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DEPARTMENT OF GEOLOGY

Volume VI Number 6

UNIVERSITY OF QUEENSLAND PRESS
ST. LUCIA

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Price: Forty Cents

University of Queensland Papers

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UNIVERSITY OF QUEENSLAND PRESS

St. Lucia

30 October 1968

WHOLLY SET UP AND PRINTED IN AUSTRALIA BY

WATSON FERGUSON AND COMPANY, BRISBANE, QUEENSLAND

1968

TRIASSIC VOLCANIC ROCKS OF AGNES WATER, QUEENSLAND

ABSTRACT. Coastal outcrops of volcanic rocks near Agnes Water, 50 miles NW. of Bundaberg, Queensland, are described. The volcanic formation (Agnes Water Volcanics) comprises a variety of acid to intermediate pyroclastic rocks (including ignimbrites) with minor acid to intermediate lavas, intrusives, and sedimentary rocks containing Triassic plant fossils. It has been strongly faulted, folded and lithified. The outcrops are the most northerly of the Maryborough Basin.

INTRODUCTION

The aim of this paper is to record the presence of volcanic rocks of probable Triassic age along the Queensland coastline between Round Hill Head and Wreck Rock (Fig. 1). The northern part of the area is accessible by road from Lowmead and Miriam Vale to Agnes Water and Seventeen Seventy. Coastal outcrops are generally good, especially for several miles south-east of Agnes Water, but they are limited to a narrow strip of country and are interrupted by long sandy beaches. On the landward side of the coastal outcrops there are sand-covered ridges up to 200 feet above sea level with hills (400 to 600 feet above sea level) of volcanic rocks further inland. Apart from the Triassic volcanics the only other deposits are Quaternary beach and dune sands, beach rock (sand cemented by calcareous and ferruginous cement) and cemented cobble and boulder deposits in the tidal zone.

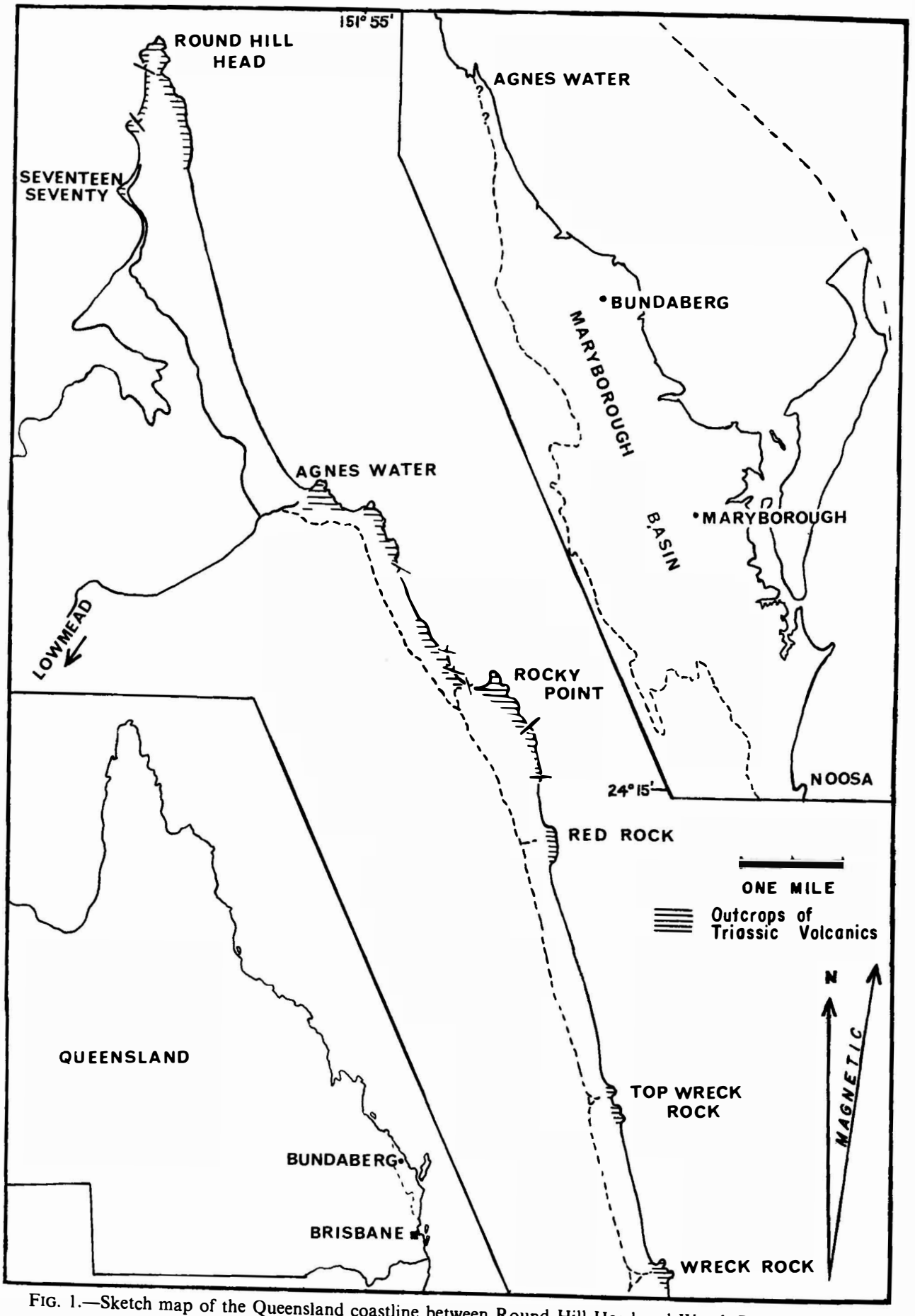

FIG. 1.—Sketch map of the Queensland coastline between Round Hill Head and Wreck Rock, and its relation to the Maryborough Basin.

There are no previous references to the geology of the area, except that the occurrence of possible Graham's Creek Formation (Jurassic-Cretaceous andesitic and rhyolitic volcanics) is indicated on a geological map of the Maryborough Basin (Fig. 42, Ridley, 1960) at Wreck Rock and several points to the north and south. W. F. Ridley has since found sandstone which he considers to be equivalent to the Lower Jurassic Myrtle Creek Formation overlying the volcanics at a point 4.2 miles south of Wreck Rock (077658 Miriam Vale 1-mile map).

The outcrops at these localities are the most northerly of the Maryborough Basin (Fig. 1), a major structural feature containing folded Mesozoic rocks, which is presumed to extend northwards beneath the Pacific Ocean (Ellis, 1966). The western margin of the Mesozoic rocks has previously been drawn crossing the coastline at or near Wreck Rock (Tectonic Map of Australia, 1962), with Palaeozoic rocks to the west. Andesitic and rhyolitic volcanics are known to occur for many miles inland, and further west, Triassic volcanic rocks have been mapped in the ranges between Lowmead and Many Peaks (Dear *et al.*, 1967). There is thus the possibility of volcanic rocks of at least two periods in the area between Lowmead and the coast.

Apart from these recent reports the nearest previously known Triassic volcanic rocks are the Ooramera Volcanics (Fig. 43, Ridley, 1960) a Lower Triassic formation of trachyte flows and pyroclastics (Ellis, 1964) to the west of Maryborough. The overlying Middle Triassic Brooweena Formation thins to the north but has been mapped to within 10 miles south of Wreck Rock.

STRATIGRAPHY

With the exception of Quaternary deposits, all the rocks in the area studied are considered by the writer to belong to the one volcanic formation, named here the Agnes Water Volcanics.

The formation, which is probably of Triassic age, consists largely of pyroclastic rocks derived from acid to intermediate volcanics with minor flows of rhyolite, trachyte and andesite, and very little sandstone and shale. Rhyolites, mostly strongly banded, are interpreted as later intrusions. The area has been folded and faulted, with no prominent regional trends. The sequence and thickness are difficult to determine because of faulting and limited outcrops.

Widely distributed rhyolitic tuffs are found to the north and south of a complex area of breccia, rhyolite, ignimbrite, andesite, trachyte and sandstone close to Agnes Water, which has been mapped in greatest detail (Fig. 2).

On the coast within half a mile of Agnes Water there are disconformable contacts between breccia and underlying sandstone, and between breccia and underlying rhyolitic ignimbrite. These contacts may be seen in the cliff just above the rock platform of sandstone and at the highest point of the bare rocky surface of the ignimbrite, on its western margin, respectively. The breccia and underlying sandstone on the south-east side of the ignimbrite appear to dip beneath it but the breccia outcrop is interrupted by an agglomerate vent and a sandy beach.

Several other rocky headlands to the south-east are composed of rhyolite which shows some similarities to the rhyolitic ignimbrite (brown colour, feldspar phenocrysts but no quartz phenocrysts) but lacks the ignimbritic groundmass. These rhyolites may be intrusive, and are designated as such on the map (Fig. 2). Most of the rhyolite contacts are faults, but breccias interbedded with thin layers of rhyolitic ignimbrite dip off the southernmost rhyolite headland. A green trachytic rock dips under breccias beyond the north-western end of Workman's Beach and a thin flow of rhyolite is interbedded with breccias on the rocky coastline to the east of the same beach. Relations between two occurrences of andesite and adjacent breccias are not clear.

From the above evidence it appears that ignimbrite, a thin rhyolite flow and a trachyte are interbedded with the breccias close to Agnes Water. The sandstone (and shale with plant remains) appears to be at the base of the sequence.

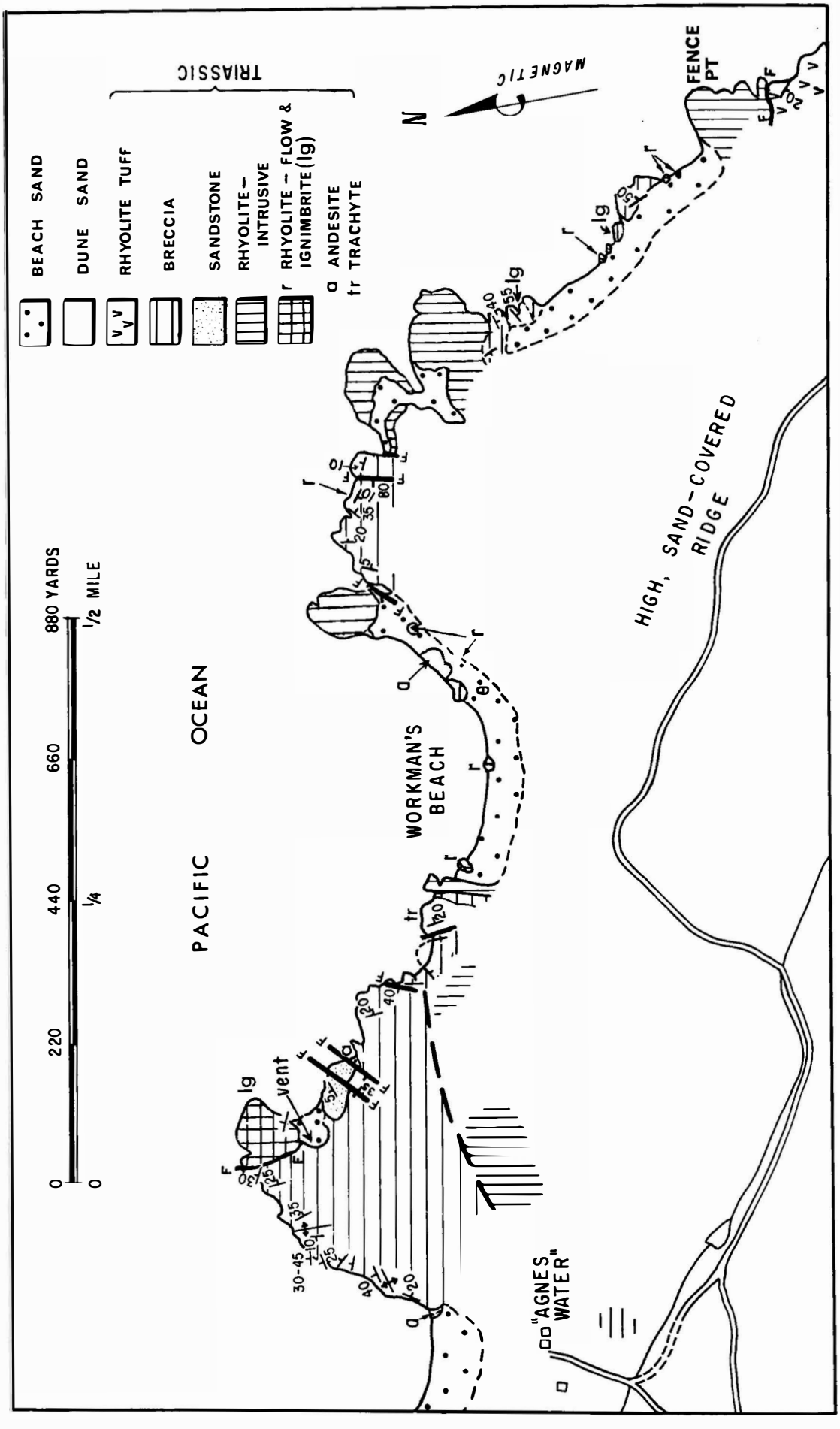

FIG. 2.—Geological map of the coastal outcrops near Agnes Water

The only contact of the widely-distributed rhyolite tuff in the area studied is a faulted one with rhyolite, presumed to be intrusive, south of Fence Point. The stratigraphic position of the rhyolite tuff is thus uncertain, but since it dips away from the nearest breccia outcrops it is likely that it overlies the members of the above sequence. Agglomerate and breccia exposed on the southern side of the fault may be at the base of the rhyolite tuff member.

STRUCTURE

In the area of breccias, rhyolite and andesite close to Agnes Water, the attitudes of bedding and faults vary considerably, and no regular pattern is evident. Two minor anticlinal axes are present in the first few hundred yards of coastal outcrops of breccia nearest to Agnes Water, and in one of the sandstone fault blocks the folding is much closer still. Where displacements caused by faulting can be measured they are quite small and there is no reason to suggest that any of the faults are of much greater magnitude.

A fault separating breccia and rhyolitic ignimbrite is well exposed on the headland closest to Agnes Waters. A small outcrop of the ignimbrite appears at the foot of a cliff on the western (downthrow) side of the fault, and the boundary with the breccia at that point is disconformable. A vent for the ignimbrite effusion may be present here.

On the opposite side of the headland, the boundary of ignimbrite and a coarse agglomerate is exposed in a cliff. The contact is nearly vertical and slightly irregular, cutting across the layering in the ignimbrite, which dips gently to the north-east. The contact could be the southern continuation of the fault described above, except that the throw would be greater at this point, and the agglomerate seems to have another vertical contact (with breccia) in the cliff nearby. The agglomerate is interpreted as a vent filling, bounded by breccia to the south and ignimbrite to the north.

The flow layers of the banded rhyolites of Fence Point, Red Rock and Wreck Rock are mostly steeply-dipping and strongly contorted, suggesting that the rhyolites are intrusive, perhaps as dykes, transverse to the coastline.

The occurrence of the rhyolite tuff to the north and south of the area of breccias, dipping away from it, suggests that the rhyolite tuffs might be on opposite limbs of an anticline, with the breccias in the core of the fold. Such an anticline would have a north-west south-east trend, a direction at variance with fold axes previously mapped in the Maryborough Basin.

PETROGRAPHY

Breccias

The breccias vary in composition, colour and grain size; typically they are medium grey, with pink, green, grey and purplish-coloured fragments, poorly sorted and angular to sub-angular. They grade into tuffs and more rarely, agglomerates. Bedding is visible in most outcrops, but is not distinct except at one or two localities.

The fragments are mostly andesitic and rhyolitic. The andesites are porphyritic in altered plagioclase and may contain epidote and calcite pseudomorphs in a fine-grained groundmass. Banded and feldspar-porphyritic, devitrified rhyolites are present in some breccias, also fragments of tuff and fine-grained volcanic rocks without phenocrysts, but with textures indicating trachytes, andesites and rhyolites. In the majority of the breccias and interbedded tuffs, quartz is present only in very small grains in, or derived from, the groundmass of the volcanic rocks.

A breccia at the base of the rhyolite tuff south of Fence Point differs from those described above in the high proportion of rhyolite and dacite fragments (some porphyritic in quartz) which it contains.

Rhyolitic ignimbrite

Hand-specimens of this rock are dark brown, with white feldspar phenocrysts in a glassy base, and could be mistaken for an andesitic pitchstone. Parallel orientation of phenocrysts and rock fragments, with differential weathering along discontinuous layers, is most marked in the outcrop closest to Agnes Waters.

Under the microscope, the feldspar phenocrysts are brown and turbid, K-feldspar less so than the albite (Ab92). Quartz is an accessory though the groundmass is siliceous enough for the rock to be termed rhyolitic (see analysis, Table 1). The included rock fragments are fine-grained, with few, small phenocrysts and are either trachytes or rhyolites. The groundmass is a brown glass which may contain shreds of partly devitrified glass, now granular quartz aggregates.

TABLE 1

	1	2		1	2		SiO_2%
SiO_2	71.47	66.24	Q	28.0	13.8	3	74.3
Al_2O_3	14.73	16.55	or	12.3	10.6	4	77.7
Fe_2O_3	1.57	0.43	ab	46.7	50.3	5	75.3
FeO	0.78	2.84	an	5.0	8.1	6	73.3
MgO	0.85	1.28	c	1.5	1.8	7	74.3
CaO	1.15	2.03	en	1.5	3.2	8	76.5
Na_2O	5.55	5.95	fs	—	4.1		
K_2O	2.10	1.76	mt	1.6	0.7		
H_2O+	0.64	1.26	hm	1.4	—		
H_2O-	0.12	0.17	il	0.9	1.5		
TiO_2	0.47	0.81	ap	0.3	0.7		
P_2O_5	0.11	0.27					
MnO	0.13	0.37					
	99.67	99.96					

Chemical analyses and C.I.P.W. norms of:
1—rhyolitic ignimbrite, 014864 Bustard Head 1-mile map, 0.3 miles north-east of Agnes Water. Anal. L. J. Sutherland.
2—acid trachyte, 016862 Bustard Head 1-mile map 3/8 miles east of Agnes Water. Anal. Avery and Anderson.
Silica determinations by x-ray fluorescence methods of:
3—banded rhyolite, Fence Point; 4—banded rhyolite, Red Rock; 5—rhyolite flow, east of Workman's Beach; 6—devitrified intrusive rhyolite, north-west of Workman's Beach; 7—rhyolitic tuff, 0.8 miles south-south-east of Rocky Point; 8—rhyolitic ignimbrite, ¼ miles north-west of Fence Point. Analyses by S. Bagley.

Grey-coloured rocks, interbedded with breccias a quarter of a mile north-west of Fence Point, have phenocrysts of K-feldspar and albite in a very fine-grained groundmass containing shreds of devitrified glass and fragments of rhyolite and andesite. These rocks have a high silica content (Table 1), and are also classed as rhyolitic ignimbrites. Somewhat similar rocks with oligioclase phenocrysts and a more obvious ignimbrite structure (visible in hand-specimen) occur on the beach 200 yards nearer to Fence Point.

Andesites and trachytes

Several different types of andesite and trachyte are interbedded with or intrusive into the breccias. Close to the western end of Workman's Beach, a grey-green rock resembling an andesite in hand-specimen is faulted against and dips under breccias. The outcrop has distinct flow-layering, and the upper part (stratigraphically) shows a honeycomb type of weathering because of the presence of abundant pyrite. Under the microscope, there are small phenocrysts of turbid

oligioclase and a little epidote in a fine-grained trachytic groundmass containing some chlorite. The analysis (Table 1) indicates that the silica and soda contents are too high for an andesite, and the rock would be more appropriately termed an acid trachyte. This rock has been intruded by a narrow dyke of andesitic composition.

A dark grey andesitic rock cropping out towards the eastern end of Workman's Beach seems to be a more normal type, with altered andesine phenocrysts. Similar andesite, silicified and much altered to epidote is associated with masses of red jasper to the south-east of the sandstone (Fig. 2).

Rhyolites

The banded, presumably intrusive rhyolites which form several of the headlands (Fence Point, Red Rock etc.) are dominantly pink-coloured with dark grey bands up to 3 mm in width. Numerous very thin bands are visible between the thicker layers, and the banding is interrupted by white or clear phenocrysts of quartz, albite and K-feldspar, but quartz may be lacking as phenocrysts. The groundmass usually has a mottled appearance as a result of quartz-feldspar intergrowths, and there may be quartz grains filling cavities into which small crystals of cristobalite or tridymite project. Epidote and pyrite are accessories. Pyrite is also found in breccias and other rocks adjacent to the rhyolitic intrusives.

The rhyolite of the two headlands east of Workman's Beach, and the flow rhyolite interbedded with breccias between the headlands resemble the feldspar-porphyritic intrusive rhyolites except that the former are darker coloured when fresh. Some of the rhyolite outcrops at the headlands furthest east of Workman's Beach are strongly bleached and altered because of weathering of the contained pyrite.

Rhyolite Tuff

This rock, which does not vary markedly over 16 miles of discontinuous outcrop south of Round Hill Head, is a medium grey rock with quartz, feldspar and rock fragments in a fine-grained matrix. Stratification is often visible, parallel to the longer axes of platy fragments, especially as a parting develops in this direction.

In thin section, the larger quartz grains are rounded and contain deep embayments and pseudoinclusions (Plate I, 3). The plagioclase seems to be andesine, despite the prevalence of quartz and the resulting high silica content (Table 1). It occurs as broken fragments or nearly complete crystals. Other minerals present are bleached, altered biotite and opaques. The rock fragments include several different types of fine-grained igneous rocks. North-west of Rocky Point, rhyolitic fragments are abundant. These contain similar phenocryst minerals to those found as fragments in the tuffs. The groundmass of the tuff is fine-grained and comprises a moderate proportion of the rock. In it are shreds of devitrified glass (Plate I, 4) which bend around fragments and resemble structures found in ignimbrites.

Sandstone

The greenish-grey sandstone which is associated with dark shale layers on the rock platform north-east of Agnes Waters is probably of tuffaceous origin or has been derived from erosion of a volcanic terrain, as it consists mainly of fragments of plagioclase, tuff and fine-grained volcanic rocks with only a small proportion of quartz. Secondary or low-grade metamorphic minerals include calcite, zoisite, epidote and sericite. The sedimentary rocks are abnormally tough and appear to have been hardened, perhaps by silicification.

AGE OF THE VOLCANIC ROCKS

The only fossils found in the district are in the small area of sandstone with interbedded shale and tuff north-east of Agnes Water. These include abundant strongly silicified and indeterminate plant stems, a few small tree trunks in their

position of growth (perpendicular to the bedding), and, according to G. McDonagh (pers. comm.), *Dicroidium odontopteroides,* indicative of a Triassic age. Although breccias disconformably overlie the sandstone, the breccias are thought (by the writer) to be also Triassic, as similar plant stems are found in shales and sandstones interbedded with tuffs and breccias in the downthrown south-easterly "block" of sediments, which appears to be stratigraphically above the disconformity.

The widespread rhyolite tuffs seem to be younger than the breccias and similar rocks underlie sandstones which have been correlated with the Jurassic Myrtle Creek Formation south of the area studied. If this is so, the rhyolite tuffs cannot belong to the Jurassic-Cretaceous Graham's Creek Volcanics, but must be older.

In southern Queensland, all ignimbrites so far recorded are of Triassic age, and the presence of ignimbrite in this volcanic formation is additional support for a Triassic age.

ACKNOWLEDGMENTS

The writer has benefited by discussions with Professor D. Hill and Dr. A. Ewart, of the University of Queensland, and Messrs W. F. Ridley, P. L. Ellis, R. M. Tucker and other members of the Geological Survey of Queensland.

Thanks are also due to Mr. G. McDonagh, for information on the fossil plants and Mr. S. Bagley for X-ray determinations of silica. Research funds of the University of Queensland helped defray costs of a chemical analysis and transport to the area.

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Explanation of Plate I

Photomicrographs of ignimbritic rocks, Agnes Water Volcanics, by Mr. E. W. Hollywood and Mr. Coker.

FIG. 1.—Rhyolitic ignimbrite, analysis 1, Table 1. Field: 15mm × 10mm

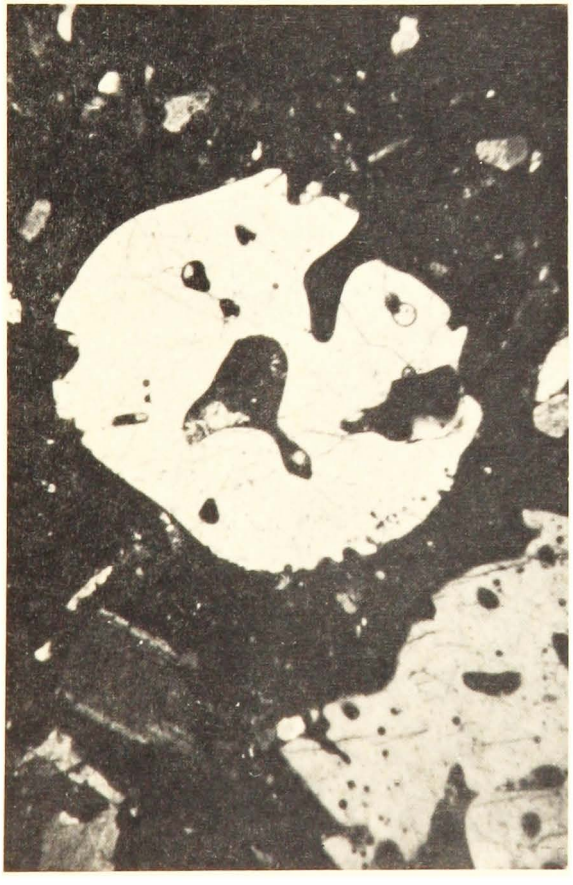
FIG. 2.—Ignimbrite, 250 yards north-west of Fence Point. Field: 18mm × 14mm

FIG. 3.—Corroded quartz phenoclast, 2mm diameter, rhyolite tuff, near rhyolite contact at Fence Point. Crossed nicols.

FIG. 4.—Ignimbrite groundmass of 3. Field: 0.7 × 0.5mm

1

2



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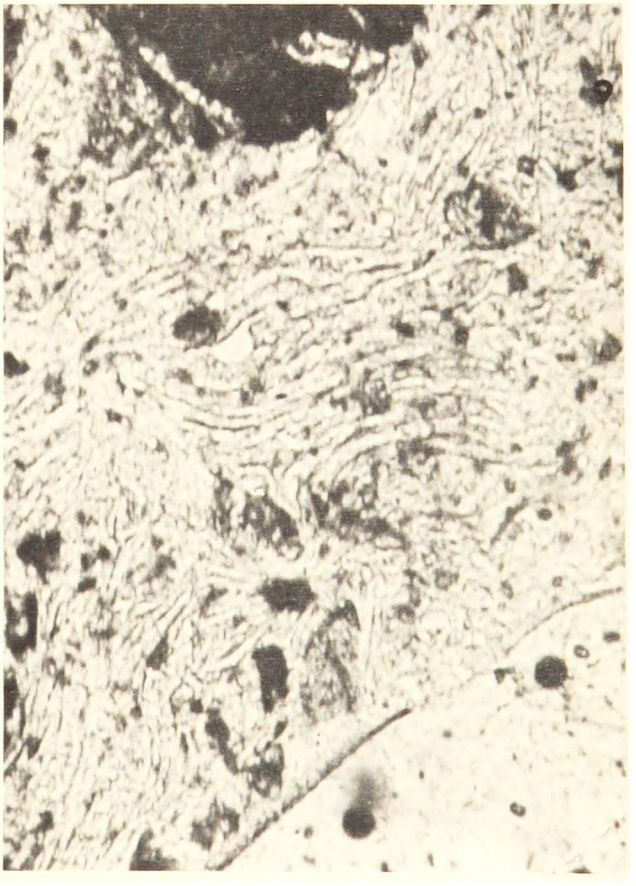

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PLATE I