COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

RECORDS.

1962/113

EXPLANATORY NOTES TO THE MOUNT DRUMMOND 1:250,000 SHEET AREA, NORTHERN TERRITORY.

Compiled by

J.W. Smith and H.G. Roberts

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EXPLANATORY NOTES TO THE MOUNT DRUMMOND 1:250,000 SHEET AREA

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INTRODUCTION

The Mount Drummond 1:250,000 Sheet area is bounded by latitudes 18°S and 19°S and longitudes 136°30'E and 138°00'E. The southern boundary of the area is 60 to 70 miles north of the Barkly Highway and the eastern margin is the Queensland border.

Springvale Homestead is the only permanent habitation within the Sheet area, although Highland Plains Homestead lies only half a mile beyond the eastern margin.

Access within the area is poor and the only roads are in the southern part; graded roads link Gallipoli Outstation to Highland Plains Homestead and Mitchiebo Waterhole to the Alexandria-Gallipoli road, and an ungraded road runs from Gallipoli Outstation to Springvale Homestead.

Maps and photographs covering the Sheet area are:-

Mount Drummond air photographs (scale 1:48,000) - flown by the Royal Australian Air Force.

Mount Drummond photoscale maps, prepared by and available from the Division of National Mapping, Department of National Development.

Mount Drummond 4-mile topographic series E 53/12 zone 5 - Division of National Mapping, Department of National Development.

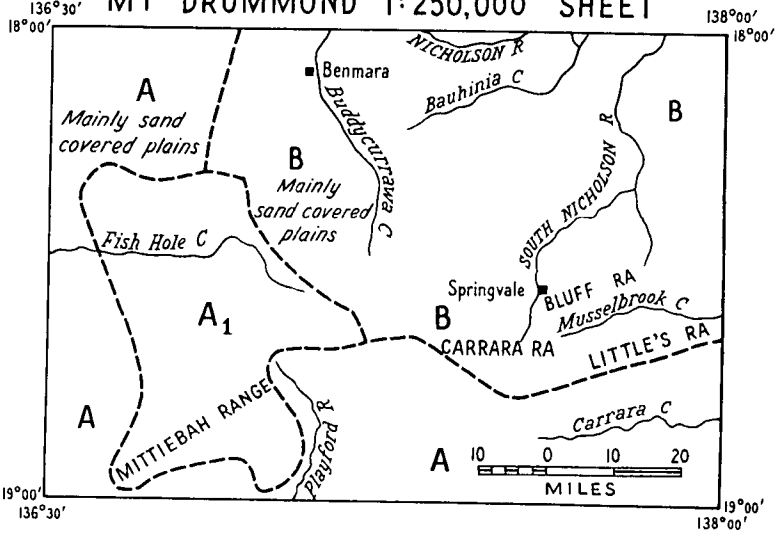
Brunette Downs 8-mile military series E 53/11-12-15-16 zone 5.

PREVIOUS INVESTIGATIONS

Until the Sheet was mapped by the Bureau of Mineral Resources in 1959 little was known of its geology. Öpik (1956a) mapped around Highland Plains Homestead, extending on to the extreme east of the Sheet area. Öpik (1956b) mentions the Cambrian 'Alexandria beds' around Alexandria Station, on the

PHYSIOGRAPHIC SKETCH MAP OF MT DRUMMOND 1:250,000 SHEET

Fig. 1



A Barkly - Beetaloo Tableland

A_1 Mittiebah Uplands

B Gulf Fall

Bureau of Mineral Resoures, Geology and Geophysics. June, 1962.

E 53/12/2

MK

GD

Playford River just south of the Mount Drummond Sheet area. Mount Isa Mines Ltd (Battey, 1959) prospected the Carrara Range area for copper in 1957. In 1958 E.K. Carter, Bureau of Mineral Resources, made rapid reconnaissances in the Mittiebah and Carrara Ranges.

Mapping of adjacent Sheet areas - Lawn Hill (Carter & Opik, 1961), Calvert Hills (Firman, 1959, Roberts, Rhodes & Yates, 1962) and Ranken (Randal & Brown, 1962) has been completed by the Bureau of Mineral Resources.

PHYSIOGRAPHY

The Mount Drummond Sheet area includes part of the Barkly-Beetaloo Tableland, including the Mittiebah Uplands, and part of the Gulf Fall (Dunn, Smith & Roberts, 1962). The distribution of the physiographic divisions is shown in Figure 1.

The National Mapping Division of the Department of National Development has determined spot heights ranging from 737 feet to 1142 feet in the Fish Hole Creek/Caulfield Claypan area, along Buddycurrawa Creek, and to the south and north of Mitchiebo Waterhole. These heights suggest that the unsurveyed Carrara and Bluff Ranges, the highest parts of the Sheet area, are 1,300 to 1,400 feet above sea level.

The Barkly-Beetaloo Tableland in the south and south-western sectors of the Sheet area consists of plains covered with Mitchell grass and rare stands of Lancewood trees. Small outcrops of strongly lateritized siltstone and chert form isolated low hills rising 20 to 30 feet above the surrounding plains. Carrara Creek and Don Creek have cut shallow, rough gorges in the (?)Camooweal Dolomite, which underlies the 'black soil' covering most of south-eastern part of the Barkly-Beetaloo Tableland.

In the south, where the Barkly-Beetaloo Tableland abuts against the Proterozoic ridges, sand is banked on the south side of ridges. South of the Mittiebah Range old sand-dunes trending south-easterly are visible on the air photographs. Sand also covers much of the north west.

The Mittiebah Uplands are low hill country, situated in the south and west, which have internal drainage. They are about 200 feet higher than the surrounding country in the Mittiebah Range and Waterfall Creek areas. Elsewhere there is less relief than in the hills of the Gulf Fall.

From Waterfall Creek northwards, the Mullera Formation and Mittiebah Sandstone crop out as low strike ridges striking north-north-east.

The north, north-eastern and eastern parts of the Sheet area are occupied by hills of the Gulf Fall. In the south, west-striking ridges of the Carrara Range and the Bluff Range Beds rise 200 to 300 feet above the level of the surrounding country. Bluff Range consists mainly of Constance Sandstone, which forms rough, dissected country. From Bluff Range north-westwards to Bauhinia Creek, horizontally-bedded Mesozoic sediments cap the Mullera Formation, which is itself eroded to form rounded, steep-sided hills. In the north-east the Constance Sandstone forms rough dissected country and the less resistant Mullera Formation and Fickling Beds crop out as low rounded hills capped, in places, with Mesozoic sediments up to 50 feet thick.

The streams of the Mount Drummond Sheet area drain both into the Gulf of Carpentaria and inland; most of the drainage is into the Gulf. The major river is the Nicholson River; it flows eastwards across the north of the Mount Drummond Sheet area and eventually enters the Gulf of Carpentaria near Burketown, Queensland. The South Nicholson River, Carrara Creek and Buddycurrawa Creek are principal tributaries of the Nicholson River. The Nicholson and South Nicholson Rivers have braided channels with numerous anabranches and in places are 300 yards wide. The drainage pattern of the Gulf-flowing streams was established on the surface of Mesozoic rocks and has been superimposed on the underlying Proterozoic rocks.

Most of the internal drainage streams flood out locally onto the 'downs' country, but the two largest, Fish Hole Creek and the Playford River, drain into the Lake Sylvester area south-west of Brunette Downs Station.

There are numerous springs in the Sheet area, most of them in the Bluff Range; they are either within the Constance Sandstone, or more commonly at its contact with softer, less porous beds; often the contact is faulted.

STRATIGRAPHY

The stratigraphy of the Mount Drummond Sheet area is summarized in Table 1.

LOWER PROTEROZOIC

Murphy Metamorphics

The Murphy Metamorphics crop out mainly in the Calvert Hills Sheet area, but are also exposed in the north-west of the Mount Drummond Sheet area around Murphy's Creek. They also crop out in a small faulted area on the south side of the Carrara Range between Boomerang Creek and Fish Hole Creek.

The rocks are very low-grade, dynamically metamorphosed yellow and purple quartz-sericite schist, sheared shale and greywacke with, less commonly, sheared calcareous siltstone and metamorphosed ashstone; only schist and sheared shale have been mapped on the south side of the Carrara Range. The schistosity is everywhere parallel to the bedding and the rocks show meagre cleavage. Quartz veins, and less commonly quartz-feldspar veins, are associated with the sediments. A sheared intermediate feldspar porphyry cropping out near Pandanus Creek has been included in the Murphy Metamorphics, but may be part of the younger Cliffdale Volcanics (Roberts, Rhodes, & Yates, 1962). Locally in the same area a sheared altered intermediate plutonic rock, possibly a differentiate of the Nicholson Granite (Roberts, Rhodes, & Yates, 1962), crops out, which is also included in the Murphy Metamorphics.

The Murphy Metamorphics are unconformably overlain by the Carrara Range Formation south of the Carrara Range and are unconformably overlain by the Cliffdale Volcanics in the Calvert Hills Sheet area.

Carrara Range Formation

The Carrara Range Formation crops out in the Carrara Range and in one small area in Maloney Creek on the north side of the Bluff Range.

In the Carrara Range the rocks are acid to basic lavas, often porphyritic and sometimes vesicular, conglomerate, tuff, and sandstone, with minor conglomerate and siltstone. A section measured between Fish Hole Creek and Boomerang Creek was 7650 feet thick. Generalised the sequence is:

1095 feet	Quartz Sandstone, fine to medium-grained, flaggy to massive. Minor conglomerate.
580 "	Quartz Sandstone, medium-grained, cross-bedded, massive, white.
625 "	Agglomerate and tuff.
550 "	Porphyritic rhyolite and trachyte, coarsely vesicular trachyte and basalt.
3300 "	Porphyritic rhyolite and trachyte, some vesicular trachyte and basalt, sandstone interbeds. (4475 feet, Total volcanics)
1500 "	Pebbly quartz sandstone with pebble bands.
7650 feet	Total.

The outcrop in Maloney Creek is a volcanic breccia consisting of angular to well-rounded volcanic fragments (95%) with a sandstone matrix (5%). Overlying conglomerate of the Maloney Formation contains cobbles of volcanics. The outcrop is referred to the Carrara Range Formation but could be younger.

In two areas, one south-west and the other north-east of Mount Drummond, cobble and boulder conglomerate overlying the lavas contain numerous lava cobbles and boulders, suggesting local erosional breaks or minor contemporaneous movement within the Formation. In one other area, north of Mount Drummond, boulder conglomerate without volcanic boulders grades laterally into intermediate lava.

Since the Carrara Range Formation is conformably overlain by the Bluff Range Beds, which are probably equivalent in part, at least, to the Lower Proterozoic Lawn Hill Formation (Carter & Öpik, 1961) the Formation is also considered to be Lower Proterozoic. No obvious equivalents are known on the adjacent Sheet areas, though the Myally Beds to the east may be contemporaneous. No comparable rocks are known in the north Mount Drummond or Calvert Hills Sheet areas.

Bluff Range Beds

The Bluff Range Beds crop out within, and south and west of, the Bluff Range, and around Highland Plains Homestead, extending on to the extreme east of the Sheet area.

The rocks in the Bluff Range area are white to yellow siltstone, sandstone, calcareous sandstone, and limestone. These west of Highland Plains Homestead are grey and purple siltstone and shale, sandstone, dolomite, and dolomitic siltstone and shale. Southwest of Bluff Range, limestone and calcareous sandstone lens out sharply westwards; elsewhere the Beds have a fairly uniform lithology. In the Bluff Range the Beds are at least 5,000 feet thick and west of Highland Plains Homestead 9,000 feet, but in neither area is the section complete.

In the Bluff Range, the Bluff Range Beds are on strike with the Lawn Hill Formation to the east. The rocks in the Highland Plains Homestead area may be equivalent to the Lawn Hill Formation or possibly the Ploughed Mountain Beds (Carter & Öpik, 1961).

UPPER PROTEROZOIC

All Upper Proterozoic rocks, with the exception of rocks to the west of Murphy Metamorphics were deposited in a sub-basin - the South Nicholson Basin of the McArthur Basin (Dunn, Smith,& Roberts, 1962). Rocks in the two basins can be correlated although they are by no means identical lithologically. Throughout the Upper Proterozoic, the ridge of Lower Proterozoic Nicholson Granite just north of the Sheet area had a strong influence on sedimentation (Roberts, Rhodes,& Yates, 1962).

TAWALLAH GROUP

Benmara Beds

The Benmara Beds crop out in four small outcrops to the west and south-west of Old Benmara Homestead. The Beds consist of sandstone, siltstone, pebble to cobble conglomerate, arkose, and acid to intermediate volcanics; the volcanics consist of rhyolitic and trachytic lavas with subsidiary agglomerate and ignimbrite.

Because of the isolated small nature of the outcrops no succession can be obtained for the Beds. It is likely, because of their proximity to the north-striking line of the Murphy Metamorphics that considerable local variation in rock type exists.

Maximum observed thickness is 1,700 feet, but the section is incomplete.

The Beds unconformably overlie the Murphy Metamorphics and are probably unconformably overlain by the Upper Proterozoic Constance Sandstone. The Beds have been placed within the Upper Proterozoic Tawallah Group (Dunn, Smith, & Roberts, 1962), since, because of the intermediate to acid nature of the volcanics and the interbeds of sediments, they most closely resemble the Gold Creek Volcanics (Roberts, Rhodes, & Paine, 1962) of the Calvert Hills Sheet area.

McARTHUR GROUP

Fickling Beds

The Fickling Beds are confined to the south of the Calvert Hills and Westmoreland Sheet areas and the north of the Mount Drummond Sheet area. On the Mount Drummond Sheet area they crop out in a dome - the Bauhinia Dome - in the north-centre and in an anticline in the extreme north-east.

In the dome the rocks consist of cobble to very coarse boulder conglomerate dolomitic feldspathic sandstone, siltstone, dolomite, and arkosic conglomerate. The dolomite in places contains fragments of granite. North-west of this outcrop on the Calvert Hills Sheet area, the Fickling Beds sit directly on the Nicholson Granite. The rocks in the anticline in the north-east consist of siltstone, shale, sandstone, dolomite and dolomitic shale.

About 3,500 feet of sediment is present in the dome and 900 feet in the north-eastern outcrop, but neither section is complete.

The Fickling Beds unconformably overlie the Fish River Sandstone of the Tawallah Group on the Calvert Hills Sheet area (Roberts, Rhodes, & Yates, 1962), and are unconformably overlain by the Constance Sandstone of the South Nicholson Group. They appear to be the equivalent of the McArthur Group, which occurs widely throughout the Gulf of Carpentaria.

SOUTH NICHOLSON GROUP

Rocks of the South Nicholson Group only occur within the South Nicholson Basin and in the west of the Sheet area. They are correlated with the Roper Group because of their similar lithology and because they unconformably overlie the Fickling Beds (Dunn, Smith, & Roberts, 1962).

Maloney Formation

The Maloney Formation crops out north of the Bluff Range and is here the base of Upper Proterozoic. The section is about 5,000 feet thick but is incomplete.

The rocks are pebble to boulder conglomerate, quartz sandstone, feldspathic sandstone, siltstone, and very minor calcareous beds. In Maloney Creek the conglomerate overlies a volcanic breccia which has been included in the Carrara Range Formation. In two observed exposures the conglomerate contains cobbles of the same volcanic rocks that occur in the breccia.

The Maloney Formation appears to represent a local facies variation and thickening of the Constance Sandstone. East of the South Nicholson River impure sandstone of the Maloney Formation grades laterally into the Constance Sandstone.

Constance Sandstone

The Constance Sandstone is widespread in the South Nicholson Basin. It crops out on the Mount Drummond Sheet area mainly in the north and north-east, in the Bluff Range and thence westwards to the Waterfall Creek area.

The dominant rock is a white to light pink quartz sandstone, commonly fine to medium-grained and rarely coarse-grained. Two siltstone lenses 200 - 300 feet thick occur locally in the Waterfall Creek area. In this area a well-banded siltstone at least 1,000 feet thick underlies the sandstone; it is of doubtful age but has been included in the Constance Sandstone.

A section to the west of the north-eastern outcrop of Fickling Beds contains 2,000 feet of Constance Sandstone; in the Bluff Range the sandstone is about 1,300 feet thick, and in the south-west it is about 5,500 feet thick.

Pandanus Siltstone Member

The Pandanus Siltstone Member crops out in the north-east, but occurs more widely in the south of the Calvert Hills Sheet area. It consists of micaceous siltstone with subsidiary quartz sandstone, calcareous sandstone and calcareous siltstone. On this Sheet area the thickness is about 150 feet.

Mullera Formation

The Mullera Formation crops out widely in the Sheet area, but in the central-east is largely obscured by a thin but widespread mantle of Mesozoic sediments.

The sediments of the Mullera Formation are sandstone, feldspathic sandstone, siltstone, shale, glauconitic sandstone, ferruginous sandstone, and ironstone. The Mistake Creek Sandstone Member (described separately) is included in the Formation. Siltstone and shale, commonly micaceous, and grey-green, purple and rarely black, are the most common rock types, but are poorly represented in outcrop. Ironstone is locally developed in thin bands from about 2 to 10 feet; but thicker bands of ironstone, probably to 20 feet thick, crop out in the southern limb of a faulted syncline west of Springvale Homestead; they grade westwards into a single band of ferruginous sandstone.

To the west of the north-striking Murphy Metamorphics and north of the Mittiebah Range, the dominant rocks are a white and pink siltstone, shale and fine-grained sandstone. These rocks may have originally been calcareous.

Lateral variation is common in the Mullera Formation in the east of the Sheet area. About 3,800 feet of sediments is exposed west of Springvale Homestead, but this section is incomplete. About 8,000 feet occur in an incomplete section exposed north of the Mittiebah Range; the formation thins northwards and around Little Pandanus Creek it is only about 1,250 feet thick.

Mistake Creek Sandstone Member

The Mistake Creek Sandstone Member of the Mullera Formation is confined to the Bauhinia Creek / South Nicholson River / Mistake Creek area.

The Sandstone is a fine to medium-grained quartz sandstone and is characterized by small-scale torrential cross-bedding. It is near the base of the Mullera Formation and is possibly equivalent to the Middle Creek Sandstone Member in the Lawn Hill Sheet area. The Mistake Creek Sandstone is about 700 feet thick.

Mittiebah Sandstone

The Mittiebah Sandstone is confined to the north-west and south-west of the Sheet area. Minor outcrops occur in the south-west of the Calvert Hills Sheet area and the north of the Ranken Sheet area. It does not crop out within the South Nicholson Basin.

In the Mittiebah Range, the sandstone is a fine to medium-grained quartz sandstone with glauconitic sandstone towards the base; in the north-west the sandstone contains some well-rounded pebbles and cobbles. Cross-beds are abundant; in the Mittiebah Range they appear to indicate a provenance to the south and west, but in the north-west the provenance appears to be to the east.

In the Mittiebah Range an incomplete section of the sandstone is about 9,000 feet thick, and like the Mullera Formation it probably thins northwards. At Little Pandanus Creek about 1,600 feet of sediments are exposed in an incomplete section.

The Mittiebah Sandstone is conformable on the Mullera Formation.

LOWER CAMBRIAN (?)

Bukalara Sandstone

A flat-lying sandstone cropping out in the extreme north of the Sheet area around Tyson Creek and Buddycurrawa Creek overlies the Mullera Formation, which is also here horizontal.

The sandstone has been related to the Lower Cambrian(?) Bukalara Sandstone, which crops out extensively north and north westwards in the Calvert Hills, Robinson River, and Bauhinia Downs Sheet areas and extends farther west to the Hodgson Downs Sheet area. It is not impossible, however, that the sandstone is related to the South Nicholson Group sequence.

The unit consists of a fine to medium-grained quartz sandstone interbedded with rare bands of pebble conglomerate 1 to 3 feet thick. South of the Nicholson River the base of the sandstone is a pebble conglomerate, but the constituent pebbles do not indicate their source. The sandstone is strongly jointed, with a dominant direction of 130°. The maximum thickness is about 50 feet.

Mapping on the Hodgson Downs Sheet area (Dunn, 1962) has shown the Bukalara Sandstone to be intimately related to the Nutwood Downs Volcanics which are considered to be Lower Cambrian.

MIDDLE CAMBRIAN

Peaker Piker Volcanics

The Peaker Piker Volcanics crop out in the west and south-west of the Sheet area and north of Mitchiebo Waterhole.

In several localities weathering of the volcanics has produced areas of black soil contiguous to outcrops of the unit. The volcanics are particularly susceptible to lateritization. Because of the strong weathering and lateritization the nature of the Volcanics is difficult to determine. They appear to be mainly vesicular and non-vesicular basalts with rare dolerite flows, although some bands may be intermediate in composition. South of Peaker Piker Creek the volcanics contain unfossiliferous sandstone lenses near the base.

Both the Mullera Formation and the Mittiebah Sandstone are unconformably overlain by the Peaker Piker Volcanics. The distribution of the volcanics is closely allied to that of the overlying Middle Cambrian (Burton Beds) and in one place a lens-shaped mass of lava, probably representing the last phase of extrusive activity, is interbedded in a siltstone shale sequence in which, only 20 feet above the lava lens, Middle Cambrian fossils have been found. The Peaker Piker Volcanics are therefore considered to be lower Middle Cambrian. Elsewhere similar volcanic rocks have been found, e.g. the Antrim Plateau Volcanics (OrdBasin, Daly River Basin), the Nutwood Downs Volcanics (Nutwood Downs) and the Helen Springs Volcanics (Tennant Creek), but these have been regarded as Lower Cambrian. The Colless Volcanics on the Lawn Hills Sheet area are considered to be Upper Proterozoic or Lower Cambrian.

Burton Beds

The Burton Beds crop out widely in the south-west and west of the Sheet area and north and north-west of Mitchiebe Waterhole.

The rocks are white and cream siltstone and shale, occasionally silicified, and chert. West of Tobacco Waterhole a red friable medium-grained sandstone crops out towards the base of the Beds, and a sandstone crops out south of the west endof the Mittiebah Range.

On the Ranken Sheet area limestone occurs within the Beds. The formal name Burton Beds now supersedes the informal lower Middle Cambrian 'Alexandria beds' (Öpik, 1956a). Öpik states that the best exposures of the 'Alexandria beds' was at the Old Well, Alexandria.

The beds are highly fossiliferous; fossils include Xystridura brownii (Etheridge), Xystridura (unpublished new species) Lyricopis abreyensis (Etheridge) Pagetia significans (Etheridge) Peronopsis elkedraensis (Etheridge) Peronopsis cf. scutatis (Salter), Biconulites hardmani (Etheridge) sponge spicules, inarticulate brachiopods, and fragments of Braderida (A.A.Öpik and J.G.Tomlinson, pers. comm.)

The maximum observed thickness in the Sheet area was about 75 feet, but from observations from bore cores on the Ranken Sheet area the unit may be 200 feet or more thick.

Border Waterhole Formation

The Border Waterhole Formation crops out in the east of the area around Highland Plains Homestead and Lancewood Creek. Similar sediments to those in the Border Waterhole Formation occurs in the west of the Sheet area, but are given a separate name (the Burton Beds) because of the lack of continuity of outcrop.

The formation consists of white and cream siltstone shale and chert with very subsidiary limestone. There is a shattered pebble conglomerate at the base of the formation north of Lancewood Creek. The rocks are fossiliferous and of Middle Cambrian age (Öpik, 1956a).

The maximum thickness of the Border Waterhole Formation is about 150 feet.

Currant Bush Limestone

The Currant Bush Limestone (Öpik, 1956a) crops out along Lancewood Creek in the east of the Sheet area. It also crops out in the adjacent Lawn Hill Sheet area.

The dominant rock is a light cream to grey, thin-bedded, rarely thick-bedded, limestone. In places it is cross-bedded. Friable medium-grained sandstone crops out about 3 miles west of the road from Gallipoli Outstation to Highland Plains Homestead, and leached siltstone and shale crop out at Lancewood Waterhole. The latter were mapped as a separate unit (the Lancewood Shale) by Öpik, but have been included within the Currant Bush Limestone on the present scale of mapping. The limestone contains abundant lower Middle Cambrian fossils. These include undescribed species of Fuchouia, a Nepeid, Personopsis cf. Scutalis (Salter), and inarticulate brachiopods (A.A. Öpik and J.G. Tomlinson pers. comm.)

The maximum thickness of the Currant Bush limestone is about 100 feet.

Camoweal Dolomite

Dolomite is widely distributed over most of the south and south-west of the Sheet area, but most of it is covered by soil and it crops out only in the Carrara and Don Creek drainage system and in an area around Tobacco Waterhole. Associated with the dolomite are chert bands and some sandstone lenses. No fossils were found.

The thickness of the dolomite is not known, but bores in the south of the Sheet area obtain water from dolomite at about 320 feet.

Öpik (1956a) related the dolomite in the east of the Sheet area to the Camooweal Dolomite, which has a widespread distribution in the Lawn Hill and Camooweal Sheet areas of Queensland. At the time of writing (1962) the age of the Camooweal Dolomite is in doubt, but falls within the range Upper Proterozoic - Ordovician. However, in the Lancewood Creek area the Currant Bush Limestone dips south under the dolomite; some, but not all, of the contact is faulted. The dolomite on the Mount Drummond Sheet area is therefore considered to be younger than the Currant Bush Limestone and Middle Cambrian (or possibly younger); the possibility that there is more than one dolomite sequence cannot be ignored.

LOWER CRETACEOUS(?)

Mesozoic sediments crop out widely in the north-east of the Sheet area; there are also minor outcrops around Lancewood Creek north of Carrara Range, and at the headwaters of Fish Hole Creek.

All outcrops except that in Fish Hole Creek consist of probable freshwater sediments; in several localities poorly preserved plant remains have been found. The sediments are mudstone, shale, siltstone, sandstone, and fine to pebble conglomerate. The maximum thickness mapped was about 190 feet in No-return Creek.

The outcrop in Fish Hole Creek (TT52) is small and consists of fine to medium-grained sandstone which contains marine pelecypods of probable Neocomian age (Dickins, 1960). Specimens identified include Inoceramus sp.nov. Iotigonia sp.nov., Trigoniidae gen. et sp. and a specimen similar in shape to Fissilunula clarkei (Moore, 1870). One large belemnite guard was also identified. The sandstone is probably less than 20 feet thick.

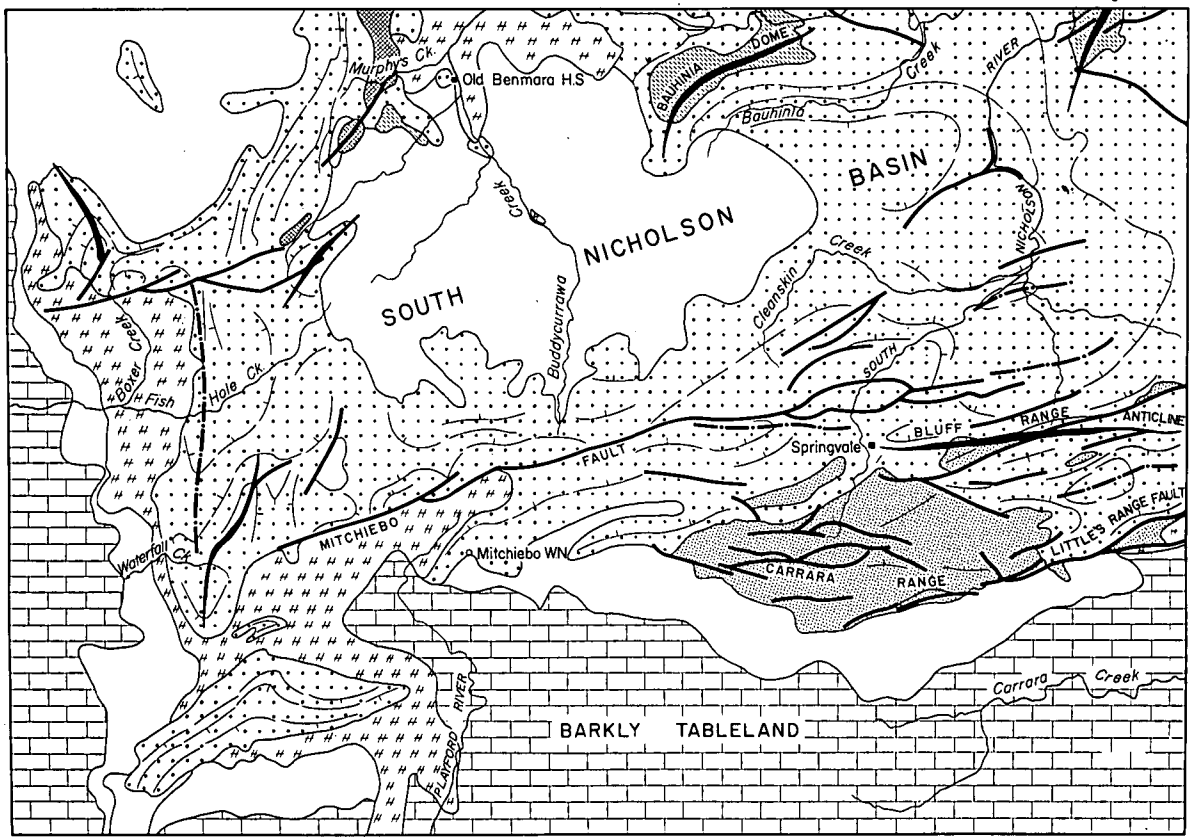
TERTIARY (?)

Cleanskin Beds

On Cleanskin Plains at the headwaters of Cleanskin Creek, and in the Fish Hole Creek area, black soil partly covers poorly outcropping Limestone. Very minor outcrops of a similar limestone crop out around Connell's bore in the extreme south-west of the Sheet area. The limestone is commonly chalcedonic with a skeletal appearance, and is unfossiliferous. Similar limestones occurring at Brunette Downs, Austral Downs, and near Urandangi have been placed in the Tertiary though these, too, are unfossiliferous. A limestone east of O.T. Downs Homestead on the Bauhinia Downs Sheet area (Smith, 1962) contains freshwater gastropods of probably Tertiary age.

There are small outcrops of limestone in Buddycurrawa Creek and north of the Carrara Range. The limestone is silicified, unfossiliferous, and horizontally bedded. It has been tentatively placed in the Tertiary, but could be older.

Fig. 2



STRUCTURAL MAP OF MOUNT DRUMMOND 1:250000 SHEET AREA

10 0 10 20 30 MILES

REFERENCE

- Cainozoic
- Camooweal (?) Dolomite and residual soil
- Cambrian excluding Camooweal (?) Dolomite
- Upper Proterozoic South Nicholson Group
- Upper Proterozoic Pre South Nicholson Group
- Lower Proterozoic Carrara Range Formation and Bluff Range Beds
- Lower Proterozoic Murphy Metamorphics
- Anticline or dome
- Syncline or basin
- Fault
- Trend line with dip

Bureau of Mineral Resources, Geology and Geophysics July 1962

E53/12/1 JK

STRUCTURE.

The general structural disposition of the stratigraphic units has been listed in Table 1. (See also Fig. 2).

Folding

The Lower Proterozoic Murphy Metamorphics are highly folded, with dips generally between 60° and vertical. In the Murphy Creek area they are folded on an axis striking north-north-east, with dips generally steep to the west. South of the Carrara Range they are folded on a west-striking axis, but the direction of dip is more variable.

The Carrara Range Formation and the Bluff Range Beds are also folded on a west-striking axis. Dips, which are usually to the north, are much shallower than those of the Murphy Metamorphics and range between 10° and 80° with an average of 25°.

The Upper Proterozoic South Nicholson Basin is bounded by the Murphy Metamorphics on the west, the Murphy Metamorphics and Nicholson Granite on the north, the Lawn Hill Formation and Ploughed Mountain Beds on the east and the Carrara Range Formation and Bluff Range Beds on the south. The long axis of the Basin strikes west. After the Mittiebah Sandstone was deposited it was compressed and gently folded. Near the margins of the Basin the strike of the Upper Proterozoic rocks parallels the margins; in the centre, dips are generally shallow, averaging less than 10°. Major structures in the Upper Proterozoic are:-

Bauhinia Dome. The sediments of the Fickling Beds north of Bauhinia Creek have been folded into a dome; the lithology of the sediments suggests derivation from an adjacent ridge of older rocks of which granite was a part. Folding of the overlying Constance Sandstone in the area is also domal, but is slightly at variance with the folding of the Fickling Beds. Dips in the dome range between 10° and 35° and folding is on a curving east to south-east axis. The Constance Sandstone to the south of the dome is sharply folded and dips of 70° have been recorded.

Syncline to the west of Springvale Homestead. The syncline within the Mullera Formation strikes west and has a very shallow plunge to the west. Dips on the limbs are shallow and average about 10°. Most of the northern limb has been eliminated by a major fault (the Mitchiebo Fault). Similar west-south-westerly faults (though apparently with little throw) affect the southern limb.

Bluff Range Anticline. In the Bluff Range, dips in the Constance Sandstone give the impression of a broad anticline over the more highly folded Lower Proterozoic Bluff Range Beds; though they may be partly depositional. The anticline is about 25 miles long and about 8 miles broad, and strikes west-south-west. Dips on both limbs are shallow; on the south they are more variable and small inliers of Bluff Range Beds crop out.

Structures in the west of the Sheet area. A large north-striking, north-plunging syncline is the main structure in the west of the Sheet area. It trends from Waterfall Creek 24 miles northwards to the headwaters of Boxer Creek, where it is truncated by a major west-striking fault. Most of the western limb is covered by Cambrian sediments and volcanics. A complementary anticline occurs to the east of the syncline; it has a curving axis and strikes north to north-east. Dips of the sediments average 30° but some are more than 60°.

Between the southern limit of the anticline and Mittiebah Range the regional strikes change from north to west; dips average 60°, but range up to vertical.

Cambrian, Mesozoic, and Tertiary rocks are sub-horizontal except where affected by faults in the Lancewood Creek area.

Faulting

Faulting is most severe in the Carrara Range / Bluff Range area. Most faults strike west or west-south-west. The area of strong faulting is bordered in the south-east by the Little Range Fault and in the north-west by the Mitchiebo Fault, the two most prominent faults in the Sheet area.

Little's Range Fault. The Little's Range Fault is about 30 miles long, but only the western 12 miles are within the Mount Drummond Sheet area. The eastern 6 miles of the fault in the Mt. Drummond Sheet area forms a rugged south-facing escarpment about 200 feet high. No definite age or ages can be assigned to the fault, but in the Lawn Hill Sheet area it has affected both the Middle Cambrian Currant Bush Limestone and the Border Waterhole Formation. The distribution of the Colless Volcanics in the Lawn Hill Sheet area closely follows the fault-line and suggests that the fault provided egress for the basalts. As the Colless Volcanics are lower Middle Cambrian or older, it is therefore fairly certain that there have been at least two movements on the fault. One area shows evidence that the fault has a horizontal component with south side moving west.

A fault almost parallel to the Little's Range Fault in the Lancewood Creek area has also displaced Cambrian sediments.

Mitchiebo Fault. The Mitchiebo Fault is about 35 miles long and stretches from west-north-west of Mitchiebo Waterhole to north-west of Springvale Homestead. The fault has severely disturbed the Constance Sandstone and Cambrian sediments. Eastwards from Mitchiebo Waterhole the outcrop is poor but the fault is inferred from the generally steep dips, the disappearance of the northern limb of the syncline west of Springvale Homestead, and the repetition of the Constance Sandstone and the Mullera Formation.

There is little faulting in the west of the Sheet area. A fault terminates a syncline at the headwaters of Boxer Creek, and a long curving fault was mapped west of Old Benmara Homestead.

Apart from at least one period of faulting in the Precambrian and one period of faulting after the Middle Cambrian, which was in part movement along pre-existing faults, minor movement also occurred after deposition of the Mesozoic. This movement was always along pre-existing faults.

ECONOMIC GEOLOGY

No mining has been undertaken within the Mount Drummond Sheet area.

Ironstone occurs within the Mullera Formation. In the Sheet area it is best developed west of Springvale Homestead but it also occurs in minor bands throughout the east and north-east of the Sheet area. No ironstone has been observed in the west of the Sheet area. Samples collected suggest that the ironstone may be too rich in silica (the most favourable analysis was SiO_2 21.8 percent, Fe_2O_3 72.5 percent) for industrial value, but a detailed sampling programme is necessary to confirm this.

Very sparse malachite stains occur in sandstone lens within the volcanics of the Carrara Range Formation at the divide between Boomerang Creek and Fish Hole Creek.

Water is found throughout the south of the Sheet area in the Camooweal Dolomite at depths up to 320 feet.

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TABLE 1

STRATIGRAPHY OF MOUNT DRUMMOND

ERA	PERIOD	ROCK UNITS, SYMBOL	DISTRIBUTION	KNOWN MAXIMUM THICKNESS IN FEET	LITHOLOGY	TOPOGRAPHY
CAINOZOIC	QUATERNARY	Sandy soil (Czs)	Widely in Buddycurrawa Creek area, also around edges of ranges.	Gen. thin; to 100 where banked by winds.	Various sandy soils	Plains with turpentine, spinifex and sparse tree cover.
		Black soil (Czb)	Wide distribution S. W. & S. Also smaller distn. Fish Hole Creek, Cleanskin Plain.	Usually thin.	Heavy clay soil; black, boggy when wet. Sink-holes.	Grass plains, featureless except for rare Lancewood stands.
		Laterite and lateritic soil (Czl)	Small areas, especially Benmara Creek and north-east.	Thin.	Leached ferruginous aluminous, fine soil, nodular in places.	
	TERTIARY(?)	Cleanskin Beds (Tl)	Cleanskin Plain, Fish Hole Creek. Small poss. o/cs Buddycurrawa Creek, Carrara Range, Connells Bore.	Thin. Probably less than 50.	White-light grey chalcedonic limestone, white chert.	Grass plains. Where o/c v. low rough rises.
		UNCONFORMITY				
MEZSOIC	LOWER CRETACEOUS(?)		Mainly N.E. Also thin deposits in E.	190	Conglomerate, siltstone, mudstone, shale, sandstone.	Mesas, flat-topped remnants, particularly on Millera Formation.
		UNCONFORMITY				
PALAEOZOIC	MIDDLE CAMBRIAN	(?) Camooweal Dolomite (Cmd)	Wide distribution, but poor o/c. West Carrara Ck. and Don Ck.	Unknown, but several hundred.	Dolomite, chert, sandstone lenses.	Rough, shallow gorges in Carrara and Don Creeks.
		Currant Bush Limestone (Cmc)	Only around Lancewood Creek in extreme E. of area.	100	Thin-bedded grey limestone with some sandy beds, chert lenses and shale.	Low, rough terrain.
		Burton Beds (Cmb) (Read after Border Waterhole etc.)	Widely south and south west.	75 +	Leached siltstone, shale, chert. Minor sandstone.	Rounded hills with lateritic caps.
		Border Waterhole Formation (Cmt)	Around Lancewood Ck. Highland Plains Homestead.	150	Leached siltstone, shale, chert. Minor limestone.	Rounded hills with occasional lateritized caps.
		Peaker Piker Volcanics (Cmp)	Mainly west and south-west.	120	Basalt, trachyte, minor dolerite, sandstone.	Lateritized flat-tops, and low rounded hills. Black soil cover.

*** - Read Burton Beds here.

				U N C O N F O R M I T Y (?)			
		LOWER CAMBRIAN (?)		Bukalara Sandstone (Clb)	North-centre around Tyson & Buddycurrawa Creeks.	50 +	Cross-bedded quartz sandstone, pebble conglomerate.	Flat-tops where dissected.
				U N C O N F O R M I T Y			
P R O T E R O Z O I C		UPPER	S O U T H N I C H O L S O N G R O U P	Mittiebah Sandstone (Bsi)	South-west and north-west.	9,000 S.W. 1,600 N.S.	Cross-bedded quartz sandstone, glauconitic sandstone; rare pebbles and cobbles.	Rugged dissected country Mittiebah Range 200' high (approx.).
				Mullera Formation (Bsl)	General	8,000 north of Mittiebah R; 3,800 west of Springvale.	Siltstone, shale, quartz sandstone, glauconitic sandstone, ironstone, ferruginous sandstone.	Shale; rounded, rubble covered hills, occasional lateritic caps. Sst rugged locally where horizontal.
				Mistake Creek Sandstone Member (Bsm)	S. Nicholson Rv. Bauhinia Creek.	650	Torrentially cross-bedded quartz sandstone.	Flat-topped hills, where dipping, rugged o/c.
				Maloney Formation (Bsd)	N. side of Bluff Range.	5,000	Conglomerate, quartz sandstone, feldspathic sandstone, siltstone.	
				(Read after Constance Sandstone)				
				Constance Sandstone (Bsa)	Wide distribution but mainly N.E. & E.	2,000 N.E. 5,500 Waterfall Creek.	Cross-bedded quartz sandstone with siltstone lenses.	Rugged dissected. Rivers in gorges.
				Pandanus Siltstone Member (Bsp)	Only in extreme N.E.	About 150	Micaceous siltstone minor quartz sandstone, calcareous siltstone, calcareous sandstone.	Low rounded hills in strike ridges.
				(Maloney Beds should be read here).				
				U N C O N F O R M I T Y				
			McARTHUR GROUP	Fiokling Beds (Emf)	Only in extreme N.E. and north of Bauhinia Creek.	4,000	Dolomite, siltstone, quartz sandstone, conglomerate, feldspathic dolomitic sandstone, shale.	Rolling country. Occasional prominent dip and scarp slopes.
				U N C O N F O R M I T Y (?)				
			TAWALLAH GROUP	Benmara Beds (Btb)	Small areas west and south of Old Benmara Homestead.	1,700	Rhyolite, trachyte, quartz sandstone, arkose. Conglom. siltstone. Minor agglomerate, ignimbrite.	Rounded ridges; rougher surface on volcanics.
				U N C O N F O R M I T Y				
		LOWER		Bluff Range Beds (Plb)	In S. & W. of Bluff Range. Also W. of Highland plains.	9,000	Quartz, sandstone, calcareous sandstone, limestone, dolomite, siltstone, shale, dolomitic shale.	Well developed ridges with dip and scarp slopes.
				Carrara Range Fm. (Plc)	Carrara Range area only.	7,650	Porphyritic rhyolite, trachyte, vesicular basalt, trachyte tuff, agglom. conglom., quartz sandstone, minor shale.	Conglom. and sandstone form rugged strike ridges. Volcanics; rounded hills.
				U N C O N F O R M I T Y				
				Murphy Metamorphics (Elm)	Murphy's Creek area, also south side of Carrara Range.	?	Quartz-sericite schist, sheared shale poor. greywacke ashstone, intermediate feldspar porphyry, minor sheared calc siltstone, metamorphosed ashstone; (?)monzonite.	Low rounded hills, o/c

	U N C O N F O R M I T Y (?)		
Sub-horizontal	Probably unconformably overlies Mullera Formation		
	U N C O N F O R M I T Y		
Shallow dips 0-30°. A few steeper to 60°. Little faulted.	Conformably overlies Mullera Formation in west.		Minor distribution on Calvert Hills and Ranken Sheet areas.
Shallow dips 0-30°	Conformably overlies Constance Sandstone.	Ironstone, siliceous, developed west of Springvale Homestead, very locally elsewhere.	6,000 feet thickness on Lawn Hill 4-mile Sheet within Basin.
Sub-horizontal. Dips to 15° in places. Minor faulting.	Towards base of Mullera Formation.		Possibly equivalent to Middle Creek Member (Lawn Hill 4-mile Sheet)
Strongly faulted in places.	Unconformably on Carrara Range Formation.		Local development north side Bluff Range. In part equivalent to Constance Sandstone.
Gentle folding to 30°; rarely steeper. Much faulting	Disconformably on Fickling Beds.	Permanent waterholes and springs.	3000'(?) thick on Lawn Hill 4-mile Sheet.
With gentle anticlinal structure. Dips 20 and under.	Towards base of Constance Sandstone.		Occurs also in the south of the Calvert Hills Sheet area.
	U N C O N F O R M I T Y		
Gentle anticlinal structure. Dips to 30°. Some faulting.			North side of South Nicholson Basin only.
	U N C O N F O R M I T Y		
Shallow dips west - to 30°. Minor faulting.	Unconformable under Constance Sandstone. Unconformably on Murphy Metamorphics.		
	U N C O N F O R M I T Y		
Dips generally N. 0-80°. Strongly strike-faulted.	Unconformably below Constance Sandstone.		Probably equivalent in part to Lawn Hill Fm. and Ploughed Mt. Beds. Markedly lenticular south-west of Bluff Range. Rocks in Highland Plains Hmst. area differ from those in Bluff Range.
Dips generally N. 0-80°. Very strongly faulted (mainly strike faults).	Unconformable on Murphy Metamorphics. Conformable with Bluff Range Beds	Very poor malachite staining.	
	U N C O N F O R M I T Y		
Near vertical dips. Murphy's Creek, overall very steeply west.		No known mineralization but little prospected.	Much quartz-veining but none in sheared porphyry and monzonite. Outcrops also on south part of Calvert Hills Sheet area

1:250,000 SHEET AREA

STRUCTURE	PALAEONTOLOGY	STRATIGRAPHICAL RELATIONSHIPS	ECONOMIC GEOLOGY	REMARKS
				Formed on Camooweal(?) Dolomite, Tertiary chalcedonic limestones and Peaker Piker Volcanics
Horizontal?	No fossils found.	Post-Mesozoic?	Possible shallow water.	Probably equivalent to Brunette Limestone, etc. and Carl Ck. Limestone.
U N C O N F O R M I T Y				
Horizontal. Minor movements along pre-existing faults.	Pelecypods and belemnites. Also poor plant remains.	Unconformable on Cambrian sediments		Both freshwater and marine present
U N C O N F O R M I T Y				
Flay-lying rare minor folds.	Stromatoliths.	Underlain in Lancewood Ck. area by Currant Bush Limestone.	Very good aquifer. Approx. depth of water 320'.	Age uncertain elsewhere. Possibly more than one dolomite unit.
Dipping S. off fault, shallows abruptly.	Highly fossiliferous.	Underlain by Border Waterhole Formation. Overlain by Camooweal(?) Dolomite.		
Sub-horizontal except near faults.	Highly fossiliferous.	Overlies Peaker Piker Volcanics.		
Sub-horizontal except near faults.	Fossiliferous (Opik 1956a)	Probably underlies Currant Bush Limestone.		
Sub-horizontal.		Unconformably overlies Mittiebah Sandstone.		Similar volcanics - Lower to Middle elsewhere. Colless Volcanics (Lawn Hill Sheet area) considered Upper Proterozoic or Lower Cambrian

PRELIMINARY EDITION. 1962

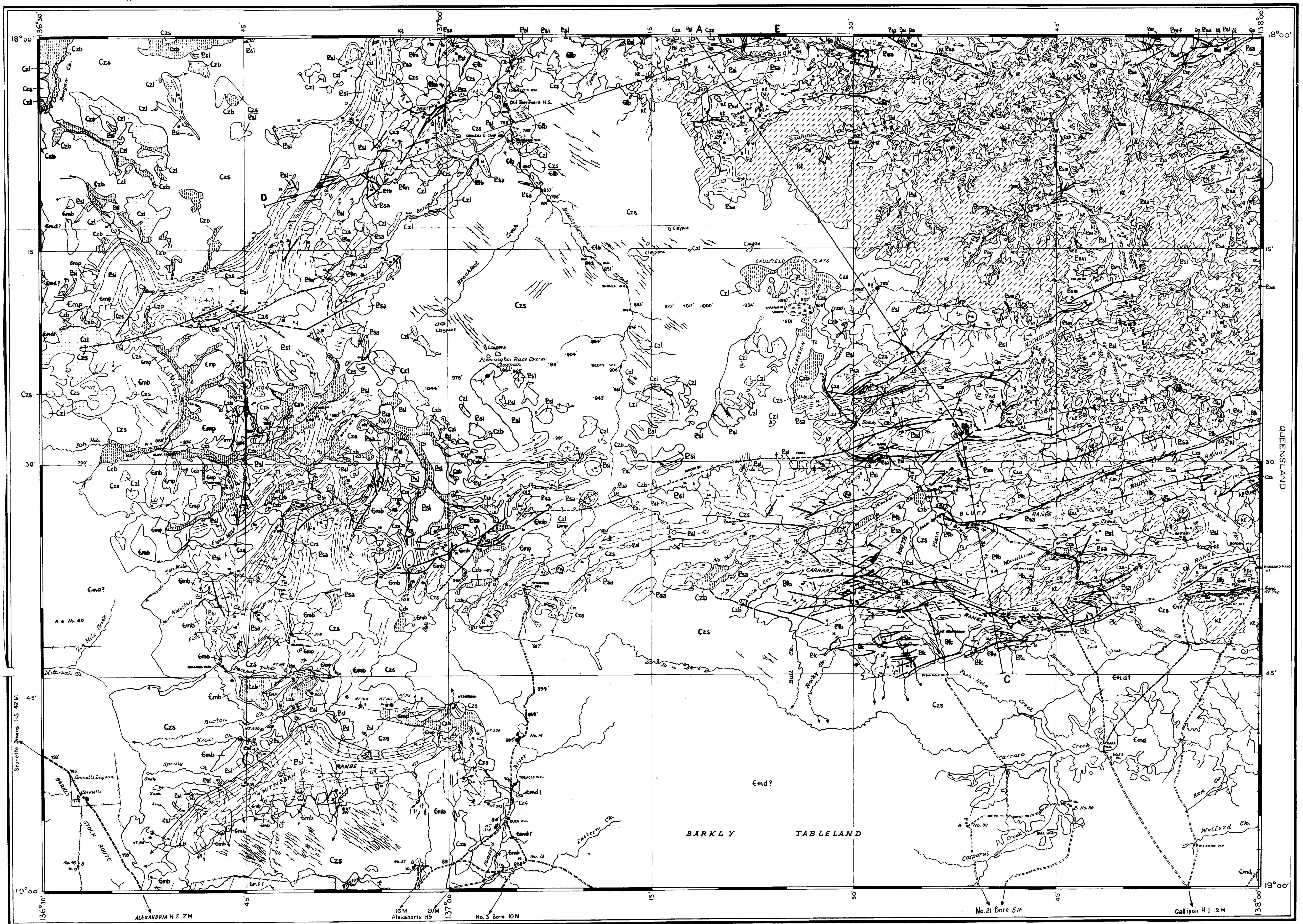
SUBJECT TO AMENDMENT

MOUNT DRUMMOND

AUSTRALIA 1 : 250,000

NORTHERN TERRITORY

1:250,000 GEOLOGICAL SERIES SHEET SE53-12



Reference

CAINOZOIC	QUATERNARY		Qa	Alluvium
	UNDIFFERENTIATED		Czs	Soil, sand
			Czb	Black soil
			Czl	Laterite, lateritic soil
	TERTIARY (?)	Cleanskin Beds	Tl	Limestone, chalcedonic limestone
MESOZOIC	LOWER CRETACEOUS ?	Undifferentiated	Kl	Mudstone, siltstone, quartz sandstone, conglomerate
PALAEOZOIC	MIDDLE CAMBRIAN	Camooweal Dolomite	Єmd	(Residual and alluvial black soil over) dolomite, chert, minor sandstone. Main outcrops shown darker
		Currant Bush Limestone	Єmc	Thin-bedded grey limestone, minor siltstone, sandstone, shale
		Border Waterhole Formation	Єmt	Siltstone, shale, chert, minor limestone, and conglomerate
		Burton Beds	Єmb	Siltstone, shale, chert, minor sandstone
		Peaker Piker Volcanics	Єmp	Basalt, trachyte, minor dolerite, quartz sandstone
	? LOWER CAMBRIAN	Bukalara Sandstone	Єlb	Quartz sandstone, pebble conglomerate
PRECAMBRIAN	UPPER PROTEROZOIC	SOUTH NICHOLSON GROUP: Mittiebah Sandstone	Ꝑsi	Quartz sandstone, glauconitic sandstone
		Mullera Formation	Ꝑsl	Siltstone, shale, quartz sandstone, glauconitic sandstone, feldspathic sandstone, ferruginous sandstone, ironstone
		Mistake Creek Sandstone Member	Ꝑsm	Quartz sandstone
		Constance Sandstone	Ꝑsa	Quartz sandstone, siltstone
		Pandanus Siltstone Member	Ꝑsp	Siltstone, minor fine-grained sandstone
		Maloney Formation	Ꝑsd	Conglomerate, feldspathic sandstone, quartz sandstone, siltstone
		McARTHUR GROUP: Fickling Beds	Ꝑmf	Dolomitic feldspathic sandstone, quartz sandstone, siltstone, shale, dolomite, dolomitic siltstone, conglomerate, arkosic conglomerate
		TAWALLAH GROUP: Benmara Beds	Ꝑtb	Feldspathic sandstone, quartz sandstone, trachyte, ryholite siltstone, arkose, pebble conglomerate, ignimbrite, agglomerate
	LOWER PROTEROZOIC	Bluff Range Beds	Ꝑlb	Quartz sandstone, siltstone, shale, dolomite, limestone, dolomitic siltstone, dolomitic sandstone
		Carrara Range Formation	Ꝑlc	Quartz sandstone, conglomerate, minor shale
				Trachyte, basalt, agglomerate, tuff, rhyolite
		Murphy Metamorphics	Ꝑlm	Quartz-sericite schist, sheared siltstone, greywacke, intermediate volcanics

Geological boundary

Fault

Synclinal axis, showing plunge

Anticlinal axis, showing plunge

Where location of boundaries, faults and folds is approximate, line is broken; where inferred, queried; where concealed, boundaries and folds are dotted, faults are shown by short dashes

65 Strike and dip of strata

Horizontal strata

Vertical strata

Trend of bedding showing direction of dip } air-photo interpretation

Joint pattern } air-photo interpretation

NT 52 Macrofossil locality and text reference

Fe Unexploited iron deposit

State boundary

Vehicle track

Fence

H.S. Homestead

YD Yard

B Water bore

WH Waterhole

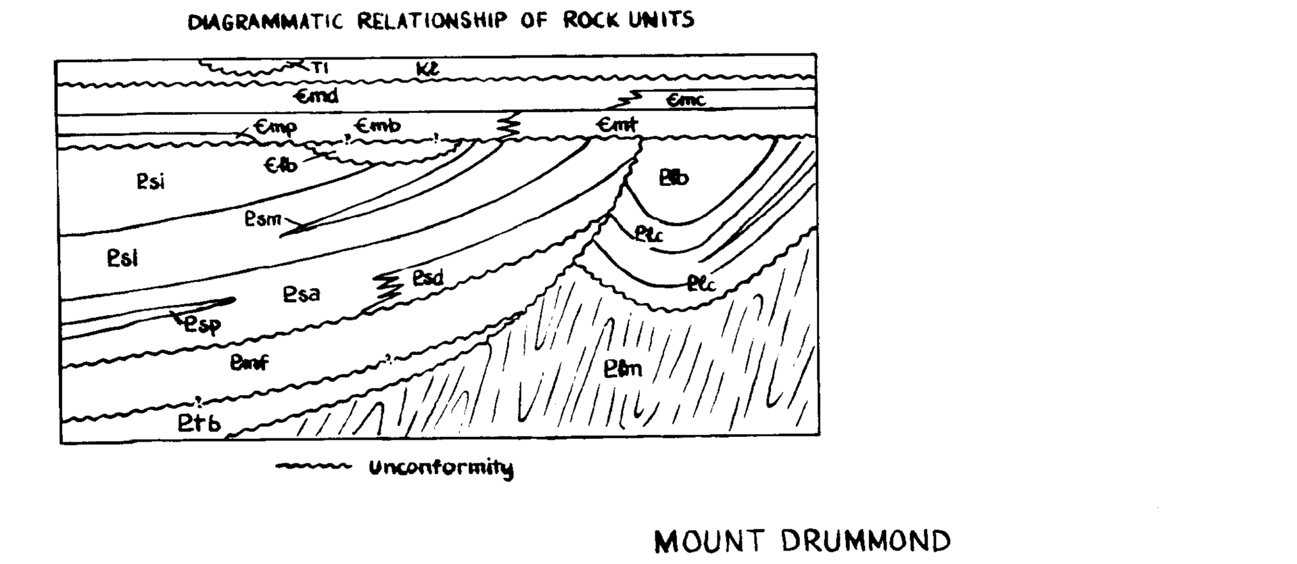
S Spring

Sand dunes

910' Barometric spot height, datum: mean sea level

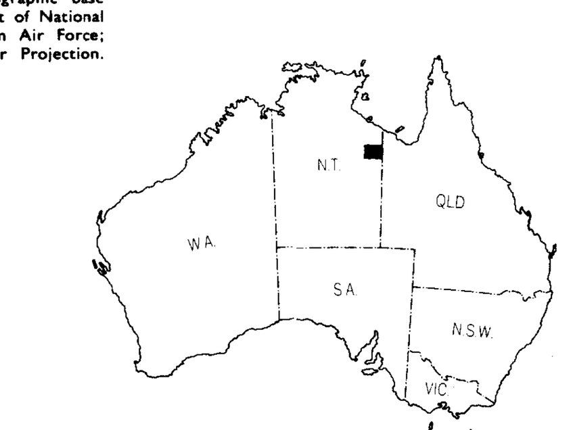
Astro station

DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS



Unconformity

Compiled and published 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 coverage at 1:50,000 scale. Transverse Mercator Projection.



INDEX TO ADJOINING SHEETS

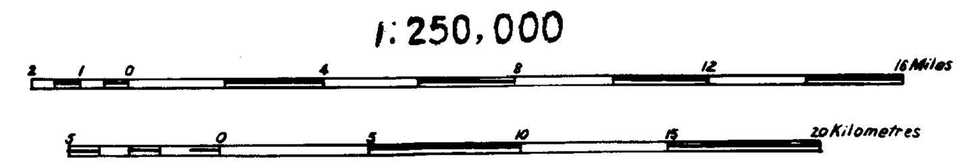
Showing Magnetic Declination

WALLHALLOW	CALVERT HILLS	WESTMORELAND
BRUNETTE DOWNS	MT DRUMMOND	LAWN HILL
ALROY	RANKEN	CAMOOWEAL

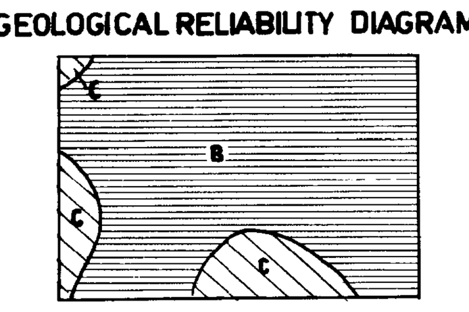
Annual Change 1'E

Scale

1:250,000

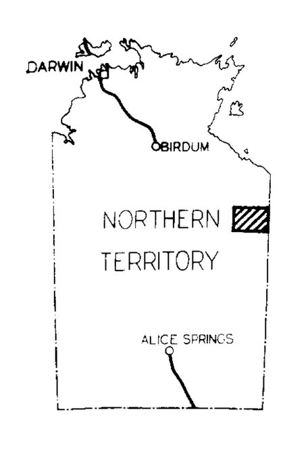


GEOLOGICAL RELIABILITY DIAGRAM



B Reconnaissance — regional traverses and air-photo interpretation

C Air-photo interpretation only



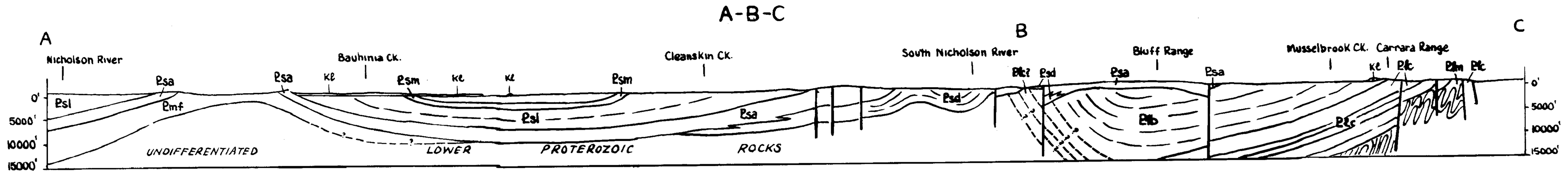
Geology, 1959, by: J.W.Smith and H.G.Roberts
Compiled, 1961, by: H.G.Roberts
Drawn by: H.G.Roberts

Sections

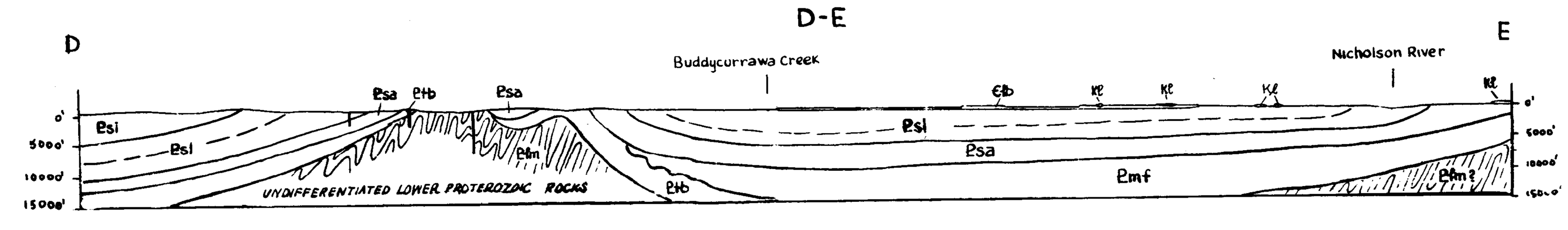
Scale V/H = 1

(Cainozoic rocks omitted from sections)

A-B-C



D-E



MOUNT DRUMMOND
Sheet SE 53-12

Copies of this map may be obtained from the Bureau of Mineral Resources, Geology and Geophysics, Canberra, A.C.T., or Darwin, N.T.