated specimens were found.

J. M. DICKINS

Summary

Western Australian Permian pelecypods and gastropods were identified and described and Lower Triassic ammonites and pelecypods described. Permian faunas from Queensland were identified. Collections were made from the Devonian and Permian of Queensland and field work carried out in collaboration with the Bowen Basin field parties.

Western Australia

A report containing the description of 43 species of pelecypods and 20 species of gastropods from the Lower Permian (Upper Sakmarian to Lower Artinskian) and the identifications of pelecypods and gastropods from all Permian formations (more than 210 species) was completed. This is to be published as a Bulletin. The work will serve as part of the basis for understanding the historical development of the Permian in Australia, with its many practical applications.

Description of the Lower Triassic ammonites and pelecypods from the Beagle Ridge bore (B.M.R.10) - a joint report with R.A. McTavish - is nearing completion.

Queensland

(a) Bowen Basin

The marine Permian fossils collected during 1960 were identified and reports on these were prepared. In connection with this work, collections were examined at the Department of Geology of the University of Queensland, the Queensland Geological Survey, and the Australian Museum, Sydney and a report on the correlations was prepared for Section C of ANZAAS. Four faunas discrete stratigraphically were recognized in the more complete marine sequence on the eastern side of the Basin. On the western side only the highest of these is present in the Clermont area indicating a late transgressive phase in this area. This year collections were made from new areas of Devonian and Permian and from parts of the Permian sequence which had not previously yielded fossils. The stratigraphical positions of the faunas were checked in the field and lateral relationships examined.

This work indicates the possibility of recognizing regional (Bowen Basin) stratigraphical units based on combining palaeontological and other stratigraphical data. It appears, for example, that the upper transgressive unit will be recognizable through at least a large part of the Basin. The work has also shown the value of using, as a basis for correlation, a large number of species whose relative stratigraphical position is known accurately, and continually expanding this knowledge from section to section.

(b) UKA Cabawin No.1

The fauna from a core in the higher part of the marine Permian was regarded as representative of the highest fauna on the eastern side of the Bowen Basin. The fauna from a core in the lower part was too fragmentary for reliable correlation.

Other Work

Assistance was given to S.K. Skwarko and R.A. McTavish in carrying out their work and preparing their reports. Arrangements were made for exchange with and gift of specimens to other institutions and individuals.

S. K. SKWARKO.

Summary.

The project involving the study of Mesozoic strata and fossils of the Northern Territory, initiated in 1960, was continued during 1961. The Mesozoic outcrops so far examined were subdivided for the first time into four areas : the Neocomian (Lower Cretaceous) beds around the Gulf of Carpentaria; the Upper Albian (Lower Cretaceous) strata on the mainland in the vicinity of Darwin; the Lower Albian - Turonian (Lower - Upper Cretaceous) strata of Bathurst and Melville Islands; and the extensive inland sediments whose age is not known but which probably also belong to the Lower Cretaceous.

Of the 40 species of pelecypods recorded so far, 37 are new. There are some new sub-genera of Trigonia which will be of world-wide interest. Further descriptive work is being done on pelecypods, while other groups such as belemnites, gastropods, corals, brachiopods and echinoderms will be described in the near future. When completed, the research will contribute new information on the Upper Mesozoic sedimentation in the Indo-Pacific region in general and Australia in particular.

Fossiliferous samples sent in from New Guinea and Timor were examined and dated.

1. Mesozoic sediments in the Northern Territory

(a) Stratigraphy: Mesozoic beds in the Northern Territory were subdivided into four groups which are to some extent areally separate, the subdivision being based on the type of environmental conditions during deposition of sediments, and their age.

i. A belt of outcrops to the south and west of the Gulf of Carpentaria consists of sandstone and claystone laid down in an estaurine or deltaic environment during the Lower Neocomian times. There is good evidence here for existence of both marine and non-marine, probably brackish, conditions in close proximity to and succeeding each other in time. Palaeontology of these sediments is discussed below.

ii. Coastal outcrops around Darwin, and others about 70 miles south-east of Darwin have been deposited under marine conditions in the Upper Albian times. A rich assemblage of ammonites, pelecypods and belemnites from coastal sections was described and dated by Whitehouse in 1926. His dating as Upper Albian has not been revised since that time.

iii. In the vicinity of Bathurst and Melville Islands, and particularly to the west of Bathurst Island, accelerated downsinking accompanied marine sedimentation which began probably in Lower Albian times. Sedimentation ceased in the Lower Turonian after a considerable thickness (over 1000 feet) had accumulated. Cenomanian shales are particularly rich in fossils. Some of these have been sent to England for examination while others (especially pelecypods) will be examined at the Bureau of Mineral Resources at Canberra.

iv. An inland belt of outcrops extends from the vicinity of the Bonaparte Gulf in the north-west to the Queensland border in the south-east. At this stage little is known about the history of sedimentation in this area. It is thought that this area was originally occupied by a lake which at a later stage was transgressed by sea on at least one occasion. The presumably lacustrine sediments contain plant remains which may be of Lower Cretaceous age. The marine sediments have recently been found to contain arenaceous foraminifera which occur in the Lower Wilgunya Formation (generally regarded as Aptian) of south-western Queensland. Arenaceous forams are long ranging forms over which there is at this stage no controlling factor in the Northern Territory.

b. Palaeontology:

Numerous collections of fossils, both marine invertebrates and plants, were gathered in a large area stretching from Bathurst Island to the northern part of the Queensland border. So far, the only fossils being described are those collected from the Neocomian sediments which occur in a belt of scattered outcrops to the south and west of the Gulf of Carpentaria. Fossil plants are being described by Mary White.

Forty species of pelecypods have been recorded so far. Of this number, 37 are new species and constitute a worthwhile contribution to the Lower Cretaceous faunas of Australia and the world in general. The already known species are Maccoyella corbiensis (Moore), Fissilunula clarkei (Moore) and Tatella? cf. aptiana Whitehouse - all three are well-known from the Aptian sediments of the Great Artesian Basin. These forms suggest Lower Cretaceous age, but the proportionally overwhelming number of genera and species hitherto not reported from Aptian or younger strata of Australia or overseas suggests that the source strata is older than Aptian, i.e. Neocomian in age. The base of Neocomian (Valanginian) is suggested by such forms as the new species of Pterotrigonia, which is closely related to P. ventricosa (Krauss) from the Valanginian of South Africa and ?Neocomian of India. P. n.sp. is also similar to P. australis Cox from the Neocomian (probably Valanginian) beds of the Carnarvon Basin. Lower Cretaceous age is also suggested by the presence of a North American Pecten (Neithea) occidentalis (Conrad), several new species of Cyprina which have marked affinities with some Lower Cretaceous Cyprinids of England, and others. Australiotrigonia and another new subgenus of Trigonia as yet not named, are two forms new to the widespread Trigoniid genera of the world.

2. Mesozoic samples from New Guinea:

Two samples from Upper Chimber, submitted by J. H. Barrett, are of Upper Jurassic (Oxfordian to Kimmeridgian) age.

3. Mesozoic samples from Timor:

Further collections received from Portuguese Timor, sent in by the Timor Oil Ltd., range in age from Middle Triassic to Tertiary.
