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Palaeozoic geology of the Warwick and Goondiwindi 1:250,000 Sheet areas,

Queensland and New South Wales

by

F. Olgers and P.G. Flood

PALAEOZOIC GEOLOGY OF THE WARWICK AND GOONDIWINDI 1:250,000 SHEET AREAS, QUEENSLAND AND NEW SOUTH WALES

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CONTENTS

APPENDICES

PLATES

FIGURES

SUMMARY

The Palaeozoic rocks of the Warwick and Goondiwindi Sheet areas form the northern part of the New England Fold Belt, comprising generally highly deformed eugeosynclinal sediments ranging in age from Ordovician to Permian, and the Permian to Lower Triassic granitic rocks of the New England Batholith. The fold belt is flanked to the south-west by the mildly deformed Permian-Triassic sequence of the Sydney Basin, and to the northwest, north and northeast are the undisturbed Mesozoic rocks of the Great Artesian and Clarence-Moreton Basins.

Deposition throughout the Devonian, Carboniferous and Permian was dominated by intermediate and acid volcanic activity. The sediments, which were all laid down in the sea, are dominantly made up of volcanic rock fragments; primary volcanic material is abundant in the Devonian and Permian sequences but forms only a minor part of the Carboniferous succession. Strong angular unconformities between the Devonian, Carboniferous and Permian rocks and probably also within the Permian sequence, the emplacement of vast quantities of granitic rock, and the prevalence of widespread volcanic activity, indicate that the area of the New England Fold Belt was, throughout the Palaeozoic, a highly mobile region within the Tasman Geosynclinal belt which did not become stabilized until the end of the Permian; it formed a physiographic high during the Mesozoic. The presence of a high (New England Arch) in this area during the Carboniferous is discounted.

The oldest rocks in the northern part of the New England Fold Belt belong to the Lower Devonian Silverwood Group. The group, which is estimated to be about 4,400 m thick, is subdivided into three formations which consist of (from the base upward): 1,800 m of fine-grained andesitic tuffs and silicified fine-grained sediments (Risdon Stud Formation), 1,400 m of coarse-grained andesitic pyroclastics and flows with some sediments, including fossiliferous limestone lenses, mainly near its top (Connolly Volcanics), and 1,200 m of sediments,

including olive-green mudstone, chert, lithic sandstone, limestone and intraformational conglomerate (Rosenthal Creek Formation). Neither the top nor bottom of the Silverwood Group is exposed, and the thickness of 4,400 m must be regarded as a rough estimate. Rich coral faunas in limestones near the top of the Connolly Volcanics and in the Rosenthal Creek Formation indicate a Lower Devonian age for the upper part of the group; the Risdon Stud Formation could at least partly range down into the Silurian.

Carboniferous rocks make up the greater part of the area west of the granite (Texas Beds) and they crop out in a narrow inlier in Permian rocks east of the batholith north of Drake (Emu Creek Formation) and around Mount Barney near the axis of the Clarence-Moreton Basin (Mount Barney Beds). The Texas Beds are a sequence of flysh-like regularly interbedded volcanolithic sandstone and mudstone with minor chert, jasper, intraformational conglomerate, intermediate volcanics and limestone containing Visean corals. The Texas Beds are intensely deformed and their thickness is not known although it is thought to be great. The beds probably unconformably overlie the Silverwood Group. The Emu Creek Formation, comprising at least 1500 m of lithic sandstone, siltstone and some conglomerate, and the Mount Barney Beds, which consist of at least 2100 m of feldspathic sandstone, shale, and minor conglomerate, are Upper Carboniferous. The units comprise the oldest rocks exposed in the Drake region and at Mount Barney and their relationship with the Lower Carboniferous Texas Beds is not known.

The Permian rocks in the northern part of the New England Fold Belt are mainly confined to small outliers, inliers and fault blocks; one large area of outcrop is east of the New England Batholith in the Drake-Rivertree region. In the Silverwood area south of Warwick, the Permian strata are confined to largely fault-bounded blocks within the Lower Devonian Silverwood Group. The sequence, which consists of conglomerate, sandstone, siltstone, pebbly sandstone and siltstone, and acid volcanic rocks, has yielded abundant marine macro fossils belonging to Faunas 2, 3A and 4 (<u>cf</u> Dickins et al., 1964). The small Permian outliers in the western part of the area are at Alum Rock, Pikedale, Terrica, Glenlyon, and Silver Spur and comprise conglomerate, pebbly sandstone and siltstone with minor volcanic rocks. Fossils belonging to Fauna 2 were collected from most of these outliers. The Permian sequence between Drake and Rivertree, which is at least 3,300 m thick, is subdivided into 4 units which consist of (from the base upward): 2,400 m of conglomerate, mudstone and lithic sandstone (Paddys Flat Formation), 300 m of mudstone (Razorback Creek Mudstone), 450 m of coarse-grained pyroclastic rocks and flows with some sediments (Drake Volcanics) and 150 m of mudstone (Gilgurry Mudstone). The sequence has yielded fossils belonging to Faunas 2 and 4. The Permian succession unconformably overlies the Carboniferous and Lower Devonian rocks; the unconformity is well exposed in the Drake region, northwest of Silver Spur, near Terrica and Alum Rock homesteads and in the Silverwood area south of Oaklands homestead.

INTRODUCTION

The Palaeozoic rocks of the Goondiwindi and Warwich Sheet areas on the border of Queensland and New South Wales were mapped from June to November 1968 and during April and June 1969 by the authors. A.D. Robertson of the Geological Survey of Queensland examined the plutonic rocks of the Queensland portion of the New England Batholith. The Mesozoic rocks of the Warwick and Goondiwindi Sheet areas were mapped during 1968 by Exon, Reiser, Casey and Brunker (1969) and Medvecky, (in prep).

Aerial photographs at a scale of approximately 1:85,000 taken by Adastra Airways Pty Ltd in 1963, were used. Photographs at a scale of approximately 1:30,000 are also available. Geological information was plotted on compliation sheets at 1:75,000 scale prepared by the Royal Australian Survey Corps.

The climate of the area is sub-tropical. The mean annual rainfall ranges from 1000 mm in the east to about 600 cm in the west, more than half of which falls in the six months from September to February. Tabulam, Wallangarra and Texas have average annual rainfalls of 980, 750, and 670 mm respectively. The mean maximum temperature varies from 14°-$16^{\circ}C$ in mid-winter, to 27°-$30^{\circ}C$ in mid-summer. Frosts occur in the granite belt (surface elevation between 900 and 1200 m), and usually the first frost occurs in early April and the last in late October. Snow falls occasionally in the Stanthorpe-Wallangarra area.

The granite belt, in the centre of the area, is a long-established fruit growing district. Clearing is continually increasingthe area under cultivation, and trial experiments at grape growing are proving successful.

Fig. 1 - General view of the rugged country east of the granite belt looking northeast from the Boorook-Rivertree track, 12 km south of Rivertree. The hills and ridges in the foreground and middle-distance consist of the Permian Drake Volcanics and the peaks and ranges on the horizon are part of the Main Range consisting of Tertiary volcanics.

(Neg. No. M/957).

The area west of the granite belt is dominantly a sheep grazing area. Large areas have been cleared of timber, but most pastures are natural on account of the unfavourable soils. All properties rely on surface water.

The region east of the granite belt experiences a high annual rainfall, and the rich volcanic soils support dense rain forests, which are the basis of the local timber industry. Grazing of cattle is also important in the area.

The alluvial flats of the Condamine and Dumaresq Rivers and Macintyre Brook are the sites of extensive cultivation for forage, grain crops, and tobacco. The proposed Border Rivers Development Scheme of the Water Conservation and Irrigation Commission of New South Wales will give impetus to the already established tobacco growing industry of the Texas-Yetman area, and the Coolmunda Dam, on Macintyre Brook 16 km east of Inglewood, should be capable of supplying ample water for irrigation purposes to the area west of Inglewood.

Previous Investigations

The earliest geological work in the area was done by Richards and Bryan (1923, 1924a) in the Silverwood area south of Warwick, and by Andrews (1908) and Voisey (1936, 1939) in the Drake region of New South Wales. Wade (1941) and Lucas (1959, 1960) mapped most of the Palaeozoic rocks west of the granite. The nomenclature used by the earlier workers has been set out in Figure 15.

Physiography

The Palaeozoic rocks of the area give rise to country ranging from gently undulating hills to extremely rugged mountainous terrain. The area cannot readily be subdivided into distinctive physiographical units, and geological units are not characterized by diagnostic physiographic features. This is particularly so in the rugged eastern part of the area where Permian sediments, including soft mudstone and hard volcanic rocks, Carboniferous strata, and granite cannot be distinguished on the aerial photographs. Relief in this eastern region is in places at least 600 m (Figs. 1 & 2).

The central part of the area, 50 to 55 km wide and coinciding largely with the outcrop of the New England Batholith, is referred to as the granite belt and is part of the Great Dividing Range. A notable feature of the landscape is its general maturity, but in places it is interrupted by areas of rugged granite tors, which are most conspicuous in the area of the National Park east of Ballandean. Along the western margin of the granite belt, the country falls away gradually and the contact with the adjacent sediments is rarely marked. To the east, however, the country falls abruptly away and the margin is deeply dissected by tributaries of the Cataract, Maryland, and Boonoo Boonoo Rivers.

The sediments to the north and west of the granite belt are steeply dipping, and resistant beds of jasper and massive sandstone produce prominent strike ridges which decrease in magnitude southward where the country is gently undulating and hilly, except in the vicinity of Sundown homestead, where the Dumaresq River is entrenched in a prominent gorge up to 300 m deep. The low-lying, gently undulating country about Pikedale, Terrica, and Glenlyon homesteads and near Silver Spur is related to the soft, thin-bedded Permian sediments.

The Dumaresq-Macintyre, Condamine, and Clarence River systems rise in the region. The divides between these systems are formed by the Great Dividing and Herries Ranges.

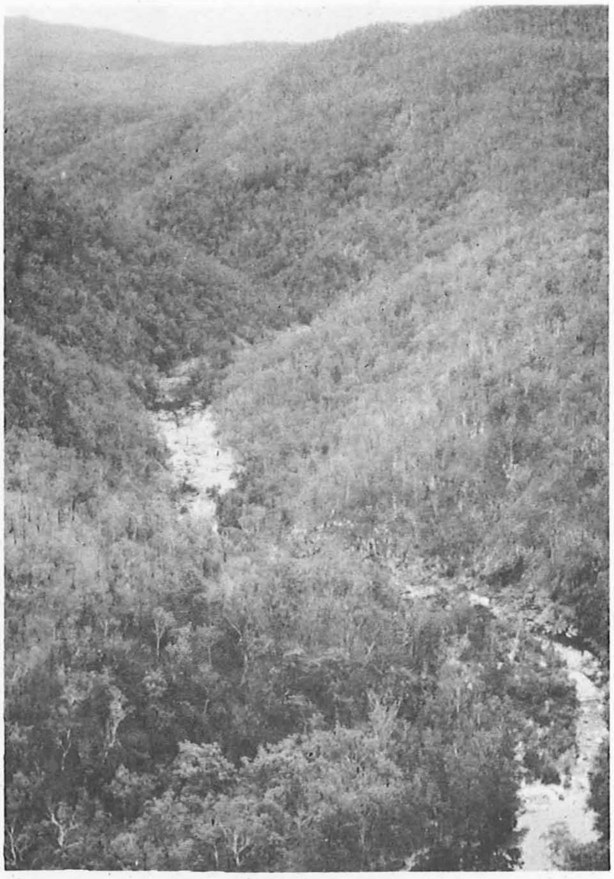

Fig. 2 - View from Red Rock looking north along the Cataract River. Relief in this deeply dissected area is at least 300 metres. (Neg.No.GA/2413)

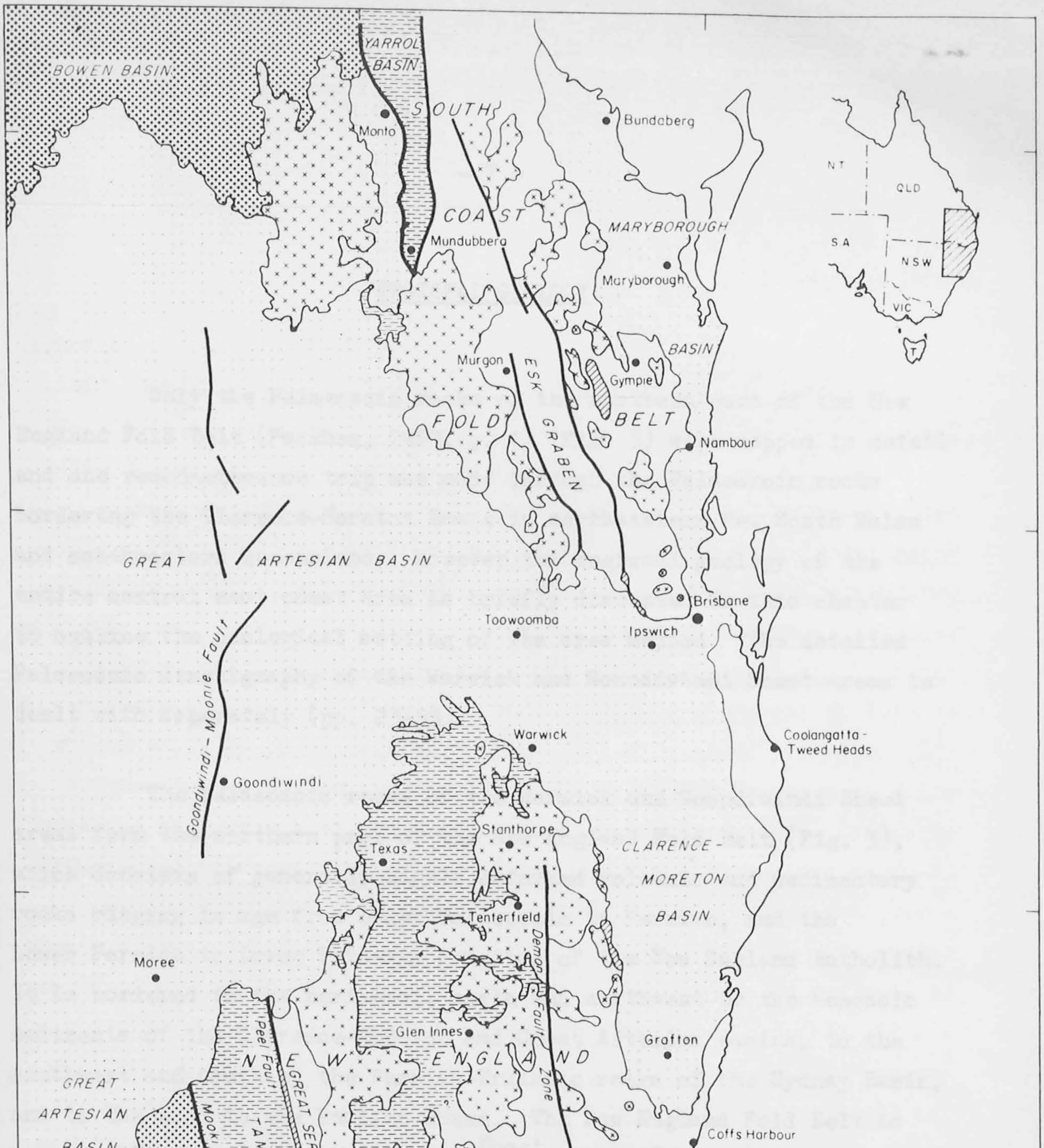

Fig. 3 - STRUCTURAL ELEMENTS, NE NEW SOUTH WALES AND SE QUEENSLAND

REGIONAL GEOLOGY

Only the Palaeozoic rocks of the northern part of the New England Fold Belt (Packham, 1969, p. 1) (Fig. 3) were mapped in detail and one reconnaissance trip was made through the Palaeozoic rocks bordering the Clarence-Moreton Basin in northeastern New South Wales and southeastern Queensland; however the regional geology of the entire central east coast area is briefly discussed in this chapter to outline the geological setting of the area mapped. The detailed Palaeozoic stratigraphy of the Warwick and Goondiwindi Sheet areas is dealt with separately (pp. 23-55).

The Palaeozoic rocks of the Warwick and Goondiwindi Sheet areas form the northern part of the New England Fold Belt (Fig. 3), which consists of generally highly deformed volcanic and sedimentary rocks ranging in age from Lower Palaeozoic to Permian, and the Lower Permian to Lower Triassic granites of the New England Batholith. It is bordered to the northeast, north and northwest by the Mesozoic sediments of the Clarence-Moreton and Great Artesian Basins, to the southwest and south by the Permian-Triassic rocks of the Sydney Basin, and to the east is the Pacific Ocean. The New England Fold Belt is practically connected with the South Coast Fold Belt* (Fig. 3) by a narrow belt of Palaeozoic rocks along the New South Wales north coast and Queensland south coast. In the Brisbane area, the Palaeozoic rocks are overlapped by Mesozoic strata which form the connection between the Mesozoic Maryborough Basin, which lies along the eastern margin of the South Coast Fold Belt, and the Clarence-Moreton Basin.

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* The area north-northwest of Brisbane, largely made up of Palaeozoic rocks but also including some deformed Mesozoic strata (Kin Kin Phyllite), bounded to the east, south and west by the undeformed Mesozoic sediments of the Maryborough, Clarence-Moreton and Great Artesian Basins. The South Coast Fold Belt covers nearly the same area as Hill's (1951) South Coastal Structural High.

Lower Palaeozoic

The oldest rocks in the region are the Rocksberg Greenstones and Bunya Phyllite (Bryan & Jones, 1950) northwest of Brisbane, the Nambucca Beds (Voisey, 1934b) on the New South Wales north coast, and the Gladstone Group (Kirkegaard, Murray & Shaw, in prep.) which crops out along the eastern margin of the Yarrol Basin. The Rocksberg Greenstones are the oldest; they are metamorphosed basic volcanics, possibly olivine basalts and related rocks (Mathews, 1954), which are conformably overlain by and interfinger with the fine-grained phyllitic rocks of the Bunya Phyllite. The Bunya Phyllite is lithologically similar to the Nambucca Beds; they consist of alternating micaceous and quartzitic bands with innumerable parallel bands of milky quartz which were formed by metamorphic differentiation and are situated along the original cleavage planes. This can be observed in outcrops in which the quartz bands are widely spaced and the relic bedding, at a very acute angle to the bands, has been preserved. The intense deformation of the rocks is due to buckling and movement upon a system of strain slip cleavage developed during a later tectonic event (Figs. 4 & 5). The Nambucca Beds are correlated with the Bunya Phyllite because of close tectonic, metamorphic and lithological similarities. The Gladstone Group, which crops out along the entire eastern margin of the Yarrol Basin as far south as Mundubbera, consists of quartzose sandstone, mudstone, chert and limestone. The rocks are intensely deformed and have been subjected to two periods of regional deformation; three events have been recognized locally (Kirkegaard et al., in prep). The most striking feature these Lower Palaeozoic rocks have in common that distinguishes them from the Devonian and younger Palaeozoic rocks of the region is the abundance of quartz. The quartz content of sandstones of the Gladstone Group is on the average about 70% whereas 5-10% quartz is the maximum observed in the Devonian and younger sediments (Fig. 11).

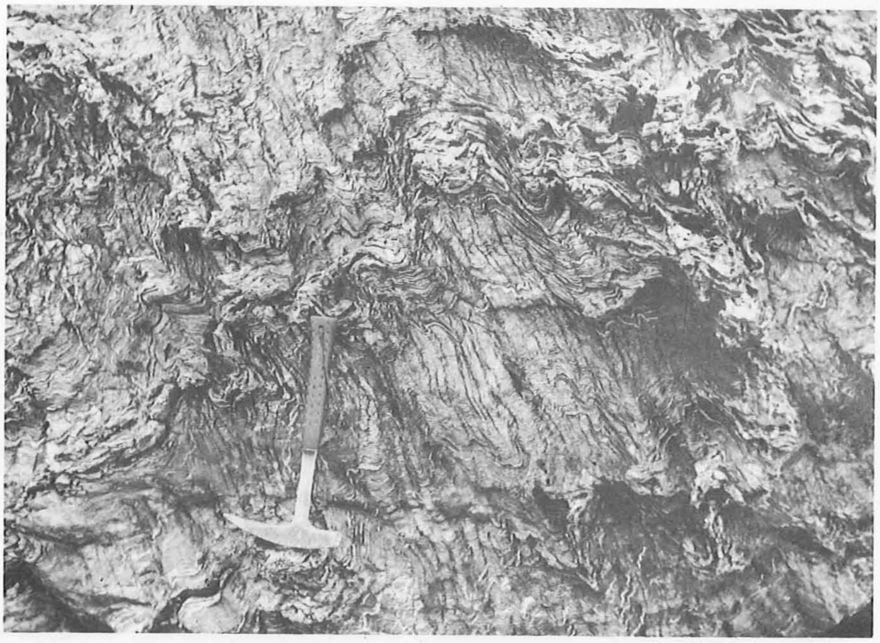

Fig. 4 - Highly contorted Nambucca Beds at Nambucca consisting of laminae of mica schist and milky quartz. The quartz bands, which were formed by metamorphic differentiation, lie along first-order cleavage planes. They were contorted by strain-slip cleavage and small-scale crumpling between individual cleavage surfaces during a second period of deformation.
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Fig. 5 - As above; showing the great variation in thickness of the quartz bands from a trace to several centimetres. It is in outcrops as the one shown, in which the quartz bands are widely spaced, that the relic bedding, at an angle to the quartz bands, can be observed. This is not visible in the photograph. (scale is a pencil, 15cm long) (Neg.No.M/910)

The age of the Lower Palaeozoic rocks will not be known until fossils are found; they are thought to be Ordovician or Silurian and to have been laid down in the Tasman Geosynclinal belt before the Bowning Orogeny when the region was mobilized and eugeosynclinal sedimentation with a very high volcanic and volcanolithic content commenced. Most of the eastern region, where the Lower Palaeozoic rocks crop out, did not become stabilized until the end of the Palaeozoic and continued to receive eugeosynclinal deposits. The oldest known fossils in the entire region are Ordovician; they were collected from the Trelawney Beds (Phillip, 1966) and from the lower part of the sequence of rocks mapped as 'Tamworth Group' (Packham, 1969, p. 231) and occurring in small fault blocks near the Peel Fault 15 km southeast of Tamworth.

Palaeozoic

Palaeozoic rocks, probably largely of Devonian or Carboniferous age, crop out along the western, southern and eastern margins of the Clarence-Moreton Basin (Fitzroy Beds; Kenny, 1937) extending northward into the Brisbane area (Neranleigh-Fernvale Group; Bryan & Jones, 1950).

At Jackadgery, 25 miles west-northwest of Grafton, the sequence comprises steeply dipping thinly interbedded sandstone and siltstone with several lenses of limestone from which poorly preserved fossils including Favosites and Tryplasma sp, indicating a Silurian or Lower Devonian age, have been collected (Whiting, 1951). These fossils provide the only clue to the age of the rocks flanking the Clarence-Moreton Basin.

Along the New South Wales coast from Sawtell (6.5 km south of Coffs Harbour) in the south to Tweed Heads in the north, are intermittent outcrops of steeply dipping tightly folded and in places isoclinally folded Palaeozoic strata which make up the eastern margin of the Clarence-Moreton Basin. They all consist of well bedded regularly interbedded sandstones and siltstones (Figs. 6-10). The sandstones consist largely of volcanic rock fragments and feldspar; quartz is a minor constituent (Fig. 11). They are generally graded and chips of siltstone are in places present. Slump structures have been noted.

In southeast Queensland, the regularly interbedded sandstone-siltstone sequence gives way to massive sandstones, individual beds attaining a thickness of 300 m or more and containing siltstone fragments of pebble size or larger. Beds containing well rounded boulders of quartzite and granite up to 1 m in diameter are also present (Denmead in Hill & Denmead, 1960, p. 136). Similar boulder beds occur in the Upper Carboniferous Emu Creek Formation and Mount Barney Beds to the west.

The Neranleigh-Fernvale Group, which unconformably overlies the Bunya Phyllite in the Brisbane area, and the Fitzroy Beds, which are faulted against the Nambucca Beds at Nambucca, are lithologically similar to the Devonian and Carboniferous rocks of the northern part of the New England Fold Belt and they have been deformed to the same extent, in contrast to the much greater deformation suffered by the Bunya Phyllite and Nambucca Beds. The Palaeozoic rocks are on these lithological and tectonic grounds tentatively correlated with the Devonian and Carboniferous rocks of the northern New England Fold Belt.

Lower and Middle Devonian

The remnants of the Lower and Middle Devonian eugeosyncline in the central part of the Tasman Geosynclinal belt are preserved in the Tamworth Basin (see p.13) (Tamworth Group; Crook, 1961a), in the northern part of the New England Fold Belt south of Warwick (Silverwood Group; Richards & Bryan, 1923), in the basement below the Yarrol Basin (Mount

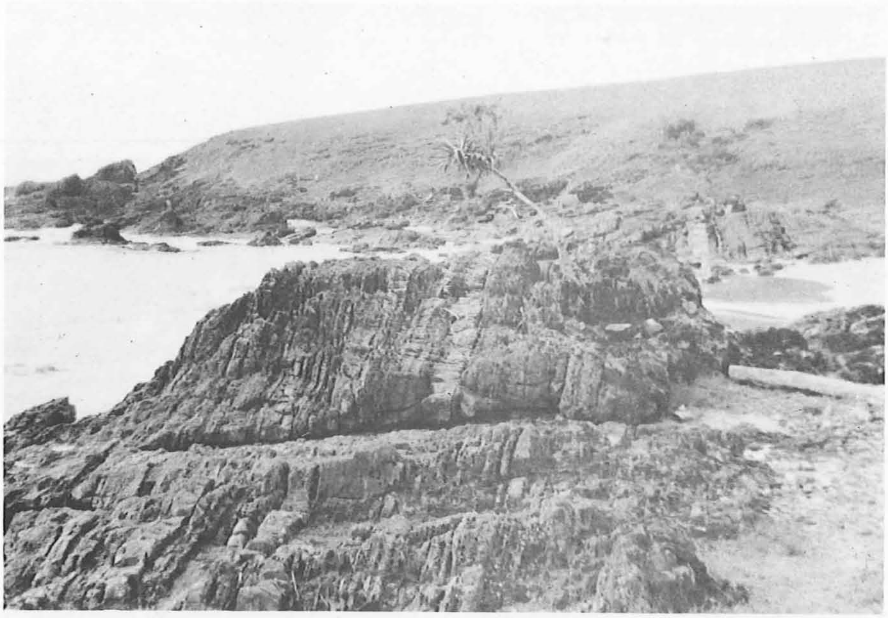


Fig. 6 - Vertical Palaeozoic strata, Green Bluff, 11 km north of Coffs Harbour. (Neg.No.M/911)

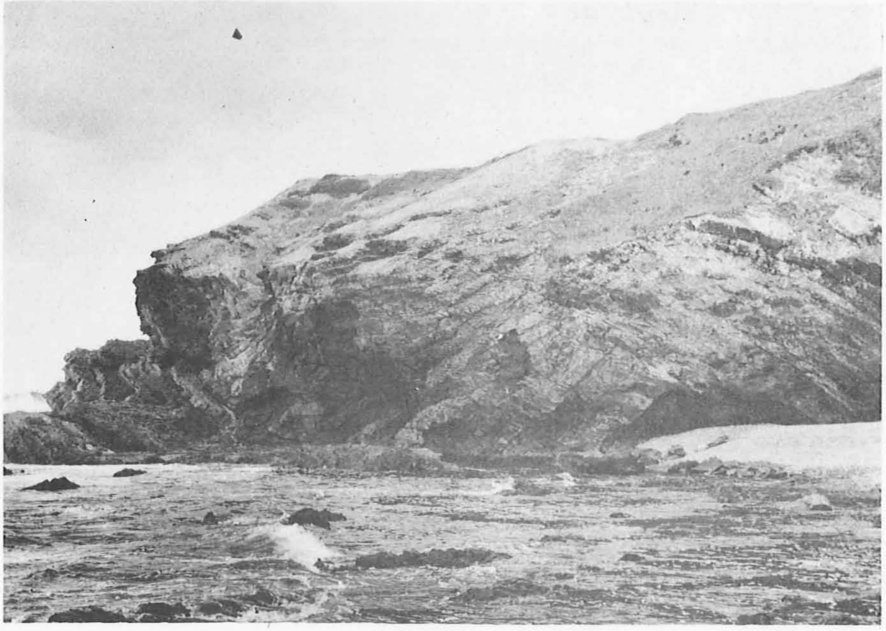
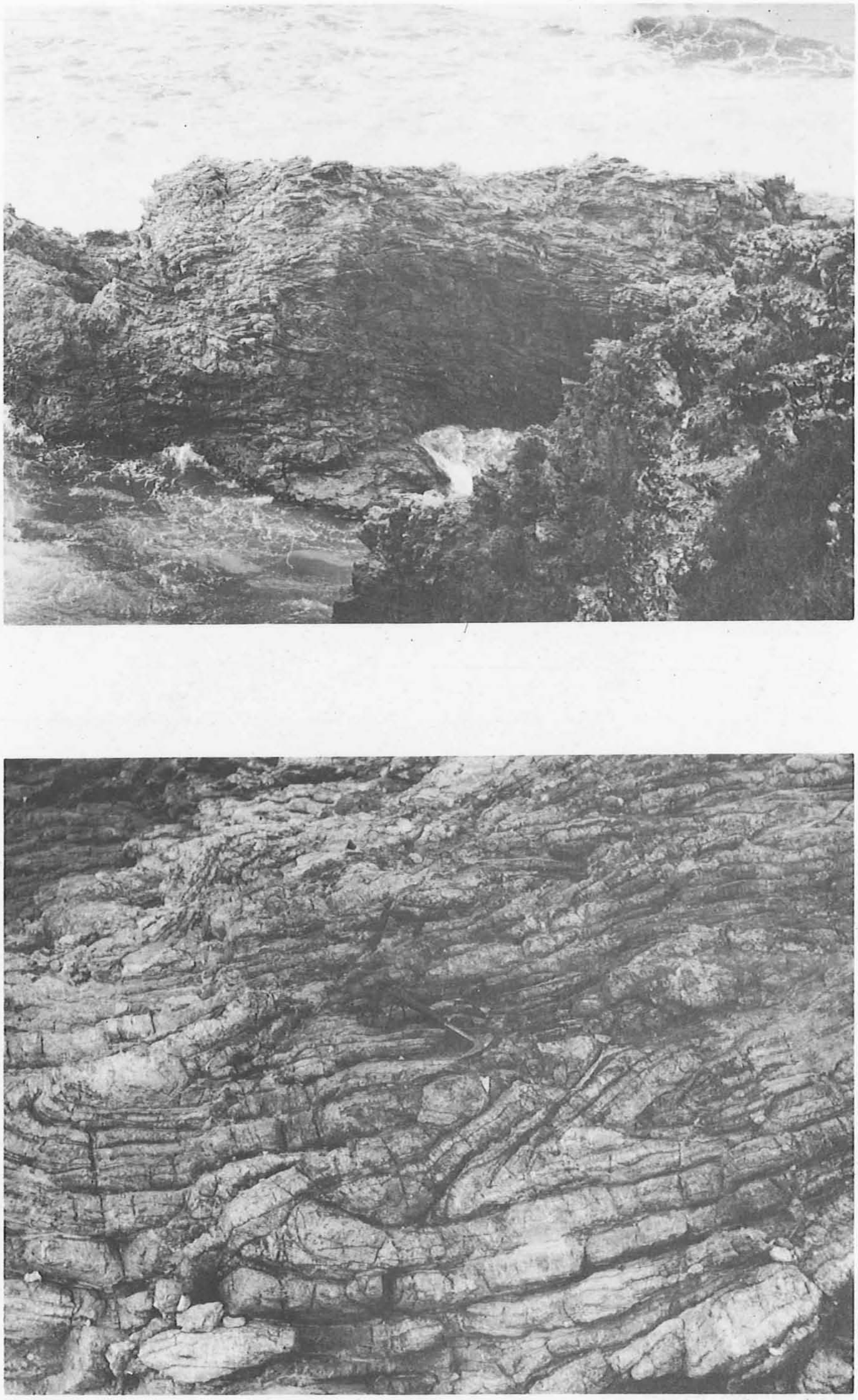


Fig. 7 - Gently folded interbedded Palaeozoic sediments, Brooms Head, 32 km southeast of Maclean. (Neg.No.M/910)



Figs. 8a,b - Isoclinally folded Palaeozoic sediments, Red Rock headland, 16 km north of Woolgoolga.

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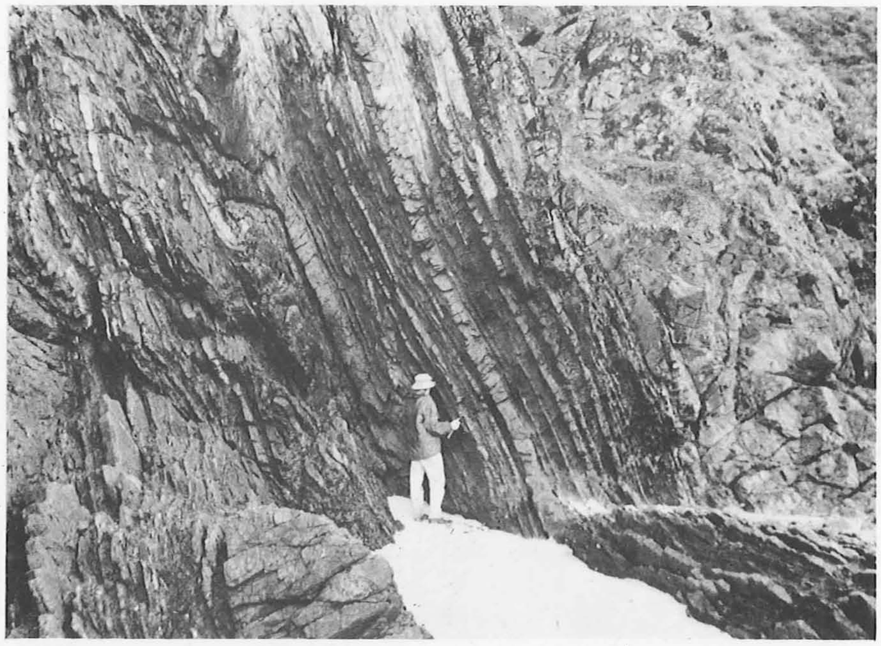
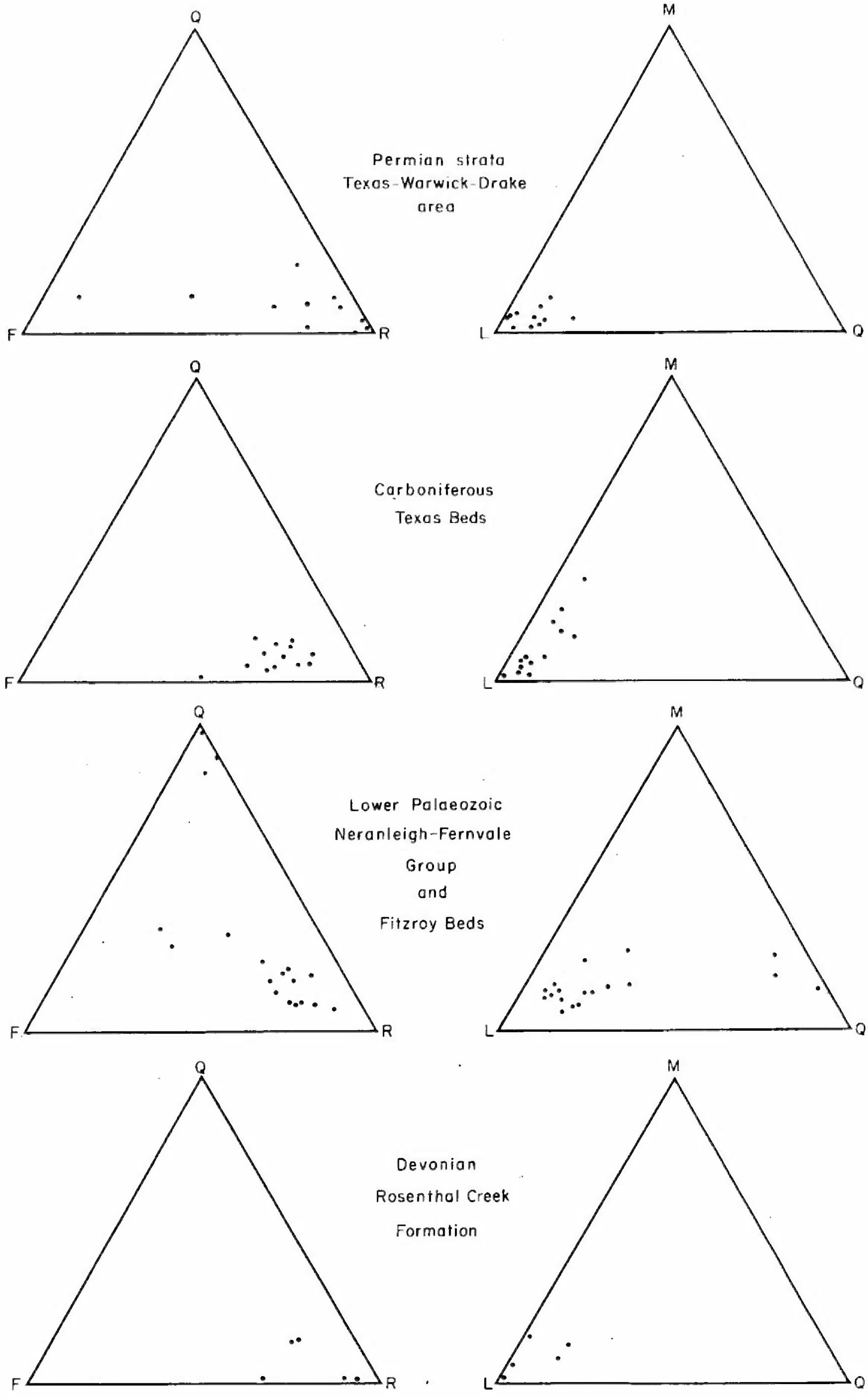


Fig. 9 - Palaeozoic interbedded sandstone-siltstone sequence, Cape Byron, Byron Bay. (Neg.No.M/910)

Fig. 10 - Interbedded Palaeozoic sediments, Schnapper Rocks, Tweed Heads. (Neg.No.M/910)



Q = quartz ; F = feldspar ; M = matrix ; R = rock fragments ; L = rock fragments + feldspar

Fig. 11 – COMPOSITION OF SOME SEDIMENTARY ROCKS IN SOUTHEAST QUEENSLAND AND NORTHEAST NEW SOUTH WALES

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Holly Beds and equivalents; Kirkegaard & Dear, 1968) and in small areas of outcrop in the region of the Anakie High (Dunstable Formation and equivalents; summarized in Olgers, 1969). The Palaeozoic rocks in northeastern New South Wales (Fitzroy Beds) and in southeastern Queensland (Neranleigh-Fernvale Group) are also part of this sequence or they belong to the Upper Devonian to Carboniferous succession (see p. 9).

The miogeosynclinal sequence, which was laid down farther to the west, is preserved in the Adavale Basin in central Queensland and in central and southeastern New South Wales.

The Lower Devonian Silverwood Group, which is about 4,400 m thick, has been subdivided into three units (Fig. 17) which consist from the base upward of 1,800 m of fine-grained andesitic tuffs and silicified fine-grained sediments (Risdon Stud Formation), 1,400 m of coarse-grained andesitic pyroclastics and flows with some sediments including fossiliferous limestone lenses, mainly near its top (Connolly Volcanics), and 1,200 m of sediments including mudstone, chert, volcano-lithic sandstone, limestone and intraformational conglomerate (Rosenthal Creek Formation). Rich coral faunas in the limestones near the top of the Connolly Volcanics and in the Rosenthal Creek Formation indicate a Lower Devonian age for the upper part of the Silverwood Group (Appendix 4).

East of Fernvale, 32 km northwest of Brisbane, are andesitic crystal tuffs which closely resemble the rocks of the lower part of the Silverwood Group. They are to the west and east adjoined by Permian strata, including tuffs, and they have tentatively been mapped as part of the Permian sequence (Fig. 14), however they may be Devonian.

The Tamworth Group was laid down farther to the southwest. The group, which in the Tamworth-Nundle district has a maximum observed thickness of 2,400 m, consists mainly of argillites, lithic sandstone, greywacke and conglomerate with several thick richly fossiliferous lenses of biohermal and biostromal limestone. Near the base of the succession is a sequence of volcanic rocks up to 300 m thick. The source area throughout the period of deposition of the Tamworth and Silverwood Groups was dominantly made up of andesitic volcanic rocks, and the sequence was probably largely laid down in a shallow sea.

In the Rockhampton region of central Queensland are extensive areas of outcrop of Lower and Middle Devonian rocks which are part of the basement to the Upper Devonian to Carboniferous Yarrol Basin sequence; they consist largely of pyroclastic rocks with some flows and sediments including lenses of richly fossiliferous limestone.

Small isolated areas of outcrop of lower Middle Devonian andesitic volcanics and coralline limestone overlie the Lower Palaeozoic rocks of the Anakie High in central Queensland.

The andesitic volcanic rocks that have been struck in a large number of oil exploration wells in the Great Artesian Basin west of the New England Fold Belt have in the past invariably been referred to as the Carboniferous Kuttung 'Series', however they could partly be equivalent to the andesitic volcanics of the Lower Devonian Silverwood and Tamworth Groups.

Upper Devonian and Carboniferous

The distribution of the Upper Devonian and Carboniferous rocks and the Upper Devonian - Carboniferous palaeogeography are shown in Figures 12 and 13. The pattern of deposition was drastically altered in the Middle Devonian by the Tabberabberan Orogeny which affected most of the region. A geanticline rose in east-central Queensland and central New South Wales separating a region in the west, which was to receive a great thickness of quartzose terrestrial sediments in the Upper Devonian and Lower Carboniferous, from a dominantly marine environment in the east, which continued to receive large quantities of andesitic detritus. The western and eastern regions have in the past been referred to as the Lachlan and New England Geosynclines respectively, however these names are not used here because it is preferred not to refer to parts of the Tasman Geosyncline, during a particular period of time, as geosynclines.

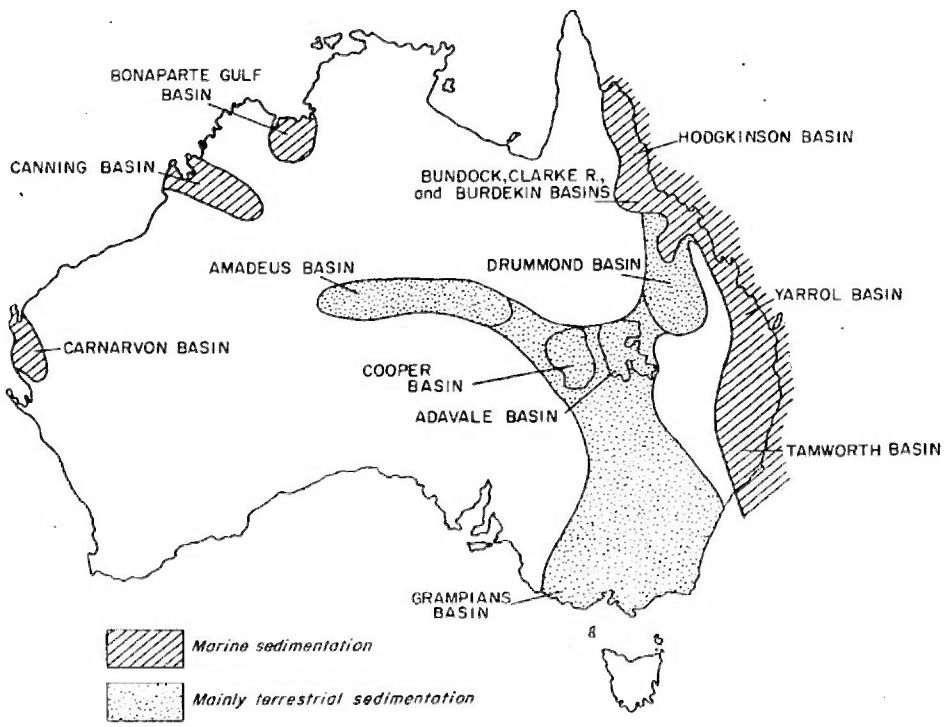

Fig. 12 - Upper Devonian - Lower Carboniferous palaeogeography

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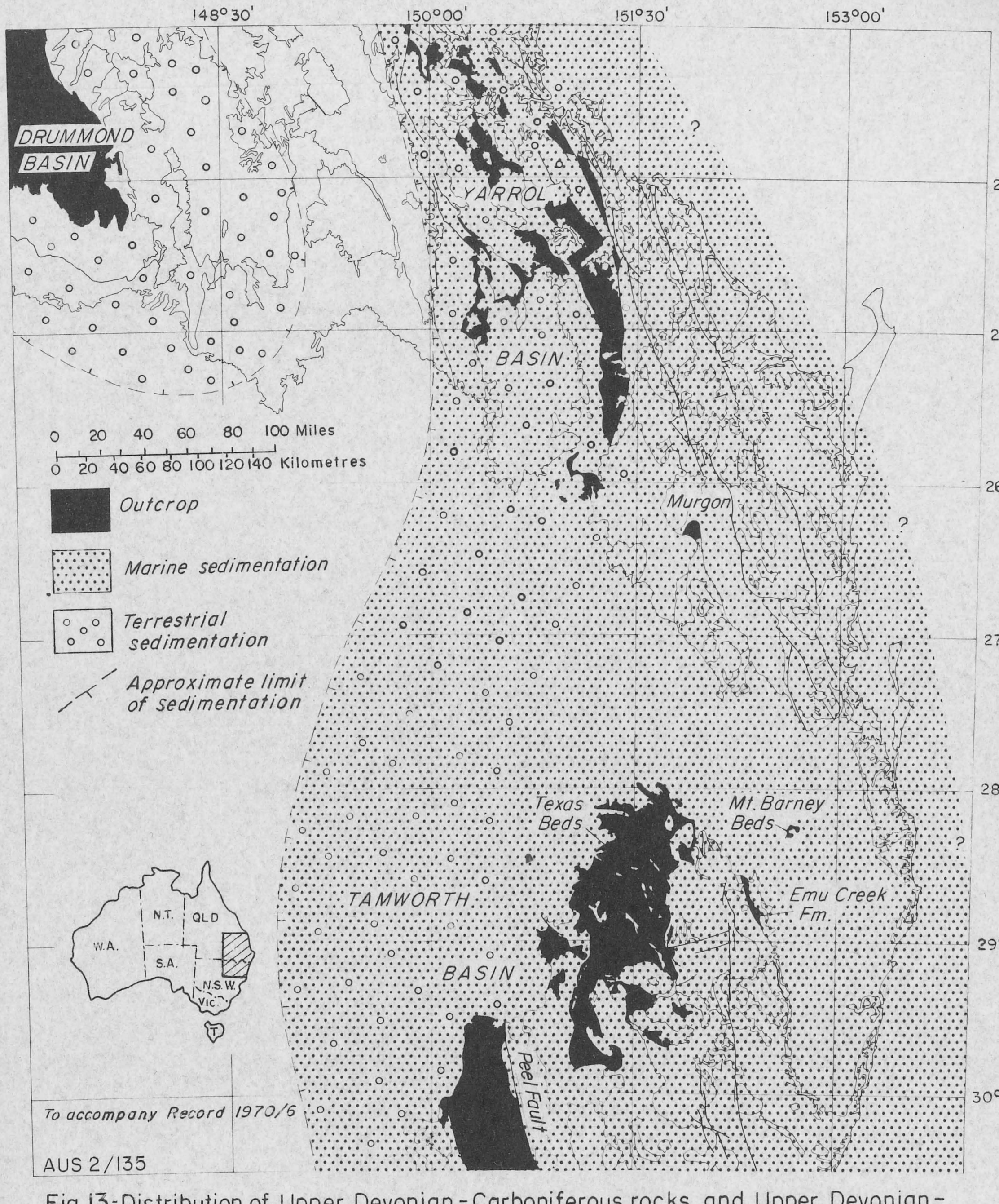


Fig.13-Distribution of Upper Devonian-Carboniferous rocks, and Upper Devonian-Carboniferous palaeogeography in southeastern Queensland and northeastern New South Wales. (For explanation of outcrop pattern, see Plate 4).

The terrestrial sedimentation in central Queensland has been fully described by Olgers (1969). About 12,000 m of dominantly fluviatile sediments, including quartz sandstone, quartz pébble conglomerate and mudstone were transported into a large intermontane basin, the Drummond Basin, by a north-flowing river system. Brief marine incursions from the north, where the terrestrial sedimentation merged with the marine deposition, may have occurred (Fig. 12). Sedimentation in the western region came to an end in the middle Carboniferous.

The dominantly marine sedimentation in the east took place in a large basin covering the eastern margin of the present-day continent (Fig. 12). Remnants of the sequence crop out in the north (Yarrol Basin) and in the south (Tamworth Trough: Crook, 1961a; Tamworth Basin in this text); the central region is covered by the Mesozoic sediments of the Great Artesian Basin, however probable equivalents of the succession have been recorded in numerous oil exploration wells. The eastern margin of the basin of sedimentation was considered to closely approximate the eastern structural margins of the Yarrol and Tamworth Basins, and the land area to the east has been referred to as the South Coastal Structural High (Hill, 1951), New England High (Brown et al., 1968, p. 156) and New England Arch (Campbell in Packham, 1969, p. 259).

The evidence for the existence of the New England Arch was summarized by Campbell (op. cit.): ......" In the New England area, Crook (1961b) has shown that the Goonoo Goonoo Mudstone thickens toward the Peel Fault where it is cut off. No undoubted equivalents of these rocks are known to the east .... but there is a thin sequence at Texas extending down to Ashford, along the eastern side of the Peel Fault line. This together with the strong angular unconformity between the Devonian and Permian in the Stanthorpe region (Lucas, 1960, p. 166), and the absence of Lower Carboniferous rocks at Mount Barney and Drake suggests a broad tectonic land extending from the Stanthorpe-Warwick area well to the south of Uralla .... It is proposed to call this feature the New England Arch" ....

Mapping of the Palaeozoic rocks in the Drake-Warwick-Texas area by the authors has shown that there is no evidence for a 'high' or arch in this region in the Upper Devonian or Carboniferous, and the following remarks can be made in relation to the evidence put forth by Campbell (op. cit.):

i) The northern part of the New England Fold Belt consists largely of Upper Devonian(?) to Carboniferous Texas Beds. The thickness of the unit is unknown but thought to be great; the Goonoo Goonoo Mudstone, which crops out farther to the south, consists of conglomerate, sandstone, greywacke, mudstone and limestone and is up to 2,700 m thick, could be equivalent to any part of the Texas Beds, and there is no basis for the assumption that easterly thinning toward a 'high' occurred.

ii) The Upper Devonian(?) to Lower Carboniferous sequence is not present in the Silverwood area south of Warwick where Permian strata unconformably overlie the Lower Devonian Silverwood Group. It has been established that orogenic movements occurred in the northern part of the New England Fold Belt at the end of the Carboniferous (see p. 18) and that considerable erosion took place before the Permian sediments were laid down. The absence of the Upper Devonian(?) to Carboniferous sequence does not necessarily indicate that the sequence was originally not laid down in this region and it cannot be concluded that the Silverwood area was part of a 'high'.

iii) The oldest exposed rocks in the Drake region of New South Wales and around Mount Barney in Queensland are Upper Carboniferous, however it cannot be assumed that the Upper Devonian(?) to Carboniferous strata were not laid down in these areas and are not preserved in the subsurface.

In addition it may be pointed out that there is no evidence to suggest that any sediments were derived from the east from the New England Arch, in fact all current measurements indicate a westerly source area (McKelvey & White, 1968). Recent work in the Yarrol Basin has shown that there is no evidence to suggest that the area east of the basin was not submerged during the Upper Devonian and Lower Carboniferous

(Kirkegaard & Shaw, pers. comm.), and the presence of Carboniferous rocks at Murgon (Fig. 13) on the supposed 'high' supports this view.

From the foregoing it can be seen that there is no evidence for an arch or high in this region during the Upper Devonian and Carboniferous, and the authors are of the opinion that the sedimentation took place in a large basin that was 'open' to the east and extended northward to include the Hodgkinson Basin (Fig. 12).

The Tabberabberan orogeny did not significantly change deposition in the eastern region. The supply of andesitic detritus continued probably from volcanic activity within and to the west of the basin, and the supply of quartz remained very low indicating that the eastern area was effectively separated from the quartz-rich source area to the west which supplied the Drummond Basin in Queensland and areas of similar terrestrial sedimentation in western New South Wales during the Upper Devonian and Lower Carboniferous.

Great thicknesses of greywacke, sandstone, conglomerate, and mudstone with some limestone and primary volcanic material were laid down in the Yarrol and Tamworth Basins. The sequence is conformable in the Yarrol Basin, but local unconformities have been reported from the Tamworth Basin (White, 1964, p. 211).

The Texas Beds, a thick sequence of flysh-like regularly interbedded lithic sandstone and mudstone (Figs. 27 & 28) with minor chert, jasper, intraformational conglomerate (Fig. 23), intermediate volcanics and limestone (Figs. 24 & 26), crop out in the northern part of the New England Fold Belt and make up the northernmost outcrops of the Tamworth Basin (Fig. 13). The sandstones, which are largely made up of angular andesitic volcanic material (Fig. 11) are generally graded. The intraformational conglomerates consist of angular mudstone fragments, up to 30 cm in diameter, set in a poorly sorted lithic sandstone matrix. They are probably slump deposits. The limestones, including massive limestone, limestone breccia and limestone 'conglomerate', occur in large lenses. They are in most areas underlain by andesitic volcanic rocks, and fragments of the limestone occur in the volcanics and vice versa. The similar occurrence of shallow water limestone within an apparently deep water turbidite sequence farther to the south in the Tamworth Basin has been explained by probable local uparching to a level at which corals and stromatoporoids could become established and limestone formed (Brown et al., 1968, p. 129). The authors suggest that it is not necessary to invoke local upwarps to provide the shallow water conditions conducive to reef formation in the Texas-Warwick area. The sediments were probably all laid down in shallow water (but below wave base), and thin submarine volcanic outpourings, up to 60 m thick, provided shallow 'banks' on which the reefs could be built. Reef breccias have been observed indicating that periods of emergence occurred locally.

The Texas Beds were severely deformed at the end of the Carboniferous and again after the Permian; it has not been possible to establish a mappable sequence within the beds, and it is not known whether local discordances occur within them.

The limestone lenses have yielded Visean corals (Appendix 3), and shelly fossils, which have tentatively been assigned to the Upper Carboniferous, were collected from a locality 3 km east of Terrica homestead (Fig. 38 & Appendix 6). The age of the beds probably ranges down into the Upper Devonian, however there are no fossils to substantiate this. There is no evidence in the Texas Beds to suggest that sedimentation at any time took place under non-marine conditions.

The relationship between the Texas Beds and the Upper Carboniferous rocks of the Emu Creek Formation and Mount Barney Beds is not known because they are, in outcrop, not in contact (Maxwell (in Hill & Denmead, 1960, p. 167) suggests that calcsilicate rocks near the base of the sequence and adjacent to the intrusion at Mount Barney could be altered Visean limestones, however this has not been proven).

The Emu Creek Formation consists of at least 1,500 m of regularly interbedded lithic and feldspathic sandstone and mudstone with minor coarse-grained polymictic conglomerate, and contains fossils of the Levipustula levis Assemblage Zone (see p. 35).

The Mount Barney Beds, which comprise feldspathic sandstone, shale, tuff, limestone and thin beds of conglomerate and contain Upper Carboniferous marine fossils, are up to 2,100 m thick. The sandstones are in places cross-bedded (see p. 36).

Upper Carboniferous fossils have recently been collected from limestones at Murgon (Palmieri, 1969) (Fig. 13) in the little known belt of Palaeozoic rocks along the western margin of the Esk Graben. Associated rocks are regularly interbedded lithic sandstone and mudstone.

In summary, it appears that sedimentation in the eastern region took place in a sea which extended to the east probably uninterrupted by large land areas or islands or island arcs. The sedimentary sequence, both in the north and south, thickens toward the east and the sediments were derived from the west from a volcanically active region. Deposition of conglomerate, sandstone, mudstone, limestone, chert and flysh-like regularly interbedded lithic sandstone and mudstone took place in shallow and deeper water (below wave base). Reefs formed, also in the areas of apparently deeper water flysh-like sedimentation, where local upwarp or submarine volcanic outpourings provided the shallow conditions conducive to their formation. The southern part of the region was tectonically unstable as evidenced by the abundance of slump deposits, the outpouring of volcanic rocks, and the presence of local angular unconformities and disconformities. In the late Visean, the sea regressed to the east and terrestrial deposits were laid down along the western margin of the basin. The shallowing of the sea extended well to the east where the Upper Carboniferous Emu Creek Formation and Mount Barney Beds, including massive conglomerate and crossbedded sandstone and containing shelly fossils, were laid down.

The easterly regression of the sea in the late Visean was due to uplift probably closely related to the uplift and deformation which occurred in the western region (Drummond Basin) at this time (Olgers, 1969).

The Upper Carboniferous terrestrial and marine sedimentation in the eastern region came to an end in the late Carboniferous when the Yarrol Basin sequence, but particularly the eastern part of the Tamworth Basin sequence (Texas Beds, Emu Creek Formation) were severely deformed in the Kanimblan Orogeny. The western part of the Tamworth Basin (west of the Peel Fault) was less affected by the orogeny.

The Carboniferous-Permian boundary in northeastern New South Wales has been variously interpreted as conformable and unconformable; a recent review (Leitch, 1969) of the literature on Permian diastrophism in the region concluded that there is no evidence of orogenic movement at the close of the Carboniferous Period. However a marked angular unconformity between Carboniferous and Permian strata has been observed by the authors at Alum Rock, Terrica, Silver Spur, and Glenmore and northwest of Tabulam (Figs. 35, 36, 38, 40, 41) and Owen & Burton (1954) recognized an unconformity between Lower Carboniferous sediments and the Ashford Coal Measures north of Ashford. The orogeny in the eastern region can be dated, within limits, by the age of the faunas occurring above and below the unconformity in the area [illegible] northwest of Tabulam, where Upper Carboniferous strata (Emu Creek Formation) containing fossils characteristic of the <u>Levipustula levis</u> Assemblage Zone (Campbell & Roberts <u>in</u> Packham, 1969, p. 262) are unconformably overlain by Lower Permian sediments (Paddys Flat Formation) containing Fauna 2 (<u>of</u> Dickins et al., 1964) fossils. The unconformity in the northern part of the New England Fold Belt does not appear to persist far to the west, southwest or south. Leitch (1969) points out that the Carboniferous-Permian sequence west of the Peel Fault and along the New South Wales coast from Port Stephens to Kempsey is broadly conformable, but local disconformities have been reported from most areas. The late Carboniferous orogenic event has been recognized as far north as the Yarrol Basin, where a slight angular break occurs between the Carboniferous and Permian successions (Kirkegaard et al., in prep.).

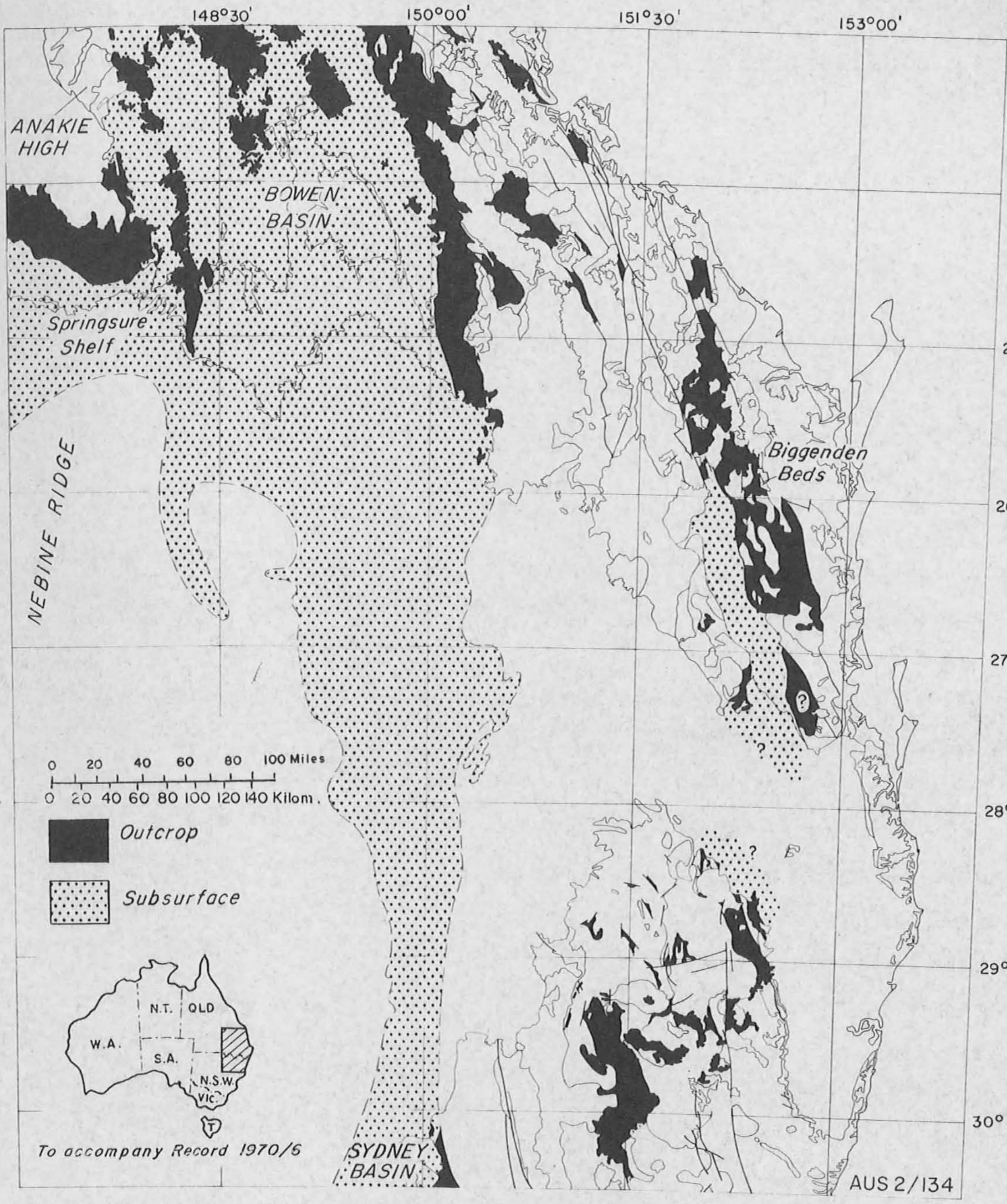


Fig.14-Distribution of Permian strata in southeastern Queensland and north-eastern New South Wales. (For explanation of outcrop pattern, see Plate 4).

Permian

The pattern of Permian sedimentation, set by the Kanimblan Orogeny, differed markedly from the Devonian-Carboniferous deposition, particularly in Queensland, and it was considerably modified during the Permian by epirogenic movements. The land separating the Yarrol and Drummond Basins became submerged and the sea transgressed to the west as far as the Anakie High and Nebine Ridge (Bowen Basin) and locally farther west still (Springsure Shelf and Galilee Basin). In the south (Sydney Basin), sedimentation took place over roughly the same area as in the Carboniferous.

A summary account of the Permian sedimentation in Queensland was given by Dear (1969) who subdivided the region of deposition into an eastern mobile eugeosynclinal zone, the remnants of which crop out in the general area of the Yarrol and Maryborough Basins extending southward into the Brisbane area and the northern part of the New England Fold Belt, and a western miogeosynclinal zone which crops out in the Bowen and Sydney Basins. Intracratonic deposition took place farther to the west in Queensland in the Galilee and Cooper Basins.

The sediments of the Bowen and Sydney Basins are continuous in the subsurface (Fig. 14), however Dickins (1968, p. 35) and Runnegar (in press) suggest that the connection between the basins was not maintained throughout the Permian and that a break occurred in mid-Permian time. The break was probably caused by epeirogenic movements in the western region, and diastrophism, folding the early Permian sediments of the eugeosynclinal zone, in the east. Evidence for the diastrophism is furnished by the angular unconformity between the Rannes Beds and Boomer Formation in the Gogango Range (Malone, Olgers & Kirkegaard, 1969) and by the break within the Drake Volcanics in the northern part of the New England Fold Belt (p. 47 & Fig. 34).

The Permian sequence that was laid down in the eugeosyncline in southeastern Queensland and northeastern New South Wales is preserved in isolated inliers, outliers and fault blocks in the northern part of the New England Fold Belt. Most of these areas of outcrop yielded marine macro fossils belonging to Faunas 2, 3A, and 4 (of Dickins et al., 1964) (Appendix 2 and pers. comm.). The correlation between the Permian units is shown in Figure 30. The greatest thickness of sediments and volcanic rocks is preserved between Rivertree and Drake where about 3,300 m of Permian strata are exposed. The lower 2,700 m consist of conglomerate, lithic sandstone, pebbly sandstone, pebbly mudstone, and mudstone (Paddys Flat Formation & Razorback Creek Mudstone). This is followed by 540 m of mainly volcanic rocks (Drake Volcanics) and 150 m of mudstone (Gilgurry Mudstone).

The abundance of volcanic rocks and the emplacement of the various phases of the New England Batholith during the Permian and early Triassic indicate that the region was highly mobile.

The presence of Faunas 2, 3A and 4 in the Silverwood area south of Warwick, the absence of Fauna 3 in the Drake region where a possible angular unconformity occurs within the Drake Volcanics between strata containing Faunas 2 and 4 respectively, and the angular unconformity between Lower Carboniferous and Permian strata containing Fauna 2 at Alum Rock, Terrica, Silver Spur and Ashford, and Fauna 4 at Glenmore, support this view and show that pronounced differences in sedimentation and intensity of deformation occurred over relatively short distances.

Mesozoic

In the Sydney and Bowen Basins, sedimentation continued uninterrupted into the Triassic, but it is doubtful whether this continuous deposition persisted far to the east, where, in the Maryborough area, the Triassic sequence overlies the Permian succession with possible unconformity (Ellis, 1968, p. 21); the relationship between the sequences in the northern part of the New England Fold Belt is not known because of overlap by Jurassic strata (Pl. 1, cross-sections), however the unconformable relationship between the Permian and Jurassic rocks near the Condamine River south of Warwick, and the fact that the Triassic-Jurassic sequence of the Clarence-Moreton Basin to the east is conformable, indicate that orogenic movements affected the Permian strata before the Triassic rocks were laid down.

Triassic sediments were laid down in the Bowen-Sydney, Maryborough and Clarence-Moreton Basins to the east and west of, and between the South Coast and New England Fold Belts, areas which were uplifted during the Bowning Orogeny and which supplied much of the material deposited in the flanking basins. Vulcanism was widespread in the early Triassic. Renewed deformation took place in the Bowen-Sydney and Maryborough Basins at the end of the Triassic, and the Jurassic-Cretaceous succession was laid down unconformably over the older rocks in these areas. The unconformity, which is most pronounced in the Bowen and Maryborough Basins, has not been reported from the Clarence-Moreton Basin.

It is of interest to note here that the bedding trends in the Palaeozoic rocks flanking the Clarence-Moreton Basin everywhere parallel the basin margin indicating that the formation of the basin was controlled by pre-existing structure.

Summary of regional geology

Early Palaeozoic. Deposition of sediments (Bunya Phyllite and Nambucca Beds) and basic volcanic rocks (Rocksberg Greenstones). Age and environmental conditions unknown.

Lower and Middle Devonian. Eugeosynclinal deposition and widespread vulcanism in a large basin covering the eastern part of the present day continent. Miogeosynclinal conditions prevailed farther to the west in the region of the Adavale Basin in central Queensland. Deposition was interrupted by the Tabberabberan Orogenic event.

Upper Devonian-Carboniferous. A great thickness of eugeosynclinal volcanolithic sediments was deposited in a large basin along the eastern margin of the present-day continent (Yarrol-Tamworth Basin). Relatively little primary volcanic material was laid down. There is no evidence that the sea was bordered in the east by a continental area or that large islands occurred within it. Sediment was derived from the west from a land that was largely made up of volcanic rocks and that separated the area of marine sedimentation from the region of terrestrial deposition farther to the west (e.g. Drummond Basin). Sedimentation in the western region came to an end in the middle of the Carboniferous and in the east at the end of the Carboniferous when orogenesis occurred.

Permian. Eugeosynclinal sedimentation continued over a large area. In the south (Sydney Basin) it coincided roughly with the region of Carboniferous deposition, but in the north (Bowen Basin) it was greatly expanded to the west. A great thickness of volcanolithic sediments was laid down and volcanism was widespread. Epeirogenic movements in the middle of the Permian temporarily separated the northern and southern parts of the area. The eastern part of the region was highly mobile and batholithic granitic intrusives were emplaced in the late Permian and early Triassic.

Mesozoic. In the western area (Sydney-Bowen Basin), sedimentation continued uninterrupted into the Triassic. In the east, deposition came to an end at the close of the Permian when folding occurred. The New England and South Coast Fold Belts were uplifted and Triassic sediments were laid down in the flanking basins. Epeirogenic movements occurred at the end of the Triassic and the Jurassic-Cretaceous succession was laid down in the Great Artesian, Maryborough and Clarence-Moreton Basins, in most areas unconformably on the Triassic and older rocks. The Mesozoic Clarence-Moreton Basin sequence is apparently conformable.

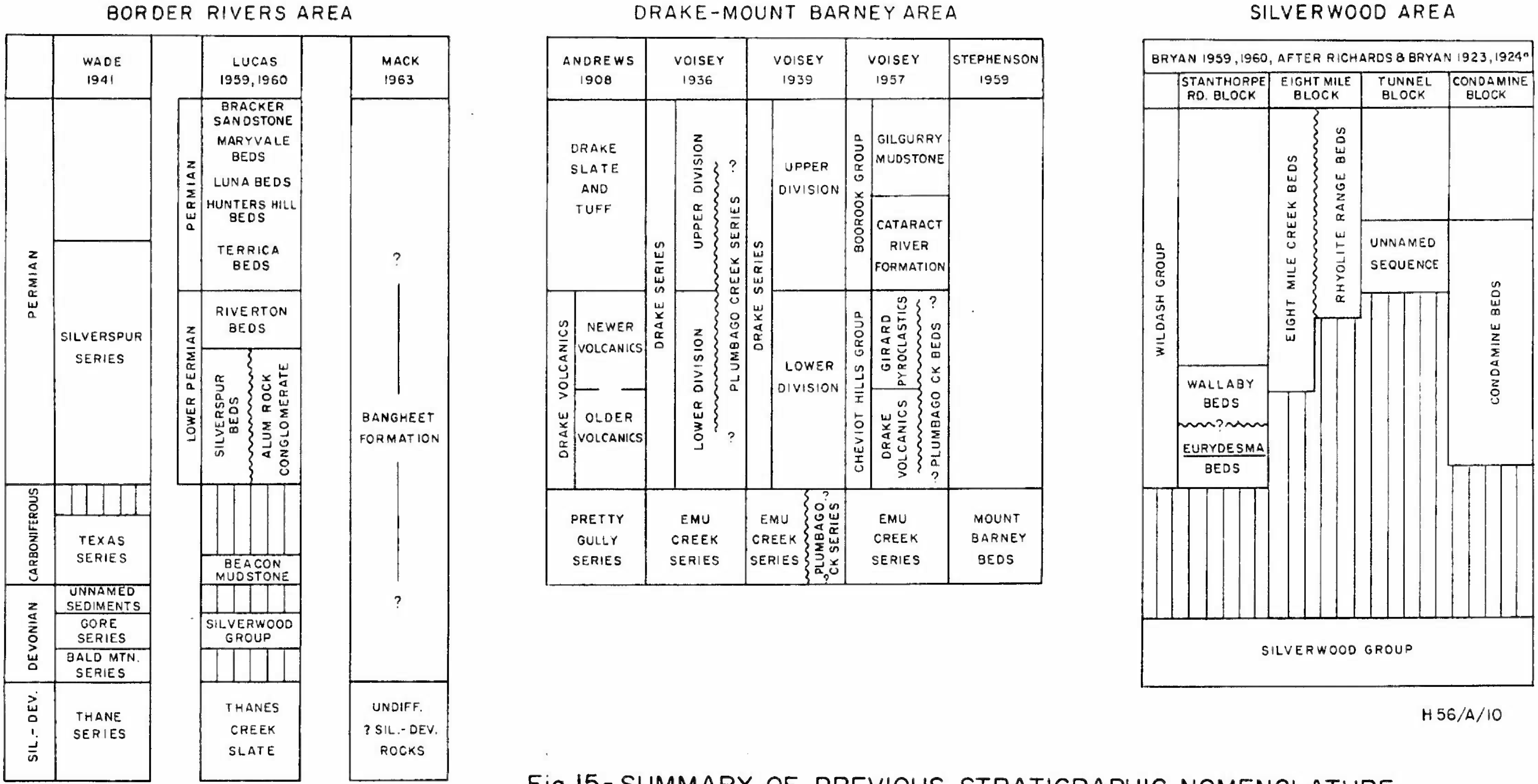


Fig. 15 - SUMMARY OF PREVIOUS STRATIGRAPHIC NOMENCLATURE FOR THE NORTHERN PART OF THE NEW ENGLAND FOLD BELT

To accompany Record 1970/6

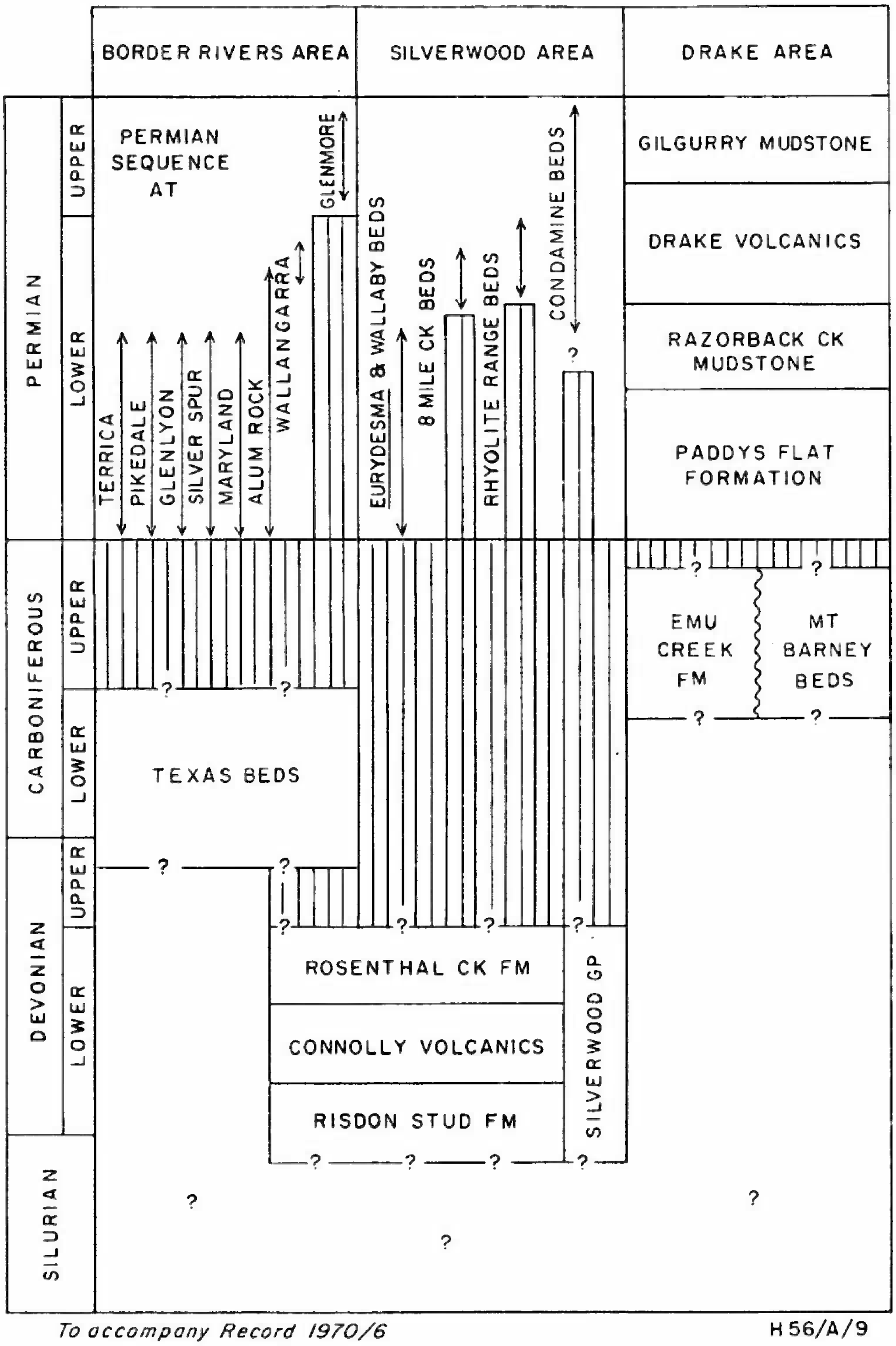
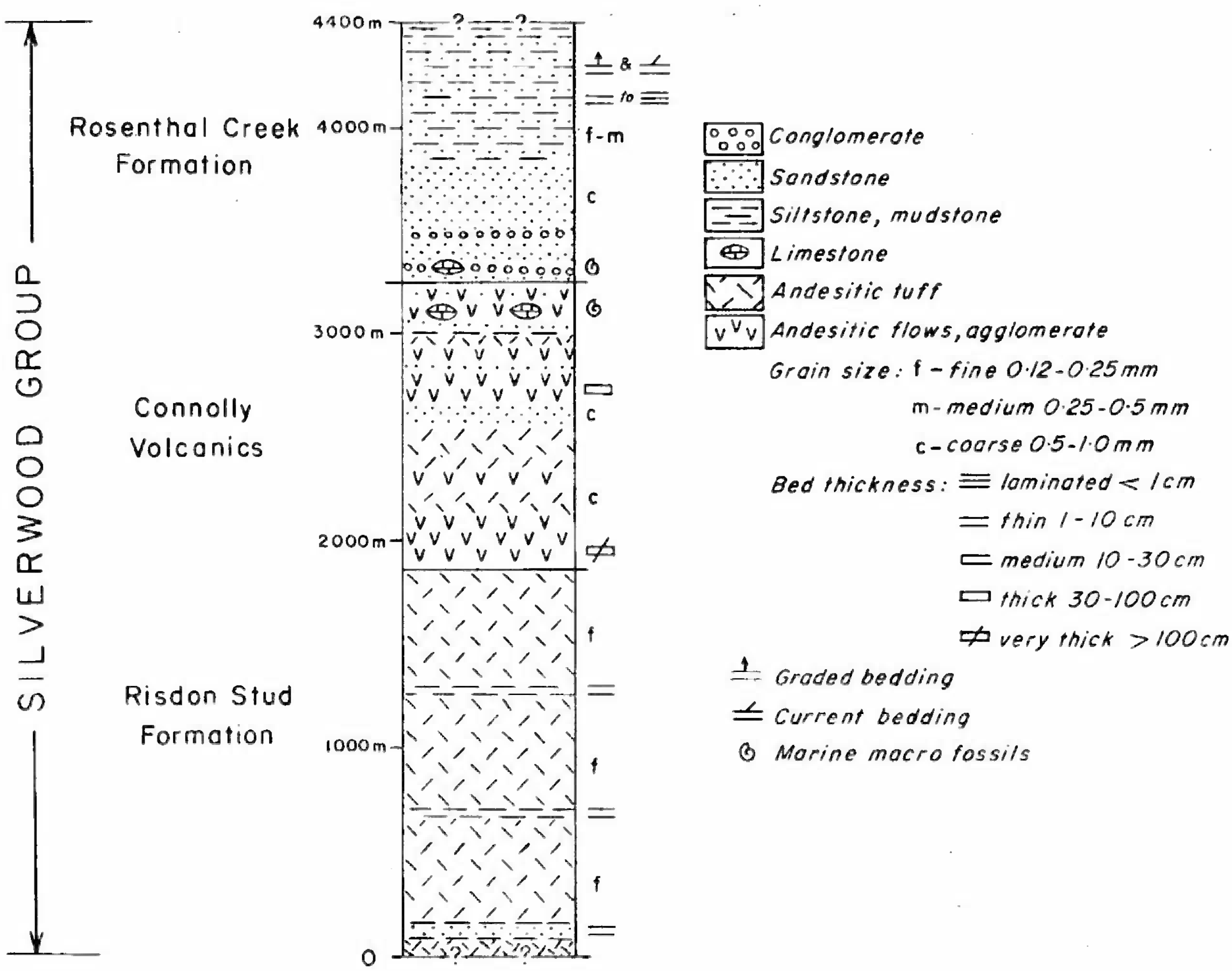


Fig.16-Correlation chart for units exposed in the northern part of the New England Fold Belt
(For location of Permian outliers see Fig.29)

TABLE : PALAEOZOIC STRATIGRAPHY OF THE WARWICK AND GOONDIWINDI SHEET AREAS

Age	Rock Unit and Symbol	Thickness (metres)	Distribution	Lithology	Palaeontology	Relationships	Environment of deposition
UPPER PERMIAN	Gilgurry Mudstone (Pul)	150	Small area west and northwest of Drake.	Grey and green mudstone, minor light brown feldspathic sandstone.	Marine macro fossils belonging to Fauna 4. (Dickins, pers. comm.).	Conformable on Drake Volcanics. Contact transitional.	Marine
LOWER TO UPPER PERMIAN	Condamine Beds (Puc)	1950+	Condamine Block 15 km south-west of Warwick. Area about 25 sq km.	Mainly dark grey slightly calcareous mudstone with 300 m of poorly sorted sandstone, pebbly sandstone, conglomerate and minor crystal-lithic tuff near the top of the exposed section.	Marine macro fossils belonging to Fauna 4. (Dickins, pers. comm.).	Faulted against the Connolly Volcanics, unconformably overlain by the Marburg Sandstone.	Marine
	(Pw)	300-450	Irregular area of outcrop west and south of Wallangarra.	Rhyolite and rhyodacitic flows and tuffs.		Intruded by the Stanthorpe Adamellite and possibly also intruded by the Dundee Adamellite Porphyrites. Probably equivalent to part of the Drake Volcanics.	
	Drake Volcanics (Pv)	450	North-northwest trending belt through Drake and Rivertree.	Northern part of outcrop area: Interbedded acid and intermediate flows and volcanolithic sediments. Southern area: Mainly pyroclastic rocks including agglomerate, breccia, crystal-lithic tuff. Minor sediments.	Marine macro fossils belonging to Fauna 2 in lower part of unit, and belonging to Fauna 4 in upper part of unit near contact with Gilgurry Mudstone. (Dickins, pers. comm.).	Conformable on Razorback Creek mudstone and conformably overlain by Gilgurry Mudstone. Both contacts are transitional. An unconformity probably exists within the volcanic sequence.	Terrestrial and marine
LOWER PERMAIN	Rhyolite Range Beds (Plh)	1200	Eight Mile - Tunnel Fault Block, 18 km long and up to 3.5 km wide south of Warwick.	About 900 m of acid volcanic rocks overlying up to 300 m of conglomerate, lithic sandstone, calcareous siltstone and mudstone.	Marine macro fossils belonging to Fauna 3A (Appendix 2).	Unconformable on the Rosenthal Creek Formation, faulted against the Silverwood Group, unconformably overlain by the Marburg Sandstone and intruded by spherulitic rhyolite and the Stanthorpe Adamellite.	Marine and possibly partly terrestrial.
	Eight Mile Creek Beds (Ple)	900	Area of about 3 sq km along Eight Mile Creek, 12 km south of Warwick.	450 m of acid volcanic rocks including agglomerate, breccia and crystal-lithic tuff at the top overlying conglomerate, pebbly sandstone, siltstone and mudstone.	Marine macro fossils belonging to Fauna 3A (Appendix 2).	Base poorly exposed but probably unconformable on the Connolly Volcanics. Faulted against Rosenthal Creek Formation, unconformably overlain by the Marburg Sandstone, and intruded by rhyolite and quartz-feldspar porphyry.	Marine and possibly partly terrestrial
	Razorback Creek Mudstone (Pla)	300+	Area of about 100 sq km in the Rivertree area.	Olive-green mudstone.		Base not exposed. Conformably overlain by the Drake Volcanics.	Probably marine.
	Eurydesma and Wallaby Beds (Plr)	200+ and 150+	Stanthorpe Road Fault Blocks at Rokeby homestead, 15 km south of Warwick. Area about 1 sq km.	*Eurydesma* Beds at base: conglomerate, lithic sandstone, siltstone and limestone. Wallaby Beds; Conglomerate, lithic sandstone, siltstone and ferruginous siltstone.	Marine macro fossils belonging to Fauna 2 (Dickins, pers. comm.).	Down-faulted in the Silverwood Group. Neither top nor bottom exposed. Probably slight angular unconformity between the units.	Marine.

Age	Rock Unit and Symbol	Thickness (metres)	Distribution	Lithology	Palaeontology	Relationships	Environment of deposition
LOWER PERMIAN	(P)	Up to 900	Six small areas of outcrop; five in the west as outliers in the Texas Beds and one northeast of Stanthorpe at Delmoak homestead.	Conglomerate, pebbly sandstone, lithic sandstone, pebbly mudstone, siltstone; minor limestone and acid volcanics.	Marine macro fossils belonging to Fauna 2 (Dickins, pers. comm.). Some plant material.	Unconformable on and faulted against the Texas Beds. Intruded by granite northeast of Stanthorpe.	Shallow marine
	Paddys Flat Formation (Plp)	2,400+	A north-northwest trending belt, 40 km long and 7 km wide along the Tabulam - Tooloom road.	Well-bedded sequence of lithic sandstone and mudstone with beds of conglomerate and minor volcanics and limestone.	Marine macro fossils belonging to Fauna 2 (Dickins, pers. comm.).	Top not exposed. Unconformable on the Emu Creek Formation and unconformably overlain by the Marburg Sandstone. Intruded by granite.	Shallow marine
UPPER CARBONIFEROUS	Mount Barney Beds (Cub)	2,100+	Small areas around Mount Barney in the northeast of the Warwick Sheet area.	Calc-silicate rocks, lithic and feldspathic sandstone, conglomerate, bryozoan mudstone, carbonaceous siltstone with minor flow rocks and tuff.	Marine macrofossils (Maxwell in Hill & Denmead, 1960, p. 167), and Lepidodendron (Stephenson, 1954).	Forced up through the Mesozoic strata by the Tertiary Mount Barney volcanic complex. Unconformably overlain by the Marburg Sandstone.	Shallow marine
	Emu Creek Formation (Cue)	1,500+	A north-northwest trending belt 35 km long and up to 5 km wide north-northeast of Drake.	Interbedded fine-grained lithic sandstone and mudstone with beds of conglomerate.	Fenestellids, a trilobite, and a rich shelly fauna characteristic of the Levipustula levis Assemblage Zone (of Campbell & Roberts in Packham, 1969, p. 262).	Base not exposed. Unconformably overlain by the Paddys Flat Formation and Marburg Sandstone, faulted against Razorback Creek Mudstone and Drake Volcanics, intruded by granite.	Marine
UPPER DEVONIAN(?) to UPPER (?) CARBONIFEROUS	[illegible] Texas Beds (Clt)	Unknown but great.	Large area west of the New England Batholith.	Regularly interbedded lithic sandstone and mudstone; intraformational conglomerate, slate, chert, jasper, intermediate volcanics, limestone.	Mainly corals collected from the limestone lenses (Appendix 3).	Probably unconformable on the Silverwood Group. Unconformably overlain by Permian and Mesozoic rocks. Intruded by granite.	Shallow marine above and below wave base.
SILURIAN(?) to LOWER DEVONIAN — SILVERWOOD GROUP	Rosenthal Creek Formation (Dlo)	1,200	Small areas near Silverwood Siding, west of Rokeby homestead and east of Dalveen.	Volcanolithic sandstone, mudstone, chert, conglomerate, limestone.	Mainly corals collected from the limestone lenses (Appendix 4); Radiolaria.	Top not exposed. Probably conformable on the Connolly Volcanics, unconformably overlain by Permian strata and the Marburg Sandstone. Intruded by granite and diorite.	Marine
	Connolly Volcanics (Dlc)	1,400	Small areas along Rosenthal Creek and west of Rokeby homestead.	Coarse-grained pyroclastic rocks including agglomerate, breccia and tuff with minor volcanic sediments and limestone.	Corals in the limestone lenses. (Appendix 4).	Probably conformable with under and overlying rocks of the Silverwood Group. Unconformably overlain by Permian rocks and Marburg Sandstone. Intruded by granite and dioritic dykes.	Marine and probably partly terrestrial.
	Risdon Stud Formation (Dlr)	1,800	A narrow north-trending belt from Dalveen to the New England Highway south of Warwick.	Andesitic crystal-lithic tuff, fine-grained volcanolithic sediments.		Probably unconformably overlain by the Lower Carboniferous Texas Beds, unconformably overlain by the Marburg Sandstone, intruded by granite and diorite dykes.	Probably marine.



To accompany Record 1970/6

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Fig.17 - Diagrammatic stratigraphic column of the Silverwood Group

STRATIGRAPHY

DEVONIAN

The oldest rocks in the area crop out south of Warwick on the northeast margin of the New England Fold Belt. The sequence is Lower Devonian and possibly partly older and has been mapped as the 'Silverwood Series' (Richards & Bryan, 1923, 1924a) and Silverwood Group (Lucas, 1959). A twofold subdivision into a dominantly volcanic unit at the base followed by a sedimentary sequence was recognized but not mapped out by Richards and Bryan (1924a).

The Silverwood Group which is estimated to be about 4,400 m thick, is here subdivided into three formations (from the base upward): Risdon Stud Formation, Connolly Volcanics, and Rosenthal Creek Formation (Fig. 17).

Rich coral faunas in limestones near the top of the Connolly Volcanics and in the Rosenthal Creek Formation indicate a Lower Devonian age for the upper part of the group (Appendix 4); the Risdon Stud Formation could at least partly range down into the Silurian.

The Silverwood Group can be correlated with the Tamworth Group (p.10) and possible equivalents of the group crop out to the northeast in the Fernvale area west of Brisbane (see p.11). The Rocksberg Greenstones and Bunya Phyllite, which crop out in a narrow belt northwest of Brisbane, are almost certainly older than any of the rocks exposed in the Silverwood area (p. 8).

Risdon Stud Formation (new name)

Derivation of name: Risdon Stud, 13 km south of Warwick.

Type area: A small east-flowing tributary of Rosenthal Creek, 1 km north of Risdon homestead.

Distribution: A north-trending belt, 1.5 to 3 km wide and 22 km long from 2 km north-northeast of Dalveen to the New England Highway 5 km south of Warwick (Fig. 18).

Lithology: Mainly silicified very fine-grained pyroclastic and sedimentary rocks. The pyroclastics crop out as structureless masses of cherty rock; they are poorly sorted andesitic crystal lithic tuffs which are made up of angular clasts of devitrified glass, feldspar and quartz set in a groundmass of devitrified glass (feldspar). Shards are present, and veinlets of plagioclase, calcite, and prehnite cut most of the rocks. The thinly interbedded nature of the less common sedimentary rocks, which are also extensively silicified, is generally well preserved. These rocks, which are similar to the regularly interbedded siltstone-mudstone sequences of the Rosenthal Creek Formation, except for their greater silicification, are in many places tightly folded. Whether this is due to tectonism or slumping is not known.

Relationships: The Risdon Stud Formation crops out along the western margin of the block of Lower Palaeozoic rocks south of Warwick. To the east, the formation is probably conformably overlain by and faulted against the Connolly Volcanics, in the south the formation is intruded by granite, and near the New England Highway it is unconformably overlain by the Marburg Sandstone. To the west are the Texas Beds. The contact between the units is in places marked by a bed of conglomerate containing abundant angular fragments of chert. Above the conglomerate are beds of massive lithic sandstone and a thin sequence of well bedded thinly bedded chert and jasper which have been traced for at least 5 km and could possibly be followed further parallel to the boundary between the units. The presence of the conglomerate, the overall change in lithology, and the pronounced difference in deformation of the sediments on either side of the contact suggest that the Texas Beds unconformably overlie the Risdon Stud Formation. The formation is intruded by feldspar porphyry and diorite dykes.

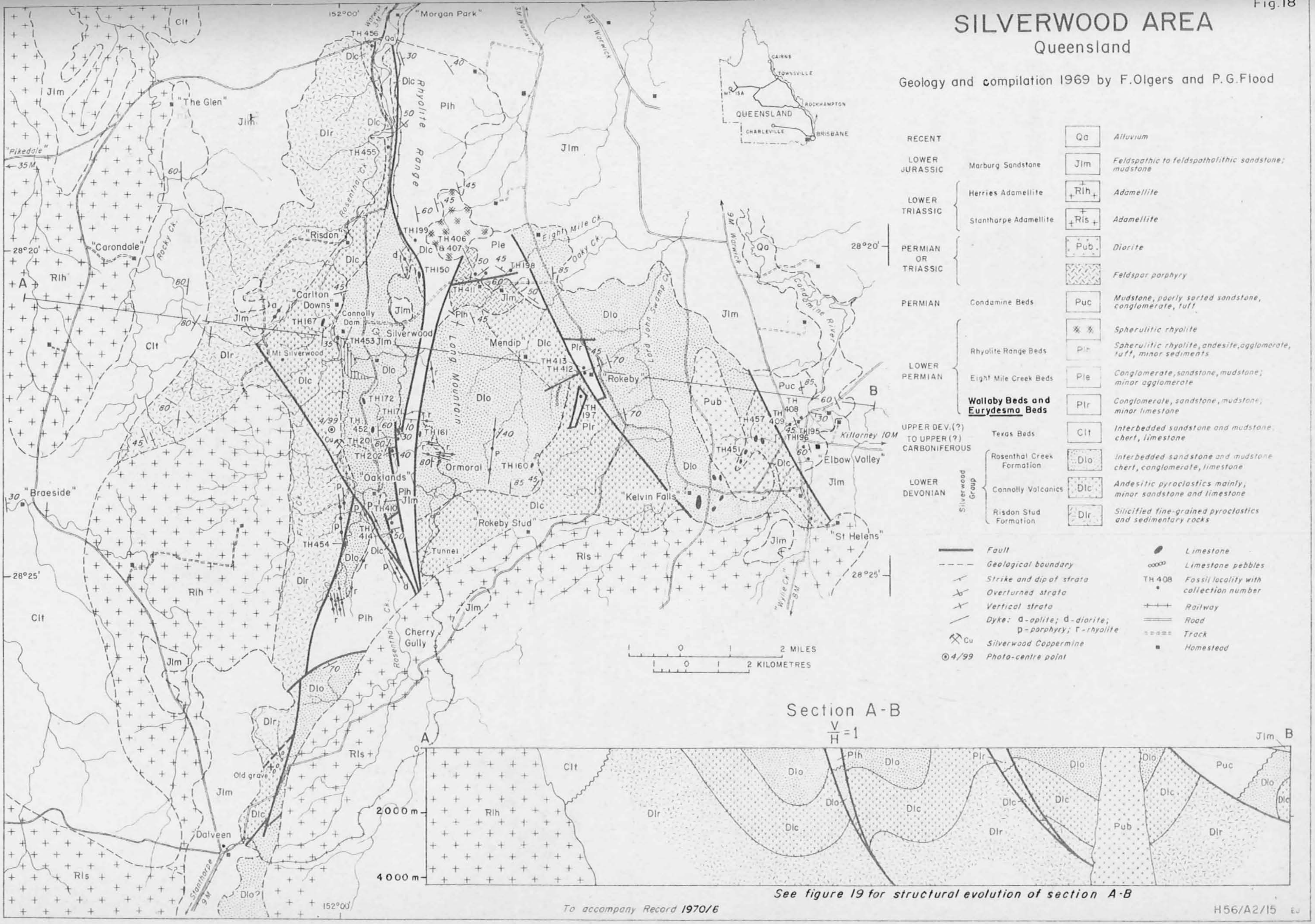


Fig.18
SILVERWOOD AREA
Queensland
Geology and compilation 1969 by F.Olgers and P.G.Flood
QUEENSLAND
CAIRNS
TOWNSVILLE
MT ISA
ROCKHAMPTON
CHARLEVILLE
BRISBANE
RECENT
Qa
Alluvium
LOWER JURASSIC
Marburg Sandstone
Jlm
Feldspathic to feldspatholithic sandstone; mudstone
LOWER TRIASSIC
Herries Adamellite
Rlh
Adamellite
Stanthorpe Adamellite
Rls
Adamellite
PERMIAN OR TRIASSIC
Pub
Diorite
Feldspar porphyry
PERMIAN
Condamine Beds
Puc
Mudstone, poorly sorted sandstone, conglomerate, tuff
LOWER PERMIAN
Spherulitic rhyolite
Rhyolite Range Beds
Plh
Spherulitic rhyolite, andesite, agglomerate, tuff, minor sediments
Eight Mile Creek Beds
Ple
Conglomerate, sandstone, mudstone; minor agglomerate
Wallaby Beds and Eurydesma Beds
Plr
Conglomerate, sandstone, mudstone; minor limestone
UPPER DEV.(?) TO UPPER (?) CARBONIFEROUS
Texas Beds
Clt
Interbedded sandstone and mudstone; chert, limestone
LOWER DEVONIAN
Silverwood Group
Rosenthal Creek Formation
Dlo
Interbedded sandstone and mudstone; chert, conglomerate, limestone
Connolly Volcanics
Dlc
Andesitic pyroclastics mainly; minor sandstone and limestone
Risdon Stud Formation
Dlr
Silicified fine-grained pyroclastics and sedimentary rocks
Fault
Geological boundary
Strike and dip of strata
Overturned strata
Vertical strata
Dyke: a-aplite; d-diorite; p-porphyry; r-rhyolite
Cu Silverwood Coppermine
4/99 Photo-centre point
Limestone
Limestone pebbles
TH 408 Fossil locality with collection number
Railway
Road
Track
Homestead
2 MILES
2 KILOMETRES
152°00'
"Morgan Park"
"The Glen"
"Pikedale"
35M
"Carondale"
Rocky Ck
"Risdon"
Rosenthal Ck
Rhyolite Range
"Carlton Downs"
Connolly Dam
Silverwood
Mt Silverwood
Long Mountain
"Mendip"
Eight Mile Ck
Oaky Ck
Lord John Swamp Ck
Condamine River
Rokeby
"Oaklands"
Ormoral
"Rokeby Stud"
"Kelvin Falls"
"Elbow Valley"
Killarney 10M
"St Helens"
Wyllie Ck
"Braeside"
Tunnel
Cherry Gully
Old grave
Dalveen
Stanthorpe 9M
Warwick 9M
28°20'
28°25'
A
B
Section A-B
V/H = 1
2000 m
4000 m
See figure 19 for structural evolution of section A-B
To accompany Record 1970/6
H56/A2/15

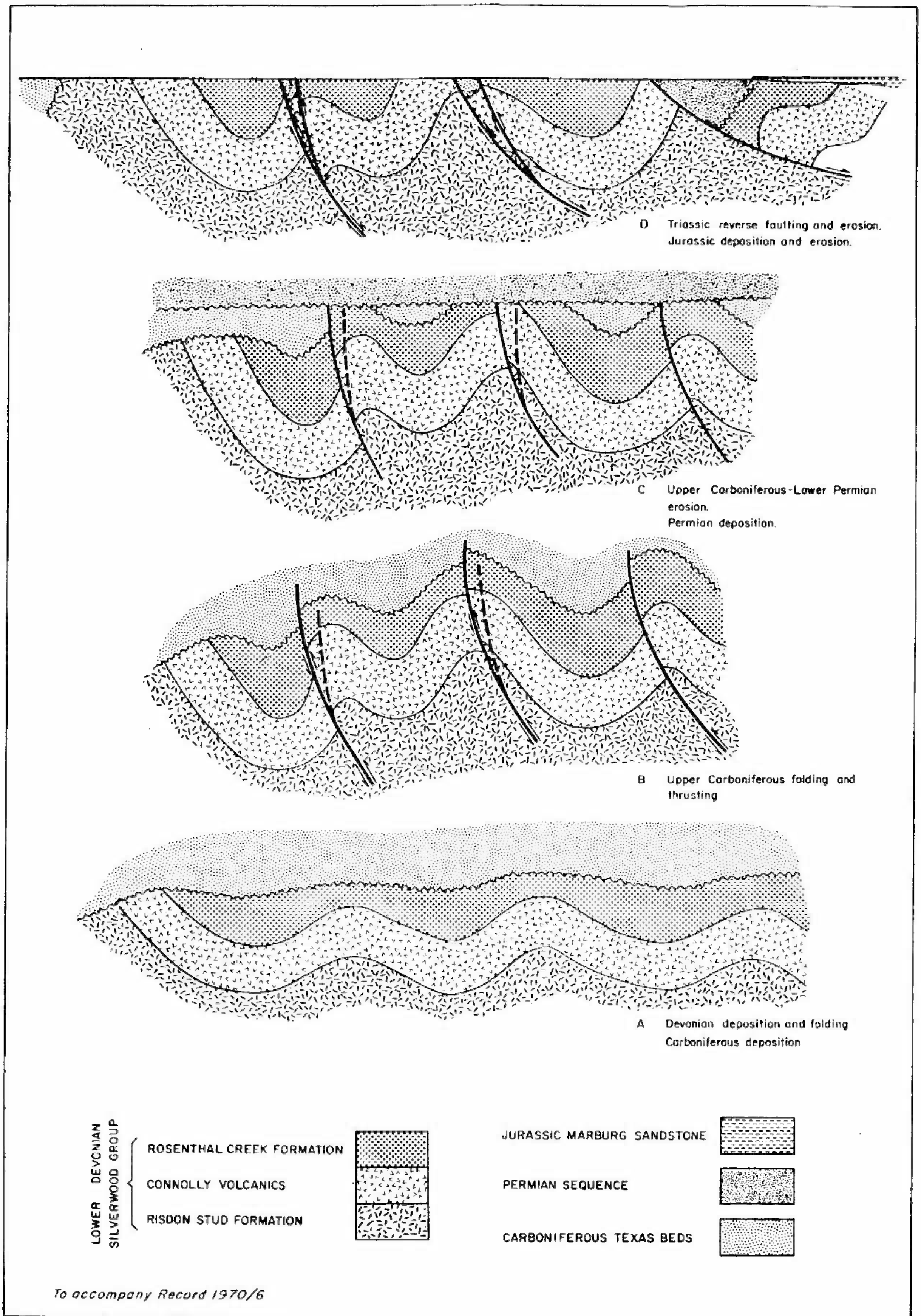


Fig. 19 — STRUCTURAL EVOLUTION OF THE SILVERWOOD AREA (For section line, see Fig. 18)

H56/A2/18

Thickness: Estimated from the cross-section of Figure 18 to be about 1800 m. It is highly speculative.

Age: Silurian (?) - Lower Devonian, based on the Lower Devonian faunas in the conformably overlying Connolly Volcanics.

Connolly Volcanics (new name)

Derivation of name: Connolly Dam on Rosenthal Creek 16 km south of Warwick.

Type area: In the east-flowing tributary of Rosenthal Creek which joins it just north of Connolly Dam.

Distribution: The formation, which forms some of the most rugged country in the Lower Palaeozoics of this area, crops out mainly in two belts, one, up to 1.5 km wide and 16 km long along Rosenthal Creek from the Silverwood Copper Mine in the south to the New England Highway, and the other, arcuate in shape, from the railway tunnel 3 km north of Cherry Gully Siding through Rokeby Stud and Mendip homestead. Small areas of outcrop are in the Elbow Valley area, 1.5 km north-northeast of Dalveen, and north of Silverwood Siding (Fig. 18).

Lithology: The Connolly Volcanics, in contrast to the underlying Risdon Stud Formation, consist mainly of coarse-grained pyroclastic material with some flows and sedimentary rocks. Agglomerate is most common but volcanic breccia and coarse-grained crystal lithic tuff and tuff are also abundant. Flow-banded and porphyritic andesites are present. Sedimentary interbeds are most common near the top of the formation and limestone lenses are the most conspicuous and important because they contain rich Lower Devonian coral faunas. Locally, also near the top of the formation and in places closely associated with the limestone lenses, is a bed of conglomerate or lithic sandstone containing rounded and subangular fragments of fossiliferous limestone identical to the limestone of the lenses. The most accessible and spectacular outcrop of these 'limestone conglomerates' is 3 km north-northeast of Dalveen at an old grave and in the creek 0.5 km to the northeast of it (Fig. 18). The conglomerate contains odd cobbles of granite and numerous boulders of limestone up to 1 m in diameter. All limestones and the locations at which limestone fragments occur in the volcanic rocks have been indicated on Figure 18. Beds of volcanolithic sandstone are also interbedded with the volcanics in the upper part of the formation.

Relationships: The Connolly Volcanics are probably conformably overlain by the Rosenthal Creek Formation and faulting has brought the volcanics into contact with the Rosenthal Creek Formation and the Permian rocks. An unconformable relationship between the volcanics and Permian strata may exist 1.5 km north-northeast of Mendip homestead (Fig. 18). The contact is not exposed due to poor outcrop, but conglomeratic sandstone and conglomerate crop out in close proximity to the volcanics and dip away from them. North of Cherry Gully Siding, the volcanics are intruded by granite, and hornfelses including garnet hornfels occur along the margin (Richards & Bryan, 1924a, p. 94). Good exposures occur in a railway cutting north of Cherry Gully Siding. A diorite stock intrudes the formation east of Rokeby homestead and several diorite dykes were observed, the largest of which crops out in a railway cutting 1.5 km north of Silverwood Siding.

Thickness: Estimated from the cross-section of Figure 18 to be about 1,400 m.

Age: The faunas contained by the limestones indicate a Lower Devonian age (Appendix 4).

Rosenthal Creek Formation (new name)

Derivation of name: Rosenthal Creek, which springs in the granite country east of Dalveen and joins the Condamine River at Warwick.

Fig. 20 - View looking north along the valley of Rosenthal Creek. The hills in the middle-distance and background consist of Devonian and Permian volcanics, and the sediments of the Rosenthal Creek Formation crop out in the valley. (Neg.No.M/957)

Reference area: Lord John Swamp Creek and areas southwest of Rokeby homestead and between Silverwood Siding and Connolly Dam (Fig. 18).

Distribution: A discontinuous belt from the vicinity of Risdon homestead in the north to Delmoak homestead on the Maryland River in the south, and two areas, drained by Oaky and Lord John Swamp Creeks, to the east and 1.5 km west of Rokeby homestead (Fig. 18).

The Rosenthal Creek Formation generally forms the more gently undulating country in the area of outcrop of the Silverwood Group, but hilly terrain with relief up to 150 m occurs west and southwest of Mendip homestead.

Lithology: The formation consists entirely of sedimentary rocks and it presents a marked lithological change from the dominantly volcanic lower part of the Silverwood Group. Primary volcanic detritus is present but reworked andestic material, presumably derived from the lower part of the group, is most common.

In the Silverwood - Elbow Valley region, it is apparent that the formation consists of a lower sandy and conglomeratic sequence and an upper finer grained succession, however no attempt was made to map out these subdivisions. The outcrop belt of the formation east of Rokeby homestead mainly comprises the upper part of the formation and the rocks in the narrow outcrop belt from northeast of Dalveen to Dalmoak homestead have been severely hornfelsed but they probably also largely belong to the upper division. The structure of the Rosenthal Creek Formation is very complicated and it is difficult, for any one area of outcrop, to determine the stratigraphic position within the formation.

The only area where the contact zone between the Rosenthal Creek Formation and the underlying Connolly Volcanics is well exposed and not faulted is southwest of Rokeby homestead and north of Rokeby Stud. The sedimentary sequence consists mainly of coarse-grained sandstone with, near the base, a small lens of limestone containing corals, and a thin discontinuous bed of conglomerate that in places contains only angular fragments of limestone up to 60 cm in diameter (Fig. 22) and elsewhere contains well rounded pebbles and cobbles of granodiorite, quartz-feldspar porphyry and sedimentary rocks including limestone. The sandstones are all massive, coarse-grained and poorly sorted and they are mainly made up of angular fragments of volcanic rocks and feldspar (Fig. 11). The quartz content is variable but generally very low. Fragments of radiolarian chert and tuff and grains of sedimentary rocks have been noted.

Similar coarse-grained rocks, including poorly sorted conglomeratic sandstone containing pebbles and cobbles of limestone and a chert breccia consisting entirely of angular pieces of banded chert crop out at Connolly Dam, and Long Mountain, 1.5 km east of Silverwood Siding, is made up of coarse-grained sandstone and intraformational conglomerate containing chert and siltstone fragments up to 25 cm long. The breccia at Connolly Dam could be a slump breccia. A small lens of fossiliferous limestone 3 km northeast of Oaklands homestead is associated with coarse-grained rocks and is part of the lower portion of the formation.

The upper part of the formation consists mainly of regularly interbedded fine-grained sandstone, siltstone and mudstone (Fig. 21) with some chert and lenses of limestone. The thickness of the beds within the interbedded sequence, although relatively uniform within any one area, ranges from a fraction of a centimetre in the west to 8 to 10 cm east of Rokeby homestead. The sandstones are finer grained and better sorted than the sandstones of the lower part of the formation, however they are very similar in composition. Graded bedding is common and cross-bedding, in units up to 3 cm thick, and slump structures have been noted in a few places. One kilometre south-southwest of Oaklands homestead is a thick bed of mudstone containing cobbles and blocks of sedimentary rock. The sequence between Oaklands homestead and Connolly Dam is dominantly mudstone. The interbedded rocks are locally silicified into banded and laminated cherts which closely resemble the silicified sedimentary rocks which are in places interbedded with the andesitic tuffs of the Risdon Stud Formation. The upper part of the

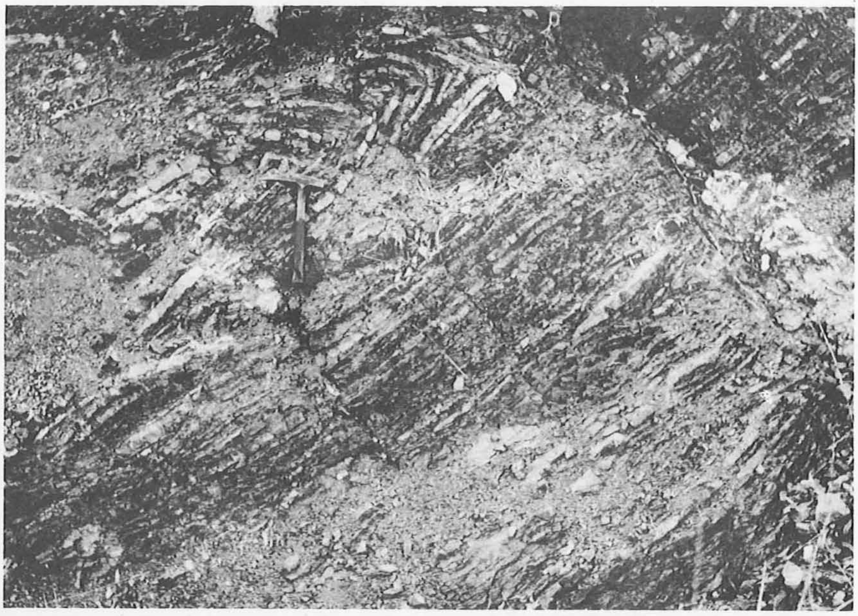


Fig. 21 - Regularly interbedded sandstone-mudstone sequence of the Rosenthal Creek Formation, 1.5 km north of Silverwood Siding. (Neg.No.GA/2217)

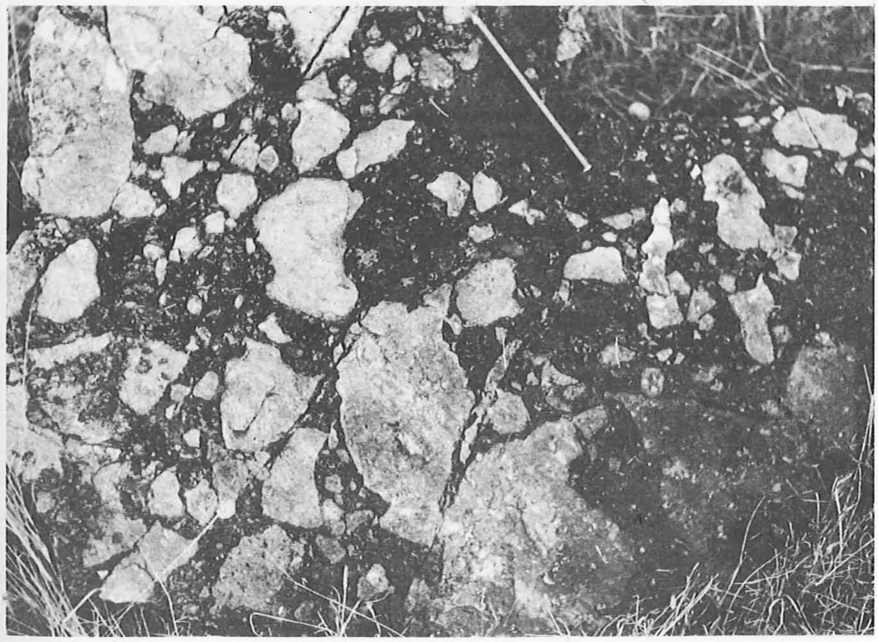


Fig. 22 - Lower Devonian limestone conglomerate 1.5 km west of Rokeby homestead (see Plate 3); scale is pencil, 17 cm long. (Neg.No.M/949)

Rosenthal Creek Formation also includes fossiliferous limestone lenses. Five are in the Elbow Valley area, two are between Oaklands homestead and Connolly Dam just east of the road, and one is 1.5 km south-southwest of Oaklands homestead. Most have or are being quarried.

The fine-grained mica hornfelses which occur east of Dalveen in the narrow outcrop belt surrounded by granite, show in places good bedding, slump structures and cross-bedding, and they are contact metamorphosed sediments probably belonging to the Rosenthal Creek Formation. Similar hornfelses and spotted slates occur near the contact with granite at the head of Lord John Swamp Creek.

Relationships: The formation probably conformably overlies the Connolly Volcanics and is unconformably overlain by Permian and Mesozoic strata. The contact zone of the formation with the Connolly Volcanics is best exposed southeast of Rokeby homestead and north of Rokeby Stud. The unconformity between the Rosenthal Creek Formation and the Permian rocks is exposed south of Oaklands homestead, where deformed mudstones are unconformably overlain by poorly sorted pebbly sandstone and conglomerate containing abundant pebbles and fragments of sedimentary rocks. The area is structurally complicated by faulting and the emplacement of numerous acid dykes. The uncomformity is locally steeply dipping and dykes have in places been emplaced along it.

The unconformity between the formation and the Mesozoic rocks is well exposed in the southern cutting of the railway tunnel east of Dalveen where steeply dipping, deeply weathered hornfelses are overlain by flat-lying Mesozoic conglomerate containing abundant fragments of hornfels, and poorly sorted quartz sandstone.

A long narrow block of Permian volcanics and sediments (Eight Mile - Tunnel Block) has been downfaulted into the formation east of Oaklands homestead and Silverwood Siding, and two small fault blocks of Permian sediments (Stanthorpe Road Block) are at Rokeby homestead.

The Rosenthal Creek Formation has been intruded by granite in several places and by a small mafic intrusion in the Elbow Valley area. Limestone along the margin of the intrusion has been brecciated and angular fragments of marble are set in a very fine-grained groundmass of igneous rock. Numerous dykes of rhyolite, diorite, and feldspar porphyry intrude the formation. The dykes at Ormoral Siding are vertically flow-banded spherulitic rhyolites ranging in width from 30 cm to 1.2 m.

Thickness: The preserved thickness has been estimated from the cross-section of Figure 18 to be about 1,200 m.

Age: Lower Devonian, based on coral faunas collected from the limestones near the base of the formation (Appendix 4).

CARBONIFEROUS

Carboniferous rocks (Texas Beds) make up the bulk of the north-western part of the New England Fold Belt, they occur in a narrow inlier in Permian rocks near the northeastern margin of the fold belt north of Drake (Emu Creek Formation), and they crop out 50 km to the east of Warwick around Mount Barney (Mount Barney Beds) (Fig. 13). Carboniferous strata crop out also along the entire western and southern margins of the Sydney and Great Artesian Basins. Similar rocks have been encountered in many of the wells drilled in the Surat Basin to the northwest (Kutting Formation). Carboniferous rocks probably also occur in the central and eastern parts of the fold belt, however fossils have not been found to substantiate this (see pp. 9,10).

The northwestern part of the New England Fold Belt was largely mapped by Lucas (1957, 1958, 1959, 1960) who recognized several units ranging in age from Siluro-Devonian to Permian. All previously established fossil locations in the northwest and many additional ones were sampled during the recent survey. All the limestones yielded Lower Carboniferous corals, one questionable Upper Carboniferous fauna was found near Terrica homestead (Appendix 6 and Fig. 38), and numerous Lower Permian faunas were collected in the vicinity of Silver Spur, and near Glenlyon, Terrica and Alum Rock homesteads.

The formations mapped by Lucas and assigned by him to the Siluro-Devonian, Carboniferous and Permian mainly represent broad facies changes within a thick and very extensive Carboniferous sedimentary sequence, which, due to intense deformation cannot be subdivided. It has been named the Texas Beds. Five small outliers of Permian rocks have been recognized within its area of outcrop in the Warwick and Goondiwindi Sheet areas. They are at Silver Spur, and Glenlyon, Terrica, Pikedale and Alum Rock homesteads and have been mapped and described in some detail (see pp. 48-52); others may yet be found.

Texas Beds (new name)

Nomenclature: The name, derived from Texas on the Queensland-New South Wales border, has been given to the Lower Carboniferous sequence that makes up the northwestern part of the New England Fold Belt. The name 'Texas Limestones' was informally used by Bryan and Jones (1946) to describe the Lower Carboniferous limestones in the Texas-Limevale area near the Queensland-New South Wales border. These limestones are part of the Texas Beds. The area west of the batholith was largely mapped by Lucas (1957, 1958, 1959, 1960) who recognized several units ranging in age from Siluro-Devonian to Permian, however his subdivisions have been abandoned.

Distribution: The northwestern part of the New England Fold Belt west and north of the New England Batholith extending southward from Queensland into New South Wales.

Type Area: Branch Creek between the Pikedale to Warwick (via Melva homestead) and Pikedale to Cooinoo roads.

Lithology: Sandstone, mudstone, slate, jasper, chert, intraformational conglomerate, limestone and andesitic volcanics. The characteristic feature of the sequence is the rhythmic alternation of sandstone and mudstone beds. The relative proportion of sandstone to mudstone varies greatly from one area to another and the section may locally consist largely of sandstone or mudstone (or slate). The thickness of the beds in any one area of outcrop is highly variable, but individual beds maintain their thickness (Fig. 27). The sandstones in the interbedded sequence are generally graded; in places they show irregular laminations. Flute casts were seen in one area, but current bedding or ripple marks were nowhere observed. The sandstones, which are generally poorly sorted, consist largely of angular volcanic rock fragments (Fig. 11). Angular pieces of black mudstone are not uncommon in the massive sandstones and they are locally very abundant to form intraformational conglomerate (Fig. 23). Slabs of mudstone up to 30 cm in diameter have been seen. Mudstone fragments rarely occur in the sandstones of the interbedded sequence.

Interbedded with the sandstone-mudstone-slate sequence are beds of jasper and chert, volcanic rocks and lenses of limestone, however they make up only a small part of the total section. The jasper beds, which grade along strike into jaspery chert and pale grey-green chert, contain radiolaria. The beds range in thickness from 60 cm to 10 m or more and they form most of the higher hills of the region. They are most common in the northern part of the area and the most prominent outcrops are east of Waroo Station, in the vicinity of Terrica homestead, and at Mount Gammie. The jaspers are not closely associated with any of the other rock types in the area and they have been found in contact with massive sandstone and volcanic rocks, and interbedded with slate

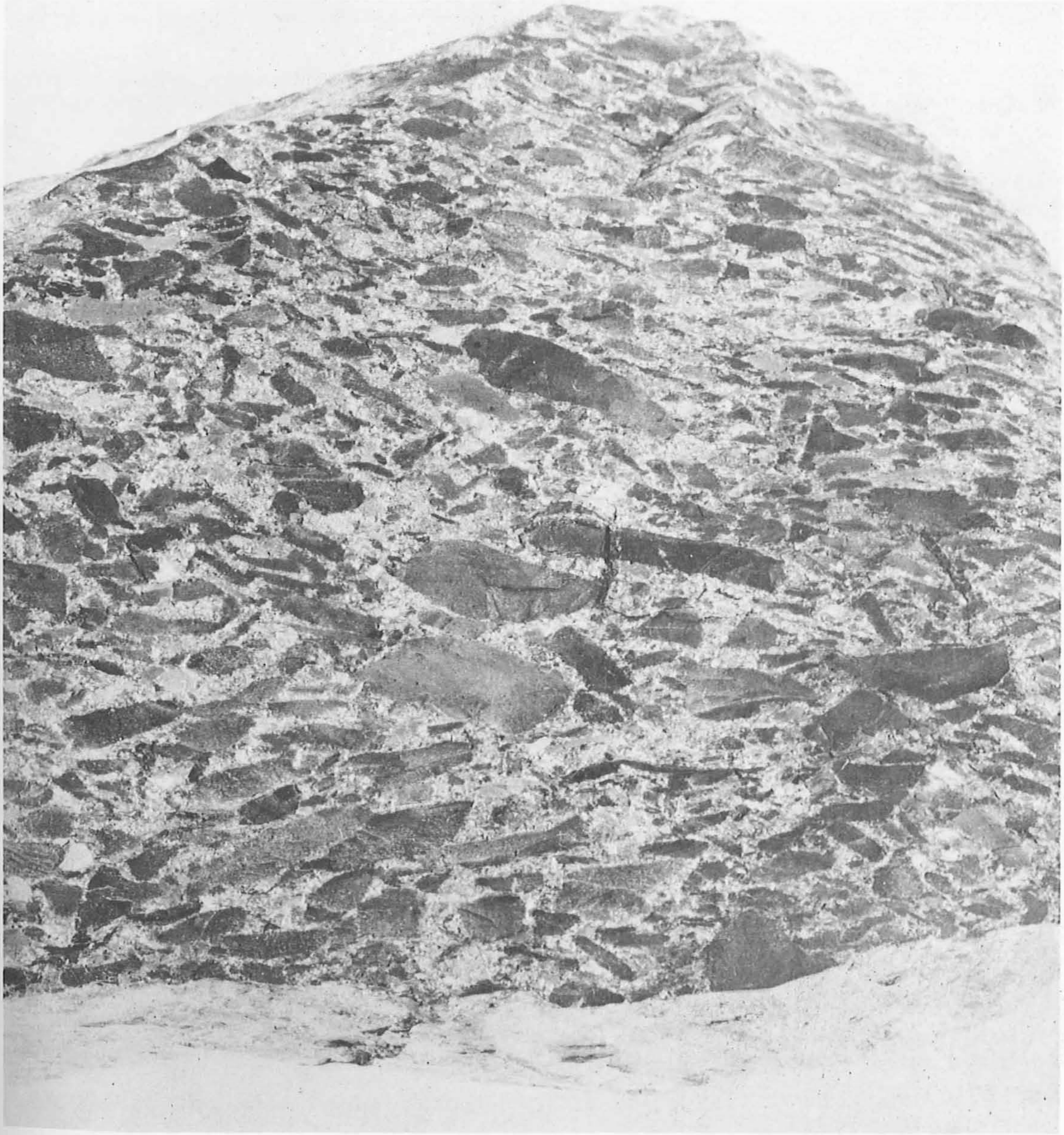


Fig. 23 - Intraformational conglomerate of the Lower Carboniferous Texas Beds exposed in the north bank of Branch Creek, east of the Terrica-Gore road, 11 km south of Gore. Angular fragments of black mudstone are set in a matrix of poorly sorted volcanolithic sandstone (natural size). (Neg.No.GA/2434)

Fig. 24 - Massive outcrop of Lower Carboniferous limestone on the south bank of Pike Creek, 6 km south-southwest of Glenlyon homestead. (Neg.No.M/950)

Fig. 25 - Limestone conglomerate containing blocks and fragments of limestone up to 30 cm in diameter. Locality as above; scale is pencil, 17 cm long. (Neg.No.M/950)

Fig. 26 - Lower Carboniferous limestone breccia, south bank of Pike Creek, 6 km south-southwest of Glenlyon homestead. (Neg.No.M/950)

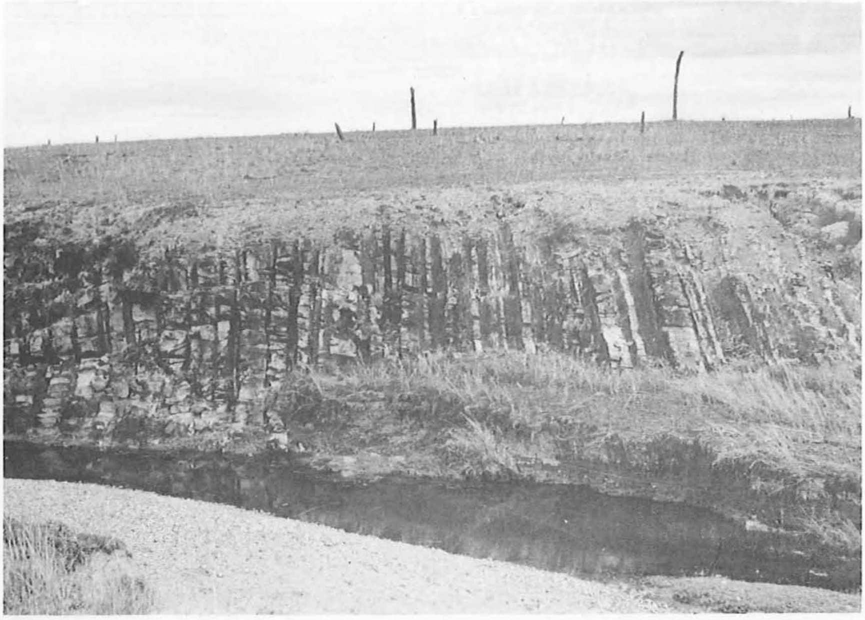


Fig. 27 - Regularly interbedded volcanolithic sandstone and mudstone of the Texas Beds in Alpin Creek, 3 km south of Silver Spur. (Neg.No.M/927)

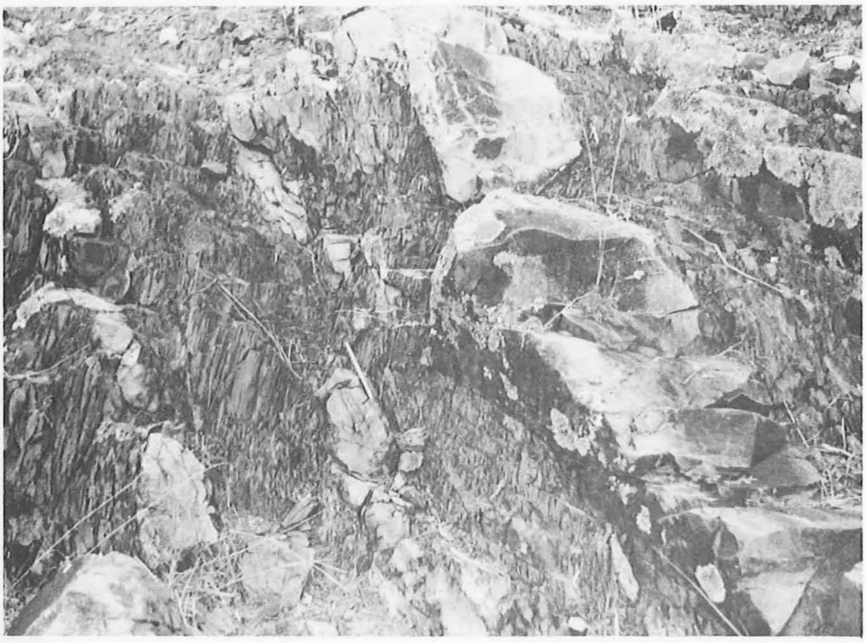


Fig. 28 - Interbedded sandstone and mudstone in Alpin Creek. The mudstone is cleaved; some of the sandstone beds show boudinage, others are fractured and disrupted. Scale is pen, 14 cm long. (Neg.No.M/927)

and phyllite and with the regularly interbedded sandstone-mudstone sequence

The jasper and chert beds can nowhere be traced for more than a few kilometres and they are of little use as marker beds. Limestone, in lenses up to 6 km long and 1 km wide, crops out at several widely scattered localities. The main occurrences are in Pike Creek 1.5 km south of Riversdale homestead, and 3.5 km to the northwest, in the Limevale area, at Cement Mills, and at Cooinoo, Barangarook, South Pikedale and Craigie homesteads. The limestone outcrops in the Inverell Sheet area to the south are shown in Figure 41A. The limestones are massive (Fig. 24) and generally poorly fossiliferous, however, Visean corals have been collected from most (Appendix 3). Fresh, water-washed outcrops in the banks of Pike Creek show that in places the limestone contains abundant coralline and crinoidal material, whole shells and fragmentary shell material. Oolites are in places also abundant. A massive limestone breccia, consisting of angular blocks cemented by calcilutite, makes up a small part of the limestone lens in Pike Creek. Most of the limestones have been recrystallized and white and some black marble is being quarried in the Limevale area, and until recently at Cement Mills. Intermediate volcanics occur sporadically within the Lower Carboniferous sequence. They are mostly closely associated with the limestones which they in all instances underlie. Fragments of the volcanics have been observed in the limestone and 'limestone conglomerate' consisting of angular blocks and fragments of limestone set in a tuffaceous matrix occurs with the limestones at South Pikedale and Craigie homesteads and in Pike Creek (Fig. 25). The volcanics are best exposed near Craigie homestead where they include porphyritic flows, agglomerate, and rocks which show vague pillow structures.

Structure: The Texas Beds are intensely deformed and attempts to subdivide the sequence were unsuccessful. Dips are generally steep to vertical and the beds are in many placed overturned. Many of the larger creek outcrops show that the rocks are tightly folded and overturned. The sandstones in the interbedded sequence are fractured and boudinage has been observed. In places, the sandstone beds have been completely broken up and the rock resembles a conglomerate consisting of sandstone 'pebbles' set in a cleaved mudstone matrix. The mudstones of the interbedded sequence are generally cleaved (Fig. 28). Slates and phyllites have invariably been formed in areas where the Texas Beds consist largely of fine-grained sediments, and cleavage is not apparent in areas where massive sandstones dominate the succession. The boundaries between the Texas Beds and the isolated areas of Permian outcrop are in many places faulted and it is suspected that many faults occur within the Lower Carboniferous sequence. Regionally, the Texas Beds have been folded into a large synclinal structure. It is outlined by bedding trends which swing from north-northwest near the New England Batholith through west and southwest between Gore and Limevale, to south-southeast at Texas and Yetman. A small subsidiary fold occurs on the west flank of the structure in the Silver Spur area, where Permian rocks are infolded with the Carboniferous sequence indicating that the Texas Beds were subjected to late or post-Permian deformation. The mineralization at Silver Spur occurs along the axis of the subsidiary fold.

Relationships: Probably unconformably overlies the Silverwood Group (see p. 24), unconformably overlain by Permian and Mesozoic strata, and intruded by the Permian-Triassic granites of the New England Batholith. The unconformity with the Permian rocks is well exposed at Glenmore homestead (Fig. 41), northwest of Silver Spur (Fig. 40), at Terrica homestead (Fig. 35) and northwest of Alum Rock homestead (Fig. 35).

Age: Lower Carboniferous, possibly extending into the Upper Devonian and Upper Carboniferous. Lower Carboniferous corals have been found in many of the limestone lenses (Appendix 3) and questionable Upper Carboniferous fossils have been collected from the area northeast of Terrica homestead (Appendix 6 & Fig. 38).

Thickness: Unknown but thousands of metres are suspected to be present.

Emu Creek Formation (new name)

Derivation of name: The Emu Creek Formation was originally named the Emu Creek Series (Voisey, 1936), which was changed to Emu Creek Beds (Voisey in McElroy, 1962). The series, as defined by Voisey (1936, 1939), included sediments which are now recognized as being of Permian age. These younger sediments, which unconformably overlie the Emu Creek Formation are called the Paddys Flat Formation.

Reference area: Along the banks of Emu Creek, near Jump-Up Hill, 13 km north-northeast of Drake.

Distribution: A continuous belt 35 km long and up to 5 km wide, trending north-northwest, from 3 km northeast of Lunatic Mine, 10 km north-northeast of Drake, to 8 km northeast of Rivertree on the upper Clarence River.

Lithology: Interbedded sequence of fine-grained feldspathic and lithic sandstone, dark grey siltstone, mudstone, and polymictic paraconglomerate containing well rounded clasts of granitic and volcanic rocks.

Relationships: The western boundary is in fault contact with Permian sediments and volcanics; to the east, the formation is unconformably overlain by the Lower Permian Paddys Flat Formation, to the north it is unconformably overlain by the Jurassic Marburg Sandstone, and it is intruded by late Permian or early Triassic granitic bodies.

Thickness: 1,500 + m.

Age: Upper Carboniferous. The formation contains fenestellids, a trilobite, and a rich shelly fauna characteristic of the *Levipustula levis* Assemblage Zone (of Campbell & Roberts in Packham, 1969, p. 262).

Mount Barney Beds (Stephenson, 1959)

Derivation of name: Mount Barney, a 1,320 m high mountain 50 km south-west of Beaudesert, just north of the Queensland-New South Wales border.

Reference area: The hilly country immediately to the east of the steep peaks of Mount Barney.

Distribution: An area of approximately 16 sq km immediately surrounding Mount Barney.

Lithology: The sequence begins with 90 to 150 m of calc-silicate rocks (probably limestones metamorphosed by the intrusion of Mount Barney), which are followed by 90 m of lithic and feldspathic sandstones with interbedded rhyolitic and trachytic lava flows and tuffs, and dark, fine-grained siltstones. Spiriferid remains are present. Carbonaceous material occurs in the finer sediments in which Staphenson (1954) recorded Lepidodendron. Succeeding these beds is the main sequence of lithic and feldspathic sandstone, conglomerate and dark bryozoan and crinoidal mudstone (Appendix 5) which reaches a thickness of about 1,800m. A narrow band of dark mudstone about 600 m above the base contains a Levipustula fauna. The conglomerate is persistent throughout the area and consists of well rounded pebbles of trachyte and rhyolite up to 8 cm in diameter. Some of the sandstones are cross-bedded and ripple marked.

Relationships: The sequence has been upthrusted through Mesozoic strata by the forceful intrusion of the Tertiary Mount Barney igneous complex.

Thickness: 2,100 + m.

Age: Upper Carboniferous. The marine fossils identified from the sediments have been listed by Maxwell (in Hill & Denmead 1960, pp. 167-8) and the material collected by the authors was examined by Wass (Appendix 5).

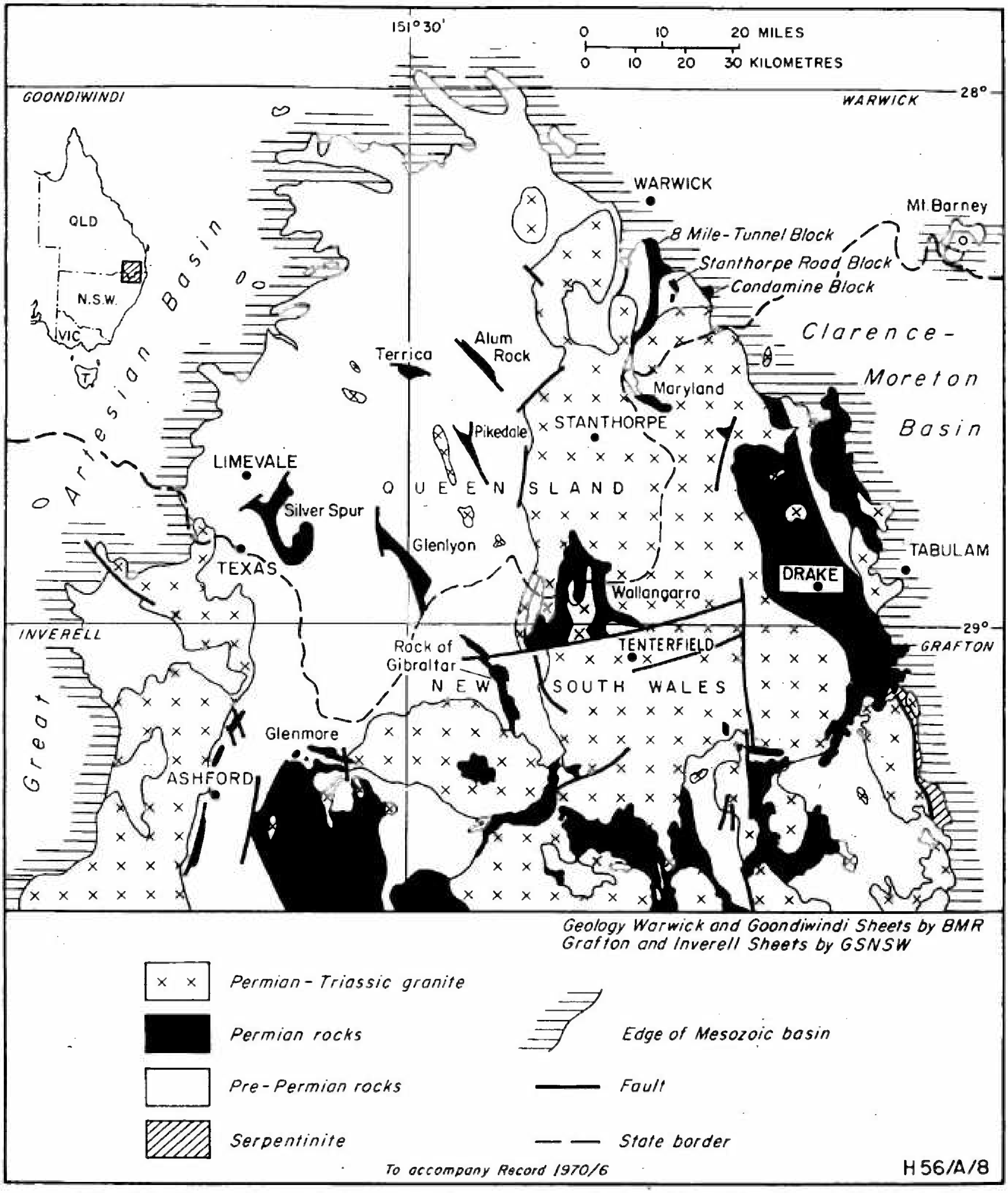


Fig.29-Permian of the northern part of the New England Fold Belt

PERMIAN

The Permian rocks are mainly confined to small outliers ,inliers and fault blocks; one large area of outcrop is east of the New England Batholith in the Drake-Rivertree region (Fig. 29).

The Permian strata in the Silverwood area, which occur in three fault blocks, the Condamine, Stanthorpe Road and Eight Mile - Tunnel Blocks, were first mapped by Richards and Bryan (1923; 1924a) and their nomenclature has been used in this report (Fig. 15).

Lucas (1957; 1958) mapped the area west of the New England Batholith and he considered large areas to be made up of Permian rocks, however our mapping has shown that the Permian strata are confined to small outliers within the Lower Carboniferous sequence. Five outliers were recognized and mapped out but it is expected that others are present

Correctly, the strata in each outlier should be given a different stratigraphic name; however this would in the future lead to a multitude of names each covering a small area of outcrop of rocks which are of the same age and lithologically indistinguishable. To avoid this, new names have not been introduced for newly mapped areas of Permian outcrop west of the batholith and the nomenclature used by Lucas (1959, 1960) has not been used in this report or on the accompanying geological maps.

The Drake region of New South Wales was mapped by Andrews (1908) and Voisey (1936; 1939). In 1957, Voisey proposed a new strati-graphic subdivision and nomenclature for the Permian sequence in the Drake region (Fig. 15). without describing the units or showing their distribution. That nomenclature is only partly used here. The authors subdivided the sequence between Rivertree and Drake into four units (from the base upward): Paddys Flat Formation (new unit), Razorback Creek Mudstone (new unit), Drake Volcanics (Andrews, 1908) and Gilgurry Mudstone (Voisey, 1957).

The Permian rocks at Wallangarra and in the Maryland River northeast of Stanthorpe, which were first recorded by Andrews (1905) and Voisey (1939) respectively, remain unnamed.

Eight Mile Creek Beds (Richards & Bryan, 1924a)

Derivation of name: Eight Mile Creek, 12 km south of Warwick.

Type area: Eight Mile Creek.

Distribution: An area of about 3 sq km along Eight Mile Creek, 3 km northeast of Silverwood Siding (Pl. 3). The outcrop of the lower part of the sequence is generally poor but the upper part is well exposed in Eight Mile Creek and the small tributaries that join it from the north.

Lithology: The lower 450 m of the unit is made up of sediments including conglomerate (containing pebbles of chert, silicified sandstone and volcanic rock), pebbly lithic sandstone, grey very hard well sorted lithic sandstone containing abundant marine fossils, siltstone, and mudstone. The upper part of the sedimentary sequence contains in places abundant Lower Permian marine macro fossils. The *Glossopteris* bearing shales reported by Richards and Bryan (1924a) could not be located. The upper 450 m of the Eight Mile Creek Beds are entirely made up of acid volcanic rocks including agglomerate, breccia, tuff and crystal lithic tuff. The volcanics are thought to be equivalent to the volcanic rocks of the Rhyolite Range Beds from which they are separated by intrusive rocks.

Relationships: The Eight Mile Creek Beds are faulted against the Rosenthal Creek Formation, they are in contact with the Connolly Volcanics, intruded by quartz-feldspar porphyry and spherulitic rhyolite, and they are unconformably overlain by the Jurassic Marburg Sandstone. The contact with the Connolly Volcanics is

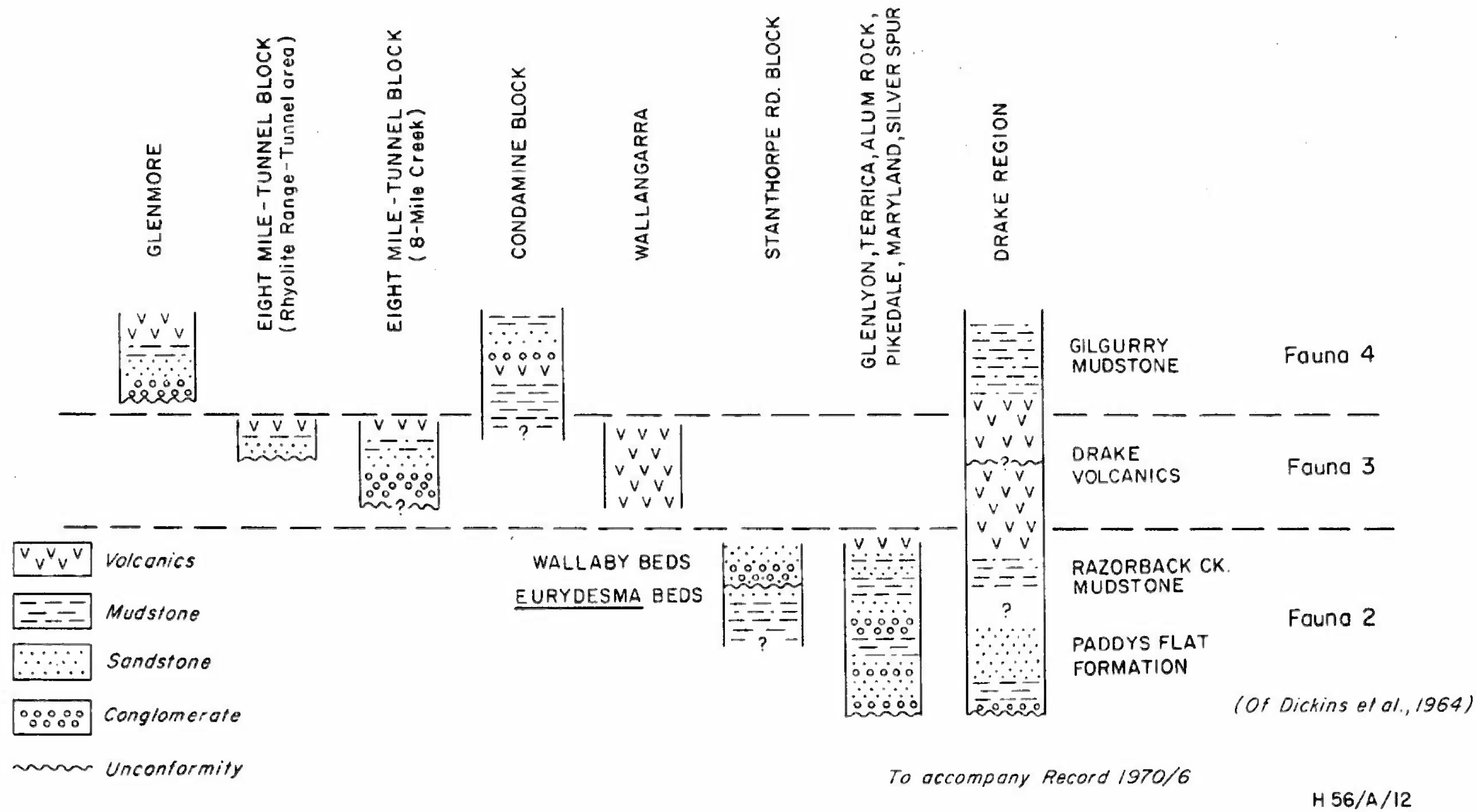


Fig. 30 - Permian correlation chart
(Thickness not to scale)

poorly exposed, however the lowermost Permian rocks are conglomerates containing abundant rounded pebbles of Devonian rocks and there is no evidence for faulting; the contact is probably an unconformity.

Thickness: About 900 m.

Age: Lower Permian. The marine fossils belong to Fauna 3A (Appendix 2).

Rhyolite Range Beds (Richards & Bryan, 1924a)

Derivation of name: Rhyolite Range, a prominent north-trending ridge which is approximately 5 km long and situated to the east of Rosenthal Creek, about 8 km south of Warwick (Pl. 3).

Reference area: Rhyolite Range and the area directly to the east of it opposite the point where the Warwick to Connolly Dam road crosses Rosenthal Creek (Pl. 3).

Distribution: The Rhyolite Range Beds crop out in the Eight Mile - Tunnel Block. Richards and Bryan (1924a) mapped the Eight Mile and Tunnel Blocks as separate entities, but recent mapping has shown them to be connected (Pl. 3). The southern boundary of the Tunnel Block, as mapped by Richards and Bryan, no longer exists because Permian volcanics and sediments extend up to 6 km south and southwest of Oaklands homestead. The Eight Mile - Tunnel Block is about 18 km long and its width varies from 3 km in the south, narrowing to about 500m in the central connecting area, and widening to 3 km in the northern part of the block.

Lithology: In the reference area, the east-dipping sequence consists of about 120 m (the thickness of exposed sediment varies along strike because of faulting) of lithic sandstone and siltstone, which is overlain by about 1200 m of predominantly acid volcanic rocks including agglomerate, spherulitic rhyolite, quartz-feldspar porphyry, crystal tuff, and minor dacitic to andesitic lavas. The spherulitic rhyolite occurs in massive lenses which may be sills related to the rhyolite dome which intrudes the Permian sequence 2.5 km northeast of Silverwood Siding. This is supported by the presence, just north of Ormoral siding, of east-trending, flow-banded spherulitic rhyolite dykes which intrude sediments of the Rosenthal Creek Formation. A succession similar to that in the reference area, is present in the southern part of the Eight Mile - Tunnel Block. About 1.5 km south-southwest of Oaklands homestead gently dipping Permian sediments unconformably overlie steeply dipping sheared siltstones of the Rosenthal Creek Formation. The unconformity is in places faulted or intruded by a quartz-feldspar porphyry dyke. This is the only known locality where the Devonian-Permian unconformity can be demonstrated.

To the northeast and southwest of Rosenthal Creek, about 1 km northeast of Oaklands homestead, in excess of 300 m of Permian sediments are exposed. They consist of fine to medium-grained lithic sandstone, pebbly sandstone, calcareous siltstone and mudstone. Of special interest is the occurrence, both in the railway cutting in the northwestern part of the Eight Mile - Tunnel Block and in this area, of a fine-grained yellow sandstone which has numerous worm trails on its upper surface (Fig. 31). From its stratigraphic position it would appear to be very close to the base of the sequence. These sediments are overlain by about 450 m of acid volcanic rocks including agglomerate, quartz porphyry, spherulitic rhyolite, and crystal tuff.

Relationships: The unit unconformably overlies the Rosenthal Creek Formation, is faulted against the Silverwood Group, is intruded by spherulitic rhyolite and the Stanthorpe Adamellite, and is unconformably overlain by the Marburg Sandstone. The correlation with other Permian strata in the region is set out in Figure 30.

Thickness: Sediments about 300 m; volcanics 1,200 m. The base and top of the sequence are not exposed.

Age: Lower Permian. The marine fossils belong to Fauna 3A (Appendix 2).

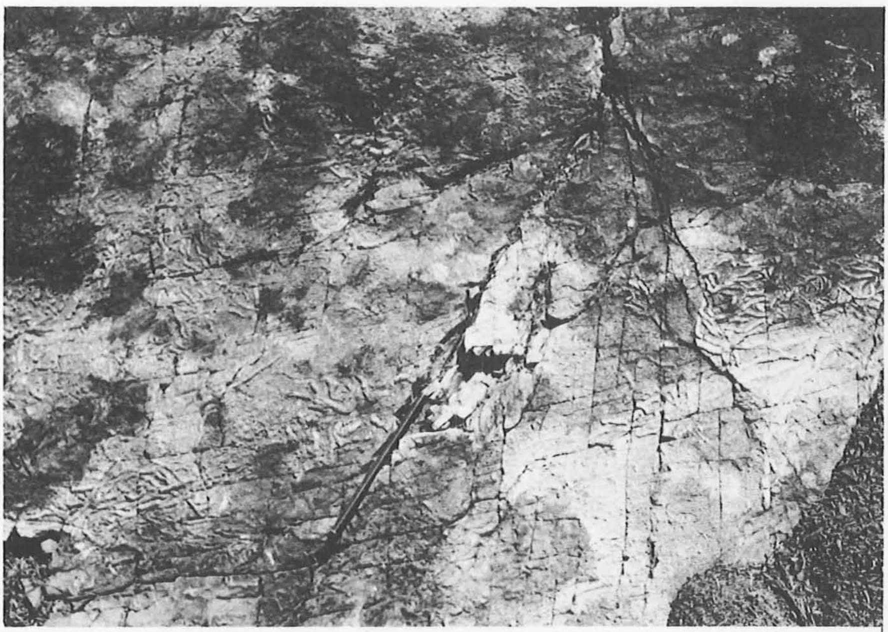
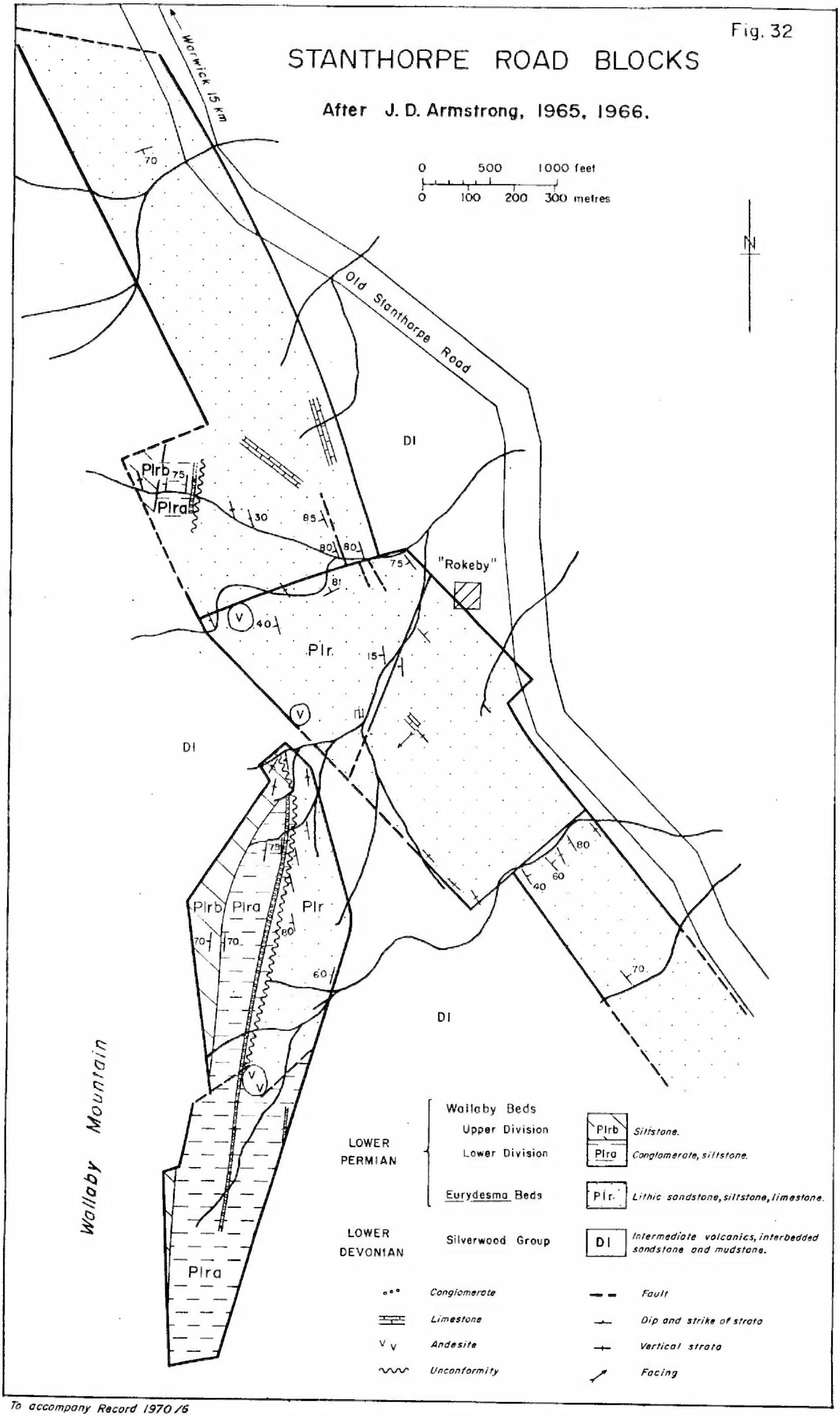


Fig. 31 - Bedding plane with numerous worm trails in the Lower Permian Rhyolite Range Beds, railway cutting 5.5 km south of Warwick. Scale is pencil, 17 cm long. (Neg.No.M/949)



To accompany Record 1970/6

H 56/A2/16

Eurydesma Beds and Wallaby Beds (Richards & Bryan, 1924a)

Derivation of name: The names were first used by Richards and Bryan (1924a) to describe the sedimentary sequence cropping out in the Stanthorpe Road Block. The name *Eurydesma* Beds is applied to the lower part of the sequence in which the fossil *Eurydesma* abounds, and the name Wallaby Beds refers to the upper part of the sequence which crops out on the east slope of Wallaby Mountain, 1.5 km south-southwest of Rokeby homestead (Fig. 32).

Distribution: Richards and Bryan (1924a) did not map out the twofold subdivision, however this was done by Armstrong (1965, 1966), and is shown in Figure 32. Because of the limited extent of both units, they are combined on the Warwick 1:250,000 Sheet. Armstrong (1965) was the first to recognise that the Stanthorpe Road Block consists of two isolated blocks. The eastern block is about 1.5 km long and less than a kilometre wide, and the smaller western block is 1 km long and one third of a kilometre wide (Fig. 32).

Lithology: The *Eurydesma* Beds consist of conglomerate, fine to medium-grained lithic sandstone, dark calcareous siltstone, and thin-bedded limestone. The Wallaby Beds are divisible into two members of approximately equal thickness, the lower consists of conglomerate, lithic sandstone, and siltstone, and the upper predominantly of ferruginous siltstone.

Relationships: Richards and Bryan (1924a) were unable to decide whether the junction between the *Eurydesma* Beds and the Wallaby Beds was an unconformity or a fault. Voisey (1935) suggests that the junction is a fault, but Armstrong (1965, 1966) states that it is more likely to be a small angular unconformity. The authors agree with the latter interpretation. Both sequences are downfaulted against the Connolly Volcanics and Rosenthal Creek Formation. The correlation of the *Eurydesma* and Wallaby Beds with the Permian rocks of the Condamine and Eight Mile-Tunnel Blocks and the other Permian strata in the region is shown in Figure 30.

Thickness: *Eurydesma* Beds about 200 m and the Wallaby Beds about 150 m. The base and top of the sequence are not exposed.

Age: Lower Permian. The marine fossils belong to Fauna 2 (Dickins, pers. comm.).

Condamine Beds (Richards & Bryan, 1924a)

Derivation of name: Condamine River south of Warwick.

Type area: Lucky Valley Creek and Condamine River 21 km south-southeast of Warwick.

Distribution: An area of about 25 sq km in the type area (Pl. 3 & Fig. 33).

Lithology: Figure 33 shows the section that was measured along Lucky Valley Creek from the Condamine River to the boundary fault in the west. The lower 330 m of the section consists largely of dark grey to black slightly calcareous mudstone with some thin beds of fine-grained sandstone. A richly fossiliferous bed occurs near the top of the mudstone sequence (Fig. 33, Loc. TH408). Scattered outcrops east of the Condamine River consist mainly of calcareous mudstone similar to the mudstone of the lower part of the measured section. Corals were observed at several localities. The mudstone sequence is overlain by two thick beds of rhyolitic crystal lithic tuff, which are separated by black fossiliferous mudstone and some coarse-grained sandstone and conglomerate. The volcanics are followed by about 300 m of poorly sorted sandstone, pebbly sandstone and conglomerate. Some of the sandstones contain abundant large angular feldspar fragments, and thin beds of tuff and reworked tuff occur. Fossils occur particularly in the coarser grained rocks. The upper part of the Condamine Beds consists of about 300 m of unfossiliferous mudstones and fine-grained sandstones which are similar to the fine-grained rocks that make up the lower part of the unit.

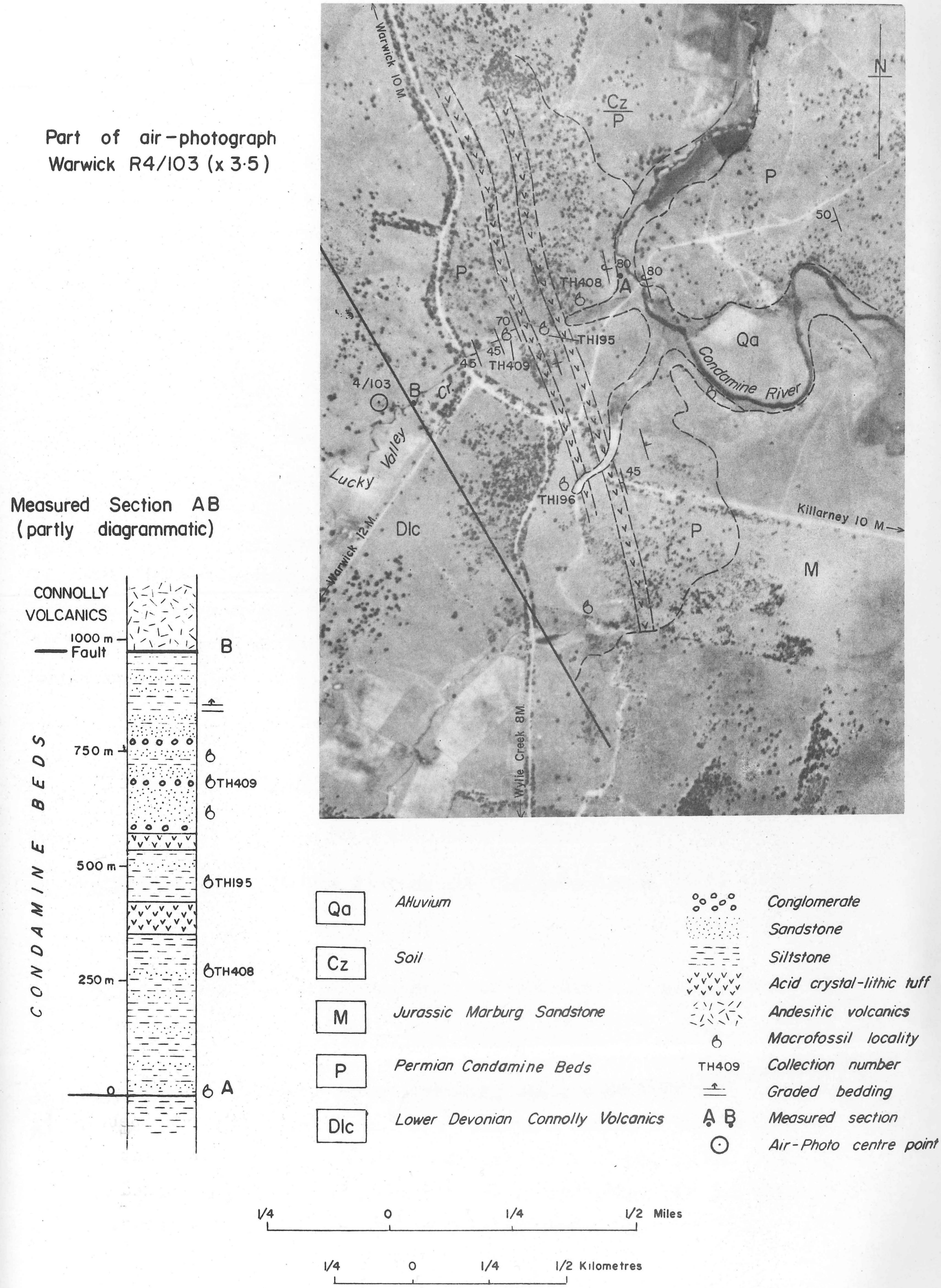


Fig. 33 - Condamine fault block

Relationships: Faulted against Devonian strata to the west and overlapped from the east by the Jurassic Marburg Sandstone. For correlation with other Permian strata, see Figure 30.

Thickness: The exposed thickness is about 2,000 m, assuming that the beds east of the Condamine River dip westerly at an average angle of 50 degrees.

Age: Upper Permian. The marine macro fossils belong to Fauna 4 (Dickins, pers. comm.).

Remarks: Outcrop is generally poor but a good section is exposed along Lucky Valley Creek which flows across the upper part of the exposed sequence. The beds dip generally to the west at angles ranging from 45 to 70 degrees; at the Condamine River, the sequence is slightly overturned and dips steeply to the east.

Paddys Flat Formation (new name)

Derivation of name: Paddys Flat on the Clarence River, 25 km northwest of Tabulam.

Type area: Exposures along the banks of the Clarence and Cataract Rivers at Paddys Flat.

Distribution: A north-northwest trending belt, 6 km wide and 40 km long along the Tooloom-Tabulam road. The formation includes the sediments previously referred to the Plumbago Creek Beds (Voisey, 1936, 1939, 1957), and the rocks which have been shown to be younger than the Emu Creek Formation , but which were previously included in them.

Lithology: The formation is essentially a well-bedded sequence of sandstone, mudstone, siltstone, conglomerate, tuff, and minor limestone. In the type area, the sequence consists of a basal conglomerate containing abundant quartz-feldspar porphyry clasts, cherty material, and other sedimentary fragments derived from the underlying Emu Creek Formation. This is followed by mudstone and a well-bedded sequence of fine-grained, poorly sorted siltstone and fine-grained sandstone. The sandstones are in places cross-bedded. A prominent massive conglomerate bed crops out near the junction of the Cataract and Clarence Rivers. This is followed by a massive sandstone sequence which is well bedded, and cross-bedded, and in which the upper surfaces of some beds display large asymmetrical ripple marks with wave lengths up to 1 m. Massive conglomerate beds up to 6 m thick are interbedded with the sandstone sequence.

To the east of the Tabulam-Tooloom Road, the formation consists of conglomerate, sandstone, pebbly sandstone, and mudstone. There is a loss of obvious bedding in this part of the sequence and the sediments are more deformed because of the proximity of granitic intrusions. One isolated lens of limestone, which was mentioned by Voisey (1936, 1939, 1957) and included by him in the Plumbago Creek Beds, occurs in the formation. The limestone crops out on Plumbago Creek, west of the Pretty Gully Road, about 10 km northwest of Tabulam. Its relationship with the adjacent poorly fossiliferous sediments is not understood and any trace of fossils in the limestone has been obliterated by recrystallization.

Relationships: Unconformably overlies the Upper Carboniferous Emu Creek Formation and is unconformably overlain by the Jurassic Marburg Sandstone and Tertiary basalt. It is intruded by granites that are probably of late Permian or early Triassic age. The relationships of the Paddys Flat Formation with the Permian sequence farther to the west, from which it is separated by a narrow belt of Upper Carboniferous rocks (Pl. 1), is not exactly known, but the formation is, on stratigraphic grounds, thought to be older than that sequence (Fig. 30 & Pl. 1, cross-section D-E-F).

Thickness: At least 2,400 m. Top not exposed.

Age: Lower Permian. The marine fossils belong to Fauna 2 (Dickins, pers. comm.).

Razorback Creek Mudstone (new name)

Derivation of name: Razorback Creek, a north-flowing tributary of the Maryland River, 32 km east of Stanthorpe.

Type area: Razorback Creek and Razorback Ridge east of the creek, 8 km southwest of Rivertree homestead.

Distribution: The unit crops out over an area of about 100 sq km along Razorback Creek and northwest and southeast of Rivertree homestead.

Lithology: Massive olive-green mudstone.

Relationships: Base not exposed and the relationship with the Paddys Flat Formation, which on stratigraphic grounds is older than the Razorback Creek Mudstone, is not known (Fig. 30). The formation grades upwards into the Drake Volcanics and the contact between the formations is taken below the first prominent bed of tuff. The eastern margin of the Rivertree outcrop belt is faulted against the Emu Creek Formation. The unit is intruded by granite and basic dykes.

Thickness; About 300 m; base not exposed.

Age: The formation is unfossiliferous but its age, which is based on the conformable relationship with the overlying Drake Volcanics, is considered to be Lower Permian.

Drake Volcanics (Andrews, 1908)

Derivation of name: Drake, a small township on the Bruxner Highway, between Tenterfield and Tabulam. The name was first used by Andrews (1908, p. 11) for the volcanic sequence which crops out in the Drake district. Voisey (1936, 1939) included part of the volcanic sequence in the Lower Division of his Drake Series (Fig. 15), and in 1957 he introduced a subdivision of the Permian sequence in the Drake region without defining the units (Fig. 15.). Voisey's (1957) nomenclature for the volcanic rocks is not used here. The name Drake Volcanics should be used until the boundary between the two units into which the volcanic sequence possibly can be subdivided (p. 47) has been mapped out.

Reference area: Road cuttings along the Bruxner Highway, from 10 km east of Drake to 6 km west of Drake where the highway descends Newmans Pinch (Pl. 1).

Distribution: An area of about 650 sq km centred about Drake and extending southward into the Grafton Sheet area.

Lithology: In the north, the unit is essentially a sequence of interbedded grey to greenish-grey acid to intermediate volcanic flows and fine-grained volcanolithic sediments. In the south, the formation consists of a thick sequence of pyroclastic rocks including dark grey to purplish agglomerate, coarse-grained tuff and crystal-lithic tuff, and volcanic breccia. Some volcanolithic sediments are present and a small lens of limestone, consisting largely of crinoidal material, occurs in a road cutting at Newmans Pinch west of Drake. Flow rocks make up a very small part of the Drake Volcanics in the southern part of the area of outcrop.

Although the volcanic sequence has been mentioned by numerous authors (Andrews, 1908; Browne, 1929; Voisey, 1936, 1939; Leitch, 1969; McKelvey & Gutsche, 1969), a detailed petrological examination of the volcanics has not been made.

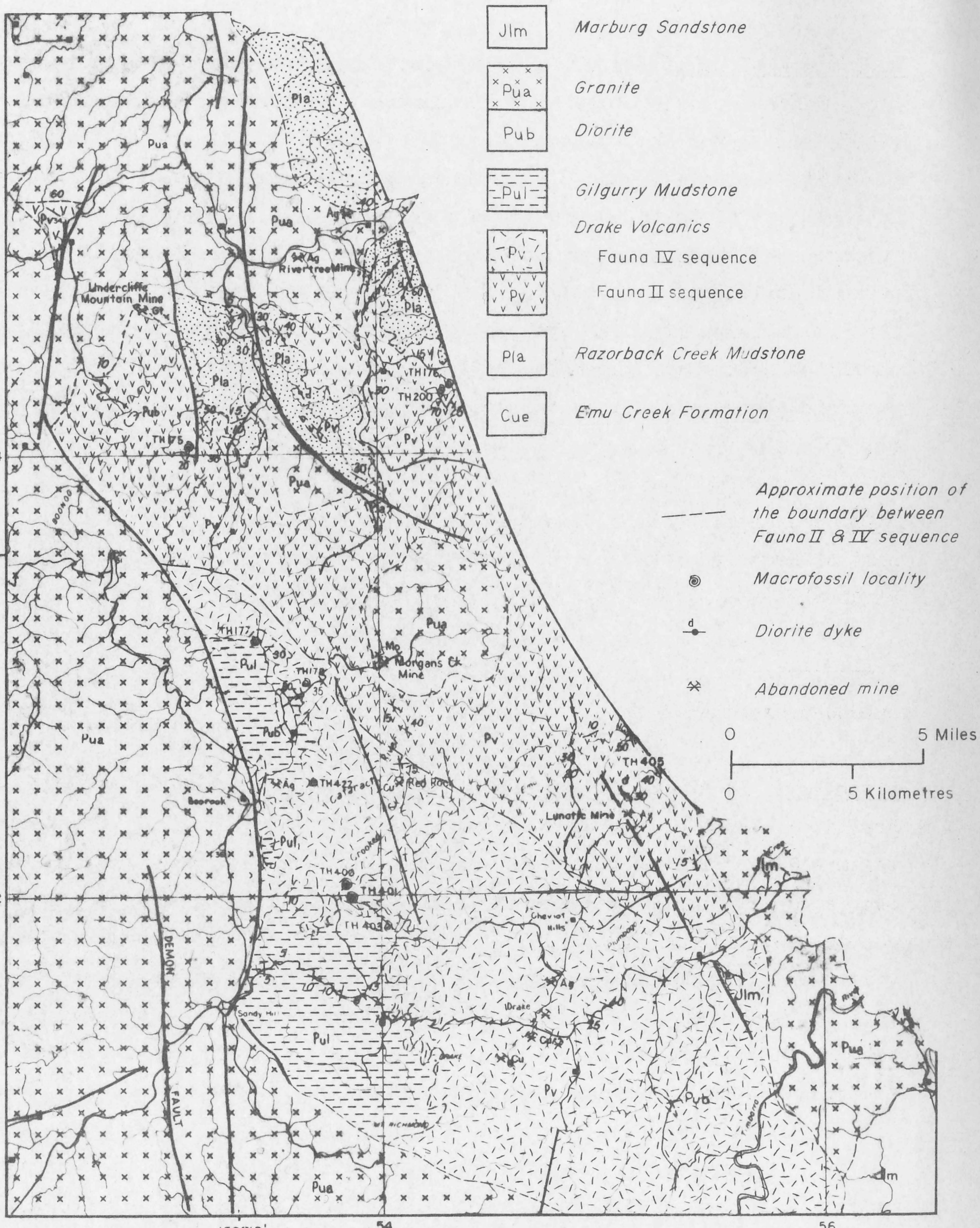


Fig. 34 — SUBDIVISION OF THE DRAKE VOLCANICS

To accompany Record 1970/6

H56/A2/17

Relationships: Conformably overlies the Razorback Creek Mudstone and is conformably overlain by the Gilgurry Mudstone. The boundaries with both units are gradational. Lower Permian fossils have been recovered from the tuffaceous sandstones and calcareous mudstones of the basal part of the sequence and Upper Permian fossils have been recovered from sedimentary interbeds high in the volcanic sequence, just below the Gilgurry Mudstone. The greater degree of deformation of the sediments containing the older fauna may indicate a significant break within the sequence. Such a break could not be located in the field, but Figure 34 shows the approximate location of the change from moderately steeply dipping interbedded sediments and volcanics to less disturbed pyroclastics and flows. This subdivision could possibly correspond to Telford's (in press) subdivision of the volcanic sequence near Red Rock into Cheviot Hills Beds (top) and Cataract River Formation (the names were introduced by Voisey in 1957).

Thickness: About 450 m.

Age: Lower to Upper Permian. The marine faunas belong to Faunas 2 and 4 (Dickins, pers. comm.).

Gilgurry Mudstone (Voisey, 1957)

Derivation of name: The name, which was introduced without definition by Voisey (1957), was derived from Gilgurry Creek which heads about 1.5 km north of Boorook homestead, and flows northward into the Boonoo Boonoo R'ver.

Reference area: Road cuttings along the Bruxner Highway for 6 km east of Sandy Hill.

Distribution: An area of approximately 75 sq km southeast and northeast of Sandy Hill, 13 km west of Drake.

Lithology: Dark grey to green siltstone, siliceous and calcareous mudstone, and minor light brown feldspathic sandstone.

Relationships: The unit conformably overlies the Drake Volcanics. The base is exposed in road cuttings west of Newmans Pinch. The upper part of the sequence has been removed by erosion. In the west and southwest, the formation is faulted against the Stanthorpe Adamellite.

Thickness: 150 m.

Age: Upper Permian. The marine fossils belong to Fauna 4 (Dickins, pers. comm.).

Permian rocks at Alum Rock homestead.

Nomenclature: Lucas (1958) first recorded Permian rocks in the vicinity of Alum Rock homestead and referred to them as the Alum Rock Conglomerate. The name is not used here (see p. 37)

Location: A narrow outlier in Carboniferous rocks at Alum Rock homestead. The extent of the outlier and the relationships with the surrounding rocks were established during the present survey.

Lithology: The lower 165 m of the sequence consists mainly of conglomerate, poorly sorted sandstone and pebbly sandstone with only one prominent bed of siltstone about 60 m above the base of the succession (Fig. 35). The conglomerates are thin to thick-bedded, in places graded, and all contain pebbles directly derived from the underlying Carboniferous sequence. The sandstones contain abundant rock fragments; they are poorly sorted and pebbly and in places show graded bedding. The siltstone bed is concretionary (Fig. 37) and contains marine fossils and pieces of fossil wood up to 20 cm long.

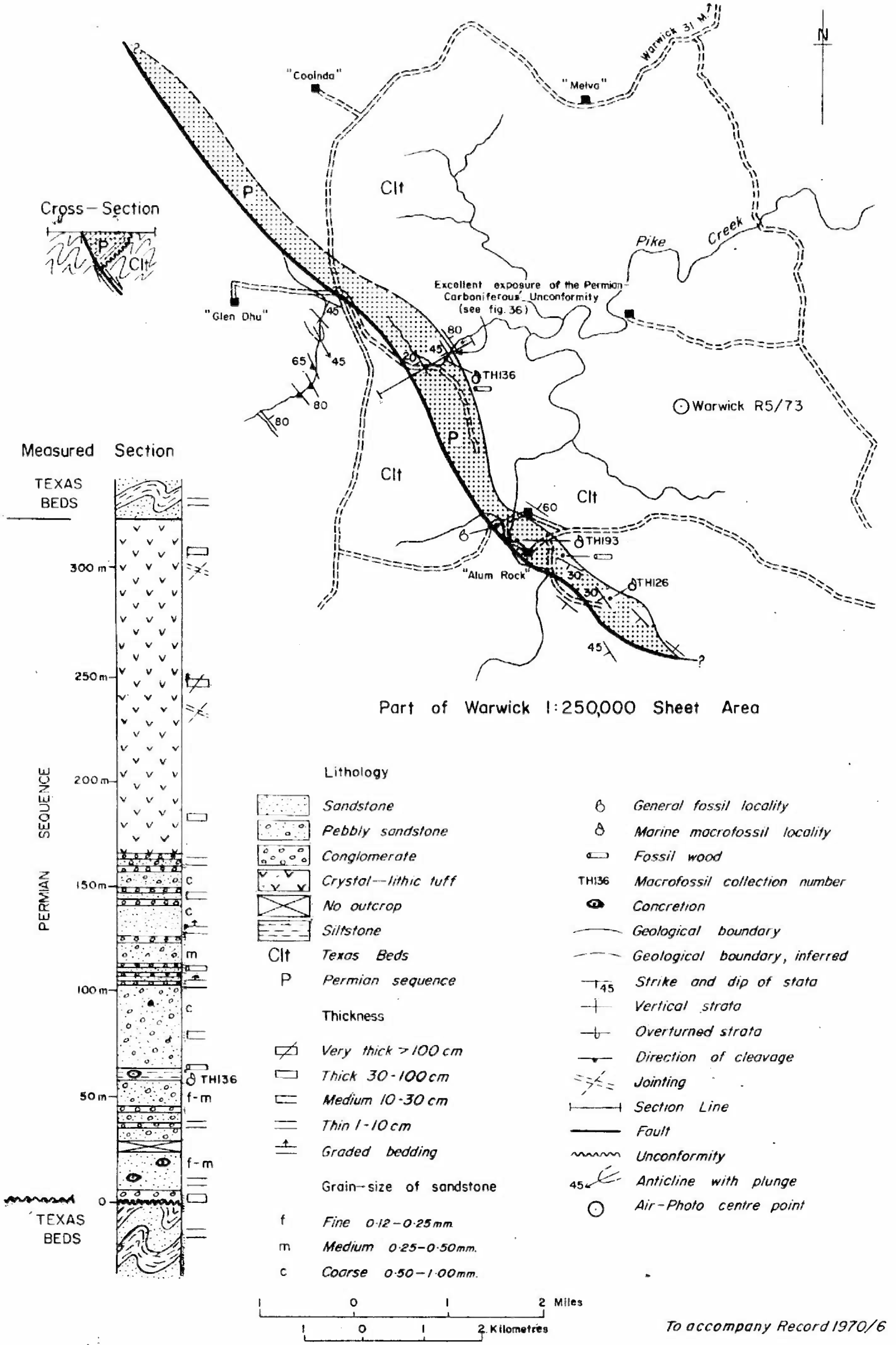


Fig.35 - Permian sequence at Alum Rock homestead.

H56/A/6 E.H.

Fig. 36 - Carboniferous-Permian unconformity exposed 3 km north-northeast of Alum Rock homestead. Looking south, the west-dipping (30^{o}) Lower Permian basal conglomerate, which is about 3 metres thick, rests unconformably on steeply east-dipping sandstone-mudstone-chert interbeds of the Lower Carboniferous Texas Beds. (Neg.No.GA/2219)

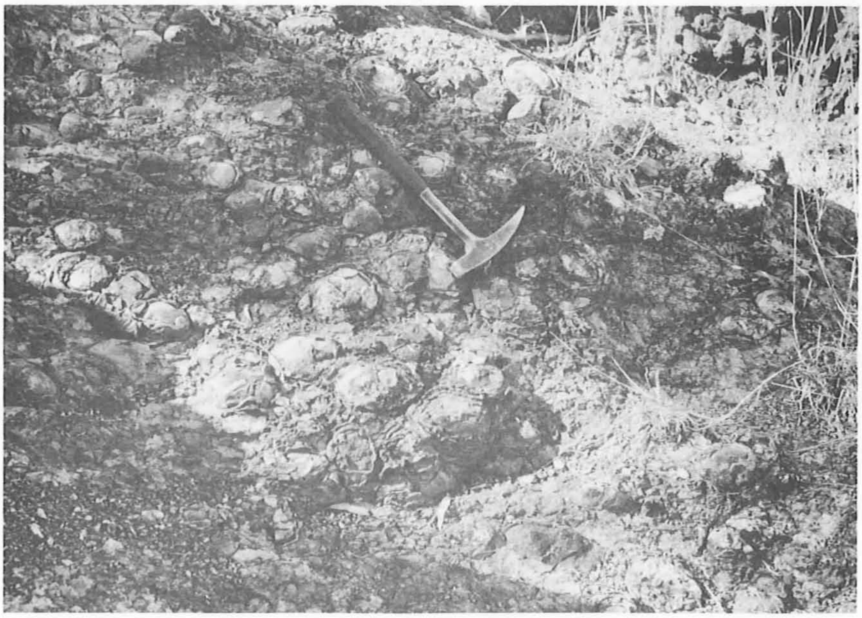


Fig. 37 - Concretionary siltstone of the Lower Permian sequence exposed 3 km north-northwest of Alum Rock homestead. (Neg.No.GA/2221)

The upper part of the sequence consists largely of crystal-lithic tuff and reworked tuff with some spherulitic rhyolite (Fig. 35).

Relationships: The Permian rocks unconformably overlie the Carboniferous sequence along the eastern margin of the outcrop belt, and the western margin is entirely faulted. The Permian rocks dip southwesterly at angles progressively decreasing from 45 degrees at the unconformity to 20 degrees near the western margin of the outlier. The unconformity is of high angle and very well exposed in a gully 4 km northwest of Alum Rock homestead (Fig. 36); it can best be reached from the Warwick to Pikedale road (Fig. 35).

Thickness: About 300 m.

Age: Lower Permian. The fossils belong to Fauna 2 (Dickins, pers. comm.).

Permian rocks at Terrica homestead

Nomenclature: The sequence has previously been referred to as the Terrica Beds (Lucas, 1959, 1960), but the name is not used here (see p. 37)

Location: A small outlier 1.5 km east of Terrica homestead on the boundary between the Warwick and Goondiwindi Sheet areas (Fig. 38).

Lithology: The sequence consists of conglomerate containing abundant chert pebbles, poorly sorted lithic sandstone and pebbly sandstone containing pebbles of chert, sandstone and volcanic rocks mainly derived from the underlying Texas Beds, and dark grey mudstone.

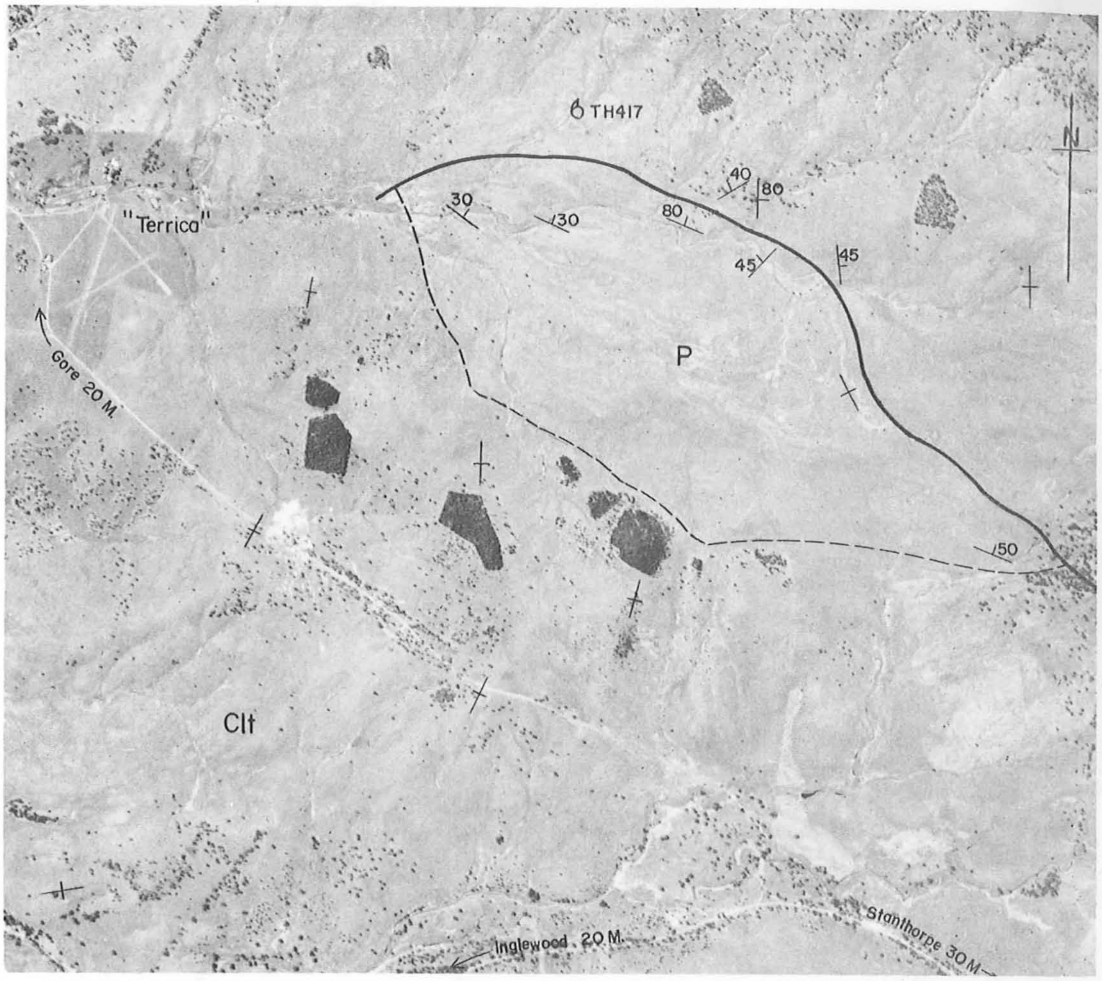
Relationships: Unconformably on and faulted against the Lower Carboniferous Texas Beds. The Permian-Carboniferous unconformity can readily be demonstrated in the field. The outcrop in the vicinity of the western contact between the Permian and Lower Carboniferous strata is very poor however the lowermost Permian rocks, which dip at a low angle to the northeast, strike across northeast-trending strike ridges made up of steeply dipping to vertical bands of chert. Also, there is no evidence for faulting or low angle thrusting.

Thickness: Preserved thickness about 300 m.

Age: Permian. Lucas (1957) reports Permian fossils from the area, however they were not found during the present survey.

Permian rocks at Pikedale homestead

Conglomerate, lithic sandstone, mudstone and acid volcanic rocks occur in a small area near Pikedale homestead. Outcrop is generally poor and the boundaries between these rocks and the typical Lower Carboniferous interbedded sandstone-mudstone sequence surrounding it have not been well established but are thought to be largely faulted. Identifiable macrofossils have not been found but fossilwood and crinoid columnals are abundant in poorly sorted conglomerate and conglomeratic sandstone just northeast of the bridge across Pike Creek. The Permian age, which has been assigned to the sequence, is based on the close similarity between these rocks and the Permian strata preserved in the other small outliers in the region.



Part of air-photograph Warwick Run 5 No 67 (x2)

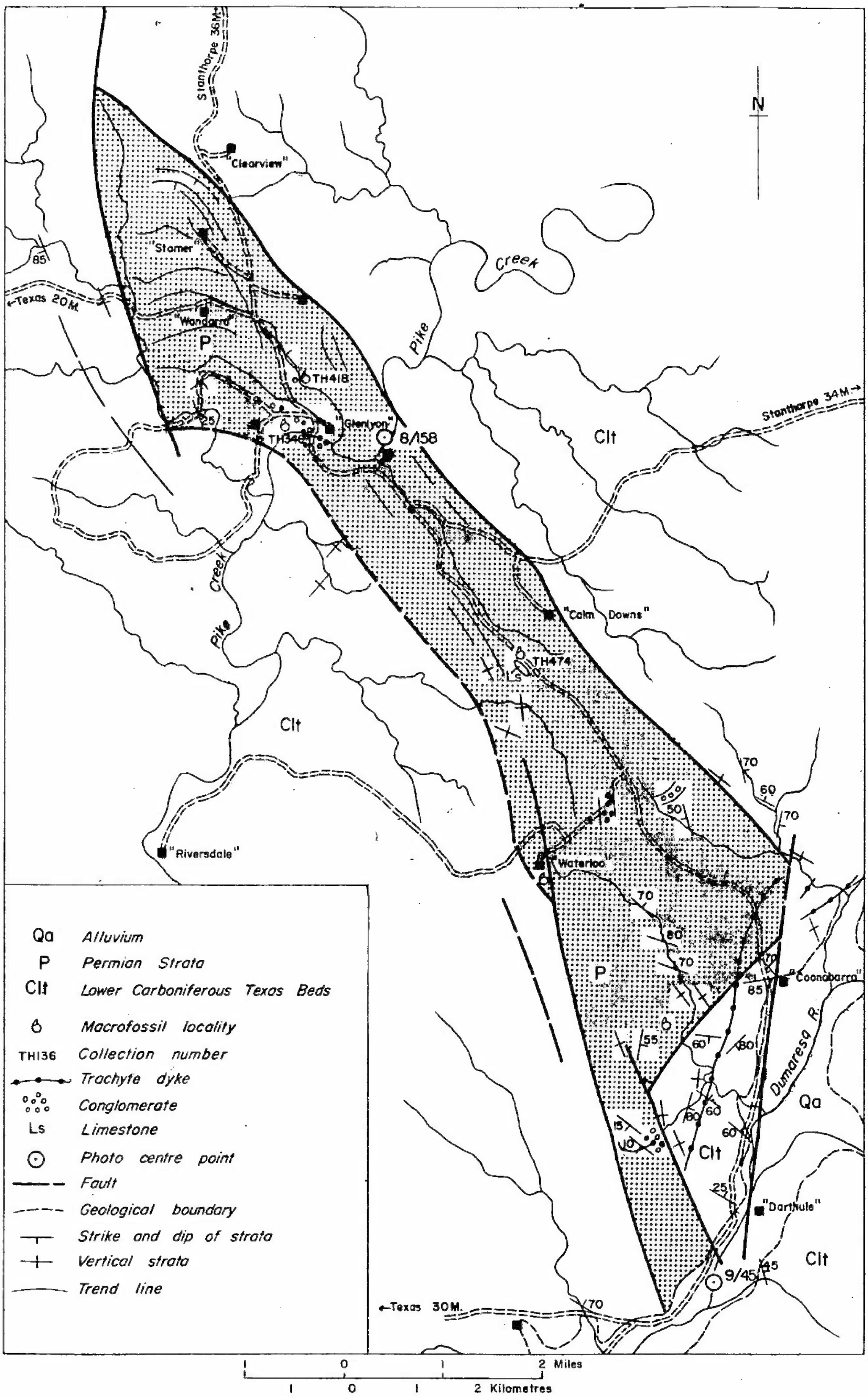
P	*Permian strata*	——	*Fault*
Clt	*Lower Carboniferous Texas Beds*	----	*Geological boundary (unconformity)*
6	*Macrofossil locality*	┬	*Dip and strike*
TH417	*Collection number*	┼	*Vertical strata*

1/2 0 1/2 1 Miles

1/2 0 1/2 1 Kilometres

Fig. 38 - Permian sequence near Terrica homestead.

To accompany Record 1970/6 H56/A2/13 E.H



To accompany Record 1970/6

Fig. 39 - Permian sequence, Glenlyon area.

H56/A/5 E.H.

Permian rocks at Glenlyon homestead

Lower Permian fossils were known from the vicinity of Glenlyon homestead in the southeast of the Goondiwindi Sheet area for some time, and Lucas (1960) included the sequence in the Silver Spur Beds. Detailed mapping in the area has shown that the Permian rocks are restricted to a narrow southeast-trending belt from the vicinity of Clearview homestead in the north to the Dumaresq River in the south (Fig. 39). Lower Carboniferous rocks crop out on the south bank of the river, however 3 km to the southeast along the Bruxner Highway are outcrops of conglomerate which are probably Permian, and still farther to the southeast in the valley of the Mole River, are extensive outcrops of Permian sediments and also volcanics (Fig. 29). The Glenlyon outlier is probably completely fault bounded. In the north the rocks generally dip at low angles to the south and southwest and in the southern part of the outlier the beds are mainly steeply inclined to vertical. The sequence consists of conglomerate made up of well rounded pebbles and cobbles of silicified sandstone, chert and volcanic rocks set in a mudstone or sandstone matrix, lithic sandstone consisting mainly of volcanic rock fragments, pebbly lithic sandstone, pebbly mudstone, and minor poorly fossiliferous limestone. Lower Permian marine fossils belonging to Fauna 2 (Dickins,pers. comm.) were noted at several localities.

Permian rocks at Silver Spur

Nomenclature: The Permian sequence in the Silver Spur area was previously mapped as the Silver Spur Beds (Lucas, 1959, 1960). The name was applied to a large area in the vicinity of Silver Spur, to a northwest trending belt of country from Red Gate homestead in the north into the valley of the Mole River south of the Rock of Gibraltar (Grafton Sheet), and to 2 smaller areas of outcrop northwest and southwest of Pikedale homestead (Lucas, 1960). The present survey has revealed that the greater part of these areas mapped as Silver Spur Beds are part of the Lower Carboniferous sequence and that the Permian strata are restricted to very small outliers. The name Silver Spur Beds is not used here (see p. 37).

Location: An irregularly shaped outlier 3 km east of Texas.

Lithology: Conglomerate, sandstone, mudstone and some thin beds of limestone. The conglomerate consists of well rounded pebbles, cobbles and boulders of silicified sandstone, chert and granite. Boulders of granite up to 2 m long have been reported from the area near Silver Spur (Wade, 1941). The sandstones are poorly sorted and consist largely of volcanic rock fragments with some feldspar and quartz. Pebbles up to 20 cm long have been observed. The mudstones are in places tuffaceous and locally contain numerous small pebbles. Marine macro fossils were found at several localities (Fig. 40).

Relationships: The Permian rocks unconformably overlie the Lower Carboniferous Texas Beds and are faulted against them along the northern margin of the outlier (Fig. 40). The unconformity is best exposed just north of the Limevale to Redgate road where Permian pebble conglomerate containing few marine macro fossils dips at a low angle to the west and overlies steeply northeast dipping interbedded lithic sandstone and mudstone of the Texas Beds. Outcrop is generally poor but the unconformity is exposed in shallow washouts on the northwest slopes of a low hill just north of Back Creek (Fig. 40).

Structure: The rocks in the Silver Spur outlier and particularly those in the southeast are more intensely deformed than those in the other outliers. The strata are generally steeply inclinded to vertical and cleavage is commonly developed in the mudstones and, in the southeastern part of the outlier just northeast of Silver Spur, also in the sandstones and conglomerates. The strike of the Permian strata in the north of the outlier and the strike of the adjoining Lower Carboniferous rocks is north-northwest. An abrupt swing in strike from north-northwest to northeast occurs in both sequences in the Silver Spur area indicating that the Permian and Lower Carboniferous rocks were together involved in a folding episode.

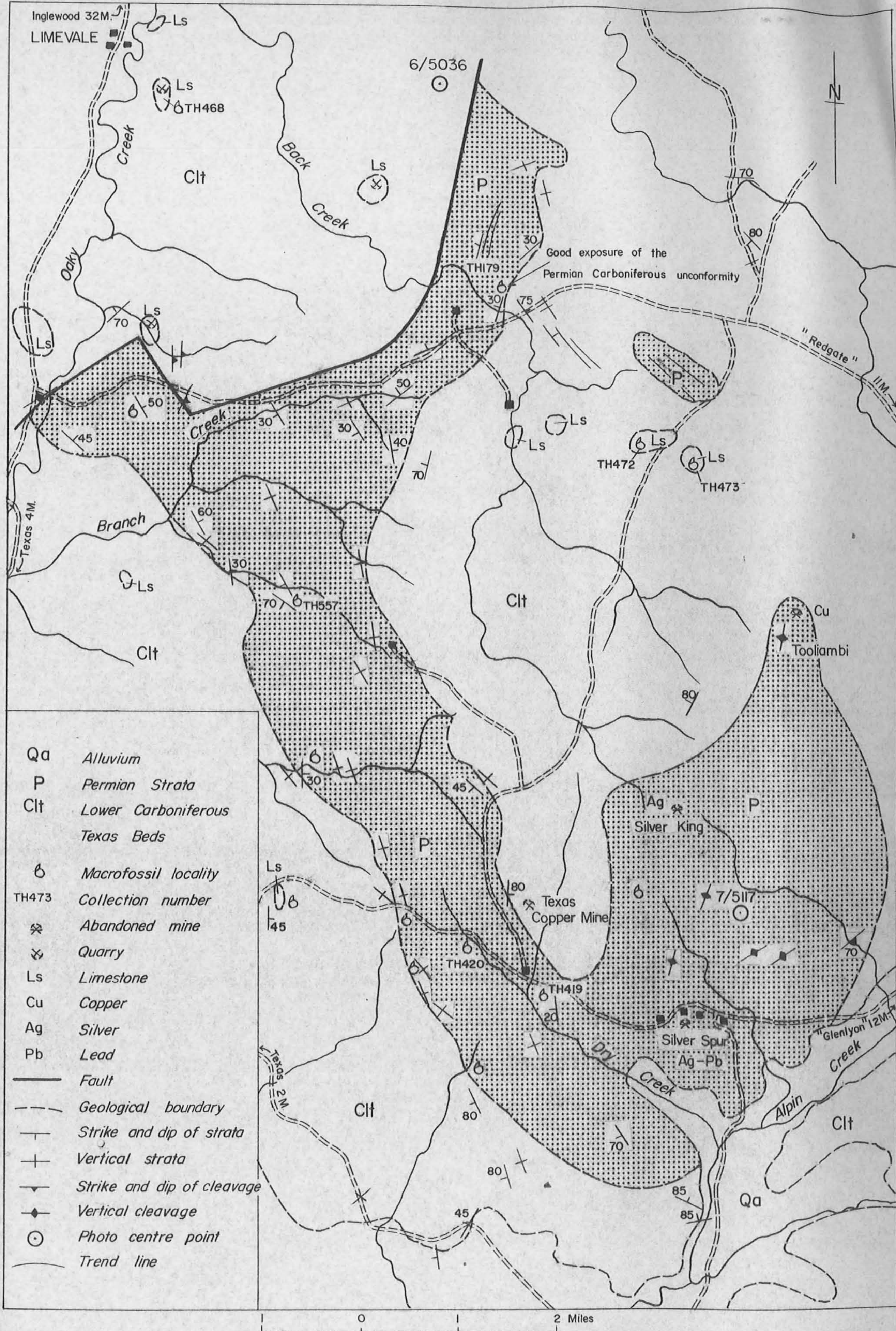


Fig. 40 - Permian sequence, Silver Spur area.

To accompany Record 1970/6 H56/A/4 E.H.

The Silver Spur Mine lies on the axis of this fold and the lenticular ore bodies which were formed by replacement of the country rocks, are all confined to the highly jointed and sheared rocks.

Thickness: The preserved thickness is estimated to be about 900 m.

Age: Lower Permian. The marine fossils belong to Fauna 2 (Dickins, pers. comm.).

Permian rocks at Glenmore homestead

Little work was done in the Glenmore area by the authors. The main purpose of the visit to the area was to locate in outcrop the fossiliferous strata, a float of which was collected by Lucas (1958) from a creek just south of Glenmore homestead (Fig. 41B).

Nomenclature: The whole area in the vicinity of Glenmore homestead, including the Lower Carboniferous Texas Beds and Permian sequence, was previously mapped as the Lower Permian Glenmore Beds (Lucas, 1960). The name should be abandoned; it cannot be applied only to the Permian strata because these are contiguous with the Permian Emmaville Volcanics of the Grafton Sheet area to the east.

Relationships: The Permian rocks unconformably overlie the Lower Carboniferous Texas Beds. The unconformity, which had not been recognized previously, is very well exposed one kilometre south of the homestead along the northern margin of the Permian outcrop belt (Fig. 41C). The Permian rocks at the unconformity are gently dipping, however dips up to 60 degrees were recorded at the fossil locality half a kilometre to the south, the deformation being due to massive quartz-feldspar porphyry dykes which intrude the sequence.

Lithology: The bulk of the Permian sequence consists of very coarse-grained acid pyroclastic material with some interbeds of dark mudstone one of which contains abundant marine macro fossils. A thin sequence of conglomerate, pebbly lithic sandstone and mudstone occurs near the base of the succession. The conglomerate contains abundant rounded pebbles of chert, mudstone and sandstone, all derived from the underlying Texas Beds, and also some fragments and blocks of contemporaneous volcanic rocks.

Age: Upper Permian. The marine fossils belong to Fauna 4 (Dickins, pers. comm.).

Permian rocks in the Maryland River

The Permian rocks were first recorded by Voisey (1939) and later examined by Phillips (1968) who made a detailed study of the phases of the New England Batholith centred around the township of Liston 16 km east of Stanthorpe.

Location: A small inlier on the Maryland River 11 km northeast of Stanthorpe.

Relationships: The inlier is largely surrounded by younger granite of the New England Batholith; to the north are hornfelses and metabasalts which have tentatively been mapped as part of the Lower Devonian Rosenthal Creek Formation (see p. 29). The nature of the contact with the Devonian sediments is not known but is suspected to be a fault. The Permian strata, which dip steeply to the south, strike at right angles to the Devonian sediments.

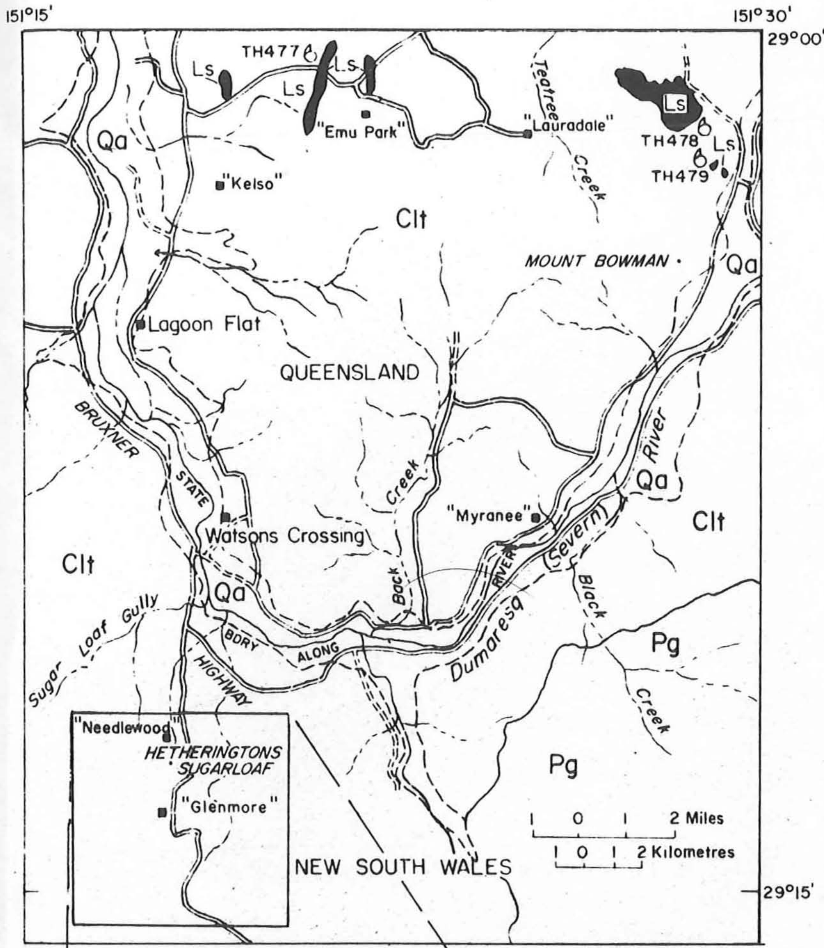


Fig. 41 A — Geological map of the Queensland portion of the Inverell 1:250,000 Sheet

Qa	*Alluvium*
Pg	*Permian granite*
P	*Permian sediments, porphyries and acid volcanics*
Clt	*Lower Carboniferous Texas Beds*
♁	*Macrofossil locality*
TH479	*Collection number*
Ls	*Limestone*
+	*Vertical strata*

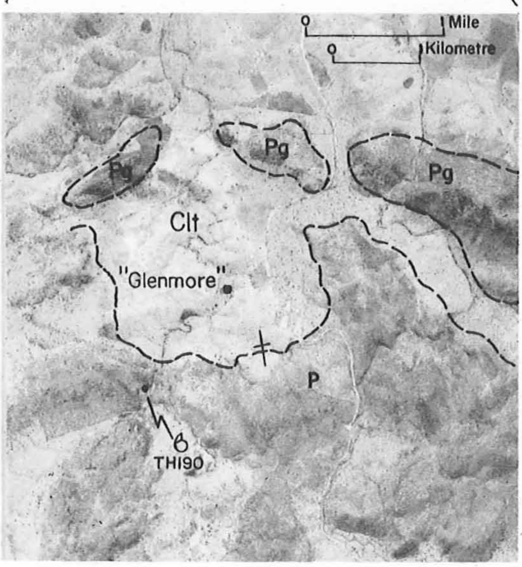


Fig. 41 B — Geology in the vicinity of Glenmore homestead (part of air-photograph Inverell 3/162)

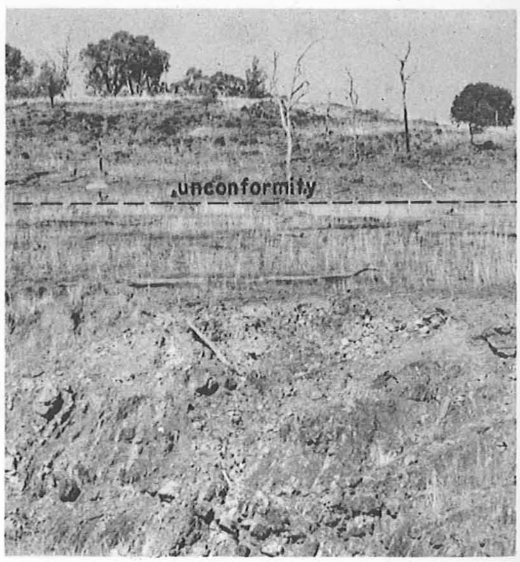


Fig. 41 C — Permian-Carboniferous unconformity south of Glenmore homestead.

Lithology: Tough black slightly carbonaceous fossiliferous siltstone and mudstone, and grey banded rhyolite.

Age: Lower Permian. The marine fossils belong to Fauna 2 (Dickins, pers. comm.).

Permian rocks at Wallangarra

The presence of volcanic rocks at Wallangarra has been mentioned by several authors (Andrews, 1905; Saint Smith, 1914; and Simmonds, 1958).

Reference area: In road cuttings at Devils Pinch on the New England Highway about one kilometre south of Wyberba railway siding, and also south of Wallangarra where the highway crosses the railway.

Distribution: An irregularly shaped area of approximately 50 sq km to the south, west and northwest of Wallangarra.

Lithology: The volcanics are mainly rhyolitic and rhyodacitic flows and tuffs. They appear to be structurally complex because of intense jointing but dips as low as 10° have been observed in bedded tuffs. On the basis of lithological similarity they are correlated with the Drake Volcanics, which crop out about 40 km to the east of Wallangarra.

Relationships: Intruded by the Stanthorpe Adamellite, and possibly also intruded by the Dundee Adamellite Porphyrite.

Thickness: 300-450 m.

Age: Probably Permian.

REFERENCES

ANDREWS, E.C., 1905 - The geology of the New England Plateau, with special reference to the Granites of Northern New England. Part II: General Geology; Part III: The Genesis of the Ore Deposits. Rec. geol Surv. N.S.W., 8, 108-152.

ANDREWS, E.C., 1908 - Report on the Drake gold and copper field. Mineral Resour. N.S.W., 12.

ARMSTRONG, J.D., 1965 - The stratigraphy and palaeontology of the Stanthorpe Road and Tunnel Fault Blocks south of Warwick. B.Sc.(Hons) Thesis Dep. Geol. Univ. Qld (unpubl.).

ARMSTRONG, J.D., 1966 - Geological notes on the Warwick - Elbow Valley area. in Southern Moreton Basin, Guidebook for 1966 Field Conference, Geol. Soc. Aust. Qld. Division, Brisbane, 15-18.

BENSON, W.N., 1913 - The geology and petrology of the Great Serpentine Belt of New South Wales. Part I. Introduction. Proc. Linn. Soc. N.S.W., 38, 490-517.

BROWN, D.A., CAMPBELL, K.S.W., and CROOK, K.A.W., 1968 - THE GEOLOGICAL EVOLUTION OF AUSTRALIA AND NEW ZEALAND. Pergamon Press.

BROWNE, W.R., 1929 - An outline of the history of igneous action in New South Wales till the close of the Palaeozoic Era. Proc. Linn. Soc. N.S.W., 52, ix-xxxiv.

BRYAN, W.H., 1959 - New names in Queensland Stratigraphy, Silverwood area. Aust. Oil Gas J., 5(11), 31-32.

BRYAN, W.H., 1960 - The Wildash Group (Warwick area). J. geol Soc. Aust., 7, 228-229.

BRYAN, W.H., and JONES, O.A., 1944 - A Revised Glossary of Queensland Stratigraphy. Pap. Dep. Geol. Univ. Qld., 2(11), 1-77.

BRYAN, W.H., and JONES, O.A., 1946 - The geological history of Queensland. A stratigraphic outline. Pap. Dep. Geol. Univ. Qld, 2(12), 1-103.

BRYAN, W.H., and JONES, O.A., 1950 - Contributions to the geology of Brisbane, No. 1. Local applications of the standard stratigraphic nomenclature. Proc. Roy. Soc. Qld, 61, 13-18.

BRYAN, W.H., and JONES, O.A., 1954 - Contributions to the geology of Brisbane, No. 2. The structural history of the Brisbane Metamorphics. Proc. Roy. Soc. Qld, 65, 25-50.

CAREY, S.W., and BROWNE, W.R., 1938 - Review of the Carboniferous stratigraphy, tectonics and palaeogeography of New South Wales and Queensland. J. Proc. Roy. Soc. N.S.W., 71(2), 591-614.

CHAPPELL, B.W., 1961 - The stratigraphy and structural geology of the Manilla - Moore Creek District, N.S.W. J. Proc. Roy. Soc. N.S.W., 95(2), 63-75.

CROOK, K.A.W., 1961a - Stratigraphy of the Tamworth Group (Lower and Middle Devonian), Tamworth - Nundle District, N.S.W. J. Proc. Roy. Soc N.S.W., 94, 173-188.

CROOK, K.A.W., 1961b - Stratigraphy of the Parry Group (Upper Devonian - Lower Carboniferous), Tamworth - Nundle district, N.S.W. J. Proc. Roy. Soc. N.S.W., 94, 189-207.

CROOK, K.AW., 1964 - Depositional environment and provenance of Devonian and Carboniferous sediments in the Tamworth Trough, N.S.W. J. Proc. Roy. Soc. N.S.W., 97, 41-54.

CROOK, K.A.W., 1968 - Upper Devonian Sedimentological Provinces in Eastern Australia and their controlling factors. International Symposium on the Devonian System. Proceedings, (2), 1335-1344.

DEAR, J.F., 1969 - The Permian System in Queensland. Spec. Publs. geol Soc. Aust., 2, 1-6.

DICKINS, J.M., 1968 - Correlation of the Permian of the Hunter Valley, New South Wales, and the Bowen Basin, Queensland. Bur. Miner. Resour. Geol. Geophys. Aust. Bull. 80, 29-44.

DICKINS, J.M., MALONE, E.J., and JENSEN, A.R., 1964 - Subdivision and correlation of the Middle Bowen Beds. Bur. Miner. Resour. Geol. Geophys. Aust. Rep. 70, 1-12.

ELLIS, P.L., 1968 - Geology of the Maryborough 1:250,000 Sheet area. Rep. geol. Surv. Qld, 26, 1-101.

EXON, N.F., REISER, R.F., CASEY, D.J., and BRUNKER, R.L., 1969 - The post-Palaeozoic rocks of the Warwick 1:250,000 Sheet area, Queensland and New South Wales. Bur. Miner. Resour. Geol. Geophys. Aust. Rec. 1969/80 (unpubl.).

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

HILL, D., and DENMEAD, A.K.,(eds),1960 - The geology of Queensland. J. geol Soc. Aust., 7.

HILL, D., and TWEEDALE, G.W, 1955 - Geological map of the Moreton district. Dep. Mines Qld.

KENNY, E.J., 1937 - Geological reconnaissance of the north coast region. A. Rep. Dep. Mines N.S.W., (1936), 92.

KIRKEGAARD, A.G., and DEAR, J.F., 1968 - Devonian of the Yarrol Basin and adjacent Pacific coast of Queensland, Australia. International Symposium on the Devonian System. Proceedings, (2), 107-110.

KIRKEGAARD, A.G., MURRAY, C.G., and SHAW, R.D., in prep. - Geology of the Rockhampton and Port Clinton 1:250,000 Sheet areas, Queensland. Rep. geol Surv. Qld.

LEITCH, E.C., 1969 - Igneous activity and diastrophism in the Permian of New South Wales. Spec. Publs. geol Soc. Aust., 2, 21-38.

LUCAS, K.G., 1957 - The geology of the Terrica - Macintyre Brook area. B.Sc.(Hons.) Thesis, Dep. Geol. Univ. Qld. (unpubl.).

LUCAS, K.G., 1958 - The sedimentary petrology of the Palaeozoic Rocks of the Border Rivers area. M.Sc. Thesis, Dep. Geol. Univ. Qld (unpubl.).

LUCAS, K.G., 1959 - New Names in Queensland Stratigraphy, Queensland-New South Wales Border Rivers Area. Aust. Oil Gas J., 5(11), 28-31.

LUCAS, K.G., 1960 - The Border Rivers area. The Texas area, in The geology of Queensland. J. geol Soc. Aust., 7, 165-166, 229-235.

MACK, Jr., J.E., 1963 - Reconnaissance geology of the Surat Basin, Queensland and New South Wales. Bur. Miner. Resour. Geol. Geophys. Aust. Petrol. Search Subs. Acts Publ. 40.

MALONE, E.J., OLGERS, F., and KIRKEGAARD, A.G., 1969 - The geology of the Duaringa and Saint Lawrence 1:250,000 Sheet areas, Queensland. Bur. Miner. Resour. Geol. Geophys. Aust. Rep. 121.

MATHEWS, R.T., 1954 - The greenstones of the Petrie - Mount Mee area, Queensland. Pap. Dep. Geol. Univ. Qld, 4(6), 1-30.

McELROY, C.T., 1962 - The geology of the Clarence - Moreton Basin. Mem. geol Surv. N.S.W., 9, 1-116.

McKELVEY, B.C.,and GUTSCHE, H.W., 1969 - The geology of some Permian sequences on the New England Tablelands, New South Wales. Spec. Publs geol Soc. Aust., 2, 13-20.

McKELVEY, B.C., and WHITE, A.H., 1968 - Regional stratigraphy of a Devonian and Carboniferous sequences in northeastern New South Wales. Rep. Dep. Geol Univ. New England, 1968/4, 1-38 (unpubl.).

MEDVECKY, A., (in prep) Goondiwindi, Q. Bur. Miner. Resour. Geol. Geophys. Aust. Explan. Not. Ser. H56-1.

OLGERS, F., 1969 - The geology of the Drummond Basin, Queensland. Bur. Miner. Resour. Aust. Rec. 1960/19, (unpubl.).

OWEN, H.B., and BURTON, G.M., 1954 - Geological and geophysical surveys, Ashford Coal field, N.S.W. Part 1: Geology. Bur. Miner. Resour Aust. Rep. 8.

PACKHAM, G.H. (ed.), 1969 - The geology of New South Wales. J. geol Soc. Aust., 16(1), 1-654.

PALMIERI, V., 1969 - Upper Carboniferous conodonts from limestones near Murgon, southeast Queensland. Publ. geol Surv. Qld, 341.

PHILIP, G.M., 1966 - The occurrence and palaeogeographical significance of Ordovician strata in northern New South Wales. Aust. J. Sci., 29, 112-113.

PHILLIPS, E.R., 1968 - Some plutonic rocks from a northern part of the New England Batholith. Pap. Dep. Geol. Univ. Qld, 6(7), 159-206.

REID, J.H., 1930 - The Queensland Upper Palaeozoic succession. Publ. geol Surv. Qld, 278, 1-96.

REID, J.H., 1931 - Correlations of the Queensland Permo-Carboniferous Basin. Proc. Roy. Soc. Qld, 43.

RICHARDS, H.C., and BRYAN, W.H., 1923 - Permo-Carboniferous volcanic activity in southern Queensland. Proc. Roy. Soc. Qld, 35, 109-126.

RICHARDS, H.C., and BRYAN, W.H., 1924a - The geology of the Silverwood-Lucky Valley area. Proc. Roy. Soc. Qld, 36, 44-108.

RICHARDS, H.C., and BRYAN, W.H., 1924b - Radiolarian jaspers in the Brisbane Schist Series. Proc. Roy. Soc. Qld., 36, 131.

RICHARDS, H.C., and BRYAN, W.H., 1926 - Note on the Devonian rocks of Central and Southern Queensland. Rep. Aust. Ass. Adv. Sci., 18, 286-290.

RICHARDS, H.C., BRYAN, W.H., and WHITEHOUSE, F.W., 1932 - Preliminary Note on the Geology of Mount Barney. Proc. Roy. Soc. Qld, 43, 64-70.

RUNNEGAR, B.N., 1969 - The Permian faunal succession in eastern Australia. Spec. Publs geol Soc. Aust., 2, 73-98.

RUNNEGAR, B., in press - Permian sedimentation in the North Sydney - South Bowen Basin. Proc. Linn. Soc. N.S.W.

SAINT SMITH, E.C., in CARNE, J.E., 1911 - The tin - mining industry and the distribution of tin ores in New South Wales. Mineral Resour. N.S.W., 14, 83-92.

SAINT SMITH, E.C., 1913 - Geology and Mineral Resources of the Stanthorpe, Ballandean and Wallangarra Districts. Qld Govt Min. J., 14, 637-647.

SAINT SMITH, E.C., 1914a - Geology and mineral resources of the Stanthorpe, Ballandean and Wallangarra districts, with notes on the Silver Spur Mine, Texas. Publ. geol Surv. Qld, 243, 1-165.

SIMMONDS, N.A.H., 1958 - Geology of the Ballandean - Sundown area. B.Sc. (Hons.) Thesis Dep. Geol. Univ. Qld (unpubl.).

SKERTCHLY, S.B.J., 1898 - On the geology of the country round Stanthorpe and Warwick, South Queensland, with special reference to the tin and gold fields and the silver deposits. Publ. geol Surv. Qld, 120, 1-51.

STEPHENSON, P.J., 1959 - The Mount Barney Central Complex, South-Eastern Queensland. Geol. Mag., 96, 123-136.

SUSSMILCH, C.A., 1926 - Carboniferous and Permian Rocks of Australia and New Zealand Committee. Rep. Aust. Ass. Adv. Sci., 18.

SUSSMILCH, C.A., 1935 - The Carboniferous Period in Eastern Australia Aust. N.Z. Ass. Adv. Sci., 22.

*

TUCKER, R.M., and HOUSTON, B.R., 1967 - The geology of the city of Brisbane. Publ. geol Surv. Qld, 324.

* TELFORD, P.G., in press - Stratigraphy and palaeontology of the Drake area, New South Wales. Proc. Linn. Soc. N.S.W.

VOISEY, A.H., 1934a - An interpretation of the Silverwood - Lucky Valley Upper Palaeozoic Succession. Proc. Roy. Soc. Qld, 46, 60-65.

VOISEY, A.H., 1934b - A preliminary account of the geology of the middle North Coast district of New South Wales. Proc. Linn. Soc. N.S.W., 59, 333-347.

VOISEY, A.H., 1936 - The Upper Palaeozoic rocks in the neighbourhood of Boorook and Drake, New South Wales. Proc. Linn. Soc. N.S.W., 61, 155-168.

VOISEY, A.H., 1939 - The geology of the County of Buller, New South Wales. Proc. Linn. Soc. N.S.W., 64, 385-393.

VOISEY, A.H., 1945 - Correlation of some Carboniferous Sections in New South Wales, with special reference to changes in facies. Proc. Linn. Soc. N.S.W., 70, 34-40.

VOISEY, A.H., 1957 - Further remarks on the sedimentary formations of New South Wales. J. Proc. Roy. Soc. N.S.W., 91, 165-188.

VOISEY, A.H., 1958 - Tectonic evolution of northeastern New South Wales, Australia. J. Proc. Roy. Soc. N.S.W., 92, 191-203.

WADE, A., 1941 - The Palaeozoic and younger formations associated with the Stanthorpe - Tenterfield granite intrusion in the Toowoomba-Texas-Tabulam triangle. Report to Shell (Queensland) Development Pty Ltd, Geol. Rep. 3 (unpubl.).

WALKOM, A.B., 1913 - Stratigraphical geology of the Permo-Carboniferous system in the Maitland - Branxton District, with some notes on the Permo-Carboniferous palaeogeography in New South Wales. Proc. Linn. Soc. N.S.W., 38.

WHITE, A.H., 1964 - The stratigraphy and structure of the upper Palaeozoic sediments of the Somerton - Attunga District, N.S.W. Proc. Linn. Soc. N.S.W., 89, 203-219.

WHITING, J.W., 1951 - Limestone Deposits, Parish Braylesford, County Gresham. A. Rep. Dep. Mines N.S.W., (1950), 87.

WILSON, G., 1952 - Ptygmetic structures and their formation. Geol. Mag., 89, 1-21.

APPENDIX 1

INTRUSIVES AND ECONOMIC GEOLOGY

The plutonic rocks of the Warwick and Goondiwindi 1:250,000 Sheet areas constitute the northern part of the New England Batholith. The batholith consists mainly of adamellite, granite, and granodiorite with minor developments of mafic rock. It has intruded Palaeozoic sediments and volcanics and is overlain by unmetamorphosed Mesozoic sediments; radiometric age determinations indicate that the batholith was emplaced during the Permian and Lower Triassic.

A.D. Robertson of the Geological Survey of Queensland has provided information concerning the intrusives and economic geology of the Queensland portions of the Sheet areas. A summary account of the intrusive rocks and economic mineral occurrences of the New South Wales portion of the Warwick Sheet is given by P.G. Flood; a more comprehensive account of the economic geology is being prepared by the Geological Survey of New South Wales.

The igneous rocks of the northern part of the New England Batholith and the related mineralization have been summarized in Table 1.

INTRUSIVES IN QUEENSLAND

by

A.D. Robertson

(Geological Survey of Queensland)

In October 1968, the author spent three weeks mapping the various phases of the New England Batholith. One new name, the Herries Adamellite, has been erected. All other phases of the batholith have been described previously by Andrews (1904), Andrews, Mingaye and Card (1907), Saint Smith (1911, 1914a), Phillips (1964, 1968), and Wilkinson, Vernon and Shaw (1964).

Previous literature

The presence of important mineral deposits, especially tin, brought the granites to the attention of Skertchly (1898), Andrews (1901, 1902, 1903, 1904, 1905, 1908), Andrews et al. (1907), Saint Smith (1911, 1913, 1914a, b, c) and Jensen (1918a and e). More recent geological papers have been by Voisey (1939, 1958), Vernon (1961), Phillips (1964, 1968), Wilkinson, Vernon, and Shaw (1964), Binns (1965a, b, 1966), Robertson (1964), and Simmonds (1958).

Dundee Adamellite Porphyrite

Only a small part of this rock unit crops out in Queensland. Its bulk occurs in the extreme southern part of the Warwick 1:250,000 Sheet area and to the south of it, in New South Wales. Andrews et al. (1907) assigned the name "Blue Granite" to this mass and considered it to be an early phase of the New England Batholith. Browne (1929) considered the rock to be a quartz-porphyrite. After examining the field relationships, bulk chemistry, and recalculated modes, Wilkinson et al. (1964) designated this rock type as an intrusive adamellite. Texturally, it is more akin to a dellenite due to rapid cooling subsequent to high-level emplacement equivalent to that of the epi-zone level of Buddington (1959).

TABLE 1. IGNEOUS ROCKS OF THE NORTHERN PART OF THE NEW ENGLAND BATHOLITH

Age	Rock unit and map symbol.	Distribution	Lithology	Relationships	Economic Geology	Principal References
LOWER TRIASSIC	Ruby Creek Granite (Rlr)	Two northwest trending belts of isolated intrusions: one from Willsons Downfall to Utopia, the other from Wallangarra to Pike Creek homestead and including Red Rock and Mt Jibbinbar. Probably includes masses at and 3 km north of Mt Bullabaang.	Massive, even-grained medium to coarse-grained granite	Age: 225 m years (Phillips, 1968). Intrudes the Stanthorpe Adamellite and Texas Beds.	Tin and gemstone - bearing alluvium in the Stanthorpe area. Lode tin in the Kilminster-Red Rock area west of Ballandean. Associated minerals: Arsenopyrite, wolframite, and molybdenite. Leis' Molybdenite mine at Wallangarra.	Saint Smith, 1914; Phillips, 1968; This text.
	Herries Adamellite (Rlh)	Two masses, one north of Dalveen, the other at, and south of Leslie Dam.	Fine and coarse-grained adamellite.	Intrudes the Carboniferous Texas Beds and Devonian Silverwood Group. Unconformably overlain by the Marburg Sandstone. Relationship to Stanthorpe Adamellite unknown. Intruded by a swarm of aplite dykes.	The Glen manganese mine working manganese oxide and silicate lenses in the Texas Beds near the contact with the adamellite.	This text.
	Stanthorpe Adamellite (Rls)	Most widespread unit in the batholith covering about 2,500 sq. kilometres.	Coarse-grained in places porphyritic adamellite.	Intrudes Devonian, Carboniferous and Permian volcanics and sediments and also the Dundee Adamellite Porphyrite, Maryland Granite and Bungulla and Undercliffe Falls Adamellites.	Some alluvial tin workings. Gemstones. Graphite in Permian sequence at Cliff Mountain east of Stanthorpe near the contact with the adamellite.	Saint Smith, 1911, 1914; Shaw in Packham, 1969, p. 289; Phillips, 1968; this text.
	Undercliffe Falls Adamellite (Rlu)	Two masses, one northwest of Undercliffe Falls and the other 10 kilometres south of Willson's Downfall.	Five varieties of adamellite are present (Phillips, 1968) but mainly adamellite with pink K-feldspar phenocrysts.	Age: 225 m. years (Evernden & Richards, 1962, p.37). Intruded by the Stanthorpe Adamellite.		Phillips, 1968, and in Packham, 1969, p.292.
	Bungulla Adamellite (Rlb)	A small mass at Wallangarra, and a larger area along the Bruxner Highway and extending into the Grafton Sheet.	Coarse-grained, sphene-bearing porphyritic adamellite. Phenocrysts are large pink K-feldspars.	Intrudes the volcanics at Wallangarra and the Dundee Adamellite Porphyrite. Intruded by the Stanthorpe Adamellite.		Shaw in Packham, 1969, pp. 288-289.
UPPER PERMIAN OR LOWER TRIASSIC	(Pg)	A large mass west of Texas in the Goondiwindi Sheet area extending southward into the Inverell Sheet area.	Granite, granodiorite.	Intrudes the Texas Beds. Unconformably overlain by Mesozoic strata. Age unknown.		Lucas in Hill & Denmead, 1960, p.233.
	(Pua)	Five isolated masses near the eastern margin of the New England Fold Belt.	Adamellite, biotite-rich granite, diorite, granodiorite.	Intrudes the Carboniferous - Permian sequence; unconformably overlain by the Marburg Sandstone.	Molybdenite, Morgan's Ck mine northeast of Boorook. Silver mines in the Rivertree area.	This text.
	Maryland Granite (Pum)	One small mass (4 sq.kilometres) just east of Maryland homestead.	Fine to medium-grained greyish blue biotite-rich granite.	Intruded by the Stanthorpe Adamellite.		Saint Smith in Carne, 1911.
	Greymare Granodiorite (Pug)	One mass (55 sq.kilometres) at Greymare railway siding, 25 km west of Warwick.	Grey medium-grained granodiorite.	Intrudes the Texas Beds.		Richards, 1918; this text.
	(Pub)	Four small masses, 18 km. south-southeast of Warwick, 3 km. northeast of Boorook homestead, 6 km southeast of Undercliffe Falls, and 6 km. southeast of Drake.	Diorite, mafic rocks (Plagioclase, actinolite, epidote, chlorite).	Intrudes Devonian sediments south of Warwick and Permian volcanics and sediments in the Drake-Boorook area.	Gold in Lucky Valley Creek possibly associated with diorite intrusion.	This text.
PERMIAN	(Pur)	A small irregularly shaped mass, 13 kilometres south of Warwick.	Spherulitic rhyolite and quartz-feldspar porphyry.	Intrudes the Devonian and Permian rocks in the Silverwood area south of Warwick. Possible feeders to the Permian volcanic sequence.		This text.
LOWER PERMIAN	Dundee Adamellite Porphyrite (Pld)	Irregularly shaped intrusions in the Wallangarra area and south of the Bruxner Highway, extending into the Grafton Sheet area.	Blue-grey medium to coarse-grained adamellite porphyrite.	Age: 242 m.years (Harding, 1966). Intrudes the volcanics at Wallangarra, which are probably equivalent to the Lower to Upper Permian Drake Volcanics. Intruded by the Stanthorpe and Bungulla (225 m.years) Adamellites.		Wilkinson, Vernon & Shaw, 1964.

Megascopically, the adamellite-porphyrite is a compact, medium to coarse-grained, bluish-grey rock, in some places possessing flow foliation (biotite phenocrysts). Phenocrysts of plagioclase, hornblende, quartz, and biotite, ranging from 1 to 2 mm in length, are present in an aphanitic grey groundmass. Small xenoliths are present in some outcrops although uniformity in texture appears to exist throughout the mass. The groundmass is composed of xenomorphic - granular quartz and K-rich alkali feldspars with common very fine-grained magnetite. The border phase of the mass tends to exhibit flow structure.

Microscopically, the rock is porphyritic. A marked difference exists between the average grain size of the phenocrysts (2 mm) and the groundmass (0.02 mm). Phenocrysts include plagioclase, quartz, biotite, hornblende, clinopyroxene, rare alkali feldspar, and rare orthopyroxene. The quartz-feldspathic groundmass is xenomorphic - granular but becomes crypto to microcrystalline fluidal in the border facies. Wilkinson et al. (1964) consider the phenocrysts to show cataclastic effects. Magnetite, sulphides, apatite, and zircon are accessory minerals. Quartz, similar to bipyramidal inverted β-quartz, is locally micro-brecciated. Plagioclase occurs as subhedral laths, glomeroporphyritic aggregates, or brecciated angular fragments, ranging in size from 1.5 x 0.8 mm to 1.0 x 0.5 mm. Biotite is rare in the groundmass. Phenocrysts show mechanical and chemical breakdown, altering to chlorite. Hornblende occurs as euhedral to subhedral phenocrysts, as fractured remnants, and as an alteration product of clinopyroxene. Clinopyroxene (augite) forms glomeroporphyritic aggregates with hornblende, biotite, hypersthene, and opaque minerals. It is usually euhedral to subhedral and extensively fractured. Exsolution is common. Orthopyroxene is rare in the northern part of the intrusion but has been reported by Wilkinson et al. in the southern masses as cores to clinopyroxene, hornblende, and biotite. Anhedral magnetite is mainly confined to the groundmass but may be up to 0.6 mm in diameter. Zircon is an accessory found mainly in the biotite.

The Dundee Adamellite - Porphyrite appears as a tear-drop shaped mass intruding volcanics south of Bald Mountain railway siding. The contacts, where seen, are relatively sharp. Radiometric age dating of this mass, using biotite, gave an age of 242 m.years (= mid Permian) (Harding, 1966).

Wilkinson et al. (1964) consider that this mass is a large scale hybrid, developed by the mixing of and limited reaction between nearly solid biotite - diorite and a low-melting silica alkali liquid. They consider the hybridization process incomplete due to comparatively rapid and forceful intrusion to high levels and to solidification following closely upon final emplacement.

Undercliffe Falls Adamellite

The adamellite forms a mass approximately 20 kilometres long with a maximum width of 8 kilometres, lensing to the west-north-west where it intrudes rhyolites, south of Baker's Hill. In the east the adamellite is abruptly terminated by the Demon Fault Shear Zone. The total outcrop area of the Undercliffe Falls Adamellite is about 160 square kilometres.

The original shape of the adamellite has been modified by the intrusion of the Stanthorpe Adamellite and by faulting along its eastern extremity. On field relationships this rock mass can be treated as a unit although five varieties have been recoginized by Phillips (1968), namely :-

Type (1) A normal type, containing pink K-feldspar phenocrysts. This variety forms the largest part of the adamellite.

Type (2) Adamellite with white K-feldspar phenocrysts.

Type (3) A medium to fine even-grained adamellite appearing along parts of the margin.

Type (4) An adamellite intermediate between Types 1 and 3.

Type (5) A brecciated variety of Type 1.

The most prominent structure in the adamellite is the preferred planar orientation of xenoliths. This orientation is generally east-west. Where the orientation of lenticular xenoliths has been measured along Herding Yard Creek, they dip southwards and the xenoliths closely parallel the contact. Further away from the contact, towards the middle of the mass, the xenoliths display a haphazard arrangement with variable dips.

Contacts between the adamellite and the country rock appear sharp and, in many cases, transgressive. Phillips (1968) reports that the adamellite at the contact with the country rock southeast of Baker's Hill can be defined as Type 3, grading through Type 4 to Type 1. In the vicinity of Undercliffe Falls adamellite of Type 1 forms a sharp contact with a small remnant of hornfels. There appears to be no marginal variety present and this may be due, in part, to the truncation of the mass by the Demon Fault Shear Zone.

The normal type (Type 1) has pink K-feldspar phenocrysts (= 11%) set in a grey phaneric matrix of plagioclase, quartz, K-feldspar, biotite, hornblende and accessory sphene. The K-feldspar phenocrysts are twinned and range from 30-40 mm x 15 mm to 15 mm x 8 mm. Fine-grained, black xenoliths, composed of minerals similar to those of the adamellite, are scattered throughout the mass and range from 5 to 30 cms.

Plagioclase (36% - 42%) ranges in composition from An25 to An33. It forms subhedral to anhedral grains and also rapakivi-like mantles (An18 - An29) around some K-feldspar phenocrysts. Quartz (22% - 25%) forms anhedral grains or grain aggregates in the groundmass but also appears as inclusions in K-feldspar phenocrysts and in myrmekite. Size ranges from 0.3 mm to 3.5 mm. K-feldspar (20% - 25%) appears both as subhedral phenocrysts and as anhedral grains in the groundmass. Plagioclase, quartz, hornblende, biotite, and in some cases sphene are present as inclusions in the phenocrysts. Biotite ($\approx$7%), 0.5 mm to 2 mm in length, forms distorted subhedral to anhedral laths associated with plagioclase and quartz, or as clusters of biotite, hornblende and magnetite. Inclusions in the biotite are usually apatite, magnetite, sphene, and zircon. Alteration to chlorite is common (α= pale straw, (β=γ= dark brown to opaque. When chloritization is partially completed, (β=γ= apple green). Hornblende (3-4%) occurs mainly as subhedral crystals, rarely euhedral, twinned, and ranging from less than 1 mm to 8 mm or more in length (α= yellow, β= greenish brown, γ= apple green). Inclusions of magnetite, apatite, zircon, and sphene are common.

Anhedral magnetite (0.1 mm - 2 mm) forms the bulk of the opaques (0.3 - 0.9%); grains of euhedral pyrite have also been noted. Sphene (0.5%) occurs as euhedral crystals, variable in size; maximum length is 3 mm. Granular sphene is associated with the breakdown of biotite. Accessory minerals, apatite, epidote, allanite tourmaline, calcite, kaolin, and zircon together rarely form more than 0.8% of the rock.

Very little mineralization is associated with this adamellite in the Warwick 1:250,000 Sheet area.

Stanthorpe Adamellite

The Stanthorpe Adamellite has the greatest surface exposure of all the granitic types present in the Warwick 1:250,000 Sheet area. Saint Smith (1911, 1914a) recognized the adamellite's variable texture, but the textural varieties could not be mapped as units. Within the adamellite, xenoliths are rare and where present show random orientation. Some K-feldspar crystals in the more porphyritic phase show crude alignment over very short distances. Andrews et al. (1907) have observed marked orientation of long rectangular feldspars at certain localities close to the contacts with the porphyritic adamellite (Undercliffe Falls type). Andrews (1905) has recorded intrusion breccias at the contacts between the country rock and the Stanthorpe Adamellite near Undercliffe Falls and Phillips (in Packham, 1969, p. 291) has observed, along Herding Yard Creek northwest of Liston, the adamellite intruding basic rock, with production of an agmatite.

Blocks of Undercliffe Falls Adamellite are contained in the Stanthorpe Adamellite along Ruby Creek. The Stanthorpe Adamellite cuts across the porphyritic adamellite. Both Andrews and Phillips consider that this relationship is evidence for the Stanthorpe Adamellite being a separate intrusion and this was confirmed by the present study. The contact between Stanthorpe Adamellite and the country rock along the western margin of the batholith is, in general, sharp and well defined.

Four distinct types of the Stanthorpe Adamellite have been recognized. Phillips (1968) has described three of these types from the Liston-Amosfield area. The following is a summary of his descriptions.

The Adamellite from Wilson's Downfall has a preferred orientation defined by subhedral off-white K-feldspar laths (1.3 - 2.0 mm) occurring with plagioclase (40.9%), quartz (25.3%), biotite (8.3%), hornblende (2.1%), and sphene (0.2%). The texture is roughly even-grained with a coarse grain size. Rare K-feldspar crystals (3.5 - 5 cms) give the rock a porphyritic appearance. Locally, these large crystals are mantled by plagioclase. The bulk of the plagioclase crystals (1 - 6 mm) are subhedral and have an average composition of An23. Quartz (2 - 3 mm) is anhedral, occurring as granular crystals. K-feldspar (2 - 6 mm) is subhedral to anhedral and has optical properties that suggest the mineral is orthoclase. Some grains show the cross-hatch twinning of microcline. Biotite, 1 to 2 mm in length, forms subhedral to anhedral flakes, and is locally altered to chlorite and sphene. Allanite is partially or completely surrounded by biotite (α = pale rusty brown, $\beta = \gamma$ = deep red brown to opaque). Hornblende (1 - 2 mm) occurs as anhedral and subhedral crystals. Pleochroic colours are patchy (α = very pale fawn grey, β = brown-green with grey tint, γ = green). Sphene, apatite, pyrite, and zircon are minor accessories.

The second variety is similar to the "Stanthorpe granite" of Saint Smith (1914a). It differs from the porphyritic phase in that there is no obvious preferred orientation of the K-feldspars. The rock is finer grained, and the texture is more inequigranular and there is a lower mafic content. The colour of the K-feldspar is not white. Macroscopically, the second variety has pink K-feldspar, white plagioclase, grey glassy quartz, and is speckled with black biotite flakes. Microscopically, quartz (24.3%), microperthite (34.1%), plagioclase (35.3%), biotite (5.4%), hornblende (0.7%), and accessories (0.2%) constitute the mineral suite of the rock. Plagioclase (An23) has a similar composition to that of the Wilson's Downfall variety and the K-feldspar is orthoclase.

The coarse-grained Stanthorpe Adamellite (variety 3) forms part of the northern contact with the Undercliffe Falls Adamellite. The rocks are even grained, hypidiomorphic-granular in texture with crystals 1 - 5 mm across. Quartz (36 - 37%), microperthite (32-33%), plagioclase (27-28%), and biotite (3%) are the dominant minerals. This variety has a higher quartz content than the other two varieties and appears to be similar to the Ruby Creek Granite. Plagioclase ranges in composition from An20-17 in the cores to An 12-10 in the margins.

The fourth variety is best developed on the Stanthorpe - Nundubbermere road, 1 kilometre north of Nundubbermere homestead. Between the Stanthorpe Adamellite - metasediment contact and this fourth variety, an adamellite of the second variety is developed. This second variety grades inwards from the contact into the fourth-variety adamellite which very closely resembles the finer grained edges of the Ruby Creek Granite mass. Megascopically, it is a fine-grained pinkish rock, of relatively even grain size, with hypidiomorphic-granular texture. Phenocrysts of quartz and K-feldspar (3 cms), up to four times the size of the average grain size of the groundmass, may be present. The phenocrysts of quartz and the quartz in the groundmass are clear and glassy, being similar to quartz in the Ruby Creek Granite along the western margin of the batholith. The fourth variety of adamellite becomes coarser to the north until it grades back into the adamellite of the second variety.

Increase in grain size is also accompanied by an increase in the number of phenocrysts. Within the gradational boundaries of this variety of adamellite, the soil development is very similar to that developed from the Ruby Creek Granite. The soil is sandy and contains a high percentage of quartz. Alluvial deposits of tin have been worked in gullies and creeks heading in ridges composed of this fine-grained adamellite.

On the Queensland side of the border the porphyritic Stanthorpe Adamellite (variety 1) has its best development in the forestry reserve northwest of Amiens, where the adamellite shows strong but local orientation of the phenocrysts. To the east, the porphyritic variety (1) grades through varieties 2 and 3 into variety 4 southeast of Passchendaele Ridge. To the north and east of this ridge, a jumbled assortment of varieties 2, 3, and 4 occurs and this in turn is intruded by a mass of Ruby Creek Granite in the vicinity of the rabbit-proof fence. The boundary of this granite (Ruby Creek Granite) is soil-covered and has been only approximately defined along its southwestern extremity.

Further to the east of Passchendaele Ridge, along the Amiens - Passchendaele - Thulimbah road, Stanthorpe Adamellite of the fourth variety grades imperceptibly into second-variety adamellite. To the south and north of this road, the Ruby Creek Granite intrudes both varieties.

South of Stanthorpe, the second variety of Adamellite is most prominent. In the vicinity of Ballandean homestead, the adamellite becomes porphyritic (variety 1) but contains both white and pink K-feldspar phenocrysts (up to 5 cms long). Occasional rapakivi-type texture occurs. South of Ballandean a small mass of granodiorite is intruded by the adamellite (variety 2). Between Bald Mountain siding and Wallangarra, the adamellite intrudes flat-lying volcanics as a series of dykes. This adamellite is itself intruded by small masses of Ruby Creek Granite and many dykes. The most prominent structure in this adamellite is a set of north-north-east trending master joints.

Herries Adamellite

The Herries Adamellite forms a large part of the batholith along its northwestern margin. The adamellite is best exposed along the northern edge of the Herries Range where it forms moderately rugged topography. Along Sandy Creek in the vicinity of the Leslie Dam, outcrop is poor and the adamellite appears as a depressed landform surrounded by the more resistant Palaeozoic rocks.

Two variations of the Herries Adamellite have been recognized, one fine and the other coarse-grained, but these cannot be mapped as distinct units as there is gradation between them over several hundred metres. In the areas of gradation, outcrop is poor, and exposure is reduced by overlying near-horizontal Mesozoic sediments. Few xenoliths are present and there is little or no lineation. Contacts between the adamellite and the surrounding country rocks, where observed, are sharp. Little is known of the relationship between the Herries Adamellite and the Stanthorpe Adamellite as outcrop is poor and soil covers the contact.

The Herries Adamellite north of Dalveen, along the Warwick - Stanthorpe road, is fine-grained, suggesting that the Herries mass may have cooled against the Stanthorpe Adamellite to the south. However, by the adamellite cooling against the country rock a similar effect may also have been produced. This, coupled with the tendency of the Stanthorpe adamellite to be finer grained towards its proposed northern margin in the vicinity of Dalveen, casts some doubt on the suggested mode of emplacement.

The coarse-grained variety which makes up most of the Herries Adamellite is even-grained in texture. Rarely are the larger K-feldspar crystals mantled by plagioclase.

Plagioclase (37%) occurs as "primary" crystals, as medium- to coarse vein perthite and as grains between larger plagioclase crystals. Small unorientated grains are present in some of the K-feldspars. Most of the plagioclase crystals are strongly zoned, subhedral and 4 to 6 mm in length, with an average composition of An24 (cores An 28, rims An20, locally An15). "Cloudy" sericite forms much of the alteration products. Clusters of small biotite, hornblende, and magnetite are included within the plagioclase.

K-feldspar (32%) varies from anhedral to subhedral crystals ranging from 0.5 mm to 7 mm. Twinning, where present, is of the Carlsbad type. In some specimens, the K-feldspar shows the cross-hatched twinning of microcline.

Quartz (21%) forms anhedral grains up to 4 mm in size and exhibits undulose extinction.

Biotite (($\approx$ 5%), (α = fawn, β = γ = dark reddish brown to opaque)) occurs mainly as anhedral flakes up to 1.5 mm in length. It is locally altered to sphene and chlorite. Inclusions in the biotite are apatite, zircon, and magnetite. Unlike the biotites of the Stanthorpe granite, allanite does not appear as an inclusion in the biotites of the Herries Adamellite.

Hornblende ($\approx$ 4%; α = fawn, β = greyish to reddish brown, γ = apple green) is mainly anhedral with rare euhedral crystals occurring. The crystals range from 0.2 mm to 3 mm in length. The hornblende forms either as isolated grains or as a cluster of grains associated with biotite, apatite and quartz.

Accessory minerals ($\approx$ 1%) include apatite, zircon, some sphene, and rare allanite.

The coarse-grained variety differs from the finer-grained adamellite in that in the latter, the plagioclase is surrounded by coarse perthite and graphic intergrowths of quartz and K-feldspar, and the plagioclase appears to be more strongly zoned.

From just west of Braeside, the Herries Adamellite has been intruded by an extensive dyke swarm, producing a prominent rib of reinforced adamellite which trends north-northeast.

Ruby Creek Granite

The granitic mass has its maximum development in an irregularly elongated structure, striking north-northwest astride the Queensland - New South Wales border. Two smaller masses occur, one to the north and the other to the south. To the west and southwest are a number of smaller outcrops of the Ruby Creek Granite. The larger of these western developments are at Red Rock, Mount Jibbinbar, Mount Bullaganang and near Mount You You. They all have a north-northwest trend similar to that of the granite mass to the east.

Contacts between the granite and the country rock are usually sharp, but diffuse boundaries and highly irregular margins have been observed in small pods of the granite in the area west-northwest of Ballandean. Contacts between the Ruby Creek Granite and other "granite" masses are sharp. Dyke-like projections from the Ruby Creek Granite into older granites are numerous.

The Ruby Creek Granite is massive, even-grained, except at the margins, and has few xenoliths and little or no alignment of the feldspar crystals. Feldspars rarely exceed 2 mm in length. The granite has a prominent north-northeast vertically dipping joint system. Aplite dykes are not common.

Because of the fine-grained margin of the Ruby Creek Granite against the Stanthorpe Adamellite along Herding Yard Creek, both Saint Smith (1914a) and Phillips (1968) considered that the Ruby Creek Granite intrudes the adamellite. This appears to be substantiated by the development of fine-grained Ruby Creek Granite against the Stanthorpe Adamellite along the rabbit-proof fence southwest of Dalveen and in the area, 8 kilometres west-northwest of Ballandean.

The granite is a homogeneous even-grained medium to coarse-grained rock. Pink K-feldspar, white plagioclase, and glassy quartz are evenly dispersed throughout a granite that is mottled with biotite. Microscopically the granite has an allotriomorphic granular texture, with a few subhedral plagioclase and biotite crystals. Grain size ranges from 0.5 mm to 2.0 mm with some feldspars to 3.0 mm. Quartz (36.5%) is anhedral and roughly equidimensional, forming interlocking aggregates. Plagioclase (30.8%) is present as (1) primary subhedral to anhedral crystals, (2) exsolved phases in perthitic intergrowths with K-feldspar, (3) intergranular albite and myrmekite, (4) rim albite, and (5) inclusions in K-feldspar.

Bulk composition of the plagioclase is An 11-12. K-feldspar (30.4%) develops subhedral and anhedral crystals whereas biotite (2.0%) forms ragged subhedral to anhedral flakes (α = fawn $\beta = \gamma$ =opaque). Zircon and apatite form inclusions in the biotite.

The finer marginal variety is allotriomorphic granular with the appearance of an aplite, although rare phenocrysts (up to 2 mm) of plagioclase and quartz are present. Eight km west of Ballandean, the Ruby Creek Granite intrudes the edge of the Stanthorpe Adamellite. The biotite in the fine-grained variety of the granite has been altered to sericite, and K-feldspar exceeds plagioclase in modal percentage (quartz 40.53%, K-feldspar 43.75%, plagioclase 9.87%, muscovite 4.85%, and accessories 1%). Away from the contact, the muscovite is replaced by biotite, and the modal composition is quartz 40.97%, K-feldspar 47.08%, plagioclase 9.60%, biotite 1.45% and accessories 0.90%.

Five kilometres south of Nundubbermere homestead, the Ruby Creek Granite has intruded both the Stanthorpe Adamellite and the Carboniferous metasediments. The granite is strongly mineralized and at this point is much more massive, finer grained and has a glassy appearance. Quartz content (49%) is higher than that from the type area (Ruby Creek, N.S.W.) and the granite becomes aplitic. It is cut by numerous quartz and quartz aplite dykes. Many of these dykes and veins are mineral bearing. The granites at Red Rock, Mount Jibbinbar, and Mount You You are similar although variations between the fine-grained marginal type and the typical granite have been noted.

Along Sandy Creek between the northern dyke swarm and the Palaeozoic sediments, an elongated depressed area exists, where aplite dykes, Ruby Creek Granite, and the Herries Adamellite phase are exposed. Because of the apparent predominance of the fine-grained granite over the Herries type, this area has been mapped as Ruby Creek Granite. Further south in the vicinity of Utopia homestead another depressed area of very poor outcrop is present. Here the soil development is similar to that derived from the weathering of the Ruby Creek Granite, and the area has been mapped accordingly.

Greymare Granodiorite

The Greymare Granodiorite forms the northernmost part of the New England Batholith, in the vicinity of Greymare railway siding. Outcrops are poor, much of the granodiorite being covered by soil and alluvium. The rock is grey, mottled by biotite, and has an even medium-grained, hypidiomorphic texture. Quartz and feldspar rarely exceed 2 mm in length. Biotite averages 1 mm in length but in exceptional cases may exceed 5 mm. Megascopically, quartz, plagioclase, K-feldspar, biotite, chlorite, and magnetite are discernible. Microscopically, quartz, plagioclase, K-feldspar, biotite, chlorite, magnetite, and accessory zircon, apatite, sphene, and allanite form the bulk of the minerals in the granodiorite. Quartz (anhedral) and plagioclase (subhedral to anhedral) are of approximately equal percentage. The plagioclase ($\approx$ 37%) is strongly zoned, the average composition being An31 with cores as calcic as An34 and rims as acid as An15. Biotite ($\approx$ 8%) forms subhedral to anhedral flakes (0.5 mm - 4 mm) which have a tendency to show orientation (α = fawn to light greenish brown, $\beta = \gamma$ = greenish brown to opaque). Alteration of biotite produces granular sphene and chlorite. K-feldspar ($\approx$ 15%), 0.1mm to 3mm in diameter occurs as anhedral grains in the groundmass. Zircon, apatite, sphene, and magnetite occur mainly as inclusions in biotite, but magnetite (anhedral) also appears in the groundmass as grains up to 2mm.

Richards (1918) originally described the material as Greymare Granite, and used the name Greymare Granodiorite in his discussion of the building stones of southeast Queensland.

The Greymare Granodiorite as such is known only from the Greymare railway siding area where it occupies an area of approximately 55 square kilometres. To the south of Ballandean, towards Accommondation Creek, a small mass of very weathered granodiorite crops out. The relationship between this mass and that at Greymare is not known. Both granodiorites are intruded by dykes; the Greymare mass is intruded by the northern extension of the large dyke swarm that extends from Braeside in the south to Greymare in the north.

Dykes

The dykes in the Warwick 1:250,000 Sheet area can be divided into three main groups:

(a) quartz-feldspar porphyry dykes;
(b) rhyolite, trachyte and dolerite dyke swarms; and
(c) miscellaneous dykes (rhyolite, diorite, aplite, basalt and trachyte).

The quartz-feldspar porphyry dykes are best developed in the Ballandean-Sundown area where two large dykes, ranging from 1 to 2 kilometres apart, are exposed in outcrop from Ballandean, through Sundown to the New South Wales border. Further south another porphyry dyke is exposed, passing through Ballandean township and Ballandean Station to the southwest.

Two large dyke swarms have been mapped on the Warwick 1:250,000 Sheet. The southernmost swarm terminates just south of Accommodation Creek near Lyra and extends in a south-southwesterly direction for 8 kilometres. The width ranges from 1 to 1.5 kilometres. The dykes form the reinforced cores of ridges composed of Stanthorpe Adamellite. Dykes of rhyolite, granophyre, trachyte and diorite appear to divide, forming an anastomosing pattern similar to that derived from material filling interlaced shear fractures.

The northern dyke swarm is composed of rhyolite, granophyre, trachyte, diorite, aplite, quartz-feldspar porphyry and rare basaltic dykes. This dyke system extends 30 kilometres from Braeside in the south to Greymare in the north-northwest. The width ranges from 1 to 3 kilometres.

Dykes recorded as miscellaneous represent those which occur as isolated structures with no great length or width. These include numerous mineralized aplite and quartz-aplite dykes. These dykes occur throughout the New England Batholith.

With the exception of the northern dyke swarm, almost all large dykes have a northeasterly trend which corresponds to the prominent northeast trending master joint system of the granites. Even within the metasediments, the northeast strike direction of the larger dykes is maintained.

Mode of emplacement of the granites

Phillips (1968) considers that the Undercliffe Falls Adamellite, the Stanthorpe Adamellite, and the Ruby Creek Granite were emplaced as a magma. Evidence cited in favour of magmatic emplacement includes preferred orientation of the xenoliths (Martin, 1953), flow-banding, corroded xenoliths of country rock aligned parallel to a sharp transgressive contact, and a decrease in grain size of the intrusion at or near the contact (Wilson, 1960).

Local alignment of K-feldspars in the Stanthorpe Adamellite is believed to indicate magmatic conditions, the preferred orientation being due to platy flow structure during magma movement. The variation in grain size and texture of the Stanthorpe Adamellite suggests different rates of cooling in a large mass of magma and this coupled with the finer grain size towards the contacts indicates chilling at or near the margins due to rapid heat loss.

The Herries Adamellite tends to be finer grained towards its margins but there is at present little evidence to indicate the mode of emplacement. Similarly, the Greymare Granodiorite and the Ruby Creek Granite show little evidence as to their mode of emplacement. The only visible evidence to suggest that the Ruby Creek Granite was magmatic is the numerous dyke-like masses intruding the older granites, suggesting the granite had the mobility of a magma.

Flow foliation of biotite and the alignment of small xenoliths in the border phase of the Dundee Adamellite Porphyrite led Wilkinson et al. (1964) to believe that this hybrid porphyrite developed from a magma which was emplaced at high levels in the earth's crust.

All the granites in the Warwick 1:250,000 Sheet area show some evidence that their origin was possibly magmatic and in general it is considered that the "granites" were emplaced in the upper levels of the earth's crust, equivalent to the epizone position of Buddington (1959).

Sequence of emplacement

Absolute age determinations have indicated that the Dundee Adamellite Porphyrite was the first to be emplaced (242 m. years = mid-Permian). It was followed by the Undercliffe Falls Adamellite and the Bungulla Adamellite (225 m. years = Permian - Triassic). The Bungulla Adamellite, best exposed south of Wallangarra in northern New South Wales, is considered to be equivalent to the Undercliffe Falls Adamellite and to have been emplaced at approximately the same time. The Stanthorpe Adamellite, the Herries Adamellite and the Ruby Creek Granite followed the Undercliffe Falls Adamellite in quick succession. The Ruby Creek Granite (225 m. years = Permian - Triassic) is considered to be the last major granitic emplacement.

The position of the Greymare Granodiorite in the intrusion sequence is obscure. A small mass of granodiorite south of Ballandean has been intruded by the Stanthorpe Adamellite. If the Greymare Granodiorite is equivalent to this mass then the Greymare Granodiorite is pre-Stanthorpe Adamellite.

The last evidence of intrusive igneous activity associated with the granites is the emplacement of dykes. Some of the aplitic dykes are synchronous with the Ruby Creek Granite but the porphyry, rhyolite, rhyodacite and basic dykes are considered to be post-Ruby Creek Granite.

Age of the plutonic rocks and mineralization.

Absolute age determinations were carried out by Evernden and Richards (1962) on several granites from the New England Batholith. Using the potassium-argon method, biotite in the Dundee Adamellite Porphyrite (GA236) gave an age of 242 m. years, equivalent to middle Permian. Biotite (GA224B) and hornblende (GA224A) in the Undercliffe Falls Adamellite gave ages of 225 m. years and 221 m years respectively. Phillips (1968) reports the age of biotite in the Ruby Creek Granite as 225 m. years. The similarity between this age and that for the biotite and hornblende in the Undercliffe Falls Adamellite suggests a relatively small time interval between the intrusion of the Undercliffe Falls mass, the Stanthorpe Adamellite, and the Ruby Creek Granite. The age of these 'granites' is considered to be Permian-Triassic. In the northern part of the intrusive complex, Triassic-Jurassic sediments overlie the granites. From age dating and structural relations, the period of plutonic activity appears to have occurred between the middle Permian and the Lower Triassic.

Absolute age determinations using the rhenium-osmium method indicate an age of 225 m. years for molybdenite from Carpenter's Gully 16 kilometres west-southwest of Ballandean (Harding, 1966). The similarity between the Re-Os age of the molybdenite and the potassium-argon age of the biotite in the Ruby Creek Granite suggests a close relationship between the mineralisation and the granitic end-products of the pluton. It is considered that the mineralization along the western edge of the batholith and that in the Silver Spur area can be placed as Permian-Triassic in age. This age agrees with that predicted by Jones (1947) when he equated the mineralization in the Stanthorpe district to the mineralization of the Gympie Epoch.

INTRUSIVES IN NEW SOUTH WALES

by

P.G. Flood

Several authors have made reference to the igneous rocks in the New South Wales portion of the Warwick and Goondiwindi Sheet areas. The most recent literature is by Phillips (1968; and in Packham, 1969, pp. 290-294), Wilkinson (in Packham, 1969, pp. 271-278) and Shaw (in Packham, 1969, pp. 285-290).

The following is a brief summary of the previous work; new information about the igneous rocks of the Rivertree, and Drake-Tabulam areas is also included.

Dundee Adamellite Porphyrite

The petrology of this unit has been evaluated by Wilkinson, Vernon, and Shaw (1964), and was briefly mentioned by Wilkinson (in Packham, 1969, p. 273) and summarized by Robertson (this Appendix).

Three isolated occurrences of this unit have been mapped in the New South Wales portion of the Warwick Sheet area. The largest is an irregularly shaped mass covering an area of approximately 50 square kilometres to the west and southwest of Wallangarra. A smaller area of outcrop is west of Sunnyside railway siding, 16 kilometres south of Wallangarra, and the third mass, covering an area of approximately 20 square kilometres crops out along the Bruxner Highway from 16 to 22 kilometres northeast of Tenterfield. All three masses extend southward onto the Grafton 1:250,000 Sheet area.

Bungulla Adamellite

The name Bungulla Porphyritic Adamellite was proposed by Shaw (in Packham, 1969 pp. 288-289) for a coarse-grained, sphence-bearing porphyritic adamellite that is widespread throughout the northern part of the New England Batholith. The unit forms two masses in the southern part of the Warwick Sheet area. One crops out over an area of about 20 square kilometres, centered about Wallangarra, and the other crops out over an area of about 30 square kilometres, 13 kilometres northeast of Tenterfield.

The rock is characterized by pink potassium - feldspar phenocrysts (average size 7.5 cm x 5 cm) which are generally aligned in a northeasterly direction. Xenoliths of dioritic composition are common, and range in size from barely visible spots to large inclusions up to 1 metre in diameter.

The thin-section description (taken from Shaw in Packham 1969, p. 289) is as follows: "the Bungulla Porphyritic Adamellite has phenocrysts of potassium-feldspar ($Or_{77}Ab_{22}An_1$) occurring in a coarse hypidiomorphic groundmass of subhedral twinned plagioclase, anhedral microperthite ($Or_{85}Ab_{14}An_1$), shapeless quartz, plates of biotite (β = 1.651), and subordinate amounts of dark green hornblende (β = 1.653) and euhedra of sphene. The microperthite of both phenocrysts and groundmass is twinned on the Carlsbad Law, and in many sections an incipient cross-hatching is present, suggestive of microcline twinning. Plagioclase (An_{19-35}) is present as two generations. The unaltered strongly zoned type appears to have crystallised directly from the melt, while a later generation marked by poikilitic inclusions of hornblende, epidote and/or clinopyroxene, is thought to have been derived from basic xenoliths. It is thought that hybridism has played a significant role in the genesis of this rock.

Maryland Granite

The name was first used by Saint Smith (in Carne, 1911) for a relatively small, semi-circular biotite granite boss just north of Bakers Hill, 10 kilometres north-northeast of Stanthorpe.

The mass covers an area of approximately 3 square kilometres. The rock is a fine to medium-grained, greyish blue biotite-rich granite. It has been intruded by the Stanthorpe Adamellite.

Igneous rocks of the Rivertree area (Pua).

A number of different rock types occur in the igneous mass in the Rivertree area, however, they have not been differentiated on the geological map (Pl. 1). The mass is faulted against the Stanthorpe Adamellite to the west and intrudes Permian and Carboniferous sediments. The rock types include diorite, granodiorite, adamellite and biotite-rich granite. Their field relationships have not been investigated but it is likely that each represents a separate intrusive body.

Granodiorite crops out to the north of the Clarence River and east of the Maryland River. The rock is medium to fine-grained and contains numerous xenoliths. Diorite crops out to the southeast of Rivertree, but the extent of the outcrop has not been determined. A small pluton of biotite granite crops out near Rivertree. Fine-grained adamellite and coarse-grained diorite crop out on the Razorback Creek road south of Rivertree, and a small mass of granodiorite occurs 5 kilometres east of Rivertree.

Igneous rocks of the Drake - Tabulam area (Pua).

Three large igneous intrusions crop out in the Drake - Tabulam area. All appear to be of similar composition to the Stanthorpe Adamellite.

The most westerly intrusion is just north of the Cataract River, 16 kilometres north of Drake. It is an adamellite pluton covering an area of approximately 42 square kilometres, and intrudes the Permian sequence. The adamellite is generally coarse-grained but a finer grained aplitic phase does occur. The mafic mineral is biotite which is generally altered to chlorite. Near the margins of the mass, the sediments and volcanics of the country rock appear to be granitized. Molybdenite mineralisation is associated with the pluton.

The other two bodies of adamellite crop out to the west and northwest of Tabulam. The large mass in the west is crossed by the Bruxner Highway and occupies an area of approximately 65 square kilometres. The smaller mass covers an area of about 36 square kilometres. They intrude the Upper Carboniferous Emu Creek Formation, the Permian Paddys Flat Formation, Razorback Creek Mudstone, and Drake Volcanics, and are overlain by the Lower Jurassic Marburg Sandstone.

Igneous rocks southwest of Texas (Pg).

A large mass made up of granite and granodiorite, previously referred to as the Ashford Granite (Lucas in Hill & Denmead, 1960, p. 233) crops out to the southwest of Texas. The mass covers an area of approximately 75 square kilometres in the Goondiwindi Sheet area and extends southward into the Inverell Sheet area.

Diorite and mafic intrusive rocks (Pub) have been mapped in the Lucky Valley area intruding the Rosenthal Creek Formation, and in the Drake - Rivertree area intruding the Permian sequence. Related dykes occur south of Rivertree homestead. The Lucky Valley intrusion consists largely of plagioclase and actinolite with accessory epidote, chlorite and iron oxide.

ECONOMIC GEOLOGY - QUEENSLAND

by

A.D. Robertson

(Geological Survey of Queensland)

Tin has been the main economic mineral won from the Warwick 1:250,000 Sheet area. Although gold was the first mineral to be worked (1863) alluvial tin soon took precedence in 1872. Silver, lead, zinc, copper, arsenic, wolframite, and molybdenite have also been worked from time to time. Coal and limestone have been the most important non-metallic minerals mined. Around the turn of the century, sandstone and granite were quarried for building material, and quarries for brick clay and road metal are still productive.

ALLUVIAL TIN

Tin was first discovered in 1854, by Joe Greer, on the Nundubbermere Run, but the value of the mineral was apparently not recognized. In February 1872, A. Ross had the first specimens of tin ore positively identified, and in April of the same year Messrs Jones and Greenup began work in Paddock Swamp east of Stanthorpe. Between 1872 and 1880, about 30,500 tons of tin concentrate were won. In January 1883, the Stanthorpe Mineral Field was proclaimed. Since 1886, annual production of tin concentrate has rarely exceeded 400 tons and in the last 25 years has exceeded 50 tons, on only five occasions.

Stream tin has been worked over an area 35 kilometres in length along the Severn River and its tributaries. The total area is approximately 500 square kilometres. The deposits occupy the present stream channels and swampy flats at the heads of the drainage system. Quart Pot Creek and its tributaries, Sugarloaf Creek and The Broadwater, have contributed much of the field's production. Four Mile, Thirteen Mile and Kettle Swamp Creeks and Paddock Swamp have also been extensively worked. Hydraulic sluicing and dredging have been applied to most of the available ground, and much of the old ground has been reworked. As a result, the reserves of the field are largely depleted.

The depth of the stanniferous alluvium averaged approximately 2 metres but it ranged from a decimetre to as much as 10 metres. The composition of the alluvium varies. In places it is composed of granitic detritus; elsewhere, of cemented clays, quartz pebbles and sand, in some places with granite boulders. Associated minerals may include ilmenite, rutile, wolframite, monazite and gold, with widespread cairngorm and topaz. Diamonds, sapphires, zircons, garnets and spinels have been reported (Skertchly, 1898).

Within the alluvial tin belt, certain areas are known to be relatively free of both ilmenite and wolframite. The area to the north of Stanthorpe, drained by Funker's Gap and Four Mile Creeks and the tributaries of Kettle Swamp Creek, is almost entirely free of ilmenite whereas that to the east, drained by Sugarloaf Creek and its tributaries contains notable proportions of "black sand" in the concentrates. On Block 609, Storm King, the alluvial concentrates held an appreciable percentage of wolframite (Skertchly, 1898). Along the headwaters of Pike Creek, gold is associated with the stanniferous gravels.

The relationship between the Ruby Creek Granite and the tin-bearing alluvium is most striking and it is here accepted that the great concentration of alluvial tin has been derived from widespread and countless disseminations and small veins carrying cassiterite in the Ruby Creek Granite.

LODE TIN

The only known lodes of any consequence occur in the precipitous country 30 kilometres southwest of Stanthorpe, where an intrusive mass of Ruby Creek Granite has been exposed along Red Rock Creek. The lodes are mainly confined to the periphery of the granite where they occur as many quartz and greisen veins along the contact of the granite and metasediments or intruding the surrounding metasediments.

Small rich concentrations of tin ore were worked to shallow depths in numerous places and were in some places associated with arsenopyrite, chalcopyrite, wolframite, and molybdenite. At Carpenter's Gully, a stanniferous zone occurs along the edge of the granite. Nearby, the pegmatites are stanniferous.

In the Sundown area, 3 kilometres farther to the southwest, veins of tin and copper ore traverse the metasediments. These veins were worked intermittently between 1893 and 1925 by open cut and shafts to produce about 270 tons of tin concentrate (Dimmick, 1953, and unpublished records of the Geological Survey of Queensland). The ore occurs as a series of lenses following the master joints, the cassiterite being associated with arsenopyrite, fluorite, siderite, calcite, and chalcopyrite. The largest mine in this area, the Sundown Mine (Dimmick, 1953), was developed to a depth of 74 metres before low metal prices and diminishing grade of ore forced it to close. Attempts to resume mining during the mid-1950's were unsuccessful.

Several small and ill-defined ore bodies have been worked at Kilminster, 10 kilometres northwest of Ballandean railway station. These are also associated with a number of small intrusions of Ruby Creek Granite into metasediments. Numerous stanniferous quartz veins intersect the granite-metamorphic contact and the granite itself, but they have proved to be uneconomic. Minerals associated with the cassiterite are similar to those at Sundown and Red Rock farther to the south.

At the headwaters of Pike Creek, gold commonly accompanies cassiterite but neither mineral has proved economic. East of Stanthorpe in the headwaters of Sugarloaf and Quart Pot Creeks, "lode type" cassiterite is mainly restricted to numerous small deposits along greisenized joint planes and quartz veins. No deposits of economic importance have been found although extensive prospecting was carried out before 1900.

GOLD

Gold was first discovered at Lord John Swamp (Lucky Valley Goldfield) in 1852. In 1863, rich but limited alluvial gold was uncovered on Canal Creek. Following close on the Canal Creek discovery where further finds at Talgai (Darkie's Flat) (1863-64), Thanes Creek (1869), Pikedale (1877), Leyburn (1872), and Palgrave (1897). Canal Creek was an alluvial goldfield only, whereas both alluvial gold and reef gold were won from the Talgai Goldfield. Thanes Creek was primarily an area of reef mining; at Pikedale and Leyburn little or no alluvial gold was won. Little is known about the Palgrave Goldfield.

Lucky Valley Goldfield

No returns for alluvial gold from this field have been recorded. The gold was won from alluvium in the "valley" and the gullies running into it. At the head of the "valley" a small hill of metasediments carried leaders of quartz showing free gold. A shaft was sunk on these leaders but was abandoned after 9 tons of ore, yielding 340 grams of gold, were recovered.

Canal Creek Goldfield

Gold was discovered by a party of seven Frenchmen working a gully 6 kilometres north of the old Canal Creek Station. Good alluvial ground was worked on the eastern side of Canal Creek up to the base of the dividing range but nothing of any consequence has been discovered on the western side of the creek. The depth of the alluvium was reported as ranging from 1.5 to 4 metres bottoming on pipe clay. The thickness of the wash varied considerably and it tended to occur as lenses. Archibald (1888) estimated that between 1863 and 1887, 565 kilograms of gold had been recovered. Although leaders of auriferous quartz were found along the dividing range in metasediments on the eastern extremity of the alluvial deposits, there is no record of any attempts to work these finds.

TABLE 2.

KNOWN MINES ON THE TALGAI, THANES CREEK, PIKEDALE, LEYBURN, AND PALGRAVE GOLDFIELDS

Talgai	Thanes Creek	Pikedale	Leyburn	Palgrave	Mines outside known goldfields
Louisa	Guiding Star 1879 1931	Good Hope reef	Lady Caroline 1882	Madam Ross 1897	Happy Smile (Palgrave)
Sultan and Taylor 1864 & 1930-31	Just-in-time 1880	Blackfellow reef	Perseverance 1872	Rimfire	Golden Bush (Silverwood)
Sawpit Reef	Queen 1881	Cameronian	Found at Last 1894	Mountain Maid 1880	Warroo
Prince of Wales	King 1881	Wanderer	Von Moltke 1873	Three Musketeers	Wild Scotchman Reef (N.W. of Pikedale GF)
St.Patrick 1892 and 1930	Lethbridge 1881	Star reef	Depression 1930	Phar Lap 1931	"Glenelg" (N.W.of Pikedale GF)
Victoria	Old Jack 1881	Webb's reef	Golden Crest	Eureka 1931	
Queenslander 1863	Princess Louise 1881	Rise & Shine	Biddles Revival 1911-12 & 1930	"JA" 1930-1	
Big Hill Tunnel 1864	Young Australian 1882	Kaffir Chief 1878	Bells Pride 1931	"PA" 1930-1	
Monte Cristo	Gladstone 1887 and 1931	"P and O"	Mt.Johnston 1931	Telief 1931	
Brilliant	Beaconsfield 1890	Dawn of Hope			
Woodman reef	Hidden Treasure 1890	Guiding Star			
New Chum 1892	Tucker's 1890	Lady Mary			
Falconers Blow	El Dorado 1891	Royal Standard			
Deaf Cat 1930-31	Try Again 1894	Dan O'Connel			
Cecilia	Surprise 1894	Lady Jane			
Golden Gate re-opened 1930-31	Howard's 1896	McLucas			
Lady Elizabeth 1930-31	Drayton's 1895 and 1931				
Old Federation	Providence 1887				
Last Try 1930-31	Anzac 1931				
Sunny South	"Better Hole" 1930-31				
Malakoff 1895 1930-31	"New Year" 1930-31				
Australian	Big Boulder				
Glen Hentley	Lonesome Trail				
Gladstone 1863	Beal's				
Yule Log	Golden Rod				
Mount Job					
May					
White					
Eastern Gate					

Talgai Goldfield

The Talgai Goldfield, originally known as Darkie's Flat, has supported both alluvial and reef mining, with spasmodic workings until recent times. Today workings are confined to limited gully-raking and "half-hearted" attempts at reef mining. The richest alluvial gold was won from Dunn's Gully at the head of Gum Flat, 5 kilometres south of Pratten. The alluvium was rich but patchy and ranged in depth from 0.5 to 6 metres. The gold was coarse and many nuggets ranging from 25 to 450 grams were unearthed. The largest nugget discovered on the alluvial fields, weighing 1.5 kilograms, was found on the Talgai Goldfield.

Traces of tin were commonly associated with the alluvial gold found on the field, the cassiterite being most plentiful in the alluvium of Dunn's Gully and the gullies leading on to Gum Flat. Skertchly (1898) recorded the find of a tinstone "nugget" weighing 250 grams. No economic deposits of tin have been recorded from this field and little trace of it is seen in the country rocks.

Many reefs have been worked on the Talgai field with varying results. Gold appeared to be patchy and in many cases the stone treated averaged 25 grams or less per ton. Several mines exceeded this average but faulting and/or small reserves were inimical to development in depth. Jack (1892) recorded that the Queensland reef was thought to be the first gold reef to be worked in Queensland. At a depth of about 21 metres, 17 kilograms of gold were recovered from 4 tons of ore. The main ore shoot was lost at depth where intersected by a quartz reef carrying pyrite.

The reefs on the field vary in size from thin stringers to veins 2 metres wide. The host rock of the gold is usually quartz that invades the metamorphics. The general strike of the gold bearing reefs is west to north-northwest and they have a southerly dip. The largest reefs found on the field have been worked along the spur of Mount Gammie North.

Thanes Creek Goldfield

Although the Thanes Creek Goldfield is not contiguous with the Canal Creek Goldfield, it appears to form an extension of the same belt of auriferous country. In contrast to the workings along Canal Creek, no alluvial gold of any great consequence has been found, most of the gold won being derived from reef mining. Lack of suitable crushing and treatment facilities, erratic gold values and faulting of the ore shoots appear to have been the main reasons for the decline of the field. No mine has been developed below about 35 metres, the average depth being about 18 metres.

Pikedale Goldfield

This field is on the southeastern extremity of the "gold belt" which extends from Leyburn in the north to Pikedale in the south. Gold production was confined to reef mining. Mineralization was found in both quartz "dykes" and fissure fillings, strongly faulted in part, and usually carrying pyrite. Occasionally cassiterite was found associated with the gold in some of the mines. The mines were not very large or very rich and difficulty was encountered with recovery of gold associated with pyrite. No record of actual production has been found. The country rocks are slate, indurated shale, and greywacke striking north - south and dipping at high angles. Small dioritic lenses have been found along relict bedding planes of the sediments in some of the mines. The strike of the auriferous deposits varies from east to east-northeast and they have a variable dip.

Leyburn Goldfield

No returns of production are available. The gold is found in dark laminated quartz reefs which tend to form lenses striking parallel to the general strike of the country rock and pitching at varying angles to the southeast. Gold has shown erratic distribution within the ore shoots; the average value per ton of stone treated rarely exceeded 30 grams. The country rocks are predominantly pink and purple phyllites, slates, and quartzites which strike approximately north 50° west and dip vertically.

Palgrave Goldfield

Little is known of the history or the workings of this field until 1931 when Denmead (1931b) reported on several mines in the vicinity. The country rocks in the vicinity of this goldfield are predominantly greywacke and slate striking a few degrees west of north and dipping to the west. Personal communications with old miners who know the field suggest that the ore was of low grade and the mines small.

Failure of the mines on all the goldfields appears to have been caused by the low average grade of the ore, patchy values, faulting, primitive methods of mining and inadequate equipment, lack of suitable crushing and treatment plants, inability to handle the pyritic ore, high cartage costs, and the discovery of richer goldfields in other parts of Queensland.

Warroo Gold and Copper Mine

The mine is situated on Portion 5, Parish of Warroo, 65 kilometres by road west of Stanthorpe and 30 kilometres east of the Cobba-da-mana railway siding. The lode was discovered in 1906 and the mine worked spasmodically until 1913. Mineralization was exploited to a depth of 60 metres and for a length of approximately 90 metres along the strike of the lode. Some 2,000 tons of ore were treated on the site either by smelting or by cyanidation for an average yield of 10 grams of gold per ton.

The mineralization occurs in a series of east-west trending indurated shales and interbedded fine-grained quartzites, with steep southerly dip. The lode varies in width from 10 centimetres to 1 metre and appears to be conformable with the strike of the metasediments although it cannot be considered to be interbedded with the country rock.

Good values were erratic. Copper mineralization was associated with the gold but appeared to be uneconomic on its own. In 1931 (Denmead, 1932), the mine was reopened for inspection and testing but activity was short-lived; the gold content of the ore proved to be sub-economic at that time.

TABLE 3

The goldfields in the northern part of the New England Fold Belt.

Goldfield	Discovered	Proclaimed	Area (km^2)	Type of Gold
Lucky Valley	1851	1869	65	alluvial
Talgai	1863	1882	200	reef & alluvial
	redefined	1902		
Canal Creek	1863	1868	55	alluvial
Thanes Creek	1869	1882	45	alluvial
Pikedale	1877	1877	80	reef
Leyburn	1872	1875	23	reef
Palgrave	1897	1897	13	reef

TABLE 4

Creeks and Gullies that have yielded gold in the Thanes Creek - Pratten area.

Date of Discovery	Name
1863-64	Yankee Gully
1864	Slaty Gully
1868	Wilson's Gully, Thanes Creek
1877	Kelly's Gully
1877	Dunn's Gully
1879	3 gullies off Surface Hill
?	Jack's Gully

COPPER

Sundown

Copper was first discovered at Sundown, Ballandean district, in 1888 but was not worked until 1898. The mine is located on a branch gully of Sundown Creek, 5 kilometres above its junction with the Severn River and 45 kilometres southwest of Stanthorpe (Ball, 1904b, Reid, 1916a).

The main mine working is an adit 90 metres in length, about 15 metres above the bottom of the gully and 20 metres below the ridge top, with winzes to some 15 metres below the adit and a 27 metres long drive at the bottom. The lode so exposed followed a well-defined east-northeasterly striking joint in silicified slates and according to Ball ranged in width from 0.5 to 2 metres. The bulk of the ore mined was found in lenses consisting mainly of arsenopyrite and quartz, with patches of cassiterite. Reid (1916a) recorded in the last 35 metres of the adit a strong body of "sooty" chalcopyrite ore up to 1 metre wide. Difficulties experienced with water and the lack of capital resulted in intermittent production throughout the mine's history. In 1899, 475 tons of ore yielded 54 tons of copper matte containing 2 kilograms of silver per ton. Fifty tons of copper matte averaging 2 kilograms of silver per ton were recovered in 1900. From 1900 to 1915 the mine lay idle. Between 1915 and 1924, about 223 tons of concentrate were produced before the mine closed in 1924 due to lack of capital. Ball (1904b) reported that the average copper content of the ore was 4.83%.

Silver Spur Mine

Copper produced during the working history of this mine (1893-1926) totalled 1,060 tons. See under "Silver-Lead".

Texas Copper Mine

The Texas Copper Mine lies 4 kilometres west of Silver Spur and has been abandoned since 1894 (Ball, 1904b). The country rock is a siliceous clay slate. Several shafts were sunk in a siliceous gossan to depths up to 18 metres, resulting in the discovery of a few isolated patches of copper ore. No records of production are available.

Silver Crown Silver - Copper Mine

The mine lies 6 kilometres east of Silver Spur. Mineralization occurs in a cupriferous gossan in clay schists which dip 80 degrees to the south-southeast. The mine was abandoned at a depth of 15 metres where galena and chalcopyrite appeared. Ore produced was reported to assay 150 grams to 1.2 kilograms of silver per ton and 14 percent copper (Ball, 1904b).

Tooliambi Copper Mine

This mine is 7 kilometres north-northeast of the old Silver Spur Township; mineralization was discovered in 1918. The main production took place between 1920 and 1922 and surface prospecting was carried out during 1927 and 1928. Mineralization is confined to silty and pebbly mudstone of Permian age and is composed of malachite, azurite, minor cuprite and chalcocite in a siliceous gangue. Five distinct lodes occur, the majority of which strike northeast and dip steeply to the southeast. Total production to date has been about 80 tons of ore raised, of which 70 tons produced about 8 tons of copper and about 360 kilograms of silver. Since 1919 official reports have been made on the mine by Ball (1919b, 1920b, 1930), Saint Smith (1923), Shepherd (1934, 1940), Simmonds (1961, 1963) and Sawers (1968).

Commodore Copper Mine

The Commodore Copper Mine is situated near the Warroo Gold Mine, 40 kilometres northeast of Texas. The ore body was discovered in 1905 and was worked at intervals between 1905 and 1912 when the mine was abandoned. The mineralization was exploited to a depth of 35 metres and laterally for approximately 85 metres. Tenor of the ore varied from 6 to 25 percent copper; gold averaged 25 grams per ton.

The ore body varied in width from about 10 centimetres to 1 metre. (Warden's reports for the Stanthorpe Mineral Field for the years 1905 to 1912 inclusive).

"The Ashton" Copper Mine

Mineralization was discovered prior to 1879 (Cribb, 1944a). Skertchly (1898) places the position of the mine on the junction of Bracker and Treverton Creeks 65 kilometres west of Stanthorpe. Little production has been recorded. The Warden's report of 1898 gives an ore assay of 30% copper and about 570 grams of silver per ton.

Silverwood Copper Mines

No date is recorded for this discovery but it is thought that the first mine was opened prior to 1915. The mines are situated on the left bank of Rosenthal Creek 4 kilometres southwest of Silverwood railway station. Mineralization is confined to the vicinity of porphyry dykes cutting silicified and highly epidotized tuffaceous sediments. The porphyry dykes and country rock carry abundant pyrite, whereas chalcopyrite and sphalerite with minor chalcocite are restricted to the contact between the dykes and the country rock and copper carbonates occur as fracture stainings. Where limestone lenses are present, galena and sphalerite tend to be predominant. Saint Smith (1924) first reported on these deposits. Since 1966, when new interest was shown in the deposits, open cutting and diamond drilling at one of them has failed to indicate prospects for other than selective underground mining (Sawers, 1969).

Small copper loades have been worked in the vicinity of Mineral Hill in the Kilminster area and at the Silver Queen Mine, 11 kilometres west of Ballandean. (See Ball (1904b), Cameron (1908b), Saint Smith (1914a) and Robertson (1964)). The deposits were small and the reserves were considered to be insignificant.

SILVER-LEAD

Pikedale

Mineralization at Pikedale was discovered in 1895 and production commenced in 1896. The mines are situated on the west bank of Woolshed Gully, near Pikedale station 50 kilometres west of Stanthorpe. The lode ranges in width from 0.5 to 2 metres and occurs in silicified shales that strike northwest and dip steeply to the northeast. The lode parallels the grain of the country but has been faulted on its northern extremity (Skertchly, 1898). The reef cap consisted of gossan with carbonates of copper and silver, which, at depth, gave way to complex sulphide ores. Mining and smelting were restricted to the years 1896-1897 and 1906-1907 due to smelting problems and finance.

Since 1907 no work has been carried out on the ore body. During the working periods of the mines, the carbonates were stoped out leaving the complex sulphide ores. No attempt has been made to work the sulphide ore to this date. When Ball (1904b) visited the mines, six shafts had been sunk, the deepest being about 50 metres. Production during 1896-1897 was reported by Ball (1904b) as about 760 tons of ore raised for a yield of about 640 kilograms of silver, 1.4 kilograms of gold, and 35 tons of copper, with an unspecified high percentage of zinc. During 1906-1907, 435 tons of ore yielded about 13 tons of copper, 135 kilograms of silver, 11 tons of lead and 70 tons of zinc (Dept. Mines, 1907, 1908; Cameron, 1908a).

Silver Spur Mine

The Silver Spur Mine is 10 kilometres east of Texas and 85 kilometres by road west-southwest of Stanthorpe. The deposit was discovered in 1891 and a small company was formed in 1892. Mining and smelting began in mid-1893 and continued without interruption until November 1913. After a period of idleness, work recommenced in June 1916 and continued until October 1926 when the mine closed; the smelter worked for short periods during 1918 and 1920.

Throughout the period of operation, ore raised and smelted (including fluxes) amounted to about 106,700 tons. Five ore bodies have been opened to a depth of 150 metres. The ore bodies occur in beds of dark-grey clay slate which are interbedded with lighter slates, and the ore shoots are localized by strike faulting and shear fractures (Ball, 1904b). The average strike of the metasediments is north-south and the easterly dip is variable. Diorite dykes intrude the metasediments in the vicinity of Silver Spur. Skertchly (1898), Stokes (1899), Ball (1904b, 1918) and Saint Smith (1913) have reported on the geology,structure and potential of this deposit. Prospects for further production have been investigated subsequently by various mining interests, but the mine has not be re-opened.

Production figures for the period 1893 to 1920 have been estimated as follows.

Silver	58,618 kilograms
Gold	150 kilograms
Lead	1460 tons
Copper	1060 tons
Silver ore shipped to Europe	920 tons
Zinc ore shipped to Europe	700 tons

In 1952, 160 tons of ore was sent overseas as a trial shipment, for a return of 875 grams of gold, 265 kilograms of silver and about 9 tons of lead.

Silver King Silver-Lead Mine

The mine, 3 kilometres north-northwest of Silver Spur, was opened in 1893. The country rock is a schistose slate containing limestone lenses. The mineralization occurred in a gossan 9 metres long and up to 1.5 metres wide, partly replacing the country rock. Carbonates of lead and copper formed the bulk of the mineralization but cut out at a depty of 10 metres. Recorded production was 30-40 tons of ore yielding 1.4 kilograms silver per ton and 5 percent lead (Ball, 1904b).

Silver Queen Silver Mine

The Silver Queen Silver Mine is on the right bank of the Severn River 13 kilometres by road west of Ballandean Railway Station. Mineralization was discovered in 1897, and the mine was first worked in 1899. The deposit consists of impregnations in and replacement of a porphyry dyke by pyrite, galena, chalcopyrite, arsenopyrite, and zine blende (Bonner, 1952). Five shafts and several pits have been sunk along the line of the mineral zone and the deepest shaft exceeds 30 metres. The ill-defined ore pipe is not uniform and the tenor of the ore is variable.

Within the ore pipe, mineral type appears to vary from chalcopyrite in the central core to blebs of coarse cubical pyrite on the circumference and in the altered dyke rock. Sphalerite tends to show greater abundance with depth at the expense of the other ore minerals. In the upper oxidized zone (surface to 18 metres) chrysocolla, malachite, azurite, and bornite are present.

The mine was worked from 1899 to 1900, 1902 to 1903 and from 1905 to 1908. In 1952 the workings were dewatered to a depth of 30 metres.

Production (Cameron, 1908b)

1899-1903	40 tons of picked ore carrying $2\frac{1}{2}$ to $4\frac{1}{2}$% copper, 15% lead and 340 grams of silver per ton.
1904	60 tons of ore treated at Aldershot (no details).
1907	$5\frac{1}{4}$ tons of concentrates assaying 2.4% copper, 48% lead, 10% zinc and 1.7 kilograms of silver per ton.
1907	(Wardens report) 268 tons of ore crushed locally for a yield of 47 tons of concentrates - no assay recorded.
1908	36 tons of concentrates in 6 parcels, ranging from 21.5 to 39.3% lead, 13 to 14.5% zinc, 0.6 to 27 kilograms of silver per ton, trace of gold and 15 to 20% sulphur, were treated at Cockle Creek.

Mrs. Allison's Sugarloaf

On the north bank of Sugarloaf Creek near Mount Sugarloaf, east of Stanthorpe, a small quartzose vein carrying galena, pyrite and chalcopyrite lies along the margin of an altered basic dyke. It was prospected many years ago and is apparently of no economic value (Skertchly, 1898).

ARSENIC

With the exception of 2 tons from an undisclosed locality in 1919, the entire arsenic output of Queensland between 1919 and 1927 came from the Jibbinbar and Sundown - Red Rock areas.

Jibbinbar State Arsenic Mine

The largest of the arsenic mines in the Stanthorpe district was the Jibbinbar Mine 38 kilometres southwest of Stanthorpe. The mineralization appears to have been concentrated in shear zones in granulites marginal to the Ruby Creek Granite. The main lode, striking east-west, averaged 2 metres in width and was worked to a depth of 65 metres before known reserves were almost exhausted and falling arsenic prices forced the mine and treatment plant to close.

The ore was bunchy and irregular. The main ore mineral was arsenopyrite, accompanied by very minor amounts of chalcopyrite, silver and galena, with scorodite and arsenates of iron in the oxidized zone.

Marshall's Lode, which adjoins the main lode, carried a low percentage of arsenic except where it intersected the main lode. Another lode (about 1 metre wide), 3 kilometres southeast of the mine, was prospected but no production from it has been recorded. This lode consisted of arsenopyrite in a quartz gangue.

From 1919 until 1924, when the mine closed down, the production totalled about 1800 tons of arsenic, (McLeod, 1965).

Sundown - Red Rock area

The Sundown group of mines is approximately 23 kilometres by road southwest of Ballandean and 8 kilometres southeast of Mount Jibbinbar. Several lodes have been opened up in strongly metamorphosed sediments and tuffs with the bulk of the production coming from the "Tin lode" and "Copper Lode" (Dimmick, 1953).

These two lodes appear to be separate and parallel. The ore occurred in shoots, with width varying up to 1 metre. Arsenopyrite, chalcopyrite and cassiterite together with fluorite, quartz and calcite, constituted the ore. Mining ceased in 1924 after about 250 tons of arsenic had been recovered.

The Beecroft Mine is half a kilometre southwest of the Sundown workings. The ore is similar to that in the Sundown Mines with the exception that wolframite appeared at depth. Two lenses, each approximately 28 metres long and up to 1.5 metres wide, were worked before 1928. Output of arsenic from this mine is estimated to be 1170 tons (McLeod, 1965).

Other mines in the area that produced arsenic ore were the Comet Mine and the Orient Mine (formerly called the "Planet").

Small arsenic lodes have been discovered in the vicinity of the Severn River 10 kilometres west of Ballandean (Simmonds, 1958; Robertson, 1964). In one instance, an attempt was made to mine the ore which assayed from 28-38% arsenic and 30-60 grams of silver per ton (Wall's claim, portion 17V, Nundubbermere). Eight kilometres west-southwest of Gore, on portions 9V and 4V Moynalty, small arsenic lodes are associated with aplite dykes. Arsenic content ranged up to 17%, with silver rarely exceeding 30 grams per ton.

MANGANESE

Many small deposits of manganese have been worked in the Palaeozoic sediments in the Warwick, Stanthorpe, and Inglewood districts.

Mount Gammie

This mine lies 8 kilometres west-southwest of Pratten and about 2½ kilometres east of Thanes Creek. The maganese deposit is on a spur of Mount Gammie, just south of the trigonometrical station on the summit. It was discovered in about 1884 and at first the deposit was open cut.

In 1896, a shaft, 4 metres deep, was sunk on the southern end of the magnniferous outcrop for a yield of 4 tons of ore. The ore body strikes north-south and has an easterly dip; the surrounding country rocks are sandy clay slates and quartzites, striking a few degrees east of north. The surface ore assayed 48.9% manganese (Ball, 1904a).

The Glen

This mine is on portion 95V, parish of Rosenthal, 8 kilometres west-southwest of Warwick. The deposit occurs as several small lenses of manganese oxide and silicate in Palaeozoic sediments near the contact of the sediments and the Herries Adamellite. First mined around 1903, the deposits have been worked spasmodically ever since. No production figures are available and the manganese content of the ore is low. Since 1962 the main interest has been rhodonite.

Mount Devine (ML 241)

The deposit was discovered prior to 1922. The workings lie just south-southeast of Yuraraba railway siding 80 kilometres from Warwick on the southwestern line. The ore is predominantly psilomelane associated with jasper and schistose slate. One open cut, 2.5 metres wide, 3 metres deep and 7 metres long yielded 80 tons of ore to 1923 (Ball, 1923).

Mount Fuller (MLs 209 and 240)

This mine is on portion 21, parish of Bodumba, near Graysholm railway siding 90 kilometres from Warwick. Manganese was discovered and worked in 1918 but the mine was abandoned several months later. The ore lenses (4.5 x 0.5 metres), with interlaminated jasperoid, occurred in thin-bedded kaolinized shales striking east-west. One small open cut and two shallow shafts yielded 90 tons of ore with an average assay (Ball, 1923) of :

Manganese	53.5 - 56.59%
Iron	2.64 - 3.0%
Insolubles	5.0 - 11.1%
Ignition loss	10.4%
Phosphorus	0.2%

War Effort Manganese Mine (Mining Claim No. 1074)

The War Effort Manganese Mine is located on portion 85V, parish of Coolmunda, in the Bracker Creek area 22 kilometres east of Inglewood. The manganese ore forms lenses striking northeast conformably with the general strike of the folded kaolinized and jasperized shales (Ball, 1923). Some of the high grade ore lenses are terminated by joints. The deposits were first worked prior to 1904 for a yield of 15 tons of ore. During 1904, 4 tons of manganese ore were recorded. In the main deposit, ore was worked at intervals over a length of some 50 metres (Ball, 1923) with an average width of 2.5 metres (Cribb, 1944b). The average assay of ore won was:-

Manganese	56.0%
Iron	2.35%
Insolubles	6.00%
Phosphorous	0.87%

The mine was worked again during 1940, 1941, and 1942 when an estimated 150 tons of ore were won (Cribb, 1944b).

In 1963 the mine was reopened with a view to the production of chemical grade manganese ore. During 1963, about 150 tons were produced and from January to May 1964 a further 80 tons had been marketed. The ore assayed up to 80.4% MnO_2, 2.6-8.8%, silica, and 3.6 - 6.5% iron.

Manganese has been found in many small uneconomic deposits throughout the area covered by the Palaeozoic rocks. Recorded localities include Braeside, Silverwood, Pratten Goldfield, Dalveen and west of Texas and Mingoola homestead.

MOLYBDENITE

Molybdenite occurs as an accessory mineral in many of the vein and fissure-type ore deposits that lie within or along the edge of the more acid granites of the New England Batholith. It is rarely concentrated in economic quantities.

The largest deposit occurs at Leis' Molybdenite Mine, Wallangarra, where the mineralized outcrop extends for 150 metres and has been mined to a depth of 9 metres. The mine is situated in the extreme southwest corner of portion 86, parish of Ballandean, 3 kilometres east-northeast of Wallangarra. The host rocks for the mineralization are the Ruby Creek Granite and numerous aplite dykes. Ball (1919d) reported on the workings of this mine. From 1916 to the end of 1919, 203 kilograms of molybdenite had been won.

Further to the west-northwest, at Carpenter's Gully in the Sundown - Red Rock area, molybdenite in concentrations of less that 1% occurs along the contact between the Ruby Creek Granite and the silicified metasediments. Ball (1919e) considered these deposits to be of the pneumatolytic - contact - metamorphic type. Traces of molybdenite have been recorded from the vicinity of the old Sundown tin mine.

To the west of Ballandean, in the Kilminster area, many small disseminated molybdenite bodies occur in the silicified Ruby Creek Granite. These deposits have proved to be, in the majority of cases, subeconomic. Saint Smith (1914a), Jensen (1918d), Simmonds (1958) and Robertson (1964) have reported the occurrence of molybdenite in this area. Where the molybdenite occurs in mineralized veins intruding the Ruby Creek Granite in the Kilminster area, it is invariably accompanied by wolframite, tin, and arsenopyrite, and more rarely by chalcopyrite, sphalerite, galena, and magnetite.

Two kilometres southeast of Stanthorpe, molybdenite associated with native bismuth and bismuth carbonate occurs in a quartz pipe-like structure 12 metres in diameter and widening downwards (Jensen, 1917, 1918d). The content of molybdenite is low, averaging from 0.2 to 0.5% MoS_2.

Molybdenite has been reported from portion 80V, parish of Wildash (Jensen, 1918d). It occurred associated with wolframite in small quartz-aplite veins and greisen "dyke structures" intruding a small mass of Ruby Creek Granite in the Stanthorpe Adamellite. The deposit proved to be uneconomic.

WOLFRAMITE

The main occurrence of wolframite is as an accessory mineral in many of the ore deposits developed within the granite. It is commonly found in the many mineralized veins crosscutting the Ruby Creek Granite and as a minor constituent in the alluvial tin deposits in many parts of the Stanthorpe Mineral Field. Little mining for wolframite has taken place.

BUILDING MATERIALS

From Greymare railway siding, "granite" was quarried for the construction of buildings in both Warwick and Brisbane. The marble deposits at Lucky Valley and Limevale have produced a limited tonnage of material, the bulk of current production being used for terrazzo.

IRONSTONE

Ironstone crops out 11 kilometres north of the Silver Spur Mine. Three lenticular masses, several metres apart, strike northwest over a distance of 35 metres. The greater part of the deposit was reported as being brown limonite with some crystalline magnetite and a little free silica (Ball, 1904c). A sample analysed :-

FeO_3, FeO	85.22
MnO_2	1.69
Al_2O_3	5.50
SiO_2	4.94
H_2O	2.65
	100.00

The ironstone was used as a flux in the smelters at Silver Spur.

LIMESTONE

Within the Warwick, Gore and Texas areas, limestone has been quarried from lenticular bodies interbedded with Palaeozoic sediments and metasediments.

Gore (70 kilometres by rail west of Warwick)

The limestone deposits at Gore occur as lenticular masses interbedded with slates which dip vertically and strike northwest. The limestone crops out intermittently over a distance of 10 kilometres from near Gore railway station to beyond Macintyre Brook. In the main working 6.5 kilometres south of Gore (Connah, 1958), a light grey limestone has been exposed and proved to a depth of 35 metres. Drillholes have indicated that the deposit extends to a depth of more than 60 metres. The lens is known to be at least 270 metres long by 30 metres wide. Cave deposits and joint fillings of clay and detrital material adversely influence cost of exploitation of the limestone. A sample analysed:-

Moisture	trace
Loss on ignition	43.4%
SiO_2	0.4%
Fe_2O_3	0.1%
Al_2O_3	0.1%
CaO	55.9%
MfO	-

Other lenses of limestone to the southeast of the main quarry, beyond Macintyre Brook, are better situated for quarrying but are further from the railway.

Limevale (16 kilometres north of Texas)

Marble has been quarried for building purposes in portion 28, parish of Silver Spur. The material has a fine even-grained texture suitable for polishing. The deposits are large and blocks of considerable size can be mined. There is said to be much variation in the colour of stone available in the area.

Silver Spur

Several small belts of limestone are known around Silver Spur and Glenlyon, 20 kilometres to the east-southeast. Parts of these deposits were exploited when the smelters at Silver Spur were operating. At Kilminster, 9 kilometres west of Ballandean, several small lenses have been reported. Adjacent to the granite, these limestones have been altered with development of garnet and wollastonite.

Lucky Valley (Elbow Valley; 11 kilometres southeast of Silverwood railway station)

Several occurrences of limestone have been reported and worked in this area. The main deposits occur on Reserve R49, and portions 1200, 1219, 106, and 107, parish of Wildash. The Stanthorpe Adamellite has metamorphosed the limestone to coarse-grained white marble. In Reserve R49, one lens, to a depth of 30 metres, has been estimated to contain 2 to 3 million tons of limestone (Connah, 1958). Analysis of marble from portion 106 was given as:-

Loss on ignition	43.1%
Insolubles	1.2%
$Fe_2O_3 + Al_2O_3$	0.6%
CaO	54.7%
MfO	0.3%

The marble deposits of this area have been quarried for building, monumental, and terrazzo material.

Silverwood (18 kilometres by rail south of Warwick)

A number of discontinuous lenses of coralline limestone occur near the railway from Morgan Park to Cherry Gully. Some of these are of considerable size and large tonnages of limestone have been quarried and burnt for lime from Lock's Quarry in portion 508, Rosenthal, and from Grieve's Quarry in portion 660.

At Grieve's Quarry, the limestone crops out over a length of 270 metres with a width of 9 metres. Analysis of the limestone from Grieve's Quarry has been reported as :-

Moisture	0.1%
Loss on ignition	42.6%
SiO_2	0.8%
Fe_2O_3	0.8%
Al_2O_3	0.9%
CaO	54.1%
MgO	0.2%

The following authors have reported on the limestones in the Warwick - Gore - Texas area: Ball (1904c, 1918, 1932, 1945), Dunstan (1913, 1914, 1918), Rands (1887), Richards and Bryan (1924), and Saint Smith (1914a, 1922).

GEMSTONES

Gemstones are mainly confined to the stanniferous gravels on the New England Batholith. Rhodonite and agate have been worked in the Warwick area on a semi-commercial scale.

Topaz

Topaz has been found in almost all the alluvial deposits within the "tin belt", and was abundant in the stanniferous gravels of Spring Creek, Cannon Creek, Quartpot Creek, the head of The Broadwater, Funkers Gap, Bald Rock Creek, Ten-Mile Creek and Swiper's Gully. The clear variety was the most common, but pale-blue, straw yellow, and rare pale green varieties are known. Generally the material was well waterworn, although some specimens showed well-developed crystal faces.

Zircon

Zircons have been recorded from all parts of the New England Batholith. They are generally less than 4 mm in diameter, however several brown specimens up to 1 cm in diameter have been recovered from Spring Creek.

Clear reddish-brown, reddish-yellow and ice-blue varieties occur.

Beryl

Beryl is a rare constituent of the stanniferous gravels. Dalcouth Creek has produced the only beryl recorded from alluvial workings. Small, green, semi-transparent crystals of beryl have been discovered in the old Kilminster mining area, west of Ballandean. These were found in situ, in the outcrop of a small pegmatite dyke. The deposits are too small to be of commercial value.

Sapphire

Sapphires have been recovered from Spring Creek, Kettle Swamp, the Severn River, and to a lesser extent from Sugarloaf Creek, Lode Creek, and the tributaries of Sugarloaf Creek. They rarely exceed 0.5 centimetre in length and they are well waterworn. Colours vary from green to blue and parti-colour. Opaque corundum is plentiful.

Diamonds

Diamonds have been found in Kettle Swamp, Spring Creek, and the head of The Broadwater. In 1873, a diamond-saving machine operated for 8 months on Spring Creek for a total gain of 4 diamonds. The source of the diamonds has never been found. Basic dykes have been suggested as a possible source. Skertchly (1898) considered that the diamonds were derived from the greisens but there is no supporting evidence for this.

Agate

Small quantities of agate have been found in the basalts of the Great Dividing Range, in the alluvium of Emu Creek and the upper part of the Swanfels valley, and as silicified wood in the Jurassic sandstones near Tannymorel. Small deposits of common opal are known east of Yangan.

Rhodonite

Rhodonite has been worked on portions 95V, 96V and 3V, parish of Rosenthal, 10 kilometres southwest of Warwick (Ball, 1904a, c). Originally opened as a source of manganese ore, the deposits have been reworked in recent years for rhodonite, to supply the jewellery trade. The quality of the material is variable.

Quartz crystal, Cairngorm and Amethyst.

Quartz crystal and Cairngorm have been found in all the tin-bearing gravels in the Warwick 1:250,000 Sheet area. Amenthyst is rarer and has been recorded from Spring Creek, The Broadwater and Kettle Swamp only. Rock crystal and cairngorm pebbles 15 centimetres or more in length are usually associated with schorl tourmaline in the coarser parts of the alluvium. All three varieties have been located at Sundown and Kilminster while doubly-terminated quartz crystals have been found in weathered pegmatite veins near Ballandean Head Station.

ORE MINERALIZATION, ZONATION AND RELATIONSHIP TO ROCK TYPES

The ore minerals associated with the granites of the New England Batholith can be classified as either late magmatic or post-magmatic hydrothermal. Wolframite is considered to be late magmatic, whereas tin, sulphides and gold have been classed as post-magmatic hydrothermal. Of the second type of mineralization, Lawrence (1955) considers there have been two phases of deposition,the first characterized by arsenopyrite, the second by galena and sphalerite. In the Warwick 1:250,000 Sheet area, the post-magmatic hydrothermal stage has been arbitrarily divided into three phases of mineral deposition. The first phase gave rise to arsenopyrite and cassiterite, the second to copper sulphide, galena and sphalerite, and the third to gold.

Copper, lead and zinc mineralization is confined mainly to the metasediments in pyrometasomatic zones, caused by the contact of underlying granite with the sedimentary host rock. Lawrence (1955) considers these deposits to be hypothermal whereas Cornelius (1964) suggests that they could be mesothermal. At Sundown, Red Rock, Carpenter's Gully (southwest of Ballandean) and at Kilminster (west of Ballandean), the cassiterite-arsenic mineralization is restricted to the metamorphics in close proximity to the contact with the granite (Ruby Creek Granite). These areas are considered to be examples of hypogene deposits.

Gold is considered to be of mesothermal origin. The gold is confined chiefly to the Palaeozoic sediments in the northwestern part of the Warwick 1:250,000 Sheet area. In the Pikedale lode west of Amiens, gold and cassiterite are associated and most of the known gold occurrences of economic significance lie northwards from this point along the western side of the batholith.

Cornelius (1964) considers that the dykes were not responsible for the gold mineralization since (a) they carry no appreciable gold themselves (b) they were emplaced in tension fractures as compared to shear fractures for gold, and (c) the dykes were late magmatic.

Most of the ore minerals classified as post-magmatic hydrothermal have been emplaced along joint and interlacing shear planes and are considered to have been derived from hydrothermal emanations during the final stages of intrusion of the Ruby Creek Granite. Because of this, many of the larger mines are in and around outcrops of this granite where it intrudes the metasediments. Exceptions are the gold deposits and the mines in the vicinity of Silver Spur.

Mineralization in the Warwick 1:250,000 Sheet area shows some evidence of zonation from south to north. Alluvial cassiterite develops its maximum concentration in the vicinity of the Ruby Creek Granite. Arsenic is confined mainly to the Sundown, Red Rock, Kilminster and Jibbinbar areas and does not extend as economic deposits much farther north than the Stanthorpe - Texas road.

Copper, silver, lead, and zinc occur in a roughly east-west trending belt from the edge of the granites to Silver Spur near Texas. Gold has its maximum development north of the copper belt and forms an inverted Y - shaped belt oriented in a northwest-southeast direction. The edge of the main Mesozoic basin in the north forms the northernmost outcrop boundary of the so-called gold belt. Manganese shows no zonal arrangement as it is scattered throughout the Palaeozoic sediments.

Rock types play an important part in the exploration for various economic minerals. Gold and manganese are confined mainly to the Palaeozoic sediments. Copper, silver, lead and zinc show similar relationships to that of gold and manganese but around Sundown, Red Rock, and Kilminster they show a strong relationship to the Ruby Creek Granite. Arsenic, tin, molybdenite and wolframite show strong affinities with the Ruby Creek Granite.

ECONOMIC GEOLOGY - NEW SOUTH WALES

by

P.G. Flood

The main areas of mineralization are: Willson's Downfall (Tin), Undercliffe Falls (Graphite), Morgan's Creek (Molybdenite), Red Rock (Gold, Silver, Copper, Lead and Zinc), Boorook (Gold, Silver, Lead and Zinc), Rivertree (Gold, Silver, Lead, Zinc and Copper), and Drake (Gold, Lead, Zinc and Copper). These areas have been discussed by several authors including Andrews (1901, 1902, 1908), Lawrence (1962), McLeod (1965), Raggatt (1938), and Saint Smith (1911).

Willson's Downfall

The cassiterite deposits of the Willson's Downfall area are continuous with those of the Stanthorpe Tin Field (see Robertson, this appendix). The alluvial tin deposits are derived from a fine-grained, highly acid granite (Ruby Creek Granite; Phillips, 1968), and particularly from pegmatite and aplite dykes and greisen seams related to it. The area has produced in excess of 17,000 tons of alluvial tin concentrate, and data concerning past mining operations can be obtained from the Annual Reports of the N.S.W. Mines Department.

Undercliffe Falls

The Undercliffe Mountain Graphite Deposits (Andrews, 1902) occur 25 kilometres east of Stanthorpe, and consist of nine small deposits of amorphous graphite, originally carbonaceous shales or coal seams, interbedded with quartz-mica-feldspar hornfelses close to the contact with the Stanthorpe Adamellite.

The largest lode is the Plumbago Deposit with moderately to steeply dipping graphite beds, up to 1 metre thick, which have been mined from shafts over a distance of about 375 metres. Wynn (1956) records a production figure of about 2750 tons of graphite of approximate average grade of 32 percent.

Morgan's Creek

The Morgan's Creek molybdenite deposit occurs in the precipitous country between the Cataract River and Morgan's Creek, approximately 8 kilometres northeast of the old Boorook mining site. The visible molybdenite mineralization is associated with a small adamellite pluton, but the concentration of disseminated flakes is restricted to very small areas.

Red Rock

The Red Rock Mineral Field is situated in the precipitous country lying between Crooked Creek and the Cataract River, 25 kilometres northwest of Drake. The deposits were discovered in 1886, and from 1887 to 1889 intense mining took place. In 1890 operations were suspended until 1911, when the area was re-opened. Mining continued until 1922, when the fall in the price of copper caused the cessation of mining. The mineralization occurs in the Permian Drake Volcanics and consists mainly of sulphides of copper and zinc. Accurate production data are not available.

Boorook

The Boorook Silver Field is situated about the old Boorook township site. In 1872, auriferous reefs were discovered but they had been worked out by the end of 1873. Other intermittent operations ensued until 1885, when mining was no longer economically feasible. The lodes were associated with porphyry dykes which were intruded into Permian volcanics and sediments. Silver sulphides are associated with galena, pyrite, sphalerite, and gold. Production figures for the years 1879 - 1884 indicate that 3,200 kilograms of silver were won.

Rivertree

The Rivertree Silver-Lead-Zinc Field is about 45 kilometres east of Stanthorpe in extremely rugged country around the Maryland and Clarence Rivers. The field was discovered in 1887, but production has been sporadic and small and work was finally suspended in 1925. Pyrite and arsenopyrite are the dominant minerals, and argentiferous galena, sphalerite, and chalcopyrite are also present (Lawrence, 1962). The numerous ore bodies are lenticular and occur along shear planes in the granite bodies and along the contacts of the granite and country rock. Detailed production figures are not available.

Drake

The ore deposits of the Drake field (Andrews, 1908) were first worked in 1878 for gold, which is associated with mixed primary sulphides in small but numerous veins and lodes. The deposits have been followed to depths of 90 metres and the gold values were as high as 540 grams to the ton in the oxidized zone, but, below the water table, the percentage of gold dropped and copper became the more significant ore mineral. Although this field has been worked sporadically for many years, production figures are not available.

About 10 kilometres north-northeast of Drake is the Lunatic Gold Field (Jaquet, 1896). Details of this field are not readily available.

REFERENCES (Appendix 1)

ANDREWS, E.C., 1901 - Report on the Rivertree silver field. Rep. Dep. Mines N.S.W. (1900), 192-193.

ANDREWS, E.C., 1902 - Note on the occurrence of graphite at Wilson's Downfall. Ibid., (1901), 170.

ANDREWS, E.C., 1903 - (No title - concerning fossils at Boorook, Undercliffe Falls and Drake). Ibid., 1902, 128-129.

ANDREWS, E.C., 1904 - The geology of the New England Plateau, with special reference to the granites of northern New England. Part I: Physiography. Rec. geol Surv. N.S.W., 7(4), 281-300.

ANDREWS, E.C., 1905 - The geology of the New England Plateau with special reference to the granites of northern New England. Parts 2 and 3: General geology and the genesis of the ore deposits. Ibid., 8(1), 108-152.

ANDREWS, E.C., 1908 - Report on the Drake gold and copper field. N.S.W. Mineral Resour., 12.

ANDREWS, E.C., MINGAYE, J.C., and CARD, G.W., 1907 - The geology of the New England Plateau, with special reference to the granites of northern New England. Part 4: Petrology. Rec. geol Surv. N.S.W., 8(3), 196-238.

ANON, 1912 - Mining in the Stanthorpe district. Qld Govt Min. J., 13, 370-372.

ANON, 1935 - Limestone quarries at Gore; short survey of operations. Ibid., 36, 81-82.

ANON, 1946 - Alleged uranium deposits, Stanthorpe district. Ibid., 47, 170.

ANON, 1957 - Lead slag from Silver Spur. C.S.I.R.O. Mines Invest. Rep., 685.

ARCHIBALD, J., 1888 - Goldfields in the Warwick district. A. Rep. Dep. Mines. Qld (1887), 68-74.

BALL, L.C., 1903a - Annual Notes Stanthorpe - notes on gems. Qld Govt Min. J., 4, 298,

BALL, L.C., 1903b - Late discovery of gold near Pratten, Talgai Goldfield - Preliminary Report. Ibid., 4, 525-526.

BALL, L.C., 1903c - Late discovery of gold near Pratten, Talgai Goldfield; (ii) Some mines on the Talgai Goldfield; and (iii) discovery of gold at Mount Sturt and Freestone Creek, Warwick district. Publ. geol Surv. Qld, 186.

BALL, L.C., 1903d - Mount Sturt and Freestone Creek, Warwick district. Report on the recent discovery of gold. Qld Govt Min. J., 4, 526-7.

BALL, L.C., 1903e - Some mines on the Talgai Goldfield. Ibid., 4, 580-584.

BALL, L.C., 1904a - Some Manganese deposits in the Gin Gin, Degibo and Warwick Districts. Qld Govt Min. J., 5, 15-17.

BALL, L.C., 1904b - Notes on tin, copper, and silver mining in the Stanthorpe district. Publ. geol Surv. Qld., 191, and Qld Govt Min. J., 5, 321-327, 376-383.

BALL, L.C., 1904c - Certain iron ore, manganese ore, and limestone deposits in the central and southern districts of Queensland. Publ. geol Surv. Qld, 194, and Qld Govt Min. J., 5, 605-609.

BALL, L.C., 1905a - Queensland stones for architectural and monumental purposes. Qld Govt Min. J., 6, 457.

BALL, L.C., 1905b - Talgai and Thanes Creek Goldfields. Ibid., 6, 515-518.

BALL, L.C., 1906 - Second report Oaks View gold mine, near Rockhampton; and Notes on mines in the Talgai and Thanes Creek Goldfields. Publ. geol Surv. Qld, 205, 25-36.

BALL, L.C., 1910 - (No title). Rep. geol Surv. Qld, (unpubl.).

BALL, L.C., 1917 - Phosphates at Gore. Qld Govt Min. J. 18, 443-4.

BALL, L.C., 1918 - Silver Spur Mine. Recent developments and future prospecting. Publ. geol Surv. Qld, 264, and Qld Govt Min. J., 19, 152-160.

BALL, L.C., 1919a - Arsenic mines near Gore, Stanthorpe Mineral Field. Qld Govt Min. J., 20, 464.

BALL, L.C., 1919b - Devlin's copper show, near Silver Spur. Ibid., 20, 330.

BALL, L.C., 1919c - Re samples from the State Arsenic Mine on ML 29, Jibbenbar. Rep. geol Surv. Qld, (unpubl.).

BALL, L.C., 1919d - Leis' Molybdenite Mine, Wallangarra. Ibid.

BALL, L.C., 1919e - Stewart's Molybdenite Mine, ML222, Carpenter's Gully, Ibid.

BALL, L.C., 1920a - An occurrence of silver-lead ore on Rocklands, near Warwick. Qld Govt Min. J., 21, 324.

BALL, L.C., 1920b - Report on Devlin's Mine, near Silver Spur. Rep. geol Surv. Qld. (unpubl.).

BALL, L.C., 1923 - Notes on manganese on the Darling Downs. Qld Govt Min. J., 24, 457-9.

BALL, L.C., 1925 - Arsenic, Jibbenbar. Rep. geol Surv. Qld (unpubl.).

BALL, L.C., 1930 - Report on Tooliambi copper mine, near Silver Spur. Ibid.

BALL, L.C., 1932 - Re Marble. Memo geol Surv. Qld (unpubl.).

BALL, L.C., 1945 - Re Limestone quarries, Gore. Ibid.

BINNS, R.A., 1965a - Regional metamorphic rocks of Permian age from the New England district of New South Wales. Aust. J. Sci., 27, 233.

BINNS, R.A., 1965b - Hornblendes from some basic hornfelses in the New England region, New South Wales. Mineralog. Mag., 34, 52-65.

BINNS, R.A., 1966 - Granitic intrusions and regional metamorphic rocks of Permian age from the Wongwibinda district, north-eastern New South Wales. J. Proc. Roy. Soc. N.S.W., 99, 5-55.

BONNER, M.H., 1952 - Silver Queen Mine, Ballandean. Rep. geol Surv. Qld. (unpubl.).

BROWNE, W.R., 1929 - An outline of the history of igneous actions in New South Wales until the close of the Palaeozoic Era. Proc. Linn. Soc. N.S.W., 54, 9-39.

BUDDINGTON, A.F., 1959 - Granite emplacement with special reference to North America. Bull. geol Soc. Amer., 70, 671-747.

CAMERON, W.E., 1908a - Annual report year 1907 - Pikedale Mine. A. Rep. Dep. Mines Qld. (1907), 170.

CAMERON, W.E., 1908b - Annual report year 1907 - Silver Queen - lead mine, Ballandean. Ibid., 171.

CAMERON, W.E., 1910 - Warwick Coal Mines Ltd., boring at Mount Thabor. Qld Govt Min. J., 11, 605.

CAMERON, W.E., 1915 - McLucas Gold Mine, Pikedale. Ibid., 16, 143.

CANAVAN, F., 1946 - Report on the Silver Spur Mine, near Texas, Queensland. Rep. Zinc Corporation Ltd. (unpubl.), available at Geol Surv. Qld Library.

CONNAH, T.H., 1958 - Summary Report, limestone resources of Queensland. Qld Govt Min. J., 59, 636-653.

CORNELIUS, K.D., 1964 - Geological relation of ore deposits to the acid intrusions of Eastern Australia between Latitudes 24° and 30° South. Thesis Dep. Geol. Univ. Qld (unpubl.).

CRIBB, H.G.S., 1937 - El Dorado mine, Thanes Creek Goldfield. Qld Govt Min. J., 38, 5.

CRIBB, H.G.S., 1944a - Copper workings, parish of Terrica; Stanthorpe district. Ibid., 45, 273-4.

CRIBB, H.G.S., 1944b - "War Effort" manganese mine, Bracker Creek, Inglewood. Ibid., 45, 300-302.

CRIBB, H.G.S., 1952 - Gold discovery, Pikedale. Rep. geol Surv. Qld (unpubl.).

CUTTLER, L.G., 1965 - Cassiterite deposits of Southern Queensland. In Geology of Australian ore deposits. 8th Commonw. Min. & Metall. Congr. 1, 383-385.

DENMEAD, A.K., 1928 - Silver Spur. Rep. geol Surv. Qld (unpubl.).

DENMEAD, A.K., 1931a - Prospecting in Thanes Creek district. Qld Govt Min. J., 32, 405-6.

DENMEAD, A.K., 1931b - Recent prospecting operations in the Warwick Goldfields. Ibid., 32, 177-179.

DENMEAD, A.K., 1932 - Warroo gold mine, Stanthorpe Mineral Field. Ibid., 33, 9-11.

DEPARTMENT OF MINES, QUEENSLAND, 1907-1914 - Stanthorpe, Pikedale and other Mineral Fields. A. Rep. Dep. Mines Qld, (1906-1913).

DIMMICK, T.D., 1953 - The Sundown tin mine, Ballandean. Qld Govt Min. J., 54, 911-915.

DIMMICK, T.D., 1960 - Report to New Consolidated Gold Fields (A'sia) Pty Ltd (unpubl.), available at Geol Surv. Qld Library.

DUNSTAN, B., 1906 - Graphite in Queensland. Qld Govt Min. J., 7, 73.

DUNSTAN, B., 1913 - Queensland Portland Cement Company's deposits at Flinders and Gore. Ibid., 14, 188.

DUNSTAN, B., 1914 - Re:Inspection of limestone quarries at Silverwood. Rep. geol Surv. Qld (unpubl.).

DUNSTAN, B., 1918 - Inglewood marbles (in Report of Chief Government Geologist). A. Rep. Dep. Mines. Qld, (1917), 196.

DUNSTAN, B., 1928 - Re : Silver Spur. Rep. geol Surv. Qld (unpubl.).

EVERNDEN, J.E., and RICHARDS, J.R., 1962 - Potassium - argon ages in eastern Australia. J. geol Soc. Aust., 9, 1-49.

HARDING, R.R., 1966 - Catalogue of age determinations carried out by the K-Ar, Rb-Sr, Re-Os and Pb-α methods on Australian rocks between June 1962 and December 1965. Rec. Bur. Miner. Resour. Geol. Geophys. Aust., 22 (unpubl.).

HILL, D., & DENMEAD, A.K., (eds.), 1960 - The geology of Queensland. J. geol Soc. Aust., 7.

IVANAC, J., 1930 - Report to Silver Spur Mines Pty Ltd (unpubl.), available at Geol Surv. Qld Library.

IVANAC, J., 1956 - Report to Silver Spur Mines Pty Ltd (unpubl.), Ibid.

JACK, R.L., 1882 - On the Stanthorpe tin mining district. Publ. geol Surv. Qld, 12.

JACK, R.L., 1892 - Report of the Government Geologist - Talgai, Thanes Creek and Pikedale reefs. A. Rep. Dep. Mines Qld. (1891), 7.

JACKSON, C.F.V., 1902 - Coal at Bringabilly Creek. Qld Govt Min. J., 3, 562.

JAQUET, T.B., 1896 - Report on the Lunatic Gold Field. A. Rep. Dep. Mines N.S.W.

JENSEN, H.I., 1917 - Benjamin's molybdenite mine. Rep. geol Surv. Qld (unpubl.).

JENSEN, H.I., 1918a - Progress report on arsenic investigations. Ibid.

JENSEN, H.I., 1918b - New developments at Sundown in reference to arsenic lodes and arsenic recovery. Ibid.

JENSEN, H.I., 1918c - Arsenic and its occurrence in south Queensland. Qld Govt Min. J., 19, 503-508.

JENSEN, H.I., 1918d - The Stanthorpe-Ballandean district - Some wolfram and molybdenite occurrences. Ibid., 19, 458-461.

JENSEN, H.I., 1918e - Notes on the geology of Jibbenbar and the State Arsenic Mine. Ibid., 19, 120-122.

JONES, O.A., 1947 - Ore genesis of Queensland. Proc. Roy. Soc. Qld, 59 (1), 1-91.

LAWRENCE, L.J., 1955 - Nature and genesis of the ore deposits of the Mole Tableland with special reference to tin and tungsten. Thesis N.S.W. Univ. of Technology (unpubl.).

LAWRENCE, L.J., 1962 - The mineral composition of the sulphide ores of the Drake and Rivertree Mining Fields, New South Wales. Proc. Aust. Inst. Min. Metall., 201, 15-42.

MAITLAND, A., GIBB, 1895 - Notes on the Pikedale Goldfield. Publ. geol Surv. Qld, 105, and Bull. geol Surv. Qld, 2.

MARKS, E.O., 1912 - Tin discoveries at Red Rock, near Ballendean, Stanthorpe district. Qld Govt Min. J., 13, 538-541.

MARTIN, N.R., 1953 - The structure of the granite massif of Flamanville, Manche, northwest France. Quart. J. geol Soc. Lond., 108, 311-41.

McCULLUM, D., 1920 - Half-yearly reports. Discovery of tin near Pikedale. Qld Govt Min. J., 21, 399.

McLEOD, I.R., (ed.), 1965 - Australian Mineral Industry : The Mineral Deposits. Bull. Bur. Miner. Resour. Geol. Geophys. Aust., 72.

MORTON, C.C., 1933 - Operations on the Warwick Goldfields. Qld Govt Min. J., 34, 349-351.

PACKHAM, G.H., (ed.), 1969 - The geology of New South Wales. J. geol Soc. Aust., 16(1).

PHILLIPS, E.R., 1964 - Myrmekite and albite in some granites of the New England Batholith, New South Wales. J. geol Soc. Aust., 11, 49-60.

PHILLIPS, E.R., 1968 - Some plutonic rocks from a northern part of the New England Batholith. Pap. Dep. Geol. Univ. Qld, 6(7), 159-206.

RAGGATT, H.G., 1938 - Red Rock Mineral Field. Rec. Dep. Mines N.S.W., 2498.

RANDS, W.H., 1887 - On the Glenelg and other reefs in the neighbourhood of Thanes Creek and Talgai, and certain mineral deposits near Stanthorpe. Publ. geol Surv. Qld, 40.

RANDS, W.H., 1890 - The mineral selections on the Ballandean and Jibbenbar Runs. Ibid., 67.

RANDS, W.H., 1898 - On the Big Hill Gold Mining Company's lease, Talgai. Ibid., 129.

RANDS, W.H., 1901 - Dredging in the Stanthorpe district. Qld Govt Min. J., 2, 247-248.

REID, J.H., 1916a - Sundown tin and copper mine, Ballandean. Ibid., 17, 260-261.

REID, J.H., 1916b - The Comet Mine, Sundown, Ballandean. Ibid., 17, 258-60.

REID, J.H., 1920 - Pikedale tin discovery. Ibid., 21, 412-413.

REID, J.H., 1922 - Coal at Freestone. Ibid., 23, 159.

REID, J.H., 1924 - Report on Thanes Creek and Talgai Goldfields, Warwick, Ibid., 25, 365-366.

RICHARDS, H.C., 1918 - The building stones of Queensland. Proc. Roy. Soc. Qld, 30, 98.

RICHARDS, H.C., and BRYAN, W.H., 1924 - The geology of the Silverwood-Lucky Valley area. Ibid., 36, 44-108.

RIDGWAY, J.E., 1935 - Golden Bush Mine (Ormoral), Silverwood district. Rep. geol Surv. Qld (unpubl.).

RIDGWAY, J.E., 1936 - Cecilia and Queenslander reefs (Paton and Son), Talgai, Qld Govt Min. J., 37, 96.

ROBERTSON, A.D., 1964 - The geology of the Kilminster area, Ballandean. B.Sc.(Hons.) Thesis Dep. Geol. Univ. Qld (unpubl.).

SAINT SMITH, E.C., in CARNE, J.E., 1911 - The tin-mining industry and the distribution of tin ores in New South Wales. Mineral Resour. N.S.W., 14, 83-92.

SAINT SMITH, E.C., in CARNE, J.E., 1913 - Silver Spur Mine, Southern Queensland. Notes on the geology, with suggestions as to future prospecting operations. Qld Govt Min. J., 14, 466-469.

SAINT SMITH, E.C., in CARNE, J.E., 1914a - Geology and mineral resources of the Stanthorpe, Ballandean and Wallangarra districts, with notes on the Silver Spur Mine, Texas. Publ. geol Surv. Qld. 243; Also extracts in Qld Govt Min. J., 14, 637-647; 15, 6-77.

SAINT SMITH, E.C., 1914b - Molybdenite in the Stanthorpe-Ballandean districts, southern Queensland, with notes on molybdenite minerals. Qld Govt Min. J., 15, 184-189.

SAINT SMITH, E.C., 1914c - Tin Kettle molybdenite and wolfram Claim, Dalveen. Ibid., 15, 385-9.

SAINT SMITH, E.C., 1918 - Proposed iron and steel works in Queensland. Ibid., 19, 354-5.

SAINT SMITH, E.C., 1920 - Gibson and Makin's Claims, Talgai Goldfield. Ibid., 21, 230-1.

SAINT SMITH, E.C., 1922 - Marble occurrences at Elbow Valley. Ibid., 23, 359.

SAINT SMITH, E.C., 1923 - Tooliambi copper mine, Silver Spur. Ibid., 24, 295-296.

SAINT SMITH, E.C., 1924 - Copper deposits at Silverwood, Warwick district. Ibid., 25, 85-86.

SAINT SMITH, E.C., 1925 - The Quartzite Dredging Lease, Kilminster, Stanthorpe mineral field. Ibid., 26, 474-475.

SAWERS, J.D., 1968 -Tooliambi copper mine. Rep. geol Surv Qld (unpubl.).

SAWERS, J.D., 1969 - Departmental diamond drilling programme at the Silverwood copper mine. Qld Govt Min. J., 70, 308-317.

SHEPHERD, S.R.L., 1934 - Tooliambi mine, four miles north of Silver Spur. Ibid., 35, 123-124.

SHEPHERD, S.R.L., 1940 - Tooliambi mine, four miles north of Silver Spur. Rep. geol Surv. Qld (unpubl.).

SIMMONDS, N.A.H., 1958 - Geology of the Ballandean-Sundown area. B.Sc. (Hons.) Thesis Dep. Geol. Univ. Qld (unpubl.).

SIMMONDS, N.A.H., 1959 - Inspection, Sultan and Taylor mine, Talgai Goldfield. Rep. geol Surv. Qld (unpubl.).

SIMMONDS, N.A.H., 1961 - Visit to Tooliambi copper mine, Silver Spur. Ibid.

SIMMONDS, N.A.H., 1963 - Inspection Tooliambi copper mine, Silver Spur. Ibid.

SKERTCHLY, S.B.J., 1898 - On the geology of the country around Stanthorpe and Warwick, south Queensland, with special references to the Tin and Goldfields and the silver deposits. Publ. geol Surv. Qld, 120.

STOKES, H.G., 1899 - The ore deposits of the Silver Spur Mine and neighbourhood, Texas, Queensland. Proc. North of England Inst. Min. and Mech. Engrs.

VERNON, R.H., 1961 - The geology and petrology of the Uralla area, N.S.W. J. Proc. Roy. Soc. N.S.W., 95, 23-33.

VOISEY, A.H., 1939 - The geology of the county of Buller, N.S.W. Proc. Linn. Soc. N.S.W., 64, 385-393.

VOISEY, A.H., 1958 - Further remarks on the sedimentary formations of New South Wales. J. Proc. Roy. Soc. N.S.W., 91, 165-89.

WILKINSON, J.F.G., VERNON, R.H., and SHAW, S.E., 1964 - The petrology of an adamellite - porphyrite from the New England Bathylith (New South Wales). J. Petrol., 5, 461-88.

WILSON, A.F., 1960 - The charnockitic granites and associated granites of Central Australia. Trans. Roy. Soc. S. Aust., 83, 37-76.

WILSON, G.I., 1961 - Report on the Silver Spur Mine, Queensland. Rep. New Consolidated Gold Fields (Australisia) Pty Ltd (unpubl.), available at Geol Surv. Qld Library.

WILSON, S., 1913 - Stanthorpe, Pikedale and other fields. A. Rep. Dep. Mines Qld, (1912), 120-124.

WOLFF, K.W., 1957 - Queensland building and monumental stones. Summary report. Qld Govt Min. J., 58, 273-291.

WOLFF, K.W., 1959 - Inspection "Happy Smile" prospecting area, parish of Palgrave, Warwick. Ibid., 60, 715-717.

WYNN, D., 1956 - Graphite. Rep. geol Surv. N.S.W. (unpubl.).

ZIMMERMAN, D.O., 1965 - Alluvial cassiterite deposits in Queensland. In Geology of Australian Ore Deposits. 8th Commonw. Min. & Metall. Congr., 1, 375-378.

APPENDIX 2

THE PERMIAN FAUNA FROM THE EIGHT MILE - TUNNEL BLOCK SOUTH OF WARWICK, QUEENSLAND

by
J.M. Dickins

SUMMARY

The fauna from the 'Eight Mile' and 'Tunnel' Blocks is regarded as representing a limited time span and for correlation is taken as a whole. It is closely related to the fauna from the Ulladulla Mudstone, the Fenestella zone and Fauna IIIA from the Gebbie Subgroup. Together these apparently form a horizon younger than Fauna II of eastern Australia and probably older than Fauna IIIB of the Bowen Basin. This conclusion seems to indicate that cooler water conditions existed in the south in eastern Australia during mid-Artinskian (Lower Permian).

IDENTIFICATIONS

(For location of fossil collections, see Plate 3).

Eight Mile Block

TH 406 (3km northeast of Silverwood Siding)

Pelecypods

Myonia sp. ind.

Stutchburia sp. ind.

Astartella sp. (as at 411)

Gastropods

Peruvispira cf. elegans (Fletcher, 1958). Occurs also in collection TH 198 from same beds. Seems to differ from species in Fauna II of Bowen Basin and in fauna from Farley Formation and possibly referrable to P. elegans. Unfortunately the photographs of this species make it difficult to recognise.

Brachiopods

Terrakea sp. (as in Fauna III, Ulladulla Mudstone etc.)

*Ambikella** cf. *ingelarensis* (Campbell, 1960) (similar to specimens from KOE 3, Springsure area)

Ambikella profunda (Campbell, 1961) or *A. angulata* (Campbell,

Notospirifer cf. *extensus* Campbell, 1961 (more like *N. extensus* than specimens from TH 198 although the beds are on strike).

TH 407 (3km northeast of Silverwood Siding)

Pelecypods

Nuculopsis (Nuculopsis) sp. ind.

Brachiopods

Stropalosia sp. ind.

Anidanthus sp.

Neospirifer sp. ind.

TH 411 (3km northeast of Silverwood Siding)

Pelecypods

Megadesmus (Megadesmus) cf. *gryphoides* (de Koninck, 1877)

Myonia sp. ind.

Vacunella sp. ind.

Deltopecten limaeformis (Morris, 1845)

Deltopecten multicostatus (Fletcher, 1929)

Etheripecten cf. *tenuicollis* (Dana, 1847)

Etheripecten fittoni (Morris, 1845)

Stutchburia cf. *randsi* (Etheridge Jnr. 1892) (radial ribs present in middle part of shell)

Astartella sp.

Gastropods

Keeneia sp.

Brachiopods

Terrakea sp. (comparable to Fauna IIIA specimens at Homevale

Ambikella ingelarensis (Campbell, 1960)

Ambikella cf. *mantuanensis* (Campbell, 1960) (adminicula as in specimens of *A. ingelarensis* but sulcus relatively flat)

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* The usage suggested by Waterhouse (1965) is followed here and *Ingelarella* Campbell, 1959 is regarded as a synonym of *Ambikella* Sahni & Srivastava, 1956.

Ambikella cf. plana (Campbell, 1960) or small A. ingelarensis
Notospirifer cf. extensus tweedalei Campbell 1961
Fenestellid Bryozoans

TH 198 (4km east-northeast of Silverwood Siding)
Pelecypods

Myonia sp. nov.? (considerable variation in shape and the development of the carina is shown by this group of shells. In shape there is some resemblance to M. carinella Runnegar, 1967).

Myonia cf. corrugata Fletcher, 1932 (these specimens seem closer to the holotype than those from Fauna IV from the Bowen Basin. The internal features seem to correspond to specimens from Fauna IIIA of the Bowen Basin - Pachymyonia sp. nov. of Dickins 1966 and Myonia sp. nov.? of Runnegar, 1967).

Vacunella cf. etheridgei (de Koninck, 1877)
Pyramus? sp. ind.
Merismopteria sp.
Etheripecten cf. tenuicollis (Dana, 1847)
Stutchburia sp. (apparently no radial ribs)
Astartella sp.

Gastropods

Peruvispira cf. elegans (Fletcher, 1958)
Warthia sp.

Brachiopods

Terrakea sp. (as in TH 406 and TH 411)

Ambikella ingelarensis (Campbell, 1960) (specimens with deep sulcus seem best identified in this way although the length of the adminicula in the brachial valve vary from that typical in A. ovata to that typical for A. ingelarensis. Forms with flattish sulcus perhaps best identified as A. cf. plana (Campbell, 1960).

Notospirifer sp. (somewhat similar to N. extensis tweedalei also similar to forms in Fauna III such as in Ingelara Formation and Catherine Sandstone

TH 199 (3km north of Silverwood Siding)

Brachiopods

Strophalosia sp. (somewhat raised muscle platform)

Ambikella sp. ind.

Neospirifer sp.

Bryozoans

Fenestellids

Stenoporoids

Tunnel Block

TH 171 (2.2km north-northeast of Oaklands homestead)

Pelecypods

Myonia sp. nov.? (as at TH 198)

Astartella sp. (apparently as at Eight Mile Block)

Gastropods Indet.

TH 201 (1.9km north-northeast of Oaklands homestead)

Pelecypods

Etheripecten cf. _subquinequelineatus_ (McCoy, 1847)

Brachiopods

Terrakea sp. (as in Eight Mile Block localities)

Strophalosia sp. (seems close to species in _Fenestella_ Zone of Branxton Formation. Considerable development of muscle platform but apparently distinct from _S. ovalis_).

Ambikella sp. ind.

Notospirifer sp.ind.

Rhynchonellid

Bryzoans

Fenestellids

Stenoporoids

TH 202 (1.4km north-northeast of Oaklands homestead)

Pelecypods

Myonia sp. nov.? (apparently same as at TH 198)

Myonia cf. _corrugata_ Fletcher, 1932.

Pyramus? sp. ind.
Etheripecten tenuicollis (Dana, 1847)
Astartella sp.

Brachiopods

Strophalosia sp. ind.
cf. *Streptorhynchus*

TH 203 (1.2km north-northeast of Oaklands homestead)

Pelecypods

Vacunella sp.?
Etheripecten cf. *subquinequelineatus* (McCoy, 1847)

Brachiopods

Terrakea sp.
Strophalosia sp. (as at TH 199 and TH 201)
Notospirifer sp.

TH 414 (1.2km south-southeast of Oaklands homestead)

Pelecypods

Myonia sp. nov.? (squashed but apparently same as in Eight Mile Block)
Stutchburia sp. (as at TH 195)

RELATIONSHIPS OF THE FAUNA FROM THE EIGHT MILE AND TUNNEL BLOCKS

With the possible exception of TH 407, much the same species are found at each locality and apparently they are of similar age. TH 407 underlies TH 408 a few hundred feet stratigraphically and is the only locality in the two blocks from which *Anidanthus* was collected. Nothing indicates that the locality is substantially older than TH 408.

In the Eight Mile Block, productids are poorly represented except at a single locality, TH 199, where pelecypods and martiniopsids plentiful at the other localities, are poorly represented. The same species, however, are represented together in the same beds in the Tunnel Block (TH 202 and TH 203) which indicates that the fauna represents a limited time span. For the purposes of correlation with other areas, the fauna is, therefore, taken as a whole.

It is most closely related to that from the Ulladulla Mudstone* of the southern part of the Sydney Basin, the Fenestella Zone of the Branxton Formation of the Hunter Valley and Fauna IIIA from the basal part of the Gebbie Subgroup of the Bowen Basin. The relationship of the Fenestella Zone has been considered by Dickins (1968). Dickins, Gostin & Runnegar (1969) suggested the fauna from the Ulladulla fauna was a mixed fauna. Runnegar (1967) referred to it as the Eurydesma-Myonia corrugata fauna and as the Ulladulla fauna (Runnegar, 1969).

The characteristic feature of the Ulladulla fauna is, that in addition to species recorded from Fauna II of the Bowen Basin, it contains species suggestive of a younger age - in particular a species referred to Myonia corrugata and Ambikella with more advanced characters than found in Fauna II. The Ulladulla fauna also has terebratuloids with younger affinities. These features are repeated in the Eight Mile and Tunnel block except for the terebratuloids which are poorly represented. The fauna from the Eight Mile and Tunnel blocks givesa clearer indication of an age younger than Fauna II than does the Ulladulla fauna as it contains a few additional species found in Fauna IIIA. It contains also a few species not so far recorded from elsewhere. In the fault blocks a species of Strophalosia with a relatively high muscle platform and closely related to that in the Fenestella zone is found whereas Strophalsia cf. preovalis has been recorded from Ulladulla Mudstone. Although Eurydesma has not so far been recorded, Deltopecten limaeformis and Deltopecten multicostatus parallel the occurrence in the Ulladulla Mudstone and a Deltopecten is found in the Fenestella Zone. Shells referred to M. corrugata are found at Ulladulla and in the fault blocks. From the examination of specimens from the fault blocks emerges the interesting conclusion that Myonia sp. nov? (Runnegar, 1967, p. 56, pl. 4, figs. 6-7)

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* Work which I have carried out subsequently shows that the fauna referred by Dickins, Gostin & Runnegar (1969, p. 221) to the Wandrawandrian Siltstone is regarded more satisfactorily as from the Nowra Sandstone. The siltstone containing the fauna grades laterally into sandstone and boundary of the main sandstone body is stratigraphically lower than the level from which the fossils came.

may represent an internal of _M. corrugata_. As in the Uladulla Mudstone and the _Fenestella_ Zone, the relationships of the _Ambikella_ in the fault blocks are puzzling. _A. ingelarensis_ is readily identifiable and confirms the conclusion that _A. ingelarensis_ was already well established and widespread by the beginning of Fauna III time. Other _Ambikella_ present seem to show a mixture of morphological features found in specimens from Fauna II time and later and perhaps a new specific name is required for the specimens from the fault blocks. Pending further information, however, on the characteristics of _A. undulosa_, this might be premature. Campbell (1961, p. 180) has recorded _A. undulosa_ from the Eight Mile Block. There seems little doubt, however, of the close relationship of these specimens in the Ulladulla Mudstone and the _Fenestella_ Zone. Clearest relationship with Fauna III of the Bowen Basin seems to be given by _Vacunella_ cf. _etheridgei_ and _Notospirifer_ cf. _extensus_. The significance in the fault of _Myonia_ sp. nov.?, _Astartella_ sp. and _Peruvispira_ cf _elegans_ in relation to the other areas isn't clear.

Consideration of the above evidence seems to justify the conclusion that the fauna of the Ulladulla Mudstone and the _Fenestella_ Zone are similar in age to Fauna IIIA of the Bowen Basin and together form a horizon distinctive from Fauna II which is found in underlying beds in all these areas. Although not altogether clear cut, this horizon seems older than Fauna IIIB, which contains a number of different species. Certainly it is readily distinguishable from Fauna IV. On this basis the concept of the mixed fauna (Dickins, Gostin & Runnegar, 1969) is of doubtful merit and could lead to glossing over morphological differences serving to distinguish the specimens in this level from those found in Fauna II and Fauna IV.

On the assumption of the time equivalence of these beds an explanation of the faunal change from south to north is warranted. A climatic or land barrier between the Bowen and Sydney Basin in Fauna III time has been postulated by Dickins (1968, p. 35). Runnegar's (1970) conclusions imply a land barrier in Fauna III time. From the fault blocks data it seems that the connection between the two faunas was not closed until after Fauna IIIA time and the faunal changes might reflect a change from cool to more temperate water conditions from south to north. This is suggested by the occurrence of Deltopecten and Keeneia in the fault blocks and the south but not in the Bowen Basin. The possibility of more persistent cool conditions in the Sydney Basin compared with the Bowen Basin has already been suggested by Dickins (1968) and this evidence seems to support this conclusion. Perhaps the occurrence of Strophalosia cf. preovalis in the Ulladulla Mudstone and Stutchburia cf randsi in the Eight Mile Block is connected with this change in water conditions. Alternatively the distribution of species might be explained by the penetration of marine tongue from the Sydney Basin in the fault blocks area, bringing into the area species found in Sydney Basin but not in the Bowen Basin at this time. This would imply that those Fauna III species common to the Sydney and Bowen Basins were established in the two areas in late Fauna II time, evolved independently in the two areas, or migration remained possible by an indirect route. These explanations do not seem as satisfying.

REFERENCES

CAMPBELL, K.S.W., 1961 - New species of the Permian spiriferoids Ingelarella and Notospirifer from Queensland and their stratigraphic implications. Palaeontographica, Abt.A, 117(5-6), 159-192.

DICKINS, J.M., 1966 - Appendix In Malone, E.J. JENSEN, A.R., GREGORY, C.M., and FORBES, V.R., Geology of the southern half of the Bowen 1:250,000 Sheet area, Queensland. Bur. Miner. Resour. Aust. Rep. 100, 68-87.

DICKINS, J.M., 1968 - Correlation of the Permian of the Hunter Valley, New South Wales and the Bowen Basin, Queensland. Bur. Miner. Resour. Aust. Bull. 80, 29-44.

DICKINS, J.M., GOSTIN, V.A., and RUNNEGAR, B.N., 1969 - The age of the Permian sequence in the southern part of the Sydney Basin. STRATIGRAPHY AND PALAEONTOLOGY: ESSAYS IN HONOUR OF DOROTHY HILL. (K.S.W. Campbell Ed.) Canberra A.N.U. Press. 211-225.

RUNNEGAR, B.N., 1967 - Desmodont bivalves from the Permian of Eastern Australia. Bur. Miner. Resour. Aust. Bull., 96.

RUNNEGAR, B.N., 1969 - The Permian faunal succession in eastern Australia. Geol. Soc. Aust. Spec. Publ. 2, 73-98.

RUNNEGAR, B.N., 1970 - The Permian faunas of northern New South Wales and the connection between the Sydney and Bowen Basins. J. Geol. Soc. Aust., 16(2), 697-710.

WATERHOUSE, J.B., 1965 - The Permian spiriferoid genus *Ambikella* Sahni and Srivastava (1956) and its relationship to *Ingelarella* Campbell (1959) and *Martiniopsis* Waagen 1883. Trans. roy. Soc. N.Z., 3(12), 159-170.

APPENDIX 3

REPORT ON COLLECTIONS OF CARBONIFEROUS CORALS FROM THE WARWICK, GOONDIWINDI AND INVERELL SHEET AREAS, QUEENSLAND

by

D.L. Strusz

The writer spent four weeks with the Texas High field party in September-October 1968, for the purpose of assiting the stratigraphic work of the party by collecting from the limestone deposits of the region. Those from the Lower Devonian at Silverwood will be the subject of a separate study. One locality (476) yeilded bryozoans of Carboniferous or possibly Permian age (see Appendix 5).

Three main regions of outcrop have yielded Carboniferous corals:

1) Silver Spur-Limevale area, northeast of Texas (localities 468, 472).
2) Glenlyon-Craigie-Riverton-Emu Park area, southeast of Texas (localities 474, 475, 477, 478, 479, 483, 485, 488, 1501)
3) Cement Mills-Cooinoo-Pikedale-Sailor Jack area, west, northwest and southwest of Stanthorpe (localities 97, 589, 592, 1507, 1508).

Most of the limestones in the first region have been extensively sheared and recrystallized; in few places were any macrofossils visible, and those collected are very poorly preserved. Preservation in the other regions varies from very poor to reasonable. The faunas are briefly described below in numerical order.

LOCALITY 97

Lithostrotion hallense PICKETT, 1966. (F23537, 23528?, 23529, 23520?*)

A fasciculate form, with corallites 6.5-10 mm. in diameter having 2x(22-24) septa, of which the major are generally slightly withdrawn from the narrow columella. The minor septa reach to about half the radius, and may be a little discontinuous. Septal dilatation is

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* BMR fossil registration numbers.

fusiform, moderate (major more than minor). The tabulae are mostly complete and steeply domed. There are 2 to 4 series of steeply inclined dissepiments, occasionally lonsdaleoid.

This form agrees well with Pickett's large-diameter variety.
Lithostrotion columnare ETHERIDGE FIL., 1900. (F23520)

This fragment of a cerioid form has corallites 3.5-5.0 mm. in diameter, with 32 septa. The presence of lonsdaleoid dissepiments and the style of septal dilatation make its identification certain. It corresponds to the small-diameter form found in the Riverleigh Limestone (HILL, 1934, Pl. X, figs 21-22).

AGE: Visean, probably Upper.

LOCALITY 468

A scarcely recognizable rugosan.

LOCALITY 472

Large smooth slabs at this locality contained several corals, none of which could be collected. Acetate peels were taken from them in the field, although insufficient for precise identification these include forms probably referable to Amygdalophyllum columellare PICKETT, 1966 (F23540, 23541), and to either A. conicum HILL, 1934 or Lithostrotion nitidum PICKETT, 1966 (F23538).

AGE: Probably Visean, possibly Tournaisian.

LOCALITY 474

Specimens of crinoidal calcarenite contain fragments of a tabulate coral possibly referable to Syringopora (F23542).

AGE: Syringopora is not definitely known above the Carboniferous, but there are similar forms in the Permian of which fragments could easily be mistaken for that genus.

LOCALITY 475

Merlewoodia? foliaceum (HILL, 1934) (F23543?, 23544, 23547, 23549). A solitary non-columellate coral, readily distinguished from other species by the thin rejuvenescence rims and the septal dilatation.

Lithostrotion hallense PICKETT, 1966 (F23545).

Fasciculate; corallite diameter 6.5 - 10 mm., 2 x (20-25?) septa. Columella variable, generally small, elongate; septa slightly withdrawn. Tabulae inversely conical; about 3 series of dissepiments. Septa dilated, fusiform.

Lithostrotion spp. indet. (F23552, 23553)

Fasciculate columellate corals whose structures are otherwise obliterated by recrystallization.

Amygdalophyllum sp. cf. praecox PICKETT, 1966 (F23546)

A single poorly preserved transverse section; corallite diameter ca 14 mm., 58 septa. The strong columella is formed by the union of the axial ends of the radial major septa with the sides of the elongate counter septum. The septa are moderately dilated, in places peripherally lonsdaleoid; the minor septa are rather long.

This form agrees with A. praecox in the frequency of its lonsdaleoid dissepiments, but in style of septal dilatation and the structure of the columella it shows some resemblance to A. columellare PICKETT.

Amygdalophyllum sp. cf. conicum HILL, 1934. (F23550)

Several fragments, up to 23 mm. in diameter, in which the major septa join with the columella and the minor septa are long, have extremely dilated septa and so are close to A. conicum. However, they lack the naotic modification of the septa which usually accompanies their strong dilatation in that species.

Amygdalophyllum? sp. indet. (F23548)

A single poorly preserved corallite about 28 mm. in diameter with an elliptical columella is probably referable to this genus.

AGE: Amygdalophyllum praecox is known from the Upper Tournaisian Rangari Limestone of N.S.W., but A. columellare comes from the Lower Visean. The other forms are known from various levels within the Visean to which this locality should be referred.

LOCALITY 477

Merlewoodia? foliaceum (HILL, 1934) (F23556).

The size and septal characteristics, in particular the wide lonsdaleoid dissepimentarium, found in this specimen are characteristic of the species.

AGE: Visean, probably Upper.

LOCALITY 478

?Merlewoodia sp. (F23558)

A single very poorly preserved non-columellate corallite is probably referable to this genus.

AGE: Visean?

LOCALITY 479

Amygdalophyllum sp. cf. conicum HILL, 1934 or columellare PICKETT, 1966. (F23559, 23560)

These two corallites of diameters of 12 and 13.5 mm., with 76 and 70 septa respectively, have prominent columellas to which are joined thick tapering major septa. Preservation is too poor for accurate identification.

AGE: Visean

LOCALITY 483

?Amygdalophyllum sp. (F23561)

The axis is not preserved, so the presence of a columella is uncertain, but the size and septal dilatation suggest either A. conicum HILL or A. columellare PICKETT

AGE: Visean?

LOCALITY 485

Rugosan indet. (F23563)

AGE: Carboniferous?

LOCALITY 488

?<u>Naoides rangariensis</u> PICKETT, 1966 (F23564).

This specimen comprises a single oblique transverse section through the calice of a corallite about 30 mm. in diameter, with about 84 septa. There is a marginarium consisting of a septal stereozone 8 mm. wide, from which the minor septa extend only a short distance towards the axis. The nearest form to which these characters could apply is <u>Naoides rangariensis</u> PICKETT, from the Upper Tournaisian Rangari Limestone of N.S.W.

AGE: Lower Carboniferous, possibly Upper Tournaisian.

LOCALITY 589

<u>Amygdalophyllum columellare breviseptatum</u> PICKETT, 1966? (F23532)

A solitary corallite with a diameter of 11 x 12.5 mm., and 46 septa. There is a strong columella consisting of the conjoined ends of the counter and cardinal septa, plus the detached ends of the other major septa. The withdrawal of the septa from the columella is characteristic of the subspecies.

AGE: Lower to Middle Visean.

LOCALITY 592

<u>Lithostrotion hallense</u> PICKETT, 1966 (F23533)

Fasciculate corallites 4.5 - 8.2 mm. in diameter, having 40-46 septa, a narrow columella more or less joined with the major septa, and several series of dissepiments, are referable to this species.

<u>Amygdalophyllum conicum</u> HILL, 1934 (F23535)

This is represented by a single corallite 13.8 mm. across, with about 60 septa. The columella is small and narrow, and there is a very wide septal stereozone.

AGE: Visean

LOCALITY 592A

Amygdalophyllum? sp. (F23536)

This is a single very poorly preserved probably columellate corallite.

AGE: Visean?

LOCALITY 1501

Lonsdaleia? sp. indet. (F23565-23567, 23570)

This coral is fasciculate, with corallites 5.5 to 9 mm. in diameter (having tabularia 4.5 to 6 mm. across), and 40 to 44 septa. The septa are conspicuously lonsdaleoid, short (the major seldom extend adaxially for more than half the radius), and thin or weakly dilated peripherally, tapering adaxially. There are 1 to 2 series generally wide lonsdaleoid dissepiments; in the wide tabularium the tabulae are flat or gently domed, marginally down-turned. In some sections a very small columella is visible.

The septal structure suggests a diphymorphic *Lithostrotion* (perhaps *L. hallense* or *L. stanvellense*), but the well developed lonsdaleoid dissepimentarium and the very poorly developed columella are more like those of *Lonsdaleia*.

AGE: Carboniferous. HILL & WOODS (1964) have reported another *Lonsdaleia* from the Visean? Baywulla Formation of Queensland.

LOCALITY 1507

?*Merlewoodia* sp. (F23571, 23573)

Both specimens are very poorly preserved large corallites with long thick septa. There is the suggestion of a columella in F23573, in which case it may be *Amygdalophyllum*.

AGE: Visean?

LOCALITY 1508

Two very poorly preserved corals, one a *Lithostrotion* (F23574) and the other probably *Amygdalophyllum* (F23575) have been identified from etched surfaces. The material is too recrystallized for sectioning.

AGE: Visean?

REFERENCES

HILL, DOROTHY, 1934 - The Lower Carboniferous corals of Australia. Proc. Roy. Soc. Qld, 45, 63-115, pls. 7-11.

HILL, DOROTHY, & WOODS, J.T., (Eds), 1964 - Carboniferous fossils of Queensland. Qld. Palaeontogr. Soc., Brisbane.

PICKETT, J., 1966 - Lower Carboniferous coral faunas from the New England district of New South Wales. Mem. Geol. Surv. N.S.W., Palaeont., 15, 1-38, pls. 1-20.

APPENDIX 4.

REPORT ON COLLECTIONS OF LOWER DEVONIAN CORALS FROM SILVERWOOD, QUEENSLAND.

by

D.L. Strusz

Corals were collected from a number of localities in the Silverwood area by the Texas High Party in 1968 and 1969, and by the writer in 1968. It is intended to re-examine all the known fossil collections from the area at a later date. In the meantime, the following preliminary identifications, mostly based on weathered or etched surfaces rather than thin sections, have been made. In general, preservation is poor because of extensive recrystallization. The age of the Silverwood corals has been discussed previously by Strusz (1967) and the present identifications uphold the previously assigned probable Emsian or Pragian age.

CONNOLLY VOLCANICS

LOCALITY TH 150 (=WRW/8) (locality 8 of Richards & Bryan, 1924)

Acanthophyllum? sp.
Favosites spp.

LOCALITY TH 167 (=WRW/11) (locality 5 of Richards & Bryan, 1924)

rugosans indet.
Favosites sp.
Coenites? sp.

LOCALITY TH 174 (=WRW/13)

Favosites spp.

LOCALITY TH 451 (=palaeontological locality WRW/1)

?*Chlamydophyllum expansum* HILL, 1942
?*Fasciphyllum* sp. aff *conglomeratum* (SCHLÜTER), Hill, 1940
Favosites? spp.
Thamnopora sp. or *Coenites* sp.
Syringopora sp.

LOCALITY TH 455 (=WRW/5) (locality 2 of Richards & Bryan, 1924)

Favosites sp.

Coenites? sp.

LOCALITY TH 456 (=WRW/6)

Acanthophyllum (Neostringophyllum) implicatum STRUSZ, 1966

Acanthophyllum sp. or Lyrielasma sp.

Xystriphyllum insigne HILL, 1940

Pseudamplexus sp. cf. princeps (ETHERIDGE, 1907)

?Chlamydophyllum expansum HILL, 1942

?Fasciphyllum sp. aff. conglomeratum (SCHLÜTER), Hill, 1940

Spongophyllum halysitoides minor HILL, 1940

Tryplasma sp. cf. columnare ETHERIDGE, 1907

Tryplasma? sp.

Plasmophyllum sp.

Favosites spp.

Pachyfavosites? sp.

Thamnopora? sp.

Coenites? sp.

Scoliopora? sp.

Alveolites? sp.

Syringopora sp.

Heliolites sp.

stromatoporoids, including Amphipora

algae

LOCALITY TH 457 (=WRW/7)

?Xystriphyllum insigne HILL, 1940

Favosites? sp.

Coenites? sp.

stromatoporoids

ROSENTHAL CREEK FORMATION

LOCALITY TH 160 (=WRW/9)

?Xystriphyllum dunstani(ETHERIDGE, 1911)

Acanthophyllum? sp.

Favosites sp.

Coenites? sp.

LOCALITY TH 161 (=WRW/10)

Acanthophyllum sp.

rugosan indet.

LOCALITY TH 172 (=WRW/12)

Acanthophyllum? sp.

rugosan indet.

Favosites spp.

Coenites? sp.

LOCALITY TH 452 (=WRW/2)

Acanthophyllum? sp.

Favosites spp.

Thamnopora sp. or Coenites sp.

Heliolites sp.

LOCALITY TH 453 (=WRW/3)

Acanthophyllum sp.

Pseudochonophyllum pseudohelianthoides (SHERZER), Strusz,1966

Spongophyllum halysitoides or Xystriphyllum insigne

Cyathophyllum? sp.

Phillipsastraeidae, indet.

Favosites spp.

Thamnopora? sp.

Heliolites sp.

LOCALITY TH 454 (=WRW/4) (locality 7 of Richards & Bryan, 1924)

?Chlamydophyllum expansum HILL, 1942

?Pseudochonophyllum pseudohelianthoides (SHERZER), Strusz, 1966

Favosites spp.

Coenites? sp.

Syringopora sp.

stromatoporoids

REFERENCES

ETHERIDGE, R. Jr., 1907 - A monograph of the Silurian and Devonian corals of New South Wales: with illustrations from other parts of Australia. Part II - the genus Tryplasma. Mem. geol. Surv. N.S.W., Palaeont., 13, - ix, 41-102, X-XXVIII.

ETHERIDGE, R., Jr., 1911 - The lower Palaeozoic corals of Chillagoe and Clermont, part I. Publ. Qd geol. Surv., 231, 1-8, A-D.

HILL, D., 1940 - The middle Devonian rugose corals of Queensland, II. The Silverwood-Lucky Valley area. Proc. R. Soc. Qd, 51, 150-168, II-III.

HILL, D., 1942 - The lower Devonian rugose corals from the Mount Etna Limestone, Qld. Ibid., 54, 13-22, I.

RICHARDS, H.C., and BRYAN, W.H., 1924 - The geology of the Silverwood-Lucky Valley area. Ibid., 36, 48-108.

STRUSZ, D.L., 1966 - Spongophyllidae from the Devonian Garra Formation, New South Wales. Palaeontology, 9(4), 544-598, 85-96.

STRUSZ, D.L., 1967 - Chlamydophyllum, Iowaphyllum, and Sinospongophyllum (Rugosa) from the Devonian of New South Wales. Ibid., 10(3), 426-435, 67.

APPENDIX 5

REPORT ON BRYOZOA FROM THE WARWICK AND INVERELL 1:250,000 SHEETS

by

Robin E. Wass

(University of Sydney)

Specimens from Locality 476, one mile north of Emu Park homestead along the Glenlyon - Bonshaw Road, Inverell 1:250,000 Sheet area (439405) and Locality 228, 1.5 miles east of Mt. Barney, Warwick 1:250,000 Sheet area (584492) were examined to determine if they are from Carboniferous strata.

Limestone from Locality 476 revealed numerous specimens of _Fistulamina_ sp. in thin sections together with stenoporids, fenestellid fragments and a rhabdonesid. From this the locality is assigned a Carboniferous age. _Fistulamina_ sp. was first described by Crockford (1947) from the Lower Carboniferous of New South Wales and Queensland and subsequent workers have added to Carboniferous records of it. Crockford (1957) records it from the Permian of Western Australia together with many other cyclostomes. Records of cyclostomes in the Permian of eastern Australia have been made only by Wass (1968a, 1968b) who recorded _Goniocladia immensa_ and _Fistulipora_ sp. from the Bowen Basin.

The fauna from Locality 228 is composed entirely of fenestellids. The most common species is _Polypora neerkolensis_ Crockford. With some measurements, e.g. fenestrules per 10 mm and zooecial apertures per 5 mm, there is a larger range than listed by Crockford (1949). From her measurements of distance between centres of zooecial apertures it is feasible to have from 9 to 14 zooecial apertures per 5 mm and this range is found in specimens from Locality 228. Some poorly preserved specimens can be referred to _Fenestella_ cf. _osbornei_ (Crockford) and _F._ cf. _loganensis_ Wass. Measurements made on two specimens of _Fenestella_ show them to be unrecorded from Australia. The first specimen has a meshwork formula of 8-9/5-6//16-17/? and is similar to species described by Shulga-Nesterenko

(1952) from the Lower Permian of the Urals. The most closely related species is Fenestella kuzminensis Shulga-Nesterenko. The second specimen has a meshwork formula of 17/14//19-21/? and is similar to species described from the Carboniferous of Russia (Shulga-Nesterenko, 1951; Trizna, 1958). This specimen is characterised by very narrow dissepiments which are peculiar to other species of Fenestella from the Carboniferous. From the fauna identified, I would say that the locality is probably in strata correlative with the Neerkol Formation which is Middle to Upper Carboniferous in age.

REFERENCES

CROCKFORD, J.M., 1947 - Proc. Linn. Soc. N.S.W., 72, 1-48.

CROCKFORD, J.M., 1949 - Ibid., 73, 419-429.

CROCKFORD, J.M., 1957 - Bur. Miner. Resour. Aust. Bull., 34.

SHULGA-NESTERENKO, M.I., 1951 - Trudy Paleont. Inst., 32.

SHULGA-NESTERENKO, M.I., 1952 - Ibid., 37.

TRIZNA, V.B., 1958 - Trudy neft. geol-razy. Inst., N.S., 122.

WASS, R.E., 1968a - Bur. Miner. Resour. Aust. Bull., 90.

WASS, R.E., 1968b - Proc. Linn. Soc. N.S.W., 92, 279-284.

APPENDIX 6

REPORT ON UPPER PALAEOZOIC FOSSILS FROM TERRICA STATION, WARWICK SHEET AREA, QUEENSLAND

by

M.G. Fleming

(Geological Survey of Queensland)

Locality: Erosion gully 1-2/3 miles east of Terrica homestead, 24 miles west-northwest of Stanthorpe. (B.M.R. locality TH 417).

Determinations: *Streblopteria* sp.
impunctate orthoid brachiopod
Fenestella cincta?
F. loganensis
F. osbornei?
Fenestella spp.

Age: ?Upper Carboniferous

Remarks: The age can be assigned only very tentatively on the basis of the presence of *F. loganensis* and the doubtful presence of *F. cincta*. Only two of the Fenestellas have the apertural face well preserved, *F. loganensis*, and a species with a strong, blunt carina and large, hollow modes which I have not previously seen. The doubtful identification of *F. cincta* is based on some specimens which are about the usual size of the species and have similar apertures. *F. osbornei*, *F. malchi* and *F. micropora* may be present, but an age could not be based on their possible presence.

AUSTRALIA 1:250,000 GEOLOGICAL SERIES

WARWICK

QUEENSLAND AND NEW SOUTH WALES

SHEET SH 56-2

Reference

	Geological boundary
	Facies boundary
	Unconformity
	Anticline
	Plunge of minor anticline
U / D	Fault (D,U indicate relative movement down, up)
	Where location of boundaries, folds and faults is approximate line is broken, where inferred, queried, where concealed, boundaries, folds are dotted, faults are shown by short dashes
30	Strike and dip of strata
	Prevailing strike and dip of strata
	Vertical strata
	Horizontal strata
80	Overturned strata
	Dip <5° (air-photo interpretation)
	Dip 5°-15° (air-photo interpretation)
	Dip 15°-45° (air-photo interpretation)
	Dip >45° (air-photo interpretation)
	Trend lines (air-photo interpretation)
	Joint pattern (air-photo interpretation)
	Fossil locality-general
TH124	Macrofossil locality and field collection number
SB1286	Plant fossil locality and field collection number
	Fossil wood locality
	Fossil wood horizon
	Dyke or vein; a-aplite, d-diorite, p-porphyry
	Boundary of gold or mineral field
	Prospect
	Mine
	Mine not worked
	Quarry
	Quarry not worked
	Alluvial working not worked
As	Arsenic
C	Coal
Cu	Copper
Au	Gold
Gt	Graphite
Pb	Lead
Ma	Marble
Mn	Manganese
Mo	Molybdenite
Ag	Silver
Sn	Tin
W	Wolfram
Zn	Zinc
	Oil well, dry hole, abandoned
St	Stratigraphic hole
	Shallow water bore
	Highway
	Road and vehicle track
	Railway with station and siding
"Melva"	Homestead
	Built up area
	State boundary
889′	Elevation in feet - accurate
45	Photo centre point

Compiled by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Issued under the authority of the Hon. R.W. Swartz, M.B.E., E.D., Minister for National Development. Provisional base map (1968) compiled by the Royal Australian Survey Corps from aerial photography at 1:85,000 scale.
Transverse Mercator Projection

INDEX TO ADJOINING SHEETS

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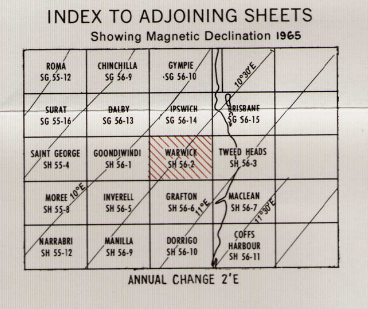

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Palaeozoic Geology 1968-69 by F. Olgers, P.G. Flood, W.J. Perry, J.M. Dickins (BMR); A.C. Offenberg, J. Cramsie (G.S.N.S.W.);
Mesozoic and Tertiary Geology mainly 1968 by N.F. Exon, A. Medvecky (BMR); R.F. Reiser, D.J. Casey, A.D. Robertson (G.S.Q.); C.T. McElroy, R.L. Brunker (G.S.N.S.W.);
N.C. Stevens, P.J. Stephenson (U.Q.)
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Cartography by Geological Branch, BMR
Drawn by Miss J.G.A. Den Hertog, I.D. Johnston, J.L. McGovern.

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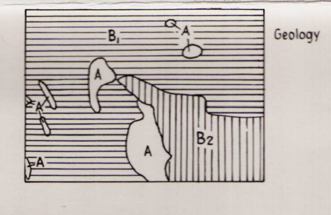


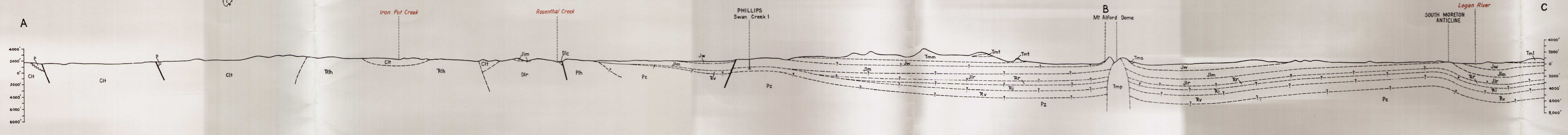
Geology A Detailed mapping
B1 Detailed reconnaissance: numerous traverses and air-photo interpretation
B2 General reconnaissance: compilation of previous work and air-photo interpretation

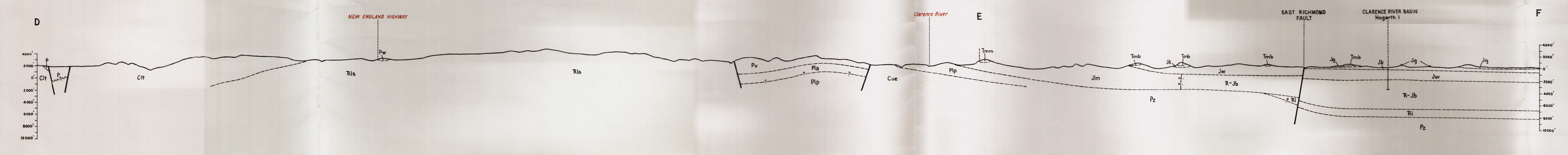
Reference

CAINOZOIC	QUATERNARY		Qs	Soil cover
			Qa	Alluvium: sand, silt, mud, gravel
	PLEISTOCENE		Qpc	Sandy alluvium of Condamine River, vertebrate fossils
	TERTIARY – MIOCENE	Main Range Volcanics	Tmm	Alkali-olivine basalt, minor tuff and sediment
			Tmt	Trachyte
			Tmo	Dolerite sills and dykes
		Lamington Volcanics	Tml	Sub-alkali basalt, minor tuff and agglomerate
			Tmr	Rhyolite, tuff, agglomerate, conglomerate, sandstone
			Tmb	Basalt
			Tmp, Tms, Tmd	Rhyolite, trachyte, granophyre; minor diorite and andesite. Tmp-plug; Tms-sill; Tmd-dyke
MESOZOIC	UPPER JURASSIC	Grafton Formation	Jg	Lithic sandstone, siltstone, mudstone
		Kangaroo Creek Sandstone	Jk	Quartzose to feldspathic sublabile sandstone
		Woodenbong Beds	Js	Medium-grained feldspathic to feldspathic sublabile sandstone, siltstone
	MIDDLE TO UPPER JURASSIC	Walloon Coal Measures	Jw	Fine-grained labile sandstone, siltstone, mudstone, coal. Calcareous in part. Plant fossils
		Bundamba Group	Ʀ-Jb	Sandstone, lesser siltstone, mudstone, conglomerate. Section only
	LOWER JURASSIC	Marburg Sandstone	Jlm	Feldspathic to feldspathic sublabile sandstone, pebbly in part; lesser siltstone, mudstone. Basal pebbly arkose in west
		Ripley Road Sandstone	Jlr	Feldspathic to quartzose sandstone with massive cross-beds
	UPPER TRIASSIC	Raceview Formation and Aberdare Conglomerate	Ʀr	Feldspathic to quartzose sandstone and siltstone with massive conglomerate near base (section only)
	MIDDLE TO UPPER TRIASSIC	Ipswich Coal Measures	Ʀi	Shale, siltstone, sandstone, conglomerate, coal (section only)
			Ʀv	Basalt, andesite, trachyte, coal (section only)
			Ʀb	Conglomerate, basic lava and tuff, quartzose sandstone, carbonaceous shale
	LOWER TRIASSIC	Ruby Creek Granite	Ʀlr	Granite
		Herries Adamellite	Ʀlh	Adamellite
		Stanthorpe Adamellite	Ʀls	Adamellite
		Undercliffe Falls Adamellite	Ʀlu	Adamellite
		Bungulla Adamellite	Ʀlb	Adamellite
PALAEOZOIC	UPPER PERMIAN OR TRIASSIC		Pua	Granite, granodiorite
		Maryland Granite	Pum	Granite
		Greymare Granodiorite	Pug	Granodiorite
			Pub	Diorite
			Pur	Spherulitic rhyolite, quartz-feldspar porphyry
	UPPER PERMIAN	Gilgurry Mudstone	Pul	Mudstone
	LOWER TO UPPER PERMIAN	Condamine Beds	Puc	Mudstone, poorly sorted sandstone, conglomerate; minor tuff
			Pw	Rhyolite, rhyodacite, tuff
		Drake Volcanics	Pv	Agglomerate, crystal and crystal lithic tuff; minor flows and interbedded sediments
	LOWER PERMIAN	Dundee Adamellite Porphyrite	Pld	Adamellite-porphyrite
		Rhyolite Range Beds	Plh	Spherulitic rhyolite, dacite, andesite, agglomerate, tuff; minor conglomerate, sandstone and mudstone at base
		Eight Mile Creek Beds	Ple	Conglomerate, sandstone, mudstone; minor agglomerate at top
		Razorback Creek Mudstone	Pla	Mudstone
		Eurydesma and Wallaby Beds	Plr	Conglomerate, sandstone, mudstone, pebbly mudstone, minor limestone
			P	Conglomerate, sandstone, mudstone, pebbly sandstone and mudstone, minor limestone and tuff
		Paddys Flat Formation	Plp	Conglomerate, sandstone, mudstone; minor volcanics and limestone
	UPPER CARBONIFEROUS	Mount Barney Beds	Cub	Lithic and feldspathic sandstone, conglomerate, mudstone; minor acid volcanics
		Emu Creek Formation	Cue	Interbedded sandstone and mudstone; minor conglomerate
	UPPER DEVONIAN(?) TO UPPER(?) CARBONIFEROUS	Texas Beds	Ct	Interbedded sandstone and mudstone, intraformational conglomerate, chert, jasper, andesite, limestone
	SILURIAN(?) TO LOWER DEVONIAN	Silverwood Group: Rosenthal Creek Formation	Dlo	Interbedded sandstone and mudstone; chert, intraformational conglomerate, limestone
		Silverwood Group: Connolly Volcanics	Dlc	Andesitic agglomerate, volcanic breccia, tuff; minor lithic sandstone; limestone lenses
		Silverwood Group: Risdon Stud Formation	Dlr	Silicified fine-grained pyroclastic and sedimentary rocks
	LOWER PALAEOZOIC		Pz	Undifferentiated Devonian, Carboniferous and Permian strata. Section only

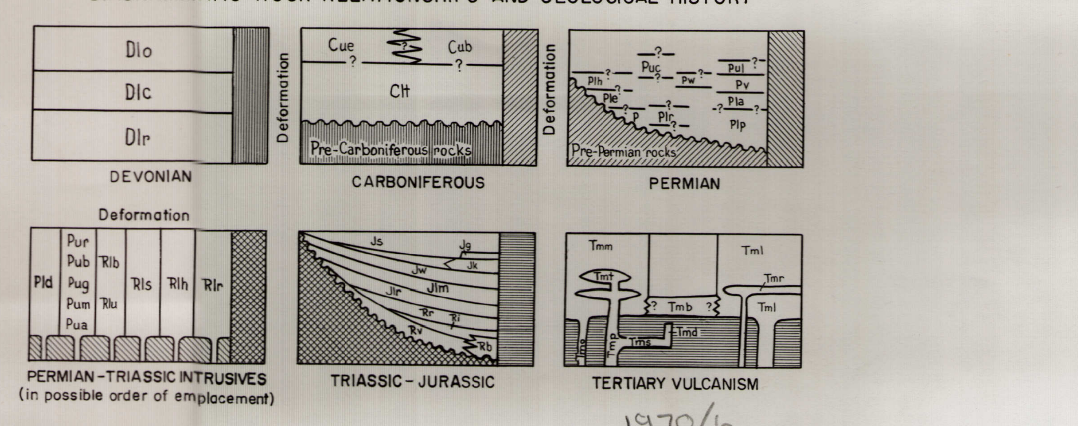
Sections

Cainozoic sediments omitted





DIAGRAMMATIC ROCK RELATIONSHIPS AND GEOLOGICAL HISTORY



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GOONDIWINDI

QUEENSLAND AND NEW SOUTH WALES

SHEET SH 56-1

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Palaeozoic geology, 1968, by F. Olgers, P.G. Flood and W.J. Perry (BMR); P. Rasmus (GNSW)
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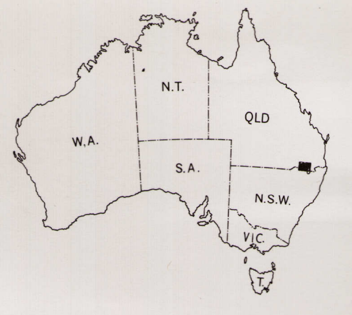
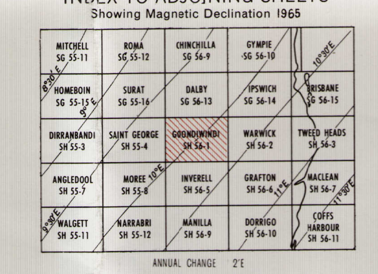


INDEX TO ADJOINING SHEETS
Showing Magnetic Declination 1965



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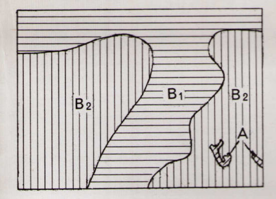
5 0 5 10 15 20 25 KILOMETRES

RELIABILITY DIAGRAM



Geology A Detailed mapping

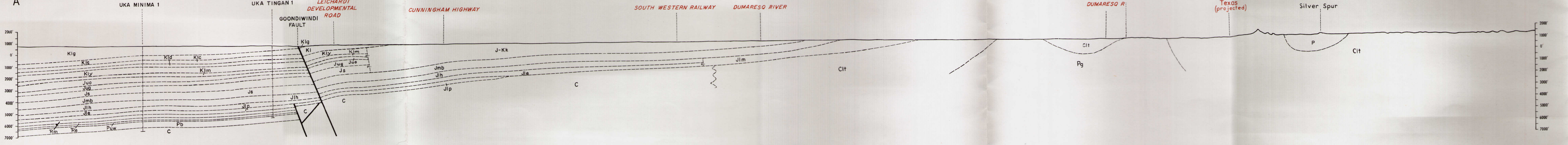
B_1 Detailed reconnaissance: numerous traverses and air-photo interpretation

B_2 General reconnaissance: some traverses and air-photo interpretation

Section

Cainozoic sediments omitted

Scale $\frac{V}{H} = 4$



Reference

CAINOZOIC — QUATERNARY	Mainly Pleistocene	Qa	Alluvium	
		Qs	Sand, soil	
TERTIARY	Miocene	Tmb	Basalt, lesser tuff, agglomerate	
	Palaeogene	Tl	Quartzose sandstone and conglomerate, silicified	
		Czw	Deep weathering profile	
MESOZOIC — LOWER CRETACEOUS	Rolling Downs Group: Griman Creek Formation	Klg	Lithic sandstone and siltstone, commonly glauconitic and calcareous	
	Surat Siltstone + Wallumbilla Formation	Kl	Siltstone, mudstone, labile sandstone, glauconitic and calcareous in part	
	Surat Siltstone	Kls	Carbonaceous mudstone and siltstone, commonly glauconitic and calcareous, minor sandstone	section only
	Wallumbilla Formation: Coreena Member	Klc	Siltstone and mudstone, minor labile sandstone; commonly carbonaceous	section only
	Doncaster Member	Kld	Carbonaceous mudstone, minor siltstone and sandstone	section only
	Bungil Formation	Kly	Siltstone, mudstone, carbonaceous sandstone	section only
	Mooga Sandstone	Klm	Clayey quartzose sandstone interbedded with siltstone and mudstone; coal	section only
UPPER JURASSIC	Orallo Formation	Juo	Siltstone, sandstone and mudstone, carbonaceous, clayey	section only
	Gubberamunda Sandstone	Jug	Clayey sublabile sandstone, interbedded with siltstone and mudstone; slightly carbonaceous	section only
MIDDLE TO UPPER JURASSIC	Springbok Sandstone	Js	Clayey sublabile calcareous sandstone, interbedded with carbonaceous mudstone and siltstone	section only
MIDDLE JURASSIC TO LOWER CRETACEOUS	Kumbarilla Beds	J-Kk	Sandstone, siltstone, mudstone; some conglomerate	
MIDDLE JURASSIC	Birkhead Formation	Jmb	Labile to sublabile sandstone; calcareous in places; minor mudstone and siltstone	
LOWER JURASSIC	Marburg Sandstone	Jlm	Labile to quartzose sandstone, some siltstone, mudstone, conglomerate and breccia	
	Hutton Sandstone	Jlh	Quartzose sandstone; minor conglomerate, siltstone, mudstone	section only
	Evergreen Formation	Jle	Siltstone and mudstone, lesser sandstone; minor coal	section only
	Precipice Sandstone	Jlp	Quartzose sandstone, conglomeratic in places; minor siltstone, mudstone	section only
MIDDLE TO UPPER TRIASSIC	Moolayember Formation	Ꞧm	Sandstone, siltstone, mudstone; tuffaceous	section only
	Clematis Sandstone	Ꞧe	Conglomeratic sandstone, mudstone, sandstone, siltstone; calcareous	section only
PERMIAN OR TRIASSIC		Pg	Granite	
PALAEOZOIC — UPPER PERMIAN	Blackwater Group	Puw	Tuff, shale, sandstone, conglomerate, coal; micaceous in part	section only
LOWER TO UPPER PERMIAN	Back Creek Group	Pb	Tuffaceous shale, siltstone, sandstone, calcareous in upper part; coal	section only
LOWER PERMIAN		P	Fossiliferous mudstone, pebbly mudstone, conglomerate, lithic sandstone; minor limestone	
UPPER DEVONIAN(?) TO UPPER(?) CARBONIFEROUS	Kuttung Formation	C	Tuff, andesite, dacite, siltstone, sandstone, conglomerate, shale	section only
	Texas Beds	Clt	Interbedded lithic sandstone and mudstone, shale; minor chert, jasper, fossiliferous limestone, andesitic lava, intraformational conglomerate	

Geological boundary
Fault
Lineament

Where location of boundaries and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries are dotted, faults are shown by short dashes

20 Strike and dip of strata
Vertical strata
Dip < 15° — air-photo interpretation
Trend lines — air-photo interpretation
Joint pattern — air-photo interpretation
Unmeasured strike and dip of foliation

TH179 Macrofossil locality with collection number
Dyke; b - basic
Mine, not worked
Open cut, quarry
Ag Silver
Au Gold
Cu Copper
Ma Marble
Mn Manganese

Dry exploration well, abandoned
St BMR stratigraphic hole

Q2822 Artesian bore, flowing
N1246 Sub-artesian bore
(deeper than 1000 feet, with registered number of the Queensland Irrigation and Water Supply Commission (Q) and Water Conservation and Irrigation Commission of New South Wales (N))
E Earth tank or dam
Dam on stream
WH Waterhole on stream
Windpump

Highway
Road
Vehicle track
Railway with station and siding
"Brentwood" Homestead
Building
Trigonometrical station
·1270′ Elevation in feet, accurate

1970/6

PRELIMINARY EDITION, 1969

SUBJECT TO AMENDMENT

GOONDIWINDI

SHEET SH 56-1

Complimentary

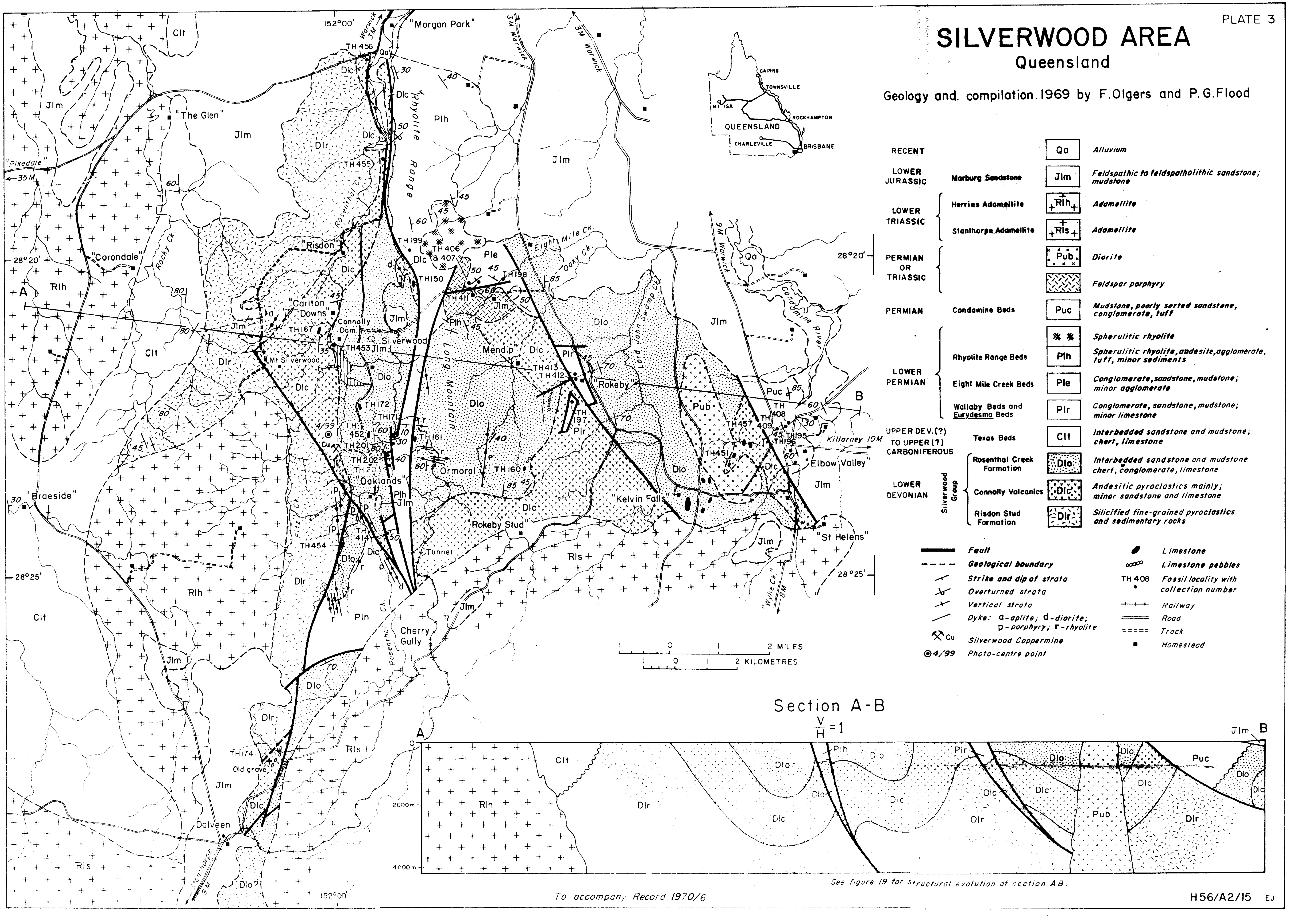


PLATE 3
SILVERWOOD AREA
Queensland
Geology and compilation 1969 by F. Olgers and P. G. Flood
CAIRNS
TOWNSVILLE
MT ISA
ROCKHAMPTON
QUEENSLAND
CHARLEVILLE
BRISBANE
RECENT
Qa
Alluvium
LOWER JURASSIC
Marburg Sandstone
Jlm
Feldspathic to feldspatholithic sandstone; mudstone
LOWER TRIASSIC
Herries Adamellite
Rlh
Adamellite
Stanthorpe Adamellite
Rls
Adamellite
PERMIAN OR TRIASSIC
Pub
Diorite
Feldspar porphyry
PERMIAN
Condamine Beds
Puc
Mudstone, poorly sorted sandstone, conglomerate, tuff
LOWER PERMIAN
Spherulitic rhyolite
Rhyolite Range Beds
Plh
Spherulitic rhyolite, andesite, agglomerate, tuff, minor sediments
Eight Mile Creek Beds
Ple
Conglomerate, sandstone, mudstone; minor agglomerate
Wallaby Beds and Eurydesma Beds
Plr
Conglomerate, sandstone, mudstone; minor limestone
UPPER DEV.(?) TO UPPER(?) CARBONIFEROUS
Texas Beds
Clt
Interbedded sandstone and mudstone; chert, limestone
LOWER DEVONIAN
Silverwood Group
Rosenthal Creek Formation
Dlo
Interbedded sandstone and mudstone chert, conglomerate, limestone
Connolly Volcanics
Dlc
Andesitic pyroclastics mainly; minor sandstone and limestone
Risdon Stud Formation
Dlr
Silicified fine-grained pyroclastics and sedimentary rocks
Fault
Geological boundary
Strike and dip of strata
Overturned strata
Vertical strata
Dyke: a-aplite; d-diorite; p-porphyry; r-rhyolite
Silverwood Coppermine
4/99 Photo-centre point
Limestone
Limestone pebbles
TH 408 Fossil locality with collection number
Railway
Road
Track
Homestead
1 0 1 2 MILES
1 0 1 2 KILOMETRES
152°00'
"Morgan Park"
"The Glen"
"Pikedale"
35M
28°20'
"Carondale"
"Risdon"
"Carlton Downs"
Connolly Dam
Silverwood
Mt Silverwood
"Mendip"
"Rokeby"
Rhyolite Range
Long Mountain
Rosenthal Ck
Rocky Ck
Eight Mile Ck
Oaky Ck
Lord John Swamp Ck
Condamine River
3M Warwick
9M Warwick
Killarney 10M
"Elbow Valley"
"Braeside"
"Oaklands"
Ormoral
"Kelvin Falls"
"Rokeby Stud"
Tunnel
"St Helens"
28°25'
Cherry Gully
Old grave
Dalveen
Stanthorpe 9M
"Wyllie Ck" 8M
Section A-B
V/H = 1
2000m
4000m
See figure 19 for structural evolution of section AB.
To accompany Record 1970/6
H56/A2/15 EJ

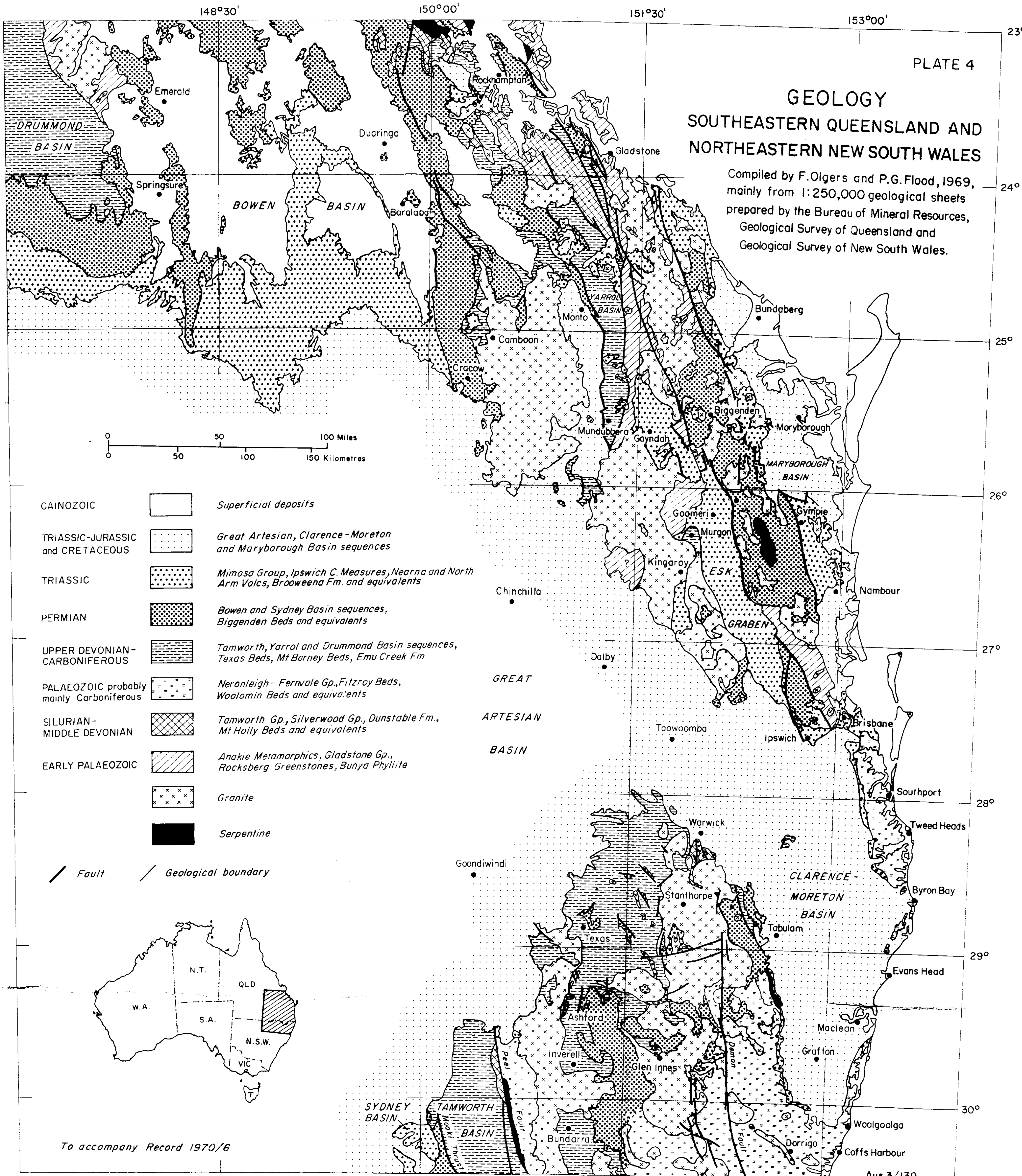


PLATE 4
GEOLOGY
SOUTHEASTERN QUEENSLAND AND
NORTHEASTERN NEW SOUTH WALES
Compiled by F. Olgers and P.G. Flood, 1969,
mainly from 1:250,000 geological sheets
prepared by the Bureau of Mineral Resources,
Geological Survey of Queensland and
Geological Survey of New South Wales.
148°30'
150°00'
151°30'
153°00'
23°
24°
25°
26°
27°
28°
29°
30°
DRUMMOND BASIN
BOWEN BASIN
YARROL BASIN
MARYBOROUGH BASIN
ESK GRABEN
GREAT ARTESIAN BASIN
CLARENCE-MORETON BASIN
SYDNEY BASIN
TAMWORTH BASIN
Peel Fault
Mooki Thrust
Demon Fault
Emerald
Duaringa
Rockhampton
Gladstone
Springsure
Baralaba
Bundaberg
Monto
Camboon
Cracow
Biggenden
Maryborough
Mundubbera
Gayndah
Goomeri
Gympie
Murgon
Kingaroy
Nambour
Chinchilla
Dalby
Toowoomba
Ipswich
Brisbane
Southport
Tweed Heads
Warwick
Goondiwindi
Stanthorpe
Byron Bay
Tabulam
Texas
Evans Head
Ashford
Maclean
Inverell
Grafton
Glen Innes
Bundarra
Dorrigo
Woolgoolga
Coffs Harbour
0 50 100 Miles
0 50 100 150 Kilometres
CAINOZOIC — Superficial deposits
TRIASSIC-JURASSIC and CRETACEOUS — Great Artesian, Clarence-Moreton and Maryborough Basin sequences
TRIASSIC — Mimosa Group, Ipswich C. Measures, Nearna and North Arm Volcs, Brooweena Fm. and equivalents
PERMIAN — Bowen and Sydney Basin sequences, Biggenden Beds and equivalents
UPPER DEVONIAN-CARBONIFEROUS — Tamworth, Yarrol and Drummond Basin sequences, Texas Beds, Mt Barney Beds, Emu Creek Fm.
PALAEOZOIC probably mainly Carboniferous — Neranleigh-Fernvale Gp., Fitzroy Beds, Woolomin Beds and equivalents
SILURIAN-MIDDLE DEVONIAN — Tamworth Gp., Silverwood Gp., Dunstable Fm., Mt Holly Beds and equivalents
EARLY PALAEOZOIC — Anakie Metamorphics, Gladstone Gp., Rocksberg Greenstones, Bunya Phyllite
Granite
Serpentine
Fault
Geological boundary
N.T.
QLD
W.A.
S.A.
N.S.W.
VIC
T
To accompany Record 1970/6
Aus 3/130
EJ