1959/115.

C.3

PROGRESS REPORT ON REGIONAL GEOLOGICAL MAPPING, NORTHERN QUEENSLAND, 1958.

by

D.A. White, J.G. Best, and C.D. Branch.

RECORDS 1959/115.

CONTENTS

	Page
SUMMARY	1
INTRODUCTION	2
PREVIOUS INVESTIGATIONS	2
STRATIGRAPHY	3
PRECAMBRIAN	3
Nomenclature	3
Correlation	3
ARCHAEAN	4
Einasleigh Metamorphics	4
PROTEROZOIC	4
Etheridge Formation	4
Robertson River Metamorphics	5
Bernecker Creek Formation	5
PALAEOZOIC	6
SILURIAN	7
Wairuna Formation	7
Greenvale Formation	8
Pelican Range Formation	10
UPPER SILURIAN - LOWER DEVONIAN	10
Graveyard Creek Formation	10
Jack Limestone Member	12
Kangaroo Hills Formation	12
Perry Creek Formation	14
DEVONIAN	15
Broken River Formation	15
CARBONIFEROUS	16
Bundock Creek Formation	16
MESOZOIC	16
Blythesdale Group	16
IGNEOUS ROCKS	17
Serpentinite and related basic rock	17
Cobbold Dolerite	17
Ring Dykes and Related Igneous Complexes	18
GRANITIC ROCKS	18
Precambrian	18
Palaeozoic	20
BASALT	21

CONTENTS (ii)

	Page
STRUCTURE	21
GEOLOGICAL HISTORY	26
MINERALIZATION	29
AIRCRAFT CHARTER	33
GRANITE SAMPLING	33
RECOMMENDATIONS	33
ACKNOWLEDGMENTS	34
REFERENCES	35

APPENDIX I. Preliminary determinations of corals in the Silurian, Devonian and Carboniferous successions of the Broken River area, Northern Queensland by Dr.D. Hill, University of Queensland.

TABLES

TABLE 1. Relationships between various rock units in Etheridge Goldfield, North Queensland.

TABLE 2. Precambrian Granites in the Etheridge Goldfield. 19

PLATES

PLATE 1. Legend for the Georgetown, Einasleigh, Gilberton and Clarke River Four Mile Sheet.

PLATE 2. Geological field map of the Georgetown and Einasleigh Four Mile Sheets. Scale 1 inch to 4 miles.

PLATE 3. Geological field map of the Gilberton Four Mile Shaet. Scale 1 inch to 4 miles.

PLATE 4. Geological field map of the Clarke River Four Mile Sheet. Scale 1 inch to 4 miles.

PLATE 5. Geological field map of the Montgomery Range. One Mile Area of the Clarke River Four Mile Sheet. Scale 1 inch to 1 mile.

PROGRESS REPORT ON REGIONAL GEOLOGICAL MAPPING, NORTHERN QUEENSLAND, 1958

by

D.A. White, J.G. Best, and C.D. Branch.

Records 1959/115

SUMMARY

From May to October, 1958 about 2,000 square miles of regional geological mapping was carried out by a combined party of the Bureau of Mineral Resources and the Geological Survey of Queensland in the Robertson River and Herbert River areas, North Queensland. This mapping was a continuation of work commenced in 1956; it completes the regional mapping of the Georgetown, Einasleigh, Clarke River and Gilberton Four Mile Sheets.

Parts of the Precambrian and Palaeozoic successions, mapped in 1956 and 1957 were re-examined. New data obtained had necessitated a revision of previous ideas on the stratigraph of these successions.

Two main subdivisions are now recognized in the Precambrian of the area. One of these, tentatively referred to the Archaean, consists of metamorphics including migmatite, gneiss and amphibolite; the other, tentatively referred to the Proterozoic, consists of unmetamorphosed or contact metamorphosed sediments, dominantly fine grained siliceous shale, sandstone and minor calcareous sediments.

The Palaeozoic stratigraphy has also been revised. In 1957 the Palaeozoic sequence was considered conformable from the Upper Ordovician to the Middle Carboniferous. Three folded unconformities are now recognized in the Broken River area; (i) early Upper Silurian, (ii) early Lower Devonian and (iii) late Middle or Upper Devonian. The recognition of the unconformities was mainly due to the discovery of index fossils, which include the first graptolites collected in Queensland.

Detailed mapping of acid ring dykes and associated granitic rocks near Kidston was completed; and a new interpretation made of the mode of emplacement of the Late Palaeozoic igneous complexes, in particular the extensive porphyritic rhyolites of the area. Many of these porphyries, including the Croydon Felsites, are believed to be porphyry hoods of shallow granite intrusions.

Volcanic vents, lava tunnels and flows, have been mapped on the McBride Basalt Province. Among these flows is the Kinrara Basalt, which probably extruded during historical times over 30 miles along the Burdekin River and its tributaries. The basalt flow has dammed the Burdekin River in recent time to form the Saltern Lakes and the Pelican Lakes, near the Valley of the Lagoons.

A pozzolan deposit, used in concrete forthe construction of the Koomboolooba Dam near Tully Falls, was recognized to be a basaltic volcanic ash.

Extensive deposits of diatomite were discovered during the survey exposed along the eastern margin of the Tertiary McBride Basalt Province near "Cashmere", "Gleneagle", Lake Walters and "Conjuboy" (the largest of the deposits contain about 1,000,000 tons of diatomite).

INTRODUCTION

Regional geological mapping was carried out from May to October, 1958, by a combined party of the Bureau of Mineral Resources and the Geological Survey of Queensland, in the Robertson River (Georgetown Four Mile Sheet), Camel Creek and Herbert River areas (Einasleigh 4 - Mile Sheet) of Northern Queensland (Plate 1). This survey completes the regional geological mapping commenced in 1956 as part of a programme of search for radioactive and metalliferous deposits, in the Georgetown, Einasleigh, and Gilberton and Clarke River 4 - Mile Sheets. Regional geological mapping will be continued in 1959 to the north of the Atherton 4 - Mile Sheets, part of which was mapped in 1956 (White and Hughes, 1957/2), and 1958 (de Keyser, Bayly and Wolff, 1959).

The geologists who took part in the survey were D.A. White (leader), J.G. Best, C.D. Branch (Bureau of Mineral Resources), W. Bush (Geological Survey of Queensland), J.R. Stewart (Atomic Energy Commission) and D.H. Wyatt (Geological Survey of Queensland), each spent about one month with the survey. A.D. Haldane (Bureau of Mineral Resources) spent two weeks with the party.

An area of about 2,000 square miles was mapped. This included the eastern portion of the Einasleigh 4 - Mile Sheet and the southern portion of the Georgetown 4 - Mile Sheet. Some of the critical sections of the Precambrian in the Ironhurst, Gilberton and Eveleigh areas and of the Palaeozoic in the Broken River, Gray Creek and Clarke River areas, mapped in 1957, were re-examined. Geological assistance was given to a Bureau Gravity Party, led by K.Tate, and to New Consolidated Goldfields Ltd., who were conducting detailed surveys of a chromite deposit at Gray Creek.

A Cessna aircraft, chartered from Bush Pilots Ltd., Cairns, was used to study Tertiary and Recent volcanic craters and flows on the Einasleigh 4- Mile Sheet; Upper Palaeozoic acid ring dykes near Bagstowe Station; the Herbert River falls and gorge; and the boundary between the Precambrian and Palaeozoic along the Burdekin River.

Field data from the aerial photographs were plotted on controlled planimetric base maps supplied by the Department of the Army, and reduced for final compilation to a scale of 1 inch to 4 miles. For the purpose of this report the data have been plotted, together with the 1956 and 1957 mapping, on uncontrolled photomosaics and reproduced at 4- mile scale. (Plates 2, 3 and 4.) 1 inch to 1 mile scale Maps of the Bagstowe Ring Dyke Complex (Branch, 1959) and the Montgomery Range One Mile Area, were also prepared.

PREVIOUS INVESTIGATIONS

Maitland (1891) described Precambrian and Palaeozoic rocks in the Upper Burdekin River area. He defined the "WAIRUNA BEDS" to be a sequence of steeply dipping shales, grits, greywackes in the vicinity of Wairuna Station.

Other geologists notably Cameron (1900), Ball (1914 and 1915), Marks (1911), and Smith (1922), described the central portions of the Etheridge and Kangaroo Hills Mineral Fields. The Camel Creek and Herbert River areas, which are situated near the boundary of the two mineral fields, had not been previously mapped. Morton (1944) and Levingston (1952), described scheelite and wolfram deposits at Perry Creek. Denmead (1947) described a tin prospect near Camel Creek Station. Twidale (1956) investigated the Tertiary and Kainozoic basalt provinces, one of which, the McBride Basalt Provinc· was re-mapped in 1959.

In 1957, G. Twidale and W. Bush of the Geological Survey of Queensland) mapped part of the Kangaroo Hills Mineral Field near Ewan, and part of the Camel Creek area on the eastern margin of the Einasleigh 4- mile Sheet.

STRATIGRAPHY

Table 1 shows the relationship between the rock units on the Georgetown, Einasleigh, Clarke River and Gilberton 4 - Mile Sheets.

PRECAMBRIAN

Nomenclature.

White and Hughes (1957) divided the Precambrian into two conformable units which they tentatively named "Etheridge Group" and "Einasleigh Metamorphics". Mapping in the Gilberton and Ironhurst areas in 1959 has shown two ages of metamorphics in the Precambrian: contact metamorphics associated with the Forsayth Batholith (White and Hughes, 1957), and an older sequence of high grade regional metamorphics. The Forsayth Batholith cuts across the older metamorphics and in some places has retrograde metamorphosed them.

It is proposed to retain "Einasleigh Metamorphics" for the older metamorphics, and to use "Etheridge Formation" for the younger sediments and their contact metamorphosed equivalents. This agrees with nomenclature used by Bryan (1925 Bryan and Jones (1944), and Whitehouse (1930); it does not entirely agree with the units defined by Jensen (1923).

The age of the younger sequence is in doubt. Nowhere in the area is the Palaeozoic seen unconformably on the Precambrian. The oldest known Palaeozoic sediments exposed in the Broken River area are Lower Silurian (or Upper Ordovician ?), and it is possible that the younger sequence, here tentatively assigned to the Proterozoic, is Lower Palaeozoic in age. The relationships between the Paddy's Creek Formation (Proterozoic (?)) and the Wairuna Formation (Lower Silurian) in the Halls Reward Mine area, are not clear, but the two formations are probably separated by a metamorphic unconformity. The lack of fossils in the younger sequence suggests a Precambrian age.

Radioactive dating of the granite intrusions will eventually provide more precise evidence of the relative ages of these sequences. Until those data are available, the younger sequence will be tentatively referred to the Proterozoi and the older sequence tothe Archaean.

Correlation.

The recognition of two ages of metamorphics in the Precambrian on the Georgetown and Gilberton 4 - Mile Sheets enables the following rock units to be collected:

TABLE I

RELATIONSHIPS BETWEEN VARIOUS ROCK UNITS IN ETHERIDGE GOLDFIELD, NORTH QUEENSLAND.

AGE			ROCK UNIT			
PALAEOZOIC	Upper Palaeozoic ((?)Permo-Carboniferous).		Croydon Felsite; Esmeralda Granite	Prestwood Micro-granite; Cumberland Range Volcanics	Cumbana Rhyolite Porphyry; Elizabeth Creek Granite; Newcastle Range Volcanics	Tiger Hill Micro-granite; Agate Ck. Volcanics; Montgomery Range Rhyolite Porphyry; Bagstowe Ring Dyke Complex; Butlers Igneous Complex; Lochaber Granite; Oweenee Granite
	Carboniferous	U				
		M				Clarke River Formation
		L	Gilberton Formation	Bundock Formation ? ? ? ?		
	Devonian	U			?Craigie Granodiorite?	? Herbert River Granite ?
		M		Broken River Formation		
		L		Boiler Gully Complex; Jack Limestone Member	Gray Creek Complex; Perry Creek Formation	Tribute Hills Sandstone
	Silurian	U		Graveyard Ck. Formation; Crooked Creek Conglomerate Member	Kangaroo Hills Formation	
		M		Pelican Range Formation		
				Greenvale Formation		
		L		Wairuna Formation	Everetts Creek Volcanic Member; Carriers Well Limestone Member ? ? ? ? ?	
	Ordovician	U				
	(?) Lower Palaeozoic of (?) Late Precambrian		Forsayth Granite	Robin Hood Granite	Dumbano Granite; Cobbold Dolerite	Dido Granodiorite; McKinnon's Creek Granite; Sandalwood Serpentinite
PRECAMBRIAN	(?)Proterozoic			Robertson River Metamorphics; Langdon River Formation; Stockyard Creek Siltstone Member; Etheridge Formation	Bernecker Creek Formation	Paddys Creek Formation; Lucky Creek Formation
	(?) Archaean			Einasleigh Metamorphics		Halls Reward Metamorphics; Stenhouse Creek Amphibolite

— — — — Unconformity

———— Conformity

6

Precambrian	Georgetown Area. (West)	Gilberton Area. (South).	Hall's Reward Mine Area (East).
	Robertson River Metamorphics	-- -- --	Paddy's Creek Formation.
	Etheridge Formation	Etheridge Formation	-- -- --
Proterozoic	-- -- --	Bernecker Creek Formation "Mt.Morgan Formation" White & Hughes, 1957).	Lucky Creek Formation.
Archaean	Einasleigh Metamorphics	Einasleigh Metamorphics (and Woolgar Area).	Hall's Reward Metamorphics
	-- -- --	-- -- --	Stenhouse Ck. Amphibolite.

ARCHAEAN

Einasleigh Metamorphics.

In the Gilberton area migmatite and ptygmatic gneiss, are exposed adjacent to sequence of siltstone, shale and calcareous sandstone. These sediments are intruded by granite and in the contact zone grade into banded calc-silicate hornfels. The granite and pegmatite veins also transgress the migmatite and ptygmatic gneiss, and thus indicate a metamorphic unconformity between contact and regional metamorphics. Similar features were found in the Ironhurst area (Plate 2) between Ironhurst and Dagworth Stations.

The Einasleigh Metamorphics, are now considered to belong to an older Archaean inlier. The Proterozoic sediments and metamorphics of the Etheridge Formation, crop out in the central eastern part of the Etheridge Goldfield and are separated by intrusive granites into five main areas.

Ironhurst/Dagworth area (Plate 2); Eveleigh/Einasleigh area (Plate 2); Gilberton/Welfern area (Plate 3); Woolgar area (Plate 3); and the Werrington/Lynd area (Plate 5)

The Einasleigh Metamorphics are similar from one area to another, excepting more gneiss than migmatite is exposed in the southern - Gilberton, Welfern, Woolgar, Werrington - areas.

PROTEROZOIC

Etheridge Formation

The Etheridge Formation is a sequence of black quartz siltstone, shale, chert with lenses of fine grained quartz sandstone, carbonaceous shale and some impure limestone The sediments crop out over an area of about 800 square miles in the central part of the Etheridge Goldfield, and extends south to Ortona and Gilberton (Plate 3). At Ortona the Formation is intertongued with and overlies crossbedded calcareous sandstone of the Bernecker Creek Formation. Similar relationships exist between impure calcareous sediments of the Lucky Creek Formation and phyllite-quartzite of the Paddy's Creek Formation in the Hall's Reward Mine area, with which the Etheridge and Bernecker Creek Formations can be correlated.

The Etheridge Formation is intruded by sills and dykes of the Cobbold Dolerite (see IGNEOUS ROCKS) at South Head, Robertson River, Ortona and Gilberton. These commonly have a low grade contact metamorphic aureole of a few feet wide.

Between the Gilbert River and the Forsayth/Ortona track, the Etheridge Formation grades into sericite and mica schists. Farther east of the track and towards the Forsayth Granite the Formation is conformably overlain by the Robertson River Metamorphics.

Robertson River Metamorphics.

The Robertson River Metamorphics consist of quartz-muscovite schist, garnet-cordierite (?) - biotite (or muscovite) schist, biotite schist and quartzite. The minerals suggest that the original sediments of the Robertson River Metamorphics contained more silica (quartz) and clay impurities than the Etheridge Formation. The metamorphics were not previously named but included in the Einasleigh Metamorphics by White and Hughes (1957). This is incorrect since the metamorphics in the Robertson River are contact metamorphics, which are younger than the regional metamorphics of the Einasleigh Metamorphics.

The Robertson River Metamorphics are best exposed along the Robertson River between the Forsayth/Ortona track and Tin Hill. Here they occupy an area of about 250 square miles and range in thickness from about 5,000 to 7,500 feet. The metamorphics also crop out over 20 square miles near Huonfels in the northern part of the Georgetown Sheet.

Generally the Robertson River Metamorphics grade laterally into the contact metamorphics to the Etheridge Formation. In some places the boundary is more abrupt, and marked by a grey silky knotted garnet - muscovite - cordierite (?) schist conformably overlying mica schist of the Etheridge Formation.

The Robertson River Metamorphics have been formed mainly by the intrusion of both the Forsayth and Robin Hood Granites, and to a lesser extent by the unknown of the Cobbold Dolerite and by earlier folding. The metamorphics thus represent a contact facies, higher in grade and with a greater areal extent than the metamorphics of the Etheridge Formation.

Bernecker Creek Formation.

The Bernecker Creek Formation has been previously described as the "Mt.Moran Formation" by White and Hughes (1957). However, because there are two localities known as Mt.Moran in the area, it is now considered advisable to change the name to the Bernecker Creek Formation. The Formation is well exposed in the Bernecker Creek and consists of calcareous quartz sand-stone and calcareous quartz siltstone with minor lenses of limestone and shale. The sandstone is commonly crossbedded and in some places exhibits micro slumping.

The recognition of a metamorphic unconformity near Welfern Station (Plate 2), has necessitated revision of the eastern boundary of the Bernecker Creek Formation as shown by White and Hughes. In the Welfern area the high grade metamorphics are mainly gneiss with some migmatite. They crop out adjacent to banded calc-silicate hornfels of the Bernecker Creek Formation. The gneiss and migmatite are regional metamorphics and are retrograde metamorphosed by the same granite, which has contact metamorphosed the Bernecker Creek Formation. Roof pendants of gneiss exposed between the Copperfield and Einasleigh rivers (Plate 2) are part of the Einasleigh Metamorphics and not the metamorphics of the Bernecker Creek Formation as previously described by White and Hughes.

PALAEOZOIC

The Palaeozoic sediments of the Broken River/Camel Creek area range from Silurian to Carboniferous in age. They crop out in a triangular-shaped area of about 6,500 square miles to the east of the Precambrian terrain. The southern boundary of the Palaeozoic rocks is along the upper reaches of the Clarke River; part of the western boundary coincides with the upper part of the Burdekin River in the Valley of Lagoons area.

In 1957 the Palaeozoic succession in the Broken River area was considered conformable from the Lower Silurian to the Upper Devonian. In the Clarke River area to the east Carboniferous sediments unconformably overlie Siluro-Devonian sediments. In 1958 Dr.Maxwell (University of Queensland) determined Tournaisian (Lower Carboniferous) brachiopods oollected in 1957 from the Burdock Creek Formation in the Broken River. This necessitated a re-examination of the Broken River section, during which the first graptolites in Queensland were discovered and the following three unconformities were established:-

(i) early Upper Silurian
(ii) early Lower Devonian
(iii) late Middle Devonian or early Upper Devonian.

The unconformities have been folded. They are recognized by faunal breaks across distinct formation boundaries; marked variations in thickness between beds on either limbs of major folded axes; the occurrence of a basal pebble greywacke conglomerate; in some places fossils derived from older underlying beds; differences in trends of fold axes above and below a formation boundary.

The early Lower Devonian unconformity is probably the most important, as it marks the close of a period of extensive greywacke sedimentation on the western and eastern margins of a Palaeozoic geosyncline. This sedimentation was followed by an orogeny during which serpentinite and gabbro masses were emplaced along the Precambrian/Palaeozoic boundary.

Table 1 shows the relationships between the Palaeozoi rock units.

SILURIAN.

Wairuna Formation.

A sequence of thinly bedded quartz siltstone, impure quartz sandstone (in places crossbedded) and shale are exposed in a belt about four miles wide, extending from the Broken River (Plate 3) north-north-east for about 80 miles along the valley of Gray Creek and the Burdekin River to Wairuna Station. (Plate 2). Maitland (1891) described similar sediments as the "Wairuna Beds". The proposed change in rank to Formation is justified by the more detailed information on these rocks now available.

The thickness of the Wairuna Formation is difficult to determine because of the tight folding, but it is estimated at about 5,000 feet.

A Late Lower Silurian age for the Wairuna Formation is based on two graptolite localities in the Broken River area. One of these is in black shale in the Broken River at the Pandanus Creek/Wando Vale road crossing (Plate 6). The other five miles to the north-east. The graptolite collection contains fragments of three species of Monograptus. These can be referred to forms ranging from Upper Llandovery to Wenlock; Ludlow can be excluded. The graptolites are being further examined by Dr. D.E. Thomas (Geological Survey of Victoria). Other fossils were collected from the Wairuna Formation in Gray Creek about half a mile west of the chromite deposit. These have been determined by Dr.Öpik as trilobites (Encrinurus, Scutellidae (two species), Proetus?, Sphaerexochus? or Onycopyge (Woodwood), brachiopods (Brachyprion), and pelecypods, corals and bryozoa. The trilobites probably indicate a "Middle" Silurian (end of Llandovery to Wenlock) age and hence the graptolites and shelly fossils most probably belong to the same age division of the Silurian. The trilobites and brachiopods are contained in buff mudstone interbedded with crossbedded thinly-bedded clayey quartz sandstone which are overlain by greywacke conglomerate of the Graveyard Creek Formation.

Lower Silurian corals occur in the Carriers Well Limestone Member of the Formation. The corals range in age from possibly the Upper Ordovician to the Lower Silurian (White, et.al., 1959).

The western boundary of the Wairuna Formation is a faulted contact with Precambrian metamorphics in the Halls Reward Mine and Valley of Lagoons areas (Plate 2). The Wairuna Formation is unconformably overlain by the Crooked Creek Conglomerate Member of the Graveyard Creek Formation to the south in Gray Creek. In the Broken River area the Wairuna Formation is unconformably overlain by a cobble greywacke conglomerate, which is probably part of the Graveyard Creek Formation. The eastern boundary of the Wairuna Formation is partly faulted against and partly conformably (?) overlain by quartz greywacke and siltstone sequence of the Greenvale Formation. The Carriers Well Limestone Member and the Everetts Creek Volcanic Member, have been described previously by White et.al. (1959). These occur near the base of the Formation.

Greenvale Formation.

The Greenvale Formation is a succession of buff quartz siltstone, claystone with lenses of quartz greywacke, pebble conglomerate and coarse-grained greywacke conglomerate. The formation is named the Greenvale Formation, from Greenvale Station, on the Burdekin River in the southern part of the Einasleigh 4 - Mile Sheet (Plate 2).

The Formation is irregularly bedded and contains a high proportion of fine-grained clastics. The greywacke of the Greenvale Formation is the first appearance of greywacke in the Palaeozoic succession; extensive greywacke sedimentation followed the deposition of the Greenvale Formation.

The thickness of the Greenvale Formation is difficult to determine owing to shearing, tight folding and lack of a marker bed. From the regional structure the thickness is estimated at about 30,000 feet.

The Greenvale Formation covers an area of 650 square miles extending from the southern edge of the Lucy Tableland (Plate 2) for about 40 miles south to the head waters of Gill and Porphyry Creeks in the Clarke River 4 - Mile Sheet (Plate 1).

Its relationship to the Wairuna Formation is not precisely known. For the most part the Wairuna Formation is faulted against the Greenvale Formation. In Gray Creek a prominent pebble greywacke conglomerate contains pebbles apparently derived from adjacent sandstone and siltstone of the Wairuna Formation. In the Camel Creek area the trend of the Greenvale Formation is oblique to that of the Upper Silurian-Lower Devonian Kangaroo Hills Formation, and together with other evidence described below the Greenvale Formation must be unconformably overlain by the Upper Silurian - Lower Devonian Kangaroo Hills Formation. Hence the age of the Greenvale Formation is Silurian, probably post-Lower Silurian and certainly pre - Upper Silurian.

Near its contact with the Pelican Range Formation (see below) the Greenvale Formation contains a "pseudo" conglomerate bed.

Figure 1. "Pseudo" or podded conglomerate of the Greenvale Formation. Note range in size of pebbles (fine-grained quartz sandstone). Gill Creek, Clarke River Four Mile, E/55/13.

11

This consists of pods of lenses of fine- to medium grained feldspathic (?) (Plate 3) sandstone embedded in thinly bedded green shale.

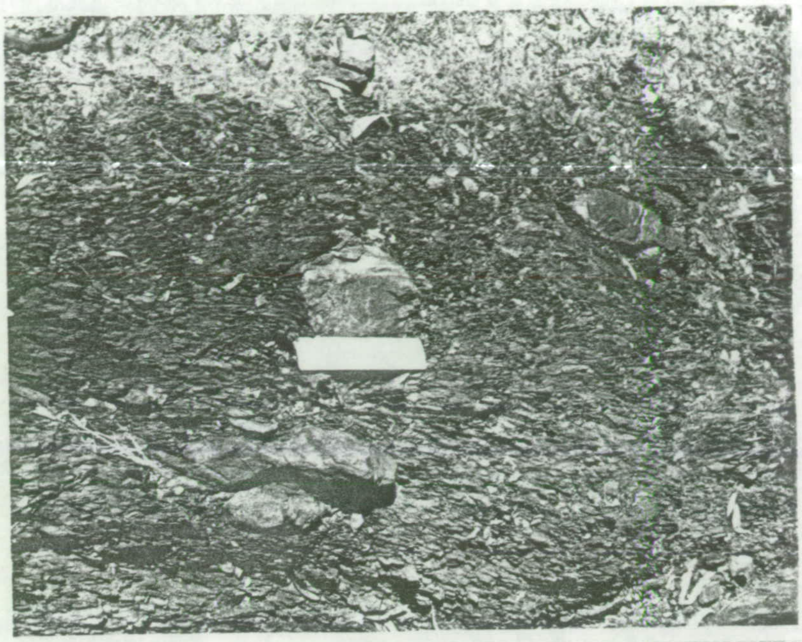


Figure 2. Close up view of the "pseudo" conglomerate in Figure 1. Matrix is sheared slate or claystone; pebbles are fine-grained impure quartz sandstones. Gill Creek, Clarke River 4 - Mile Sheet, E/55/13.

The pods or lenses range in length from a few inches to fifteen feet. They are commonly orientated parallel to the bedding of the shale. In places the lithology of the pods is the same as the thin beds of coarse sandstone interbedded with the shale. The pods have been modified by later shearing, but their shape cannot be entirely due to shearing. An alternative hypothesis could be that the "pseudo" conglomerate bed is a tidal deposit formed on the edge of a slope. Continual accumulation of this deposit produced unstable conditions and the coarser beds rolled over the finer mudstones to form pods or lenses. In some cases, particularly the larger pods, inertia would carry the pods some distance down the slope. Later shearing probably orientated the pods or lenses of sandstone parallel to the bedding.

The Greenvale Formation is intruded by outliers of the Herbert River Granite near the Perry Creek Wolfram diggings (Plate 2). Contact metamorphic effects are only incipient spotting of the sediments. Extensive linear masses of dolerite intrude the Greenvale Formation along its trend in the central part of its outcrop and formed jasper and siliceous rocks from the surrounding quartzose sediments.

In the Pelican Range the Greenvale Formation is faulted against the Pelican Range Formation.

Pelican Range Formation.

This formation consists of brown massive to thinly bedded, coarse- to medium-grained clayey quartz sandstone with some interbedded quartz siltstone and shale. In places the sandstone contains load and flow casts. The thickness of the formation probably does not exceed 5,000 feet.

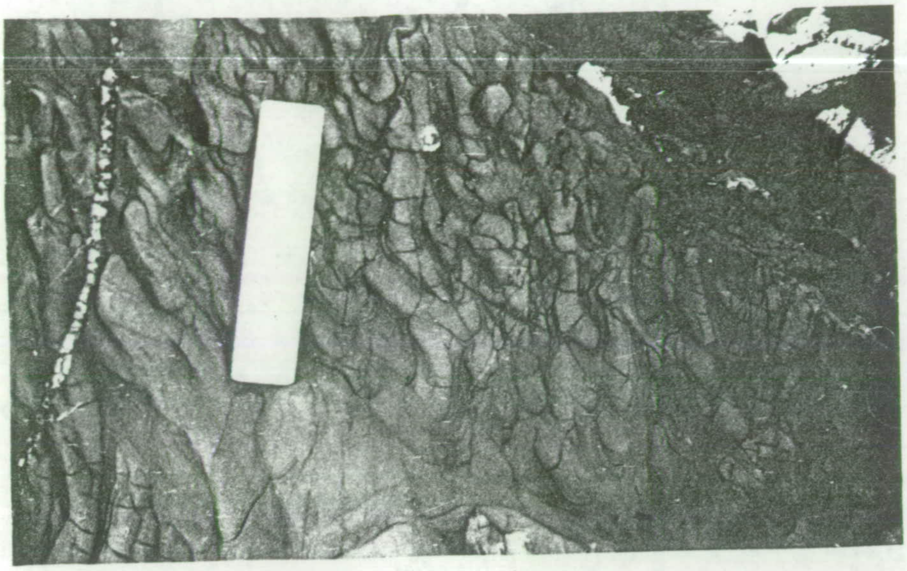


Figure 3. Flow or groove casts along the bedding plane of clayey medium-grained sandstone of the Pelican Range Formation (Silurian). Gill Creek, Clarke River 4 - Mile Sheet. E/55/13.

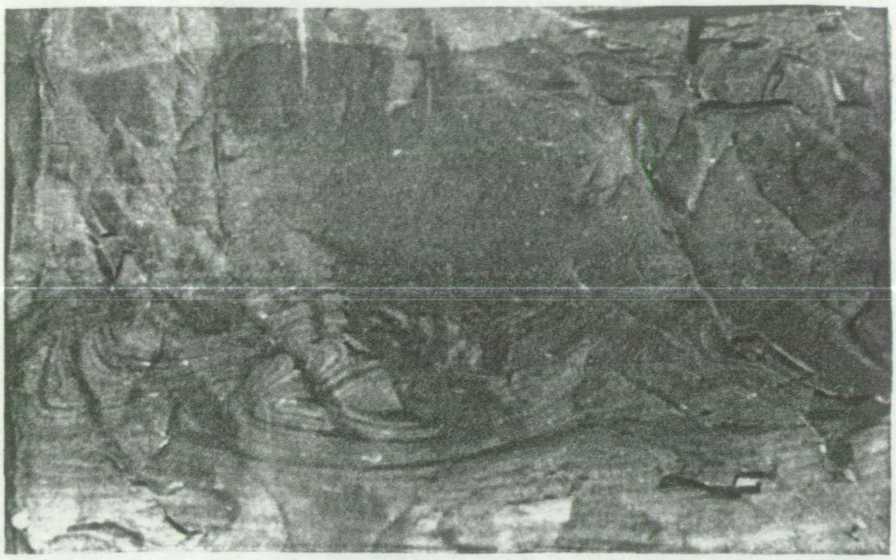
The age of the Pelican Range Formation is not precisel known. It is younger than the Greenvale Formation and it is down-faulted into the Greenvale Formation.

The Pelican Range Formation is a linear mass about 30 miles long and averages two miles wide. It extends from near the Valley of Lagoons south to Gill Creek on the north-eastern portion of the Clarke River 4 - Mile Sheet.

UPPER SILURIAN TO LOWER DEVONIAN.

Graveyard Creek Formation.

This has been described by White et.al.(1959) to consist of rhythmic alternating greywacke, which is graded bedded, and in places contains structures, which are similar to convolute bedding as described by Kuenen (1953).



<u>Figure 4</u>. Convolute bedding due to slumping, (below), cut off by graded bedding, (top), in greywacke of the Graveyard Creek Formation (Upper Silurian to Lower Devonian). Gray Creek, Clarke River 4 - mile Sheet, E/55/13.

Corals collected in small limestone lenses within the greywacke beds suggests an Upper Silurian to Lower Devonian age for the Graveyard Creek Formation.

White et.al.(1959) considered the Graveyard Creek Formation to be conformable with the underlying Wairuna Formation and the overlying Broken River Formation. However, on re-examination of these contacts together with further fossil evidence these formations must be unconformable. The junction between the Wairuna Formation and the Graveyard Creek Formation is abrupt and is generally marked by a greywacke conglomerate containing pebbles of the Wairuna Formation, and in places, pebbles of the Everetts Creek Volcanics. Also the fossils collected in 1959 from the two formations suggest that a considerable time break between Lower Silurian and Upper Silurian exists between the deposition of the formations.

The boundary between Graveyard Creek Formation and the Broken River Formation is marked by similar features. This boundary can be traced to the Black Creek and Broken River areas where again there is evidence of a time break from the Upper Silurian to the Middle Devonian between adjacent limestones in the two formations. Accepting this boundary as an unconformity does explain the difference in thickness of some 10,000 feet of the Graveyard Creek Formation on either side of a major overturned anticline in Graveyard Creek (Plate 4), and immediately below the Broken River Formation.

The Graveyard Creek Formation is correlated with the Kangaroo Hills Formation farther on the Einasleigh 4 - mile Sheet (Plate 2). The two formations are similar in age - Upper Silurian to Lower Devonian; they both contain rhythmic alternating beds of greywacke, and impure quartz sandstone. The greywacke Creek Formation contains a greater proportion of greywacke than the Kangaroo Hills Formation.
Graveyard

The Graveyard Creek Formation contains towards its upper part an Upper Silurian - Lower Devonian limestone, here named the Jack Limestone Member.

Jack Limestone Member.

Little mapping of this unit was carried out in 1958. Since the Jack Limestone Member was first described by White et.al.(1959), it is now known to include the limestone lens at Magpie Creek (A lens) together with three other lenses (B, C, and D), which crop out in Back Creek (B) and the Broken River (C and D).

In 1958 further corals were collected viz: BRS83 (A lens) and BRS81 (B lens). Preliminary determinations of these corals by Dr.D. Hill (Appendix I) suggest a Devonian BRS83) and a Silurian (BRS81) age.

The Jack Limestone is correlated with the limestone lenses in the Perry Creek Formation in the north-eastern corner of the Clarke River Formation.

Kangaroo Hills Formation.

The Kangaroo Hills Formation consists of a thick sequence of rhythmic alternating thinly bedded fine-grained clayey quartz sandstone, siltstone and shale, with thicker beds of coarse-grained greywacke and lenses of greywacke conglomerate exposed in the Camel Creek area (Plate 2). The fine-grained sandstone exhibits micro-crossbedding, which in places passes into micro-slumping. The greywacke generally shows graded bedding and load casts. Minor limestone lenses are also present in the formation.

Figure 5. Load cast in greywacke bed interbedded with rhythmic alternating impure sandstone and shale of the Kangaroo Hills Formation (Upper Silurian to Lower Devonian). Gill Creek, Clarke River 4 - Mile Sheet, E/55/13.

This formation is the thickest (35,000 - 40,000 feet) and most extensive of the Palaeozoic sequences . It covers an area of about 1,000 square miles in the Kangaroo Hills Mineral Field, from which it is named. The Kangaroo Hills Formation extends from an area about ten miles west of Camel Creek Station for about 25 miles east toward Kangaroo Hills Station, on the south-eastern corner of the Ingham 4- Mile Sheet. The formation is probably represented farther east at Ewan as roof pendants in granite.

To the north the Kangaroo Hills Formation passes under lateritic deposits of the Lucy Tableland; it extends south to Gill Creek on the Clarke River 4 - Mile Sheet (Plate 4) where it is unconformably overlain by Carboniferous sediments.

The Kangaroo Hills Formation, as defined here, is used in place of the Kangaroo Hills Series, which was first described by Smith (1922), to consist of quartzites, slates, mudstones, grits, limestones and interbedded andesites and rhyolites of the Kangaroo Hills Mineral Field. Reid (1931) considered the "Kangaroo Hills Series" to be the same as his "Metalliferous Series" (Upper Silurian), and he correlated it with the "Chillagoe Series". Denmead (1948) reported Upper Silurian to Lower Devonian corals in the "Kangaroo Hills Series"

The Kangaroo Hills Formation is in contact with the Greenvale Formation to the west of Camel Creek Station and probably along its northern boundary. The western contact is abrupt and generally marked by a cobble to pebble greywacke conglomerate, which consists of pebbles apparently derived from the Greenvale Formation. The shape of outcrop of the greywacke conglomerate suggests that it represents a shore line conglomerate. Hence although in any one section the Kangaroo Hills Formation is not observed unconformably overlying the Greenvale Formation, considerations of sedimentation and structure favour an unconformity between the two formations. The unconformity is also based onthe marked difference in regional trend between the two formations. The trend of the Kangaroo Hills Formation is generally 45° and in places itis about 80°, whereas the trend of the Greenvale Formation is generally 00°. This is particularly the case in the northern part of their outcrop in the Camel Creek area. In the south the trend of the two formations are more or less parallel.

The age of the Kangaroo Hills Formation is Upper Silurian to Lower Devonian, since it passes conformably up into the Perry Creek Formation, which contains limestone lenses with Upper Silurian - Lower Devonian corals. Fragments of corals, crinoid, stem-joints and probably brachiopods collected from greywacke of the Kangaroo Hills Formation, were too poorly preserved to be further identified. To the south in the Gill Creek area the Kangaroo Hills Formation is unconformably overlain by the Clarke River Formation (Lower to Middle Carboniferous). It is intruded by diorite at Camel Creek, porphyry and the Herbert River Granite.

The Kangaroo Hills Formation is correlated with the Graveyard Creek Formation. Both formations show rhythmic alternations of fine-grained beds from about one inch to five inch thickness. Graded bedded greywacke is prominent in both formations. The main differences between the two formations are a greater proportion of fine-grained impure quartz sandstone with micro cross-bedding in the Kangaroo Hills Formation and a greater proportion of greywacke in the Graveyard Creek Formation. This is probably due to the different geosynclinal environments between the two formations.

The Graveyard Creek Formation probably resembles the flysch facies of the Alpine Tertiary sedimentation. The Kangaroo Hills Formation has sediments similar to both the flysch and molasse facies. It resembles the flysch in being rhythmic and containing greywacke; on the other hand the abundance of micaceous micro cross-bedded clayey sandstone (?subgreywacke) and siltstone in the Kangaroo Hills Formation is typical of the molasse facies. If we accept the formation of cross-bedding by turbidity currents, the Kangaroo Hills Formation may be a special variety of the flysch facies. The two formations are an interesting occurrence of two geosynclinal facies deposited simultaneously in the one geosyncline.

The Kangaroo Hills Formation was probably deposited on a moderately inclined slope merging into a trough, which adjoined a land mass of moderate relief. Detritus was continuously supplied over a long period, which was interrupted by shorter intervals when the amount of detritus increased and turbidity currents formed. The currents transported detritus over long distances down slope (and probably up-slope) into the trough.

In comparison, the Graveyard Creek Formation was deposited in a steep-sided trough being supplied with detritus from surrounding high terrain. The detritus was quickly transported by turbidity currents to the centre of the trough thus allowing little to no reworking of the deposits by wave action.

Perry Creek Formation.

The Perry Creek Formation described by White et.al. (1959) is a thick sequence of siltstone, impure sandstone, greywacke, conglomerate, and limestone lenses exposed in the Perry Creek and Burdekin River areas.

In 1959 an unconformity was recognized within the Perry Creek Formation of White et.al.(1959), and hence it was necessary to abandon the name Perry Creek for these beds, which have now been sub-divided into the Greenvale Formation and the Kangaroo Hills Formation.

It is now proposed to refer the "Perry Creek Formation" to a sequence of limestone, limestone conglomerate, calcareous sandstone, and impure quartz sandstone with minor amounts of quartz siltstone, which are exposed in Perry Creek about three miles above its junction with the Burdekin River. This formation is a northerly outlier of similar beds outcropping south of the Burdekin River in the Christmas Creek area, which were referred to by White et.al.(1959) as the 4 - Mile Creek Formation. It is now proposed to replace the formation name "Four Mile Creek" by "Perry Creek", where the beds are better exposed.

The Perry Creek Formation occupies an area of about ten square miles in the type section of Perry Creek. This locality is separated from the Christmas Creek locality by a narrow "high" of Kangaroo Hills Formation. The Christmas Creek area is the larger of the two areas and here the Perry Creek Formation extends over about 200 square miles from the Christmas Creek Outstation south to the Clarke River, where it grades into the Tribute Hills Sandstone.

The thickness of the Perry Creek Formation is about 3,500 feet.

The limestone lenses in the Perry Creek Formation are more extensive and thicker in the northern part of their outcrop between the Telegraph Line and Perry Creek than in the south. Here the lenses are thinner and scattered along an arcuate belt, adjacent to its eastern boundary with the Perry Creek Formation. To the west of this limestone belt is a thick sequence of clayey sandstone. The limestone conglomerate and greywacke conglomerate containing limestone pebbles are generally exposed adjacent to limestone lenses, and are part of the detritus formed off shore from limestone reefs. If this was the case, the limestone was originally thicker than is shown by its present outcrop. Also the sandstones probably originally contained considerable calcareous material which have since been silicified into a white friable quartz sandstone

12

The age of the Perry Creek Formation is Upper Silurian to Lower Devonian (See Appendix I), as determined by Dr.D. Hill from the corals in the lenticular limestones.

The Perry Creek Formation conformably overlies the Kangaroo Hills Formation. The rhythmic alternations of the beds of the Kangaroo Hills Formation are repeated in the sandstone and siltstone of the Perry Creek Formation. The sediments of the Perry Creek Formation are cleaner and contain a greater proportion of quartz than the Kangaroo Hills Formation, and in places are calcareous. To the south in Gill Creek the Perry Creek Formation is unconformably overlain by the Carboniferous Clarke River Formation.

The Perry Creek Formation is correlated with the Jack Limestone in the Broken River area, which contains thicker limestones and the age is also Upper Silurian to Lower Devonian. The rhythmic alternating calcareous quartz sandstone and siltstone associated with the Jack Limestone is similar to the sediments associated with the limestone lenses in the Perry Creek Formation.

DEVONIAN

Broken River Formation

This formation has been defined by White et.al.(1959). However, in view of the unconformities discovered in 1958, the Broken River Formation is now restricted to the Lower Devonian - Middle Devonian (or ?Upper Devonian) limestone sequence exposed immediately above the Graveyard Creek Formation in the Pandanus Creek area and above the Jack Limestone in the Broken River area (Plate 6).

The upper age of the Broken River Formation is in doubt. It certainly extends to the late Middle Devonian (Givetian), and it may include the Upper Devonian (Frasnian). The probable Upper Devonian age for the top of the Broken River Formation is obtained from a thin lens of richly fossiliferous limestone (BRS 16, 103 and 104) exposed near the base of the Bundock Creek Formation at Gregory Springs (Plate 3). The mapping suggests that the limestone lens is confined in a syncline of the Bundock Creek Formation, and it is unlikely to be an inlier of the Broken River Formation. The Gregory Springs Frasnian occurrence is difficult to correlate with any of the other Devonian limestones as elsewhere Frasnian fossils are absent.

The Broken River Formation contains abundant coralline limestone lenses which have been deal with elsewhere (White et. al., 1959). Further corals with some brachiopods were collected in 1958 at localities BRS95, BRS76, BRS90, BRS88, BRS86, BRS87, BRS85, BRS84, BRS82, BRS96, BRS99, BRS80, BRS98, (Plate 5). These indicate a Lower Devonian to Middle Devonian age for the Broken River Formation.

The Broken River Formation is unconformably overlain by the Bundock Creek Formation.

IGNEOUS ROCKS

Serpentine and Related Basic Rocks.

Serpentine and gabbro intrusions near the Precambrian/Palaeozoic boundary area in the Halls Reward Mine have been described by White, Branch and Green (1958), and from the Gray Creek area, by Green (1958) and by White et.al. (1959).

Two ages of serpentine and basic intrusions were recognized: late Precambrian or early Palaeozoic, Sandalwood Serpentine, and Upper Devonian Gray Creek Complex and Boiler Gully Complex. However, the recognition of more than one unconformity in the Siluro-Devonian succession has shown, that the Upper Devonian age for the main serpentine intrusion, the Gray Creek Complex, is incorrect. In the Pandanus Creek area serpentine intrudes the Upper Silurian Graveyard Creek Formation and is overlapped by the Lower Devonian Broken River Formation. Nowhere in the area does serpentine intrude the Devonian or Carboniferous rocks; and it is now considered that the later serpentine and basic rocks were intruded during the early Lower Devonian orogeny.

The 1958 mapping showed the serpentinite to be discontinuous lenses near the Precambrian/Palaeozoic boundary extending north to Gunnawarra Station (Plate 2), near the southern boundary of the Atherton 4-Mile Sheet. The lenses include prominent exposures at Minnamoolka Station and about four miles north-east of the Valley of Lagoons Station (Plate 3). Here the serpentine has been leached and silicified to form a gossan-like outcrop, consisting of earthy iron oxides and a silica boxwork. In places silicification is almost complete.

The total length of the serpentinite belt is about 110 miles. The serpentinite and associated basic lenses are en echelon and trend from 010° to 020°. The en echelon pattern in the northern part of this belt may be due to transverse faults which trend at 340°.

Cobbold Dolerite

The Cobbold Dolerite consists of stocks and cupolas which intrude and dome the Etheridge Formation between the Gilbert and Robertson Rivers in the southern part of the Georgetown 4-Mile Sheet (Plate 2). The largest mass is about four square miles in area and the intrusion has formed radial, incipient tension joints ("b" lineation) in the overlying Etheridge Formation.

The name is derived from Cobbold Creek, which joins the Gilbert River in the southern part of the Georgetown 4-Mile at longitude 143°24' and latitude 18°48'.

Two large stock-like masses in the Gilbert River and Robertson River areas range in texture from medium-grained dolerite to fine-grained basalt which in places appear to exhibit flow line. Flow lines in the rock indicate that only the roof of these two masses is exposed and they are regarded to be cupolas of a larger basic mass at depth.

The contact metamorphic aureole is narrow and metamorphism restricted to a slight induration of the sediments.

The Cobbold Dolerite has been metamorphosed to diorite and amphibolite by the Forsayth and Robin Hood Granites. Dolerite sills and dykes intrude the Etheridge Formation between the Gilbert River and the Forsayth/Georgetown road and at Ortona.

Ring Dykes and Related Igneous Complexes.

Nomenclature:

In order to distinguish between extrusive and intrusive rhyolite rocks, "rhyolite" is used to denote an extrusive origin and "rhyolite porphyry" is used where the rock is rhyolitic, porphyritic and intrusive. The same scheme is used for other extrusive and intrusive porphyritic rocks.

Acid ring dykes associated with granitic stocks are intruded into the Dumbano and Forsayth Granite near Bagstowe Station. The ring dykes consist dominantly of rhyolite porphyry with minor andesite porphyry. These are intruded by cone sheet swarms of rhyolite porphyry and semi-circular mass of micro-granodiorite. The final phase of igneous activity is the intrusion of an oval-shaped granite stock into the geometric centre of the dyke complexes. The granite intrusion is capped with a thick hood of flow banded rhyolite porphyry.

The ring dyke and related igneous complex has been studied in detail by Branch (1959).

GRANITIC ROCKS

(?)Precambrian:

Granitic rocks of probable Precambrian or early Palaeozoic age intrude the Precambrian succession. They crop out about 4,000 square miles in the Etheridge Goldfield area. Samples from these rocks have been collected for age determinati Until dates are available the intrusions are tentatively assigned to late Precambrian.

White and Hughes (1957) referred to the whole of the Precambrian granites as the Forsayth Batholith. They recognized variations within this batholith but did not subdivide it. In 1958 the Forsayth Batholith was subdivided into four different granites and a granodiorite (Table 2). The relationships between the granites and granodiorite are not precisely known.

The main granite is a grey porphyritic biotite granite called the Forsayth Granite . The name "Forsayth Batholith" is discarded. It is commonly massive but in places exhibits platy flow of feldspar phenocrysts around its margin. Near Forsayth this granite is rich in biotite, probably due to contamination by Proterozoic shales.

The geographical distribution of the Precambrian granites suggests preferred intrusion into the Archaean mass or along the boundary between the Archaean and Proterozoic. Foliation in many of the Precambrian granites conforms to the Precambrian margin. This is particularly shown by the Dumbano Granite in the Clarke River area, where foliation trends, from 360° to 080° in conformity with an abrupt change in the Proterozoic/Archaean boundary.

The granites have contact metamorphosed the Proterozoi sediments. The Robin Hood Granite has formed andalusite, muscovite, cordierite and garnet in the Robertson River metamorphics. The Dumbano Granite has contact metamorphosed the

E 2. PRECAMBRIAN GRANITES IN THE ETHERIDGE GOLDFIELD

UNIT	LITHOLOGY	STRUCTURE	THICKNESS	RELATIONSHIP AND REMARKS.
ayth ite	Grey, porphyritic biotite granite	Usually massive. Occasional platy flow of felspar.	Covers an area of 2,000 sq.miles in central part of Etheridge Goldfield.	Intrudes Einasleigh Metamorphics (Archaean(?)), Etheridge Formation and Robertson River Metamorphics (Proterozoic(?)). Forms wide aureole of contact metamorphics in Robertson River Area.
bin od anite	Pink-grey massive hornblende- biotite granite. Quartz frequently porphyritic.	-	Covers an area of 350 sq,miles between Robin Hood and Mt.Hogan.	Intrudes Robertson River Metamorphics and Bernecker Creek Formation with formation of a wide contact metamorphic aureole. Possibly genetically related to the Dumbano Granite. Relationships with other Granites unknown. Intrudes the Cobbold Dolerite.
mbano anite	Medium grained grey biotite granite with pink, porphyritic feldspar. In places, pink-cream pegmatitic muscovite granite	Tectonically foliated. Foliation conforms to edge of Pre-Cambrian.	Covers an area of 1,700 sq.miles between Welfern and Reedy Springs Stations.	Intrudes the Einasleigh Metamorphics, Bernecker Creek Formation. Unconformably overlain by Carboniferous Bundock Creek Formation and intruded by the Upper Palaeozoic Bagstowe Ring Dyke Complex. Relationship to Forsayth Granite is unknown. The Robin Hood Granite is probably a differentiate of the Dumbano Granite. Pegmatite dykes at Woolgar Goldfield may also be related.
do anod- rite.	Grey foliated medium grained granodiorite.	Foliated	Covers an area of 240 sq.miles between Lyndhurst and Wyandotte Stations.	Intrudes the Lucky Creek Formation to form a wide contact metamorphic aureole. Probably intrudes the McKinnon's Creek. Granite.
Kinnon's eek. anite	Coarse- even-grained cream-pink muscovite granite with felspar in places porphyritic.	Some fine-grained parts are tectonically foliated.	Covers an area of about 120 sq. miles.	Intrudes the Halls Reward Metamorphics and Stenhouse Creek Amphibolite (Archaean(?)). Also intrudes the Lucky Creek Formation, Paddys Creek Formation and Sandalwood Serpentinite. It is unconformably overlain by Siluro-Devonian sediments. Probably intruded by the Dido Granodiorite.

the Bernecker Creek Formation to form wide aureoles of quartz-actinolite-epidote and calc-silicate hornfels. Similar metamorphic assemblages have been formed in the Lucky Creek Formation by the intrusion of the Dido Granodiorite.

The intrusion of the Precambrian granites has resulted in retrograde metamorphics of the Archaean Einasleigh Metamorphics.

Palaeozoic.

Granite and granodiorite intrude the Palaeozoic succession in the Broken River and Herbert River areas. The ages of granitic intrusion within the Palaeozoic are not precisely known: Jones (1948) considers two main periods of igneous granitic intrusion - the "Herberton Epoch" in the late Devonian or early Carboniferous, and the "Gympie Epoch" in the late Palaeozoic (Permian(?)). There are at least two ages of granite in the Palaeozoic in this area. These may conform to the Herberton and Gympie Epochs; but there is some evidence in the Broken River area to suggest that the main period of Palaeozoic granitic intrusion took place earlier than proposed by Jones (1948). In the Broken River area a major orogeny took place in the early Lower Devonian; it would not be surprising if the main bulk of the Herbert River Granite was intruded during this orogeny.

The Herbert River Granite is the most extensive of the Palaeozoic granites. It crops out over 180 square miles in the Herbert River area. Small exposures farther south at Perry Creek Wolfram Diggings, Rocky Dam and Frazers Creek are probabl outliers of the Herbert River Granite. It is commonly a grey granite, in many places containing phenocrysts of pink feldspar up to 2 cm. in length. The granite grades into syenite towards its roof in the Herbert River Falls and Camel Creek Station area It is intruded by a pink massive even grained porphyritic microgranite, the Tiger Hill Microgranite, which has a hood of flow banded rhyolite porphyry.

The younger Palaeozoic granites commonly grade up into rhyolite porphyry hoods. This feature is shown by the Elizabeth Creek Granite in the north-eastern part of the Einasleigh 4 - Mile Sheet. The granite is even fine to medium-grained, massive and pink. It is well jointed in outcrop consisting of many tors, which form rugged high hills. It grades through a pink microgranitic zone to pink rhyolite porphyry, the Cumbana Rhyolite Porphyry, The rhyolite is flow banded in part and porphyritic throughout, with a glassy groundmass, which is microgranitic away from the granite/porphyry contact. The Elizabeth Creek Granite probably extends north on the Atherton 4 - Mile Sheet (towards Atherton).

Other probable younger Palaeozoic hooded granites are the Esmeralda Granite, near Croydon and the Oweenee Granite south of the Clarke River.

The Esmeralda Granite crops out in scattered areas, totalling eight square miles in the Gregory Range. Felsite (Honman, 1937). The granite is a massive, even-grained grey granite with pegamtite and graphite zenoliths.

In many places the Esmeralda Granite is separated from the Croydon Felsite area by a narrow transitional zone of microgranite which ranges from one to one hundred feet wide. The Croydon Felsites consists mainly of grey porphyritic rhyolite, in places flow banded. It crops out over an area of about one thousand square miles.

From recent examination the Croydon Felsite is considered to be a rhyolite porphyry hood of the Esmeralda Granite. Evidence for this is: gradation between granite through microgranite into rhyolite porphyry and felsite; the marginal distribution of the granite in the Croydon Felsite Area; the occurrence of graphite in the granite and Croydon Felsite; the conformity of flow lines in the rhyolite to its contact with granite; the low angle of dip, and in places the domal attitude, of the gold lodes in the felsite area. If interpretation is correct, there is only one age of Upper Palaeozoic igneous activity in the Croydon area.

BASALT.

There are at least four main periods of Cainozoic vulcanism on the Einasleigh Sheet. The volcanics, consisting almost entirely of basalt, were extruded from 112 known centres. The centres consist mainly of scoria cones with some shield volcanoes, pit craters and minor composite cones.

The Kinrara Crater, a pit crater, was probably active in historical time (1,000 years) and extruded basalt for about 30 miles toward the Burdekin River where it has dammed the river to form many lakes. Features such as pahoetoe, sinks and depressions are preserved in the Kinrara Basalt.

Lava tunnels are also exposed in older basalts. The largest tunnel extends over 30 miles from the Undara Crater. This crater is located in the central part of the McBride Basalt Province.

STRUCTURE

The recognition of two types of metamorphics in the Precambrian and the discovery of unconformities in the Siluro-Devonian succession have necessitated a review of some of the structure in North Queensland, described by White and Hughes (1957) and White et.al. (1959).

Throughout the structure the fundamental control appears to be the configuration of the margins of pre-existing basement rocks. For example the arcuate trends of the Proterozoic conform to the shape of a central cone or nucleus of Archaean metamorphics. Again the linear eastern boundary of the Precambrian appear to have controlled the trends of later Palaeozoic sediments, since the north-north-east trend of the Palaeozoic sediments conforms to the trend of the Precambrian margin along the Burdekin River, and the east-north-east trend of the Palaeozoic sediments conforms to the margin of the Precambrian along the Clarke River.

Precambrian

Although partly obscured by later granite intrusions the Archaean mass can be considered to consist of two masses or nuclei; one in the north situated on the central eastern margin of the Georgetown 4 - Mile Sheet and the other in the south not so clearly defined, situated in the central - western part of the Clarke River 4 - mile. The trend within the Archaean are arcuate to circular. Generally at any one place the Archaean trend conforms to the trend of the Proterozoic sequence, with the result that the Proterozoic trend is arcuate. This is particularly the case in the Etheridge Goldfield, where the trend ranges from north in the northern part of the goldfield, through an arc, to east in the central and southern parts

The folding of the Archaean has been obscured by regional metamorphism and plastic flow in many places.

The folding of the Proterozoic is moderate with anticlines and synclines pitching up to 30°. In the central part of the Georgetown Four Mile small basins and domes are formed.

Axial Plane Foliation and Lineation in the Proterozoic.

In the Robertson River area the Etheridge Formation and the Robertson River Metamorphics are folded along east-west axes with the formation of a marked axial plane foliation and a "b" lineation which was followed by intrusion of the Cobbold Dolerite, which domed the sediments and finally intrude by the Robin Hood Granite.

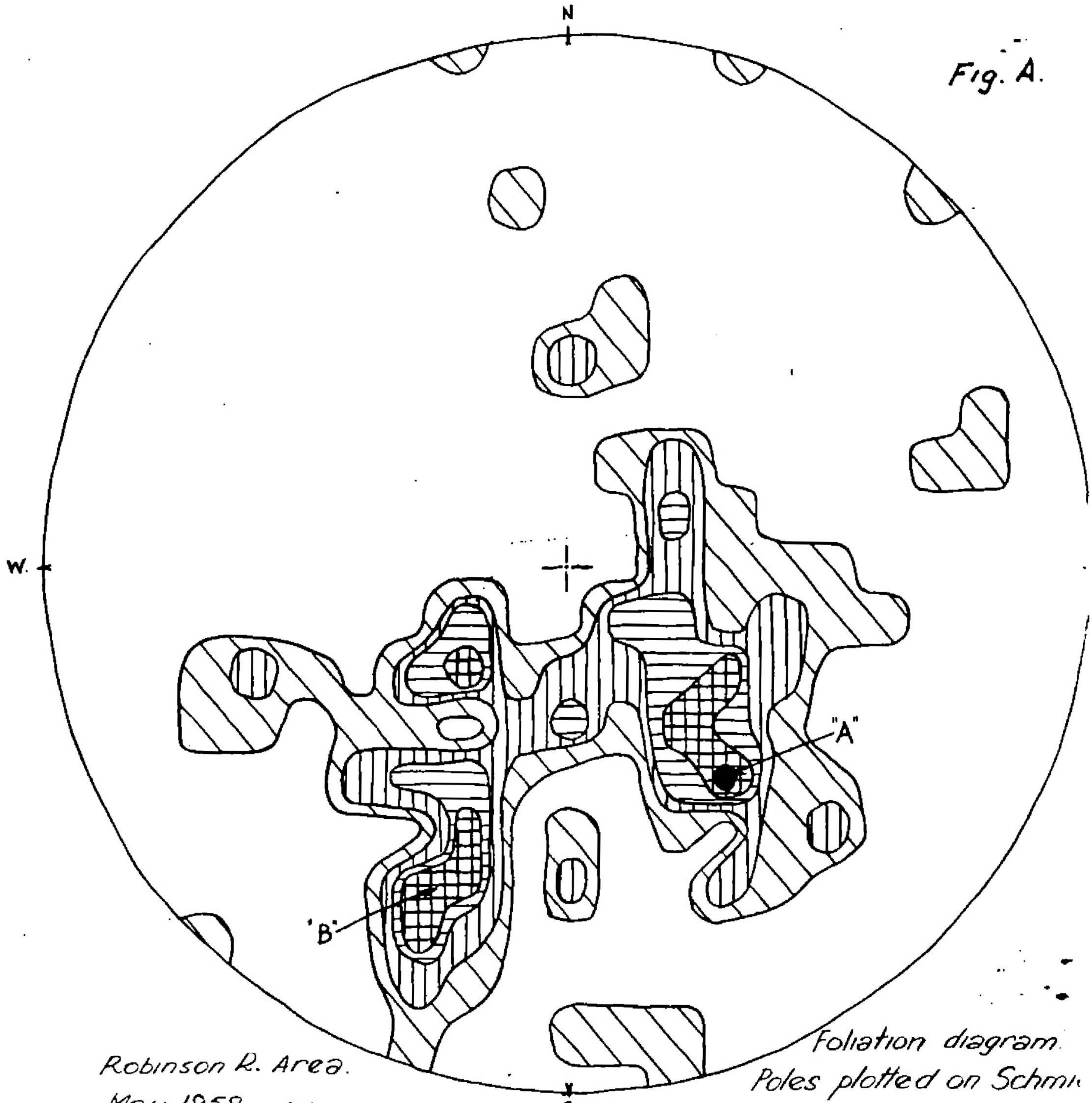
Hand Specimen Description: Specimens from the Robertson River area show three lineations: -

1. Fine crenulations of the foliation surface. The crenulations have an amplitude of 0.5mm. to 2.0mm; a wave length ranging from 4.0mm. to 15.0mm; and an axial length of 1.0 cm. to 4.0 cm. A 'b' lineation is developed on these small folds, represented by a micro-crenulation. The lineation is practically universal in the area and is commonly found without the other two.

Figure 6. Fine lineations ("b" lineation i.e. parallel to the fold axis) and widely spaced coarse lineations or crenulations (pencil) along the bedding plane of quartz-sericite schist of the Robertson River Metamorphics. (Proterozoic ?). Cave Creek, Georgetown Four Mile E/55/12.

2. A coarser crenulation, like a small monocline, with th following diagnostic measurements: Amplitude, 0.2mm: wave length 15-30cm; and an axial length of over a meter. (Figure 6). The lineation usually contains fine crenulation, which are always folded by the coarse crenulations, showing that the fine are older than the coarse. The angle between the two is generally between 50 and 80 degrees, although in rare exposures it may be 10 degrees.

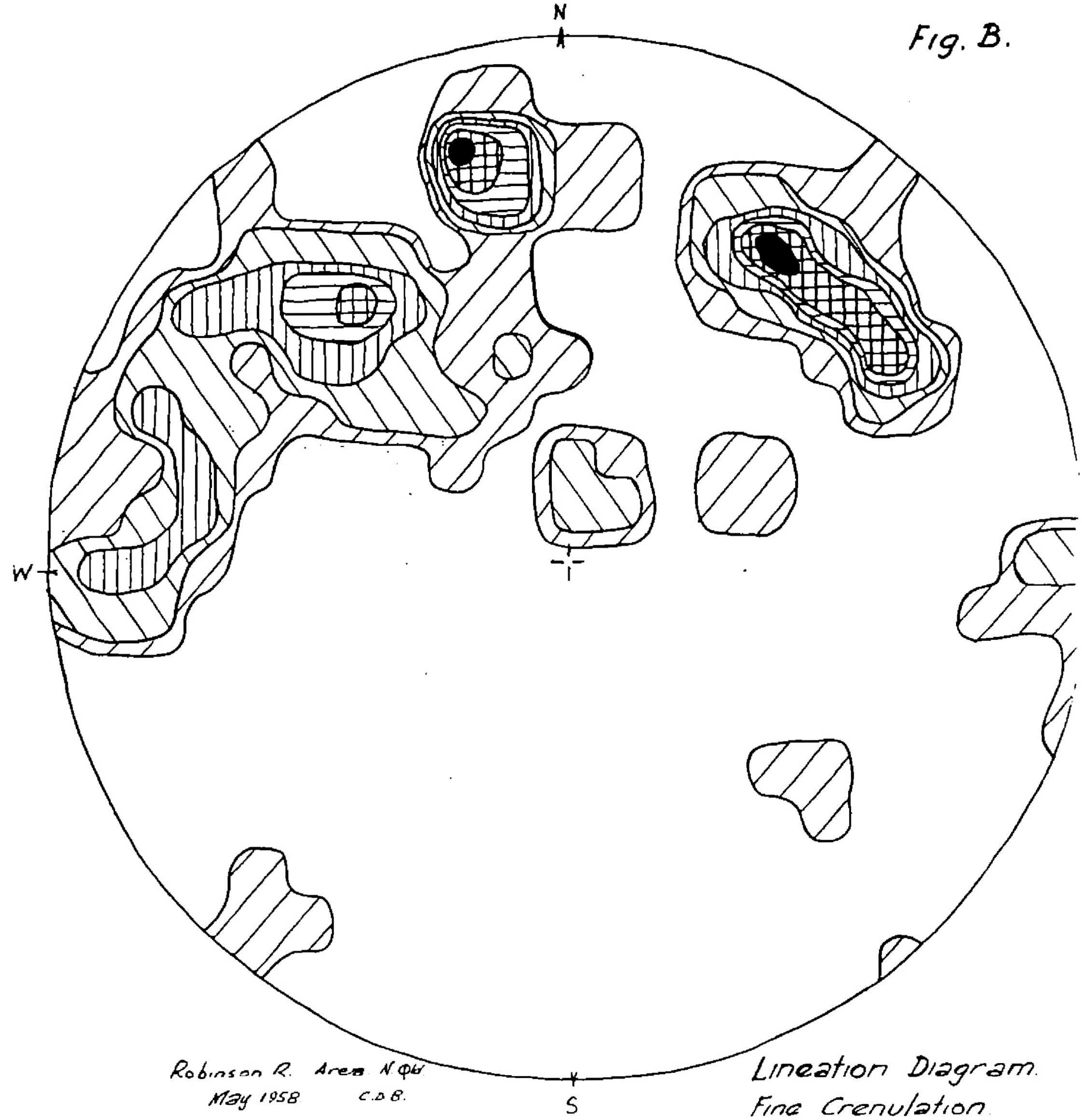
Fig. A.



Robinson R. Area.
May 1958, CDB

Foliation diagram.
Poles plotted on Schmi
Net. Contours 2%, 3%, 4%.
(97 poles.) Lower Hemis:

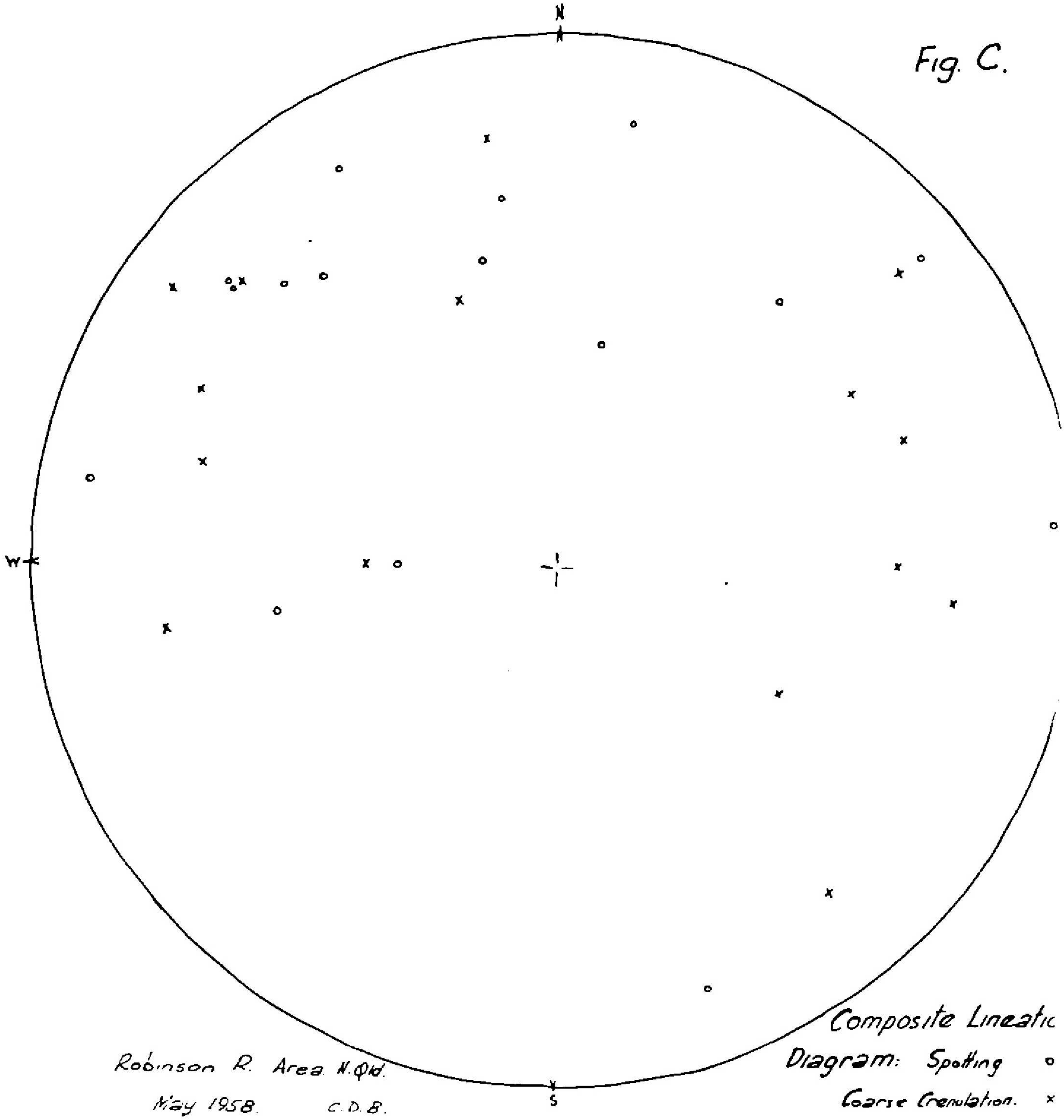
Fig. B.



Robinson R. Area N.W.
May 1958 C.D.B.

Lineation Diagram.
Fine Crenulation.
60 points plotted on Schmidt Net
Lower Hemisphere
Contours: 1.5, 3, 5, 6.5, 8, 9

Fig. C.



Robinson R. Area N. Qld.
May 1958. C.D.B.

Composite Lineatic
Diagram: Spotting o
Coarse Crenulation. x
Schmidt Net. Lower Hemis

3. Occasionally a third lineation is exposed due to a regular orientation of elongated spots and knots of metamorphic origin. The lineation forms at various angles to the other lineations; one example being 55 degrees to the fine (1) and 45 degrees to the coarse lineation (2).

Foliation: Foliation planes are well exposed in the fine-grained sediments and metamorphics. It is probably axial plane foliation (flow cleavage) . The foliation plane is inclined at a small angle (5 - 10 degrees) to the bedding, but in most outcrops the bedding has been obliterated by shearing.

97 foliations were measured and the poles of these plotted and contoured on the lower hemisphere of an equal area Schmidt net. (Figure A). This plot shows a wide dispersion of the poles and three maxima. The original maxima is represented by the 5% maxima 'B'. This foliation was formed during the east-est folding and probably was universal over the area. It represents a foliation striking 290 degrees, and dipping to the north at 60 degrees.

Later doming by the Cobbold Dolerite and Robin Hood Granite has distorted the bedding (and associated foliation) giving the dispersion depicted on the Figure A. The 6% maxima The 6% maxima 'A' and the spread of poles to the north is especially prominent, because it represents the area between the two domes where most were measured. Foliation here ranges in strike from 050 to 335 degrees andin dip from 20 to 60 degrees north-west to west, and is possibly overturned.

Fine Crenulation: Figure B shows the fine crenulation lineations, plotted on a similar net to the foliation, and when contoured, tend to fall on a great circle dipping north at 30 degrees. Although the points are fairly dispersed, the maxima bear a constant angular relationship of 80 degrees to the folia-tion maxima. This is shown in small areas, for example, the 40 square miles of one aerial photograph, where the foliation and fine crenulation bear a constant relationship and only vary by plus or minus 20 degrees.

For example the following data was recorded from observation points on Georgetown Air Photo Run 13, number 5105.

Feature	Characteristic.	Max.	Min.	Average.
Foliation	Strike	060°	020°	040°
Foliation	Dip	80°	30°	55°
Fine Crenulation	Strike	350°	310°	330°
Fine Crenulation	Dip	60°	20°	40°
Difference in strike	70°			
Difference in Dip	15°			

This indicates that the lineation is a 'b' lineation developed on folds plunging 30 degrees mainly to the west.

Coarse Crenulation: This crenulation was formed under tension and is unlike the fine crenulation, which is a minute crumpling of the rock due to drag giving a compression normal tothe fold axes. The lineation is exposed where incipient joints (the spacing is a little too great to call it fracture cleavage) intersect the axial plane foliation at a moderate to high angle. Optical orientation of the micas changes over the joint, due to bending of the rock (like a small monocline), but rupture is not oomplete.

Because only 17 lineations were measured, the diagram on which they are plotted (Fig.C) has not been contoured but it can already be seen that they are lying on a girdle 40 degrees in from the margin. This indicates that the lineations represent incipient radial tension joints. This lineation is only found in a zone eight miles wide round the Cobbold Dolerite which suggests that the dolerite was intruded in a plastic state and domed the sediments above them. The gap in the girdle to the south-west corresponds to where younger Cretaceous sediments cover the Proterozoic rocks.

Lineated Spots: Spotting is common in the slates and schists surrounding a pegmatitic phase of the Robin Hood Granite west of Robin Hood Station. In rare instances the spots are lineated and 16 of these are plotted on figure C. Like the coarse crenulations, these points plot on a girdle 35 degrees in from the primitive, but their orientation is difficult to explain. Their outcrop pattern suggests that the sediments have been domed by the granite, and that the stresses related to this movement must have been localised into zones, represented by the lineated spots, around the granite margin.

Conclusions: The structural sequence of events is envisaged to be: -

1. Folding of sediments along east-west axes, which plunge generally to the west at 30 degrees, accompanied by the formation of axial plane foliation and 'b' lineations (fine crenulations).

2. Intrusion of Cobbold Dolerite in a plastic mass doming the overlying sediments and forming radial, incipient, tension joints, ('b' lineation).

3. Intrusion of Robin Hood Granite with general spotting in the metamorphic aureole and lineation of these spots in localised, radial stress zones.

Palaeozoic

The trend of the Palaeozoic sediments generally conforms to the configuration of the Precambrian basement. This can be seen in the trend of the Palaeozoic sediment along the eastern boundary of the Precambrian, which is slightly arcuate from 20 degrees in the north to 50 degrees in the south. And again in the south the Palaeozoic trends conform to the edge of the Precambrian basement, which changes abruptly and trends about 80 degrees to almost coincide with the Clarke River.

Although this conformity is generally true along the Precambrian margins, there are major discrepancies in trends further away from the Precambrian within the Palaeozoic between formations above and below the unconformities. The most marked difference in trend is between the Upper Silurian and Lower Devonian Kangaroo Hills Formation and the Silurian Greenvale Formation on the eastern part of the Einasleigh Four Mile Sheet. Here the trend of the Kangaroo Hills Formation is about 80° and the Greenvale Formation is 360°. This difference in trend is probably due to a land mass, which formed a north-south ridge in the Pelican Range area in early Silurian time. The shape of the eastern shoreline of this land mass in the Perry Creek area formed many east-west bays in which the basal beds of the Kangaroo Hills Formation were deposited.

nally a third lineation is exposed due to a[redacted] orientation of elongated spots and knots of ·p[redacted]ic origin. The lineation forms at various to the other lineations; one example being ·ees to the fine (1) and 45 degrees to the l[redacted]neation (2).

ion: Foliation planes are well exposed in the i[redacted]nts and metamorphics. It is probably axial f[redacted]ow cleavage) . The foliation plane is al[redacted] angle (5 - 10 degrees) to the bedding, but the bedding has been obliterated by shearing.

ia[redacted]ions were measured and the poles of these oured on the lower hemisphere of an equal area g[redacted]e A). This plot shows a wide dispersion of r[redacted] maxima. The original maxima is represented [redacted]'. This foliation was formed during the east- probably was universal over the area. It i[redacted]ion striking 290 degrees, and dipping to the e[redacted].

doming by the Cobbold Dolerite and Robin Hood o[redacted]ed the bedding (and associated foliation) r[redacted]ion depicted on the Figure A. The 6% maxima ' and the spread of poles to the north is n[redacted]t, because it represents the area between the m[redacted]st were measured. Foliation here ranges in t[redacted] 335 degrees andin dip from 20 to 60 degrees ist, and is possibly overturned.

[redacted]nulation: Figure B shows the fine crenulation tted on a similar net to the foliation, and when t[redacted] fall on a great circle dipping north at 30 [redacted] the points are fairly dispersed, the maxima angular relationship of 80 degrees to the folia- his is shown in small areas, for example, the [redacted] one aerial photograph, where the foliation a[redacted]on bear a constant relationship and only minus 20 degrees.

x[redacted]ple the following data was recorded from i[redacted]s on Georgetown Air Photo Run 13, number 5105.

	Character- istic.	Max.	Min.	Average.
[redacted]	Strike	060°	020°	040°
	Dip	80°	30°	55°
n[redacted]	Strike	350°	310°	330°
n	Dip	60°	20°	40°
trike	70°			
i[redacted]	15°			

[redacted]dicates that the lineation is a 'b' lineation [redacted]s plunging 30 degrees mainly to the west.

[redacted] Crenulation: This crenulation was formed [redacted] is unlike the fine crenulation, which is a g of the rock due to drag giving a compression [redacted] axes. The lineation is exposed where [redacted] (the spacing is a little too great to call it ge) intersect the axial plane foliation at a h angle. Optical orientation of the micas joint, due to bending of the rock (like a [redacted], but rupture is not oomplete.

ineations were measured, the lotted (Fig.C) has not been contoured that they are lying on a girdle 40 This indicates that the lineations tension joints. This lineation is niles wide round the Cobbold Dolerite erite was intruded in a plastic ts above them. The gap in the girdle is to where younger Cretaceous zoic rocks.

Spotting is common in the slates and itic phase of the Robin Hood Granite In rare instances the spots are plotted on figure C. Like the oints plot on a girdle 35 degrees heir orientation is difficult to tern suggests that the sediments te, and that the stresses related en localised into zones, represented the granite margin.

structural sequence of events is

ts along east-west axes, which the west at 30 degrees, accompan- on of axial plane foliation and 'b' enulations).

d Dolerite in a plastic mass g sediments and forming radial, joints, ('b' lineation).

Hood Granite with general spotting aureole and lineation of these radial stress zones.

laeozoic sediments generally con- the Precambrian basement. This ie Palaeozoic sediment along the ıbrian, which is slightly arcuate o 50 degrees in the south. And oic trends conform to the edge of h changes abruptly and trends ncide with the Clarke River.

mity is generally true along the major discrepancies in trends ian within the Palaeozoic between unconformities. The most marked the Upper Silurian and Lower ion and the Silurian Greenvale of the Einasleigh Four Mile Sheet. Hills Formation is about 80° 360°. This difference in trend , which formed a north-south a in early Silurian time. The e of this land mass in the Perry st bays in which the basal beds n were deposited.

In detail the folding within the Palaeozoic sequence sequence decreases in intensity from the oldest to the youngest formations. The folds in the Wairuna Formation (Lower Silurian) are tight with steep to vertical dips and much shearing and minor crumpling. In the Graveyard Creek Formation (Upper Silurian) the folds are more open and pitch at moderate angles to the south-west. In the Clarke River Formatinn (Carboniferous the folds are moderate and shallow with the formation of domes and basins. This effect is due mainly to the older formations being subjected to several periods of folding, and also due to the older sediments being more fine-grained than the younger sediments, which would make them more incompetent to later folding.

The folding within the Carboniferous is more intense in the western part of the outcrop than it is in the east. This may be due to the proximity of the Carboniferous Bundock Creek Formation in the west to the Precambrian basement. Here compressional forces would be more intense due to the thin cover of Palaeozoic sediments over the basement.

Folds within the Siluro-Devonian are generally tight with the incompetent shale beds more crumpled and sheared than the competent greywacke, sandstone and conglomerate beds. In the Kangaroo Hills Formation (Upper Silurian - Lower Devonian) the main structure is a broad syncline or synclinorium, which trends about 45° through Camel Creek Station and pitches to the south-west at 50°. The limestone beds of the Perry Creek Formation probably occupies the south-western extension of this syncline about 15 miles south-west of the Camel Creek Station. This suggests, that the syncline may be the centre of the trough in which the Kangaroo Hills Formation was deposited, and which later determined the site of isolated shallow basins farther south in which the limestone sequence of the Perry Creek Formation was deposited.

In conclusion some major structures are formed along definite preferred directions. These may be termed lineaments. The main lineaments in the area trend 020°, 080° and 340°. Structures which conform to one or other of these directions are:-

(i) the Precambrian/Palaeozoic boundary;
(ii) the long axes of Precambrian(?) and Palaeozoic granitic, serpentinite and related basic intrusions.
(iii) the major joints in the Upper Palaeozoic volcanics;
(iv) some of the Tertiary and Recent craters;
(v) major faults.

The repetition of these lineaments in the Palaeozoic and Tertiary suggests a hexagonal framework, which probably originated in Precambrian time. This hexagonal framework has been previously recognised by Walpole (1958) to be a fundamental unit in the Precambrian Structure of Northern Australia.

(i) <u>The Precambrian/Palaeozoic boundary</u>. Although obscured by later granitic intrusions and basalt flows, for the most part this boundary is determined by faults. The boundary in the Chillagoe area is linear and trends about 340°. Farther south this boundary is obscured by the Herbert River Granite, and in the Burdekin River it trends about 020°. From here the trace of the boundary to the south is arcuate, until the trend is about 060° in the Bundock Creek area. The Precambrian/Palaeozoic boundary in the Clarke River area trends about 080°. This linear fracture pattern of the Precambrian/Palaeozoic boundary may have been the fundamental control for the formation of a westerly embayment along the western margin of the Tasman Geosyncline in the Broken River area.

(ii) The long axis of the main Precambrian(?) batholith in the area, which includes the Forsayth, Robin Hood and Dumbano Granites, trends about 340°. Superimposed on this intrusion is the Newcastle Range Volcanics, whose emplacement in the Upper Palaeozoic was probably aided by arcuate and linear fractures, which have a meridional trend.

A marked east-west lineament is shown by the exposure of the Elizabeth Creek Granite in the north of the Einasleigh Four Mile Sheet.

The long axis of the Bagstowe Ring Dyke Complex (Branch, 1959) together with the related Lochaber Granite trends about 030°, and conforms to a major fault, which separates the Proterozoic from the Archaean in the Gilberton area.

Finally the long axis of the serpentinite and related basic intrusions trend about 020° parallel to the Precambrian Palaeozoic boundary in the Gray Creek, Valley of Lagoons, Minnamoolka and Gunnawarra areas (Plate 2). This lineament has been active from early Precambrian to late Palaeozoic time.

(iii) The major joints of the Upper Palaeozoic Newcastle Range Volcanics and Croydon "Felsites" trend about 340°, 080° and 020° (Plate 2).

(iv) In the central northern part of the McBride Basalt Province the volcanic craters tend to be aligned in a broad east-west belt. The other direction of alignment is 020° as shown by the Mt.Tabletop, Undara and Racecourse Knob line of craters. The 020° trend conforms to the Precambrian/Palaeozoic fault boundary along the Burdekin River.

(v) Some of the major faults in the area show a preferred orientation. This is particularly the case in the Halls Reward Mine area, where the major faults trend 020°, which conforms to the Precambrian/Palaeozoic boundary. Also a conjugate set of faults in this area, particularly in the Pelican Range, trend about 340° and 080°. All formations from Precambrian to Carboniferous have been faulted adjacent to the Precambrian/Palaeozoic boundary. Here the faults are particularly abundant along the junction of the Precambrian craton and the Pelican Range Silurian land areas. The faults are strike faults, along which the movement was mainly vertical.

GEOLOGICAL HISTORY

Although this has been outlined before by White et.al (1959), it seems advisable to review the geological history, especially in view of the new discoveries in the stratigraphy of the Precambrian and Palaeozoic, of the Georgetown, Einasleigh, Gilberton and Clarke River Four Mile Sheets.

The first event in the geological history probably took place in the Archaean, when original sandy and shaly beds were migmatized by the injection of granitic material at great depths. This process formed a craton of migmatite, gneiss and schists of the EINASLEIGH METAMORPHICS in the Einasleigh, Gilberton and Woolgar areas. The migmatization was accompanied by amphibolitization of original impure calcareous beds in the Halls Reward Mine area to form the Stenhouse Creek Amphibolite and Halls Reward Metamorphics.

In the Proterozoic (?) fine-grained clastic sediments were deposited on a slope in an euxinic environment on the western margin of the Einasleigh Metamorphics. Here small amounts of detritus from the Archaean craton on the east were supplied over a long period, when at times the reduced supply encouraged stagnant conditions in which lenticular pyritic and carbonaceous siltstone (Stockyard Creek Siltstone) were deposited with chert in black grey quartz siltstone, shale and fine-grained quartz sandstone (ETHERIDGE FORMATION)

Similtaneously with this deposition, quartz sandstone and siltstone were deposited on a shelf, nearer the western edge of the Archaean craton in the Robertson River area. Also to the south of the Archaean in the Gilberton area, calcareous sandstone and siltstone (BERNECKER CREEK FORMATION) accumulated in a shallow restricted area, where they intermingled with fine-quartz clastics of the Etheridge Formation. In a similar stable environment to the east of the Archaean craton impure calcareous (LUCKY CREEK FORMATION) and quartz sandy beds (PADDYS CREEK FORMATION) were deposited. These formations are similar to the orthoquartzite - carbonate facies of Pettijohn (1957) generally deposited on stable cratonic foreland areas.

In late Precambrian time the Proterozoic(?) sediments were folded and intruded by dolerite sills and dykes (COBBOLD DOLERITE) account in the central part of the Etheridge Goldfield This was accompanied by the emplacement of serpentinite and gabbro (SANDALWOOD SERPENTINITE) in the Archaean metamorphics of the Halls Reward Mine Area along the eastern edge of the Precambrian. The period of basic and ultrabasic emplacement was followed by the intrusion of a large granite batholith, which includes the Forsayth, Robin Hood, McKinnon's Creek, Dido and Dumbano Granites. The granitic intrusions formed extensive contact metamorphosed Proterozoic sediments, especially in the Robertson River area, where a wide contact aureole of quartzite and garnet-mica schist (Robertson River Metamorphics) was formed. During the Late Precambrian igneous intrusion "b" lineations were superimposed upon earlier "b" lineations in the Robertson River Metamorphics and the Etheridge Formation. The granitic intrusions transgressed the pre-existing Archaean metamorphics, with some retrograde metamorphism.

The earliest record of Palaeozoic sedimentation is in early Silurian or late Ordovician, when marine sedimentation was restricted to the last of the Precambrian mass in the Gray Creek and Broken River areas. Here fine-grained quartz clastics (WAIRUNA FORMATION) with some lenses of coral limestone (Carriers Well Limestone) were deposited in a shallow water environment, which received minor amounts of detritus from a mature Precambrian land mass to the west. Farther away from the Precambrian land mass conditions were favourable for graptolite and trilobite life, in the Broken River and Gray Creek areas, respectively. During this period basalts (EVERETTS CREEK VOLCANICS) were extruded adjacent to the limestone reefs in the Gray Creek area. These volcanics contain some pyroclastics.

During Middle Silurian marine sedimentation continued east in the Pelican Range and Greenvale area. During this period the first greywacke of the area was deposited (Greenvale Formation) in the Palaeozoic, which was probably due to a slight emergence of the Precambrian land mass with a subsequent, deepening of the geosynclinal trough in the Greenvale area. Closer to the Precambrian land mass clean quartz sandstone with minor quartz siltstone (Pelican Range Formation) were deposited probably in a shelf environment.

In early Upper Silurian conditions became unstable. The Silurian sediments were folded along north and north-north-east axes, and possibly intruded by linear dolerite bodies, which formed numerous jasper beds in the Silurian sediments. At the culmination of this orogeny, these sediments formed tectonic land, which together with the Precambrian land mass in the Bauhinea Creek area, supplied a great amount of detritus for an extensive period of greywacke geosynclinal sedimentation. Following the rise of tectonic Silurian land in the central part of the area, two troughs were formed one on either side of this north-trending Silurian land ridge. The western trough in the Gray Creek area received a variety of detritus from the Precambrian to the west, and from the Silurian land ridge to the east. There conditions were favourable for thick rhythmic, alternating graded bedded greywacke beds, (Graveyard Creek Formation) to be deposited in the western trough. The eastern trough was shallower than the western trough and received lesser amounts of greywacke and greater amounts of fine grained quartz sand and silt, which now exhibit micro cross-bedding and micro slumping (KANGAROO HILLS FORMATION The differences between these two flysch facies suggest that the Silurian tectonic land mass was steeper on its western side than its eastern side, where the detritus (sand, shale and rock fragments) was deposited on a gentle slope and transported long distances by turbidity currents into a trough.

By the late Upper Silurian or Lower Devonian the eastern and western troughs were probably filled with geosynclinal sediments and consequently reduced in depth. Sedimentation was restricted to a few isolated basins, where conditions were favourable for growth of thick coral reefs. These reefs were thicker on the western basin (Jack Limestone) than in the eastern basin, where a greater amount of reef detritus (Perry Creek Formation and Tribute Hills Sandstone)accumulated.

A major orogeny occurred in the early Lower Devonian, when the Upper Silurian - Lower Devonian greywacke and limestone beds were folded and intruded by an extensive suite of serpentinite and basic rocks (Gray Creek Complex and Boiler Gully Complex) adjacent to the earlier serpentinite intrusions (Sandalwood Serpentinite) and parallel to the Precambrian/ Palaeozoic boundary. The ultrabasic intrusions were followed by the emplacement of granitic rocks, such as the Herbert River Granite, in the Herbert River and Perry Creek areas.

Following the Lower Devonian orogeny marine sedimentation was restricted to the Broken River area, where conditions were favourable for the growth of thick coralline limestone reefs and deposition of reef detritus and shale. (BROKEN RIVER FORMATION). In places freshwater sediments with thin shale beds containing primitive "Problematica" plants were intercalated with the marine limestones. This sedimentation in the Broken River area continued up to the Givetian (late Middle Devonian) and may have extended into the Frasnian (Upper Devonian) in the Gregory Springs area. This period was followed by an orogeny with the intrusion of small granodiorite bodies (Craigie Granodiorite).

After the late Middle or early Upper Devonian orogeny paralic sedimentation was further restricted into the south in the Bundock Creek area, where freshwater sandstone and minor conglomerate, with thin basal marine limestone were deposited up to the Lower Carboniferous (Tournaisian) (Bundock Creek Formation) Similar freshwater basins were formed in the Clarke River, Gray Creek and Blue Range areas where deposition of coarse-grained sandstone, conglomerate and shale continued into the Middle Carboniferous (Clarke River Formation).

During this period, or probably in the Upper Devonian - Lower Carboniferous, freshwater conglomerate and sandstone were deposited in a shallow basin in the Gilberton area (Gilberton Formation).

The Carboniferous period of paralic freshwater sedimentation was followed by an orogeny, probably in the Permian, during which extensive rhyolite flows were extruded (Agate Creek Volcanics, Newcastle Range Volcanics, Cumberland Range Volcanics) accompanied with minor basalt flows and some pyroclastics. During this orogeny and closely following the vulcanism, the main bulk of granites (Lochaber, Elizabeth Creek, Oweenee and Esmeralda Granites) with their related porphyry hoods (Cumbana Rhyolite Porphyry and Croydon Felsite) were emplaced in a thin sedimentary cover. The granitic intrusions were accompanied by, or slightly preceded by, acid ring dyke intrusion (Bagstowe Ring Dyke Complex and Butlers Igneous Complex) in the Kidston area. Some of the Permo-Carboniferous igneous masses were emplaced along old fractures in the Precambrian granites or weaknesses in the Precambrian structure, such as contacts between granite and metamorphics, and along Archaean/Proterozoic boundaries. After this period of igneous activity, the area became more stable until the Upper Jurassic or Lower Cretaceous, when thin freshwater sandstone and shale transgressed over the western part of the Etheridge and Woolgar Goldfields extending east to Gregory Springs and the Hann Highway, and covering a considerable area of Precambrian metamorphic and granite.

The Cretaceous was the completion of the main sedimentation in the area, although some small areas probably contain Tertiary sediments, but as yet no fossils have been found in them.

The last geological record is in the late Tertiary (Pliocene (?)), when basalt vulcanism commenced and extended intermittently into the Recent. Basalt flows were extruded from craters in the McBride, Chudleigh and Nulla areas. In some places the volcanic craters were centred on old fracture weaknesses in the basement rocks. The younger flows have dammed the present river systems to form numerous lakes, e.g. Lake Walters, G.W. Swamp, and Pelican Lakes (Plate 2). Diatomite deposits were formed in some of the lakes.

MINERALIZATION

During the 1958 survey many mines were located. No mines were mapped as in most cases the underground workings were inaccessible, and in other cases detailed mapping had been previously carried out by the Geological Survey of Queensland.

Gold

In 1958 two mines were being worked in the Woolgar Goldfield;

(i) "Soapspar", leased by Roger Barnes and Tom Guest (Hughendon).

(ii) "Red Jacket", leased by Bob Cummins, (Richmond).

(i) The Soapspar Mine which was originally opened about 1883 is situated ten miles east-north-east of Lower Camp and two miles south-east of Old Mill on the southern edge of the

Woolgar River. Operations have been irregularly continued for eight years on the present workings. An open cut mine was commenced about eighteen months ago on a pod of auriferous sheared serpentinized dolerite 15 feet in diameter with subsidiary pods 6" - 12" in diameter. This hasnow been removed and exploration is continuing following stringers of sheared and podded dolerite. The country rock is a strongly jointed and sheared granite with some amphibolite. Movement appears to have been overthrust to the east on flat lying, westerly dipping joint planes.

(ii) The Red Jacket mine (1932) is located on the northern side of the Woolgar River, approximately 13 miles north-east of Lower Camp. A shaft 9 feet square with an underlie of 70^{o} S.E. has been sunk on a gold-bearing quartz reef to a depth of 106 feet since work commenced in September 1957. At present development is concentrated on driving east-north-east and west-south-west at the 70 foot level.

The reef exposed in the shaft has a consistent width of 6 to 7 feet to the 70 foot level. To the east-north-east the reef cuts out after 25 feet and to the west-south-west it is divided by a 3 foot wide dolerite dyke. The wall rocks are massive dolerite, which in places especially on the hanging-wall, is sheared and talcose. Occasionally the dolerite wall is broken through to expose mica schist.

The country rock for the mine is Precambrian mica schist (probably part of the Archaean Einasleigh Metamorphics), which is intruded by a dolerite dyke 10 feet - 15 feet wide, striking 060^{o} and dipping 70^{o} south-east. The dolerite dyke has been intruded along its strike by a quartz reef, probably derived by differentiation from massive cream granite and pegmatite exposed nearby. Near Middle Park Station these granites have been intruded by younger pink porphyritic micro-granite.

The gold is mainly disseminated in the quartz reef, although small amounts are also in the dolerite. Other minerals present include galena at the 70 foot level, pyrite and chalcopyrite at the 106 foot level. No figures on the grade of the ore are available.

Mt.Moran Gold Mine: The Mt.Moran Goldfield is situated about two miles north of the Ortona Copper Mine on the Percy River (Plate 3). Three lodes were mined in 1913 and later in 1932, known as "Bosca", "Iona" and "Mona", which averaged between 2 to 3 ozs.Au/ton. The lodes consist of narrow quartz leaders with a maximum width of three feet, strike east and dip vertical in weathered and sheared diorite. The lodes were probably worked to a depth of 50 feet. There were no stope values within 20 feet of an overlying Cretaceous sandstone cover. One of the lodes, the Bosca, was mined under the Cretaceous cover over a length of about 300 feet. The ore was treated by two five head stamp Batteries and three Berdan amalgamating pans.

Tungsten

The main tungsten field in the Etheridge/Kangaroo Hills area is the Perry Creek Wolfram and Scheelite Diggings. This is situated near the headwaters of Perry Creek, about 12 miles north-west of Camel Creek Homestead (Plate 2).

Wolfram and scheelite are in separate quartz lodes in a small outlier of the Herbert River Granite, which intrudes siltstone and greywacke, of the Greenvale Formation. Wolfram has also been mined four miles farther south in quartz lodes in the Greenvale Formation on a steep hill, locally known as "Wolfram Hill".

The scheelite deposits have been described by Morton (1944). Later the wolfram of Wolfram Hill and scheelite deposits were described by Levingston (1952). Since then mining has been carried out by A.A. Redwood on small wolfram lodes situated in the same granite as the scheelite lodes, described by Morton (1944) and Levingstone (1952). Here three wolfram lodes have been mined. The main wolfram lode, locally known as the "Paper Weight" trends about 80° with a vertical dip. The lode ranges in width from two feet to six feet with an average width of about five feet. It has been developed to a depth of 24 feet and over a length of 160 feet. The quartz lode is enclosed by clean walls of kaolinised granite. The quartz lodes are fissure fillings along the 80° joint in the granite. The best wolfram values are found in bulges of the quartz lode. The total production of wolfram from this lode is about 4 cwt.

During 1958 alluvial tin in Perry Creek near the wolfram and scheelite diggings was being worked. About 5 to 7 lbs. of tin per yard were being recovered from the bed of Perry Creek.

Tin

Tin has also been reported by Denmead (1947) in Tertiary sediments capped with billy deposits associated with basalt, five miles west of Camel Creek Station. Tin values averaged 2½ lb. per cubic yard over an area 500 yards square.

Copper.

The main copper mine in the Greenvale area is the Halls Reward Mine, which was described by White, Branch and Green (1958). Since then the main development has been on the 125 foot level, where a north drive has been opened up to a length of about 40 feet. Here the same lenticular behaviour of the copper lode was experienced as in other levels of the mine. When inspected in July, 1958, the lode in the newly developed part of the mine had decreased to a width of about two feet. Rich patches of native copper were encountered in fractures in the siliceous lode on the footwall side (west).

Small amounts of copper, lead and silver are present in silicified and sheared Herbert River Granite, south of the Herbert River Gorge about four miles north-east of Princess Hills Station. These deposits have been described by Cameron (1914) and Knight (1949).

The main copper lode known as the Wambanu Lode, was developed over a length of 146 feet and a width ranging from two feet to four feet. However, mineralization in the lode was extremely irregular and poor.

The silver-lead ore is in separate lodes about a few hundred yards east of the Wambanu Copper Lode. About three tons of galena and carbonate ore containing 43 per cent lead and 10 oz. of silver per ton have been mined from this lode.

Chromium.

The chromium deposits associated with serpentine gabbro at the south-eastern margin of the Gray Creek Complex were tested from July to September 1958, by the Bureau Geophysical Party. The deposits were first described by White et.al.(1959), and were mapped in 1959 by the New Consolidated Goldfields Company. The geophysical survey suggested that there was unlikely to be any major vertical or horizontal extensions to the chromite lenses as exposed on the surface at locality "A" (White et.al. 1959). They estimate the maximum reserves of chromite in this locality to be about 10,000 tons.

During the survey, geologists from the New Consolidated Goldfields, discovered a green micaceous mineral, which has been identified by W.Dallwitz as a chromium mica containing some nickel. This mineral is disseminated in a serpentine belt about three-quarters of a mile to the north-east of the chromite lenses. From preliminary investigations the nickeliferous serpentine is about one and a half miles long and averages fifty feet in width. The chromiferous (?) mineral is concentrated in the carbonate-rich part of the serpentine. All stages of carbonate replacement is recognised and where the carbonate considerably replaces the serpentine, it has a hard silicified surface capping. The origin of the carbonate is not certain, but it is probably due to hydrothermal alteration of serpentine, or it may be a weathering effect. Here the silicification appears to be due to surface weathering, although elsewhere in Gray Creek, Green (1958), contributes it to faulting.

Diatomite

Diatomite deposits were discovered in five localities around the the eastern and southern borders of the McBride Basalt Province (Plate 2). These localities described by White and Crespin (1959) are:

(i) Cashmere Station
(ii) Gleneagle Station
(iii) Princess Hills
(iv) Conjuboy
(v) Lake Walters

Pozzolan

Pozzolan deposit near Tully Falls, Ravenshoe was inspected by D.A. White and J.G.Best towards the end of the survey. This deposit has been described in detail by J.G.Best (1959). This pozzolan deposit is the first to be used in concrete on a dam project in Australia. It was previously thought to be a weathered basalt but it has been interpreted by J.G. Best and others in the party to be a basaltic volcanic ash.

AIRCRAFT CHARTER

A Cessna aircraft (182) VHBPA "Lucky Downs Star" was chartered from Bush Pilots Airways, Cairns, on the 19th July to examine geological features of interest on parts of the Clarke River and Einasleigh Four Mile Sheets. These features included the ring dykes of the Bagstowe Complex, the Recent (probably Historical) lava flows and volcanic craters on the central part of the McBride Basalt Plateau, the Herbert River Falls and Gorge.

During the flight about two hundred photographs were taken from a height ranging from 500 to 1,000 feet. The flight was planned with the aid of the four mile photomosaics. The aircraft charter greatly assisted in the regional mapping of inaccessible areas and provided valuable information on areas previously mapped in the ground.

GRANITE SAMPLING

From the 27th August to 11th October, 62 granites were sampled for radioactive age determination from the Croydon, Georgetown, Einasleigh, Clarke River, Gilberton, and parts of the Atherton and Mossman Four Mile Sheets. These determinations will greatly assist in the age relationships of the various granites and also assist in the dating of some of the Precambrian and Palaeozoic orogenies.

RECOMMENDATIONS

Geological

(a) Detailed mapping of the Tertiary basalt area on the Atherton Tableland. In view of the recent interpretation of the pozzolan deposit near Tully Falls, Ravenshoe, to be a basaltic volcanic ash, more attention should be given to the delineation of pyroclastic areas, in particular to fine-grained pyroclastics, in the Atherton Tableland. The pozzolan deposit at Tully Falls is being used in concrete for the construction of the Koomooloomba Dam, and it is likely that other engineering projects on the Atherton Tablelands will require pozzolan for use in their concretes, following its success at the Koomooloomba Dam.

(b) Detailed mapping of the Croydon Felsite Area, in particular the southern part of the felsite area in the Gregory Range. In view of the recent interpretation of the Croydon Felsite to be a possible porphyry hood over granite, more prospecting and geological mapping should be carried out in the Felsite Area to the south of Croydon in the Gregory Range, to determine a possible extension or repetition of the Croydon Goldfield and Stanhills Tin field.

(c) Reconnaissance mapping of the Mossman and Cooktown Four Mile Sheets as a preparation for geological mapping of these sheets in 1950.

Geophysical.

(a) Regional seismic or gravity survey of the McBride Basalt Province to determine the thickness of the Basalt cover over the granitic basement. The centre of the McBride Basalt Province contains little to no water and the main cattle grazing areas are confined to the edge of the basalt, where springs supply plenty of water for cattle. Some idea of the configuration of the granitic basement would greatly assist in selecting drilling targets (which are costly in the basalt) in the dry centre of the McBride Basalt Province. The McBride Basalt Province covers about 1,800 square miles. To our knowledge the thickness of the basalt in the centre of the province would be between 500 feet to 1,000 feet thick. There are few known bores in the basalt; the deepest bore is about 300 feet located near the Hann Highway 15 miles west of Kinrara.

ACKNOWLEDGMENTS

The authors wish to thank Mr.A.K. Denmead, Chief Government Geologist, Geological Survey of Queensland, for his co-operation in all stages in the progress of the survey.

Also grateful acknowledgments to Mrs.Phoebe Atkinson (Camel Creek), Mr. & Mrs.J. Atkinson (Greenvale), Mr.& Mrs.J. Lethbridge (Ten Mile), and many others of the Einasleigh area for their hospitality during the field survey.

REFERENCES

BALL, L.C. 1914 - Einasleigh Freehold Copper Mine. Qld geol.Surv.Publ., 246.

BALL, L.C., 1915 - Etheridge Mineral Field. Ibid. 245.

BEST, J.G., 1959a- A natural pozzolan deposit near Tully Falls, North Queensland. Bur.Min.Resour. Aust.Rec. 1959/117.

BEST, J.G., 1959b- Kainozoic Basalts on the Einasleigh Four Mile Sheet. Ibid., 1959/117.

BRANCH, C.D., 1959 - Progress report on Upper Palaeozoic intrusions controlled by ring fractures near Kidston, North Queensland. Bur.Min.Resour.Aust. Rec. 1959/

BRYAN, W.H., and JONES, O.A., 1944 - A revised glossary of Queensland stratigraphy. Univ.Qld Dep. Geol.Pap., 2(11).

CAMERON, W., 1900 - The Etheridge and Gilbert Goldfields. Qld.geol.Surv.Publ., 151.

CAMERON, W., 1914 - Report on copper and silver-lead lodes on Wairuna Station. Qld geol.Surv.(unpublish

DENMEAD, A.K., 1947 - Camel Creek Tin, Kangaroo Hills Field. Qld Govt Min.J., 48.

GREEN, D.H., 1958 - Geology and petrology of the Gray Creek area, North Queensland. Bur.Min.Resour. Aust.Rec., 1958/110.

HILL, D., 1951 - Geology in Handbook for Queensland. Aust.Ass.Adv.Sci., Brisbane, 13-24.

HILLS, E.S., 1936 - Records and descriptions of some Australian Devonian Fishes. Proc.Roy.Soc.Vic., 48(2), 161-171.

HONMAN, C.S., 1937 - Report for Queensland in Rep.Aer.Surv. N.Aust., 1936, 26-30, 52-67.

JACK, R.L., and ETHERIDGE, R. Junr., 1892 - The Geology and Palaeontology of Queensland and New Guinea. Government Printer Brisbane. Qld geol.Surv.Publ., 92.

JENSEN, H.I., 1923 - The geology of the Cairns Hinterland and other parts of North Queensland. Qld geol Surv.Publ., 274.

KNIGHT, C.L., 1949 - Herbert River Gorge Prospects. Rep.Ent. Exp.Co.Pty.Ltd., (Unpublished).

KUENEN, Ph.H., 1953 - Features of graded bedding. Bull.Amer. Assoc.Petrol.Geol., 37, 1044-1066.

LEVINGSTON, K.R., 1952 - Perry Creek wolfram and scheelite workings. Qld Govt Min.J., 53.

MAITLAND, A.G., 1891 - The geology and mineral resources of the Upper Burdekin. Qld geol.Surv.Publ. 71. Parl.Pap. C.A., 19-1891.

MARKS, E.O., 1911 - The Oaks and Eastern Portion at the Etheridge Goldfield. Qld geol.Surv.Publ., 234.

MORTON, C.C., 1944 - Perry Creek Scheelite Camel Creek Holding, Ibid., 45 (510), 94.

QLD MIN. DEP., 1932 - The Woolgan Goldfield. Prospects for Miner and Millowner. Present stage of development. Qld Govt Min.J., 33 (Dec)., 386 - 389.

SMITH, E.C.S., 1922 - Geology and mineral resources of portion of the southern section of Oakley Creek district, Kangaroo Hills mineral field. Qld Govt Min.J., 23, 309-314, 349-355.

TWIDALE, C.R., 1956 - A physiographic reconnaissance of some volcanic provinces in North Queensland, Australia. Bull.Volcan. 2(18).

WHITE, D.A. and HUGHES, K.K., 1957 - Progress report on Regional Geological Mapping Northern Queensland, 1956. Bur.Min.Resour.Aust.Rec. 1957/38.

WHITE, D.A., BRANCH, C.D. and GREEN, D.H., 1958 - Geology of the Halls Reward Copper Mine Area, Northern Queensland. Bur.Min.Resour.Aust. 1958/60.

WHITE, D.A. AND CRESPIN, I., 1959 - Some Diatomite Deposits, Northern Queensland. Bur.Min.Resour.Aust. 1959/12.

WHITE, D.A., STEWART, J.R., BRANCH, C.D., GREEN, D.H., and WYATT, D.H., 1959 - Progress report on Regional Geological Mapping of Northern Queensland, 1957. Gray Creek, Broken River and Clarke River Area. Bur.Min.Resour.Aust., 1959/114.

WHITE, M.E., 1959 - Report on further collection of plant fossils from the Einasleigh region of N.E. Queensland. Bur.Min.Resour.Aust.Rec. 1959/75.

WHITEHOUSE, F.W., 1930 - The geology of Queensland in HANDBOOK FOR QUEENSLAND. Aust.Ass.Adv.Sci. Brisbane.

APPENDIX I.

PRELIMINARY DETERMINATIONS OF CORALS IN THE SILURIAN, DEVONIAN AND CARBONIFEROUS SUCCESSIONS OF THE BROKEN RIVER AREA, NORTHERN QUEENSLAND

(Plate 5).

by

Dr. D. Hill.
University of Queensland.

BUNDOCK CREEK FORMATION

B.R.S. 77.

? Palaeoneilo sp. (Dickins' ident.) same as in B.R.S.78.
Also Turreted gastropod.
Lithology of this identical with B.R.S.92.

Age: Devonian or Carboniferous.

B.R.S. 77, 78, 92 are united as a group by fauna and lithology.

B.R.S.78 (Dickins' identifications)

Crenipecten sp. appears to be most closely related to C.winchelli Hall from the Waverly Sandstone, which is in Devonian or L.Carboniferous.

Allorisma ? sp.
? Straparolus sp.
Turreted gastropod.
Compares well with B.R.S.92.

Age: Upper Devonian or Lower Carboniferous.

B.R.S.92 (Dickins' determinations).

High spired gastropod. Pleurotomariid gastropod.
Nuculand ? sp.
Goniophora ? sp.
Leiopteria sp.cf. type common in Middle and Upper Devonian.
Pelecypod gen et sp.
Crenipecten sp. (may be same as in B.R.S.78).

Age: Mr.Dickins suggests Upper Devonian on the lamellibranchs. I have sent a few fragments over to Glenister to see if any conodonts are recoverable.

B.R.S.97. Tentaculites shales.

Tentaculites
Hyolithes: (Pteropods anyway)
Small brachiopods
? Leda
? Leiopteria
Productella sp.
Straight Pectenoid with concentric and radial ribs.

Age: Middle or Upper Devonian or basal Carboniferous.

BROKEN RIVER FORMATION

B.R.S.76 (Road 1.8 air miles S.E. of Pandanus Ck.Homestead)

Amphipora ramosa
Stromatorporoids
Endophyllum or Sanidophyllum sp.
Sinospongophyllum
Cystiphyllum (? Atelophyllum)
? Stenophyllum
Favosites ? goldfussi
Alveolites or Favosites
Dendrostella sp.
Tryplasma sp.
Acanthophyllum sp.

Age: MIDDLE DEVONIAN. I think this may be the same age as B.R.S.38.

B.R.S.80.

Striatopora sp.
Alveolites sp.
Cystiphyllum sp.
Stromatoporoid
Dendrostella sp.
? Grypophyllum sp.

Age: Possibly Middle Devonian (Givetian).

B.R.S. 82.

Heliolites sp.
Favosites spp.
Acanthophyllum ?clermontense
Pseudamplexus princeps

Age: Possibly top of Lower Devonian.

B.R.S.90 Reef Breccia

Favosites sp.
Omphyma or Amplexus sp. one as from B.R.S.38.
Heliolites sp.
Disphyllum sp. or Macgeega sp.
Spongophylloides thomasi or Acanthophyllum sp.
Acanthophyllum or Dohmophyllum sp.
Phillipsastrea sp.
? Litophyllum sp.
Thamnopora sp.
Cystiphyllum (Atelophyllum sp.)
Alveolites sp.
Stromatoporoids

Age: Middle Devonian.

B.R.S.94

Stringophyllum sp. or Neospongophyllum sp.
Stromatoporoid
Heliolites sp.
Favosites sp.
Phillipsastrea sp.
Acanthophyllum sp. or Dohmophyllum
Sinospongophyllum sp.
Cystiphyllum (Atelophyllum) sp.
?Spongophyllum
Alveolites sp.
? Crypophyllum sp.
Large brachiopod with median septum -?Stringocephalus

Age: Middle Devonian, probably early Givetian.

B.R.S. 95.

Cystiphyllum sp.
Calceola sp.
Disphyllum (Phacellophyllum) sp.
Stromatoporoid
Dendrostella sp.
Alveolites sp.
Acanthophyllum or Dohmorphyllum sp.
Endophyllum sp. (large, phacelo-cerioid)
Favosites sp.
Branching Favosites

Age: Middle Devonian, Givetian, possibly a little younger than B.R.S.94.

B.R.S. 98.

?Stringocephalus sp.
Acanthophyllum sp.
Alveolites sp.
?Sinospongophyllum sp.
Disphyllum (Phacellophyllum) sp.
Heliolites sp.
?Calceola sp.
Stromatoporoid
Cystiphyllum sp.
Fine Thamnopora sp.

Age: Middle Devonian probably Givetian.

B.R.S. 99.

Thamnopora sp.
Dendrostella sp.
Favosites sp.cf. goldfussi
Heliolites sp.
cerioid Dendrostella (11)
Romingeria sp.
Litophyllum sp.
Alveolites sp.
Cystiphyllum sp.

Age: Middle Devonian, Givetian.

B.R.S.103. cf. Gregory Springs.

Thamnopora sp.
Favosites sp., polyzoan or Litophyllum.
Aulopora
? Alveolites
Stromatoporoids
or Fish scales
very small gastropods
Megaphyllum or Peneckiella ?
? and Macgeea ?

Age: As for Gregory Springs B.R.S. 16. ? Frasnian. (Base U.D.).

B.R.S. 104.

Same fauna and horizon as B.R.S. 103.

BROKEN RIVER FORMATION (B. LENS)

B.R.S.84.

Alveolites sp.
? *Cladopora*

Age: Silurian or Devonian.

B.R.S. 85.

Favosites sp.
Alveolites sp.
Cystiphyllum sp.
Cladopora sp.
small gastropods
?*Disphyllum* sp.
?*Calceola* sp.
?*Acanthophyllum* sp.

Age: Devonian.

B.R.S. 86.

Phillipsastraea sp.
Acanthophyllum or *Dohmophyllum* sp.
? *Omphyma* as from B.R.S. 38.
Cystiphyllum or *Atelophyllum* sp.
Alveolites sp.
Heliolites sp.
Stromatoporoid
Favosites sp.
Radiophyllum sp.

Age: Middle Devonian, probably basal Givetian.

B.R.S. 87.

?*Favosites* sp. (or possibly *Emmonsia*)
Polyzoan or Stromatoporoid

Age: Possibly Devonian.

B.R.S. 88.

Favosites spp.
Cystiphyllum sp.
Crinoid stems
? *Radiophyllum* sp.
Acanthophyllum or *Grypophyllum* sp.

Age: Middle Devonian probably.

BROKEN RIVER FORMATION (E. LENS)

B.R.S.96.

Grypophyllum or Neospongophyllum sp.
Xystriphyllum or Eddastraea
Alveolites sp.
Litophyllum sp.
Heliolites sp.
Thamnopora sp.
Acanthophyllum or Dohmophyllum sp.
Favosites sp.cf. goldfussi
?Stringophyllum sp.
?Cladopora sp.
?Disphyllum sp.
Stromatoporoid
Brachiopod

Age: Devonian, probably Middle Devonian.

JACK LIMESTONE (B. LENS)

B.R.S.81

Favosites sp.
?Tryplasma sp.
?Heliolites

Age: Silurian or Devonian, possibly Silurian.

JACK LIMESTONE (A.LENS).

B.R.S.83.

Favosites sp.
?Xystriphyllum sp.
?Tryplasma

Age: Silurian or Devonian, possibly Devonian.

WAIRUNA FORMATION(?).

B.R.S. 79.

Very coarse quartzose marine grit with moulds of lamellibranch and other shells, indet.
? Rhynchonellid
? Polyzoan or fine Thamnopora mould

Age: Indet.

B.R.S. 100.

problematica - a linear pyritised fossil has since oxidised and destroyed its form.

GRAVEYARD CREEK FORMATION

B.R.S.89

?*Pseudamplexus* sp.

Age: Possibly Lower Devonian

B.R.S.93.

Favosites sp.
?*Tryplasma* sp. solitary
?*Calostylis* sp.solitary

Age: Very doubtfully Silurian. Requires checking after thin sections prepared.

B.R.S.108.

Cladopora sp.
small gastropods
Favosites sp.
?*Thecia* sp.
?*Striatopora* sp.
?*Tryplasma* sp.

Age: Silurian or Devonian; if *Thecia* turns out on cutting a section to be a correct identification, Silurian.

B.R.S.109.

Tryplasma sp. (solitary, slender)
Halysites sp.
Cystiplyllum sp.
Favosites spp.
Tryplasma or *Pycnostylus* sp. (fasciculate)
Cladopora sp.

Age: Silurian.

PERRY CREEK FORMATION

18/4/5185 CR.

Favosites sp.
Spongophyllum sp.
Cladopora or *Thamnopora* sp.
?*Halysites* sp.
Heliolites or *Plasmopora* sp.

Age: Possibly Silurian if ident. of Halysites is confirmed on sectioning.

18/4/5165 CR.

Cladopora sp.
Spongophyllum sp.
Tryplasma sp.
Heliolites sp.

Age: Same as 18/4/5185.

REFERENCE TO ACCOMPANY GEORGETOWN; EINASLEIGH; GILBERTON AND CLARKE RIVER FOUR MILE SHEETS.

KAINOZOIC

QUATERNARY

- Qa — *Alluvium, Soil Cover.*
- Qbk — Kinrara Basalt

TERTIARY

- Q-Tbm — McBride Basalt
- Q-Tbc — Chudleigh Basalt
- Q-Tbn — Nulla Basalt

MESOZOIC

LOWER CRETACEOUS TO UPPER JURASSIC

- K-Jg — Gilbert River Formation
  Sandstone, conglomerate, shale
- Klb — Blythesdale Group
  Sandstone, conglomerate, shale

PALAEOZOIC

UPPER PALAEOZOIC UNDIFFERENTIATED

- Pzuc — Croydon Felsite
  Rhyolite, rhyolite porphyry
- Pzuge — Esmeralda Granite
- Pzua — Cumbana Rhyolite Porphyry
- Pzugz — Elizabeth Creek Granite
- Pzugt — Tiger Hill Microgranite
- Pzum — Montgomery Range Rhyolite Porphyry.
- Pzugo — Oweenee Granite
- Pzugp — Prestwood Microgranite
- Pzub — Butlers Igneous Complex
  Granite, rhyolite porphyry, trachyte
- Pzugl — Lochaber Granite
- Pzug — Bagstowe Ring Dyke Complex
  Rhyolite porphyry, andesite porphyry, microdiorite
- Pzun — Newcastle Range Volcanics
  Rhyolite, tuff with thin basal sediments
- Pzuu — Cumberland Range Volcanics
  Rhyolite with thin basal sediments.

PERMO-CARBONIFEROUS

- P-Ca — Agate Creek Volcanics
  Rhyolite, agglomerate with thin basal plant beds.

MIDDLE TO LOWER CARBONIFEROUS.

- Cc — Clarke River Formation
  Impure sandstone, shale (plants), some conglomerate, limestone.

LOWER CARBONIFEROUS TO UPPER DEVONIAN

- Cb — Bundock Creek Formation
  Impure sandstone, shale (plants), some congl[illegible] [illegible] limestone.
- D-Cg — Gilberton Formation
  Conglomerate, sandstone, shale (plants, some [illegible]
- Dgc — Craigie Granodiorite
- Dgh — Herbert River Granite

MIDDLE TO LOWER DEVONIAN

- Db — Broken River Formation
  Limestone, calcareous sediments, shale.

? LOWER DEVONIAN

- Dlb — Boiler Gully Complex
  Serpentinite, gabbro, some diallagite.
- Dlg — Gray Creek Complex
  Serpentinite, gabbro, pyroxenite, granodiorite

LOWER DEVONIAN TO UPPER SILURIAN

- Dl-Sup — Perry Creek Formation
  Sandstone shale, conglomerate, limestone lenses.
- Dl-Sut — Tribute Hills Sandstone
- Dl-Sug — Graveyard Creek Formation
  Greywacke, greywacke siltstone, limestone lenses.
- Dl-Suc — *Crooked Creek Conglomerate Member.*
  Greywacke Conglomerate
- Dl-Suk — Kangaroo Hills Formation
  Impure sandstone, shale, greywacke and greyw. congl. lenses
- Suj — Jack Limestone

SILURIAN

- Sp — Pelican Range Formation
  Sandstone, some shale.
- Sg — Greenvale Formation
  Siltstone, shale, greywacke lenses

LOWER SILURIAN TO ? UPPER ORDOVICIAN

- Slw — Wairuna Formation
  Shale, claystone, impure sandstone
- Sle — *Everetts Creek Volcanic Member*
  Albitized basalt, some pyroclastics.
- Sla — *Carriers Well Limestone Member.*

PRECAMBRIAN

LOWER PALAEOZOIC OR UPPER PROTEROZOIC

- Pgf — Forsayth Granite
- Pgr — Robin Hood Granite
- Pgd — Dido Granodiorite
- Pgm — Mckinnon's Creek Granite
- Pgu — Dumbano Granite
- Pdc — Cobbold Dolerite
- Pss — Sandalwood Serpentinite
  Serpentinite, some gabbro.

? PROTEROZOIC

- Pr — Robertson River Metamorphics
  Quartzite, quartz-biotite-schist, quartz-garnet-sericite schist
- Pa — Langdon River Formation
  Red shale, siltstone, some impure sandstone lenses
- Pe — Etheridge Formation
  Grey quartz siltstone, sandstone, chert carbonaceous shale and sericite-andalusite schist
- Ps — *Stockyard Creek Siltstone Member.*
  Carbonaceous siltstone
- Pb — Bernecker Creek Formation
  Calcareous siltstone, calcareous sandstone, marble lenses banded calc-silicate hornfels
- Pp — Paddys Creek Formation
  Phyllite, quartzite.
- Pl — Lucky Creek Formation
  Calcareous sandstone, calcareous greywacke, calc-silicate hornfels and thin marble lenses.

? ARCHAEAN

- Ae — Einasleigh Metamorphics
  Gneiss, migmatite, schist.
- Ah — Halls Reward Metamorphics
  Migmatite, quartzite, schist
- As — Stenhouse Creek Amphibolite
- ○ Volcanoes
- ○ Airborne Radiometric Anomaly

Bureau of Mineral Resources, Geological Section,
CANBERRA A.C.T. *March 1959.*

REFERENCE TO ACCOMPANY GEORGETOWN; EINASLEIGH; GILBERTON AND CLARKE RIVER FOUR MILE SHEETS.

KAINOZOIC

QUATERNARY

- Qa — *Alluvium. Soil Cover.*
- Qbk — Kinrara Basalt

TERTIARY

- Q-Tbm — McBride Basalt
- Q-Tbc — Chudleigh Basalt
- Q-Tbn — Nulla Basalt

MESOZOIC

LOWER CRETACEOUS TO UPPER JURASSIC

- K-Jg — Gilbert River Formation
  Sandstone, conglomerate, shale
- Klb — Blythesdale Group
  Sandstone, conglomerate, shale

PALAEOZOIC

UPPER PALAEOZOIC UNDIFFERENTIATED

- Pzuc — Croydon Felsite
  Rhyolite, rhyolite porphyry
- Pzuge — Esmeralda Granite
- Pzua — Cumbana Rhyolite Porphyry
- Pzugz — Elizabeth Creek Granite
- Pzugt — Tiger Hill Microgranite
- Pzum — Montgomery Range Rhyolite Porphyry
- Pzugo — Oweenee Granite
- Pzugp — Prestwood Microgranite
- Pzub — Butlers Igneous Complex
  Granite, rhyolite porphyry, trachyte
- Pzugl — Lochaber Granite
- Pzugs — Bagstowe Ring Dyke Complex
  Rhyolite porphyry, andesite porphyry, microdiorite
- Pzun — Newcastle Range Volcanics
  Rhyolite, tuff with thin basal sediments.
- Pzuv — Cumberland Range Volcanics
  Rhyolite with thin basal sediments.

PERMO-CARBONIFEROUS

- P-Ca — Agate Creek Volcanics
  Rhyolite, agglomerate with thin basal plant beds.

MIDDLE TO LOWER CARBONIFEROUS.

- Cc — Clarke River Formation
  Impure sandstone, shale (plants), some conglomerate, limestone.

LOWER CARBONIFEROUS TO UPPER DEVONIAN

- Cb — Bundock Creek Formation
  Impure sandstone, shale (plants), some conglomerate and limestone
- D-Cg — Gilberton Formation
  Conglomerate, sandstone, shale (plants, some fish)
- Dgc — Craigie Granodiorite
- Dgh — Herbert River Granite

MIDDLE TO LOWER DEVONIAN

- Db — Broken River Formation
  Limestone, calcareous sediments, shale.

? LOWER DEVONIAN

- Dlb — Boiler Gully Complex
  Serpentinite, gabbro, some diallagite
- Dlg — Gray Creek Complex
  Serpentinite, gabbro, pyroxenite, granodiorite

LOWER DEVONIAN TO UPPER SILURIAN

- Dl-Sup — Perry Creek Formation
  Sandstone, shale, conglomerate, limestone lenses.
- Dl-Sut — Tribute Hills Sandstone
- Dl-Sug — Graveyard Creek Formation
  Greywacke, greywacke siltstone, limestone lenses.
- Dl-Suc — *Crooked Creek Conglomerate Member.*
  Greywacke Conglomerate
- Dl-Suk — Kangaroo Hills Formation
  Impure sandstone, shale, greywacke and greywacke congl. lenses
- Suj — Jack Limestone

SILURIAN

- Sp — Pelican Range Formation
  Sandstone, some shale.
- Sg — Greenvale Formation
  Siltstone, shale, greywacke lenses

LOWER SILURIAN TO ? UPPER ORDOVICIAN

- Slw — Wairuna Formation
  Shale, claystone, impure sandstone
- Sle — *Everetts Creek Volcanic Member*
  Albitized basalt, some pyroclastics.
- Sla — *Carriers Well Limestone Member.*

PRECAMBRIAN

LOWER PALAEOZOIC OR UPPER PROTEROZOIC

- Pgf — Forsayth Granite
- Pgr — Robin Hood Granite
- Pgd — Dido Granodiorite
- Pgm — Mckinnon's Creek Granite
- Pgu — Dumbano Granite
- Pdc — Cobbold Dolerite
- Pss — Sandalwood Serpentinite
  Serpentinite, some gabbro.

? PROTEROZOIC

- Pr — Robertson River Metamorphics
  Quartzite, quartz-biotite-schist, quartz-garnet-sericite schist
- Pa — Langdon River Formation
  Red shale, siltstone, some impure sandstone lenses
- Pe — Etheridge Formation
  Grey quartz siltstone, sandstone, chert, carbonaceous shale and sericite-andalusite schist
- Ps — *Stockyard Creek Siltstone Member.*
  Carbonaceous siltstone
- Pb — Bernecker Creek Formation
  Calcareous siltstone, calcareous sandstone, marble lenses banded calc-silicate hornfels
- Pp — Paddys Creek Formation
  Phyllite, quartzite.
- Pl — Lucky Creek Formation
  Calcareous sandstone, calcareous greywacke, calc-silicate hornfels and thin marble lenses.

? ARCHAEAN

- Ae — Einasleigh Metamorphics
  Gneiss, migmatite, schist.
- Ah — Halls Reward Metamorphics
  Migmatite, quartzite, schist
- As — Stenhouse Creek Amphibolite
- ○ Volcanoes
- ○ Airborne Radiometric Anomaly

Bureau of Mineral Resources,
Geological Section,
CANBERRA A.C.T. *March 1959.*

PLATE

Approx Scale 1 inch = 4 miles   GEORGETOWN FOUR MILE SHEET   1958 Geological Field Sheet

Approx Scale 1 inch = 4 miles   EINASLEIGH FOUR MILE SHEET   1958 Geological Field Sheet