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PROGRESS REPORT ON REGIONAL GEOLOGICAL MAPPING NORTHERN QUEENSLAND, 1956

by

D.A. White and K.K. Hughes

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SUMMARY

Sedimentary and metamorphic rocks of probable Precambrian, Palaeozoic, Mesozoic and Tertiary age crop out in the Etheridge and Chillagoe Mineral Fields of Northern Queensland. The Precambrian succession was deposited in a geosyncline, which is tentatively named here the Georgetown Geosyncline. The geosynclinal pile is subdivided into formational units, and sedimentary environments within the geosyncline are suggested. The Precambrian succession is folded and intruded by a large mass of granite known as the Forsayth Batholith, which in turn is intruded by a succession of porphyries and comagmatic granites known as the Croydon Complex.

The south-eastern margin of the Georgetown Geosyncline is determined by a fault zone against the Broken River Beds of Silurian-Devonian age of the Tasman Geosyncline. This fault zone is probably a thrust along parts of which serpentinized ultrabasic rocks were intruded.

In the southern part of the Georgetown Geosyncline fresh water sediments of Lower Carboniferous age unconformably overlie Precambrian calcareous sediments.

The Precambrian and Palaeozoic rocks are unconformably overlain by rocks of Mesozoic and Tertiary age.

Mineralization on the Etheridge and Oaks Goldfields consists mainly of auriferous quartz veins within the Forsayth Batholith. Quartz veins with lead and silver are exposed at Mosquito Creek along the western margin of the Forsayth Batholith and similar veins with gold, silver and copper at Percyville. From 1877 to 1899 the total production in the Etheridge Goldfield was 300,830 tons of ore averaging 1 oz. 6 dwts. of gold per ton. The Einasleigh Copper Mine was the biggest producer with a total production of 8,107 tons of copper. The Ortona, Hall's Reward (Ninety Mile) and Gordon Stanley copper deposits were mined during 1956 in the southern and eastern parts of the Etheridge Goldfield. Uranium minerals are found in small quantities in quartz veins and shears in the Forsayth Batholith. A small quantity of uranium ore was mined during 1956 from Limkin's Prospect, but this mine was abandoned later in the year.

Fifty-four radiometric anomalies, found by the airborne scintillometer, were examined during the regional mapping of the area. About 60 per cent of these anomalies were located in granite. The anomalies do not warrant further investigation.

Geological, geophysical and geochemical work have been recommended for certain areas within the area mapped. These areas include the Ninety Mile Copper Mine, the Stockyard Creek Siltstone and parts of the Precambrian metamorphics.

INTRODUCTION

This report deals specifically with the regional geological mapping carried out by a combined party of the Bureau of Mineral Resources and Geological Survey of Queensland in the Georgetown, Einasleigh, and Chillagoe areas of Northern Queensland from May to October, 1956. The survey was part of the programme of search for radioactive and metalliferous mineral deposits undertaken by the Bureau of Mineral Resources and the Geological Survey of Queensland.

The geologists who took part in the survey were D. A. White (leader), K. K. Hughes, J. B. Firman, for a period of 2½ months, R. D. Stevens for 3 months, from the Bureau of Mineral Resources; and D. H. Wyatt from the Geological Survey of Queensland.

An area of approximately 20,000 square miles was mapped at a scale of 1 inch equals 4 miles. The area covered the Georgetown, and parts of the Einasleigh, Gilberton, Clarke River and Atherton Army Four Mile Series (Plate I.). The area mapped includes the Etheridge and Oaks Goldfields, Chillagoe Mineral Field and parts of the Herberton and Kangaroo Hills Mineral Fields (Plate I).

Field sheets on a scale of inch equals 4 miles were compiled from photomosaics for immediate distribution. Data from the field sheets and aerial photographs will be replotted on planimetric base maps for final compilation.

The photomosaics and planimetric base maps covering the area mapped were compiled by the National Mapping Division, Department of National Development, from photographs provided by the Royal Australian Air Force.

HISTORY.

The earliest record of metamorphic rocks in the Etheridge Goldfield was made by Daintree in 1870 and in 1872. Cameron (1900) was the first to describe the gold reefs of the Etheridge and Gilbert Goldfields, and Marks (1911) was the first to describe the geology and mineralization of the Oaks and eastern portion of the Etheridge Goldfield. Later Ball (1915) provided a detailed account of the Etheridge Goldfield, as well as (1914) a description of the Einasleigh Copper Mine. Whereas previous geologists were concerned with detailed descriptions of mineral deposits, Jensen (1920, 1923 and 1941) described the regional geology of the Etheridge, Chillagoe and other Mineral Fields in Northern Queensland, in an attempt to correlate the rock units within these areas.

The earliest record of the geology of the Chillagoe and Herberton Mineral Fields was provided by Jack (1898) and later by Skertchly (1899). These areas were mapped by the Aerial, Geological and Geophysical Survey of Northern Australia and the results are contained in unpublished reports by Jensen (1939 and 1941). The latest report on the Chillagoe and Herberton Mineral Fields was written by Broadhurst (1953a and 1953b).

Recently Walpole and Langron (1955) carried out a reconnaissance of the Georgetown area in conjunction with the investigation of airborne radiometric anomalies.

STRATIGRAPHY

Geosynclinal sediments of probable Precambrian age crop out in a broad belt between the Langdon River in the west and the Burdekin River in the east. The sediments are unconformably overlain by Mesozoic and Tertiary sediments in the north of the area mapped. The Precambrian sequence is faulted against Palaeozoic sediments in the south-east and overlain by Tertiary basalt and Mesozoic sediments in the south of the area.

In the area mapped the geosynclinal belt is approximately 120 miles wide and 100 miles long. This geosyncline is tentatively named here the Georgetown Geosyncline. Sediments considered as representative of the trough and shelf environments of the geosyncline have been folded and metamorphosed and intruded by granitic rocks of the Forsayth Batholith. Both sediments and granite are intruded by igneous rocks known as the Croydon Complex. Palaeozoic rocks are faulted against the earlier sediments and unconformably overlie the Forsayth Batholith near Blackbraes and Gregory Springs Stations (Plate 5).

In the Gilberton area (Plate 4) in the southern part of the Georgetown Geosyncline, Precambrian calcareous sediments are unconformably overlain by and faulted against two small areas of freshwater sediments of probable Lower Carboniferous age.

Cretaceous and Tertiary rocks unconformably overlie the Georgetown geosynclinal sediments and Palaeozoic succession.

The stratigraphical succession of rock types involved in the area mapped is given in Table I. The sediments and metamorphics of the Georgetown Geosyncline are shown in the table in geographical order from west to east in descending order.

PRECAMBRIAN

The age of the sediments deposited in the Georgetown Geosyncline is not precisely known. Previous ideas of their age were mainly based on the grade of metamorphism in comparison with other known Precambrian and Palaeozoic sequences. Jensen (1920) correlated the intensely metamorphosed rocks of the eastern portion of the Etheridge Goldfield with the Precambrian of the Cloncurry district. He also considered outliers of sediments in the western part of the field as tenatively of Ordovician age, as well as noting their resemblance to Precambrian rocks of the Agicondi Province of the Northern Territory. Bryan (1925) recorded similar conclusions to those of Jensen by comparing the trend and degree of metamorphism of the Etheridge rocks with the Cloncurry rocks. (Also Jones (1948) considered the gneisses and schists of the Etheridge Goldfield to be definitely pre-Devonian and because of their stronger metamorphism suggested a Precambrian age.) The Precambrian age of the rocks of the Etheridge Goldfield as indicated by Jensen has been accepted by later geologists, including Hills (1946) and Hill (1951) and the age of the rocks is shown as Precambrian on the Geological Map of Queensland (1953).

Evidence from the 1956 mapping suggests that the age of most of the Georgetown geosynclinal sediments is Precambrian.

Since the Forsayth Batholith intrudes the Georgetown geosynclinal sediments and the batholith is overlain by the Broken River Beds of Silurian-Devonian age, the geosynclinal sediments must be pre Silurian-Devonian in age. Part of the sediments in the geosyncline is fossiliferous (Dr. Opik, personal communication), but not sufficient material was collected to determine the nature of the fossils. Also, the general absence of fossils in the Etheridge Goldfield suggests that the age for most of the field is Precambrian rather than Lower Palaeozoic.

Seven formations have been recognized in the Georgetown geosynclinal pile. The relationships between these rock units and their probable sedimentary environments are shown in Plate 2.

Trough type sediments of the geosyncline crop out between the Langdon River in the west and the Forsayth/Ortona track in the east. These sediments may extend as far west as Croydon, which was not examined in 1956. The northern limit of outcrop of these sediments is the Georgetown/Croydon road, the southern limit is not yet known, but it is expected to extend not far beyond the southern boundary of the Georgetown Four Mile Sheet (Plate 3).

Shelf type sediments are more extensive than those of the trough zone. They crop out from the Forsayth/Ortona track in the west to the Burdekin River in the east over a distance of about 100 miles. The northern and southern limits are not yet known.

The trough sediments consist mainly of greywacke, carbonaceous and quartz siltstones. The shelf sediments consist of quartzite, quartz schist, calcareous sandstone, calcareous siltstone and some quartz siltstone and sandstone.

The metamorphism varies from low grade contact in the trough zone to medium to high grade contact and regional metamorphism in the shelf zone. This is partly due to the location of the main granite intrusion in the shelf area of the geosyncline.

The rock units recognised in the Georgetown Geosyncline are described below.

Etheridge Group

The Etheridge Group is named from the Etheridge Goldfield and includes those sediments considered as belonging to the trough environment of the Georgetown Geosyncline. The Etheridge Group consists of the Langdon River Formation, the Green Hills Formation and the Stockyard Creek Siltstone Member. This sequence contains mainly lutites, in which quartz siltstone is abundant with some carbonaceous and greywacke siltstones and chert.

The rocks belonging to the Etheridge Group were first described as metamorphic by Daintree (1872) and later by Cameron (1900), Ball (1914, 1915) and Marks (1911). Jensen (1920) defined the "Etheridge (or Etheridgean) Series" as the metamorphic rocks of the eastern part of the Etheridge Goldfields and the "Herberton (or Herbertonian) Series" as the low grade metamorphics and sediments of the western part of the goldfield. Also Jensen (1920) considered the "Etheridge Series" to be older than the "Herberton Series". Bryan (1925) considered the metamorphics in the Einasleigh area to be older than the rocks of the western part of the Etheridge Goldfield as described by Ball (1914). He named these metamorphics the "Einasleigh Metamorphics". The Geological Map of Queensland (1953) shows all the rocks of the Etheridge Goldfield under the heading "Etheridge Complex". More recently, Walpole and Langron (1955) considered the rocks of the Etheridge Goldfield as a group, the "Etheridge Group", containing trough type geosynclinal sediments, which they compared with the sediments considered to be deposited in the trough of the Pine Creek Geosyncline of the Northern Territory. Moreover, Walpole and Langron (1955) recognised that the metamorphism within the "Etheridge Group" increased from west to east towards the Forsayth Batholith.

The Etheridge Group as defined here corresponds to the "Herberton Series" of Jensen (1920) and part of his "Etheridge Series". The "Herberton Series" cannot be used for rocks of the Etheridge Goldfield as earlier Skertchly (1899) used the "Herberton Series" for a sedimentary sequence in the Herberton and Chillagoe areas of Queensland.

The youngest formation of the Etheridge Group is the Langdon River Formation, which conformably overlies the Green Hills Formation. The Green Hills Formation interfingers with the Stockyard Creek Siltstone Member towards the top of its succession and near its boundary with the Langdon River Formation.

Metamorphism in the Etheridge Group is mainly confined to contact effects around small granite intrusions in the western and central parts of its outcrop area. The Etheridge Group is regionally metamorphosed to mica schists along its eastern margin, and here the schists interfinger with quartzite and quartz schist of the Einasleigh Metamorphics.

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The trend of the sediments of the Etheridge Group is arcuate from north-south near Forest Home Station to east-west in the Robertson River area. The folds in the Etheridge Group vary from simple anticline and syncline along the western margin of its outcrop area to complicated tight dome and basin structures along the eastern margin. A regional pitch change of the folds is located near the Gilbert River. To the west of the Gilbert River the pitch of the folds is to the west or north-west and east of the river the pitch is either to the north-east or east.

The sediments of the Etheridge Group are faulted. Ten miles north-west of North Head Station a small fault displaces the Stockyard Creek Siltstone for a horizontal distance of about 4 miles. A fault may have caused a sharp swing in the trend of the Etheridge Group near the Macdonaldtown gold diggings in the central part of the Georgetown Four Mile Sheet (Plate 3).

Langdon River Formation

The Langdon River Formation is named from the Langdon River, which joins the Gilbert River near Forest Home Station at about longitude 143°1' and latitude 18°17'.

The Langdon River Formation consists mainly of greywacke siltstone and quartz siltstone with some minor lenses of quartz greywacke and greywacke. The siltstone beds vary in thickness but they generally alternate in layers ranging from about 1 inch to 2 inches in width. The greywacke siltstone generally weathers to a buff colour and the quartz siltstone weathers to a grey colour.

Photo interpretation of a synclinal structure about 25 miles south of Forest Home Station suggests that the maximum thickness of the Langdon River Formation is about 10,000 feet.

The sediments have not been previously named although they probably form a part of the "Herberton Series" described by Jensen (1920). Walpole and Langron (1955) were the first to record greywacke exposed along the Langdon River.

The Langdon River Formation crops out in the central western part of the Georgetown sheet from the Gilbert River south for about 32 miles along the valley of the Langdon River and its eastern tributaries. The sediments are well exposed on the track which runs from Forest Home Station south along the eastern side of the valley of the Langdon River (Plate 3).

The sediments thin to the north and south of the area. The sediments in part conformably overlie and in part interfinger with the Green Hills Formation and the Stockyard Creek Siltstone Member. The siltstones are altered to andalusite hornfels near their contact with small granite intrusions in the northern part of their outcrop.

The lithology and position in relation to the other rock units suggest that the Langdon River Formation represents a trough type geosyncline deposit (Plate 2).

Green Hills Formation

The Green Hills Formation is named from the Green Hills Station, which is situated on the Gilbert River about in the centre of the Georgetown Four Mile Sheet at longitude 143°17' and latitude 18°29'.

The Green Hills Formation consists of black quartz siltstone, chert with minor lenses of fine-grained quartz sandstone, and limestone. The thickest section of the Green Hills Formation is near North Head Station, where about 15,000 feet of sediments are exposed in a broad syncline.

The Green Hills Formation forms most of the "Herberton Series" as described by Jensen (1920). Also the beds probably correspond to Cameron's (1900) description of the rocks of the western part of the Etheridge Goldfield as "an unfossiliferous series of very evenly stratified slates, mica schists, micaceous sandstones and quartzites of unknown age".

The Green Hills Formation in part conformably underlies and in part interfingers with the Langdon River Formation.

The Green Hills sequence crops out over an area of about 800 square miles around Green Hills Station and between Ironhurst and Huonfels Stations in the northern part of the Etheridge Goldfield (Plate 3).

Chert with some carbonaceous siltstone is restricted to the top of the Green Hills Formation. Here a lithologically distinct carbonaceous pyritic siltstone is exposed, and this member has been mapped separately and referred to as the Stockyard Creek Siltstone Member. Along the eastern margin of outcrop between the Gilbert River and the Forsayth/Ortona track, quartz siltstone grades along its strike into sericite schist. Here the sericite schist interfingers with quartz schist and quartzite of the Einasleigh Metamorphics. This relationship is also seen near Huonfels and Ironhurst Stations. Elsewhere the siltstone is contact metamorphosed to andalusite-muscovite schist near its contact with the Forsayth Batholith.

The sediments are intruded by sills and dykes of dolerite and gabbro, which are folded with the sediments and intruded by the Forsayth Batholith between Georgetown and Forsayth townships.

The folding in the Green Hills Formation varies from simple open structures in the west to contorted closed structures east of the Gilbert River. These contortions may be due in part to regional slumping.

The lithology and position of the sediments of the Green Hills Formation in the geosynclinal pile suggest that they may represent deposition in both slope and trough environments of the Georgetown Geosyncline.

Stockyard Creek Siltstone Member

The Stockyard Siltstone is named from Stockyard Creek, which joins the Gilbert River at longitude 143°16' and latitude 18°34'.

The deposit consists of lenticular beds of black, carbonaceous, pyritic siltstone. The type area of the Stockyard Creek Siltstone Member is in the headwaters of Stockyard Creek on the Georgetown Four Mile Sheet (Plate 3). It has a maximum thickness of about 300 feet.

The Stockyard Creek Siltstone Member crops out towards the top of the Green Hills Formation and below the Langdon River Formation. Here the Stockyard Creek Siltstone Member interfingers with chert of the Green Hills Formation.

Since the Stockyard Creek Siltstone Member for the most part separates an area of greywacke siltstone deposition from an area of quartz siltstone deposition, it is suggested that the area covered by the Stockyard Creek Siltstone Member corresponds to a reduction in the supply of sediments into the trough of the Georgetown Geosyncline and a corresponding change from oxidizing to reducing conditions in this area, which favoured carbon deposition.

Einasleigh Metamorphics

The Einasleigh Metamorphics are named from the township of Einasleigh (Plate 3), where the metamorphics are well exposed in the nearby Einasleigh River. The Einasleigh Metamorphics are also exposed between Forsayth and the Robertson River along the Forsayth/Robin Hood track.

The metamorphics consist of quartz schist, quartzite, paragneiss, garnet-hornblende-sericite schist and hornblende-felspar gneiss and schist. The paragneiss member is generally ptygmatic as exposed at the junction of Stockman Creek and the Einasleigh/Forsayth road. The lithology and position of the Einasleigh Metamorphics in relation to the Etheridge Group suggests deposition of the sediments in a shelf environment of the Georgetown Geosyncline.

The Einasleigh Metamorphics correspond to most of the "Etheridge or Etheridgean Series" as described by Jensen (1920 and 1923), the "Einasleigh Series" Bryan (1925) and Bryan and Jones (1944), and the "Einasleigh Gneiss" Whitehouse (1930). The rocks of the Einasleigh district were first described by Marks (1911) and later by Ball (1914), but the rocks were not named as a unit. Bryan (1925) considered the "Einasleigh Series" as older than the rocks described by Marks (1911) and Ball (1914) in the western part of the Etheridge Goldfield.

The outcrop area of the Einasleigh Metamorphics is separated by the Forsayth Batholith into three main areas:-

(i) The Forsayth/Robertson River area;

(ii) the Ironhurst area; and

(iii) the Einasleigh/Eveleigh area.

The Forsayth/Robertson area in the western part of the outcrop area (Plate 3) contains quartzite and quartz schist, which interfinger along their western margin with sericite schist of the Green Hills Formation. Here hornblende-felspar schist, gneiss and interbedded impure quartzite are well exposed along the Robertson River between the Forsayth/Ortona and Forsayth/Robin Hood tracks, where the metamorphics are intruded by pegmatite sheets of the Forsayth Batholith.

The grade of metamorphism within the Einasleigh Metamorphics increases from low grade regional on the western margin of the Forsayth Batholith in the Forsayth/Robertson River area to high grade regional in the eastern part of outcrop in the Einasleigh/Eveleigh area. Here the metamorphics are intruded by numerous granitic veins and they frequently contain garnet and are generally ptygmatic.

At Percyville (Plate 3 and Plate 4) along the southern margin of outcrop of the Einasleigh Metamorphics, graded bedded quartzite is intruded by numerous pegmatite and granite veins and locally granitized. The high grade regional metamorphism of the Einasleigh Metamorphics in the Percyville and Einasleigh areas has influenced previous geologists, including Bryan (1925), to consider the metamorphics in these areas as the oldest sequence in the Etheridge Goldfield. Although these areas are separated from the main area of the Einasleigh Metamorphics by granite intrusions the 1956 mapping suggests that these metamorphics can be considered part of the Einasleigh Metamorphics, which interfinger with low grade metamorphics of the Green Hills Formation along its western margin in Robertson River area of the Etheridge Goldfield (Plate 3). Also it is thought that the high grade metamorphism in the Einasleigh Metamorphics along the eastern margin of the Forsayth Batholith is due to the deep unroofing of the batholith in this area.

Mt. Moran Formation.

The Mt. Moran Formation is named from Mt. Moran, whioh is situated in the north-eastern part of the Gilberton Four Mile Sheet at longitude 143°52' and latitude 19°11' (Plate 4).

The sediments of the Mt. Moran Formation crop out in the southern portion of the Etheridge Goldfield in the Gilberton area of the Gilberton Four Mile Sheet (Plate 4). The Mt. Moran Formation extends north-eastwards into the Einasleigh and Clarke River Four Mile Sheets, where it is exposed as roof pendants in the Forsayth Batholith.

The Mt. Moran Formation consists mainly of calcareous sediments, which grade to the east along their strike toward the Forsayth Batholith, firstly into banded calc-silicate hornfels and finally into gneiss. The calcareous sediments gradeto the west along their strike toward the Ortona Copper Mine into quartz siltstone and fine quartz sandstone.

Daintree (1872) first described the rocks of the Gilberton area as slates of Devonian age. Later Jack and Etheridge (1892) compared the slate, shale and mica schist of the Gilberton area with the Lower Silurian sequence of Victoria. Also they considered these rocks to be geologically different from rocks of the Etheridge Goldfield. Ball (1914) was the first geologist to recognise limestone in the Gilberton area, where he considered the age of slate and limestone as early Palaeozoic.

In Bernecher Creek near Gilberton (Plate 4) the Mt. Moran Formation consists of interbedded, cross-bedded and slumped, fine grained calcarenite and calcilutite with some lenses of limestone, which is overlain by calcareous siltstone. The calcareous beds occur in bands which vary from ½ inch to 2 inches in thickness. Ten miles further east from this area the first stage of metamorphism of the Mt. Moran Formation can be recognised in the headwaters of Granite Creek near Mt. Moran. Here the rocks are recrystallised calcilutite and spotted quartz-albite-epidote hornfels. The Mt. Moran Formation is about 15,000 feet thick in this area. Still further east along the strike of the Mt. Moran Formation, roof pendants of hornblende gneiss are exposed in the Forsayth Batholith between Kidston and Carpentaria Downs (Plate 3). This gneiss contains plagioclase, quartz, sphene, and hornblende and is considered an advanced stage in regional metamorphism of the calcareous sediments of the Mt. Moran Formation (Appendix I). The hornblende gneiss of the Mt. Moran Formation has been traced as far east as the junction of the Einasleigh/Lynd and Conjuboy/Lynd roads on the Einasleigh Four Mile Sheet (Plate 3), where it probably conformably overlies the Lucky Creek Metamorphics with some interfingering. A small area of interbedded quartz schist and quartzite between Werrington and Ten Mile Stations (Plate 5) are considered part of the Mt. Moran Formation.

Amphibolite is interbedded with hornblende gneiss in the Oak Park and Werrington areas (Plate 4), where they are considered to be derived from impure, calcareous sediments of the Mt. Moran Formation. Some of these metamorphics are described in appendix I.

The Mt. Moran Formation is moderately folded and the regional dip is to the south. A major anticline with a south westerly pitch is exposed in Bernecher Creek.

The relationship between the Mt. Moran Formation and the Einasleigh Metamorphics is not precisely known. The boundary between these two formations is exposed in a small area near Limkin's Uranium Prospect in the south-eastern part of the Georgetown Four Mile Sheet. There the boundary is linear and trends south-east towards Percyville (Plates 3 and 4). The absence of a fault and the sudden change in lithology across this boundary is suggestive of a regional unconformity between the Einasleigh Metamorphics and the Mt. Moran Formation.

Some specimens of the Mt. Moran Formation collected in the Gilbert River about 3 miles south-east of the Gilberton Station suggest that the formation is fossiliferous (Dr. Öpik, personal communication). The fossils cannot be determined, hence the age of the Mt. Moran Formation will have to depend on further collection from this area in 1957. Its age is tentatively regarded as Precambrian.

The crossbedding and slumping in the basal calcareous beds of the Mt. Moran Formation suggest that the formation was deposited on a slope on the southern margin of the shelf area of the Georgetown Geosyncline. Moreover the southerly dip of the Mt. Moran Formation suggests that this slope dips to the south. The lithology of the Mt. Moran Formation suggests that it was deposited in a different sedimentary environment from the Einasleigh Metamorphics. These rocks may represent idiogeosynclinal deposits (Kay, 1947) on a marginal trough formed on the south-eastern shelf area of the Georgetown Geosyncline.

Lucky Creek Metamorphics

The Lucky Creek Metamorphics are named from Lucky Creek, which joins the Dry River in the southern part of the Einasleigh Four Mile Sheet (Plate 3) at longitude 145°0' and latitude 18°52'.

The Lucky Creek Metamorphics consist of actinolite schist, quartz-chlorite-epidote schist and quartz-albite-hornblende schist, with thinly bedded impure marble and calc-silicate hornfels. The metamorphics are well exposed in Lucky Creek at longitude 144°52' and latitude 18°58', where they are about 15,000 feet thick.

The Lucky Creek Metamorphics have not been previously described, although the weathered amphibolite described by Denmead (1947) as the footwall rock of the Ninety Mile Copper lode is probably part of the Lucky Creek Metamorphics.

The Lucky Creek Metamorphics crop out between the Conjuboy/Lynd road and the Ninety Mile Copper Mine area in the southern part of the Einasleigh Four Mile Sheet. Along their eastern margin the metamorphics are sheared and intruded by serpentinized ultrabasic rock, which for the most part separates them from sediments of the Broken River Beds. The metamorphics are flanked on their western margin by hornblende gneiss of the Mt. Moran Formation. Tertiary basalt unconformably overlies the Lucky Creek Metamorphics along its northern margin.

The folding of the Lucky Creek Metamorphics is moderate and the fold axes trend north-east, which conforms to the trend of the Mt. Moran Formation. The regional dip is to the north-west. The metamorphics are intruded by small granite and porphyry masses in the central and northern parts of its outcrop area. The granite is coarse grained and probably part of the Forsayth Batholith. The metamorphism of the Lucky Creek Metamorphics is high grade regional probably within the albite-epidote amphibolite facies of metamorphism. Some of the Lucky Creek Metamorphics are described in Appendix I.

The relationship between the Lucky Creek Metamorphics and the Mt. Moran Formation is not yet known, but they are probably conformable with some interfingering towards the bottom of the Mt. Moran Formation. Moreover the lithology of the Lucky Creek Metamorphics suggests that they may represent a fine grained, impure calcareous variation of the Mt. Moran Formation. The age of the Lucky Creek Metamorphics is tentatively regarded as Precambrian.

Paddy's Creek Metamorphics

The Paddy's Creek Metamorphics are named from Paddy's Creek, which joins Lucky Creek at longitude 144°55' and latitude 18°57' on the southern part of the Einasleigh Four Mile Sheet.

The Paddy's Creek Metamorphics consist of quartz schist with minor lenses of quartz siltstone and fine grained quartz sandstone. The thickest part of the metamorphics crops out about 4 miles north-west of the Ninety Mile Copper Mine on the Conjuboy/Greenvale track, where about 3,000 feet of quartz schist are exposed.

The first description of the Paddy's Creek Metamorphics was recorded by Morton (1941), when he described the country rock of the Ninety Mile Copper Mine to consist of phyllite, talcose schist and coarse schist.

The Paddy's Creek Metamorphics are exposed in a small area of about 48 square miles near the Ninety Mile Copper Mine in the southern part of the Einasleigh Four Mile Sheet (Plate 3).

The quartz schist is commonly crenulated and the quartz grains elongated and flattened. This deformation is probably due to thrust movements along the boundary between the Paddy's Creek Metamorphics and the Broken River Beds. Moreover the dip of the schist is generally steep, but in parts of the deformed areas the dip is as low as 30 degrees, which may be due to the thrust movements.

The Paddy's Creek Metamorphics are moderately folded and trend north-north-east, which conforms to the trend of the Lucky Creek Metamorphics, and in part to the trend of the Broken River Beds in the Ninety Mile Copper Mine area.

The Paddy's Creek Metamorphics probably conformably underlie the Lucky Creek Metamorphics with some interfingering.

Dargalong Metamorphics

The Dargalong Metamorphics are named from the Dargalong silver-lead mine, 10 miles south-west of the Chillagoe Township on the Atherton Four Mile Sheet (Plate 6).

The Dargalong Metamorphics consist of quartzite, mica schist, andalusite schist, and garnet schist. The metamorphics are well exposed in the Tate River from the Tate Township to Bolwarra Station, where they are about 5,000 feet thick.

The Dargalong Metamorphics correspond to the "Dargalong Series" described by Skertchly (1899). The metamorphics were later referred to by Jensen (1923) as the "Cardross-Muldiva Series" and by Whitehouse (1930) as the "Dargalong Gneisses". Jensen (1923) correlated the metamorphics on the Dargalong area with his "Etheridgean Series" of Precambrian age. However, later Jensen (1941) considered the age of the "Etheridgean Series" of the Chillagoe area to be probably Cambrian, and compared its metamorphism to the "Kalkadoon-Argylla Series" of the Cloncurry district.

In the Dargalong area the metamorphics are exposed as roof pendants in granite, which is probably related to the same period of intrusion as the Forsayth Batholith. Along their western margin the Dargalong Metamorphics are unconformably overlain by Mesozoic sediments, and along their eastern margin they are probably unconformably overlain by the Chillagoe Beds of Lower Palaeozoic age. Here Jensen (1941) considered the Dargalong Metamorphics to be faulted against the Chillagoe Beds.

The Dargalong Metamorphics are intruded by dolerite dykes and sills, which are folded with the sediments. A large mass of coarse grained massive granite intrudes the Dargalong Metamorphics and for the most part this granite separates the metamorphics from the Chillagoe Beds to the east and from the Einasleigh Metamorphics to the south-west. The regional metamorphism of the Dargalong Metamorphics varies between the green schist and albite-epidote and amphibolite facies. The metamorphism is probably related to the period of granite intrusions.

The Dargalong Metamorphics are tightly folded and trend north-north-west, which is parallel to the trend of the Lower Palaeozoic sediments exposed along its eastern margin.

The age of the Dargalong Metamorphics is considered Precambrian. Their lithology and distribution suggest that they may be the northerly extension of the Einasleigh Metamorphics from the Talaroo Station area (Plate 3). These areas of metamorphics are separated by granite and quartz porphyry intrusions of the Forsayth Batholith and Croydon Complex.

PALAEOZOIC

Fossiliferous sediments of Lower and Middle Palaeozoic age crop out in the south-eastern and eastern parts of the are mapped. The sediments were not investigated in detail during the present survey except along their boundary with the metamorphics and granite of probable Precambrian age. Hence little can be added to previous knowledge of the succession.

SILURIAN-DEVONIAN

Sediments of early Palaeozoic age crop out along the south-eastern margin of the Precambrian metamorphics in the Broken River area (Plate 5) and along the eastern margin of the metamorphics in the Chillagoe area (Plate 6). Corals and brachiopods collected from limestone beds in the Broken River area suggest that Silurian and Devonian sediments (Dr. D. Hill, Appendix II), are exposed in the Broken River area. Fossils from the Chillagoe area have not been determined.

Broken River Beds

The Broken River Beds are named from the Broken River, which joins the Clarke River in the central part of the Clarke River Four Mile Sheet (Plate 5) at longitude 144°54' and latitude 19°32'.

The Broken River Beds consist of quartz greywacke, quartz and calcareous siltstones, arkose, conglomerate and limestone. The limestone contains corals with some brachiopods, the localities of which are shown on Plate 5. Preliminary examination of the corals by Dr. D. Hill, University of Queensland, suggests an Upper Silurian, Lower Devonian and Middle Devonian age for the limestones of the Broken River Beds. The limestone is bedded and generally crops out toward the middle of the sequence in the Broken River area (Plate 5). It is conformably overlain by interbedded quartz greywacke, conglomerate and quartz siltstone and conformably underlain by a dominantly siltstone sequence.

Fragmentary fossil plants were collected at two localities near the Hann Highway (Plate 5) from claystone and chert interbedded with quartz greywacke towards the top of the Broken River Beds. Although the fossil plants are poorly preserved and are mainly stem impressions, they have been described and tentatively regarded as Silurian-Devonian by M. E. White (Appendix III). This represents the first record of freshwater sediments in the Broken River Beds. Also since these sediments are interbedded with rhyolite, the top of the Broken River Beds may be equivalent in age to the fresh water sediments of the Gilberton Formation (see later).

The thickness measured from known structure and from interpretation of aerial photographs in the Broken River area, suggeststhat about 15,000 feet of sediments are exposed. Etheridge in Jack and Etheridge (1892) described a similar section which had been previously recorded by Daintree (1872) from the Broken River area, in which he listed about 27,000 ft. of sediments. However, this estimation of thickness may be excessive since the section containsrepeated beds due to strike faults in the Broken River area.

Etheridge in Daintree (1872) first recorded limestone in the Broken River area and he referred to it as the "Broken River Limestone". Later Jack and Etheridge (1892) correlated the "Broken River Series" with the "Burdekin Beds" of Middle Devonian age. Reid (1930) considered the age of the "Broken River Seires" to be Silurian. Although the Broken River Beds are shown on the Geological Map of Queensland (1953) as a group, the term beds is used here until the constituent formations are established by mapping in 1957.

The Broken River Beds extend for about twenty miles south-west from the type area to Gregory Springs and Blackbraes Stations, where they unconformably overlie the Forsayth Batholith. Here the Broken River Beds are in turn unconformably overlain by Tertiary basalt. Along their north-western margin the Broken River Beds are faulted against the Forsayth Batholith and hornblende gneiss of the Mt. Moran Formation. In the Ninety Mile Copper Mine area the boundary between the Broken River Beds and the Precambrian metamorphics to the north is complicated by thrust movements and later serpentinized ultrabasic intrusions. Little is known of the sediments to the north and east of the Burdekin River (Plate 3), but the steeply dipping quartz sandstone and siltstone beds with some limestone exposed between Greenvale and Camel Creek Stations are considered a part of the Broken River Beds.

In the Broken River area the beds are folded into dome and basin structures with dips up to 70°. Here the Broken River Beds are intruded by quartz porphyry sills and dykes. The Broken River Beds are also intruded by a small granodiorite mass near the Pandanus Creek/Wando Vale track crossing of the Broken River and by a small mass of granite at the Perry wolfram field between the Valley of Lagoons and Camel Creek Stations (Plate 3).

Chillagoe Beds

The Chillagoe Beds are named from the township of Chillagoe situated on the Atherton Four Mile Sheet (Plate 6) at longitude 144°30' and latitude 17°8'.

The Chillagoe Beds consist of limestone, limestone conglomerate, limestone breccia, sedimentary breccia, silicified calcareous siltstone, quartz greywacke, quartz siltstone with some interbedded basalt. The limestone is fossiliferous and commonly crops out as sharp fluted outcrops reaching a maximum height of about 300 feet above the general ground level, or low lying slabs. The limestone contains corals which are tentatively regarded as Silurian or Devonian in age.

The fossiliferous beds in the Chillagoe and Mungana areas were first described by Jack and Etheridge (1892) who considered them to be Permo-Carboniferous in age. Later Skertchly (1899) named these sediments the "Chillagoe Series" and he considered them to belong to the late Carboniferous. Later geologists dealt mainly with the age and correlation of the Chillagoe Beds. For instance, Dunstan (1901) recorded their age as Silurian, Etheridge (1904) as Ordovician or Silurian, Jensen (1923) and Bryan (1925) as Silurian, Whitehouse (1930) and David (1932) as Upper Silurian, Hill (1943) as Ludlovian and Devonian, and Bryan and Jones (1946) as Upper Silurian to Lower Devonian. Recently Broadhurst (1953b) described the breccias in the Chillagoe Beds as volcanic breccias in diatreme structures. McKinstry (1955) considered that even if Broadhurst is correct in his interpretation of the brecciated chert as silicified lava, the pipes filled with this breccia may not necessarily be the result of volcanic explosion. The 1956 mapping does not agree with Broadhurst's interpretation of the mode of formation of the breccias. The breccias consist of fragments of silicified fine grained sediments embedded in a clayey or silty matrix. The sedimentary fragments in the breccia at Mt. Redcap were derived from the one sedimentary type. It is thought that if these breccias were formed by explosive volcanic action that the fragments would be shattered and that the matrix of the breccia would be tuffaceous. Moreover, volcanic rocks would be abundant in the Chillagoe Beds. Some of the breccias are interbedded with limestone conglomerate and fresh limestone. The 1956 mapping agrees with Jensen (1941) who believed that some of the breccias were formed by wave action on reef limestone and other sediments.

The Chillagoe Beds are exposed in a linear belt which trends north-north-west in the northern part of the Atherton Four Mile Sheet (Plate 6). Along their western margin they unconformably overlie the Dargalong Metamorphics and along their eastern and southern margins the Chillagoe Beds are intruded by granodiorite and quartz porphyry. Their northern limit of outcrop is not yet known, but the beds probably extend as far as the Palmer River on the Cooktown Four Mile Sheet (Plate 1). A sequence of quartz greywacke and siltstone in the Emuford and Irvinebank areas (Plate 6) has been tentatively placed in the Chillagoe Beds. Part of this sequence may belong to the "Herberton Series" as described by Skertchly (1899) and later by Dunstan (1913) and others in the Herberton area (Plate 6).

The structure of the Chillagoe Beds is difficult to map due to the fluted appearance of the limestone. However, a syncline has been mapped near the Chillagoe Township, where the limbs dip at about 45 degrees. The thickness of sediments in the syncline is about 5,000 feet, which is probably about the maximum thickness of the Chillagoe Beds. Elsewhere the dip of the Chillagoe Beds ranges from about 45 to 90 degrees.

DEVONIAN-CARBONIFEROUS

Two small areas containing plant-bearing freshwater sediments of Devonian or Carboniferous age are preserved in the Gilberton area on the north-eastern part of the Gilberton Four Mile Sheet (Plate 4). These sediments may also crop out in the Agate Creek area in the northern part of the Gilberton Sheet, where Cameron (1900) described flat lying sediments under the general heading of "later Sedimentaries".

Gilberton Formation

The Gilberton Formation is named from Gilberton Station, which is situated on the Gilbert River at longitude 16

143°40' and latitude 19°15' in the north-eastern part of the Gilberton Four Mile Sheet (Plate 4).

The Gilberton Formation consists of a thin basalt bed of ferruginous shale and siltstone overlain by a crossbedded pebble conglomerate. The basal beds commonly contain lepidodendron fossil plants and possibly other plants. The Gilberton Formation ranges from 200 feet to about 700 feet in thickness.

The Gilberton Formation was first recorded by Jack (1890) as the "Star Beds", but this name cannot be used for the Palaeozoic sediments in the Gilberton area, since Jack (1879) previously described the "Star Beds" of similar age in the Star River, Charters Towers area. Later Cameron (1900) described sediments of the Gilberton Formation under the general heading of "Later Sedimentary Strata". The Geological Map of Queensland (1953) records the age of the "Gilberton Beds" as Devonian-Carboniferous.

Fossil plants in the Gilberton area were first recorded by Jack (1890) near Commissioner's Hill. Later de Vis Gipps was reported in Jones (1948) to have collected Lepidodendron australis plants in 1932 to the south and south-west of Gilberton. Hills (1936) records a Middle Devonian fish Antiarchan from this formation. During the 1956 mapping plant fossils, including lepidodendrons, were collected from two localities, one about 4 miles north-east of Gilberton, and another about 1 mile south of Gilberton (Plate 4). M. E. White (Appendix V) considers the lepidodendroid plants a species of Leptophloeum.

The Gilberton Formation is exposed in two areas (Plate 4), one of these is about 45 square miles in area and is situated 4 miles north of Gilberton Station. The other outcrop is about 2 square miles in area and is situated on the southern banks of the Gilbert River adjacent to Gilberton Station.

The Gilberton Formation usually unconformably overlies the Mt. Moran Formation, but along its eastern margin in the Granite Creek area (Plate 4), the Gilberton Formation is faulted against the Mt. Moran Formation. Bedding dips range from about 10 degrees to 30 degrees with steeper dips in the Granite Creek area.

UPPER PALAEOZOIC

Acid volcanic rocks with some associated intrusive acid rocks either intrude or overlie the Precambrian and Lower Palaeozoic sequences. These rocks cover large areas between the Gregory Range in the western part of the Georgetown Four Mile Sheet and the Featherbed Range in the northern part of the Atherton Four Mile Sheet. These rocks include the "Featherbed Porphyries" and the "Croydon Felsites" as shown on the Geological Map of Queensland (1953).

The age of these rocks is not precisely known but it is considered as Upper Palaeozoic since the "Featherbed Porphyries" conformably underlie Permian coal measures in the Mt. Mulligan area (Ball 1912). The "Featherbed Porphyries" were not mapped during 1956 and hence little can be added to present ideas.

Croydon Complex

The Croydon Complex is named from the Croydon Township situated at longitude 142°15' and latitude 18°10'.

The Croydon Complex consists of rhyolite, quartz porphyry, granite porphyry and granite with some quartz 17 greywacke, siltstone, conglomerate and limestone. The type area for these rocks at Croydon was not visited during 1956 but the felsites recorded there by Honman (1937) are thought to be a part of the Croydon Complex.

Graphitic granite, graphitic rhyolite and quartz porphyry are exposed on the eastern side of the Gregory Range (Plate 3). This exposure is thought to be an extension of the "Croydon Felsites" which crop out on the western edge of the range near Croydon.

On the north-eastern margin of the Newcastle Range (Plate 3) the base of the Croydon Complex contains about 200 feet of limestone, quartz greywacke, conglomerate and siltstone interbedded with some rhyolite, which is conformably overlain by about 6,000 feet of rhyolite and quartz porphyry. Near the Ten Mile Station (Plate 5) granite is genetically associated with ring dykes of quartz porphyry and granite porphyry, which are considered to belong to the Croydon Complex. Most of the granite and quartz porphyry areas between the Tate River and the Einasleigh (Plate 6) are also considered as part of the Croydon Complex.

Near the Percy River (Plate 4) about 75 feet of rhyolite conformably overlies the Gilberton Formation. This rhyolite is thought to be part of the Croydon Complex and hence may be further evidence in support of an Upper Palaeozoic age for the Croydon Complex. Moreover similar sediments to those which contain plant fossils at the base of the Gilberton Formation, are exposed at the base of the Croydon Complex along the eastern margin of the Newcastle Range. Also similar sediments have been recorded by Reid (1932) at the base of the Cumberland Range, near Georgetown, where they are conformably overlain by rhyolite of the Croydon Complex.

The quartz porphyry intrusions and interbedded rhyolite flows in the top of the Broken River Beds in the Broken River area are considered part of the Croydon Complex period of intrusion. Here again the acid igneous rocks are associated with plant bearing sediments.

The Croydon Complex intrudes the Precambrian metamorphics, the Forsayth Batholith and the Broken River Beds. They are unconformably overlain by Mesozoic sediments in the Gregory Range and by Tertiary basalt in the Conjuboy area (Plate 3).

The volcanics in the Croydon Complex generally crop out as elongated masses. The Newcastle Range is the largest mass. Here the structure is a syncline or basin, in which rhyolite crops out at the base and dips at about 35 degrees towards the centre. Part of the Newcastle Range basin is bordered by fractures and ring dykes of quartz porphyry and granite porphyry.

The estimated thickness of the Croydon Complex in the Newcastle Range basin is about 6,000 feet and the volume of rhyolite extruded in the Newcastle Range basin is about 800 cubic miles. The mechanism of emplacement of this quantity of volcanics is not fully understood, but it is thought by cauldron subsidence of the country rock. Fractures partly filled with quartz porphyry such as those which generally accompany cauldron subsidence, are exposed up to 20 miles along the western and eastern margin of the Newcastle Range basin of the Croydon Complex. These fractures are probably complementary fractures to the main area of fracturing and cauldron subsidence in the Newcastle Range.

MESOZOIC

Mesozoic freshwater and marine sediments form the eastern margin of the Great Artesian Basin and are exposed mainly on the western part of the area mapped in the Georgetown, Gilberton and Atherton Four Mile Sheets. Small outliers of Mesozoic sediments are exposed further east in the Newcastle Range area. The sediments crop out as mesa cappings.

These sediments were not investigated in detail, except along their boundary with the underlying Precambrian metamorphics and granite, hence little can be added to previous knowledge of the Mesozoic succession.

Blythesdale Group

Flat lying beds of sandstone, conglomerate and arkose with some claystone and siltstone are exposed along the western and south-western margins of the area mapped. These are thought to represent part of the intake beds for the Great Artesian Basin and belong to the "Blythesdale Group". Whitehouse (1955), who named this group has indicated that it consists of possibly four formations.

The age of the Blythesdale Group is not precisely known. The Geological Map of Queensland (1953) indicates a Lower Cretaceous age for the "Blythesdale Sandstone" and Whitehouse (1955) considered the "Blythesdale Group" to overlap the junction between the Jurassic and Cretaceous systems.

Plant fossils containing Cladophlebis and other types were collected at the base of a sequence of flat lying conglomerate and siltstone, 5 miles north-north-west of Forest Home Station (Plate 3). (Appendix III, M.E. White). These plants suggest an Upper Jurassic-Lower Cretaceous age for this part of the Blythesdale Group. This sequence is tentatively regarded as part of the freshwater sediments at the base of the "Blythesdale Group" Whitehouse (1955).

TERTIARY

Tertiary Basalt

Tertiary basalt crops out in the three main areas in the area mapped. These are the Atherton Tablelands (Plate 6), the Mt. Surprise/Conjuboy area (Plate 3) and the Blackbraes/Nulla Nulla area (Plate 5).

Twidale (1956) named the "Chudleigh Basalt" and the "Sturgeon Basalt" from the Blackbraes area. Also he regarded the basalt of the Sturgeon Province as the oldest in the area and considered it to be post lateritic in age. Twidale (1956) divided the Chudleigh Province into the Newer Chudleigh Basalt of early to middle Pleistocene age, and the Older Chudleigh Basalt of Pliocene to early Pleistocene age.

The basalt crops out on plateaus and mesas and fills old river valleys, such as that occupied by the Einasleigh River. Extinct volcanoes can be recognised in all basalt areas and some contain crater lakes such as Lake Eacham and Lake Barrine on the Atherton Tablelands. In the area mapped the thickness of basalt ranges from 10 feet to 75 feet.

Tertiary Laterite

Laterite crops out in the Burdekin and Clarke River areas as cappings on top of the Broken River Beds (Plate 3 and Plate 4). Only part of the laterite was examined in 1956 and

and so far no appreciable amounts of bauxite have been discovered. The laterite ranges from 5 feet to about 15 feet in thickness and covers an area of about 20 square miles.

IGNEOUS ROCKS

GRANITIC ROCKS

At least two ages (possibly three) of granitic intrusives can be recognised in the area mapped. These are:

1. Pre-Silurian intrusives
2. Post-Silurian intrusives (these may contain two ages of igneous intrusion).

1. Pre-Silurian Intrusives

A large granite pluton, known here as the Forsayth Batholith, intrudes the Precambrian metamorphics of the Etheridge Group, Einasleigh Metamorphics, Mt. Moran Formation and Lucky Creek Metamorphics. In the area mapped the Forsayth Batholith extends from the Etheridge River in the north to the Clarke River in the south and covers an area of about 2,500 square miles. It is overlain unconformably by the Broken River Beds near the Blackbraes and Gregory Springs Stations (Plate 5). Until the age of the Forsayth Batholith is determined by radioactive means the batholith is tentatively considered to be emplaced at the end of the Precambrian.

The main rock type is a massive coarse grained porphyritic biotite granite. Many textural variations are present and large pegmatite bodies crop out over an area of about 35 square miles along the western margin of the batholith. Here a contaminated biotite granite is exposed over an area of about 16 square miles. So far separate granitic intrusives have not been discovered in the Forsayth Batholith; the variations within the batholith can be adequately explained by contamination with some differentiation.

The intrusion of the Forsayth Batholith has been part of the regional metamorphism of the Einasleigh Metamorphics, Etheridge Group and Mt. Moran Formation. The grade of metamorphism increases towards the Forsayth Batholith from the greenschist to the amphibolite facies.

Granite intrudes the Dargalong Metamorphics in the Tate River area (Plate 6). This granite is petrologically similar to granites of the Forsayth Batholith and is probably related to the same period of intrusion. The granite in the Tate River area is gneissic near its contact with the Dargalong Metamorphics. This gneissic banding is parallel to the trend of the Dargalong Metamorphics and the bands probably represents partial assimilation of the metamorphics by the granite.

2. Post-Silurian Intrusives

These intrusives consist of granite and granodiorite.

Granite is genetically associated with rhyolite and quartz porphyry of the Croydon Complex. This granite contains graphite on the eastern margin of the Gregory Range and grades into quartz porphyry towards the top of the range. In the Newcastle Range, Ten Mile and Tate River areas the granite does not contain graphite and it varies from a granite porphyry to a massive medium grained granite.

Granodiorite intrudes the Chillagoe Beds along their southern and eastern margins with formation of garnet hornfels from the impure limestones (Plate 6). There is some evidence to suggest that this granodiorite intrudes the granites of the Tate River area near the Muldiva Mine (Plate 6). The granodiorite is massive medium grained and contains some monzonite and more basic and undersaturated granitic types, as exposed at the Ruddygore Copper Mine and the Metal Hills, near Chillagoe.

Also granodiorite intrudes the Broken River Beds near the Pandanus/Wando Vale track crossing of the Broken River (Plate 5) and near the Perry wolfram diggings between Camel Creek and Valley of Lagoons Stations (Plate 3).

The relative age of the granite and granodiorite is not precisely known. The granites of the Croydon Complex intrude the Forsayth Batholith, the Broken River and Chillagoe Beds. Preliminary petrological examination of the rhyolite in the Redcap area, Chillagoe, indicates that the rhyolite is intruded by the granodiorite. If this is correct it is possible that the granodiorite at Chillagoe was emplaced in the Late Palaeozoic, the "Gympie Epoch", Jones, 1948, and the granite of the Croydon Complex was emplaced in the late Devonian or early Carboniferous, the "Herberton Epoch", Jones, 1948. The tin and wolfram bearing granites of the Herberton and Bamford areas (Plate 6) were not studied in 1956, but they probably contain granites that belong to the "Herberton" and "Gympie Epochs".

SERPENTINE

Elongated masses of serpentinized ultrabasic rocks are intruded near the boundary of the Broken River Beds and Lucky Creek Metamorphics in the Gray Creek and Ninety Mile Copper Mine areas (Plate 5). Some of these intrusions have been emplaced along faults and in shear zones. All stages in the serpentinization of dunite and peridotite can be recognised. Gabbro and diorite is exposed at the southern part of the serpentine mass along the western valley of Gray Creek. Here the country rocks have been silicified probably due to release of silica during serpentinization which resulted from the intense stresses during emplacement. The age of the serpentine intrusion must be post Silurian-Devonian; the upper limit is not clear although most serpentine intrusions in Queensland are considered to be emplaced in the late Devonian (Jones, 1948).

The mechanism of emplacement of the serpentine is not fully understood and evidence is inconclusive to support either intrusion contemporaneous with the faulting or as a diapiric intrusion after the faulting.

DOLERITE AND GABBRO

There are at least two ages of intrusion of dolerite and gabbro in the area mapped:

(i) Pre Forsayth Batholith intrusive

(ii) Post Forsayth Batholith intrusive

Dolerite and gabbro dykes and sills intrude the Precambrian metamorphics. Dolerite intrudes the Green Hills Formation and it is later metamorphosed by the Forsayth Batholith.

Dolerite dykes intrude the Forsayth Batholith between Einasleigh and Rosella Plains (Plate 3) and near Bolwarra Station (Plate 6).

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MINERALIZATION

ETHERIDGE GOLDFIELD

The Etheridge Goldfield includes that area drained by the Gilbert, Etheridge and Einasleigh rivers and extends west to the junction of the Gilbert and the Einasleigh rivers. (Plate I). Mining operations commenced in 1877, but the isolation of the field and difficulties of transport hindered its successful exploitation, although this was improved by rail connection with Chillagoe and Cairns in 1909.

Mineralization is associated with the Forsayth Batholith, with basic igneous intrusions, and with the Croydon Complex. Granite occupies the greater part of the gold field.

Quartz reefs in the Forsayth Batholith were the main gold producers, and contain smaller amounts of gold in the sediments. The gold in the reefs is associated with pyrite, galena, chalcopyrite and sphalerite in the primary zone. The reefs range up to 15 feet wide but most have an average width of about 1 to 2 feet. The reef at the International Mine has been traced for a mile in length.

The oxidised zone in the Etheridge Goldfield extends from 60 to 100 feet depth. Most of the small reefs were not worked below 100 feet level, because of the difficulties encountered with deeper workings and the refractory nature of the primary ore. Only 14 mines have been worked to a depth greater than 200 feet and in general it was found that the gold content decreased below 300 feet.

The main gold producers in the Etheridge Goldfield were the Cumberland, Durham, Queenslander and Nil Desperandum mines.

The Cumberland Mine is situated in the Forsayth Batholith about 13 miles west of Georgetown and it was the biggest gold producer (Plate 3). Total production was 65,713 oz. of gold from ore averaging 1 oz. 18 dwt. per ton. Exploratory diggings were to a depth of 1106 feet on the underlie (800 feet vertical depth), with little payable ore below 400 feet. The ore shoots were about 400 feet long and up to 15 feet in width.

The Durham mine is situated in the Forsayth Batholith about 4 miles west of Georgetown (Plate 3). The mine was worked to a vertical depth of 950 feet and was the deepest mine on the field. Ore of 1 oz. 15 dwt. per ton grade was won from above the 300 feet level. At the 450 feet level the grade decreased to 15 dwt. per ton. At 750 feet a small quantity of ore averaging 5 oz. per ton was recorded, but apparently no quantity of this was discovered as the mine was closed down at a developed depth of 950 feet.

The Queenslander gold mine is situated on the western edge of the Forsayth Batholith, 4 miles north-west of Forsayth (Plate 3). The reef strikes east and west and dips steeply to the north. Down to 280 feet the average yield was $1\frac{1}{2}$ oz. per ton. Although the grade decreases in the deeper levels the reef has been proved to be mineralized to a depth of 300 feet. The mine was a consistent producer from a well defined reef about 18 inches wide developed over a length of 540 feet.

The Nil Desperandum gold mine is situated two miles south-east of the Queenslander (Plate 3). The ore averaged 1 oz. 15 dwt. per ton but the grade values declined below the 300 feet level. The reef averaging 6 feet in width was developed intermittently over a length of 1,000 feet. The primary ore consists of gold with some galena, pyrite, chalcopyrite and sphalerite.

Quartz reefs with lead and silver are exposed along the western edge of the Forsayth Batholith at Mosquito Creek (see Plate 3) and with gold, silver and copper along the southern edge of the batholith at Percyville (see Plate 4).

The ore at Mosquito Creek averages 50 to 60 per cent lead, with silver varying up to 90 oz. per ton. Deepest workings were to a depth of 184 feet at the Southern Cross Mine. The reefs averaged 3 feet in width and up to several hundred feet in length. 2,600 tons of ore were mined from the Mosquito Creek field of which 2,000 tons were produced before 1915.

The Percyville reefs are up to 1/4 mile long with an average width of about 2 feet. Lead with silver, and copper with gold and silver are the main ore types. L. C. Ball (1915) suggested that the lead and silver ores were associated with pegmatite reefs and the copper, gold and silver ores with quartz porphyry.

The Union Mine was the biggest producer in the Percyville field. The primary ore averaged 20 to 25 per cent copper and 6 to 7 oz. gold per ton, with some small rich patches up to 100 oz. gold per ton. The mine produced abo t 2,800 oz. of gold.

The Woolgar Goldfield covers an area of about 400 square miles and adjoins the southern boundary of the Etheridge Goldfield on the Gilberton Four Mile Sheet (Plate 4). This mineral field was not mapped in 1956, but the total production from the Etheridge and Woolgar Goldfields to the end of 1945 was about 592,800 oz. of gold.

Although small quantities of base metals were mined from some of the auriferous reefs on the Etheridge Goldfield, large amounts of copper were mined from the Einasleigh mine and to a lesser extent from the Ninety Mile and Ortona Mines.

The Ortona Copper Mine, situated on the Percy River, is one of three copper mines at present working on the Etheridge mineral field. L.C. Ball (1915) described the old workings. The reefs fill fissures or contraction joints in diorite dykes and have a maximum width of 15 feet and maximum length of 600 feet. The ore consists of quartz and hematite with copper, silver and gold. The workings were to a depth of 140 feet in the oxidised zone. The secondary ore at present mined averages 35 per cent copper. Total production is about 1,750 tons of ore averaging 25 per cent copper.

The Einasleigh Copper Mine is situated at the junction of the Einasleigh and Copperfield rivers near the township of Einasleigh (Plate 3). The mine was first described by Ball (1914) and more recently by the Geological Survey of Queensland (1953).

The Einasleigh Copper Mine was worked between 1898 and 1924 with a total production of 134,257 tons of ore averaging 6 per cent copper, 8 grains of gold and 1 oz. silver per ton. During the operation of the mine, production was increased at the expense of development and with a decline in the price of copper, the mine was forced to close with no immediate reserves of high grade ore.

The country rock consists of schist, gneiss and quartzite of the Einasleigh Metamorphics, which are intruded by pegmatite and aplite. The metamorphics trend generally north and south and contain an east-west fracture system, which forms fissures and channels for ore deposition. The orebodies are present where fissures are sufficiently large and where the country rock consists of mica schist, which is readily replaced by ore minerals. The ore bodies are up to 200 feet long and 50 feet wide. The mine has been worked to a depth of 580 feet.

A quartz porphyry dyke of the Croydon Complex intrudes the Einasleigh Metamorphics at about a quarter of a mile to the east of the mine. This dyke has been suggested as a source of the mineralization. The ore of the Einasleigh Mine contains pyrite, magnetite, molybdenite, bismuth and garnet. This assemblage is indicative of contact metamorphism, with an igneous mass at no great depth giving rise to the metamorphism and mineralization. This may be related to the granite intrusion, which is exposed a mile to the south-east of the mine.

The Gordon Stanley Copper Prospect is situated approximately 14 miles south-west of Werrington Station (Plate 5). The prospect was mined for a short period in 1956 by M.B. Fisher, who abandoned it in October, 1956, through lack of a ready market for the ore.

The workings consist of a shaft which has been sunk to a depth of 40 feet on a 3 feet wide copper bearing quartz-hematite reef. To within a few feet of the surface the ore is partly silicified containing some copper carbonate, which grades into copper oxide ore with minor malachite in vughs and cavities. Mr. Fisher claimed that some of the ore assayed up to 20 per cent copper and that there were a few tons of ore at grass.

Seventy yards west of this copper prospect is a large unworked quartz and hematite reef, which is about 15 feet wide and contains traces of copper. The country rock consists of hornblende gneiss, mica schist and quartzite, which are sheared and intruded by numerous quartz veins.

The Ninety Mile Copper Mine (Hall's Reward) is situated about 25 miles south-east of Conjuboy (Plate 3). The mine workings have been described by Morton (1940 and 1943) and recently by Denmead (1947).

The ore occurs in a fissure along the contact of sericite schist and hornblende gneiss. Serpentine crops out 150 feet east of the lode and the altered rock in the fissure consists mainly of serpentinous and kaolinic material. The lode channel has an average width of 8 to 12 feet and the more sheared parts have favoured ore deposition. The ore in the present workings is concentrated mainly along the footwall of hornblende gneiss, which is a member of the Lucky Creek Metamorphics. The ore shoots have an average width of about seven feet and the lode has been worked over a length of 470 feet. Most of the ore mined to date is secondary.

Drilling by the Geological Survey of Queensland in 1953 and 1954 and subsequent development indicates that the length of the lode can be increased by 130 feet to make the total length 600 feet. A further extension is possible. Little work has been dond below the 150 feet level and drilling indicated only weak mineralization at 250 feet. The mine has been worked continuously since 1936 and production to the end of 1955 was 11,952 tons of ore with an average grade of 17.7 per cent copper at 3.8 dwt. gold per ton.

THE OAKS GOLDFIELD

This field includes the workings near three prominent hills known as Wise, Macks and North Knobs, about 1 mile west of Kidston township (Plate 1 and Plate 3). Gold was discovered here in 1907 and mined up to 1942.

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Marks (1911) was the first to describe the Oaks Goldfield.

The country rock is mainly crushed, brecciated and sericitised granite of the Forsayth Batholith, which is intruded by pegmatite and quartz veins and porphyry dykes. The sericitised granite and quartz veins contain gold with some pyrite, galena and sphalerite. The quartz veins appear to occupy a ring structure, which is about 5/8 of a mile in diameter and resulting from concentric fracturing and crushing. The fracturing movement was not great, as dykes are brecciated but not displaced. Although the mineralization is post-porphyry it can probably be related to the final phase of emplacement of the Croydon Complex.

The quartz veins are small, averaging less than six inches in width, and although rich they were too narrow to mine profitably at depth. The grade of ore won was 5 oz. per ton and showed no sign of diminution with depth. The oxidized zone extends between 75 and 100 feet. Underground workings did not exceed a vertical depth of 190 feet. The ore was free milling and was treated on the field. Some open cut mining has been carried out with yields of up to 2 dwt. of gold per ton.

The battery at Kidston was closed down in 1942 and the last crushing in this year averaged 1 dwt. per ton. The battery was re-opened in 1947. Very low annual yields of 12 oz. of gold in 1948 and 29 oz. of gold in 1949 were obtained and the battery ceased operations in 1949.

The total production for the Oaks Goldfield was about 75,000 oz. of gold.

CHILLAGOE MINERAL FIELD

Very little mapping was carried out in this field in 1956. Most of the mines were located (Plate 6) and some of the regional geology was mapped. As it is intended to map this field in more detail in 1957 or 1958 the mines will not be discussed here. The various types of deposits are summarized in Table 2.

URANIUM

Uranium mineralization is found in small quantities in quartz veins and shears in the Forsayth Batholith. These deposits, including Limkins and Blackwells, have been previously described by Walpole and Langron (1956), Taylor (1956), and more recently by Wyatt (1957). Limkins Prospect was mined for about three months during 1956 when a small quantity of uranium ore was won. However, the mine was abandoned in September, 1956, because of insufficient reserves of ore and labour difficulties.

EXAMINATION OF AIRBORNE RADIOMETRIC ANOMALIES

An airborne reconnaissance carried out by D. C. 3 aircraft during 1955 recorded 107 radiometric anomalies on the Georgetown (2 anomalies), Gilberton (32), Clarke River (15), Einasleigh (44) and Atherton (14) Four Mile Sheets (Parkinson and Mulder, 1955).

Fifty-four of these anomalies were located and investigated on the ground during 1956. A separate report was compiled for each of the anomalies examined. None of these anomalies warrants further investigation. The position of the anomalies in relationship to the regional geology is shown on Plates 3, 4, 5 and 6.

A summary of the geological setting of the anomalies examined is as follows:

Granite	16 anomalies
Alluvium derived from granitic rocks	13 anomalies
Quartz porphyry or rhyolite	13 anomalies
Metamorphics (schist, gneiss and quartzite)	8 anomalies
Pegmatite	3 anomalies
Sediments (arkose)	1 anomaly.

The probably geological settings of the anomalies not examined are:-

Granite	26
Sediments (mainly siltstone)	10
Quartz porphyry	3
Basalt	1

Walpole and Langron (1955) investigated some of the airborne radiometric anomalies recorded by D.C. aircraft of the Bureau of Mineral Resources in 1954 on the Georgetown Four Mile Sheet, as well as Limkin's and Blackwell's Uranium Prospects. J. Taylor (1956) of the United Kingdom Atomic Energy Authority re-examined these anomalies and prospects during this survey.

RECOMMENDATIONS FOR FUTURE WORK

1. Geological

The following work is recommended to complete the regional survey of the Etheridge, Herberton and Chillagoe Mineral Fields of North Queensland.

(a) Regional mapping of the Mt. Garnet and Herberton area at 1 inch = 4 miles scale. Tin dredging in the Mt. Garnet area is being carried out by Tableland Tin Dredging and Ravenshoe Tin Dredging Companies. In the Herberton and Irvinebank areas lode tin is mined by a few prospectors. Areas to the north and west of the leases held by Tableland Tin Dreding and Ravenshoe Tin Dredging companies may be favourable for tin dreding. This mapping together with the mapping of the Bamford Wolfram Field will complete the regional mapping of the Atherton Four Mile Sheet (Plate 6) at a scale of linch = 4 miles.

(b) Regional mapping at 1 inch = 4 miles scale of the Broken River Beds between the Clarke and Burdekin Rivers on the Clarke River Four Mile Sheet (Plate 5) and to the east and north of the Burdekin River on the Einasleigh Four Mile Sheet (Plate 3) is required to complete the regional mapping of these sheets.

(c) Regional mapping at 1 inch = 4 miles scale of the Precambrian metamorphics in the area between the Robertson River and Gilbert River. This mapping together with the location of gold mines between Georgetown and Forsayth will complete the regional mapping of the Georgetown Four Mile Sheet (Plate 3).

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(d) Regional mapping at 1 inch = 4 miles scale of the metamorphics between Gilberton and the Gregory Range, as well as the mapping of the Woolgar Goldfield will complete the reconnaissance of the Gilberton Four Mile Sheet (Plate 4).

Reconnaissance mapping should be carried out to the north of Mungana as far as the Palmer River in order to test the extension of the mineralized Chillagoe Beds into the O.K. and Palmer Goldfields. If favourable results are obtained in these areas in 1957 the Mossman and Cooktown Four Mile Sheets should be regionally mapped at 1 inch = 4 miles scale in 1958.

The following detailed mapping is recommended in the Etheridge Chillagoe and Herberton mineral fields:

(a) Mapping at 1 inch = 1000 feet scale of the Calcifer, Zillmanton, Red Cap and Lady Jane/Girofla group of mines in the Mungana and Almaden areas on the Atherton Four Mile Sheet. This area is 16 miles long by 4 miles wide and includes the leases held by Clutha Development and Metals Exploration in 1956.

(b) Mapping at 1 inch = 1000 feet scale of the Ninety Mile Copper Mine on the southern part of the Einasleigh Four Mile Sheet. This area includes the thrust system and associated serpentinized ultrabasic rock intrusions along the contact of the Lower Palaeozoic sediments and Precambrian metamorphics. This area is 16 miles long and 4 miles wide.

(c) Mapping at 1 inch = 1000 feet of the tin lodes between Watsonville and Herberton on the Atherton Four Mile Sheet. This area measures about 8 miles long and 2 miles wide.

2. <u>Geophysical</u>

There are several areas and prospects in the Chillagoe and Einasleigh areas that warrant geophysical work. These are:

(a) Airborne radiometric survey by Auster aircraft of the Stockyard Creek Siltstone Member on the Georgetown Four Mile Sheet (Plate 3). This siltstone gives radiometric counts generally higher than any other bed in the Etheridge Goldfield.

(b) Aerial electromagnetic survey of the Mt. Moran Formation on the Gilberton (Plate 4) and Einasleigh Four Mile Sheets (Plate 3). The general depth of weathering in these sediments is only a few feet and the area should be suitable for prospecting by electromagnetic methods. The lithology and geological setting of the Mt. Moran Formation is similar to that of the Mt. Isa Shale and most of the area is covered by soil and alluvium.

(c) Airborne magnetometer survey of the Chillagoe and Mungana area (Plate 6). This area is about 40 miles long and 12 miles wide. Some of the outcropping orebodies are magnetic and there is a good chance that other orebodies exist along the granite and limestone contact within a reasonable depth of the surface.

(d) Ground magnetometer surveys should test selected airborne anomalies and the method should be used in conjunction with the detailed geological investigation of mineral occurrences in the Chillagoe, Mungana and Ninety Mile Copper Mine areas (Plate 3).

The magnetic surface outcrop at the Harper Mine (Plate 6) in the Chillagoe area indicates a lode of about 10,000 tons per foot of depth. The oxidized ore at Chillagoe passes into a mixed sulphide ore with a quartz-garnet-hematite-magnetite gangue. Few of the orebodies have been worked below the oxidized zone and there seems to be no reason why some at least of the orebodies should not continue in depth. Moreover geophysical anomalies discovered at this stage might encourage mining companies, such as Metals Exploration and Clutha Development, who are at present interested in the Chillagoe area, to carry out testing by drilling.

Other geophysical methods such as self-potential may be used in the Ninety Mile Copper Mine area.

3. Geochemical

(a) Geochemical sampling and testing should be carried out in conjunction with the detailed geological mapping of the Ninety Mile Copper Mine area (Plate 3). The sampling should be restricted to soils along the trend of the copper lode and for about $\frac{1}{4}$ mile each side of the trend. Gridding should not be considered until favourable areas of mineralization have been established. The samples should be qualitatively tested for copper, lead and zinc in the field. If favourable results are obtained in the field they should be tested later in the laboratory quantitatively for these metals and cobalt, nickel and chromium.

(b) Geochemical sampling and testing of the known geophysical electromagnetic anomalies as shown by Langron (1950) over the Zillmanton lode in the Chillagoe area (Plate 6).

(c) Geochemical sampling and testing of the river silts derived from the Stockyard Creek Siltstone Member on the Georgetown Four Mile Sheet. Sampling should at first be restricted to the Black Gin Creek and later to the eastern tributaries of the Langdon River. Tests should be carried out for uranium and copper.

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APPENDIX I.

Petrography by R. D. Stevens

The following are identifications and petrographic description of certain selected specimens collected during 1956 in the area mapped.

The descriptions of some of the Lucky Creek Metamorphics indicate a similar grade of metamorphism to that of the Mt. Moran Formation. Moreover, the descriptions suggest that the Lucky Creek Metamorphics can be considered an impure calcareous facies of the Mt. Moran Formation. This interpretation agrees with the field mapping.

The micrometric analydes at the end of the section indicate that the calcareous sediments of the Mt. Moran Formation include calcareous siltstone as well as calcilutite.

Lucky Creek Metamorphics

Specimen B.105

Two specimens are included under this number, one dark greenish-grey and slightly foliated and the other lighter grey and laminated to schistose in hand specimen.

The darker and more massive specimen is an actinolite schist consisting of oriented actinolite, plagioclase and quartz, with a minor amount of sphene. The plagioclase (40%) forms coarse anhedral crystals of oligoclase-andesine (An 32). Actinolite (50%) occurs as elongated crystals with a preferred orientation. Quartz (8%) forms irregular grains and patches, and sphene (2%) is generally found in film-like, finely granular aggregates parallel to the foliation throughout the rock.

Narrow veins of finely felted (?)anthophyllite cut through the rock in random directions. The rock has been entirely reconstituted and no original textures remain to indicate the character of the parent material. It would seem, however, that such a rock would be produced from either an impure calcareous sediment or a basic igneous rock. The fact that this schist is associated with known calcareous sediments suggests the possibility of sedimentary origin.

The lighter grey, more highly foliated rock is a medium to fine-grained quartz-chlorite-epidote schist with a cataclastic texture in thin section, as shown by numerous sheared, lenticular quartz aggregates, which probably represent original sedimentary quartz grains.

Additional constituents, all in significant quantities, are calcite, actinolite and magnetite. Calcite occurs as narrow lenticular masses oriented parallel to the foliation, and as small anhedral grains throughout the rock. Actinolite forms large, idoblastic crystals (?porphyro-blasts), and finely granular magnetite is scattered throughout the matrix.

It is suggested that this rock has formed from an impure, calcareous sandy sediment.

Specimen B.2355

Specimen B.2355 (a) is a calc-silicate hornfels consisting mainly of calcite (40%), epidote (30%), tremolite and actinolite (total, about 20%), quartz (10%) and a small amount of chlorite. The texture is generally hornfelsic, and is made up of crystalloblastic epidote in a matrix of calcite, tremolite-actinolite and quartz. 32

In thin section the rock is massive, but a cut face on the light green-grey hand specimen exhibits a weak foliation. The calc-silicate rock has formed by thermal metamorphism of an argillaceous limestone. The association of free quartz and calcite suggests high confining pressures.

Specimen B.2355 (c) is a coarse-grained, impure marble consisting of about 80% calcite, 15% epidote, 4% quartz and albite and 1% chlorite, magnetite and apatite.

The specimen has a distinct foliation in thin section and, most particularly, in the green-grey hand specimen. This foliation is due to the concentration of epidote and chlorite in narrow bands and films in parallel orientation embedded in moderately crystalline marble with small amounts of intergranular quartz, magnetite and chlorite. However, most of the quartz is located in the silicate bands and may represent original detrital sand grains in the marble. Apatite is also confined to the coloured silicate bands.

Specimen B.2355(b) is transitional between (a) and (c), but is more foliated.

Specimen B.2356.

The rock is a dark grey, foliated quartz-albite-hornblende schist carrying minor amounts of epidote, magnetite and apatite. The rock is crystalline, with no shearing or cataclastic texture, and it is thought that there has been a complete recrystallization of the rock.

The hornblende has a blue colour, indicating a sodic composition, and it is also evident that the plagioclase is of sodic composition. These observations suggest that the rock has been subjected to sodic metasomatism in addition to simple recrystallization.

Specimen B.109

The rock is an amphibolite, consisting mainly of green hornblende (49%), basic plagioclase (bytownite, An_{70-74}; 40%) and quartz (1%). Accessory minerals are sphene, clinozoisite, sericite, carbonate, magnetite and pyrite.

In the plane of the section, which is normal to the lineation exhibited in the hand specimen, the texture of the three main constituents hornblende, plagioclase and quartz is generally granoblastic. Sphene occurs as aggregates of small, drop-like crystals, and sericite and carbonate as an alteration replacement of feldspar. Clinozoisite may also have formed from the alteration of feldspar.

Generally amphibolites are formed during moderate to high-grade regional metamorphism, involving high temperature and pressure conditions, from basic igneous rocks or impure calcareous or dolomitic sediments. It is suggested that the original material of the Lucky Creek Metamorphics was probably a calcareous or dolomitic sediment; this hypothesis is supported by high calcic content of the plagioclase in Specimen B109.

Specimen 2359

The rock is a slightly metamorphosed, fine, calcareous siltstone consisting of quartz and albite in about equal proportions and totalling about 70% of the rock, calcite (15%), sericite (10%), chlorite (4%) and magnerite (1%).

The rock has been recrystallised to a hornfelsic texture with interlocking grain boundaries and an even grain size. Chlorite forms poikiloblastic porphyroblasts of larger size, and fine flakes of sericite and musoovite are scattered throughout the rock.

Magnetite is mainly confined to narrow parallel bands which probably represent the original bedding.

Narrow, chlorite filled veins are also common. These appear dark grey in the generally light grey hand specimen, and cut across the cross-bedding.

Specimen 2354

The rock is a partlyrecrystallised, slightly metamorphosed calcilutite and consists of calcite (45%), quartz and albite (47%), sericite (5%), chlorite (2%)and magnetite (1% less). Quartz, albite, calcite and sericite form a fine, equigranular, mosaic textured (hence apparently recrystallized) aggregate, which contains a few large crystals of magnetite and areas of chlorite.

The thin bedding, which is seen in hand specimen, is represented in thin section by a faintly banded distribution of dark green chlorite. The magnetite grains are irregularly distributed.

Specimen B.4189

The rock is a quartz-albite-epidote hornfels which contains some pyroxene and calcite. It exhibits strong mineralogical and textural banding on a fine scale, and this banding is thought to represent the bedding of an originally finely laminated, impure calcareous sediment. A second specimen is a more coarsely banded and siliceous rock and represents a less calcareous phase of the same sedimentary sequence.

In the more basic rock quartz and feldspar from a granoblastic matrix carrying abundant granular sphene, and, in some bands, poikiloblastic porphyroblasts of colourless pyroxene.

Specimen B.4196.

While this rock appears to be granulitic in hand specimen, it must necessarily be regarded as a para-gneiss on the basis of micro-texture and mineralogy, consisting of a gneissic, granoblastic aggregate of quartz, plagioclase, hornblende and sphene, with various accessory minerals. Hence the rock is a hornblende gneiss with a regular banded structure due to a parallel segregation of mafic and felsic minerals. This structure is seen in hand specimen.

Thin section examination shows the rock to consist of a banded crystallo-blastic aggregate of granoblastic quartz (30%), plagioclase (5 %), hornblende (17%) and accessory sphene (2%), epidote, apatite and (?)biotite. The major constituents have an average grain diameter of 0.4 to 0.5 mm., with sphene and epidote grains generally no more than 0.1 mm. in diameter.

The plagioclase is an intermediate andesine (An_{36}), occasionally exhibiting a poikiloblastic texture with relation to quartz. Scattered inclusions of quartz, sphene and apatite are common. Generally, the feldspar has been finely altered to epidote-like material and sericite.

The amphibole is a deep green hornblende pleochroic from deep blue-green through deep green to straw coloured. The accessory constituents of sphene and epidote are generally concentrated in the hornblendic bands, and apatitie in the quartz-felspathic bands. Biotite is rare, but found marginal to amphibole grains and thus may represent slight retrograde metamorphism.

The uniform banding of the gneiss suggests original sedimentary lamination both in hand specimen and in field character. Thin section examination offers no conclusive evidence, but it shows no features incompatible with a sedimentary origin.

Chillagoe Beds

Specimen B.128

Section of D.D. core, Metals Exploration Ltd., Chillagoe-Mungana.

This specimens, is fine grained, dark grey rock which was thought to be an altered limestone in the field. Though altered, the relict texture and mineralogy show that the rock is a basalt with fine laths of plagioclase and intergranular pyroxene. The plagioclase has been albitized and the pyroxene chloritized and uralitized.

Micrometric Analyses:

B.2355(a) Calc-silicate rock from the Lucky Creek Metamorphics.

Calcite 39.3%	Epidote 38.0%	Amphibole 12.2%
Quartz 6.8%	Chlorite 2.3%	Albite 0.6%

B.109 Amphibolite from the Mt. Moran Formation.

Amphibole	54.5%	Plagioclase	34.6%	Clinozoisite	4.1%
Sericite	2.5%	Quartz	1.7%	Sphene	1.7%
Carbonate	0.4%	Chlorite	0.2%	Apatite	0.1%
		Magnetite	0.1%		

B2359 Calc-Silt from the Mt. Moran Formation.

Quartz 33.5%	Albite	25.8%	Calcite	16.7%
Sericite 13.6%	Chlorite	6.9%		
Magnetite and other oxides 2.4%				
Leuxocenic material 1.0%				

B2354 Calcilutite from the Mt. Moran Formation.

Too fine-grained for micrometric analysis. Grain diameter smaller than thickness of thin section.

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APPENDIX II.

PRELIMINARY NOTE ON SOME FOSSILS FROM THE BROKEN RIVER BEDS, COLLECTED IN 1955 AND 1956

By Dr. D. Hill, University of Queensland.

Listed below are preliminary notes on fossils, which are mainly corals collected from the Broken River Beds on the Clarke River Four Mile Sheet (Plate 5) by the Bureau of Mineral Resources and the Queensland Geological Survey in 1956, and by C. E. Prichard of the Bureau of Mineral Resources in 1955.

I. GRAY CREEK LOCALITY (Five miles east-north-east of Pandanus Creek Station. Locality is shown on Plate 5 as I.)

Pseudamplexus sp. cf. princeps (Etheridge) common.

Acanthophyllum sp. cf. Spongophylloides perfecta moderately common.

?Cystiphyllum sp.

?Tryplasma sp.

Operculum of Rhizophyllum or Calceola

?Phaulactis sp.

Favosites spp., one with squamulae as in Lower Devonian species.

Heliolites sp.

?Cladopora sp.

Straight nautiloids (2).

Gastropod.

Crinoid cups (weathered) and plates.

Atrypa

Oolites

The genera represented are all found in Upper Silurian and Lower Devonian rocks, but then the absence of all genera confined to the Silurian leads me to oonclude that this is a Lower Devonian limestone.

II. G35 and G36, PRITCHARD COLLECTION. (Base and top respectively of thick limestone 2.1-2.0 miles north of the Broken River crossing, on road. ? Jacks 300 ft. limestone. Locality shown on Plate 5 as II.)

?Omphyma sp.

?Tryplasma sp.

Halysites sp.

Favosites spp.

Plasmopora or Heliolites sp.

Algae

Pentamerid brachiopod.

This assemblage suggests Upper Silurian or Lower Devonian, with the odds slightly in favour of the former.

III. G28, PRITCHARD COLLECTION. (3.5 miles north of the Broken River crossing. ? Jacks 12 ft. limestone. Locality shown on Plate 5 as III.)

Alveolites sp. or Coenites sp.

Algae

Age doubtful, possibly Devonian.

IV. PANDANUS CREEK LOCALITY. (Limestone 3 miles north of the Pandanus Creek Station. Locality shown as IV on Plate 5).

Favistella rhenana (Frech).

Small solitary Rugosa.

Thamnopora sp.

Alveolites sp.

Branching stromatoporoids

Amphipora sp.

Massive stromatoporoids

This limestone is Middle Devonian, possibly basal Givetian.

V. PANDANUS CREEK LOCALITY. (Limestone breccia 4 miles north of the Pandanus Creek Station. Locality shown as V on Plate 5).

Favosites

?Lithophyllum

This is believed to be the same horizon as G33, 34 Pritchard Collection $3\frac{1}{2}$ miles north-west ofPPandanus Creek station which has

Acanthophyllum sp. cf. clermontense (Etheridge)

Amphipora

Stromatoporoids

Age is Middle Devonian.

VI. PANDANUS CREEK LOCALITY ($\frac{1}{4}$ mile west of the Pandanus Creek Station. Locality is shown as VI on Plate 5).

Endophyllum abditum (E. & U.)

Phillipsastraea spp.

?Pachyphyllum

Thamnopora sp.

Branching stromatoporoids

Massive stromatoporoids

Age is Middle Devonian. This may prove to be an Upper Middle Devonian limestone of the age of the Burdekin Limestone. This collection is an extremely interesting one altogether, seeming to indicate that a marine sequence exists from the Upper Silurian at least to the base of the Upper Middle Devonian.

Confirmation of the Upper Middle Devonian age for the Lot VI. is required and may be obtained when further thin sections are cut.

Further collections from these important corraline limestones, which obviously represent several horizons, will be made in 1957.

APPENDIX III.

REPORT ON PLANT FOSSILS FROM THE BROKEN RIVER BEDS, NORTHERN QUEENSLAND.

By Mary E. White.

Plant fossils were collected from two localities on the Clarke River Four Mile Sheet in 1956. Two specimens (35-36) were collected from a chert bed in the Broken River Beds at Locality VII shown on Plate 5 and nine specimens from a claystone bed in the Broken River Beds at Locality VIII.

The two specimens from the chert show numerous impressions which may be rootlets, but might be algal and are indeterminate.

Numerous fragmentary stem impressions occur in the claystone together with a number of stem impressions of various sizes which appear to be of a fern-rachis type. Many of the stems show branching which is not of a regular dichotomous nature. An example illustrated in Fig. I shows a main axis with two laterals arising alternately. Several of the stems show a marked mesial angle, and the stems prior to the fossilation may have been triangular in cross section. There is no sign of any of the leaves.

Among the fragmentary impressions of small, narrow stems there are several which show a feature which suggests their affinity with Psilophyton. The main axis bears laterals which are abruptly terminated close to the rachis. Some of these short side branches have lateral projections broken off close to thier points of junction (Fig. 2). One larger rachis (Fig. 3) also shows similarity to Psilophyton in the angle of the attachment of the lateral branch.

Two species of Psilophyton occur in the Devonian beds in the Perry Formation of S.E. Maine (Smith and White 1904) and the illustrations of these show such similarity to the specimens under discussion that a tentative identification of Psilophyton can be made. Psilophyton cannot be regarded as a true genus but Silurian and Devonian plant fragments of this type can be conveniently referred to it in the absence of further evidence.

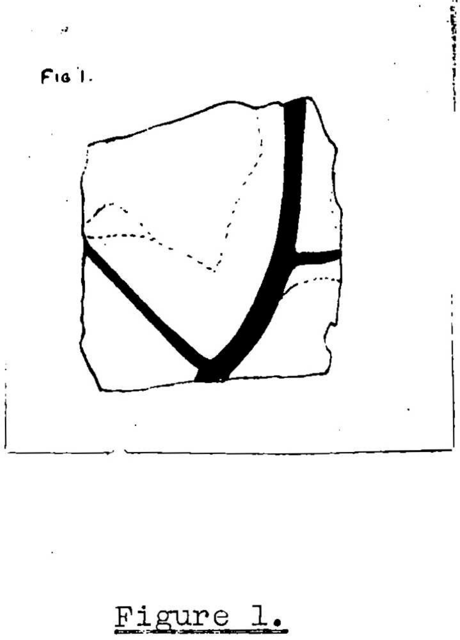
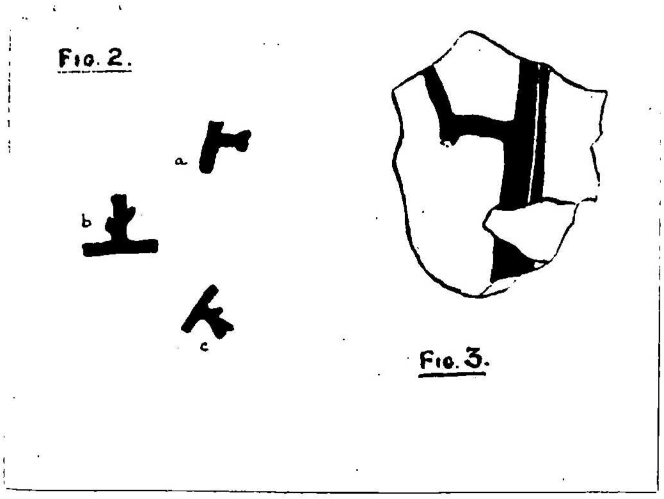


Figure 1.



Figures 2 and 3.

REFERENCES

SEWARD, A.C., 1910 : Fossil Plants. II. Camb. Univ. Pr.

SMITH, G.O. & WHITE, D., 1904 : Geology of the Perry Basin, S.E. Maine. US.G.S. Prof. Pap. 35 (Plate 5).

APPENDIX IV.

PRELIMINARY REPORT ON SOME FOSSIL PLANTS FROM THE BLYTHESDALE GROUP

by M. E. White.

Fossil plants were collected by the Bureau of Mineral Resources and the Geological Survey of Queensland in 1956 from the base of the Blythesdale Group near Forest Home Station on the Georgetown Four Mile sheet (Plate 3).

Locality

The fossil locality is situated about 40 miles west of Georgetown on the Georgetown Four Mile sheet (Plate 3) and about 5 miles north-west of the Forest Home Station. The locality is situated on aerial photograph Georgetown run 3, number 5120 in quadrant A with co-ordinates x equals 2.5 inches, y equals 2.2 inches and z equals 3.4 inches.

Lithology of the fossil plant bearing beds

The sediments are horizontal and outcrop as a low lying hill, where three separate beds are identified as follows:

1. Upper Bed of Pebble Conglomerate. This is exposed as debris. Thickness is unknown.

2. Middle Bed of Ferruginous Sandstone. This bed contains irregular lenses of pebble conglomerate and a lens of light grey sandstone, which is about 5 ft. thick. The light grey sandstone contains tubular structures (Specimens No. 4170, 71, 72). Fossil plants are exposed at the bottom of the middle bed in an horizon about 6 inches thick. (Specimens No. 4142, 43---69). The maximum thickness of the ferruginous sandstone bed is about 20 feet.

3. Lower Bed of Light Grey Silty Claystone. This bed contains pebbles and clay pellets. Fossil plants are also exposed (Specimen No. 4134--41). The bottom of the bed is not exposed and the thickness of the bed is unknown.

Palaeobotany.

1. Fossil plants from the Lower Bed of light grey silty claystone (Specimens No. 4134-4141).

The fossils in these rocks are mainly in the form of red and yellow iron staining and the state of preservation is poor. The plant remains were macerated and the material is largely indeterminate. There is, however, one example of a portion of a leaf which is well preserved and there are several small cones in a good state of preservation.

The leaf fragment is referable to *Linguifolium* sp. As only the basal part of the leaf is present, it is not possible to determine the species, but the fragment is similar to *Linguifolium lillieanum* Aber. The range of *Linguifolium* is Rhaetic-Jurassic.

Small cones, mostly incomplete or broken, occur in specimens 4140 and 4138. The average diameter of these is about $\frac{1}{2}$ cm. Without further evidence it is not possible to determine the affinities of these cones. They appear to be Conifer type, but it is not impossible that they are Equisetalean. They are therefore of no value in determining the age of the rocks.

PLATE I.

Fig. 1 : *Linguifolium* sp. from the lower bed light grey silty claystone. X3.

Fig. 2 : *Cladophlebis australis* Morr.

Fig. 3 : *Cycadites* sp.

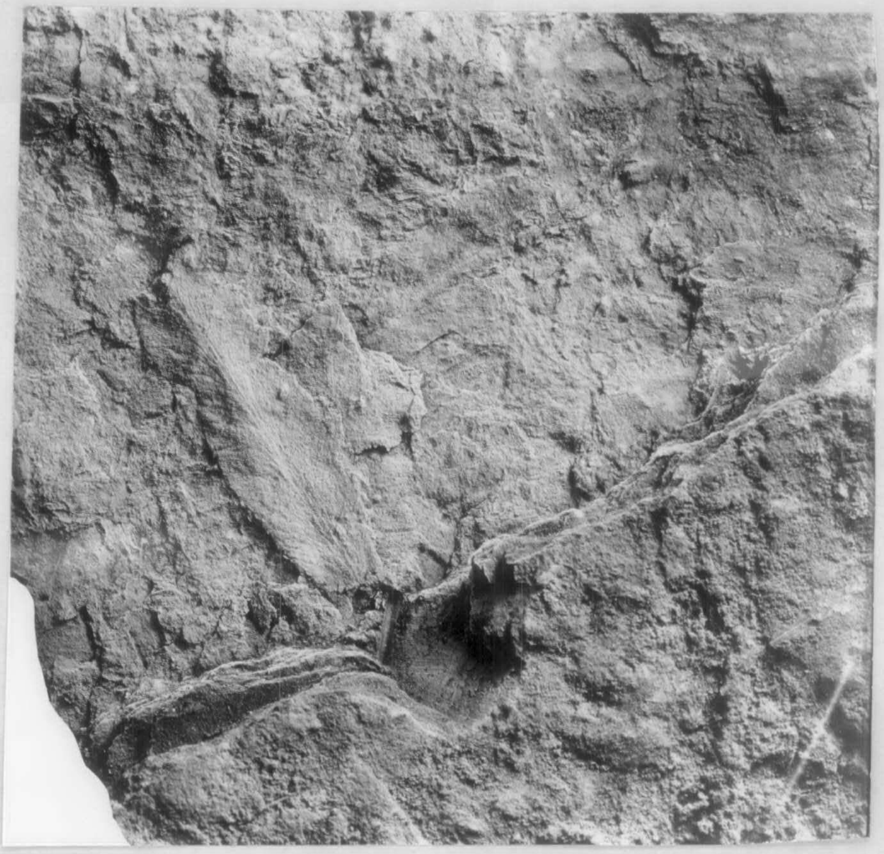


Fig. 4 : Linguifolium lilleanum Arber ?

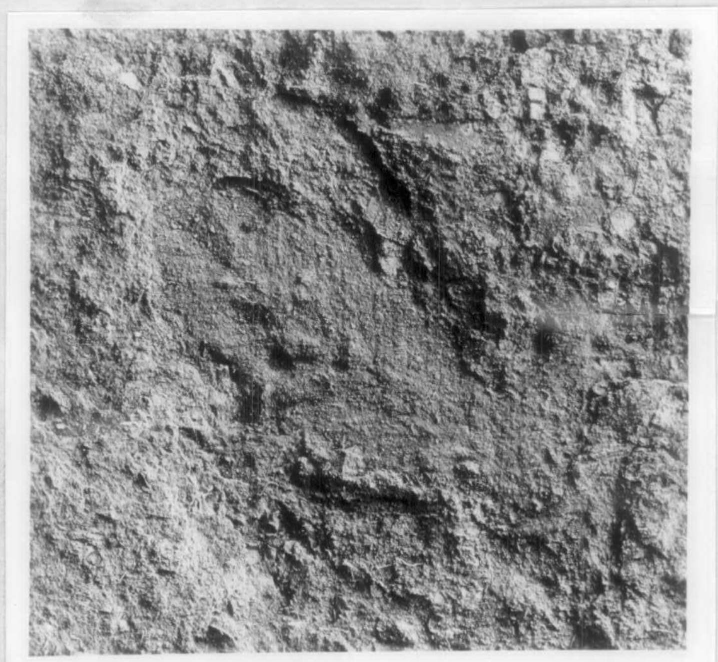


Fig. 5 : Phyllopteris lanceolata Walk. x2.

2. Specimens from the lens of sandstone in the middle bed of ferruginous sandstone (No. 4170-4172).

These specimens show no plant remains and the nature of the tubular structures is uncertain.

3. Fossil plants from the base of the middle bed of ferruginous sandstone (Specimen No. 4142-4169).

The following plants have been identified:

(a) Cladophlebis australis (Morris). Several forms of this species are present. It is a species which characteristically shows a great deal of variation. The range of this species is Rhaetic-Lower Cretaceous.

(b) Cladophlebis albertsi (Dunk). This is regarded as an Upper Jurassic or Cretaceous form.

(c) Linguifolium cf. Lillieanum Arber. The genus recorded from Rhaetic and Jurassic strata.

(d) Linguifolium sp. A species of Linguifolium with a very much elongated leaf, with somewhat undulating margins. The apex of the leaf is not present, and there is no indication as to whether the leaf is a pinnule of a compound leaf. This species may be more strictly referable to Phyllopteris than to Linguifolium. The age of this plant can be roughly given as Rhaetic-Cretaceous.

(e) Phyllopteris lanceolata Walkom. This species is one of the commonest and most characteristic plants of the Burrum Series (Lower Cretaceous) in Queensland.

(f) Cycadites sp.? This assemblage of plants denotes an Upper Jurassic-Lower Cretaceous age for the fossiliferous horizon at the base of the ferruginous sandstone.

APPENDIX V

LEPIDODENDROID PLANT FOSSILS FROM THE BASE OF THE GILBERTON FORMATION, NORTH QUEENSLAND.

by M. E. White.

Lepidodendroid plant fossils were collected in 1956 from ferruginous siltstone at the base of the Gilberton Formation from two localities. Specimens (46-49) were collected 4 miles north-north-west of Gilberton Station and specimens (50-62) were collected 1 mile south of Gilberton Station as shown on Plate 4.

All determinate specimens are referable to Leptophloeum australae M'Coy. The fossils are in an excellent state of preservation and show a range of forms similar to that seen in collections from Upper Devonian strata in New South Wales as illustrated by Feistmantel (1904) and referred by him to Lepidodendron australae M'Coy. (The two species later merged and considered closely related to Leptophloeum rhombicum Dawson. For synonomy see Walton, 1926).

A comparison of the specimens with photographs of the type specimens of Leptophloeum rhombicum Dawson shows close similarity but sufficient diversity to justify retaining the separate species.

Surface, near surface and more deeply decorticated forms of young and old stems are present in the material from the base of the Gilberton Formation.

Leptophloeum australae M'Coy, as seen in the typical range of forms here assembled, is a most characteristic plant fossil in beds of Upper Devonian-Lower Carboniferous age in Australia. At the present state of knowledge it is not possible to state that it does not range above these horizons. Any decorticated stem impressions with the very definite rhombic pattern, such as is seen as a form of Leptophloeum australae from undoubted Upper Devonian-Lower Carboniferous Beds, tend to be assigned to the species without question. Where only isolated decorticated forms are present without the full range of forms diagnostic of the species, there is the possibility of error and confusion. The related Lycopodiopsis pedroanus Carr. (the Sigillaria Brardi of South Africa which occurs in the Glossopteris Flora there, see Seward 1897) has a decorticated form with a rhombic pattern which might easily be confused.

T.W.E. David records Leptophloeum australae from Upper Carboniferous beds in Queensland and from the Permian of Western Australia. It seems to me to be most probable that the latter reference represents a rhombic form which is referable to Lycopodiopsis pedroanus Carr. Research is necessary to investigate all known occurrences of the species concerned, and systematic collecting will have to be carried out to elucidate the problem.

In the present case there is no doubt of the identity of the species with that characteristic of Upper Devonian-Lower Carboniferous horizons.

The range of Leptophloeum australae M'Coy can be given tentatively as Upper Devonian-Carboniferous.

References.

DAVID, T.W.E., 1914 : The Geology of the Commonwealth of Australia. Brit.Ass.Adv.Sci.

PLATE I

Fig. I : Young stem.

Fig. 2 : Knorria condition of large stem.

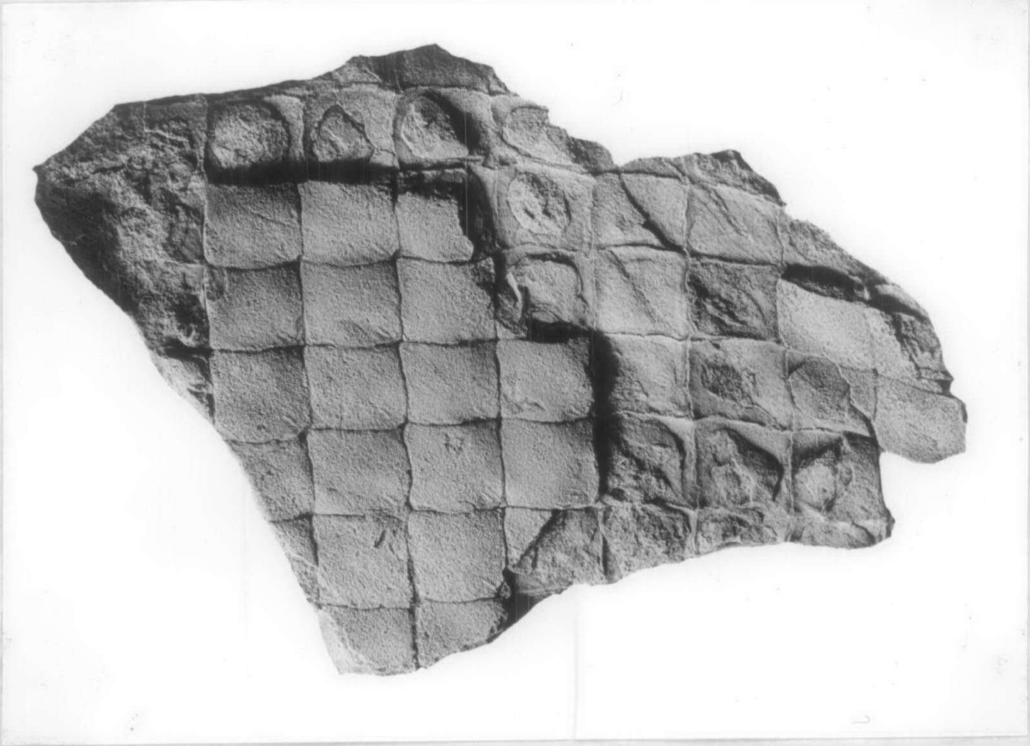


Fig. 3 : Surface view of mature stem.

PLATE II.

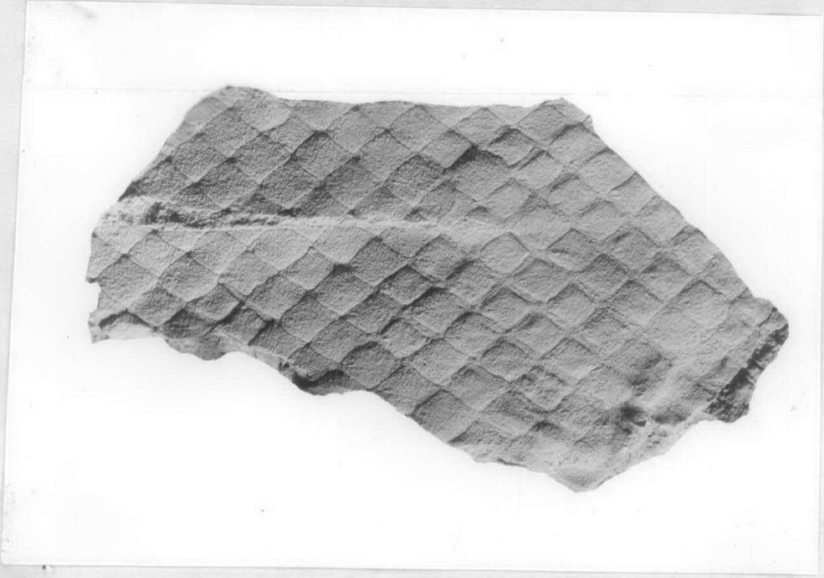


Fig. 4 : Young stem, partly somewhat decorticated.

Fig. 5 : Decorticated mature stem showing characteristic double margins of leaf cushions at this level.

EDWARDS, W.N., 1952 : Lycopodiopsis, a Southern Hemisphere Lepidophyte. Palaeobotanist I. Lucknow.

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SEWARD, A.C., 1897 : The Association of Sigillaria and Glossopteris in South Africa. Q.J.G.S. 53, Plates 23, 34, text Fig. 1.

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TABLE I.

STRATIGRAPHY OF THE GEORGETOWN-CHILLAGOE AREA, NORTH QUEENSLAND.

AGE	ROCK UNIT	LITHOLOGY	STRUCTURE	THICKNESS	RELATIONSHIPS & REMARKS
TERTIARY		Laterite	Mesa cappings	10-30'	
	Unnamed	Basalt	Plateau basalts, mesas and old valley fillings	10-75'	Three main areas: 1. Atherton Tablelands 2. Mt. Surprise-Conjuboy 3. Mt. Sturgeon.
CRETACEOUS	Blythesdale Group	Sandstone, conglomerate, arkose, claystone and siltstone.	Flat lying - usually as mesas.	50'-200'	Fossil plants collected from base of succession near Forest Home, Georgetown.
UPPER PALAEOZOIC (Undifferentiated)	Croydon Complex	Rhyolite, quartz porphyry, granite porphyry, granite and minor lenses of limestone, arkose & greywacke, and some andesite.	Usually as elongated N-S basins, with dips up to 50°, and associated ring dykes. Dykes.	1,000' to 8,000'	Gradation between graphitic granite (base) and graphitic rhyolite (top) in Gregory Range Section. Sediments confined to base of Newcastle Range Section. Emplacement probably by cauldron subsidence.
CARBONIFEROUS -DEVONIAN.	Gilberton Formation	Arkose, conglomerate, and minor ferruginous shales.	Dips 10°-30°. Steep dips near faulted contact with Mt. Moran Formation.	200'-750'	Two areas near Gilberton Station. Unconformably overlies and faulted against Mt. Moran Formation. Contains Fossil Fish (antiarchan) and Plant (Lepidodendron).
	SERPENTINE and other ultrabasic intrusions.		Elongated masses		Intruded along boundary between Lucky Creek and Paddy's Creek Metamorphics and Broken River Beds in Gray Creek area.
	Granodiorite intrusion		Medium grained		Intrudes Chillagoe Beds. Includes monzonite types probably due to contamination by the limestone.
SILURIAN-DEVONIAN.	Broken River Beds	Arkose, conglomerate, quartz greywacke, limestone, quartz siltstone, calcilutite and limestone conglomerate.	Dips usually 60°. Moderate folds. Basin and domes Trend N.E. to N.	10'-15,000'	Relationship with Etheridge Group and older beds not completely known. For most part separated by a fault, probably thrust system with serpentine intrusions.
	Chillagoe Beds	Reef and bedded limestone, limestone conglomerate and breccia, sedimentary breccia, quartz greywacke and quartz siltstone.	Dips from 45° to 90°. Structure probably synclinal in Chillagoe Township area. Strike faults. Trend N.N.W.	Unknown probably does not exceed 5,000'	Relationship with Dargalong Metamorphics not completely known. Trends in these beds are parallel.
	Granite Intrusion Forsayth Batholith		Coarse porphyritic types predominate. Numerous pegmatites and quartz veins.		Covers area of approx. 2,500 sq. miles between Forsayth, Einasleigh and Lyndhurst.
	Basic Igneous Intrusions		Dolerite and gabbro dykes and sills. Fine to coarse grain.		Intrudes Etheridge Group and Mt. Moran Formation. Metamorphosed by granite in Forsayth area.

TABLE 2.

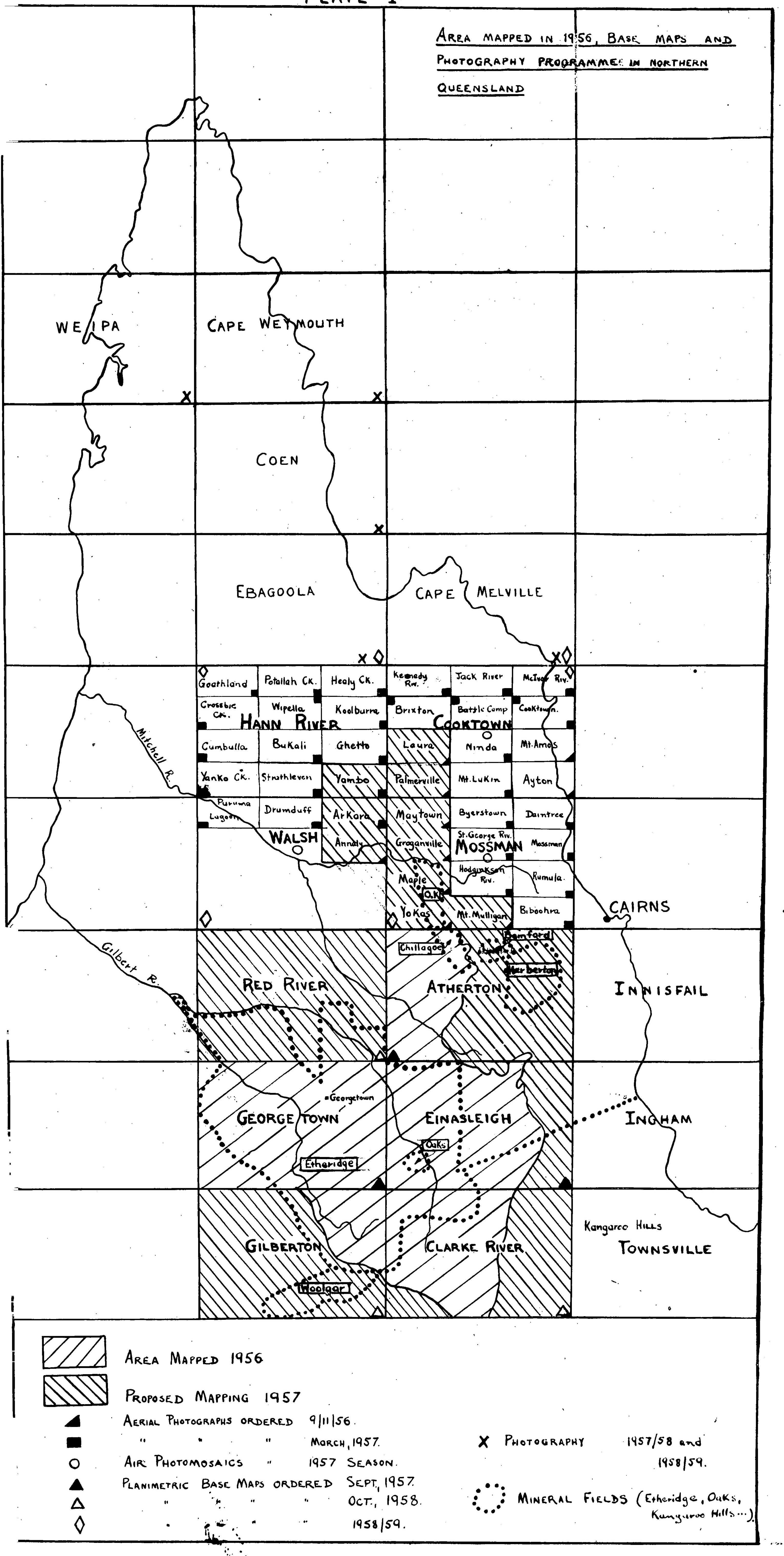
MINERALIZATION - ETHERIDGE, EINASLEIGH, CHILLAGOE AREAS.

MINERAL FIELD	TYPES OF DEPOSIT	ECONOMIC MINERALS	MINERALIZER	GENERAL
ETHERIDGE Total production 1877-1899 Gold 300,830 tons of ore averaging 1 oz. 6 dwt. of gold per ton. Yielding [illegible]00,079 oz. gold.	(1) Mineralized quartz reefs in granite-veins filling faults and joints.	Gold Silver Lead	Mineralization associated with Forsayth granite intrusive. (Pre-Croydon Complex).	In general impoverished below 300'. Largest gold mines of area in this group. Cumberland biggest producer. 1877 to 1899 - 65,713 oz. Au averaging 1 oz. 18 dwt./ton. Exploratory diggings to 1,106' at Cumberland.
	(2) Mineralized quartz veins in sediments and sediment/granite contacts. Fissure fillings.	Lead Silver Gold	Mineralization associated with Forsayth granite intrusive.	Reefs smaller than (1). Average width 3' and length 200'. Not worked much below 80' (ground water level).
	(3) Mineralized quartz veins in diorite, filling contraction joints and fissures.	Copper Silver	Mineralization associated with diorite intrusive.	Ortona - lodes (15' width max. (600' horizontal max. Workings into sulphide ore at 190'. Some rich ore with silver values to 250 oz/ton. Copper to 30%.
	(4) Mineralized quartz veins in sediments, adjacent to diorites - fissure fillings.	Copper Silver	Mineralization associated with diorite intrusive.	Ortona - lodes 3'-6' wide. 35% Cu now being worked.
EINASLEIGH Total production 134,257 tons of ore yielding [illegible],107 tons Cu. [illegible],288 oz. Au. 131,284 oz. Ag.	Lenticular orebodies resulting from replacement of sediments and fissure filling.	Copper Silver Gold	Mineralization associated with Forsayth Granite?	Einasleigh Copper Mines - max. depth 580'. Ore grade 6% Cu, 1 oz. Ag, 8 gr. Au/ton. Minerals garnet, bismuth, pyrrhotite, magnetite, typical of contact metamorphism.
OAKS GOLD FIELD.	Small quartz leaders in concentric crush zones in granite and porphyry (Croydon Complex).	Gold	Related to porphyry? (Croydon Complex)?	Leaders very small - few workings more than 100 ' deep. 1908-1910 20,750 oz. Au produced.
RADIOACTIVE				
Black Wells Prospect	Etheridge(1). Sheared granite with thin quartz veins.	Lead, copper, zinc. No uranium mineral evident.	Forsayth Granite	Accumulative effect in trenches giving higher than normal readings of radioactivity.
Limkins Prospect	Cross-fracture displacing quartz reef in granite.	Uranium copper	Forsayth Granite? Secondary deposit?	Secondary uranium ore. Kaolinized granite and fracture quartz as host rock. No appreciable amount of ore mined. Abandoned towards end of 1956.
Quest End	Mineralized shear in granite.	Copper No uranium mineral evident.	Forsayth Granite	Slight radioactivity of copper ore. May be trace of uranium present.
Ninety Mile Mine (Hall's Reward).	Mineralized shear along serpentinised, dunite intrusion.	Copper Gold	Dunite?	Production 800 tons per annum of 20-30% Cu. Workings to 100' depth - 500' long. Ore comprises cuprite, malachite, azurite. Operating at present.
CHILLAGOE Total production 543,856 tons of ore averaging [illegible].9% Cu, 6.2% Pb, 7.7 oz. Ag.	Deposits in shears - these occur in limestone, in sediments, and along limestone/granite contacts.	Copper Lead Silver	Granodiorite	Zillmanton lode discontinuous over 3 miles. Mungana Mines - irregular orebodies along fissure in limestone. Production - 333,590 tons of ore averaging 9.6% Pb, 2.3% Cu, 9.7oz.Ag.
	Contact Deposits. (1) Granodiorite/limestone (2) Granite/limestone	(1) Copper silver (2) Copper, lead, silver, zinc.	(1) Granodiorite (2) Granite	(1) Large size grade deposits averaging 2% Cu. Garnet usually abundant. Egs: Ti-tree, Harper, Hobson, Boomerang (Calcifer Group). (2) Smaller deposits but richer in ore. Garnet present. Comprise Muldiva group of mines. At Eclipse mine sulphide mineralization passes to zinc at depth.
	Disseminations in granodiorite.	Copper Silver	Granodiorite	Ruddygore Mine - lode occupied area 1,800 ft. long x 400 ft. wide, grade 1.5% Cu. 29,293 tons of hand picked ore won.
	Fissures in sediments. (Distant from limestone)	Copper Lead Silver	Granite	Dargalong Mine.

AGE	ROCK UNIT	LITHOLOGY	STRUCTURE	THICK-NESS	RELATIONSHIPS AND REMARKS
LOWER PALAEOZOIC OR PRECAMBRIAN	Etheridge Group	Greywacke, quartz and carbonaceous siltstones, schist, gneiss and quartzite.	Dips from 50° to 75°. Moderate to tight folding. Trend is arcuate from N-S to E-W from Forest Home to Einasleigh.	15,000' max.	Interfingering trough and slope type of geosynclinal sediments. Metamorphism changes from contact in trough and slope zones to regional towards shelf zone.
	Langdon River Formation	Greywacke siltstone, quartz siltstone with minor lenses of quartz greywacke.	Tight folds, which pitch to north. Dips 60°. Trend N-S to N.N.W.	10,000' max.	Trough type of geosynclinal sedimentation. Interfingers with Stockyard Creek Siltstone and Green Hills Formation.
	Stockyard Creek Siltstone Member	Carbonaceous quartz siltstone with or without pyrite.	Dips 60°. Lenticular. Trend N-S to N.N.W. to E-W.	50'-300'	Crops out as lenses along boundary between Langdon River and Green Hills Formations. Interfingers with chert member of Green Hills Formation.
	Green Hills Formation	Black quartz siltstone, chert, minor limestone, andalusite and muscovite, schists and hornfels.	Moderate to tight folds. Complicated contortions in centre of Georgetown Sheet interpreted as slumps. Trend E-W.	15,000' max.	Slope to trough type of geosynclinal sedimentation. Interfingers with the Stockyard Creek Siltstone Member, Langdon River Formation and Einasleigh Metamorphics.
	Einasleigh Metamorphics	Quartz schist, quartz-muscovite-, and-garnet and-andalusite schists, quartzite, hornblende schist and gneiss.	Moderate folds. Dips from 50°-70°. Trend E-W to N.E.	5,000-7,000'	Lithology and interfingering relationship with Green Hills Formation suggest shelf type of geosynclinal sedimentation. Subsequent regional metamorphism by granite in Forsayth and Einasleigh areas.
	Mt. Moran Formation	Interbedded calcarenite and calcilutite, quartz siltstone, calcareous siltstone, hornblende-epidote-felspar gneiss, amphibolite, quartz-albite-epidote hornfels.	Gentle folds. Dips from 50°-70°. Regional trend E-W to N.E. Crossbedding in some calcarenites.	10,00-16,000'	Lithology suggests deposition on a shallow depression on south eastern edge of shelf area. Linear and abrupt boundary with the Einasleigh Metamorphics suggest an unconformity (regional). Hornblende gneiss is the metamorphic equivalent of the interbedded calcarenite and calcilutite.
	Lucky Creek Metamorphics.	Thinly bedded impure marbles, actinolite schist, quartz-chlorite-epidote schist, quartz-albite-hornblende schist.	Gentle folds. Dips 50°-70°. Regional trend E.N.E.	10,000-15,000'	May be a fine grained impure variation of Mt. Moran Formation.
	Paddy's Creek Metamorphics	Quartz schist with some quartz siltstone and fine quartz sandstone.	Gentle folds. Dips from 30°-60°. Regional trend N.E.	1,000'-3,000'	Schists have been deformed due to thrust movements along its boundary with the Broken River Beds.
	Dargalong Metamorphics	Mica, andalusite, garnet schists, quartzite.	Moderate folds. Steep dips. Trends N.N.W.	5,000'?	Exposed as large roof pendants, west of Chillagoe Beds. Metamorphism due to granite intrusions. Trends of Dargalong Metamorphics and Chillagoe Beds are parallel.

80

PLATE 1

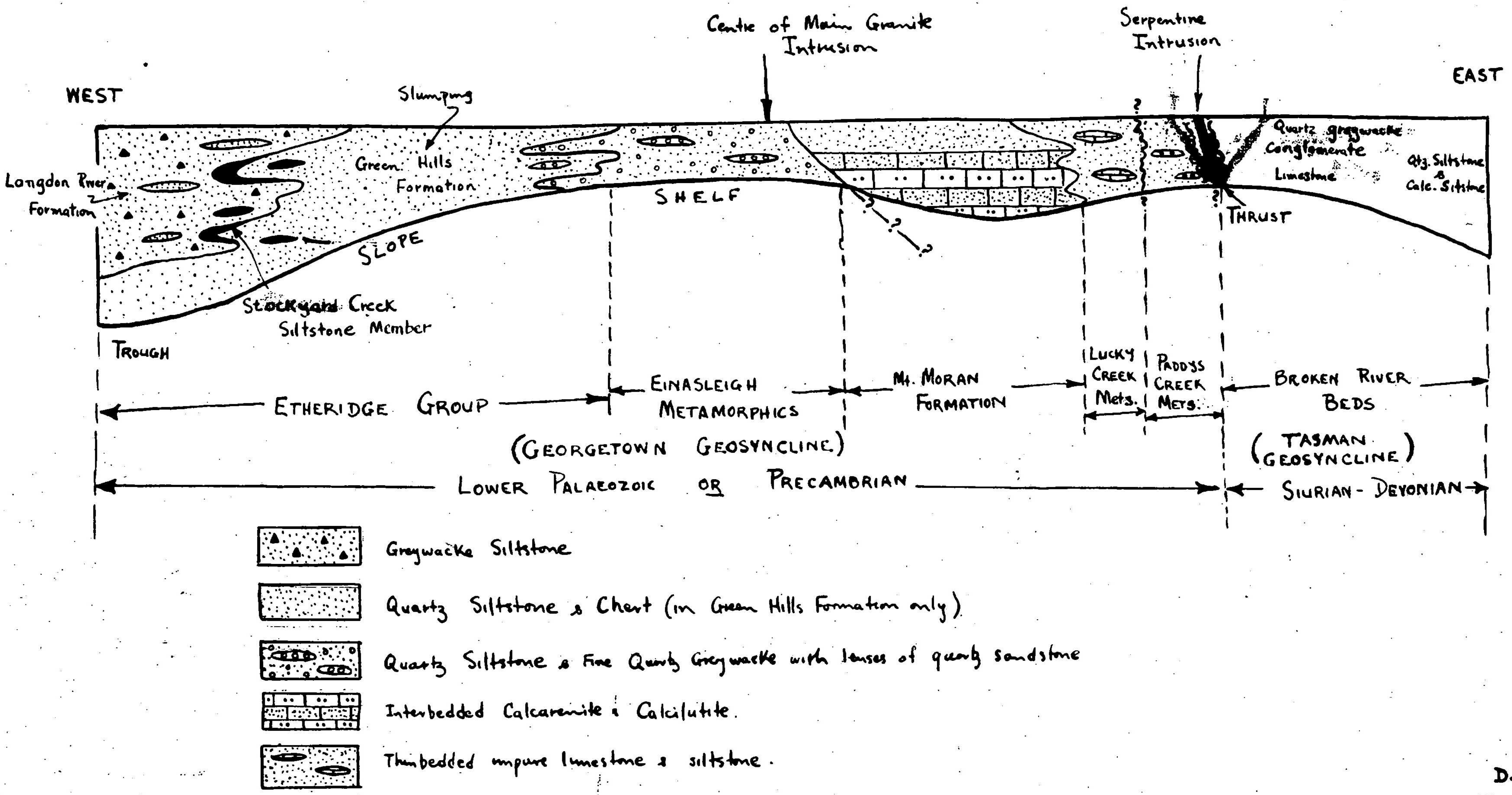


AREA MAPPED IN 1956, BASE MAPS AND PHOTOGRAPHY PROGRAMMES IN NORTHERN QUEENSLAND
WEIPA
CAPE WEYMOUTH
COEN
EBAGOOLA
CAPE MELVILLE
Goathland
Potallah Ck.
Healy Ck.
Kennedy Riv.
Jack River
McIvor Riv.
Crossbie Ck.
Wipella
Koolburra
Brixton
Battle Camp
Cooktown.
HANN RIVER
COOKTOWN
Cumbulla
Bukali
Ghetto
Laura
Ninda
Mt. Amos
Yanko Ck.
Strathleven
Yambo
Palmerville
Mt. Lukin
Ayton
Mitchell R.
Puruma Lagoon
Drumduff
Arkara
Maytown
Byerstown
Daintree
WALSH
Annaly
Groganville
St. George Riv.
MOSSMAN
Mossman
Maple
O.K.
Hodgkinson Riv.
Rumula
Yokas
Mt. Mulligan
Biboohra
CAIRNS
Chillagoe
Bamford
Herberton
Gilbert R.
RED RIVER
ATHERTON
INNISFAIL
Georgetown
GEORGE TOWN
EINASLEIGH
INGHAM
Oaks
Etheridge
GILBERTON
CLARKE RIVER
Kangaroo Hills
TOWNSVILLE
Woolgar
AREA MAPPED 1956
PROPOSED MAPPING 1957
AERIAL PHOTOGRAPHS ORDERED 9/11/56.
" " " MARCH, 1957.
AIR PHOTOMOSAICS " 1957 SEASON.
PLANIMETRIC BASE MAPS ORDERED SEPT., 1957.
" " " " OCT., 1958.
" " " " 1958/59.
PHOTOGRAPHY 1957/58 and 1958/59.
MINERAL FIELDS (Etheridge, Oaks, Kangaroo Hills...)

BMR

PLATE 2.

DIAGRAM TO ILLUSTRATE POSSIBLE RELATIONSHIPS and SEDIMENTARY ENVIRONMENTS OF ROCK UNITS in the GEORGETOWN and EINASLEIGH AREAS, Nth. Qld.



D.A.W.
17-1-57.

51

BMR


Approx Scale 1inch = 4 miles
GEORGETOWN FOUR MILE SHEET
1956 Geological Field Sheet
Plate 3
Approx Scale 1inch = 4 miles
Einasleigh Four Mile Sheet
1956 Geological Field Sheet
Gilbert River
Forsayth Batholith
Georgetown
Forsayth
Newcastle
Einasleigh
Gregory Range
Herbert River
Robin Hood
Carpentaria Downs
Lake of Lagoons
Wyandotte
Camel Creek
Greenvale
Pzuc
Kℓb
pЄm
pЄg
Tb
S-Db

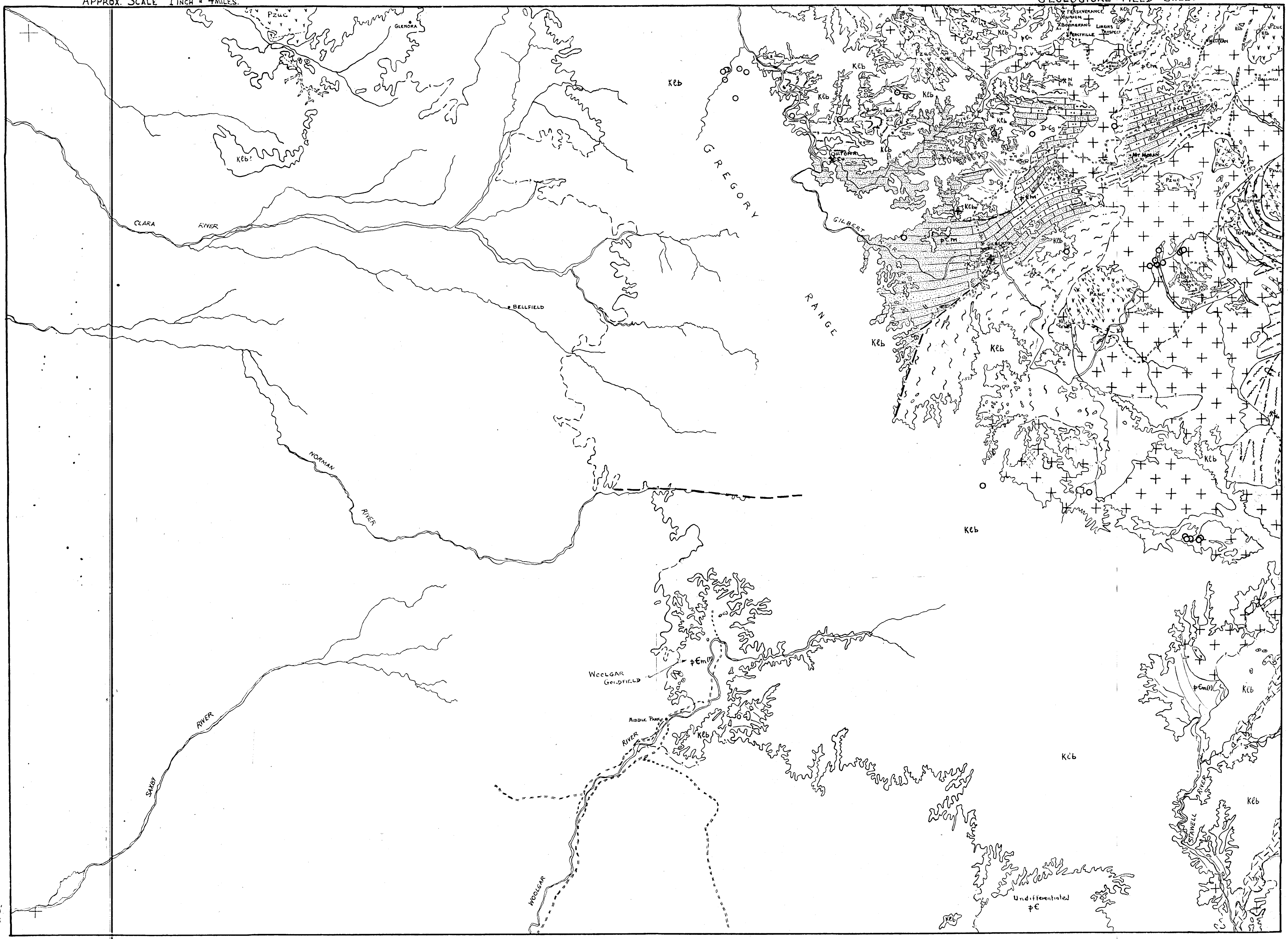
GILBERTON

Plate 4

Approx. Scale 1 inch = 4 miles.

Geological Field Sheet

142° 30′ approx — 144° 00′ approx — 19° 00′ approx — 20° 00′ approx

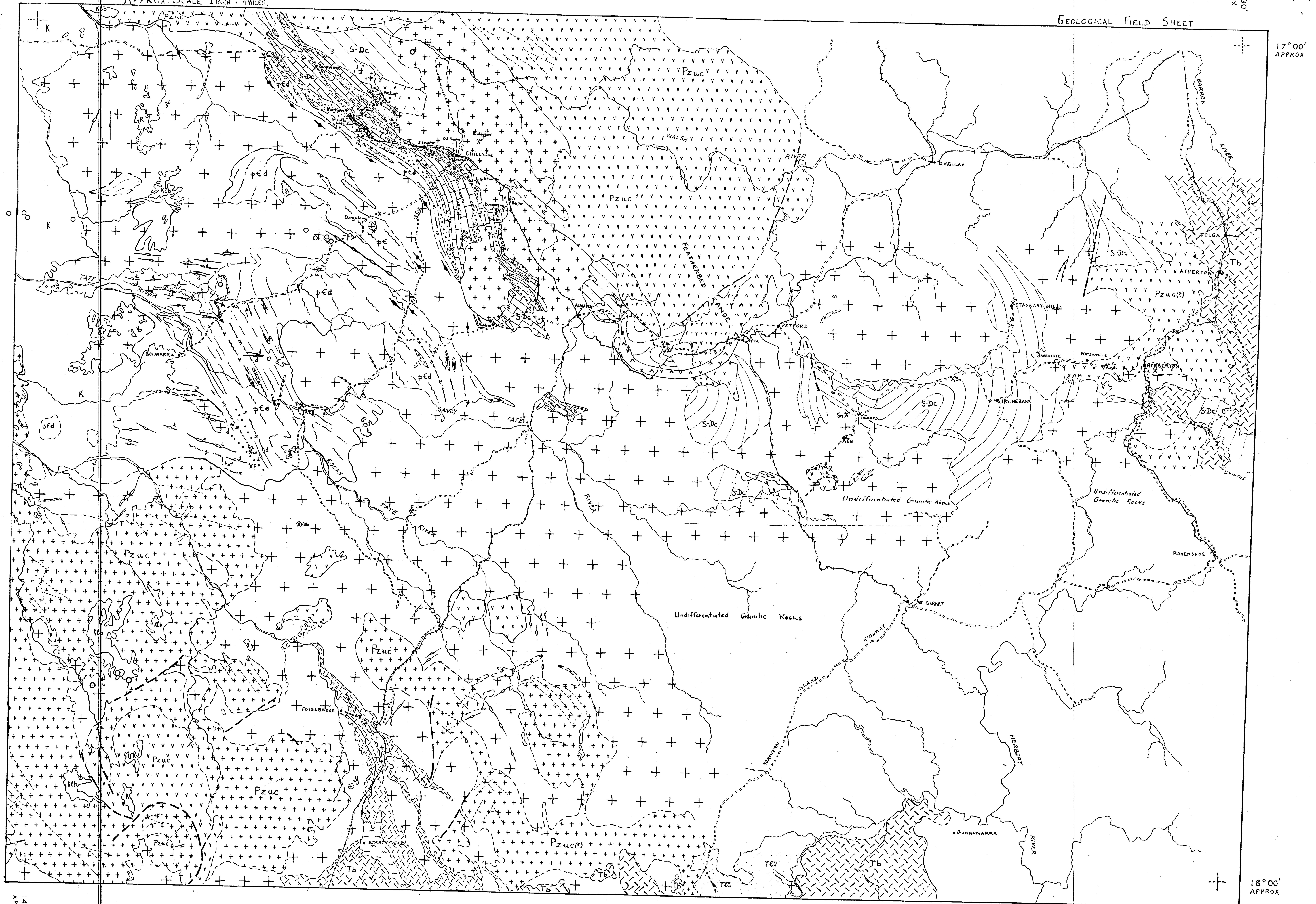


CLARKE RIVER

PLATE 5

ATHERTON

PLATE 6.



LEGEND

To accompany Geological Field Sheets of Georgetown, Einasleigh, Gilberton, Clarke River & Atherton Four Miles.

RECENT.

- Alluvium.
- Soil Cover.

TERTIARY.

- Tb — Basalt.
- Tl — Laterite.
- T — Tertiary elsewhere.

CRETACEOUS

- Klb — Blythesdale Group
- K — *Cretaceous, undifferentiated*

UPPER PALAEOZOIC.

- Pzuc — Quartz Porphyries and Rhyolites with sediments (Croydon Complex)
- Pzuc — Granite - graphitic in Gregory Range Area (Croydon Complex)

DEVONIAN—CARBONIFEROUS

- D-Cg — Gilberton Formation.

SILURIAN - DEVONIAN

- S-Db — Broken River Beds.
  - S-Db — *Interbedded Quartz Greywacke & Conglomerate.*
  - S-Db — *Limestone, usually with Corals.*
  - S-Db — *Quartz Siltstone with some calcareous siltstone.*
- S-Dc. — Chillagoe Beds.
  - S-Dc — *Limestone with some corals.*
  - S-Dc — *Silicified Quartz Siltstone.*
  - S-Dc — *Interbedded Quartz Greywacke & Siltstone.*
  - S-Dc — *Limestone Conglomerate or Breccia.*

PRECAMBRIAN OR LOWER PALAEOZOIC.

- pЄe — Etheridge Group.
  - pЄl — *Langdon River Formation.*
  - pЄg — *Green Hills Formation.*
    - pЄs — *Stockyard Creek Siltstone Member.*
- pЄn — Einasleigh Metamorphics.
- pЄm — Mt. Moran Formation.
  - pЄm — *Interbedded Calcarenite, Calcilutite and Quartz Siltstone.*
- pЄk — Lucky Creek Metamorphics.
- pЄp — Paddy's Creek Metamorphics.
  - pЄp — *Quartz siltstone with lenses of quartz sandstone.*
- pЄd — Dargalong Metamorphics.

IGNEOUS ROCKS.

- Granite. - Pre Silurian
- Granite - Post Silurian

  (gd. - granodiorite; g.p. - granite porphyry. with small crosses)
- Dolerite and Gabbro.
- Serpentine.
- Pegmatite.
- Dykes - pegmatite (p); dolerite (d)
- Quartz Veins.
- Quartz porphyry dykes.

METAMORPHIC ROCKS

- Schist {*a=andalusite, m=mica, h=hornblende, q=quartz, s=sericite, qb=quartz-biotite, ghs=garnet-hornblende-sericite, ac=actinolite.*}
- Gneiss {*h=hornblende, mq=muscovite-quartz, qb=quartz-biotite*}
- Quartzite.
- Ptygmatic Gneiss.
- Hornblende-epidote-felspar-quartz-gneiss.
- m — Impure Marble.

MISCELLANEOUS

- Airborne Radiometric Anomalies.
- Fault.
- MARINE FOSSIL; FRESHWATER FOSSIL.
- Joints.
- Mines (with indication of Metal).
- Overturned Syncline.
- Track.
- Trend & dip of Bed.