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Geology of the Mundubbera District

by

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(with 3 text-figures, 2 tables, 1 map)

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Abstract. In the Mundubbera district Upper Palaeozoic sediments of the southern portion of the Yarrol Basin are exposed in a broad syncline. The sequence has been divided into two Devonian and six Carboniferous formations. Consideration of fossil zones and stratigraphic and structural relations infers that the Carboniferous rocks are of Tournaisian, Viséan, and possibly Namurian age. Lithologic variation throughout the Carboniferous indicates a single strong vertical movement of the Gogango High at the end of Tournaisian time. Evidence is presented showing that this vertical movement of the high may be related to orogenic movements within the Yarrol Basin. Various lines of evidence suggest that the eastern margin of the basin is here marked by a thrust sheet of Lower Palaeozoic rocks. Faulting along the western margin of the basin is also discussed. The structural and stratigraphic history of the district is outlined.

Introduction

The Mundubbera district is bounded on the east by the Binjour Plateau and on the south and west by the Burnett River. Within the district are Devonian, Carboniferous, Triassic, and Post-Triassic sediments. The Devonian and Carboniferous are incorporated into the late or post-Permian folding affecting the Yarrol Basin and are exposed on the flanks of a large syncline here called the Mundubbera Syncline. Folded Triassic strata are found in the western part of the district in a fault block which has been dropped relative to the strata of the Mundubbera Syncline. Horizontal sandstones overlying both the Triassic and the Carboniferous represent either the Tertiary or the post-Triassic Mesozoic.

Drainage within the district is consistently toward the Burnett River, the streams running either west or south. The three principal tributaries are Philpott Creek, Killala Creek and Lacon Creek, all of which flow south.

Previously published work on the Mundubbera district is negligible. Dr. D. Hill made available to the writer unpublished field notes designating scattered outcrops and fossil localities within the district. The only detailed study prior to the present work was made by Hill (1934) on the coral fauna of the Riverleigh Limestone exposed in Portions 21 and 22, Parish of Mundowran.

The writer is indebted to members of the Department of Geology, University of Queensland; in particular to Dr. D. Hill for aid in identification of the coral faunas and encouragement throughout the course of the project and to Dr. W. G. H. Maxwell for advice on all phases, but particularly for help in identification of the brachiopod and gastropod faunas. Appreciation is due to many residents of Mundubbera, among them Mr. Kevin Burns, Mr. and Mrs. V. D. Edwards, Mr. Harold Mutch and Mr. Sid Nelson. Mr. Evan Phillips aided in identification of igneous rocks. The writer's wife gave assistance both in the field and the laboratory. A Fulbright Grant, awarded between August 1958 and August 1959 made this work possible.

STRATIGRAPHY

I. INTRODUCTION

This investigation includes work upon Middle and Upper Devonian, Lower Carboniferous, Triassic and Post-Triassic rocks. Emphasis is placed upon the stratigraphic and structural relations of the Lower Carboniferous strata incorporated in the folding of the Mundubbera Syncline.

Table I shows the stratigraphic succession within the Mundubbera district. It should be noted that all formational names in this paper, with the exception of Riverleigh Limestone, are new, being here proposed for the first time. A scarcity of geographic names frequently has forced the writer to use the names of geographic features which are somewhat removed from the various type localities.

II. STRATIGRAPHICAL SUMMARY

Devonian strata are exposed on the east flank of the Mundubbera Syncline in the Mundubbera district. The Philpott Limestone, containing two beds of tuffaceous sandstone, occurs at the base of the Upper Palaeozoic sequence. A coral fauna from this limestone studied by Hill indicates a Middle Devonian age (personal communication). This unit is conformably overlain by the First Branch Creek Sandstone which, on the basis of stratigraphic position and lithologic character, appears to represent the Upper Devonian.

Carboniferous strata in the Mundubbera district are here referred to as the Mundowran Group. Only tentative correlations between the formations of the Mundowran Group exposed on the west flank of the Mundubbera Syncline and those found on the east flank have been possible. Consequently, the eastern and western flanks must be treated separately.

On the eastern flank the Pumpkin Hut Mudstone overlies the First Branch Creek Sandstone, a gradational contact between this Carboniferous unit and the underlying Devonian being well exposed in Philpott Creek. The Pumpkin Hut Mudstone is succeeded by the Spectre Creek Beds, the basal part of which contains lenses of sandstone and conglomerate and the entirety of which contains beds of chert, sometimes of considerable thickness.

The Washpool Creek Formation is the lowest Carboniferous unit exposed on the western flank of the Yarrol Basin in the Mundubbera district. This sequence of cherts, sandstones and limestones is bordered on the west by the Mulgildie Fault System and on the east is overlain by the O'Bil Bil Road Conglomerate which, in turn, is succeeded by the Mundubbera Sandstone. The basal Lacon Creek Member of the Mundubbera Sandstone is chert, thus differing from the formation's typical lithology. The Killala Creek Limestone is the highest fossiliferous formation in the district and, where it occurs, conformably overlies the Mundubbera Sandstone. Above the Killala Creek Limestone is a series of mudstones and sandstones here referred to the Spectre Creek Beds.

With the exception of the Spectre Creek Beds all Carboniferous formations on the west flank of the Mundubbera Syncline contain fossiliferous horizons. All such horizons occur within limestone lenses in the various formations. Corals are most common within these lenses but brachiopods, gastropods, polyzoa, lamellibranchs, nautiloids and trilobites are also represented.

TABLE 1—Stratigraphic Succession

<table>
<tr><td colspan="3">Post Triassic Sandstones</td><td>TERTIARY or MESOZOIC</td></tr>
<tr><td colspan="3">Folded Triassic Beds</td><td>TRIASSIC</td></tr>
<tr><td rowspan="5">Mundowran Group</td><td>Spectre Creek Beds</td><td rowspan="4">Spectre Creek Beds</td><td rowspan="4">NAMURIAN ?
——?——?——?—
VISEAN</td></tr>
<tr><td>Killala Creek Limestone</td></tr>
<tr><td>Mundubbera Sandstone</td></tr>
<tr><td>O'Bil Bil Road Conglomerate</td></tr>
<tr><td>Washpool Creek Formation</td><td>Pumpkin Hut Mudstone</td><td>TOURNAISIAN</td></tr>
<tr><td colspan="2" rowspan="2"></td><td>First Branch Creek Sandstone</td><td rowspan="2">DEVONIAN</td></tr>
<tr><td>Philpott Limestone</td></tr>
</table>

III. FAUNAS

There are numerous fossil horizons on the west flank of the Mundubbera Syncline from the Washpool Creek Formation upward to the Killala Creek Limestone.

Corals and occasional lamellibranchs are almost universally present in fossiliferous beds of the Mundowran Group. Gastropods are more numerous in the basal part of the group, notably in the Washpool Creek Formation and in the *Daviesiella* Bed of the O'Bil Bil Road Conglomerate. No gastropods have been found above the *Daviesiella* Bed. Brachiopods appear to be more plentiful in the upper part of the Mundowran Group, notably in the Killala Creek Limestone and the *Rhipidomella fortimuscula* Bed of the Mundubbera Sandstone. Further work will be necessary before any significance can be attached to this variation in faunal constituents.

Fossils being limited to limestones, and limestones being irregularly scattered through the Mundowran Group, it is difficult if not impossible to define significant stratigraphic ranges for species. Table 2 shows the stratigraphic ranges of those species which have been identified but, in examination of this table, it must be kept in mind that fossils are not found continuously through the sequence.

All fossil material collected by the writer is housed in the University of Queensland.

TABLE 2

Range chart showing the stratigraphic distribution of the Mundubbera faunas. The species are arranged in ascending order of appearance in the stratigraphic column, the oldest ones occurring at the top of the chart, the youngest at the bottom.

SPECIES	FORMATIONS			
	Washpool Creek Formation	O'Bil Bil Road Conglomerate	Mundubbera Sandstone	Killala Creek Limestone
Zaphrentoid new to Australia	—			
Syringopora sp. nov.	—			
Mourlonia sp.	—			
Loxonema sp.	—	—		
Carcinophyllum cf. *patellum* Hill	—	—	—	
Palaeacis cf. *cuneiformis* Haime	—	—	—	—
Waagenella sp.		—		
Euomphalus sp.		—		
Straparolus sp.		—		
Rhipidomella sp.		—		
Daviesiella cf. *aspinosa* (Dun)		—		
Carcinophyllum sp.		—		
Syringopora syrinx Etheridge		—		
Schizophoria sp.		—		
Lithostrotion columnare Etheridge		—		
Amygdalophyllum etheridgei Dun & Benson		—		
Amygdalophyllum conicum Hill		—	—	
Amygdalophyllum inopinatum (Etheridge)		—	—	—
Diphyphyllum sp.			—	
Lithostrotion arundineum Etheridge			—	
Symplectophyllum sp.			—	
Aphrophyllum foliaceum Hill			—	
Brachythyris ? sp.			—	
Rhipidomella fortimuscula Cvancara			—	
Caninophyllum sumpheuns (Etheridge)			—	
Dictyoclostus simplex Campbell				—
Marginirugus barringtonensis (Dun)				—

IV. FORMATIONS

1. The Philpott Limestone

(a) *Distribution.* The Philpott Limestone, which attains a thickness of over 2,000 feet, is here defined as the sequence of interbedded blue grey to pink, moderately fossiliferous, limestones and tuffaceous sandstones striking north-east and exposed between the junction of First Branch Creek with Philpott Creek and Philpott railway station. The type section extends along the "Blue Rocks" on the south side of the Burnett River, Portion 65, Parish of Mundubbera, and the name is taken from Philpott Creek in the eastern part of the district.

Exposure of this formation is discontinuous over most of its extent. Notable outcrops, other than the type section, are found at Philpott railway station and at the junction of Philpott and First Branch Creeks. At the latter locality both the Philpott Limestone and the First Branch Creek Sandstone may be observed.

(b) *Lithology.* Three distinct limestone units separated by two tuffaceous sandstone units are exposed at the "Blue Rocks". Due to poor exposure to the north-east of this outcrop these units have not been mapped. The massive, blue grey, finely crystalline limestones are occasionally altered to marble, but where this is not the case, a fossil coral assemblage is sometimes present. Stringers of secondary calcite are commonly present in both the limestone and the marble. The unsorted tuffaceous sandstones are largely composed of lithic fragments. These sandstones have been considerably altered and secondary hematite is commonly found in the matrix.

(c) *Faunas.* A coral fauna of both compound and solitary types is present in the Philpott Limestone and has been partially examined by Hill. She assigns the fauna to a Middle Devonian age (personal communication). The Philpott Limestone was provisionally assigned to the Lower Devonian by Bryan and Jones (1945, p. 28) but they did not define the unit or discuss its extent. Stratigraphic position, as well as the work done by Hill, infers that the Middle Devonian age determination is correct.

2. The First Branch Creek Sandstone

(a) *Distribution.* The First Branch Creek Sandstone overlies the Philpott Limestone, the contact apparently being conformable. It is exposed in a north-east trending belt truncated in the north by the Yarrol Thrust Sheet and presumably continuing across the Burnett River in the south. The formation, as here defined, is approximately 2,600 feet of very hard, medium grey, massive sandstone. No complete section is exposed in the Mundubbera district but numerous scattered exposures are found along Philpott Creek above its junction with First Branch Creek. This then is the type area. Other notable exposures are found in First Branch Creek and on the Robert Cross Farm, Portion 230, Parish of Binjour.

(b) *Lithology.* The character distinguishing the First Branch Creek Sandstone from all other lithologies in the Mundubbera district, and particularly from all Carboniferous lithologies, is its extreme hardness. A hammer, striking the rock's surface, rebounds with a ringing sound. This, together with the grey to grey blue colour, the massive character, and the generally constant grain size, allows no confusion with other units. In the upper part of this sandstone scattered pebbles, and rarely, cobbles up to 5 inches in diameter, are found. The exposure in Philpott Creek immediately north of the Philpott road crossing (co-ordinates 8.0, 17.0 on accompanying map) show this character. A gradational contact with the overlying Carboniferous Pumpkin Hut Mudstone is well exposed in Philpott Creek north of the Philpott road crossing (co-ordinates 8.3, 16.8 on accompanying map).

(c) *Fauna.* No fossils are present in the First Branch Creek Sandstone. It is here tentatively assigned to the Upper Devonian on the basis of stratigraphic position and lithologic character. It overlies the fossiliferous Middle Devonian Philpott Limestone and shows lithologic characters strikingly different from those of the immediately overlying Carboniferous units.

3. The Pumpkin Hut Mudstone

(a) *Distribution.* The Pumpkin Hut Mudstone is here defined as the lowest Carboniferous mudstone unit on the east flank of the Mundubbera Syncline in the Mundubbera district. It is discontinuously exposed, principally in the tributaries of Philpott Creek, from the north-east corner of the area of study south-west to the Burnett River. The type section consists of plentiful but discontinuous exposures in the unnamed creek flowing south-west from the Mundubbera-Gayndah road across Portions 50 and 51, Parish of Mundowran, and joining Philpott Creek at co-ordinates 8.8, 16.8 on the accompanying map. The name is taken from Pumpkin Hut Creek in the eastern part of the district. A number of minor folds, some of which are delineated on the accompanying map, have developed in this unit. Variation in dip and suspected minor faulting, as well as the incompetent nature of the formation, have further complicated the structure. Consequently, the thickness of approximately 3,300 feet must be regarded as a rough estimate.

(b) *Lithology*. The olive coloured Pumpkin Hut Mudstone varies from fissile to massive. It is relatively free of impurities in contrast to the overlying Spectre Creek Beds, which, although principally mudstone, often contain sand and chert. An appreciable sand content is, however, occasionally found in the Pumpkin Hut Mudstone. When this is the case the main mineralogical constituents are quartz, chert, quartzite, feldspar, lithic fragments and calcite.

(c) *Fauna*. No fossils were found in this mudstone. A local resident, Robert Wernike, reports that fossil gastropods were obtained from a well at co-ordinates 9.3, 16.3 (see accompanying map) at a depth of 45 feet. This well was sunk a number of years ago and most of the tailings have been obscured by vegetation. No fossils were found there by the writer. The Pumpkin Hut Mudstone is tentatively correlated with the Washpool Creek Formation on the west flank of the Mundubbera Syncline, the basis for such a correlation being stratigraphic position, thickness, and structural similarities.

4. The Spectre Creek Beds

(a) *Distribution*. The Spectre Creek Beds constitute the core of the major syncline in the Mundubbera district and the upper part of the unit represents the youngest Carboniferous in the area. Due to the uncertain relationship of the lower part of the Spectre Creek Beds on the eastern flank of the Mundubbera Syncline with the various units on its western flank, as well as to the poor nature of exposures, due principally to alluvial cover, the beds are not here defined as a formation. The Spectre Creek Beds underlie the town of Mundubbera and the full drainage area of Killala Creek, expanding northward to cover a continuously widening area. Scattered exposures are found throughout this area. Incompetency in the Spectre Creek Beds, particularly in those parts which are dominantly mudstone, has led to variation in dip and minor folding which, associated with the expensive alluvial cover, makes estimation of the thickness difficult. As calculated from the accompanying map thicknesses vary between 6,500 feet and 9,500 feet. It is thought that these beds are thicker on the east than on the west flank of the syncline.

(b) *Lithology*. Exposures of this unit to the east of the major synclinal axis reveal an olive mudstone commonly becoming somewhat sandy with numerous lenses of sand and chert and commonly chert nodules. At the base of the unit in the southern part of the district a series of coarse sandstone and pebble conglomerate beds are developed. The best exposures of these are found immediately to the north of the Mundubbera-Gayndah road (co-ordinates 8.5, 19.6 on accompanying map). On the western flank of the syncline mudstone, sandy mudstone and chert remain the dominant lithologic types of the Spectre Creek Beds but, whereas on the eastern flank the chert beds are quite thin, on the western flank they form massive units which are more resistant to erosion than the mudstones and give rise to many of the north-south trending ridges in the area of exposure. No lateral continuity of lithology is present, chert grading into mudstone quite rapidly along the strike. In the sandy parts of the unit andesitic rock fragments, chert, quartz, feldspar and, less commonly calcite, are the principal constituents. The matrix is normally of argillaceous material but occasionally of calcite or cryptocrystalline silica. Grains are poorly sorted and angular to subangular. Oolites are present only rarely.

(c) *Fauna.* No fossils have been found in the Spectre Creek Beds. On the basis of lithology, stratigraphic position, and thickness it is proposed that the lower part of these beds on the eastern flank of the Mundubbera Syncline represent a mudstone facies of the O'Bil Bil Road Conglomerate, the Mundubbera Sandstone, and the Killala Creek Limestone (see the discussion on local correlation).

5. The Washpool Creek Formation

(a) *Distribution.* The Washpool Creek Formation, attaining a thickness of approximately 3,700 feet, is here defined as the sequence of cherts, sandy cherts, cherty sandstones, sandstones, mudstones, and limestones exposed immediately east of the Mulgildie Fault System. The unit, although structurally complex, has a predominantly eastward dip and is overlain on the east by the O'Bil Bil Road Conglomerate. The type section, only partially exposed, is found in the headwaters of the tributaries flowing south-east into Lacon Creek along Section A, A' as shown on the accompanying map. The Washpool Creek Formation is the lowest Carboniferous formation exposed on the west flank of the Mundubbera Syncline. The best exposures are found in the north-western part of the Mundubbera district but the unit may be traced south, beneath the alluvium of Lacon Creek, to the Burnett River.

(b) *Lithology.* Cream coloured or sometimes banded chert is the principal lithologic type represented in the Washpool Creek Formation but all gradations between chert, subgraywacke, graywacke, tuff, and limestone are present. Scattered mudstone lenses are present in the north and become quite plentiful in the southern part of the area of exposure. None of the lithologic types maintain themselves laterally for any appreciable distance. There are no key beds to aid in structural interpretation with the possible exception of one or two of the limestone lenses. The commonly öolitic grey limestones within the Washpool Creek Formation are characteristic of the unit. An appreciable admixture of sand is present in most of them. Normally these limestones are terminated laterally either by pinching out or by intersection with one of the numerous minor faults cutting the formation. Fossils have been found only in the limestones. Sandstones are common throughout the formation being second only to cherts in abundance. The most common mineralogical constituent is quartz but feldspar, andesitic rock fragments and occasional calcite grains are also represented. The matrix is normally made up of argillaceous material but is sometimes siliceous and less commonly calcitic. Sorting is poor and the grains are dominantly subangular. Shards are present in many of the various sandstone types and occasionally true tuffs may be developed.

(c) *Faunas.* Poor faunas are developed in limestone lenses at various horizons through the Washpool Creek Formation. Forms identified from these horizons include:

Palaeacis cf. *cuneiformis* Haime
Carcinophyllum cf. *patellum* Hill
Syringopora sp. nov.
Zaphrentoid new to Australia
Loxonema sp.
Mourlonia sp.

Palaeacis cf. *cuneiformis* occurs at locality number 4 (see accompanying map). *Carcinophyllum* cf. *patellum*, the new zaphrentoid, *Loxonema* sp. and *Mourlonia* sp. are found at locality number 3 and the new zaphrentoid at locality number 1 as well. The new species of *Syringopora* occurs at locality number 2.

The occurrence of *Palaeacis* cf. *cuneiformis* in the Washpool Creek Formation is noteworthy since this form has not previously been reported from rocks so low in the Carboniferous sequence. *P.* cf. *cuneiformis* occurs at various stratigraphic levels from the Washpool Creek Formation to the Killala Creek Limestone.

6. The O'Bil Bil Road Conglomerate

(a) *Distribution.* The O'Bil Bil Road Conglomerate is here defined as the conglomerate and coarse sandstone reaching an approximate thickness of 1,300 feet, the outcrop pattern of which extends in a sinuous belt from near the north-west corner of the Parish of Mundowran south to just west of the mouth of Lacon Creek. The unit invariably dips east being underlain by the Washpool Creek Formation and overlain by the Lacon Creek Member of the Mundubbera Sandstone. The type section, only partially exposed, is found 1.5 miles west of Mundubbera on the hills immediately north of the road at the O'Bil Bil-Riverleigh turn off (co-ordinates 6.5, 24.8 on accompanying map).

(b) *Lithology.* Light orange to light red conglomerate, largely of pebble size fragments, or coarse sandstone. The coarser grades appear to be dominant in the middle and upper part of the formation and the coarse sand to be more common at the base. Quartz, andesitic rock fragments and chert are the most common constituents but feldspar grains are not uncommon in the matrix, which almost without exception also contains some calcium carbonate, commonly as öolites, and some argillaceous material. Sandy grey limestone lenses are developed at various levels through the formation and it is within these lenses that fossils are occasionally found.

(c) *Fauna.* Three fossil beds have been found within the O'Bil Bil Road Conglomerate. At the base of the unit in the southern part of the area of exposure (locality number 5 on accompanying map) a series of coarse detrital pebbly limestones contain:

Daviesiella cf. *aspinosa* (Dun)
Rhipidomella sp.
Straparolus sp.
Loxonema sp.
Euomphalus sp.
Waagenella sp.

Gastropods similar to those reported here have been found by Maxwell (personal communication) stratigraphically below the reef limestone at "Old Cannindah" in the Monto district.

Approximately at the stratigraphic middle of the O'Bil Bil Road Conglomerate (locality number 6 on accompanying map) two corals, *Syringopora syrinx* Etheridge and *Carcinophyllum* sp. occur.

The highest fossiliferous bed found in the conglomerate is at locality number 7 (see accompanying map). Occurring at this horizon are:

Lithostrotion columnare Etheridge
Amygdalophyllum conicum Hill
Amygdalophyllum etheridgei Dun and Benson
Amygdalophyllum inopinatum (Etheridge)
Syringopora syrinx Etheridge
Schizophoria sp.

7. The Mundubbera Sandstone

(a) *Distribution.* The Mundubbera Sandstone is approximately 2,000 feet thick, the outcrop area being a linear belt extending from the mouth of Lacon Creek north across the Mundubbera district. The type section is found along the southern boundary of Portion 91, Parish of Mundowran. As here defined, the formation is divided into two members. The lower Lacon Creek Member is approximately 300 feet of chert and is overlain by the Corsers Bridge Member which is approximately 1,700 feet of sandstone. In the southern part of the Mundubbera district the Lacon Creek Member is somewhat thinner than it is to the north. In the extreme north of the district neither the Mundubbera Sandstone nor the two members of which it is composed are as clearly defined as they are to the south. Lenses of conglomerate are found throughout the formation and particularly in its upper part in the northern part of the exposure area. Chert too is found throughout the formation, not being limited to the basal member as it is in the south. It may be found that lithologic change along the strike to the north will make the tracing of this unit beyond the Mundubbera district difficult if not impossible.

(b) *Lithology.* The Lacon Creek Member is a rather clean finely crystalline chert with occasional sand lenses. Colour varies from cream to black and occasionally banded chert is found in the unit. In its typical development the overlying Corsers Bridge Member is a poorly sorted, dark grey sandstone, the major constituents of which are quartz, chert, andesitic rock fragments, and, to a lesser extent, feldspar. Rarely, the sandstone becomes tuffaceous. The matrix is commonly composed of either argillaceous material or calcite or some mixture of the two. The rock is a graywacke when the matrix is composed of argillaceous material. Oolites are quite rare, even when calcite makes up the matrix, except in the limestone lenses. Sorting is poor and grains are normally angular to subangular.

(c) *Faunas.* Within the Mundubbera Sandstone three fossiliferous beds have been found. In the basal member a limestone lens in the northern part of the district (locality 8 on the accompanying map) has yielded numerous corals including:

Aphrophyllum foliaceum Hill
Amygdalophyllum conicum Hill
Carcinophyllum cf. *patellum* Hill
Diphyphyllum sp.
Lithostrotion arundineum Etheridge
Symplectophyllum sp.

Hill (personal communication) considers the above fauna to be more closely related to that found in the Riverleigh Limestone of the Latza Fault Block than any other occurring in the district. It seems probable that the Latza Block was dropped to its present position from a stratigraphic level approximately equivalent to this horizon.

Above the coral fauna of the Lacon Creek Member and stratigraphically approximately in the middle of the formation (locality number 9 on accompanying map) occurs a fossiliferous and rather continuous limestone containing:

Rhipidomella fortimuscula Cvancara
Palaeacis cf. *cuneiformis* Haime
Brachythris ? sp.

Rhipidomella fortimuscula is very common and characteristic of this limestone.

Caninophyllum sumphuens (Etheridge) is found at locality number 10 (see accompanying map) in the upper half of the Corsers Bridge Member of the Mundubbera Sandstone.

8. The Killala Creek Limestone

(a) *Distribution.* As here defined the öolitic, dark grey Killala Creek Limestone is a lens-shaped formation attaining a maximum thickness of approximately 850 feet. It contains a thin but persistent sand lens situated approximately in the middle of the unit. The type section is on the first hills to the west of the O'Brien farm house, Portions 88 and 89, Parish of Mundowran (co-ordinates 8.6, 24.0 on accompanying map). The lenticular outcrop area extends from the Mundubbera-Riverleigh road approximately 1 mile west of Mundubbera in the south to the Mundubbera-Eidsvold road in the north. Excellent exposures are present, especially in the central part of the lenticular outcrop area. Areal distribution and lithologic character suggest that the Killala Creek Limestone may represent the flank beds of a biohermal mass. This view is supported by the occurrence of a bioherm at an equivalent stratigraphic level as indicated by faunal similarities at "Old Cannindah" near Monto to the north of the Mundubbera district (Maxwell, 1960, in press).

(b) *Lithology.* The Killala Creek Limestone is massive, öolitic, fossiliferous, medium grey, and commonly coarsely crystalline. Crinoid stems, often up to 0.5 inches in diameter, occur as the principal rock-forming material in thin lenses within the unit. Crinoid stems, brachiopods, polyzoa and, less commonly, corals are represented in the fauna. The most important fossil in the unit, *Marginirugus barringtonensis* (Dun), is found both above and below the thin sand lens in the middle of the formation.

(c) *Fauna.* Fossils found in the Killala Creek Limestone (locality number 11 on accompanying map) are:

Marginirugus barringtonensis (Dun)
Dictyoclostus simplex Campbell
Palaeacis cf. *cuneiformis* Haime
Amygdalophyllum inopinatum (Etheridge).

M. barringtonensis is the most common form in the formation and is found throughout the unit. This form has been described from New South Wales by various authors (Campbell, 1956; Cvancara, 1958). It is reported by Maxwell (personal communication) from the Monto area of Queensland and appears to be an excellent index form in the Lower Carboniferous rocks of the Gloucester area, N.S.W. and the Yarrol Basin.

D. simplex is reported from the Watts, Babbinboon area (Campbell, 1957). *Dictyoclostus* showing affinities with those collected from the Killala Creek Limestone and those from the Watts, Babbinboon area has been collected by Maxwell from the Merlewood area, N.S.W. stratigraphically below, and not far removed from the Watts, Babbinboon locality. It seems probable that the stratigraphic range of *D. simplex* is grater than previously supposed.

9. The Folded Triassic Beds

(a) *Distribution.* A thick, structurally complex series of folded, fluviatile and lacustrine, Triassic clastics is found immediately west of the Mulgildie Fault System. This series of beds extends west beyond the Burnett River on the west side of the area but is overlain in the western part of the district by flat-lying Post-Triassic deposits. Excellent exposures of the folded Triassic Beds are present along the railway in Portions 158, 159, 162 and 166, Parish of Mundowran, and at "Parr's

Rocks" on the Burnett River in Portion 149, Parish of Mundowran where the unconformable contact between the folded Triassics and the overlying Post-Triassic sandstone may be observed. Other scattered exposures are found throughout the western part of the Mundubbera district.

(b) *Lithology*. The folded Triassic Beds are a series of conglomerates, sandstones, siltstones, shales and interbedded rhyolites. Iron staining often gives the beds, particularly the conglomerates, a red or orange colour but no single colour is characteristic of the unit as a whole. There is little lateral continuity of lithology. Single lenses of conglomerate can rarely be traced along the strike for more than a mile and invariably are found to pinch out. Detailed study of the Mesozoic strata has not been attempted by the writer but it is possible that future work will show that the rhyolites can be used as marker beds.

(c) *Flora*. Along the railway in Portion 159, Parish of Mundowran (co-ordinates 6.5, 28.9 on accompanying map) numerous plant fragments, none in sufficiently good condition to allow identification, were found in scattered boulders of light brown siltstone and sandstone. This is the only fossil locality known to date in the folded Mesozoics within the Mundubbera district. Hill identified *Ginkgo* cf. *magnifolia*, *Taeniopteris*, *Nilssonia* and *Pterophyllum* from this locality in 1929 (unpublished notes). These fossils are diagnostic of the Esk age of the flora. These folded Mesozoics are consequently, at least in part, Triassic. Flora indicative of Esk age is also reported by T. S. Laudon (personal communication) from Mesozoic sediments faulted into Carboniferous strata immediately north of the Mundubbera district. This locality is near the southern boundary of Lochaber station approximately 150 feet north of the intersection of the boundary fences of Lochaber station and Portions 26 and 27, Parish of Lochaber.

10. The Post-Triassic Sandstone

(a) *Distribution*. Post-Triassic time is represented in the Mundubbera district by a series of horizontal, quartzose sandstones which commonly occur as cappings on flat-topped hills. The best exposures of this sandstone are found on the flat-topped hill in the northern part of the district. Here the sandstone lies across the axis of the Mundubbera Syncline. There are also good exposures along the Burnett River in Portions 11 and 149, Parish of Mundowran.

(b) *Lithology*. These beds are composed of white, coarse, quartzose, horizontal sandstones. Occasionally bands of quartz pebbles are present and commonly a high clay content. Basaltic lavas are reported to be interbedded with identical sandstones immediately north of the district (T. S. Laudon, personal communication). Such interbedded basalts are typical of the Tertiary sandstones of the Yarrol Basin.

(c) *Fauna*. No fossils have been found in the horizontal sandstone. On the basis of stratigraphic position it is not possible to date them more accurately than Post Triassic.

V. CORRELATIONS

1. Local Correlation

Correlation of the various Carboniferous formations on the east and west flanks of the Mundubbera Syncline is difficult. On the west flank are the distinctive lithologies of the Washpool Creek Formation, the O'Bil Bil Road Conglomerate, the Mundubbera Sandstone, and the Killala Creek Limestone, none of which show marked lithologic similarity with the mudstones and sandy mudstones of the eastern flank of the syncline. Fossil zones present on the west flank are not repeated on the east flank.

The Washpool Creek Formation of the syncline's west flank is here correlated with the Pumpkin Hut Mudstone on the east flank. Each of these units represents the lower-most Carboniferous on its respective flank of the syncline. The transitional contact between the Devonian First Branch Creek Sandstone and the Carboniferous Pumpkin Hut Mudstone infers that the Pumpkin Hut Mudstone is wholly, or in part, of Tournaisian age, and the fossil assemblage of the Washpool Creek Formation may indicate a Tournaisian age (Hill, personal communication). Both the Washpool Creek Formation and the Pumpkin Hut Mudstone are structurally similar in that they have been affected by minor faulting and folding. Both of these units are of approximately the same thickness.

Two plausible explanations for the correlation of the post-Washpool Creek units on the west flank with the lower part of the Spectre Creek Beds on the east flank may be proposed. These are demonstrated in figure I, A and B. The writer favours the explanation shown in B as that most likely to be true. The relationship shown here proposes that the O'Bil Bil Road Conglomerate and the Mundubbera Sandstone, as well as the Killala Creek Limestone, are time equivalents of the lower part of the Spectre Creek Beds.

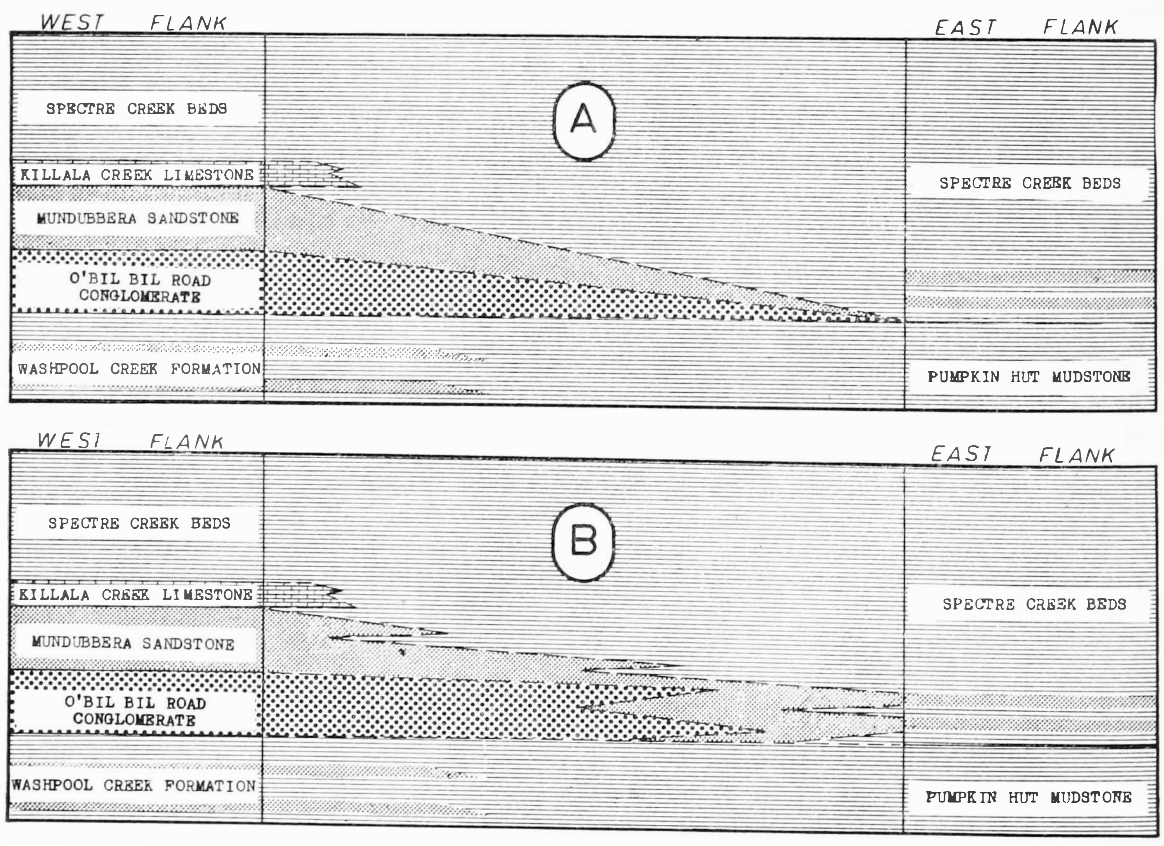

FIGURE 1.- Two possible correlations between the formations on the eastern and western flanks of the Mundubbera Syncline.

The alternate hypothesis shown in A of figure 1 is that the O'Bil Bil Road Conglomerate and the Mundubbera Sandstone have no time equivalents on the east flank of the syncline. Such an explanation necessitates a period of non-deposition succeeding the deposition of the Pumpkin Hut Mudstone. No evidence for such was found.

The interpretation that the O'Bil Bil Road Conglomerate and the Mundubbera Sandstone pinch out to the east (fig. 1, A) might be varied so that only the Mundubbera Sandstone pinches out, the O'Bil Bil Road Conglomerate correlating with the lower sandy part of the Spectre Creek Beds. The writer considers that this variation upon the interpretation shown in figure 1, A, although a possible explanation, is not as satisfactory as that shown in B.

2. Regional Correlation

The first detailed stratigraphic study within the Yarrol Basin was made by Maxwell (1953, 1954) in the Mount Morgan district. It has not proved possible to correlate the Mundubbera strata with this district; however, there are notable faunal similarities with areas in northern New South Wales and in the Monto district of Queensland.

Cvancara (1958) described certain fossils, notably *Rhipidomella fortimuscula* Cvancara, from a mudstone in the upper part of the Lower Burindi Group in the Barrington-Gloucester area of New South Wales. Cvancara says (1958, p. 848) "Approximately 150 feet stratigraphically above (the mudstone), is the "*Productus*" *barringtonensis* bed, . . ." and "Approximately 150 feet stratigraphically below the mudstone are two thin, öolitic limestones separated by a very thin mudstone with a characteristic fauna, which includes a large chonetid, *Daviesiella aspinosa* (Dun)."

Daviesiella cf. *aspinosa*, *Rhipidomella fortimuscula* and *Marginirugus barringtonensis* occur in the Mundubbera district in the same order of occurrence as reported by Cvancara. However, whereas Cvancara (1958, p. 848) reports an approximate stratigraphic thickness of 400 feet separating the *Daviesiella* and *M. barringtonensis* zones, there are approximately 3,000 feet of sediments between them in the Mundubbera district. The Barrington-Gloucester sequence, which is poorly exposed, may prove to be a compressed sequence of faunal zones due to depositional or structural breaks.

Maxwell (personal communication) reports *Daviesiella* sp. from both above and below the reef limestone at "Old Cannindah" in the Monto district. He considers this reef limestone to be equivalent to the *M. barringtonensis* zone of the same area. The occurrence of *Daviesiella* above the *M. barringtonensis* zone indicates that the stratigraphic range of the genus is not so limited within eastern Australia as was previously supposed.

Discussion of the fauna of the Riverleigh Limestone seems appropriate since it lies within the Latza fault block of the Mundubbera district. The large coral fauna from the Riverleigh Limestone can be correlated with the Viséan D_2 fauna of England (Hill, 1934, p. 105). Its exact relation to the Viséan Lion Creek Limestone of the type section of the Rockhampton Series is not certain. Etheridge (1900, p. 5) in the first description of the Lion Creek fauna, considered that it had attributes of the combined Carboniferous and Permo-Carboniferous. Whitehouse (1927, p. x and 1928, p. 441) states that it may be correlated with the Viséan D_2 of England. More recently, Hill (1934, p. 104) says "the Lion Ck. fauna contains no form which may fairly be used to fix its horizon to any zone smaller than the Viséan of the English succession. . . ."

Fossil assemblages from several other limestones in eastern Australia show sufficient similarities with the faunas of the Lion Creek Limestone and the Riverleigh Limestone to warrant designation as of Viséan age (Carey, 1937, p. 352; Raggatt, 1941, p. 107; Hill, 1943, p. 62) but at no locality other than that of the Riverleigh Limestone has the form diagnostic of Viséan D_2, *Orionastraea lonsdaleoides* Hill, been reported.

There is no reason to believe that the numerous Viséan limestones of eastern Australia were deposited at the same time as the Riverleigh Viséan D_2 Limestone. The occurrence of numerous limestones throughout the Lower Carboniferous in the Mundubbera district indicates that environmental conditions were favourable to corals and the development of coral limestones at various times during the Tournaisian and Viséan.

The coral fauna in the Lacon Creek Member at the base of the Mundubbera Sandstone (locality number 8 on accompanying map) has more affinities with the fauna of the Riverleigh Limestone than does any other found in the district (Hill, personal communication). For this reason it appears that the stratigraphic position of the Riverleigh Limestone prior to faulting was approximately equivalent to the lower Mundubbera Sandstone but it should be noted that *O. lonsdaleoides* was not found in the Mundubbera Sandstone.

Vaughan's (1915) classic study of the Tournaisian-Viséan boundary has led workers throughout the world to attempt correlation with the European Carboniferous. The position of the Tournaisian-Viséan boundary in the Lower Carboniferous rocks of eastern Australia is uncertain. Workers in New South Wales, notably Campbell and Cvancara, on the basis of brachiopods compared principally with North American species, place the boundary at least as high as the top of the *Rhipidomella fortimuscula* mudstone fauna worked by Cvancara (1958) and the Watts, Babbinboon fauna studied by Campbell (1957). Workers at the University of Queensland, notably Hill and Maxwell, believe the boundary to be somewhat lower in the stratigraphic sequence. Hill bases such an opinion on comparison of corals, principally with English and European species, and Maxwell on stratigraphic thicknesses and brachiopod faunas in the Yarrol Basin sequences.

Neither brachiopods nor corals are ideal for intercontinental correlation due to the sessile nature of adult forms. It is beyond the scope of this paper to evaluate the merits of the two groups for correlation in eastern Australia.

The Tournaisian-Viséan boundary in the Mundubbera district is tentatively proposed to be at the top of the Washpool Creek Formation. Evidence supporting this is: (1) the possible Tournaisian aspect of the Washpool Creek fauna as interpreted by Hill (personal communication), (2) the Viséan character of the coral faunas above the Washpool Creek Formation, particularly the faunas of the Lacon Creek Member of the Mundubbera Sandstone and the *Lithostrotion columnare* fauna of the O'Bil Bil Road Conglomerate, (3) the fact that minor folds and faults within the Washpool Creek Formation and the Pumpkin Hut Mudstone indicate orogenic movements which are not reflected in the immediately overlying beds and which therefore may have occurred at the end of Washpool Creek time, and (4) the distinctive change in the sedimentational environment as reflected by lithologic changes at the end of Washpool Creek time and the beginning of O'Bil Bil Road time.

If the approximate equivalency of the Riverleigh Limestone with the lower part of the Mundubbera Sandstone and the position of the Tournaisian-Viséan boundary are accepted, it follows that the Viséan S zones of the European sequence are represented within the O'Bil Bil Road Conglomerate.

It has not proved possible to define the Viséan-Namurian boundary. It should be noted, however, that the *M. barringtonensis* of the Killala Creek Limestone lies approximately 2,000 feet above the coral fauna of the lower Mundubbera Sandstone which shows affinities with the Riverleigh Viséan D_2 Limestone. It seems probable that the upper part of the Spectre Creek Beds, which directly overlie the *M. barringtonensis* Bed are, at least in part, of post-Viséan age.

VI. AN INTERPRETATION OF LOWER CARBONIFEROUS SEDIMENTARY ENVIRONMENTS

The influence of tectonic factors throughout the deposition of the Mundowran Group is evident in these sediments. Chert, sandstones, and tuffaceous sandstones grading eastward into mudstones were deposited in Washpool Creek and Pumpkin Hut time. Volcanic activity, indicated by the tuffaceous sandstones in the Washpool Creek Formation, was more pronounced than in any succeeding part of Mundowran time. Taliaferro (1933) has demonstrated the importance of volcanism in the formation of siliceous sediments. It seems probable that much of the chert deposited during Washpool Creek time was derived from volcanic ash. Graywackes and sub-graywackes from the Gogango High (Hill, 1951), a relatively low sediment source to the west, were occasionally deposited but, in periods of quiescence, mudstones and thin lenticular limestones developed. A gastropod-coral fauna was plentiful in these quiescent intervals and is preserved in the lenticular limestones. No fossils have been found in the enclosing clastic sediments, possibly because the environmental conditions associated with graywacke deposition, *e.g.* turbulence and muddy bottoms, were unfavourable. The presence of corals and öolites indicate that, at no time, was subsidence sufficiently rapid to produce deep water conditions.

In O'Bil Bil Road time the Gogango High was strongly elevated relative to the Yarrol Basin. Whether this movement was of a strictly epeirogenic nature, was due to eustatic changes in sea level, or was related to orogenic forces acting on the Yarrol Basin as well as the Gogango High is uncertain (see section on structural development). In any case the O'Bil Bil Road Conglomerate, becoming coarser in the middle and upper parts, represents "flysch type" sediments deposited as a result of differential movement between the basin and the Gogango High. Despite tectonic activity in the high there were occasional intervals of quiescence. However, the coarse clastic limestone at the base of the O'Bil Bil Road Conglomerate (co-ordinates 5.9, 24.8 to 7.4, 25.5 on accompanying map) containing broken gastropods, brachiopods, and occasional corals indicates a thanatocoenosic assemblage and does not represent such an interval, the fauna having been transported some little distance prior to deposition. But the coral assemblage of the small lenticular limestone at locality number 7 (see accompanying map) contains *Amygdalophyllum conicum, A. etheridgei, A. inopinatum, Lithostrotion columnare,* and *Syringopora syrinx* in profusion. This assemblage is suggestive of a small bioherm and thus indicates a quiescent period during deposition of the O'Bil Bil Road Conglomerate. Similar though less well developed intervals are found at other stratigraphic levels in the formation.

Coincident with the beginning of deposition of the Mundubbera Sandstone vertical movements in the Gogango High ceased and no further movement occurred throughout the remainder of Mundowran time. The high was steadily reduced by erosion and supplied fewer and fewer sand sized clastics to the Yarrol Basin. Unsorted quartz, rock fragments, feldspar, and argillaceous material were still being deposited in the basin in quantity during most of Mundubbera time and resulted in the formation of the graywackes of the Corsers Bridge Member of the Mundubbera Sandstone. The chert of the Lacon Creek Member represents a period of quiescence.

Another notable interval of quiescence is indicated by the *Rhipidomella fortimuscula* zone of the Corsers Bridge Member and, at this time, a rather persistent limestone developed. Other quiescent periods are represented by occasional thin, lenticular, coral-bearing limestones. Some tuffaceous material is found in the Corsers Bridge Member indicating volcanic activity but clastic post-orogenic "molasse type" sediments derived by normal erosional processes from the Gogango High account for the bulk of the Mundubbera Formation.

Immediately following Mundubbera time conditions were sufficiently quiescent to allow the development of the Killala Creek Limestone. This limestone may well represent the flank beds of a biohermal mass now either removed by erosion or buried in the Mundubbera Syncline. With continued reduction of the high the mudstones, which for most of Mundowran time were the principal sediments on the eastern side of the basin, were also deposited on its western side. The environmental changes, induced by the deposition of this upper part of the Spectre Creek Beds on top of the Killala Creek Limestone, were unfavourable to reef-forming organisms and reef formation ceased. No limestone has been found above that of the Killala Creek. The upper part of the Spectre Creek Beds contains the youngest rocks in the Mundowran Group. They may well represent a final filling of the depositional basin by sediments from the Gogango High.

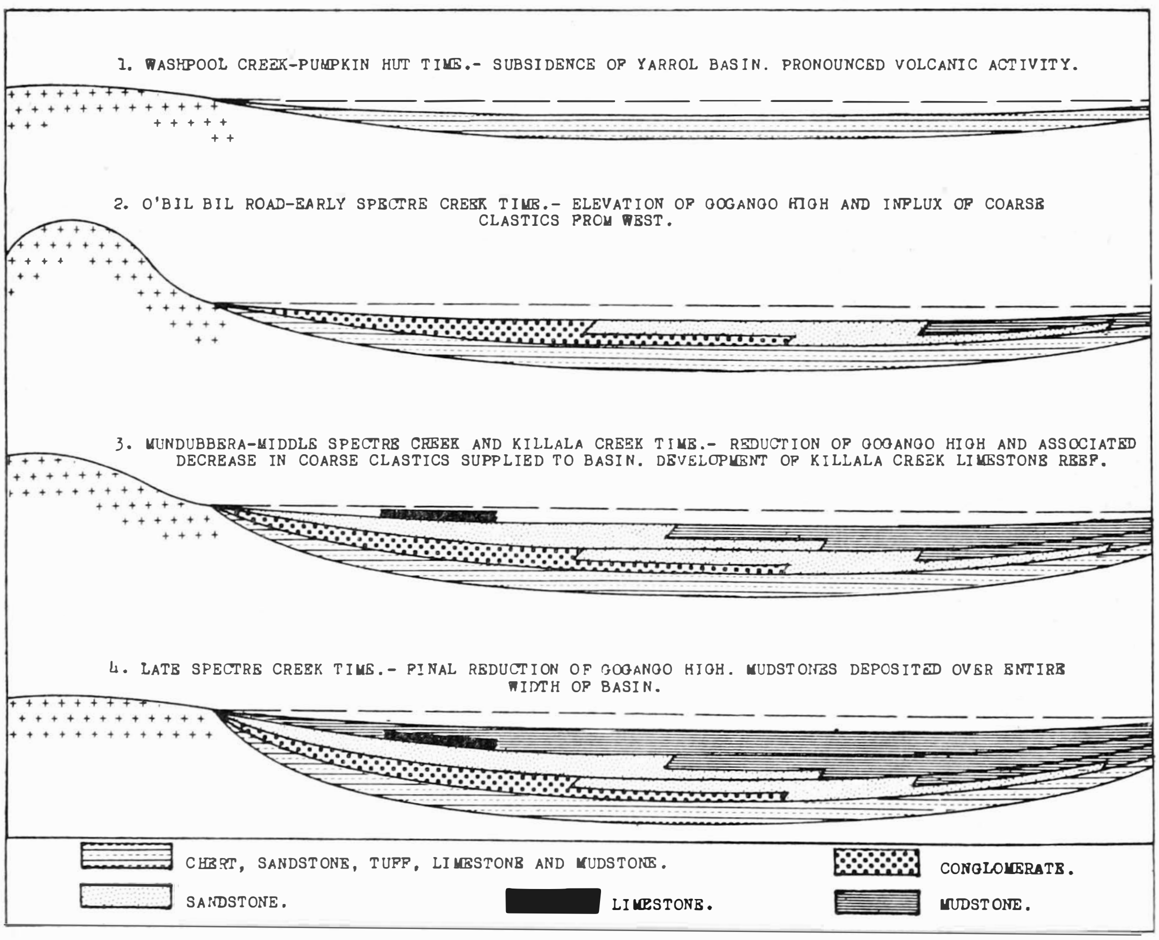

FIGURE 2.- Tectonic and sedimentational development of the Yarrol Basin in the Mundubbera district during the Lower Carboniferous.

Thus, in summary, the Yarrol Basin in the Mundubbera district was a rapidly subsiding trough in which sediments of geosynclinal thicknesses and character accumulated. The marine sea occupying the basin was never of any great depth. Vulcanicity contributing andesitic material was most active in the early part of Mundowran time, decreasing after deposition of the Washpool Creek Formation. The majority of Mundowran sediments were derived from the Gogango High a short distance to the west of the basin as indicated by the presence of coarse clastics on the west flank of the Yarrol Basin but not on the east flank. A single important vertical movement of the high occurred during Mundowran time and is represented by both pre- and post-orogenic sediments. Frequent intervals of quiescence are indicated during deposition of the group and, in these intervals, marine organisms, notably corals, flourished.

STRUCTURE

I. INTRODUCTION

Although the southern nose of the Yarrol Basin is south of the Burnett River the Mundubbera district, as indicated by closing trend lines on aerial photographs south of the river, lies very near the basin's southern extremity.

The Mundubbera Syncline underlies the major part of the district in a wide north-south belt. It is bordered by faults on both the east and west. The eastern margin of the syncline lies beneath the lower Palaeozoic Yarrol Thrust Sheet. The western margin is truncated by a series of faults thought to be the local expression of the Mulgildie Fault, found further to the north. These are here referred to as the Mulgildie Fault System. West of the Mulgildie Fault System folded Triassic sandstones, conglomerates, shales and interbedded rhyolites are exposed.

Flat-lying Post-Triassic sandstones form a capping occasionally present on both the folded Carboniferous and the folded Triassic Beds. Small intrusives are present in the Devonian, Carboniferous and Triassic strata.

II. THE YARROL THRUST

The Lower Palaeozoic along the eastern margin of the Mundubbera district is represented by a white, pink or orange quartzite. This quartzite forms a series of high sharp hills and ridges, the western margin of which extends north-north-east from immediately east of Philpott railway station. Two high quartzite hills, representing klippes of the Lower Palaeozoic thrust sheet, are found in the north-eastern part of the Mundubbera district (co-ordinates 11.0, 16.0 and 12.7, 15.3 on the accompanying map).

The Lower Palaeozoic quartzite is here considered to be a thrust sheet which has, due to compressional forces from the east, moved westward over the eastern margin of the Mundubbera Syncline. It seems probable that this same thrust can be traced along the eastern margin of the Yarrol Basin for a considerable distance north of the Mundubbera district and it is here referred to as the Yarrol Thrust. Three lines of evidence indicate thrusting in the Mundubbera district:

(*a*) In all areas examined it was found that Devonian and Carboniferous strata were truncated and replaced by quartzites at the base of the quartzite hills. This is best shown in the klippe which is separated from the main thrust sheet by Pumpkin Hut Creek (co-ordinates 11.0, 16.0 on accompanying map). The Pumpkin Hut Mudstone is exposed at various localities on all sides of this high quartzite hill.

(*b*) The attitudes measured in the quartzite of the thrust sheet and klippes are at variance with those of the underlying units. The Devonian and Carboniferous strata on the east flank of the syncline generally strike north-east. The Lower Palaeozoic quartzites commonly strike north or north-west.

(*c*) At a number of localities a fractured and recemented quartzite occurs as cobbles at or near the base of the quartzite hills. This may well represent a fault breccia, but since the quartzite is commonly jointed and fractured and since no exposure of this breccia has been found in place, the evidence is inconclusive.

No quartzite cobbles or boulders were found any appreciable distance west of the present thrust sheet and associated klippes. This should not be taken as evidence that the original westward limit of the thrust sheet prior to erosion was much the same as it is now. There have been at least two extensive erosional cycles prior to the present one since thrusting of the Lower Palaeozoic, and it is impossible, with the evidence available, to estimate the original westward extent of the thrust sheet.

III. THE MULGILDIE FAULT SYSTEM

The western fault boundary of the Yarrol Basin in the Mundubbera district is less well understood than that on the east. Exposures are poor and scattered and lithologies on opposite sides of the fault less distinctive. Reid, who first described the Mulgildie Fault (1927) from the Mulgildie Coalfield, considered it to be a simple reverse fault dipping east. Dear (1959, p. 53) found what he considered to be a continuation of the Mulgildie fault in the Cania district to the north. Here, as in the Mulgildie Coalfield, the eastern block has moved up relative to the western one.

Faulting separates the Carboniferous Washpool Creek Formation from the folded Triassics. The western Triassic block has been dropped relative to the eastern Carboniferous block but it has not been possible to determine the nature of the fault, or more probably faults, operating between these two blocks. There appear to be a number of relatively small transverse faults striking generally east-west which have offset the principal north-south fault.

This zone of faulting, though not well defined, is considered to be a southern extension of the Mulgildie Fault along the western margin of the Yarrol Basin. Certain of the faults making up the Mulgildie Fault System in the Mundubbera district may be located with a high degree of confidence. Exposures at which faults may be readily mapped are found along the railway (co-ordinates 5.8, 27.8 on accompanying map) and in the overturned anticline in the north-western part of the district (co-ordinates 11.9, 28.3 on accompanying map).

The structural and stratigraphic relations in the area of Latza's farm, Portions 21 and 22, Parish of Malmoe, are particularly complex and ill-defined. Alluvial cover makes interpretation difficult. The fauna from the fossiliferous Riverleigh Limestone within the folded and faulted Latza Fault Block has been correlated with the Viséan D_2 fauna of England by Hill (1934, p. 105) principally on the occurrence of *Orionastrea lonsdaleoides* Hill and *Aulina simplex* Hill. To the north, west and south of Latza Block folded Triassic sandstones and conglomerates are partially exposed. The Washpool Creek Formation, here dated as probably Tournaisian, is found to the east of the block with an eastward dip. Dips within the Latza Block are to the west and north-west as are those in the surrounding folded Triassic Beds. The structural relations of the Latza Fault Block are poorly understood but it seems probable, due to the position of the block, that the structure is, at least in part, controlled by development of the Mulgildie Fault System. On the basis of faunal similarities it appears that the Latza Block has been dropped to its present position from a stratigraphic level approximately equivalent to the lower part of the Mundubbera Sandstone.

IV. THE MUNDUBBERA SYNCLINE

1. Major Structural Features

Between the Yarrol Fault on the east and the Mulgildie Fault System on the west Carboniferous strata are found conformably above Devonian strata in a broad synclinal trough becoming narrower southward. The synclinal axis extends from immediately east of Mundubbera to the north-north-east. It lies to the east of and generally parallel with Killala Creek and is concealed partially by alluvium and, in the northern part of the district, by horizontal Post-Triassic sandstones overlying the Carboniferous.

In the Mundubbera district beds lying on the western flank of the Mundubbera Syncline are much less steeply dipping than those on the east. Throughout the north-south extent of the beds on the western flank a dip of approximately 35° east is typical. On the eastern flank numerous dips of 60° and 70° west have been recorded. Although Burnett River alluvial deposits make interpretation difficult, lithologic and structural evidence suggest that, near the mouth of Killala Creek, in the southern part of the district, the east flank of the Mundubbera Syncline has been overturned toward the west.

2. Minor Structural Features

(a) *Folds.* A number of small anticlines and synclines have been mapped within the major Mundubbera Syncline. These normally do not exceed a mile or mile and a half in length.

A single anticlinal fold, too small for representation on the accompanying map, is exposed along the Mundubbera-Eidsvold road (co-ordinates 10.4, 24.1 on accompanying map) in the Spectre Creek Beds. With this single exception no minor folds have been found above the lowest Carboniferous units exposed in the area; the Washpool Creek Formation on the west and the Pumpkin Hut Mudstone on the east.

Minor folding within the area is best demonstrated in the north-western part of the district. Here, within the Washpool Creek Formation, a syncline and two anticlines, one of which is overturned toward the west, are exposed. Reversal of dip in the Washpool Creek Formation in the southern part of the district indicates a minor anticline, but in this area mapping is complicated by alluvial cover.

Four minor folds have been mapped to the west of Philpott Creek in the Pumpkin Hut Mudstone. Due to the non-resistant nature of these beds outcrops are scattered and the folds are not as well defined as those in the Washpool Creek Formation. A synclinal-anticlinal pair of folds is present immediately north of the Burnett River in the Pumpkin Hut Mudstone. A similar pair is found two miles further north. It is possible that these folds join with one another but present evidence on this point is not conclusive.

(b) *Faults.* A number of small transverse faults are present in the Washpool Creek Formation. Displacement of limestone lenses indicates that apparent horizontal displacement along these faults does not normally exceed 150 feet and is often much less. These small faults appear to belong to two systems striking generally north-east and north-west. The writer believes that these may be considered as shear faults formed by the same compressive force from the east which gave rise to the folds within the Washpool Creek Formation. If this is true, these faults must be considered as distinct from those transverse faults associated with the Mulgildie Fault System.

No faulting was found elsewhere in the Carboniferous with the exception of the Pumpkin Hut Mudstone where certain exposures, notably those along the Mundubbera-Gayndah road, indicate fracturing and the possible presence of minor faults.

V THE IGNEOUS INTRUSIVES

A few small intrusions are found scattered over the Mundubbera district. Three of these are in the eastern part of the district (co-ordinates 6.5, 17.6, 6.7, 16.3 and 12.5, 16.8 on accompanying map) and cut the Philpott Limestone, the First Branch Creek Sandstone, and the Pumpkin Hut Mudstone. These three bosses are all gabbro, commonly being somewhat altered.

Three additional intrusions are found in the western part of the district. The one occurring at co-ordinates 13.4, 28.8 (see accompanying map) is a biotite granite. T. S. Laudon (personal communication) reports granitic intrusions along the northern extension of the Mulgildie Fault System north of the Mundubbera district. It seems probable that the biotite granite is related to these and that these, in turn, are related to the large granitic intrusion near Eidsvold. At co-ordinates 12.0, 28.2 (see accompanying map) an olivine basalt occurs in a knob. Exposures are poor and the exact nature of the occurrence of this basalt is questionable A feldspar-quartz porphyry cuts folded Mesozoic sediments at co-ordinates 5.2, 29.4 (see accompanying map).

VI. STRUCTURAL DEVELOPMENT OF THE MUNDUBBERA DISTRICT

Late or post-Permian compressive forces acting from the east upon the marine basins of eastern Australia have been postulated by various authors (David, 1932, p. 73; Carey and Browne, 1938, p. 608; Hill, 1951, p. 20; etc.). These same forces are, in all probability, responsible for the major folding of the southern part of the Yarrol Basin and for the overthrusting of Lower Palaeozoic rocks found in the eastern part of the Mundubbera district. There is, however, structural and stratigraphic evidence indicating the possibility of local compressive movement immediately following deposition of the Washpool Creek Formation.

Evidence to be considered in evaluating this possible movement is: (*a*) the anticlinal and synclinal folds present in the Washpool Creek Formation and Pumpkin Hut Mudstone but not known in the immediately overlying beds; (*b*) the small shear faults present in the Washpool Creek Formation and the suspected faulting in the Pumpkin Hut Mudstone; (*c*) the occurrence of the O'Bil Bil Road Conglomerate, fine at the base but becoming rapidly coarser upward, immediately overlying the Washpool Creek Formation.

If a compressive force were active immediately after Washpool Creek time the anticlinal and synclinal folds in the Washpool Creek Formation and Pumpkin Hut Mudstone, as well as the shear faults in the Washpool Creek, could be an expression of the crustal shortening involved. The O'Bil Bil Road Conglomerate represents detritus from a rejuvenated source area, the Gogango High, to the west. The conglomerate indicates a vertical movement of the high relative to the Yarrol Basin. Such elevation of the high can be explained as a vertical expression of the same lateral compressive movements which structurally affected the Washpool Creek Formation and the Pumpkin Hut Mudstone. The above explanation is favoured by the writer.

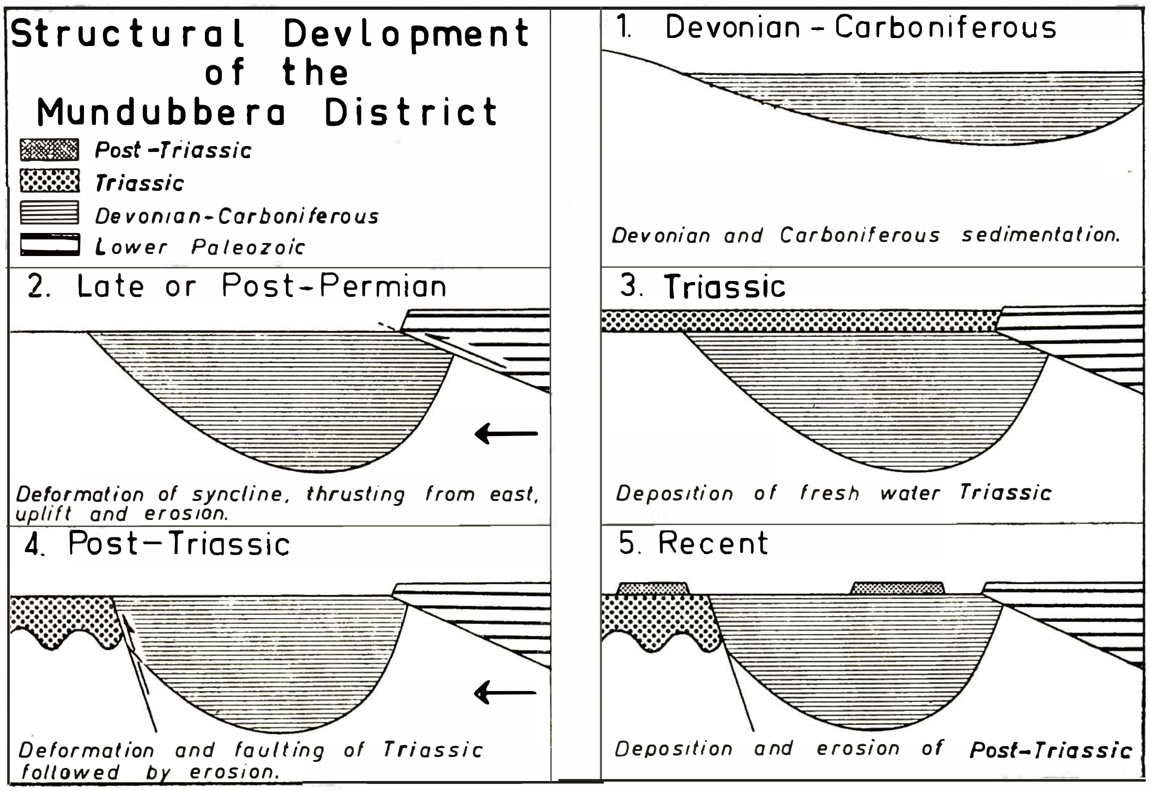

FIGURE 3.- Structural development of the Mundubbera district. The diagram illustrates the major structural movements which have affected the Yarrol Basin since deposition of the Carboniferous.

An alternative explanation refers all compressive movements to the late or post-Permian. If this is true, the distribution of minor folds and faults may be explained by assuming that the Washpool Creek Formation and Pumpkin Hut Mudstone, because they are exposed on the margins of the basin, were more affected by compressive forces than were the overlying formations. On the other hand, it is possible that the late or post-Permian compression was able to affect minor folding and faulting in the sediments of the Washpool Creek Formation and Pumpkin Hut Mudstone but not in those of the O'Bil Bil Road Conglomerate and the Mundubbera Sandstone. Consideration of the lithologic types involved leads the writer to believe this latter explanation unsatisfactory. In this alternative explanation as well as the previous one, it is necessary to postulate differential vertical movement of the Yarrol Basin and the Gogango High at the end of Washpool Creek time in order to account for the deposition of the O'Bil Bil Road Conglomerate. With such an explanation the vertical movement is not considered to be related to compressive forces.

Following, or as a result of, the late or post-Permian deformation the Mundubbera district was uplifted and subjected to erosion. Triassic fluviatile and lacustrine sandstones, conglomerates, shales, and rhyolitic flows were deposited. Post-Triassic compressive forces folded these beds. Associated faulting in the Mulgildie Fault System dropped the western folded Triassic block, thus protecting it from the post-Triassic erosion which followed.

In Post-Triassic time a series of coarse white quartzose sandstones, which in some parts of the Yarrol Basin are associated with basaltic flows, were deposited over the Mundubbera district. There has been no deformation since the deposition of these beds. Subsequent uplift and erosion has largely removed them but remnants of these beds remain as occasional flat-topped hills.

Figure 3 diagrams the most important features of the structural development of the Mundubbera district. It should be noted that the possible compressive movement at the end of Washpool Creek time is not shown in this figure.

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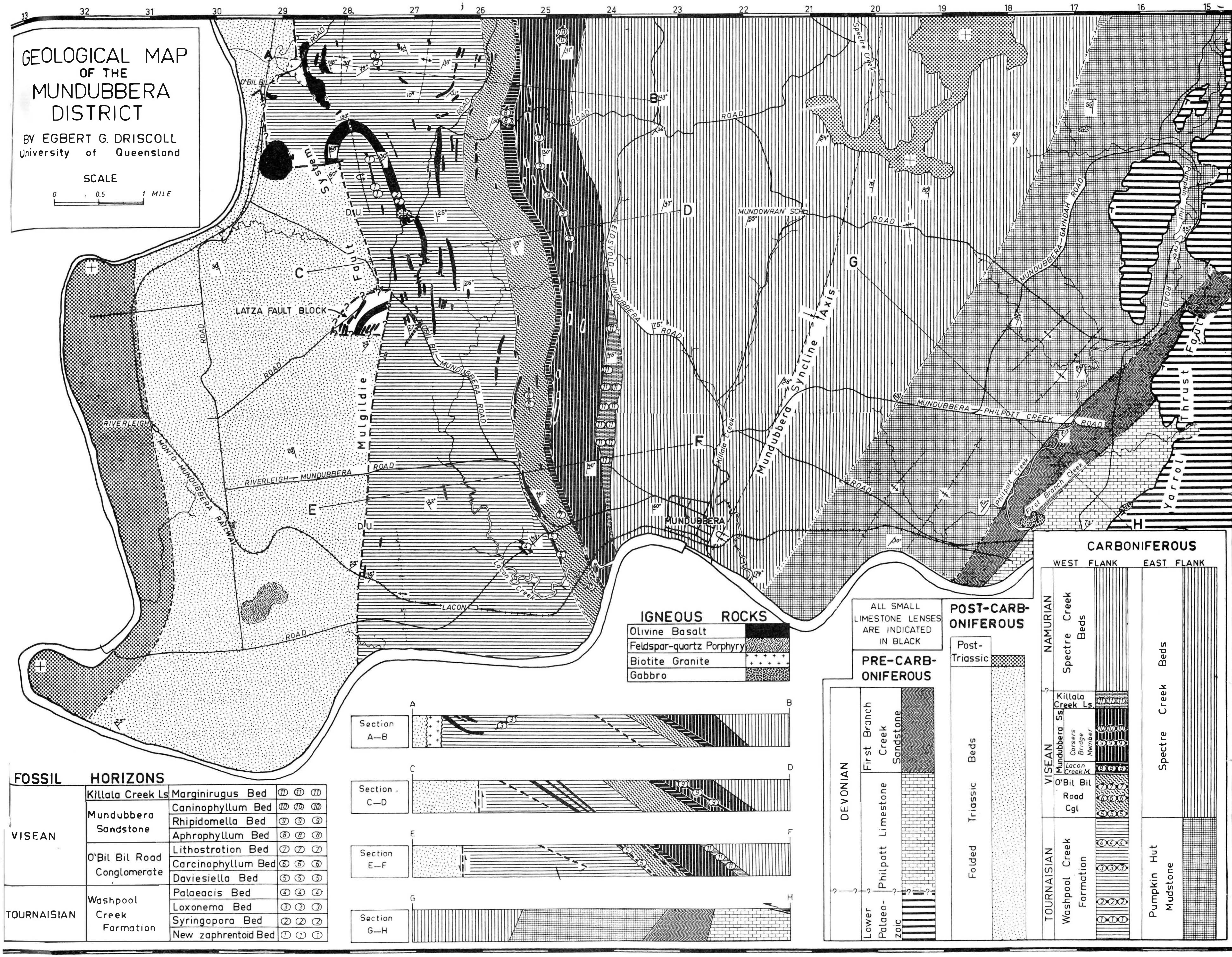
GEOLOGICAL MAP
OF THE
MUNDUBBERA
DISTRICT
BY EGBERT G. DRISCOLL
University of Queensland
SCALE
0 0.5 1 MILE
O'BIL BIL
Mulgildie Fault System
LATZA FAULT BLOCK
D.U.
RIVERLEIGH
RIVERLEIGH — MUNDUBBERA ROAD
MONTO — MUNDUBBERA RAILWAY
O'BIL BIL — MUNDUBBERA ROAD
EIDSVOLD — MUNDUBBERA ROAD
LACON ROAD
Lacon Creek
MUNDUBBERA
Killala Creek
Mundubbera Syncline Axis
MUNDOWRAN SCH.
Spectre Creek
MUNDUBBERA — GAYNDAH ROAD
MUNDUBBERA — PHILPOTT CREEK ROAD
Philpott Creek
First Branch Creek
Yarrol Thrust Fault
Pumpkin Hut
ROAD
A B C D E F G H
IGNEOUS ROCKS
Olivine Basalt
Feldspar-quartz Porphyry
Biotite Granite
Gabbro
ALL SMALL LIMESTONE LENSES ARE INDICATED IN BLACK
PRE-CARBONIFEROUS
DEVONIAN
First Branch Creek Sandstone
Philpott Limestone
Lower Palaeozoic
POST-CARBONIFEROUS
Post-Triassic
Folded Triassic Beds
CARBONIFEROUS
WEST FLANK
EAST FLANK
NAMURIAN
Spectre Creek Beds
VISEAN
Killala Creek Ls.
Mundubbera Ss
Corsers Bridge Member
Lacon Creek M.
O'Bil Bil Road Cgl
TOURNAISIAN
Washpool Creek Formation
Spectre Creek Beds
Pumpkin Hut Mudstone
Section A—B
Section C—D
Section E—F
Section G—H
FOSSIL HORIZONS
VISEAN
TOURNAISIAN
Killala Creek Ls — Marginirugus Bed — 11
Mundubbera Sandstone — Caninophyllum Bed — 10
Rhipidomella Bed — 9
Aphrophyllum Bed — 8
O'Bil Bil Road Conglomerate — Lithostrotion Bed — 7
Carcinophyllum Bed — 6
Daviesiella Bed — 5
Washpool Creek Formation — Palaeacis Bed — 4
Loxonema Bed — 3
Syringopora Bed — 2
New zaphrentoid Bed — 1