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BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

RECORDS:

1963/72

THE GEOLOGY OF THE ALROY AND BRUNETTE DOWNS 1:250,000 SHEET AREAS, NORTHERN TERRITORY

by

M.A. Randal and R.A.H. Nichols

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THE GEOLOGY OF THE ALROY AND BRUNETTE DOWNS 1:250,000 SHEET AREAS, NORTHERN TERRITORY

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SUMMARY

During 1962 a field party from the Geological Branch of the Bureau of Mineral Resources, Geology and Geophysics mapped the Brunette Downs and Alroy Sheet areas and re-examined part of the Wallhallow Sheet area. These areas, which occur in the central and northern part of the Barkly Tableland, form the north-western part of the Georgina Basin* and adjoin the southern part of the Carpentaria Upper Proterozoic Province. (Dunn, Smith & Roberts, in preparation). For the most part they consist of black soil plains covered by Mitchell grass and contain few rock outcrops. The southern part of the Alroy Sheet area consists of a large "desert" which extends onto the adjacent Tennant Creek, Bonney Well, Frew River, Avon Downs and Sandover River Sheet areas.

Rocks of Upper Proterozoic, Cambrian, Mesozoic and Tertiary age occur in the Alroy and Brunette Downs areas. Superficial deposits are widespread; stratigraphic information is obtained with difficulty due to the paucity of outcrop and the lack of exposed contacts. Structures (dips and lineations) which appear on air-photographs cannot be verified on the ground.

A medium-grained quartz sandstone, partly ferruginous and strongly cross-bedded, crops out in the north-east of the Brunette Downs Sheet area where it dips gently to the south-south-west. It is continuous with the Upper Proterozoic Mittiebah Sandstone which occurs on adjoining sheets to the east and north. It is at least 200 feet thick in the Brunette Downs Sheet area.

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* This north-western area is described in B.M.R. Report 41A (1960) as the Barkly Basin, which includes the rocks described in this record. A discussion of this term is included in this Record in the section on Structure.

Cambrian rocks in these Sheet areas form part of the widespread lower Middle Cambrian sediments on the Barkly Tableland. The Top Springs Limestone on the Wallhallow Sheet area is near the base of the sequence and contains early Middle Cambrian or late Lower Cambrian fossils. On the Brunette Downs Sheet area, the Anthony Lagoon Beds consist of limestone, dolomitic limestone, dolomite and algal limestone; quartz sandstone and siltstone occur as interbeds. Extensive chert gravel represents silicified oolitic and shelly limestones and silicified shale and siltstone. On the Alroy Sheet area outcrops of Middle Cambrian rocks, the Wonarah Beds, consist of silicified limestone, siltstone, chert, silicified shale and quartz sandstone. Chips of fossiliferous limestone from nearby water bores are lithologically similar to the Burton Beds to the east near Alexandria. Lateritization leaching and silicification obscure many features of these rocks, but it is probable that some of these beds were deposited in a continuous Middle Cambrian sea. The rocks are generally horizontal, but very low dips have been photo-interpreted in some parts. Bore data suggest that the Anthony Lagoon Beds are at least 700 feet thick and the Wonarah Beds 450 feet thick.

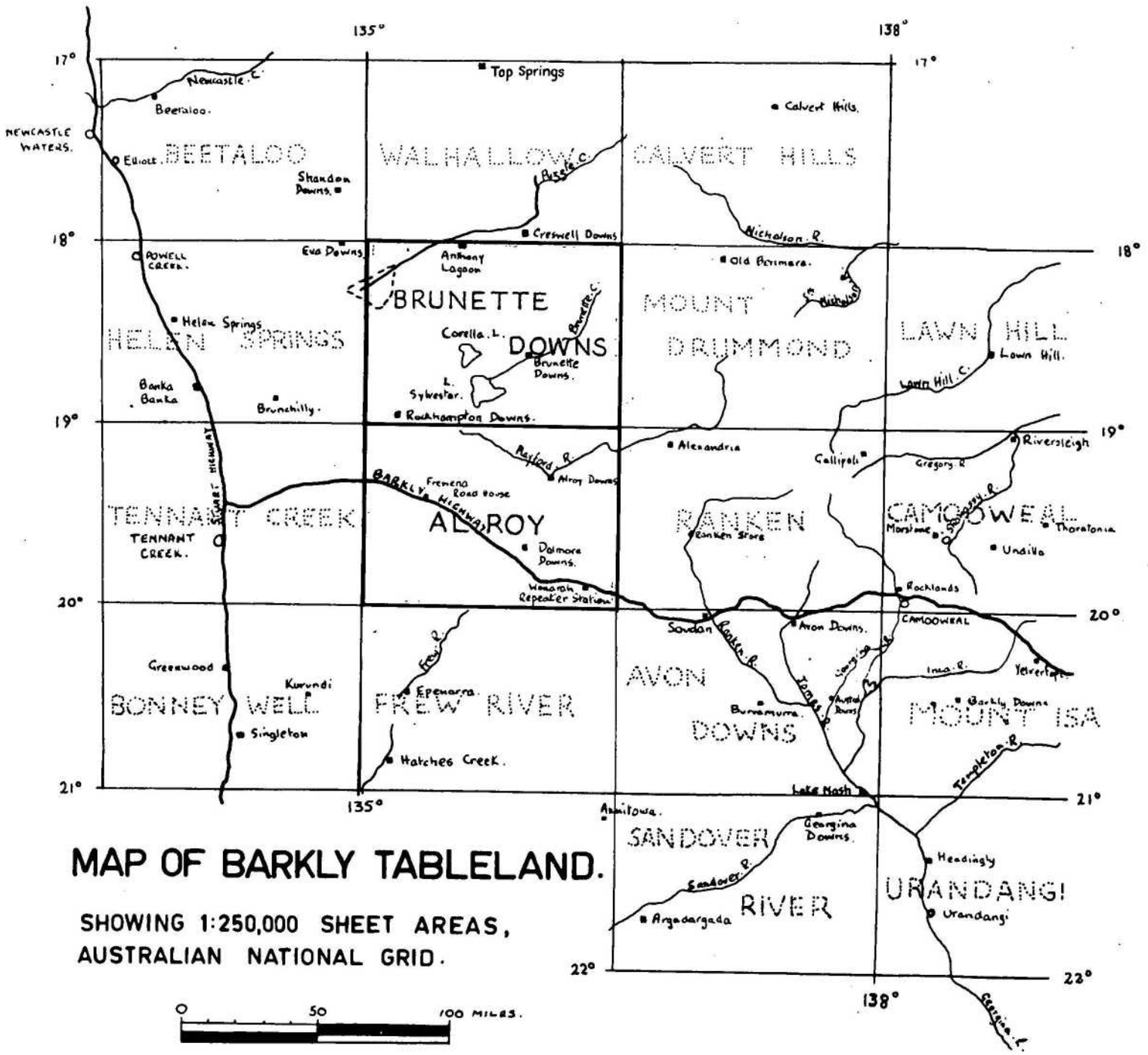
Silicified sandstone containing plant fossils of Mesozoic age occurs as an isolated outcrop in the northern part of the Brunette Downs Sheet area.

Tertiary sedimentation is represented by the Brunette Limestone which is a siliceous white nodular limestone, with small sandy interbeds. The limestone was previously thought to be of lacustrine origin, but a single fossil locality suggests some marine influence. The Brunette Limestone is probably flat lying; it is at least sixty feet thick.

Travertine covers large areas in the southern part of the Alroy Sheet area, but it has a different composition and topographical expression from the Brunette Limestone.

Unconsolidated superficial deposits consist of various clayey soils, sand and gravel of Tertiary and post-Tertiary ages.

FIG. 1.



MAP OF BARKLY TABLELAND.

SHOWING 1:250,000 SHEET AREAS, AUSTRALIAN NATIONAL GRID.

Bureau of Mineral Resources, Geology & Geophysics. April, 1962.

To accompany Records 1962/49, 55, 56, 61. 1963/72

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INTRODUCTION

Location

The Brunette Downs Sheet area lies in the Northern Territory of Australia between longitudes 135°E and 136°30'E and latitudes 18° and 19°S; the Alroy Sheet area adjoins it to the south and lies between the same meridians and latitudes 19° and 20°S. (Fig. 1). The bitumen-sealed Barkly Highway from Mt. Isa and Camooweal in Queensland to Tennant Creek on the Stuart Highway, diagonally bisects the Alroy Sheet area from south-east to north-west. It provides access to the numerous station tracks and stock routes in the region* . Six cattle stations occupy the region; Dalmore Downs, Alroy Downs and parts of both Brunette Downs and Rockhampton Downs in the Alroy Sheet area, and parts of Brunette Downs, Rockhampton Downs, Cresswell Downs and Anthony Lagoon in the Brunette Downs Sheet area. The western limit of the Alexandria Holding extends in a strip about 4 miles wide along the eastern edge of the region. Cattle movement in the north is by the Barkly Stock Route which connects Brunette Downs to the west with Elliot via Anthony Lagoon and to the east Camooweal via Alexandria. In the south, movement is along the South Barkly Stock Route which connects the Barkly Stock Route at Ranken Store to the Stuart Highway near Banka Banka (Fig. 1). At present the Commonwealth Department of Works is constructing a Beef Road from the Barkly Highway to Anthony Lagoon via Alroy Downs and Brunette Downs stations.

Previous Investigations

Until 1962 no detailed systematic mapping had been carried out in these Sheet areas. However, these and adjoining areas of the Barkly Tableland have been traversed in the past by explorers and by geologists engaged in regional reconnaissance mapping.

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* Unless otherwise qualified the word "region" in this record refers to the combined area of the Alroy and Brunette Downs 1:250,000 Sheet areas.

A Cambrian fossil was first found on the Barkly Tableland by H.Y.L. Brown (1895) who found a Middle Cambrian trilobite in the spoil from a well near Alexandria Homestead. Etheridge (1897) described the fossil as Olenellus browni but the species was later assigned by Whitehouse (1936) to his new genus Xystridura. This find was followed in 1898 by Davidson's discovery of Pagetia significans and Peronopsis elkedraensis (Etheridge 1902) south-east of (old) Elkedra Homestead on the southern environs of the Barkly Tableland. Prior to 1915, Merrotsy, in the course of surveying trips on the Barkly Tableland, discovered a cast of a trilobite eight miles east of Alroy Downs Homestead. The discovery was reported and described by Etheridge (1919), but he states that the specimen previously had been figured in Bulletin of the Northern Territory, No.14 (1915). Etheridge's determination was Ptychoparia alroyensis; subsequently Whitehouse (1939) assigned it to the new genus Lyriaspis.

Woolnough (1912) passed through this region in the course of a trip from McArthur River to Cloncurry. His report contains references not only to the Cambrian limestones and "quartzites" of the region but also to the sub-artesian water resources of the Barkly Tableland.

Jensen (1914) also passed through the area and commented on the Cambrian rock types and made minor reference to the water resources. In subsequent papers, Jensen (1923 and 1944) referred to these rocks as the Barkly Tableland Series.

In 1947 and 1948 Noakes and Traves (in C.S.I.R.O., 1954) visited the Barkly Tableland in the course of the C.S.I.R.O. investigation of the Barkly Region. In addition to the above report, a great deal of original observations and fossil localities are described in unpublished material by Noakes and Traves which is retained in the files of the B.M.R. At this time the Cambrian rocks of the Tableland were called the Barkly Group (Noakes, 1951, Noakes and Traves in C.S.I.R.O. 1954).

Since 1948, A.A. Öpik has made a number of visits to the Barkly Tablelands and has made many fossil collections. The results of this work are contained in a number of unpublished reports which form the basis of papers published by Öpik (1957)*.

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* These papers were presented and published at the 20th International Geological Congress at Mexico City in 1956. They were subsequently combined with other papers and published in 1957 as B.M.R. Bulletin No.49.

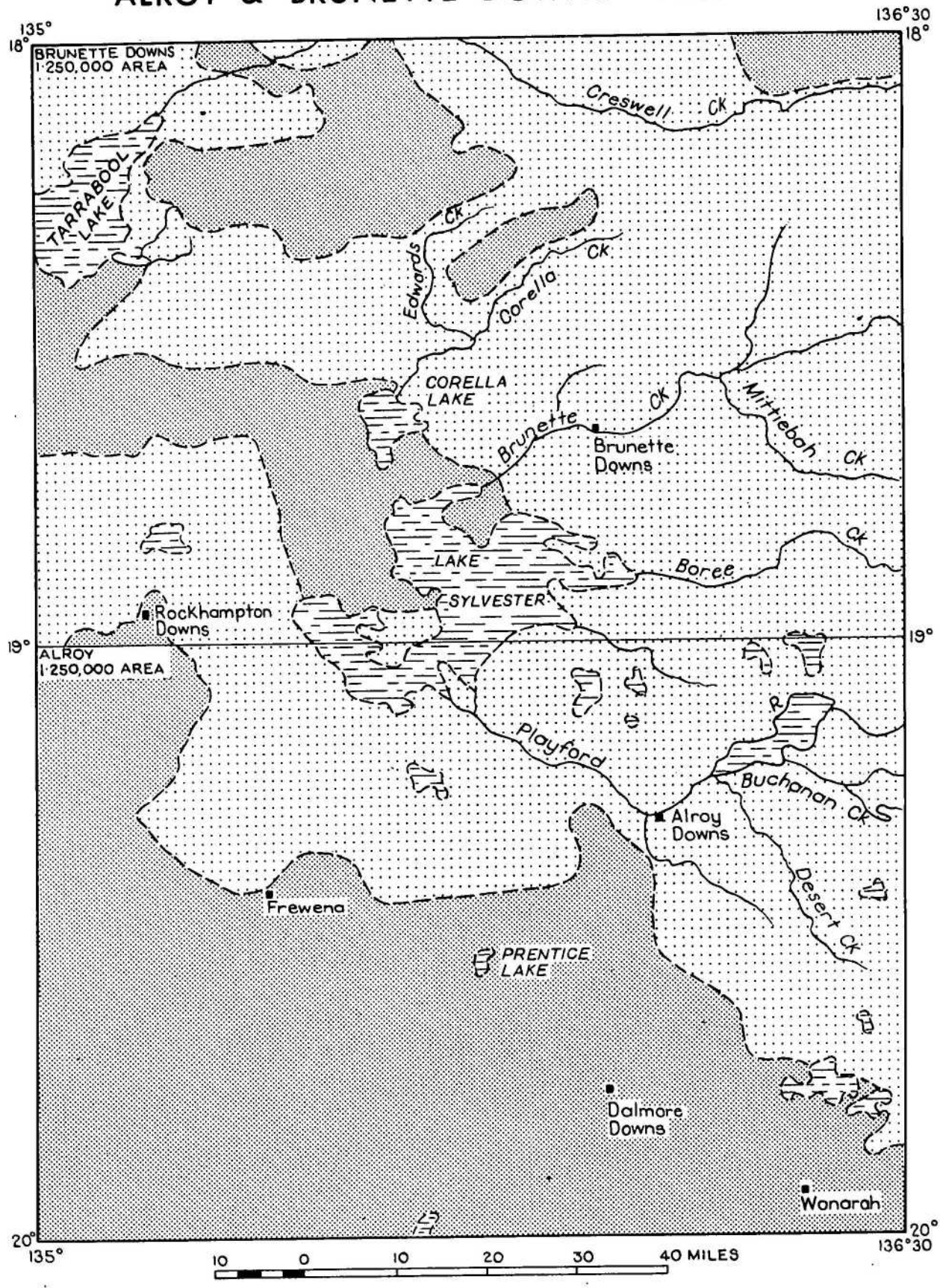
Studies of the Cambrian succession in N.W. Queensland are relevant to the Alroy and Brunette Downs Sheet areas, and in this connection the most important contributions are those of Öpik (op.cit.) and Whitehouse (1927-1945). Mapping by the Bureau on the adjoining Sheet areas of Tennant Creek (Ivanac, 1954), Wallhallow (Plumb & Rhodes 1963) and Ranken (Randal & Brown, 1962a) are relevant to the Cambrian stratigraphy of these two Sheet areas.

In addition to the mapping carried out in 1962 on the Alroy and Brunette Downs Sheet areas, the Bureau of Mineral Resources carried out a programme of core hole drilling in the Georgina Basin (Milligan, 1963); three of these holes Grg15, 15a and 17 were drilled on the Alroy Sheet area. Preliminary results of this work are given on Plate 1.

Air Photographs and Maps

The two Sheet areas are covered by vertical aerial photographs at a scale of 1:46,500, flown by the R.A.A.F. in 1947; the photos are not clear and many bores and tracks have been put in since they were flown. In 1959 the Division of National Mapping published the Alroy Sheet in the 4-mile Topographic series and in 1960 published the Brunette Downs Sheet in the same series but at the new 1:250,000 scale. These maps were compiled from the 1947 photography supplemented by spot photography and ground control both of which were carried out in 1958. Photo-scale compilations of the separate one-mile areas are available and these show all cultural information to 1958. During the 1962 field season, mapping of the new bores and tracks was carried out concurrently with geological traversing.

PHYSIOGRAPHIC SKETCH MAP OF ALROY & BRUNETTE DOWNS AREA



REFERENCE

- Timbered Areas
- Lakes or Swamps
- Grassy Downs

PHYSIOGRAPHY

The entire region falls within the Barkly Internal Drainage Basin (C.S.I.R.O., 1954; Randal, 1962a). The divide separating this basin from the Georgina River Basin lies to the east on the adjoining Ranken Sheet area and the divide separating it from the Gulf fall lies to the north and east on the Walhallow, Mount Drummond and Ranken Sheet areas (Fig.1).

The Barkly Internal Drainage Basin is not a single entity; it consists of a number of blue-bush swamps or lakes which are themselves internal drainage centres. The largest of these is Lake Sylvester (including Lake De Burgh) which occupies the centre of the region and in the wet season receives water from a large area in the central eastern part of the region and beyond. This area is drained by Brunette and Mittiebah Creeks, Boree Creek, and the Playford River and its tributaries Buchanan and Desert Creeks; these streams join Lake Sylvester in deltas and long lagoons. Of secondary importance are Tarrabool Lake in the north-west, fed by Creswell Creek, and Lake Corella in the central part, fed by Corella and Edwards Creeks. As well as the major lakes, smaller blue-bush swamps and claypans occur south of the Playford River, between the Playford River and Boree Creek, and north of Tarrabool Lake. These act as foci for small gullies and gilgais during brief periods of local seasonal flooding. In the far south of the region the Frew River which rises in the Davenport Ranges (Fig. 1), empties into a local internal drainage claypan or swamp.

The streams in the region are braided in their lower courses and have broad shallow valley profiles; in the upper reaches they are well entrenched with sharp, though not deep, valleys. The major streams rise in the stony ridges to the east on the adjoining Ranken and Mount Drummond Sheet areas. The main streams and the lakes are shown in Fig. 2.

Besides the internal drainage systems in the region, physiographic features are delineated by the division of the land forms into downs, "desert country" and timbered areas (Fig.2). A well-developed timberline enters the Alroy Sheet area from the east eight miles north of Wonarah Telegraph Station and with minor changes in direction strikes north-west to near Alroy Downs Homestead; from there it strikes

westward to Frewena Roadhouse on the Barkly Highway and thence north-westwards and northwards to Rockhampton Downs Homestead. From Rockhampton Downs it swings south-westward onto the adjoining Tennant Creek and Helen Springs Sheet areas, where it is yet to be examined. The continuation of this line to the east is strongly developed on the Ranken and Avon Downs Sheet areas (Randal & Brown, 1962 a & b). This line separates the mainly carbonate lithologies of the downs country to the north from the mainly timbered and scrubby areas of outcrop of shale, siltstone and chert (and some carbonates) of the Wonarah Beds and from the areas of Cainozoic travertine, red sandy soil and sand dunes (Plate 2). The area south of this line includes the Wonarah and Prentice Land systems of Stewart (in C.S.I.R.O., 1954).

Immediately south of the line and east of Frewena the country is moderately well timbered and scrubby, with strongly developed, though low, stony rises. Drainage is by very small gullies or local depressions. The timbers in this area are mainly box and bloodwood with minor shrubs and grasses. South of the Barkly Highway and north-west of Frewena, the country is gently undulating with the vegetation consisting mainly of snappy gum with some Acacia spp and mallee scrub, particularly in the south. In the central part of the southern area low sand-dunes trend with a north-west strike. The scrublands south of the Highway form part of a large semi-desert area which extends from near Georgina Downs north-westward to near Brunchilly and the Stuart Highway (Fig.1).

A second timbered area extends from the western margin of Lake Sylvester to Corella Lake, thence westwards to south of Tarrabool Lake which it adjoins. It broadly corresponds to the Drylake Land System within the Tertiary Lake Alluvia unit (Stewart, Stewart et al in C.S.I.R.O. 1954). Vegetation is typically coolibah with some Acacia spp and bluebush; associated with the bluebush are blue grass, Mitchell and Flinders grasses and minor occurrences of other grasses. The topography is generally flat, but the soils are broken and traversed by strong gilgais. The area occasionally is flooded, but usually the water accumulates in the swamp lakes on its margins (e.g. Sylvester, Corella, Tarrabool).

Areas of moderate timber cover occur between Corella Creek and Edwards Creek, and between Edwards Creek, Anthony Lagoon and Tarrabool Lake. Stony rises, lateritic and sandy soil and occasional black soil flats give the area the characteristics of both the Wonarah Land System (Stewart, 1954) and the downs country. Snappy gum and acacias predominate, with some coolibah trees and Mitchell grass. The areas are associated with heavily lateritised or leached rocks probably in the more sandy and silty parts of the Cambrian sequence.

Along the upper reaches of Creswell Creek outcrops of Upper Proterozoic sandstone and the sandy plains surrounding them are moderately timbered with snappy gum, silver box and bloodwood. Blue grass predominates over various species of Mitchell grass.

The downs country, which forms the remainder of the region, is best developed in the eastern part of the region, and also immediately north of Rockhampton Downs. It is essentially a grassland with various types of Mitchell grass dominant over Flinders and couch grasses, and blue grass. The topography is gently undulating with low gravelly rises supporting various species of eucalypts and acacias, which also occur along the main watercourses. The drainage is well developed and dendritic; however major watercourses are widely spaced due to the low run-off. The downs country is developed mainly on carbonate rocks of Cambrian and Tertiary ages.

Relief over the area is low; the highest point in the Alroy Sheet area, Mount Lamb, is 880 feet above sea level, and rises 80 feet above the general level of the downs country. The highest part of the downs country is between Kerringnew Swamp and Desert Creek on the Alroy Sheet area (between 800 and 825 feet above sea level). The ridges in the north-east of Brunette have an altitude of 880 feet. The lowest area is Lake Sylvester (630-660 feet above sea-level). The regional slope of the region is westward, with the main watercourses, (Playford River, Buchanan, Brunette, Boree and Creswell Creeks) flowing in a general westerly direction. However, on the western side of the lakes area the slope appears to be eastward, but is not well defined. The country to the south (Davenport Ranges), to the west (Tennant Creek and the Ashburton Ranges)

and to the north (Wallhallow area) is considerably higher than the general level of the downs country.

STRATIGRAPHY

In the Alroy and Brunette Downs Sheet areas, stratigraphic information is obtained with difficulty due to the paucity of outcrop and the lack of exposed contacts. Large areas are covered by black soil or sand, with "floaters" of dolomite, and by an extensive scree of chert pebbles and pisolitic ironstone gravel. There are over 200 water bores in the two Sheet areas but only a little over half of the logs have the driller's descriptions of rock types, but in the majority of the logs the driller's terms are too vague to be of any stratigraphic value. Logs of some value are shown on the bore maps (Plates 1 & 2). Chips from a few bores have been logged by geologists and three stratigraphic holes were put down in 1962 (Milligan, 1963).

It is difficult to define rock units because of the lack of stratigraphic information, consequently the Cambrian units are described by the informal term "Beds". Formations may be recognised if more detailed sub-surface information becomes available.

UNDIFFERENTIATED PROTEROZOIC

In the sections (Plates 3 and 4) undifferentiated Proterozoic rocks are shown underlying the Cambrian rocks. The Proterozoic rocks do not crop out and no sub-surface information on them is available; it is not known whether they are Upper or Lower Proterozoic. The Cambrian succession may be underlain by the Warramunga Group and the Ashburton Sandstone, (Noakes & Traves, 1954; Ivanac, 1954) in the west, by the Upper Proterozoic Mittiebah Sandstone in the north and north-east (Smith & Roberts, 1963; Plumb & Rhodes 1963), and by the Lower Proterozoic Hatches Creek Group in the south and south-west. (Smith et al 1961a). The depth to magnetic basement is about 800 feet near Wonarah Telegraph Station (Jewell, 1960), but its composition and age is unknown.

UPPER PROTEROZOIC

Mittiebah Sandstone

Medium-grained quartz sandstone crops out as low ridges in the north-east corner of the Brunette Downs Sheet area; it is similar to, and appears to be an extension of the Mittiebah Sandstone which crops out extensively to the east on the adjoining Mount Drummond Sheet area (Smith & Roberts, 1963). It is named after a Mittiebah Range on the Mount Drummond Sheet and ten miles north of Alexandria Homestead (Fig.1). The range is the type area for the formation; no type sections have been described but Smith & Roberts (1963) estimate an incomplete section of 9000 feet of quartz sandstone.

In the Brunette Downs Sheet area, the Mittiebah Sandstone crops out as low ridges north of Creswell Creek in the north-eastern corner of the area. The ridges, which are roughly aligned east-west, rise about 80 feet above the general level of the plains country from which they are separated by Creswell Creek, but they do not contain any outcrops on which reliable measurements can be taken. Surrounding these ridges, sandy soil and lateritic gravel support a growth of small shrubs and trees; red ant-hills are common and the area is locally referred to as "desert country".

The Mittiebah Sandstone on the Brunette Downs Sheet area is mainly a fine to medium grained quartz sandstone, in part ferruginous; pebble and boulder conglomerates occur as lenses. The rock is friable but in places is extensively silicified and recrystallised. Bedding ranges from medium to very thick; cross beds are numerous, ripple marks are rare.

These outcrops appear to dip at less than 5° to the south-south-west; the dip is inferred from photo-interpretation. The strike of the ridges is the same as in the Mittiebah Range. The Mittiebah Sandstone appears to be overlain unconformably by the Cambrian rocks in both the Mount Drummond and Brunette Downs Sheet areas. In the Mount Drummond Sheet area it conformably overlies the Mullera Formation of siltstone, sandstone and shale (Smith & Roberts, 1963); it is regarded as Upper Proterozoic because of its stratigraphic position.

TABLE 1.

TABLE OF MIDDLE CAMBRIAN UNITS ON THE BARKLY TABLELAND? NORTHERN TERRITORY

UNIT	AREA OF OUTCROP	REFERENCE	LITHOLOGY	FOSSIL ASSEMBLAGE	AGE	THICKNESS	RELATIONSHIPS
CAMOOWEAL DOLOMITE	Ranken, Avon Downs Sheet areas; also on the Camooweal and Mount Isa Sheet areas in Queensland.	Randal & Brown, 1962a, b, & c.	Crystalline and pellet dolomite, dolomitic limestone and quartz sandstone. Chert nodules lenses and stringers	No fossils have been found in site.	Cambrian	about 800 feet	Rocks which have been called Camooweal Dolomite have different relationships with Middle Cambrian rocks in different parts of the Georgina Basin (see Randal & Brown, 1962c). The Camooweal Dolomite in part interfingers with the Middle Cambrian Age Creek Formation in the Undilla Basin in North-western Queensland.
RANKEN LIMESTONE	Valley of the Ranken River on the Ranken and Avon Downs Sheet areas.	Öpik, 1957; Randal & Brown 1962a & b.	Fragmental and crystalline limestone with chert nodules and lenses. Silicified limestone.	Kootenia Asaphiscus Peronopsis Archaeocyathus Biconulites Hyolithes Helcionella Cymbionites Peridionites Eocystis Acrothele Lingulella Bohemiella(?) Nisuia(?) Asthenopsis Papyriaspis	Lower Middle Cambrian. However at one locality there is evidence of upper Middle Cambrian.	Unknown, but may exceed few hundred feet.	May intertongue with the Wonarah Beds to the west (Öpik, 1957). Appears to grade upward into fossiliferous dolomite which may be part of the Camooweal Dolomite (Randal & Brown, 1962a).
GUM RIDGE FORMATION	Eastern part of Tennant Creek Sheet area, western part of Frew River Sheet area. Associated outcrops occur at Banka Banka, 60 miles north of Tennant.	Ivanac, 1954. Smith et al, 1961b. Opik, 1957).	Fossiliferous limestone chert, siliceous shale and sandstone.	Xystridura browni (at base) Peronopsis cf. alkedraensis Pagetia cf. significans Chancelloria Eiffelia Biconulites Billingsella cf. humboldti Redlichia at Banka Banka: Xystridura sp.	Lower Middle Cambrian	Unknown, maximum exposed is 45 feet.	Probably equivalent to Wonarah Beds. Unconformably overlies Lower Cambrian Helen Springs Volcanics and Proterozoic Warramunga Group and Ashburton Sandstone in the Tennant Creek area. Unconformably overlies Lower Proterozoic Hatches Creek Group in the Frew River Sheet area.
BURTON BEDS	Crops out on the Mount Drummond and Ranken Sheet areas in the vicinity of Burton Creek and Alexandria Homestead.	Smith & Roberts, 1963; Randal & Brown 1962a. Previously referred to as "Alexandria beds" by Öpik (1957).	Fossiliferous limestone shale, silicified limestone and shale and chert.	Xystridura spp. Pagetia spp. Peronopsis spp. Lyriaspis lroyensis Biconulites Brachiopods	Lower Middle Cambrian	at least 300 feet.	Unconformably overlies Upper Proterozoic Mittichah Sandstone. Equivalent to and may be an actual extension of the Wonarah Beds.
WONARAH BEDS	Occur mainly on the Ranken and Alroy Sheet areas; extend on to the Avon Downs Sheet area, and may occur on the Frew River Sheet area.	Öpik, 1957 Randal & Brown, 1962a & b.	Fossiliferous siltstone chert, silicified shale and silicified oolitic limestone. Leached dololutite chert, limestone and dolomite.	Xystridura browni Xystridura spp. Pagetia significans Cryctocephalus Peronopsis spp. Helcionella Ptycheparids Brachiopods	Lower Middle Cambrian	at least 450 feet.	Contiguity of the Wonarah Beds with the Gum Ridge Formation in sub-surface and the Sandover Beds (Opik, 1957; Smith et al. 1961a) is possible but not proven.
ANTHONY LAGOON BEDS	Brunette Downs Sheet area and southern part of Wallhallow Sheet area.	Plumb & Rhodes, 1963.	Dolomite, dolomitic sponge and algal limestone, dolomitic limestone, quartz siltstone and sandstone chert and silty micaceous limestone.	Algae sponges (?) Trilobite remains and Echinodermata fragments.	Lower(?) Middle Cambrian	Probably at least 700 feet.	Relationships uncertain possibly overlies the Top Spring Limestone, and may be in part equivalent to the Burton Beds and Wonarah Beds.
TOP SPRINGS LIMESTONE	Northern part of the Wallhallow Sheet area.	Plumb & Rhodes, 1963.	Fine grey and black foetid limestone, coarse crystalline limestone and dolomitic limestone with chert nodules.	Redlichia cf. forreati	Lower Middle or upper Lower Cambrian.	Greater than 30 feet.	Overlies Lower Cambrian and Upper Proterozoic sediments. May be base of carbonate sequence on Barkly Tableland.

The thickness of the Mittiebah Sandstone in the Brunette Downs Sheet area is not known, but bores on Creswell Downs Station in the south-east of the Wallhallow Sheet area penetrate about 200 feet of "very hard sandstone" and "hard red sandstone." Chips from these bores have been examined and they are similar to the sandstone in the nearby outcrops.

CAMBRIAN

The Cambrian rocks cropping out in the Brunette Downs and Alroy Sheet areas are part of a widespread Cambrian sequence which covers most of the Barkly Tableland in both the Northern Territory and Queensland. Since 1948 the regional geology and palaeontology of this sequence has been studied by A.A. Öpik (Öpik, 1957), whose work is a necessary background to the study of the Cambrian rocks in the Alroy-Brunette Downs area. Of particular relevance are the Cambrian units on the adjoining Tennant Creek Sheet area (Ivanac, 1954), Ranken and Avon Downs Sheet areas (Randal & Brown 1962 a & b) and the Walhallow Sheet area (Plumb & Rhodes, 1963).

The distribution, lithologies and stratigraphic relationships of these units are given in Table 1. The position of the units in the Table does not necessarily imply superposition as some of these rocks may be in part lateral equivalents. Notes on a recent find of Cambrian fossils on the Wallhallow Sheet area are given in Appendix 1. Cambrian rocks on the Alroy and Brunette Downs Sheet areas have been divided into the Anthony Lagoon Beds and the Wonarah Beds. Undifferentiated Cambrian rocks occur in parts of the areas.

Anthony Lagoon Beds

The Anthony Lagoon Beds crop out in the central and northern parts of the Brunette Downs Sheet area and extend northwards onto the Wallhallow Sheet area. The rocks are an essentially carbonate sequence with sandstone and siltstone interbeds; dolomite, dolomitic limestone, algal dolomite, leached carbonate and sandstones attain a thickness of several hundred feet.

These rocks form part of the Middle Cambrian sequence of the Barkly Tableland and probably overlie the Top Springs Limestone to the north.

Figure 3: Anthony Lagoon Beds: scattered boulders and blocks of dolomitic limestones. Near Brunette Downs Bore D19. Neg./G5452.

The name Anthony Lagoon Beds was used by Plumb and Rhodes (1963) to describe carbonates, sandstone, chert and silicified limestone cropping out in the vicinity of Anthony Lagoon Homestead and Creswell Downs Homestead on the Wallhallow Sheet area. They extend onto the Brunette Downs Sheet area and are continuous with, and similar to, Cambrian outcrops in the central part of the Brunette Downs Sheet area. These rocks were presumably included in the Barkly Group (Noakes and Traves, 1954) which name however is not valid in the terms of the Australian Code of Stratigraphic Nomenclature, and has been discontinued.

In the vicinity of Corella Lake to the west of Brunette Downs Homestead the rocks consist of blocky boulders and slabs scattered in the grassy black soil downs (Fig.3). The rocks occur similarly in the north-west of the area but, in addition, sandstone and leached carbonates form low well defined ridges with a strong scrub and timber cover. In the central part of the area, in the vicinity of Corella and Edwards Creeks the lateritized rocks form low scrub covered rises. Drillers' logs from water bores suggest that much of the black soil of the downs overlies the Anthony Lagoon Beds and is a weathering product of it. The area is covered by chert and scree, derived from silicified coquinites and oolites and from chert nodules within the carbonates.

The rocks of the Anthony Lagoon Beds are extremely varied, but the bulk of the sequence appears from surface exposures to be made up of carbonates; drillers' logs suggest mainly carbonate rocks at depth, but also indicate more siltstone and sandstone than is obvious on the surface. Common rock types are dolomite, dolomitic sponge and algal limestone, dolomitic calcarenites and calcilutites, and quartz siltstone and sandstone. Rock chips from bore drains contain micaceous silty carbonates. Many of the occurrences form rises of chert rubble derived from silicified carbonate rocks. Both the chert and the unaltered carbonate rocks are in part fragmental and oolitic. The colours of the carbonate rocks are dark grey, grey, buff, cream and brown; two tone dolomite is common. Chert nodules are rare. The fragmental rocks are similar to the Ranken Limestone, but no identifiable fossils have been found; algal and sponge (?) remains are present in the dolomitic limestones

Figure 4: Anthony Lagoon Beds. Styolites in massive block of limestone. One mile north-west of Brunette Downs Corella No.2 Bore. Neg./G5450.

south of Anthony Lagoon Homestead (Bt 330) and west of Brunette Downs Homestead (BT 316). Fragments of trilobites and echinodermata(?) have been seen in thin sections of these rocks. Cross sections of trilobites were found in land specimens collected near Edwards Creek on the Barkly Stock Route. Bedding is variable; stylolites are commonly present (Fig.4).

Grey, tan and red-brown quartz sandstone are associated with the carbonate rocks of the Anthony Lagoon Beds both on the surface and in chips from water bores. The sandstones are often flaggy and occasionally are ripple-marked. The quartz grains are variable in size but generally the rocks are fine to medium-grained. Surface silicification is common but chip samples from bores are extremely friable. Some of the sandstones are original, but others are probably leached carbonates which contained quartz. At locality BT326 (eastern side of Tarrabool Lake) a coarse red-brown sandstone overlies leached carbonate rocks and contains organic(?) structures. These structures consist of saucer-like layers 8 cms. in diameter and 0.5 cms thick arranged in adjacent columns. The dimensions of the grouped columns are variable but the maximum observed dimensions are 30 x 15 x 23 cms. The nature of these organisms and the petrology of the Anthony Lagoon Beds are discussed in detail in Nichols (1963).

The carbonate rocks of the Anthony Lagoon Beds show the marked leaching effects seen in carbonate rocks elsewhere on the Barkly (Condon, 1961; Randal & Brown 1962a and b). This, with the extensive lateritisation of the siltstone and sandstone portions of the sequence, hinders an appraisal of the sub-surface lithology, and the differentiation in outcrop between parts of the Cambrian sequence and possible marine Mesozoic rocks. This latter problem particularly arises north of the Barkly Stock Route between Edwards and Corella Creeks, where a strongly developed rise consists of a heavily-lateritised siltstone which is similar to both marine Mesozoic and Cambrian rocks elsewhere in the Northern Territory and Queensland. However, in the absence of definite information about its age, the outcrop is regarded as lateritised Cambrian.

Because of both the poor nature of the outcrops and the extreme superficial cover it has not been possible to evaluate the structure and thickness of the Anthony Lagoon Beds. Minor structural trends in these Beds and the regional structure of the Cambrian sequence are discussed elsewhere in this report (p.23). The maximum known thickness of the Anthony Lagoon Beds is from Brunette Bore K5* where the driller's log describes 707 feet of limestone. It has not been possible to ascertain any dip values from a correlation of the lithological variations as reported by drillers, however it is hoped that future bores in this area will be geologically logged, thereby providing more accurate information on lithological variations. This knowledge may allow the determination of dip values based on correlation of lithological intervals.

Because of the lack of diagnostic fossils the exact stratigraphic relationship of the Anthony Lagoon Beds with other Cambrian rocks is indefinite. However, it is probable that these beds are in part at least a correlate of the lower Middle Cambrian Burton Beds which crop out in the Ranken Sheet area and the Wonarah Beds which crop out in the Alroy Sheet area. They probably overlie the Top Springs Limestone which crops out in the Wallhallow Sheet area.

The environment of the Anthony Lagoon Beds seems to have been shallow water with medium current activity. Shallow lagoonal conditions favoured the growth of algae and sponge-like organisms while more open shelf conditions favoured the accumulation of intraclastic and pelletal limestones. Sandstones and siltstones probably formed nearer land, the former under current action, and the latter in a quiet and restricted area. The environment of these rocks is discussed in detail in Nichols (1963).

Wonarah Beds

In the south-eastern part of the Alroy Sheet area, the Wonarah Beds form low hills covered by a loose scree of fossiliferous chert, siliceous shale and limestone. These fossiliferous rocks may be continuous with Middle Cambrian rocks elsewhere on the Barkly Tableland; they are deeply lateritised, with a lateritic capping up to thirty feet thick. The thickness of the Wonarah Beds is probably

* This bore, though important because of its depth, is not shown on Plate 2 because the driller's log does not show any lithological variations, whereas logs for bores in its immediate vicinity do show interesting changes.

several hundred feet.

Öpik (1957) used the name Wonarah Beds to describe outcrops of Cambrian rocks along the Barkly Highway, west of Soudan Homestead. These rocks were included in the Alroy Downs Beds (David, 1932) and subsequently in the Barkly Group (Noakes & Traves, 1954). The sequence was named after Wonarah Telephone Repeater Station (long. 136°20'E; lat. 19°54'S.) on the Barkly Highway.

The Wonarah Beds crop out between the Barkly Highway and the South Barkly Stock Route in the south-eastern part of the Alroy Sheet area. They extend onto the adjoining Ranken, Avon Downs and Frew River Sheet areas, but are not known on the Brunette Downs Sheet area. They may extend westward under the cover of travertine and sand in the central western and southern part of the Alroy Sheet area; outcrops have been photo-interpreted in the western part of the area. The Wonarah Beds usually occur as low rubble-covered hills or small mounds of chert gravel in the black soil areas along the South Barkly Stock Route. Öpik (pers. comm.) considers that fossiliferous limestone rocks from the well at No.4 Bore Alroy are in sequence with the Wonarah Beds on Mt.Lamb to the south; they are regarded as part of the Wonarah Beds which were protected from the extensive lateritisation and leaching which is common in outcrops of the unit.

The Wonarah Beds consist of fossiliferous siltstone, chert, silicified shale and silicified oolitic limestone. Condon (1961) reports leached dololutite and chert replacing dolomite. Chips of fossiliferous blue-grey silty limestone have been recovered from bore drains in the area. Milligan (1963) records calcareous siltstone, calcareous sandstone and limestone with chert bands and nodules from B.M.R. Core hole No.Grg 17 near Frewena. From B.M.R. Core hole Nos. Grg15 and 15A, 17 miles north-north-west of Wonarah, he records calcarenite, coquinite, siltstone, ferruginous sandstone and chert bands to 200 feet. No further recovery was obtained from Grg15A until 248 ft from which depth brown grey fossiliferous crystalline limestone continued to the final depth of 270 ft. There was no recovery from Grg 15 between the interval 200 ft and 304 ft, but between 304 ft and the final depth of 310 feet, the drill penetrated crystalline dolomite with fossiliferous chert lenses. Bedding is thin to medium; laminate bedding is common and convolute bedding is reported from B.M.R. Core hole No.Grg17. Outcrops of the Wonarah Beds are intensely lateritised, leached and

silicified; the hard siliceous capping on the outcrops has prevented a more complete erosion of the hills (Randal & Brown, 1962a & b).

The structure of the Wonarah Beds is not evident from field mapping because of the rubbly nature of the outcrops; dips in varying directions have been photo-interpreted. The relationship between the Wonarah Beds and the Anthony Lagoon Beds to the north is not certain, but from the nature of the lithologies it is probable that they are in part at least, contemporaneous. Their stratigraphic relationship with other Cambrian rocks is evaluated from the fossil assemblages.

Fossil localities in the Wonarah Beds are numerous; virtually any occurrence of scattered chert scree will yield fragments of trilobites, brachiopods and biconulites. The two most prolific occurrences in the Alroy Sheet area are AL7 (Mt. Lamb) and AL100, 14 miles east of Wonarah on the Barkly Highway. Öpik (1957) lists the fauna from the Wonarah Beds as "'Xystridura' browni, X. aff. browni, Xystridura, Pagetia significans, Oryctocephalus, several species of Peronopsis, three genera of ptychoparids, brachiopods and Helcionella. No Queensland species occur, but the Alexandria fauna is well represented". At Alroy No. 4 Bore, six miles north of Mt. Lamb, spoil from an old well consists of fossiliferous grey and dark grey foetid nodular limestones. Öpik (pers. comm.) considers that the beds from which these rocks were taken are in sequence with the outcrops on Mt. Lamb. The rocks are similar to fossiliferous limestone in the Alexandria area. These occurrences and the occurrence of scattered fossiliferous scree along the road between Alroy and Alexandria, together with the similar fossil assemblages are strong evidence for the contiguity of the Wonarah Beds and the Burton Beds, which Öpik (1957) suggests is a possibility. Contiguity of the Wonarah Beds with the Sandover Beds and the Gum Ridge Formation is probable but is not proven. The age of the Wonarah Beds is lower Middle Cambrian.

The thickness of the Wonarah Beds is not known but is several hundred feet at least; B.M.R. Core Hole No. Grg17 penetrated 310 feet of fossiliferous rocks and bore 8A Alroy, passed through 450 feet of fossiliferous calcareous rocks. It is not known if these rocks are all lower Middle Cambrian as the fossil determinations are yet to be completed.

Figure 5: Girvanella(?) in undifferentiated Cambrian rocks, Alroy Downs No.1 Bore. Neg./G5456.

Jewell (1960) reports the depth to magnetic basement near Wonarah as 800 feet, but it is not known if any non-magnetic Proterozoic or Lower Cambrian rocks are present in the sub-surface.

Undifferentiated Cambrian

On the Alroy and Brunette Downs Sheet areas, scattered chert scree and white crystalline dolomite which bear little resemblance to the other units in their vicinity have been shown as undifferentiated Cambrian. Undifferentiated Cambrian is shown in the section in the eastern part of the Brunette 1:250,000 Sheet area; information on these sub-surface Cambrian rocks is obtained from drillers' logs from some water bores, and the examination of chip samples from others. The Cambrian rocks in this part of the area are mainly white crystalline and pellet dolomite with plentiful chert bands and nodules and minor sandstone bands. One driller's log records "volcanics" but this may be hard red sandstone. These rocks are not very similar to the Anthony Lagoon Beds, which contain a high percentage of micaceous silty limestone in bore chips. At Alroy Bore No.1 a yellow-brown dolomitic limestone boulder contains Girvanella (Fig. 5).

MESOZOIC

Undifferentiated

Brown-grey fine-grained quartz sandstone crops out in the Brunette Downs Sheet area near its northern boundary. The rocks occur at a single locality as scattered boulders, and contain plant remains which indicate a Lower Cretaceous age (M.E. White, per. comm.).

The occurrence is 7 miles south-east of Creswell Downs Homestead and 2.3 miles north-west of Bore No.5 Creswell on the Creswell Downs - Brunette Downs road. The outcrop consists of scattered blocks and boulders in grass-covered black soil downs.

The rock is a brown-grey fine-grained silicified quartz sandstone with a mottled appearance; plant remains are common. It is composed of detrital quartz grains of uniform grain size (about 0.08 mm.); a few larger quartz grains (0.5mm.) are scattered throughout the rock. Both

sets of grains are angular or sub-angular, a few are rounded. Cementation is by the growth of authigenic quartz around individual grains; the matrix is limonite. No internal plant structures were found in thin section.

A large collection of plant material was obtained from this locality; on the map it is shown as BT60, but the Mesozoic survey locality if TT 63. The flora have been examined by M.E. White who lists the following forms (the numbers are the museum references).

F22309: Ptilophyllum pecten (Phil.)
Brachyphyllum
Pagiophyllum
} - Conifer stems

F22310: Pterophyllum fissum Feist.
F22311: Thinnfeldia pinnata Walk.
F22312: Otozamites bechei Brong.
F22313: Pterophyllum fissum Feist.
F22314: Pterophyllum fissum Feist.
? Otozamites bengalensis (Morr.).
F22315: Otozamites bengalensis (Morr.).
F22316: Taeniopteris spatulata McClell
F22317: Pterophyllum fissum Feist.
F22318: Ptilophyllum pecten. (Phil.)
F22319: Pterophyllum fissum Feist.
F22320: Otozamites bengalensis (Morr.)

Noakes and Traves collected from this locality during the Barkly Survey (C.S.I.R.O. 1954); their collection was examined by R.O. Brunnschweiler (1950) who listed Ptilophyllum sp. nov, Cycadites sp. ind., and Elatocladus cf. planus and gave the age as Lower Cretaceous. M.E. White (file note) discusses the age of the recent collection in the following way: "All the plant species present in these specimens were identified in the 1960 and 1961 collections of Mesozoic plants from the Northern Territory. The previous collections were from beds dated by marine faunas as Lower Cretaceous. The age of the present collection is probably the same, but it must be emphasised that the range of the Otazamites-Pterophyllum etc. flora is not known. The flora probably originated in Jurassic times and may persist beyond Lower Cretaceous."

It is hardly possible to evaluate the environment of these rocks from a single locality. It must be examined in the light of information obtained by Skwarko (1963) on Mesozoic rocks in adjoining areas.

CAINOZOIC

Brunette Limestone

Tertiary limestone occurs as a veneer on the Cambrian carbonate sequence in the eastern and western parts of the Brunette Downs Sheet area, and the northern parts of the Alroy Sheet area. The limestone, which is 60 feet thick in places, is lithologically similar to the Austral Downs Limestone on the Avon Downs Sheet area (Randal and Brown 1962b). The rocks were previously believed to be lacustrine in origin but a recent find of marine Tertiary fossils in rocks which may be in sequence with the Brunette Limestone is of considerable interest.

Noakes and Traves (1954) used Brunette Limestone to describe a white nodular limestone which crops out near Brunette Downs, Alroy Downs and Rockhampton Downs. They describe no type sections but list the outcrops at Crow's Nest Bore and Bore 9 Alroy as the best exposures.

The Brunette Limestone crops out along Brunette, Mittiebah and Boree Creeks in the south-west of the Brunette Downs Sheet area; it occurs extensively in the western part of the Sheet area between Rockhampton Downs and the eastern side of Tarrabool Lake, and isolated outcrops around the lower part of Corella Creek. In the Alroy Sheet area the Brunette Limestone extends from Kennedy Creek in the north-east to 10 miles south of Lake Sylvester, thence northwards along the western margin of the Lake, to link the western and eastern outcrops on the Brunette Downs Sheet.

The Brunette Limestone occurs as scattered blocks and boulders in the black soil, particularly in minor topographic depressions; however, it should be noted that while the internal drainage system is ringed by Tertiary rocks, no Tertiary rocks have been recorded in the low-lying areas of the main lakes themselves.

The unit is a white to brown fine-grained to coarsely crystalline limestone and dolomite. The rock is siliceous, containing chert and opaline nodules and smears; it is frequently nodular or skeletal in appearance.

Figure 6: Brunette Limestone. About 45 feet of medium and massive bedded siliceous limestone exposed in a sinkhole, An additional 15 feet is exposed on surrounding rises. Point PT84 on Mittiobah Creek.
Neg./G5445.

Figure 7: Brunette Limestone. The boulder below the hammer is Cambrian dolomite. To the left of the hammer head and on the edge of the photo, angular fragments of Cambrian dolomite are included in the siliceous nodular limestone. Point BT84. Neg./G5449.

Boulders of sandstone and siltstone found on the surface probably are in the sequence and some sandy limestones are known. At locality BT167 (Bore 18 Rockhampton Downs) the limestone is algal. Siliceous pelletal calcilutites occur at this and other localities; the silica is present as micro- and crypto-crystalline silica, amorphous silica, fibrous chalcedony and drusy quartz. Some of the silica may be replacing organic remains (Nichols, 1963). At locality BT169 (2 miles north-east of Bore 18 Rockhampton Downs) a conglomeratic shelly limestone (almost a coquinite) occurs on the surface with rocks of the Brunette Limestone but it is not certain if the two are in sequence. The rock is friable and contains many gastropod and pelecypod shells set in a matrix of micro- and crypto-crystalline calcite. Quartz grains and angular chert fragments are present. In addition to the shelly fossils, forams and ostracods have been found in this sample. The significance of the fossils is discussed later.

Bedding is poorly developed in the Brunette Limestone; the few solid outcrops are rounded and irregularly jointed. At locality BT48 on Mittiebah Creek 60 feet of medium and massive bedded nodular limestone is exposed in a sinkhole and on the low rises surrounding it (Fig.6). The beds contain sub-angular fragments of brown and white crystalline dolomite - presumably from the Cambrian carbonate sequence (Fig.7).

The Brunette Limestone is probably a thin deposit unconformably laid down on the Lower Palaeozoic rocks. It is similar to the Austral Downs Limestone (Noakes, 1951). Noakes and Traves (1954) considered both these units were laid down contemporaneously with the lateritisation of the older rocks and that the leaching of silica and lime from these rocks provided the source for the younger siliceous limestones. The limestone has been previously regarded as a lacustrine deposit, but the fossils found at locality BT.169 indicate some marine influence.

Lloyd (1963) has examined the fossil collection and considers the pelecypods are more probably marine forms than freshwater ones. The sample contains gastropods some of which are similar to the freshwater form Planorbina, but several specimens are similar to the marine forms Lanistes and Diastoma. Lloyd also records numerous specimens of the foram Ammonia beccarii (Linne) and a single ostracod.

Consequently there has been some marine influence during the deposition of this fossiliferous limestone. Its exact relationship with the surrounding siliceous limestone is not certain, but there are no apparent reasons to prevent its being in sequence. Lloyd (1963) considers the age as "not older than Middle Miocene and possibly not younger than Pliocene", whereas Noakes (1951) places the siliceous limestone in the Miocene, and Paten (1961) places it as late Tertiary.

A probable explanation of the environment is that a brief marine transgression occurred during the deposition of siliceous carbonates under essentially lacustrine conditions, with the consequent development of local lagoonal or estuarine conditions. However, as this is the only known locality for marine fossils in this area it would be premature to speculate on its environment until further localities are found and the fauna examined. Paten (1961) has inferred brackish water conditions for the Austral Downs Limestone south of Urandangi.

Travertine

Outcrops of travertine are widespread in the central part of the Alroy Sheet area between Dalmore Downs Homestead, Alroy Downs Homestead and Frewena Roadhouse. A large expanse of travertine or travertine and sand has been photo-interpreted in the south-west part of the Alroy Sheet area. Isolated outcrops of travertine occur in the vicinity of Tarrabool Lake and Lake Sylvester in the Brunette Downs Sheet area. Both Stewart, and Noakes and Traves (in C.S.I.R.O. 1954) considered this travertine as aeolian loess, being wind blown material from the Tertiary Lake Limestone (i.e. the Brunette Limestone) which was being deposited to the north.

The travertine is in part opaline and siliceous like the Brunette Limestone; however, it contains more detrital quartz and is not so cohesive. Despite this it forms well-developed but low scrubby and stony rises in contrast to the usual grassy flat plains associated with the Brunette Limestone. The thickness of the travertine is not known but exceeds fifteen feet.

Superficial deposits

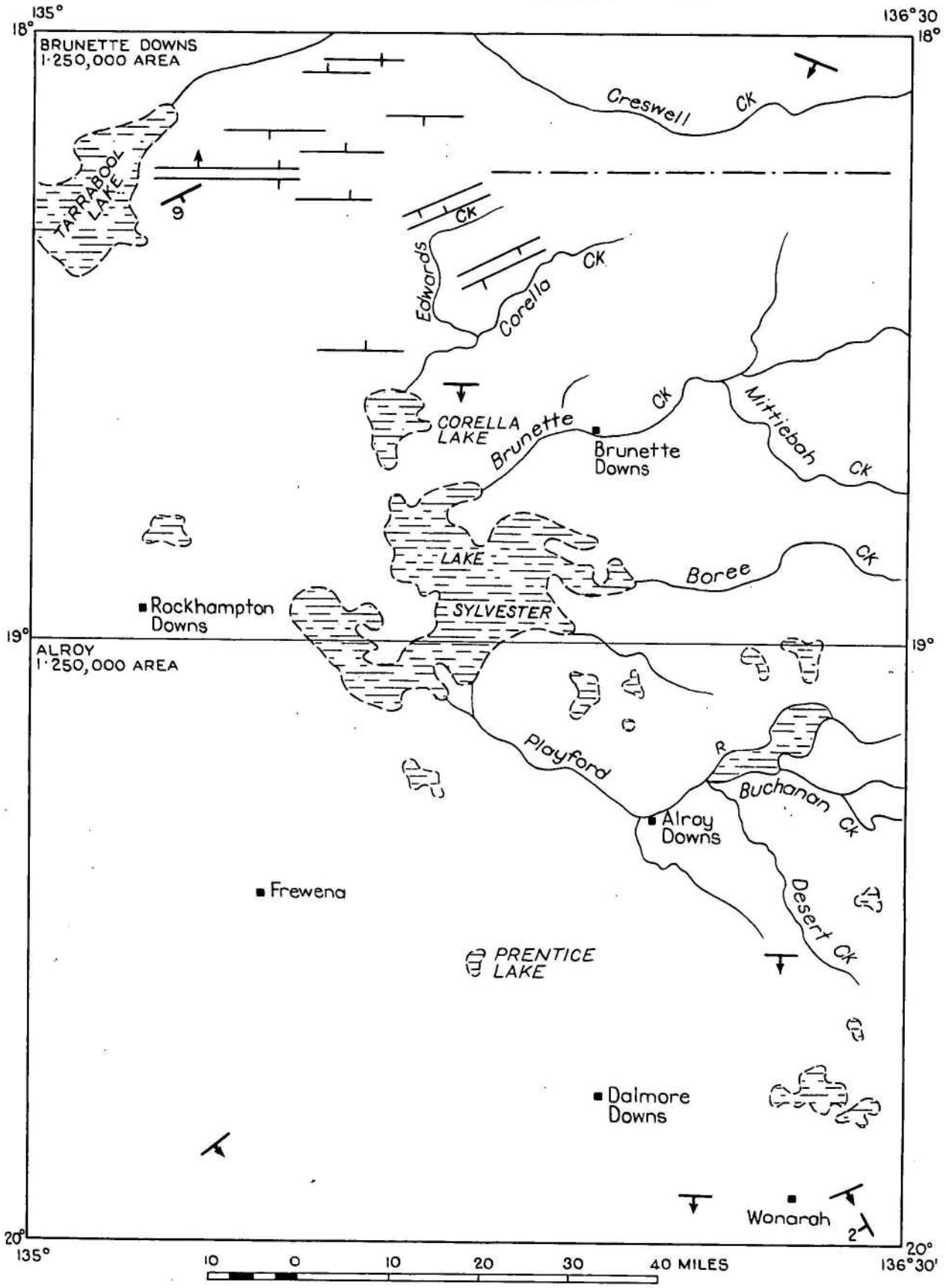
Unconsolidated Cainozoic deposits are widespread over the Alroy and Brunette Downs Sheet areas; they consist of black and grey clayey soils, alluvium, sand and sandy soils, river gravels, and residual (?) gravelly rises of chert and ironstone pebbles.

The grassy downs country in the area is underlain by black and grey pedocalcic soils, moderately to weakly leached and with carbonate and gypsum horizons. Stewart (in C.S.I.R.O., 1954) considers the areas now occupied by these soils were swamp-lands during the Tertiary lateritic cycle with the water table at or above their surface. These soils overlie the carbonate rocks of the Cambrian sequence and the Tertiary Brunette Limestone; they are of mixed origin, partly residual on the carbonate rocks and partly from material deposited in the Tertiary swamp. Chert gravel is widespread and may be residual from chert nodules and bands in the underlying carbonate rocks. Rises of pisolitic ironstone gravel are presumably remnants of lateritic horizons, but in places are detrital laterites derived from re-working of the lateritised material.

Deposits of detrital laterite are extensive along the Barkly Highway where they are 3-4 feet. The deposits are well sorted but to the west they become coarser and contain much chert rubble; they quickly thin to the west. These deposits appear to have been derived from the stripping of a laterite profile and the transportation of the lateritic material from west to east.

Sand and sandy soils occur in the southern parts of the Alroy Sheet area and the western part of the Brunette Downs Sheet area. The term "sandy soils" is mainly a textural description; quartz sand is often subordinate but gives the soil a sandy or ashy texture which is distinct from the clayey nature of the black pedocalcic soils. This is particularly so in the timbered area west of Lake Sylvester where grey pedocalcic soils have a texture and vegetation more in common with the sandy areas than with the grassy downs country. The soils shown on the map as sand and sandy soils are termed by Stewart (in C.S.I.R.O., 1954) red desert alluvial soils, calcareous desert soils, lateritic red sand and lateritic red earths.

STRUCTURAL SKETCH MAP OF ALROY & BRUNETTE DOWNS AREA



REFERENCE

- Strike and dip of strata (measured)
- Strike and dip of strata (photo interpreted)
- Low linear rise with direction of shallow slope
- Trend of divide

Stream alluvia is made up of transported gravels and re-worked clayey and sandy soils. The fine textured alluvia in the swamps of the Internal Drainage Basin also are derived from clayey black soils.

STRUCTURE

The structure in this region is difficult to work out because of the poor outcrops, the lack of exposed contacts and the indefinite terminology contained in drillers' logs. Very few outcrops have well-defined dip and strike directions; a few dip directions have been photo-interpreted (Fig.8) but often these cannot be verified on the ground. Nowhere have the various units been seen in contact or in definite superposition and it has not been possible to use the variations in lithology as reported by drillers, not only because of vagueness of terms, but because of the possibility of lateral variation. However, it is hoped that future water bores will be logged by geologists and the information so obtained may prove useful for both stratigraphic and structural purposes. Recommendation for a magnetometer survey and stratigraphic drilling is discussed later (p. 27).

In addition to the dips shown on the structural map, a number of geomorphological trend lines are known; these may have some structural significance. These features, which consist of low rubble-covered linear rises having one slope steeper than the other may be remnants of original strike scarps and dip slopes in the Cambrian sequence. These features occur mainly in the Anthony Lagoon Beds on the Brunette Downs Sheet area, but similar features are known in Cambrian rocks west of Frewena. West of Tarrabool Lake and immediately north of Corella Lake these ridges strike east-west, which is also the trend of the divide between Creswell Creek and the streams draining into Lake Sylvester and Corella Lake . This trend also occurs along the northern edge of the Barkly Tableland north of Lily Creek on the Wallhallow Sheet (Plumb & Rhodes, 1963).

North-west of Corella Lake, the ridges strike south-west and this also is the direction of flow of Corella Creek, the upper reaches of Edwards Creek, Brunette Creek and part of the Playford River. The contours of both

the standing water levels in the water bores and the depths to aquifers also reflect these trends (Randal, 1963b) and may indicate the presence of minor folds in the Cambrian sequence.

The regional structure of this area must be considered with respect to the adjoining areas. Upper Proterozoic rocks in the north of the Brunette Downs Sheet area and on the Mt. Drummond and Ranken Sheet areas dip south and south-west and in some parts form the basement for the Cambrian sequence. On the Tennant Creek and Helen Springs Sheet areas, Middle Cambrian sediments dip eastward off the Precambrian Ashburton Sandstone and Warramunga Group. It appears that the Cambrian rocks have been deposited in depressions in the Precambrian land surface. Some sediments probably were draped over basement highs; on the Ranken Sheet area the thickness of the Cambrian rocks varies between 120 ft and 1750 ft (Randal & Brown 1962a).

In the Bureau of Mineral Resources Report 41A the area occupied by the Alroy, Brunette Downs and Wallhallow Sheets was included in the "Barkly Basin", which is shown as the link between the Georgina Basin and the Daly River Basin, although the connection of the "Barkly Basin" with the Daly River Basin is obscured by Mesozoic and Cainozoic cover. The stratigraphic sequence in the "Barkly Basin" is equivalent in time to only a part of that in the Georgina Basin. Also, the Georgina Basin probably contains three to four times the total thickness of sediment as the Barkly Basin. A minor structural demarcation between the two basins is possible but it is not proven. A possible position of a zone of demarcation is along a line trending south-west from near Alexandria to near Wonarah and thence onto the Frew River Sheet. Proterozoic rocks which form the margins of the Georgina Basin project into the basin and occur as inliers at each end of this zone. The position of this possible zone is reflected by the physiography and by a number of hydrological parameters. The northern part of this zone forms the divide between the streams of the Internal Drainage Basin and those of the Georgina River Basin. For most of its length it corresponds to a "pressure ridge" on the piezometric surface of the underground water of the Barkly Tableland; this "pressure ridge" separates two directions of underground water flow which broadly correspond

to the physiography. Along this line there are also changes in depth to aquifers and in the chemical characteristics of the water (Randal, 1963b). However, these features may be coincidental and until drilling and geophysical work provide more accurate work the concept of a basement high in this zone must be regarded as an unsubstantiated hypothesis. At present the Cambrian rocks of this region are considered to be part of the Georgina Basin.

GEOLOGICAL HISTORY

The geological history of the Alroy and Brunette Downs Sheet areas can only be given in a broad outline. Details are either obscured or impossible to connect because of the lack of available information.

During Proterozoic time extensive sedimentation occurred to the west, north and east of these areas, with the deposition of the Warramunga Group, Ashburton Sandstone and the rocks of the Carpentaria Upper Proterozoic Province. Presumably the Proterozoic sedimentation extended onto the Brunette Downs and Alroy Sheet areas but the rocks are now covered by the Cambrian sediments. After the folding of the Proterozoic rocks, which form the basement for the Cambrian, the area was transgressed by early Middle Cambrian seas, with rises forming islands in the initial stages. The presence of islands permitted the development of shore-line facies in widespread parts of the area. The Cambrian sediments were deposited in depressions in the basement surface; on the Ranken Sheet area to the east sediments were presumably draped over basement highs (Randal & Brown 1962a).

There is very little remaining evidence of the geological history of these two Sheet areas between the deposition of the Cambrian sediments and the deposition of the Mesozoic sediments. It is not known if any sediments were deposited and subsequently completely eroded during this interval. However, Skwarko (1963) records "Cambrian cherts" in the Mesozoic rocks. It is probable that the Cambrian rocks were raised and partly eroded before submergence of the region in the Lower Cretaceous. During the Lower Cretaceous freshwater sediments were deposited and to the north similar sediments are interbedded with marine sediments (Skwarko, 1963).

Gentle folding or warping proceeded during the Late Mesozoic or Tertiary with the development of freshwater lakes between divides of some elevation. Probably in the Late Tertiary, lateritisation proceeded on the higher ground and silica and lime leached from the older rocks were deposited in the lakes and submerged river valleys. A brief marine transgression of unknown extent occurred in this area in the Miocene. The pre-laterite land form is still reflected in the present-day topography of the Barkly Tableland. It has to some extent been modified by the partial stripping of the laterite to the west and its redeposition as detrital laterite further eastward. Slight rejuvenation of the streams has produced the present cycle of erosion.

ECONOMIC GEOLOGY

Petroleum Prospects

Until the surface mapping of this region is supplemented by adequate subsurface investigations, no reliable assessment of petroleum prospects can be made. Additional surface mapping is not likely to resolve the structural and stratigraphic problems of the Cambrian succession.

The thickness of the Cambrian rocks is of prime importance. Alexandria No. 1 Bore in the Ranken Sheet area passed through 1760 feet of carbonate rocks and bottomed presumably in the Mittiebah Sandstone; however in the Alroy/Brunette/Downs area no bores penetrate the full thickness of the Cambrian sediments. Brunette Bore K5 passed through 700 feet of carbonate rocks, presumably Anthony Lagoon Beds, and bores in the Wonarah Beds (8A Alroy) indicate at least 450 feet of Cambrian section. The depth to magnetic basement near Wonarah is 800 feet (Jewell 1960), but it is not known if this includes non-magnetic Proterozoic or Lower Cambrian rocks.

Fossiliferous marine Cambrian rocks are known in the area. The carbonate rocks could form reservoirs for oil or gas; the large quantity of sub-artesian water produced from these rocks is proof of their porosity but also of their transmissibility which may have permitted the escape of any accumulations. On the other hand, of the numerous bores in

these Sheet areas only Brunette No. 23 recorded oil slicks, but few have penetrated more than half of the probable section. Fine-grained and compact carbonates are known in outcrop and have been reported in drillers' logs; these may act as cap rocks for possible reservoir beds. However, the structure and lithological sequence of these potential source, reservoir, and cap rocks are not well known.

The main stratigraphic problems are the inter-relationships between the Gum Ridge Formation, the Wonarah Beds, the Anthony Lagoon Beds and the undifferentiated Cambrian rocks. These problems may be clarified by shallow core-holes between the areas of outcrop of the units.

It is probable that the Cambrian sediments have been laid down in shallow basin-like depressions in the surface of the Proterozoic rocks, but the nature and extent of these depressions are not known. No definite information is available about structures within the Cambrian sequence itself. Wherever Cambrian outcrops are seen, they have shallow dips; any petroleum accumulations are probably controlled more by stratigraphic and hydrodynamic conditions than by structural traps. However, a knowledge of the Cambrian structure is necessary to evaluate the stratigraphy of this region.

Probably the magnetometer is the best geophysical tool to use at this stage. The disadvantage of gravity methods is that in many areas the density of the sediment (dolomite) is greater than that of the underlying basement (presumably sandstone and schist); however, gravity would give the trend of basement features. Seismic work is difficult to carry out successfully in an area of mainly carbonate rocks and a great deal of costly experimentation will probably be necessary before useable results are obtained.

Although a magnetic survey is probably the best and most economical method, the effect of Proterozoic sediments on the calculations to the depth of magnetic basement is a problem. The magnetic properties of these rocks are not completely known, neither is their sub-surface distribution. It will therefore be necessary to carry out readings over the Upper Proterozoic Mittiebah sandstone in the north-east. Magnetic basement crops out at Tennant Creek in the west and at Thorntonia, east of

the Undilla Basin, but whether these magnetic rocks extend under the Barkly Tableland is not known. If the Mittiebah Sandstone shows some magnetic effects, then the interpretation of "basement" as far as oil search is concerned may be easier.

Stratigraphic drilling should be tried before any gravity or seismic work is undertaken, and three sites for drilling are suggested at this stage, on the understanding that they may be better positioned if magnetometer results indicate better positions for them.

i. Near bore K5 Brunette to examine the 700 plus feet of probable Cambrian rocks in an attempt to erect a lithological sequence and to determine basement.

ii. North of Creswell to ascertain if the Top Springs Limestone and other Cambrian rocks are present at depth beneath the Mesozoic cover, and also to determine their thickness.

iii. In the vicinity of Wonarah (eastward of it) to ascertain what constitutes the magnetic basement at about 800 ft.

Water Resources

Surface water resources in the Alroy and Brunette Downs area are inadequate for the present level of cattle stocking. The rainfall is adequate to provide plenty of good quality grasses, but none of the watercourses are perennial and few waterholes are permanent because of the low rainfall, the shallow valley profiles and the high evaporation. Consequently, the cattle industry is dependent on the availability of underground water.

In these Sheet areas nearly 240 bores have been drilled; less than 10% have been abandoned. Only two dry holes are known; the others have been abandoned for reasons of poor supply, poor quality or mechanical breakdown (including silting). Some of the bores are temporarily shut-down depending on stock distribution and many of the recently drilled bores on Brunette Downs Station are yet to be equipped.

The underground water is sub-artesian; it comes from aquifers between 10 and 600 feet above sea-level and has a potentiometric surface ranging between 500 and 650 feet above sea level (Randal, 1963b). The nature of the aquifers is not properly understood, but in some areas at

least the depth to water is controlled by the incidence and size of fractures and cavities. Supplies are usually adequate and most bores yield 1500 to 2500 g.p.h.; often the production is limited by the capabilities of the present pumping equipment, but pastoralists regard most supplies as "unlimited". A study of the distribution and production from the bores and of probable recharge areas indicates that underground water reserves in the area are adequate for a higher rate of exploitation if quantity rather than quality is of prime importance (Randal, 1963b).

The quality of the underground water in the Alroy and Brunette Downs Sheet areas is extremely variable. It is generally suitable for stock, but many of the waters have been classified as unfit for human consumption because of high salinity (i.e. $\geq$2500 ppm of total dissolved salts, high sulphate content ($\geq$ 250 ppm or high fluoride content ($\geq$ 1.5 ppm). However, such waters are still safe for human consumption for very short periods. Numerous water analyses are available from bores of this area (60 from Alroy Sheet area, 122 from Brunette Downs Sheet area) and are presented in detail in Randal (1963b).

The hydrology and the significance of the chemical nature of the underground water cannot be dealt with satisfactorily in only these areas; the problems and conclusions must be considered in relation to the surrounding areas of the Barkly Tableland and they are discussed in a progress report on the hydrology of the Barkly Tableland (Randal, 1963b).

Construction Materials

Flaggy carbonate rocks and sandstones have been used for minor building purposes. Dolomite slabs are used for pathways and pavement floors for out-buildings around homesteads. Heavier slabs have been used for mounting bore equipment and as foundations for cattle troughs and over-shot dams. In places slabs and boulders have been bonded together by cement to give greater strength and cohesion to the structures listed above.

Gravel supplies are scattered over wide areas, but the concentration and thickness is low. Brunette Creek has abundant supplies of well mixed gravel from pebble to boulder size. In the downs country, the gravels are mainly chert with minor occurrences of silicified ironstones. In the timbered areas in the central northern part of Brunette Downs, and along the Barkly Highway detrital laterite gravels attain a thickness of 3-4 feet, and locally 5-6 feet. Those gravels along the Barkly Highway were used for its construction and are still used for its maintenance. However, such gravel deposits should, before use, be tested for their grading and plasticity characteristics, as chert and silty sand are frequently admixed. Analyses of detrital laterite taken from quarries on the Barkly Highway are presented below. The high silica content and the remoteness of the locality at present precludes these deposits as sources of iron. The analyses were carried out by the Australian Mineral Development Laboratories, Adelaide.

Sample No.	Iron as Fe	Aluminium as Al	Silicon as Si
AL 102	27.1	11.7	12.0
AL 103	28.8	10.5	12.4
AL 104	42.2	4.8	8.25
AL 105	33.2	7.25	13.3

There are no occurrences of good quartz sand; the ferruginous, and often silty sand, of the "desert" and timbered areas is of doubtful value for building purposes. Most streams contain gravel and reworked black soil rather than sand.

The heavy clayey soils of the downs country make excellent earth tanks for the storage of bore waters. These soils become plastic and impervious when wet, and if maintained in a moist condition and with plenty of support (i.e. thick walls of well compacted black soil) make a virtually water-proof container (turkey nests). These reservoirs readily crack and weaken however, if they are allowed to dry out; they are considerably weakened by admixed sand and in the sandy areas the use of iron tanks is the only permanent solution against leaking turkey nests. The earth tanks are also weakened by running water and most installations are equipped with overflow pipes and inlet pipes which prevent the water flow from striking the walls of the tank.

REFERENCES

BROWN, H.Y.L., 1895- Report on Northern Territory explorations. Sth.Aust.Parl.Pap.82.

BUREAU OF MINERAL RESOURCES, 1960 - Summary of Oil Search Activities in Australia and New Guinea to June, 1959. Bur.Min.Resour. Aust. Rep. 41A.

BRUNNSCHWEILLER, R.O., 1950 - Macropalaeontological report on Northern Australia Regional Survey Rock Samples. Bur.Min.Resour. Aust.Rec. 1950/13. (unpubl.).

CONDON, M.A., 1961- Notes on field trips, 1960. Bur.Min. Resour.Aust.Rec. 1961/46.(unpubl.).

C.S.I.R.O., 1954- Survey of Barkly Region, 1947-48. Land Research Series No. 3.

DAVID, T.W.E., 1932- Explanatory Notes to accompany a new Geological Map of the Commonwealth of Australia. Sydney.

ETHERIDGE, R.,Jr.,1897- Official contributions to the palaeontology of South Australia No. 9: On the occurrence of Olenellus in the Northern Territory. Sth.Aust. Parl. Paper.

ETHERIDGE, R.,Jr.,1902- Idem, No.13 - Evidences of further Cambrian trilobites. S.Aust.Parl. Papers.

ETHERIDGE, R.,Jr.,1919- The Cambrian trilobites of Australia and Tasmania. Trans.Roy.Soc.S.Aust., Vol.43, pp. 373-393.

IVANAC, J.F., 1954- The geology and mineral deposits of the Tennant Creek Gold-Field, N.T. Bur.Min.Resour.Aust.Bull.22.

JENSEN, H.I., 1914- Geological Report on the Darwin Mining District, McArthur River District and the Barkly Tableland. Bull.N.Terr.10.

JENSEN, H.I., 1915- Report on the geology of the country between Pine Creek and Tanami. Bull.N.Terr. 14.

JENSEN, H.I., 1923 - The probable oil formation of north-eastern Australia. Proc.Pan-Pacif. Sci.Cong.Aust. pp. 1254-1276.

JENSEN, H.I., 1944 - The geology of Central Australia. Proc.Roy.Soc.Q'ld, 56, 85-94.

JEWELL, F., 1960 - Great Artesian Basin, Aeromagnetic Reconnaissance Survey 1958. Bur.Min. Resour.Aust.Rec. 1960/14 (unpubl.).

LLOYD, A.R., 1963 - Possible Tertiary marine fossils from the Brunette Limestone Barkly Tableland, N.T. Bur.Min.Resour.Aust. Rec. in prep.

MILLIGAN, E.N., 1963 - The B.M.R. Georgina Basin Core Drilling Programme. Bur.Min.Resour. Aust.Rec. (in prep).

NICHOLS, R.A.H., 1963 - The sedimentary petrology of the Alroy and Brunette Downs Sheet areas N.T. Bur.Min.Resour.Aust.Rec.1963/69 (unpubl.).

* NOAKES,L.C., 1951 - Explanatory Notes to the Urandangi 4-mile geological Sheet (1st edition, out of print).

NOAKES, L.C., "OPIK, A.A., and CARTER, E.K., 1959 - Explanatory Notes to the Urandangi Four Mile Geological Sheet. Bur.Min.Resour. Aust. Explan. Notes 1.

NOAKES, L.C. and TRAVES, D.M., 1954 - Outline of the Geology of the Barkly Region in Survey of the Barkly Region. Sci.ind.Res.Org.Melb.,Land. Res.Ser.3, 34-46.

"OPIK, A.A., 1951 - Progress in the Study of Cambrian Fossils from the Northern Territory and North-west Queensland. Bur.Min. Resour.Aust.Rec. 1951/26, (unpubl.).

---

* First edition, out of print; now superseded by Explan. Notes No. 1 by Noakes et al. 1959 q.v.

"OPIK, A.A., 1954 - Cambrian stratigraphy of the Camooweal Region (Progress Report) Bur.Min.Resour.Aust.Rec.1954/31 (unpubl.).

"OPIK, A.A., 1954 - Dolomite Problems. Bur.Min.Resour. Aust.Rec. 1954/51 (unpubl.).

"OPIK, A.A., 1957 - Cambrian Geology of the Northern Territory and Cambrian Geology of Queensland in The Cambrian Geology Australia. Bur.Min.Resour.Aust.Bull. 49.

"OPIK, A.A., 1959 - Correlation chart of Cambrian and Ordovician in Australia. Bur.Min. Resour.Aust.Rec. 1959/52, (unpubl.).

PATEN, R.J., 1961 - The Tertiary geology of Western Queensland. Bur.Min.Resour.Aust.Rec. 1961/52 (unpubl.).

PLUMB, K.A. and RHODES, M., 1963 - Wallhallow 1:250,000 geological series. Bur.Min.Resour. Aust.Explan.Notes E/53-7.

RANDAL, M.A., 1962a- Hydrology of the eastern Barkly Tableland (progress report, 1962). Bur.Min.Resour.Aust.Rec.1962/61 (unpubl.).

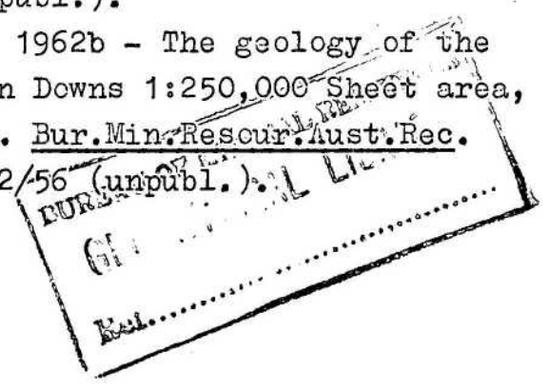
RANDAL, M.A., 1962b- Fergusson River 1:250,000 geological series. Bur.Min.Resour.Aust.Explan. Notes D/52-12.

RANDAL, M.A., 1963a- Katherine 1:250,000 geological series.Bur.Min.Resour.Aust.Explan. Notes D/53-9.

* RANDAL, M.A., 1963b- Hydrology of the Barkly Tableland. (Progress report 1962). Bur.Min. Resour.Aust.Rec.(in preparation). *

RANDAL, M.A., and BROWN, G.A., 1962a- The geology of the Ranken 1:250,000 Sheet area, N.T. Bur.Min.Resour.Aust.Rec.1962/55 (unpubl.).

RANDAL, M.A. and BROWN, G.A., 1962b - The geology of the Avon Downs 1:250,000 Sheet area, N.T. Bur.Min.Resour.Aust.Rec. 1962/56 (unpubl.).



RANDAL, M.A., and BROWN, G.A., 1962c - Additional notes on geology of the Camooweal Sheet area. Bur.Min.Resour.Aust.Rec. 1962/49 (unpubl.).

SKWARKO, S.K., 1963 - Observations on occurrences of Cretaceous strata in Queensland and the Northern Territory. Bur.Min. Resour.Aust.Rec. 1963/11 (unpubl.).

SMITH, J.W., and ROBERTS, H.G., 1963 - Mount Drummond 1:250,000 geological series. Bur. Min.Resour.Aust.Explan.Notes. E53/-12.

SMITH, K.G., VINE, R.R., and MILLIGAN, E.N., 1961a - Progress report on the Palaeozoic Geology of the Elkedra 4-mile Sheet N.T. Bur.Min.Resour.Aust.Rec. 1961/60 (unpubl.).

SMITH, K.G., STEWART, J.R., and SMITH, J.W., 1961b - The Regional Geology of the Davenport and Murchison Ranges N.T. Bur.Min.Resour.Aust.Rep. 58.

STEWART, G.A., 1954 - Geomorphology of the Barkly Region in Survey of the Barkly Region, 1947-48. Sci.ind.Res.Org.Melb. Land Res.Ser. 3.

WHITEHOUSE, F.W., 1927 - Notes accompanying an Exhibit of Fossils. Proc.Roy.Soc.Q'ld. Vol.39, pp.vii-viii.

WHITEHOUSE, F.W., 1930 - The Geology of Queensland. Q'ld. Handb. for Aust.Assoc. for Adv. of Sci., 1930, pp.23-39.

WHITEHOUSE, F.W., 1931 - Report of the Palaeontologist. Ann.Rept. Dept Mines Q'ld. for 1930 pp. 141-142.

WHITEHOUSE, F.W., 1936 - The Cambrian Faunas of north-eastern Australia. Parts 1 and 2. Mem.Q'ld.Mus.Vol. 11.

WHITEHOUSE, F.W., 1939 - Idem, Part 3: Ibid. p.179.

WHITEHOUSE, F.W., 1940 - Studies in the late geological history of Queensland. Pap.Univ. Q'ld. Geol. Dept Vol. 2 (n.s.)No.1.

WHITEHOUSE, F.W.; 1941 - The Cambrian faunas of north-eastern Australia. Part 4: Mem.Q'ld.Mus. Vol. 12, p.1.

WHITEHOUSE, F.W., 1945 - Idem, Part 5: Ibid p.117.

WOOLNOUGH, W.G., 1912 - Report on the Geology of the Northern Territory. Bull.N.Terr. No.4.

APPENDIX 1

Notes on a new occurrence of Redlichia.

During the survey of the Alroy and Brunette Downs Sheet areas, outcrops of the Top Springs Limestone (Plumb & Rhodes, 1963) were examined in an attempt to determine its relationship to the carbonate rocks further south.

The Top Springs Limestone crops out in the northern part of the Wallhallow Sheet area (Plumb & Rhodes, 1963), where it unconformably overlies rocks of the Carpentaria Upper Proterozoic Province and the Bukalara Sandstone of probable Lower Cambrian age. The limestone probably has a low regional dip to the south under the Mesozoic cover. The lithology is varied; fine grey and black foetid limestone, coarse crystalline limestone and dolomitic limestone are interbedded and contain chert smears and nodules. The outcrops are capped by a sandy and silicified leached zone which is also characteristic of the Tindall Limestone in the Daly River Group (Randal 1962b, 1963a). Trilobite remains were found at a locality ¾ mile north of Top Springs Homestead on the track to Leila Lagoon. The fossils have been examined by A.A. Öpik, who (personal communication) reports the following:

> "The trilobite belongs to the genus Redlichia Cossman, and represents a species close to Redlichia forresti (Etheridge, Jnr.) of the Negri sequence of Northern Territory and Western Australia. The age of the limestone is therefore early Middle Cambrian; it is, however, possible that the Negri may extend downward into the latest Lower Cambrian - a provision to be kept in mind in the dating of the new discovery".

INTERPRETATION OF DRILLERS LOGS IN THE ALROY SHEET AREA.

135°0′ 135°30′ 136°0′ 136°30′

19°0′ 19°30′ 20°0′

9. SBSR.
8. SBSR.
R. 30.
R. 32.
R. 14.
R. 31.
7. SBSR.
17. GRG.
B. D1.
B. 34.
B. D11.
B. 24.
B. K9.
B. K7.
B. D16.
A. 8 A.
15. GRG.
WONARAH TS.

N

0 5 10 MILES.

100 ft. 50 0

KEY

- • SUB ARTESIAN BORE
- A ALROY DOWNS.
- B BRUNETTE DOWNS.
- R ROCKHAMPTON DOWNS.
- SBSR. SOUTH BARKLY STOCK ROUTE.
- GRG. GEORGINA BASIN CORE.
- B.D1. etc. BRUNETTE DOWNS WATER BORE No D1
- W LEVEL OF AQUIFER.
- SWL STANDING WATER LEVEL
- 300′+ FIGURES ON RIGHT REFER TO HEIGHT ABOVE SEA LEVEL.
- −300′ FIGURES ON LEFT REFER TO DEPTH BELOW COLLAR.

- m SOIL.
- CLAY: VAR. COLOURS.
- SHALE.
- SAND, SANDSTONE(T) LATERITISED(L).
- GRAVEL & BOULDERS
- CHERT BOULDERS.
- Fe IRONSTONE CONGLOMERATE.
- DOLOMITE
- LIMESTONE & LIMESTONE BOULDERS VAR. COLOURS & CALC SILTSTONE.
- RIBBONSTONE & LIMESTONE WITH CHERT NODULES.
- CALCARENITE COQUINA
- V V VOLCANIC ROCK.
- W WATER STONE.

Bureau of Mineral Resources, Geology and Geophysics.

To accompany Record No 1963/72

E 53/11/1

INTERPRETATION OF DRILLER'S LOGS IN THE BRUNETTE DOWNS SHEET AREA

135°0′ 135°30′ 136°0′ 136°30′

18°0′ 18°30′ 19°0′

AL.16. AL.17. AL.18. AL.19. AL.20. AL.21. AL.11. AL.13. AL.14. AL.12. B.D32. B.18. BLUE BUSH. AL.1. B.6. B.D26. B.D27. B.D25. B.30. B.9. B.37. B.D7. B.10. B.D41. B.36. B.11. B.D19. B.D38. B.23. B.42. B.28. B.44. B.D44. B.58. C.13. B.D5. B 57 B.19. B.21. B.50. B.22. B.D46. B.14. B.38. B.D33. R.33. B.D35. B.D36. B.D37. B.D12. B.D14. B.53. B.52. B.26. B.25.

KEY

- ● SUB ARTESIAN BORE.
- AL ANTHONY LAGOON.
- B BRUNETTE DOWNS.
- C CRESWELL DOWNS.
- R ROCKHAMPTON DOWNS.
- B.DI. etc. BRUNETTE DOWNS WATER BORE No.D1.
- W LEVEL OF AQUIFER.
- ▼ SWL STANDING WATER LEVEL.
- 300′+ FIGURES ON RIGHT REFER HEIGHT ABOVE SEA LEVEL.
- -300′ FIGURES ON LEFT REFER TO DEPTH BELOW COLLAR.

- m SOIL.
- CLAY: VAR. COLOURS.
- SHALE.
- SAND, & SANDSTONE (T).
- GRAVEL & BOULDERS; CONGLOMERATE (T)
- CHERT BOULDERS & BANDS.
- LIMESTONE & LIMESTONE BOULDERS, VARIOUS COLOURS.
- RIBBONSTONE, LIMESTONE & CHERT NODULES
- VOLCANIC ROCK.
- SLATE.
- W WATER STONE.
- DOLOMITE & CHERT.

N

0 5 10 MILES

100 ft. 50 0

ALROY

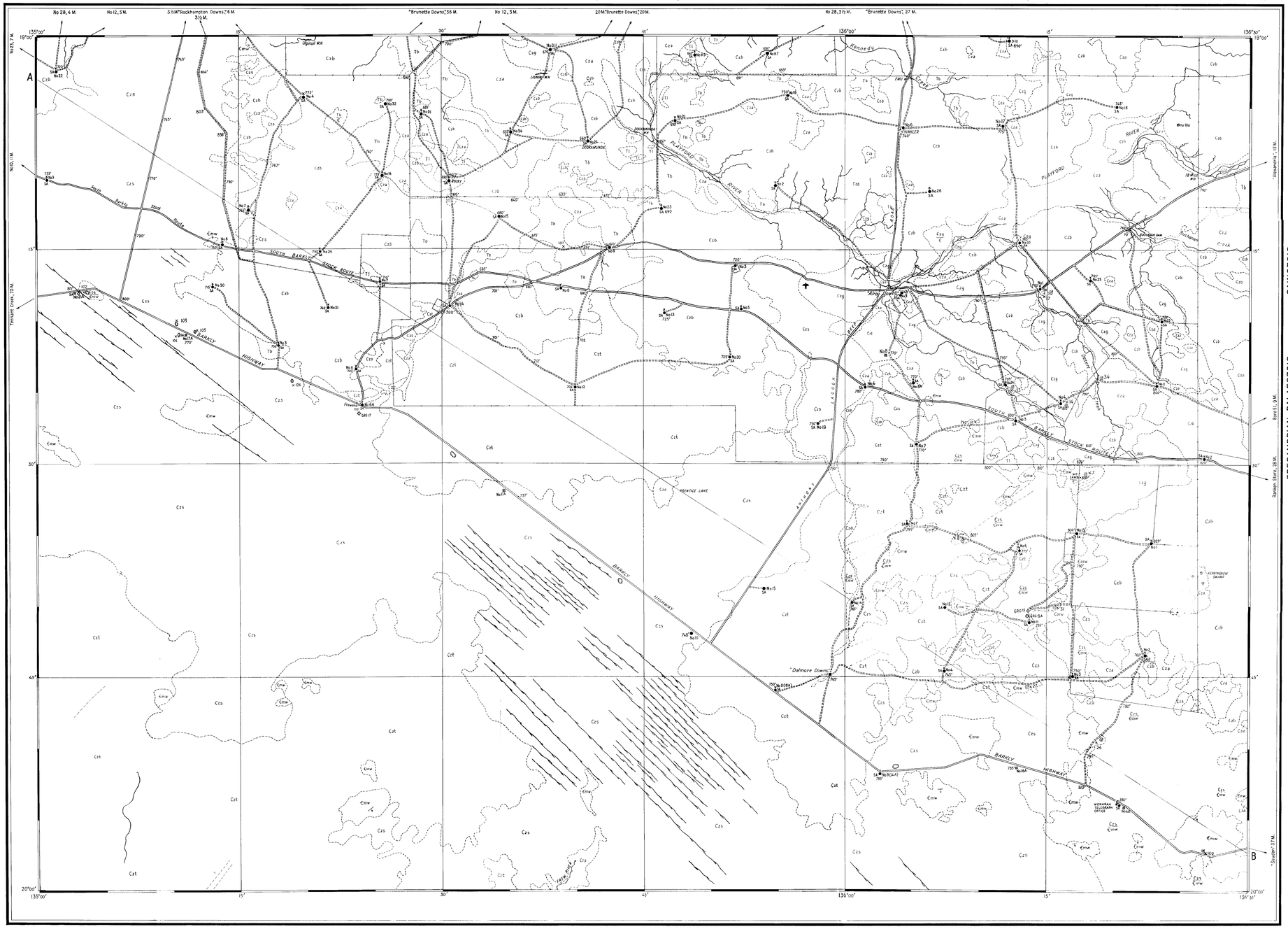
AUSTRALIA 1:250,000

NORTHERN TERRITORY

1:250,000 GEOLOGICAL SERIES SHEET SE 53-15

PRELIMINARY EDITION, 1963

SUBJECT TO AMENDMENT



Reference

CAINOZOIC		Czs	Alluvium and river gravels, some black soil
		Czb	Black and grey clayey soils, some sand and gravel
		Czg	Gravel, pebbles of pisolitic ironstone and chert
		Czs	Mainly sand; black soil and gravel, travertine and detrital laterite, red clayey soil
		Czt	Travertine, some detrital laterite
	TERTIARY — Brunette Limestone	Tb	Nodular white limestone silicified in part and containing chert nodules and bands. Minor quartz sandstone and conglomerate
	TERTIARY	Tl	Laterite. Mainly ferruginised sandstone and siltstone, leached carbonate rocks; some gravel and sand
PRECAMBRIAN PALAEOZOIC	CAMBRIAN — Undifferentiated	Ç	Limestone and chert scree
	MIDDLE CAMBRIAN — Wonarah Beds	Cmw	Fossiliferous silicified limestone and dolomite, siltstone chert and silicified shale. Leached carbonate rocks
	PROTEROZOIC — Undifferentiated	P	Section only

- Geological boundary, position approximate
- Strike and dip of strata
- Dip < 15° (Air-photo interpretation)
- Joint or trend line (Air-photo interpretation)
- Macrofossil locality
- Specimen locality and reference number (Test reference prefixed by 'A')
- SA ● No 12 — Bore with windpump (SA, Sub-artesian)
- SA ● No 15 — Bore (SA, Sub-artesian)
- ⊠ No 16A — Abandoned bore
- Dam
- WP — Waterhole
- Swamp
- Quarry
- GR6-17 — Stratigraphic hole
- Sand dune
- Road
- Vehicle track
- Track
- Fence
- "Alroy Downs" — Homestead
- Yard
- Landing ground
- Astronomical station
- •720' — Height in feet, barometric datum, mean sea level

Compiled and issued by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Topographic base compiled by the Division of National Mapping, Department of National Development. Aerial photography by the Royal Australian Air Force; complete vertical coverage at 1:46,500 scale. Transverse Mercator Projection.

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SOUTH LAKE WOODS SE 53-9	HELEN SPRINGS SE 53-10	BRUNETTE DOWNS SE 53-11	MT DRUMMOND SE 53-12	LAWN HILL SE 54-9
GREEN SWAMP WELL SE 53-13	TENNANT CREEK SE 53-14	ALROY SE 53-15	WARREN SE 53-16	CARDWELL SE 54-13
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MT PEAKE SF 53-5	BARROW CREEK SF 53-6	ELKEDRA SF 53-7	SANDOVER RIVER SF 53-8	DIAMOND SF 54-5

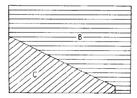
ANNUAL CHANGE 1'E

Scale 1 : 250,000

5 0 5 10 15 MILES

5 0 5 10 15 20 25 KILOMETRES

GEOLOGICAL RELIABILITY DIAGRAM

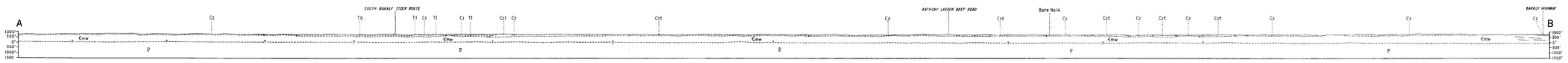


B. Detailed reconnaissance, numerous traverses
C. Air-photo interpretation

Geology, 1962, by: M.A. Randal and R.A.H. Nichols
Compiled, 1963, by: M.A. Randal and R.A.H. Nichols
Drawn by: P.J. Brown and G. Matveev

Section

Scale: $\frac{V}{H} = 4$



AUSTRALIA 1:250,000

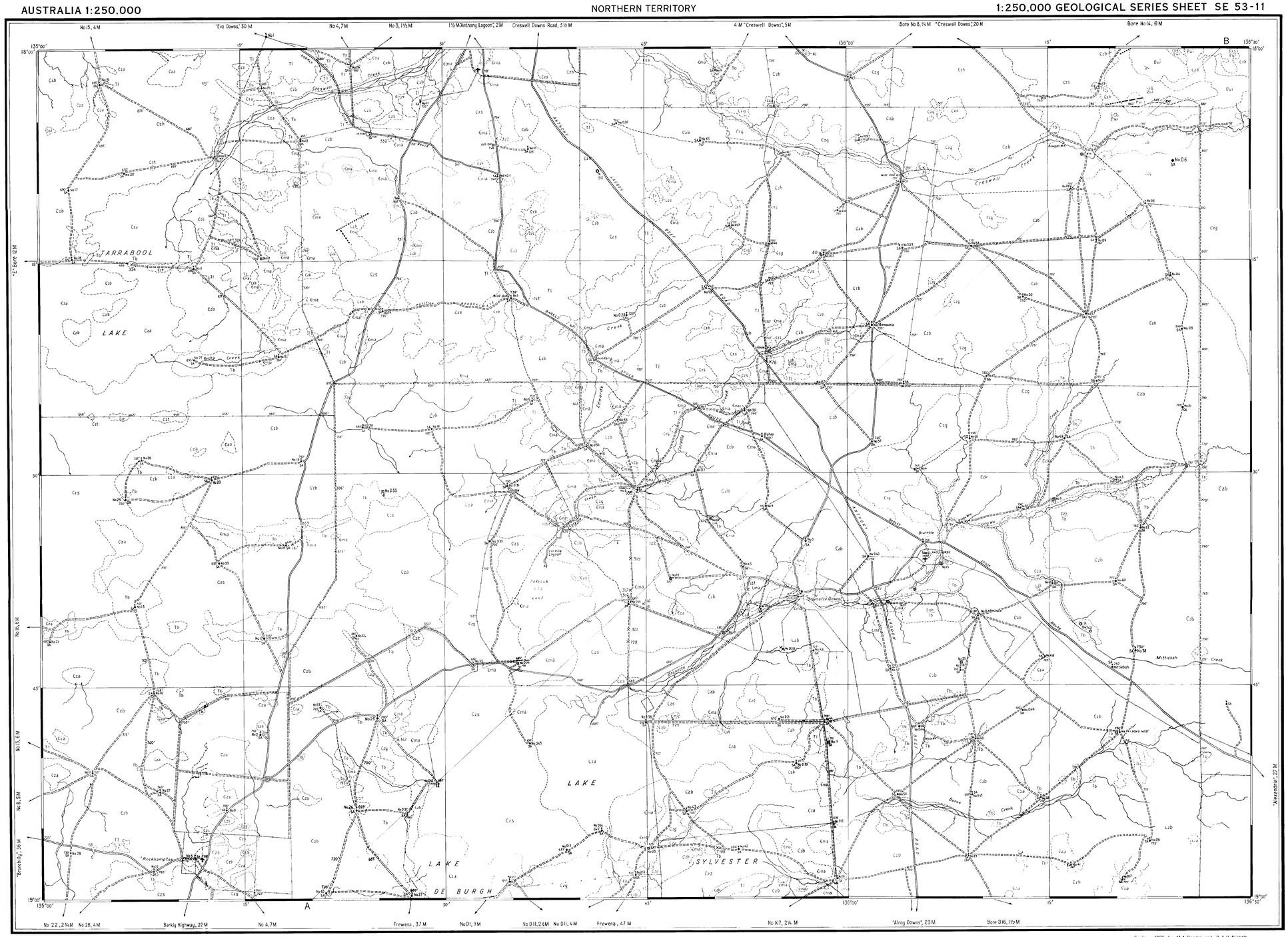
BRUNETTE DOWNS

NORTHERN TERRITORY

1:250,000 GEOLOGICAL SERIES SHEET SE 53-11

PRELIMINARY EDITION, 1963

SUBJECT TO AMENDMENT



Reference

CAINOZOIC		Czа	*Alluvium and river gravels, some black soil*
		Czb	*Black and grey clayey soils, some sand and gravel*
		Czg	*Gravel, pebbles of pisolitic ironstone and chert*
		Czs	*Residual sand, some black soil and gravel*
		Czt	*Travertine*
	TERTIARY — Brunette Limestone	Tb	*Nodular white limestone silicified in part and containing chert nodules and bands. Minor quartz sandstone and conglomerate. Fossiliferous*
	TERTIARY	Tl	*Laterite. Mainly ferruginised sandstone and siltstone and leached carbonate rocks, some gravel and residual sand*
MESOZOIC	LOWER CRETACEOUS	Kl	*White quartz sandstone, partly silicified with plant remains*
PALAEOZOIC	CAMBRIAN — Undifferentiated	C	*Chert scree, dolomite and sandstone. (dolomite and sandstone in section)*
	MIDDLE CAMBRIAN — Anthony Lagoon Beds	Cma	*Dolomite and limestone, both with chert nodules and bands; some algal dolomite. Ferruginous, grey and white quartz sandstone and siltstone*
PRECAMBRIAN	UPPER PROTEROZOIC — Mittiebah Sandstone	Pui	*Cross-bedded and ripple marked ferruginous quartz sandstone*
	UNDIFFERENTIATED	P	*Section only*

- *Geological boundary, position approximate*
- *Fault*
- *Where location of fault is approximate, lines are broken; where concealed, faults are shown by short dashes*
- *Dip < 15°, air-photo interpretation*
- *Strike and dip of strata*
- *Macrofossil locality*
- *Plant fossil locality*
- *Sample locality (Text reference prefixed by "BT")*
- SA ● No D8 — *Bore with windpump*
- SA ● No 17 — *Bore* } SA = Sub-artesian
- ⊗ No 12 — *Abandoned bore (D = dryhole)*
- *Dam*
- *WH — Waterhole*
- *Sink hole*
- *Road*
- *Vehicle track*
- *Track*
- *Fence*
- "Brunette Downs" — *Homestead*
- Yd — *Yard*
- *Landing ground*
- *Astronomical station*
- 720' — *Height in feet, barometric: datum, mean sea level*

Compiled and issued by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Topographic base compiled by the Division of National Mapping, Department of National Development. Aerial photography by the Royal Australian Air Force; complete vertical coverage at 1:46,500 scale. Transverse Mercator Projection.

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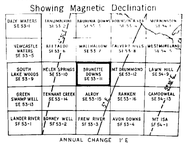

Scale 1 : 250,000

5 0 5 10 15 MILES

5 0 5 10 15 20 25 KILOMETRES

GEOLOGICAL RELIABILITY DIAGRAM

B — *Detailed reconnaissance, numerous traverses*

Geology, 1962, by: M.A. Randal and R.A.H. Nichols

Compiled, 1962, by: M.A. Randal and R.A.H. Nichols

Drawn by: G. Matveev

Section

Scale: V = 4 H