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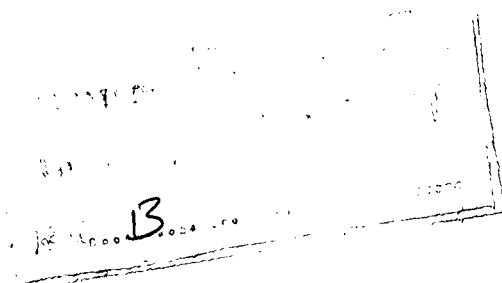
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THE GEOLOGY OF THE ELKEDRA 1:250,000 SHEET  
NORTHERN TERRITORY

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by

K.G. Smith and E.N. Milligan



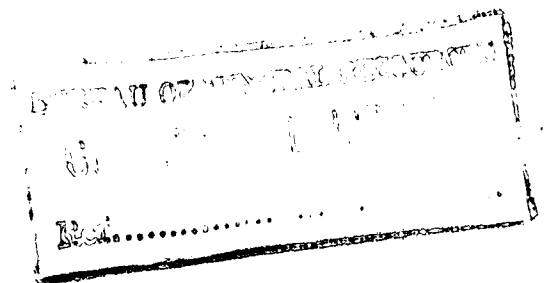
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THE GEOLOGY OF THE ELKEDRA 1:250,000 SHEET  
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SUMMARY

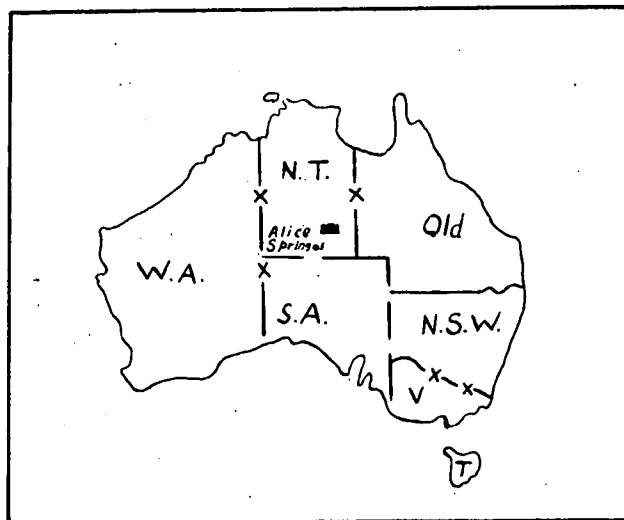
During the 1961 field season a field party from the Geological Branch of the Bureau of Mineral Resources, Geology and Geophysics completed the mapping of Palaeozoic sediments exposed on the Elkedra 1:250,000 Sheet, Northern Territory. This programme had been partly completed by the same field party in 1960, and Precambrian rocks in the north-western part of the Elkedra Sheet were mapped by a Bureau party in 1956. The 1960 and 1961 surveys were part of a regional survey of the Georgina Basin and they linked the Palaeozoic geology of the Elkedra Sheet to that of the adjoining Huckitta and Tobermory Sheets, which had been mapped previously, and to the adjoining Sheets of Barrow Creek and Alcoota which were mapped during 1961.

On the Elkedra Sheet, richly fossiliferous lower Middle Cambrian sediments (the Sandover Beds) dip south and east off the margins of Precambrian rocks exposed in the Davenport Ranges, which occupy the north-western quadrant of the Sheet area. In the south-western part of the Sheet the Sandover Beds consist of a basal sandstone and pebble conglomerate which is succeeded by siltstone, shale and limestone; outcrop is generally poor and discontinuous, and the total thickness of the Sandover Beds is estimated to be of the order of 800 feet. In this south-western area, the Sandover Beds are overlain unconformably by poorly-outcropping, fossiliferous sandstone, of late Upper Cambrian age, which forms the lower part of the Tomahawk Beds; these Beds are overlain unconformably by the Dulcie Sandstone, of Devonian age.

In the eastern part of the Elkedra Sheet there is very little outcrop, and sand conceals most of the underlying rocks. The Sandover Beds dip east off the eastern margin of the Davenport Ranges but only the lower parts of the Middle Cambrian sequence are exposed. From the region of Annitowa homestead, ridges of carbonate rocks, with interbeds of quartz sandstone, trend south-west for about 40 miles, and dip gently to the south-east. No fossils have been found in these beds which are about 300 feet thick; in the Annitowa area, records of water bores indicate that they are underlain by a non-outcropping sequence of carbonate rocks at least 300 feet thick. The age of these carbonate sequences is regarded tentatively as Upper Cambrian.

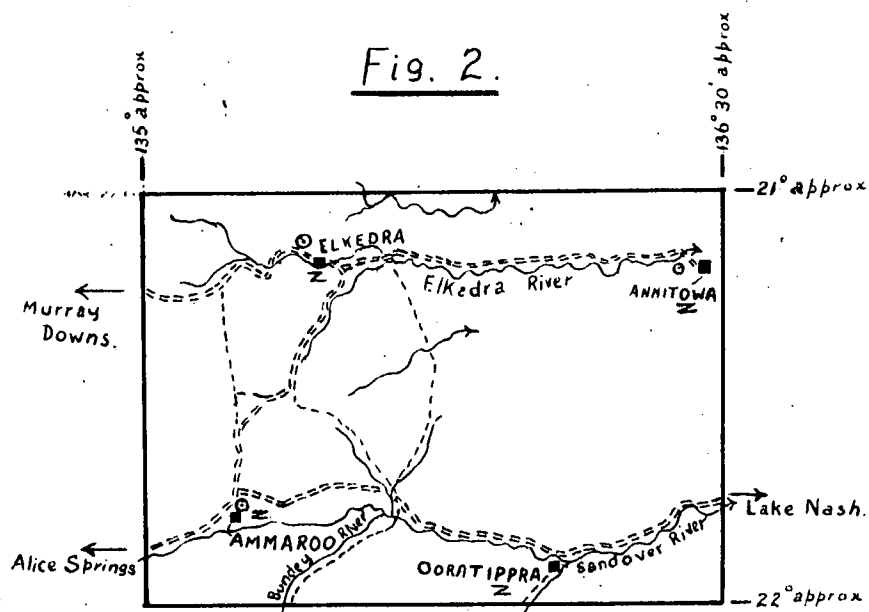
Because of the meagre outcrop, the petroleum prospects are difficult to assess on the basis of surface mapping alone; from considerations of regional geology, the Palaeozoic sequence should thicken to the east of the Davenport Ranges, but there are no suitable surface structures, and the geological history is practically unknown. In the south-western part of the Sheet, natural gas was encountered during the drilling of a water bore on Ammaroo Station in 1956, but in this area there are no

Fig. 1



Locality Map, showing ELKedra area.

Fig. 2.



Locality Map.

Scale: 32 Miles to 1 inch.

Reference:

- == Road
- Vehicle Track
- Homestead
- Landing Ground
- z Transceiver.

obvious surface structures and the transgression of late Upper Cambrian sediments over the Sandover Beds detracts from the prospects.

Numerous successful water bores have been drilled into fractured Sandover Beds and into sandstone of the Tomahawk Beds. In the Annitowa area five successful water bores have been drilled into the non-outcropping carbonate sequence of probable Upper Cambrian age. All available data on water bores of Ammaroo and Annitowa Stations have been collected and are presented as an Appendix to this report.

### INTRODUCTION

In 1961, a field party consisting of K.G. Smith and E.N. Milligan, from the Geological Branch of the Bureau of Mineral Resources, Geology and Geophysics, completed the regional mapping of the Palaeozoic sediments exposed on the Elkedra 1:250,000 Sheet. This survey began in 1960 when a small area was mapped in the south-eastern part of the Sheet (Smith, Vine and Milligan, 1961 unpubl.). Precambrian sedimentary and igneous rocks, which crop out in the north-western part of the Elkedra Sheet, had been mapped previously (Smith, Stewart and Smith, 1961). The areas mapped on each of the three surveys are shown on Figure 4.

The specific objects of the 1961 survey were:

- (a) To map the area at photo scale and to link the mapping with that done already on the adjoining Huckitta and Tobermory Sheets and with that currently in progress on the Barrow Creek and Alcoota Sheets which adjoin Elkedra to the west and south-west respectively.
- (b) To measure sufficient stratigraphic sections to establish the sequence and its variations.
- (c) To assess the petroleum prospects, mineral potential and underground water potential of the area.

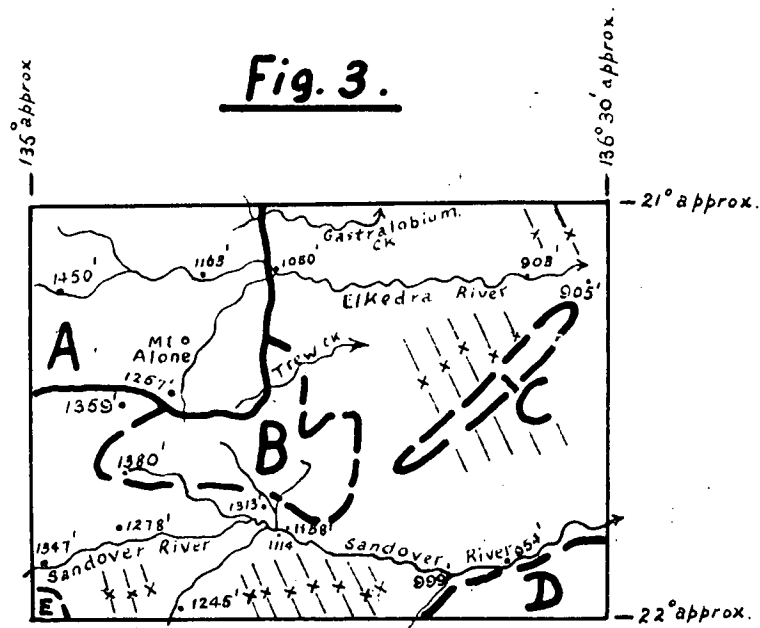
A complete air photograph cover at 1:50,000 scale was available from photographs taken by the Royal Australian Air Force in 1950. In the field, observation points and specimen localities were marked on the photographs, and notes on these points were recorded in field note-books. Controlled templates at photo scale were provided by the Division of National Mapping; geology was transferred to the templates, which were then reduced photographically to 1:250,000 scale.

### Area:

The Elkedra Sheet is bounded by the 21st and 22nd parallels of south latitude and the meridians of 135 degrees and 136 degrees 30 minutes of east longitude, and it occupies about 7,000 square miles of land surface.

### Location and Access:

Figure 1 shows the location of the Elkedra Sheet area with reference to the town of Alice Springs. Figure 2 shows the major roads of the area, and the more important vehicle tracks. In addition there are numerous roads

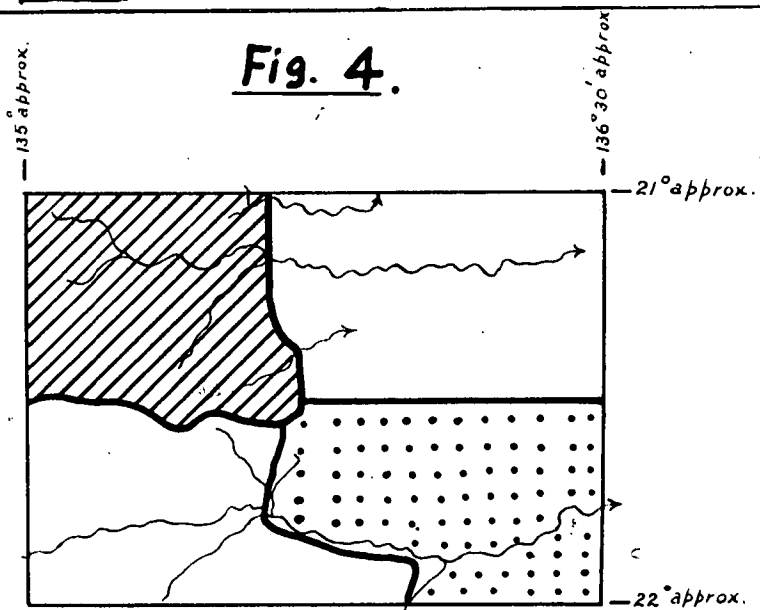


Topographic Map.

Scale: 32 Miles to 1 inch.

Reference:



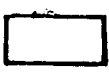
- A** Davenport Range area
- B** Low, heavily-dissected hills.
- C** Belt of low, discontinuous ridges.
- D** Mesas and low, discontinuous hills.
- E** Dulcie Range



Plan. showing areas mapped

Scale: 32 Miles to 1 inch.

Reference:

-  Area mapped 1956.
-  Area mapped 1960.
-  Area mapped 1961

leading to watering places for stock. All of the major roads are formed, with an earth surface; they may become impassable for several days after heavy rainfall.

#### Communications:

The area has no normal telegraph and telephone facilities and there is no scheduled service for surface mail. All of the station homesteads (see Figure 2) operate transceivers which are linked with the Alice Springs Base Station of the Royal Flying Doctor Service. This Service provides prompt medical attention and transmits and receives telegrams. From its base at Alice Springs, Connellan Airways operates a weekly mail, passenger and freight service to most of the cattle stations in the area.

Alice Springs is the northern terminus of the railway operated by Commonwealth Railways from Port Augusta; the service provides two passenger rail services per week in winter and one per week in summer.

#### Climate:

Long, hot summers and short, mild winters are normal. Throughout the year the prevailing wind blows strongly from the south-east.

#### Water Supplies:

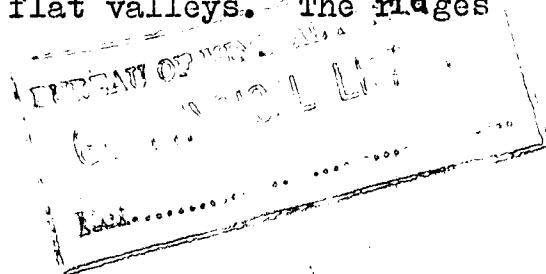
The average annual rainfall is 10 inches but it is very unreliable. There is little surface runoff except in the Davenport Ranges (in the north-west) and therefore the supplies of natural surface water are small. In the western part of the Elkedra River system, the river and some of its important tributaries contain several large but impermanent waterholes; in the eastern (flood-out) area there are two waterholes in the Elkedra River but neither is permanent. A waterhole at the junction of the Bunday and Sandover Rivers retains water for reasonable periods after heavy rainfall.

The pastoral industry relies mainly on water supplies from sub-artesian bores. There are some earth tanks and dams but these suffer a high loss by evaporation in summer months.

#### Topography:

Figure 3 shows the main drainage system, some levelled heights (obtained by surveyors from the Department of the Interior) and the main areas of hills. The remainder of the area covered by the Elkedra Sheet is either gently-undulating, soil-covered country, or sand plain with low, broad dunes.

Area A on Figure 3 contains the Davenport Ranges, which form the only rugged topography in the Sheet area. The Ranges consist of steep-sided, flat-topped, roughly-parallel ridges, separated by wide, flat valleys. The ridges





rise generally about 200 feet above the valley floors; the tops of the ridges are about 1600 feet above mean sea-level.

The hills of Area B are capped by silcrete and are, generally low and heavily-dissected, with a characteristic radial drainage pattern. In the west-central part of this area the erosion level has been lowered below the silcrete capping and the drainage is aligned with low, parallel ridges.

In Area C there is a discontinuous north-east trending belt of ridges which rise about 200 feet above the level of the surrounding country; the country around the base of these ridges is usually rough, with numerous cavities, in dolomite, filled with blown sand.

Area D contains low, discontinuous hills and mesas; the highest mesas rise about 200 feet above the surroundings. Area E contains low, flat-topped hills flanking the northern scarp of the Dulcie Range.

#### Vegetation:

Low, sparse, stunted shrubs, and spinifex, are the only vegetation over much of the area. However, thick stands of mulga occur to the north and north-west of Ammaroo homestead, and gidyea is common in areas underlain by dolomite and limestone.

#### PREVIOUS INVESTIGATIONS

H.Y.D. Brown made the first geological reconnaissance in the Elkedra area, traversing part of the Davenport Ranges (Brown, 1896). In 1898, A.A. Davidson led a prospecting team through part of the area (Davidson, 1905). At a locality 45 miles south-east from the (old) Elkedra homestead Davidson collected fossils which Etheridge (1902) described as Pagetia significans (Eth) and Peronopsis elkedraensis (Eth). Whitehouse (1936) re-described these fossils.

Hossfeld (1954) published observations on the geology of the Elkedra area, in an account of the stratigraphy and structure of the Northern Territory. Opik, Noakes and Casey, in 1953, made a geological reconnaissance along the Sandover River. Opik, (1957) gave the informal name 'Sandover Beds' to the lower Middle Cambrian sediments which crop out between the Davenport Ranges and the Sandover River; he described the lithology of the sediments and identified several fossils which occur in them.

In 1956, Smith, Stewart and Smith (loc.cit.) mapped the Precambrian rocks in the Davenport Range area of the Elkedra Sheet; in the same year Mackay and Jones reported the geology of Palaeozoic sediments in an area to the north-east of Ammaroo station where an occurrence of natural gas had been reported in a water bore. (Mackay and Jones, 1956 unpubl.) This area was inspected during 1956 by several geologists from exploration companies interested in the occurrence.

Hurley et al. (1961) and Walpole and Smith (1961) recorded the age and geological setting of a granite sample collected from the Elkedra area and dated by the Potassium-Argon ratio method.

On numerous occasions between 1952 and 1960 officers from the Bureau's Resident Staff at Alice Springs made geological observations in the area of the Elkedra Sheet. These officers include Bell, Firman, Jones, Catley, Quinlan and Woolley; their observations are not documented but have been made freely available to the present authors.

## GEOLOGY

The Lower Proterozoic Hatches Creek Group and associated intrusive rocks form the basement in the area. The oldest Palaeozoic rocks are the Sandover Beds, which dip off the basement at low angles; the next youngest sediments belong probably to the Upper Cambrian Arrinthrunga Formation, but there is much concealed ground between outcrops of the two units and the sequence could include non-outcropping units of middle Middle Cambrian age. The next youngest outcrops are sandstones of the Cambro-Ordovician Tomahawk Beds; these are overlain unconformably by the Dulcig Sandstone, of Devonian age.

The names for Groups, Formations and Beds used in this report have previously been accepted by the Territories Committee on Stratigraphical Nomenclature and are in accordance with the Australian Code.

### Precambrian

#### Lower Proterozoic

Hatches Creek Group. Hossfeld 1954 (loc.cit.) named this Group in the Hatches Creek area, on the adjoining Frew River Sheet. Smith, Stewart and Smith, (loc.cit.) traced the Group from the Hatches Creek area southwards into the north-western quadrant of the Elkedra Sheet.

The Hatches Creek Group is confined mainly to the north-western part of the Elkedra Sheet, but scattered inliers occur to the south of Andagera Bore. The southern and eastern margins of outcrop of the Group are easily determined but its extent in the subsurface to the south and east of the Davenport Ranges is unknown. The geology of the Hatches Creek Group has been reported previously by Smith, Stewart and Smith (loc.cit.) and will not be repeated here.

### Palaeozoic

#### Middle Cambrian

The Sandover Beds. Opik (1957, loc.cit.) recorded well-preserved lower Middle Cambrian trilobites from "friable mudstone, shale and chert"; he gave the informal name 'Sandover Beds' to these sediments. Smith, Stewart and Smith (loc. cit.) extended this name to include unfossiliferous sandstone and conglomerate which form the basal part of the sequence on the southern margin of the

Davenport Ranges. Smith, Vine and Milligan (1961, loc.cit.) followed this usage.

The Sandover Beds form the low hills flanking the south and south-east margins of the Davenport Ranges (refer area B, Figure 3). Outcrops of the fine-grained sediments are generally poor in the south-east and here the hills are capped by a silcrete which has resulted in distortion, and sometimes even eradication, of the bedding structures. In the northern-central area erosion has cut back the silcrete to reveal good outcrop.

Four units comprise the Sandover Beds but only the basal unit can be mapped with accuracy. The approximate distribution of the four units is shown in Figure 5. Details of these units are as follows:

1. The basal arenite-rudite unit. This is a well-defined unit which forms good exposures along the southern and south-eastern margins of the Davenport Ranges. The thickness of the unit ranges from 30 to 120 feet; representative sections of it and their location are shown in Figures 6, 7, 8 and 9.

The rudites are usually poorly-sorted pebble conglomerates with much sandstone matrix. The pebbles are predominantly quartzite and quartz sandstone of the Hatches Creek Group, with some vein quartz. Boulder conglomerate occurs rarely but a local boulder breccia with blocks up to 4 feet across occurs near Andagera Bore.

The arenites are predominantly cross-bedded, granular and pebbly sandstones which are occasionally micaceous and commonly have ripple marks and mud flake casts. Micaceous siltstones occur rarely in these beds; they are buff and purple with green mottling and rarely exceed 10 feet in thickness.

2. The lutite unit. This forms the major part of the Sandover Beds and crops out over a wide area; however, the dips are low and it is estimated that the total thickness exposed does not exceed 500 feet. This unit is remarkably uniform; minor variations occur from bed to bed but these variations alternate so rapidly that it is impracticable to establish marker beds. Fluctuations in the amount and size of fossil fragments, mica flakes and sand grains in the bedding laminae are reflected by variations in the thickness of bedding. In general, the thicker beds (4-6 inches) contain large fragments and complete specimens of Xystridura with scattered agnostids; the thin beds contain rich accumulations of smaller specimens of Xystridura, and agnostid fragments.
3. The limestone unit. This crops out in the western part of the Sandover Bed outcrop. The older beds are poorly exposed; they are usually either highly silicified or laterised and the presence of limestone in the subsurface is inferred by the irregular attitude of the fossils and the nodular nature of the chert fragments on the surface. This contrasts with the platy chert chips of the lutite unit which have the fossils oriented to the bedding laminae. Occasional

sink holes reveal calcareous rock below the overall surface. The fauna at this level of the limestone unit is composed mainly of ptychopariid trilobites, linguloid brachiopods and an occasional large archeostracan.

Good exposures of limestone occur above these older beds, at a locality a few hundred yards south of Limestone Bore. These limestones are for the most part sub-lithographic zoogenous and algal limestones. Oolitic limestone occurs to the east where the limestone thins out and interfingers with lutite beds containing a rich Pagetia fauna. A part-section was measured in good exposures of unit 3 to the south of Limestone Bore (location in fig. 10) and the sequence is given below:

Top of rise

40	feet of	<u>limestone</u> ; poorly-exposed;
$\frac{1}{2}$	foot of	<u>algal limestone</u> with bioclastic matrix;
40	feet of	<u>limestone</u> ; bioclastic, grey medium-bedded;
18	feet	concealed;
2	feet of	<u>limestone</u> ; bioclastic; grey
3	feet of	<u>limestone</u> ; blue, sub-lithographic, with small archeostracans and lingulids, and a few agnostids; (sample No. E 10.)
12	feet of	<u>limestone</u> ; bioclastic; grey.
15	feet	concealed;
2	feet of	<u>limestone</u> ; bioclastic, grey medium-bedded;
6	feet of	<u>limestone</u> ; massive, ?algal, blue, with small abundant fossil fragments;
26	feet of	<u>limestone</u> ; sub-lithographic, blue grey thin to medium-bedded; with occasional concretionary nodules with large <u>Bicomulites</u> sp. (Sample No. E20); alternating with bioclastic <u>limestone</u> ;
9	feet of	<u>limestone</u> ; well-bedded, sub-lithographic, dark grey, with numerous <u>Pagetia</u> and lesser numbers of other agnostid trilobites; (Sample No. E9.)
<u>175</u>	feet approx,	thickness of part section, whose base is not exposed

4. The white siltstone unit. The exact extent of this unit is unknown but it seems to form the bulk of the south-western outcrop of the Sandover Beds. In most places the outcrops are of chert which is readily distinguished from the highly silicified rocks of the lutite unit by the virtual absence of fossils (except in thin coquinite bands).

The best outcrop occurs in a hill 2 miles west of Discovery Bore. Here, 50 feet of white, unfossiliferous, soft, micaceous siltstone is exposed. Rare thin bands of silicified coquinite occur, crammed with biconulites. A thin coquinite band with small hyolithids and trilobites located on the Sandover highway some 8 miles west of No. 12 Bore is considered to belong to this unit, because of lithological similarity.

To the east of the Davenport Ranges there are no exposures of indubitable lower Middle Cambrian sediments. Most of this area is covered by sand; along the Elkedra-Annitowa road there are a few small patches of white and buff chert but they are apparently unfossiliferous and whilst their age is almost certainly Cambrian, no subdivision may be made. A sequence of carbonate rocks in the Annitowa area may be of Middle Cambrian age but no fossils have been found in it and on lithological grounds the succession is referred to the Upper Cambrian.

#### Upper Cambrian

Smith, Vine and Milligan (1961 loc. cit.) mapped the Upper Cambrian Arrinthrunga Formation and the overlying Cambro-Ordovician Tomahawk Beds, in the south-eastern part of the Elkedra Sheet where they are continuous with well-dated units on the adjoining Huckitta Sheet. These authors also reported low, discontinuous outcrops of carbonate rocks with interbedded quartz sandstone extending towards Annitowa homestead and they placed these beds tentatively in the Arrinthrunga Formation.

During the 1961 field season, Upper Cambrian sandstone of the Tomahawk Beds was mapped in the western part of the Elkedra Sheet and the ridges of predominant carbonate rock were traced from Annitowa homestead southwest to link with the mapping done in the previous year. The two areas will be considered separately.

- (a) the eastern area. Low ridges of carbonate rocks extend for about 40 miles south-west from Annitowa homestead, and on the plains to the west and north of this homestead there are low outcrops and 'near outcrops' of carbonate rocks. To date no fossils have been found in any of these sediments.

The ridges continue eastward from Annitowa homestead on to the adjoining Sandover River Sheet, which has not yet been mapped. Because the mapping is incomplete no formal name is yet proposed for the carbonate sequence.

To the east of Annitowa homestead an estimated 300 feet of section is exposed poorly; it consists of an estimated 150 feet of red and brown, friable quartz, <sup>sandstone with chert and</sup> weathered dolomite, overlain by an estimated 150 feet of buff and light grey, fine-grained limestone, oolitic limestone and thin, soft, grey, calcareous sandstone. The regional dip is to the south east, at a low angle; however, there are numerous small local flexures with dips ranging to 30 degrees; these flexures, and the poor nature of the outcrops have prevented the reliable measurement of sections.

To the south-west of Annitowa homestead, dolomite becomes more abundant in the sequence and there are also numerous beds of green and purple siltstone. Quartz sandstone too becomes prominent and there are numerous beds and lenses, with total thickness ranging to 75 feet. The sandstone is weathered to a prominent orange colour but fresh samples are fairly clean, medium-coarse grained, white in colour and have numerous ripple marks. Regional dips are again to the south-east, at low angles, and the total thickness exposed is estimated to be 300 feet.

The lithology of this carbonate sequence in the eastern area bears general resemblance to that of the top part of the Arrintherunga Formation, of Upper Cambrian age; the sequence could dip south-east under the Tomahawk Beds, or it may be equivalent to these Beds. Another possibility is that the sequence is of Middle Cambrian age. Because wide expanses of sand conceal sequences above and below this unfossiliferous carbonate sequence its age is entirely speculative, although it is certainly Palaeozoic. During 1962 the Bureau cored two shallow holes at the base of the outcropping carbonate sequence in the Annitowa area, but no fossils were obtained. For the present, the authors refer the sequence to the Upper Cambrian.

- (b) the western area. The Tomahawk Beds (named by Smith, Vine and Woolley, 1960, unpubl.) extend from the Huckitta Sheet onto the south-western part of the Elkedra Sheet. Low outcrops have been mapped at Corella Bore, on the northern side of the Sandover River, where fossil sample No. 15 was collected. Other richly fossiliferous outcrops have been mapped to the east of Bluebush Bore and in this area the following sequence has been measured: (location in fig. 11).

Devonian sandstone unconformably overlying

- 125 feet of quartz sandstone; white and red, leached, with many small worm trails, rare cruzianas, and very small trilobite fragments;
- 10 feet of sandstone; white, soft, fine grained, thin-bedded, with worm trails and rare fossil fragments.

- 4 feet of sandstone; hard, white and yellow, medium-grained, medium-bedded, cross-bedded, with a rich fauna on bedding and cross-bedding faces; trilobite fragments up to 2 inches; Sample No. ~~E 17~~ 17;
  - 19 feet of sandstone and siltstone; thin-bedded, with trilobite fragments;
  - 12 feet of sandstone; soft, white, fine-grained, with interbeds of white siltstone;
  - 2 feet of chert; semi opaline with opal veins;
  - 5 feet of sandstone; white and yellow, soft, with trilobite fragments and numerous ribeirioids;
  - 35 feet of sandstone; soft, yellow, with worm trails and trilobite fragments; alternating with sandstone; red and grey, with trilobite fragments and numerous ribeirioids; Sample No. E18;
  - 35 feet concealed;
  - 40 feet of sandstone; red-brown weathering, glauconitic, extremely rich in ribeirioids; Sample No. E19;
  - 4 inches of limestone; grey-weathering, glauconitic;
- 282 feet thickness of part-section, whose base is not exposed.

The fossils in Samples Nos. 17-19, from this section, and in E 15, from Corella Bore, are of Upper Cambrian age (Opik and Tomlinson, pers. comm.). No Ordovician fossils have been obtained from the Tomahawk Beds exposed on the Elkedra Sheet.

Interbedded sandstone and white, micaceous siltstone crops out in many small areas west of the road between Honeymoon and McRob Bores; the outcrops extend westward to the western boundary of the Elkedra Sheet. The sandstone is usually strongly weathered and no fossils have been found either in the sandstone or the siltstone interbeds. Because of lithological similarity to fossiliferous Upper Cambrian/<sup>Barrow</sup>Creek Sheet, these sediments on the Elkedra Sheet are placed in the Tomahawk Beds. Finely crystalline pale green grey limestones, lying topographically below these sandstones, crop out south and east of McRob Bore. These are considered to be part of the Upper Cambrian sequence due to their lithologic affinities with Upper Cambrian carbonate rocks elsewhere. Although no outcrops have been located in most of the area between the Sandover and Bunday Rivers, it is believed that most of this area is underlain by the Tomahawk Beds; this possibility coupled with the distribution of outcrops of Tomahawk Beds indicates, on the Elkedra Sheet, that Upper Cambrian sediments of the Tomahawk Beds have transgressed the Middle Cambrian Sandover Beds and have overlapped on to the Precambrian Hatches Creek Group.

Early in 1962 the Bureau cored two shallow holes to test this theory; an Upper Cambrian fossil was obtained in Core No. 1, at 173 feet, in hole No. Grg 5; the second hole was drilled in the Barrow Creek Sheet and penetrated Devonian sandstone.

### Devonian

The Dulcie Sandstone, of Upper Devonian age (Smith, Vine and Woolley, 1960 unpubl.) continues from the Huckitta Sheet on to the south-western corner of the Elkedra Sheet. Outcrops are low and discontinuous on the Elkedra Sheet; no fossils have been found there but they have been found previously on the Huckitta Sheet and, in 1962, were found on the Barrow Creek Sheet on extensions of the outcrops in the Elkedra area.

### ECONOMIC GEOLOGY

The prospects for petroleum and underground water form the main subjects in this section of the report. No ore minerals have been mined in the Palaeozoic rocks exposed on the Elkedra Sheet; galena has been recorded in samples of limestone from Discovery Bore but no occurrence of sedimentary lead have been observed in outcrops of carbonate rocks. The small inliers of Precambrian rocks have been examined unsuccessfully for copper and wolfram (small deposits of these minerals have been worked in Precambrian rocks on the Elkedra Sheet).

#### (a) Underground water.

The logs of Government Stock Route Bores Nos. 12-16 inclusive were reported by Smith, Vine and Milligan (1961, loc. cit.); during the 1961 field season all available information re bores on Ammaroo and Annitowa Stations was collected. Most of this information was obtained from records held by the Bureau's Resident Geologist at Alice Springs, but was supplemented by information from local pastoralists and from drillers. The data are given in Appendix A; the information is incomplete in some cases, particularly for bores which were unsuccessful.

All of the bores are sub-artesian; most are equipped with windmills, some are equipped with engine only, and some have an engine in addition to the windmill. Whilst individual opinions differ about the requirements of a successful stock bore, in general the bore is required to produce a minimum of 600 gallons per hour, from a pump depth which does not exceed 600 feet.

In the area mapped during 1961, most pastoral holdings have sufficient water for their needs and the demand for new bore sites is not expected to be heavy because stocking capacity probably could not be increased greatly. There is a large area of unoccupied country but this is of a type useful for drought relief but not for continuous grazing.



In Palaeozoic sediments, several successful bores have been drilled into the Sandover Beds. These sediments do not appear to be good aquifers and water probably is obtained from fractures in siltstone and from fractures and caverns in limestone. Numerous unsuccessful bores have been drilled into the Sandover Beds; some of these e.g., King's Bore, were drilled in places where the Sandover Beds were thin and the drill penetrated impervious Precambrian rocks. Other bores were abandoned because of technical difficulties in drilling hard limestone. In general, prospects of a bore beginning in the Sandover Beds are difficult to assess because of the uncertainty of sufficient fractures at depth and because the basement configuration is unknown. Nevertheless, the success rate of bores in the Sandover Beds is fairly high.

The Upper Cambrian sandstones of the Tomahawk Beds have yielded useful supplies of water on Ammaroo Station and in fact these beds have a good record everywhere in the region. In the Annitowa area five successful bores have been drilled into a non-outcropping sequence of carbonate rocks which underlie the carbonate sequence in the ridges trending south-west from Annitowa homestead. The drilling of these bores was generally hard and one early attempt was abandoned for this reason.

Although drilling may be hard, it is considered that good supplies of water may be obtained in the carbonate sequence, with interbedded quartz sandstone, which crops out in the ridges south-west from Annitowa homestead. Sites selected on the southern side of these ridges should be good prospects but there is no available indication of the position of the water table in this area. On the northern side of these ridges the prospects are highly speculative.

On the Elkedra Sheet there are no bores in the Dulcie Sandstone but elsewhere this formation has yielded good supplies of good quality water, at shallow depth.

#### (b) Petroleum prospects

Although natural gas was encountered in Discovery Bore, the petroleum prospects in thin Middle Cambrian sediments on the southern flanks of the Davenport Ranges may be slim. The subsurface lithology of these sediments is little known because no drilling other than drilling for water has been done in them. The Sandover Beds may contain source beds for petroleum, but the reservoir characteristics are unknown and there are no suitable surface structures. The party's mapping indicates that the Upper Cambrian Tomahawk Beds unconformably overlie the Sandover Beds and if this indication is correct it further decreases the petroleum prospects of the western part of the Elkedra Sheet.

In the eastern part of the Elkedra Sheet the petroleum prospects are difficult to assess because most of the area is concealed by sand, and the total lack of fossil evidence to date causes speculation about the age of the outcrops which are present. On a regional basis, the Palaeozoic sequence thickens to the east and south-east of the Davenport Ranges, but in detail no surface structures are known in the meagre percentage of outcrop and the history of sedimentation is quite incomplete. An adequate

assessment of petroleum prospects in this area requires geophysical work - the Geophysical Branch of the Bureau carried out a reconnaissance gravity survey of the whole of the Elkedra Sheet in 1961, but the results are not yet available. Seismic work in the eastern area may fail to get interpretable results through sequences of carbonate rocks, but an aerial magnetometer survey may be of considerable assistance in delineating the Precambrian basement (which is probably highly irregular and may be close to the surface at some places). To get additional information on the petroleum prospects, stratigraphic drilling would be required, based according to the assessment of geophysical results.

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APPENDIX "A"

Logs of Water Bores

(a) Ammaroo Station

	No.9 Govt.	No.10 Govt. (Honeymoon)	Corella	No.11 Govt. (Bull.Plain)
Elevation	1367'	-		
Total Depth	184'	-	115'	No inform-
Standing Water	125'	-		ation.
Level				
Water Struck at	-			
Pump Depth	-	-		
Date drilled	1948	-		
Supply	720 gph	-		
Driller's Log	0-40' soil 40-85' sand & gravel 85-103 yellow sandstone 103-117 brown sandstone 117-132 yellow sandstone 132-149 brown sandstone 149-164 yellow sandstone 164-184 brown sandstone.			

Author's Comments:

- No. 9      Almost certainly drilled into Upper Cambrian sandstone of the Tomahawk Beds.
- No. 10     Probably drilled into the Sandover Beds.
- Corella    Low outcrops of fossiliferous Upper Cambrian sandstone of the Tomahawk Beds are exposed 50 yards north of this bore and the drill should have penetrated these beds.
- No. 11     Drilled on a sand plain which may be underlain by Tomahawk Beds.

(ii)

	Megalong	King's (dud)	Limestone
Elevation			
Total Depth		317'	
Standing water		130'	
Level			
Water Struck at			
Pump Depth	400'		
Date Drilled		1952	1954
Supply	'Poor'	120 gph	
Driller's Log	No data	0-7' sand 7-41' stony seams 41-121' red clay 121-171' stony seams 171-191' red shale 191-201' stone bar 201-251' red sand- stone 251-276' brown sandstone 276-296' shale 296-316' red clay 316-317' granite.	No data

Authors' Comments:

Megalong. Drilled on a sand plain which may be underlain by Tomahawk Beds.

Kings. Drilled through Sandover Beds into Precambrian granite. Insufficient supply, hole abandoned.

Limestone. Drilled into the Sandover Beds.

(iii)

Bluebush

Arganara

Discovery

Elevation		
Total Depth	2008	425'
Standing Water Level	No data	
Water Struck at		
Pump Depth	191'	
Date Drilled	1950	
Supply	1200 gph	
Drillers' Log	0 - 8' soil 10 - 80' white clay 80 - 185' brown clay 185 - 200' coarse gravel	logged partly by B.M.R. and partly by Geosurveys of Australia Ltd.

Authors' Comments

Bluebush Probably drilled into Tomahawk Beds.

Arganara. Drilled into Sandover Beds and probably ended in the base of them.

Discovery Mainly limestone and calcareous dark shale, of the Sandover Beds. Rich fauna obtained.

	McRob	Hagen's	Dingley
Elevation	1300'		
Total Depth	195'	218'	
Standing Water Level	160'		
Water Struck at	-		
Pump Depth	-		200'
Date Drilled	1948		
Supply	800 gph	1200	
Driller's Log	0 - 20' gravel 20 - 30' sandst. one 30 - 44' blue clay 44 - 127' yellow ochre 127 - 164' brown ochre 164 - 195' sandst- one	not available	

Authors' Comments

McRob Drilled into the Sandover Beds.

Hagen's May have drilled through thin Tomahawk Beds into Sandover Beds.

Dingley. Probably drilled into the Tomahawk Beds.

(b) Annitowa Station

	No.1	No.2	No.3.	No.4	No.5
Elevation	900' approx				
Total Depth	280'	215'	255'	248'	209'
Standing Water Level				233'	
Water Struck at		150'			
Pump Depth	250'				
Date Drilled				1957	
Supply	1000 gph	1000 gph	900 gph	1000 gph	1000 gph
Driller's Log	Sedimentary layers of lime- stone and sandstone	Sediment -ary layers of lime- limest- one and sandst- one.	Very hard lime- stone all the way.	alluvium jasper & limestone yellow pug white pug white sand	No data

Authors' Comments

All of these bores have been drilled into a non-outcropping sequence of carbonate rocks which are probably of Upper Cambrian age. There is an unconfirmed report that No.1 Bore bottomed in feldspar but no details of this occurrence are available.

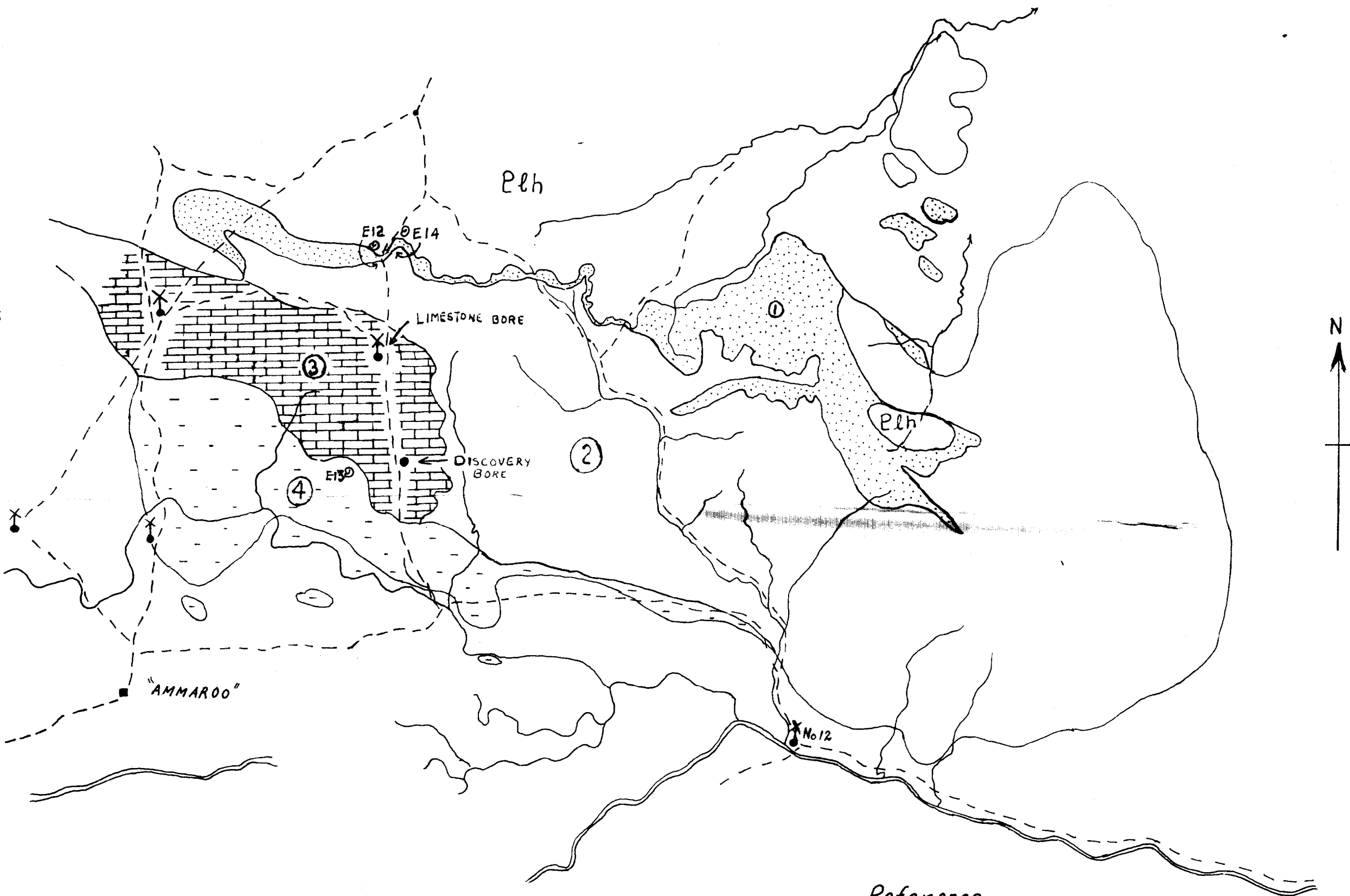


Fig. 5.

APPROXIMATE DISTRIBUTION OF SANDOVER BED UNITS



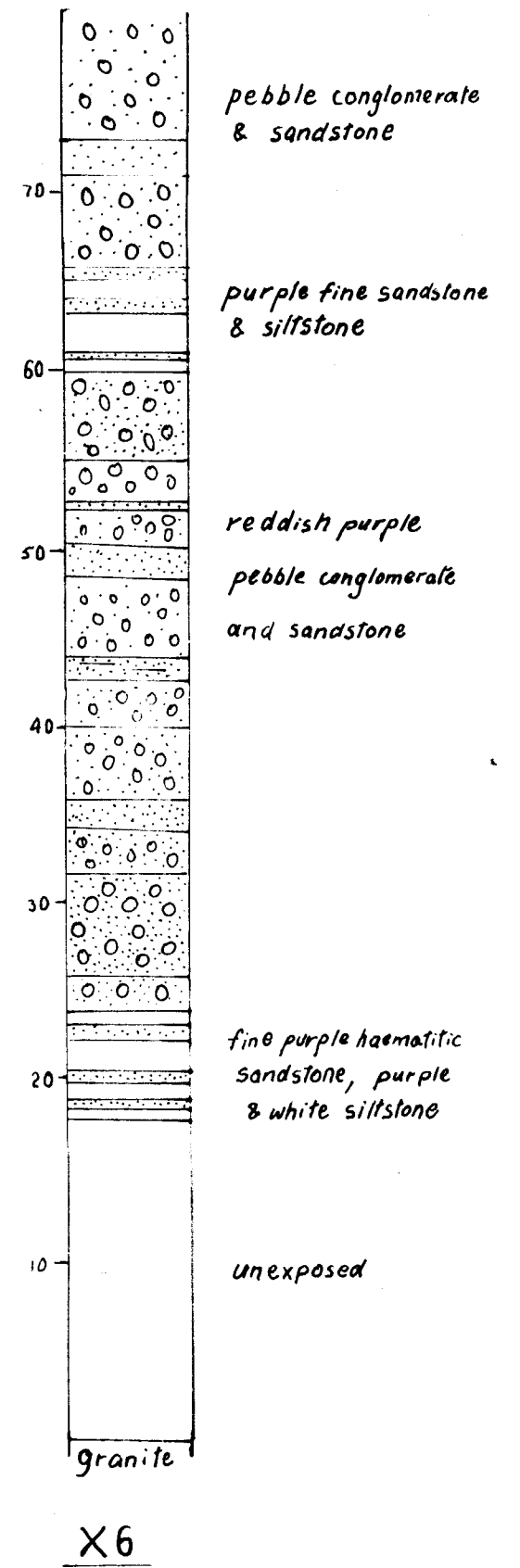
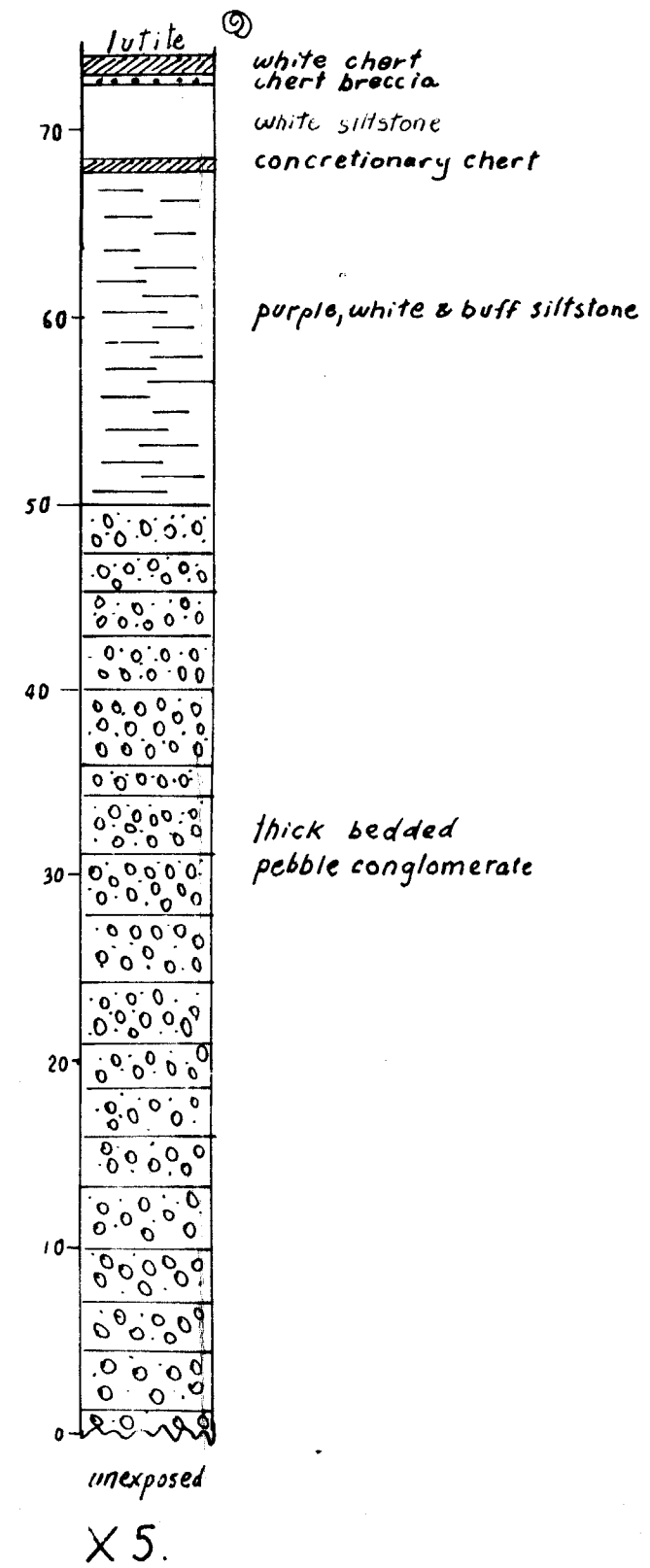
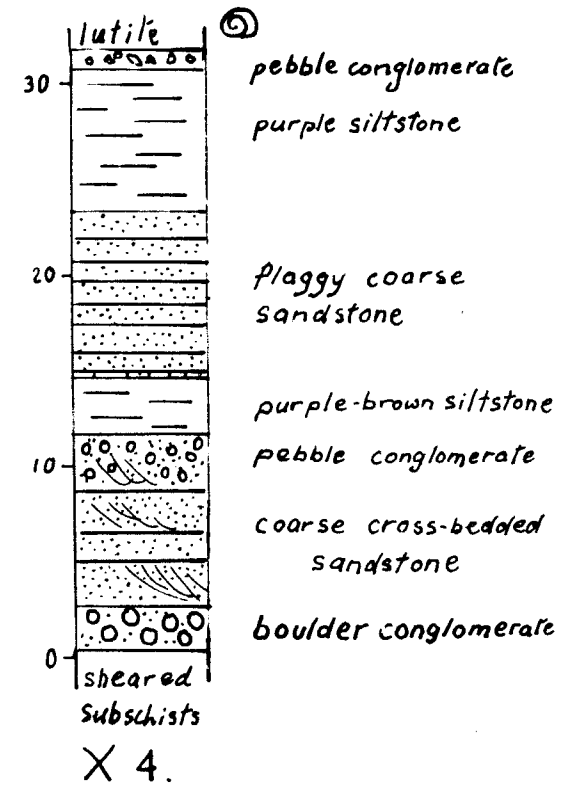
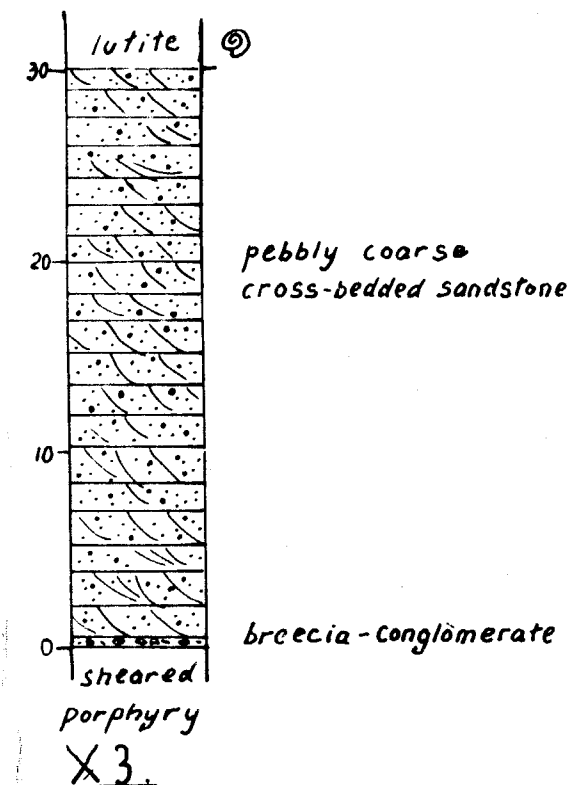
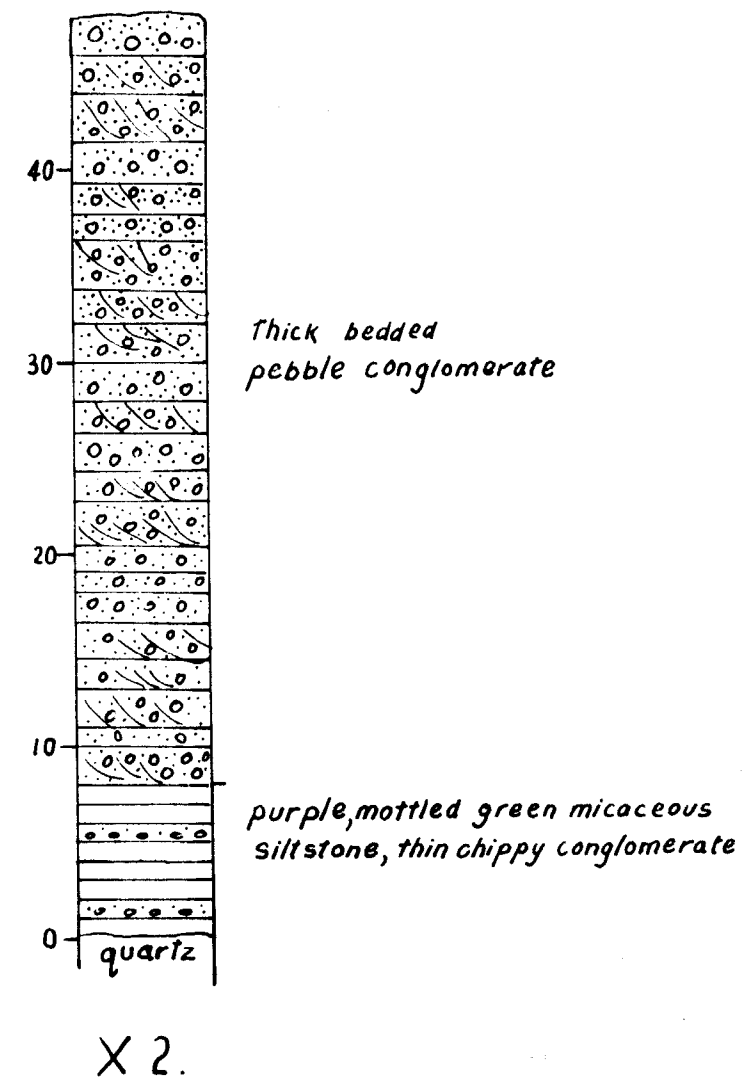
Reference

- ① Arenite-rudite unit
- ② Lutite unit
- ③ Limestone unit
- ④ White siltstone unit
- Roads & tracks
- Bore
- X Bore (equipped)

Plh Lower Prot. Hatches Creek Gp.



E



W

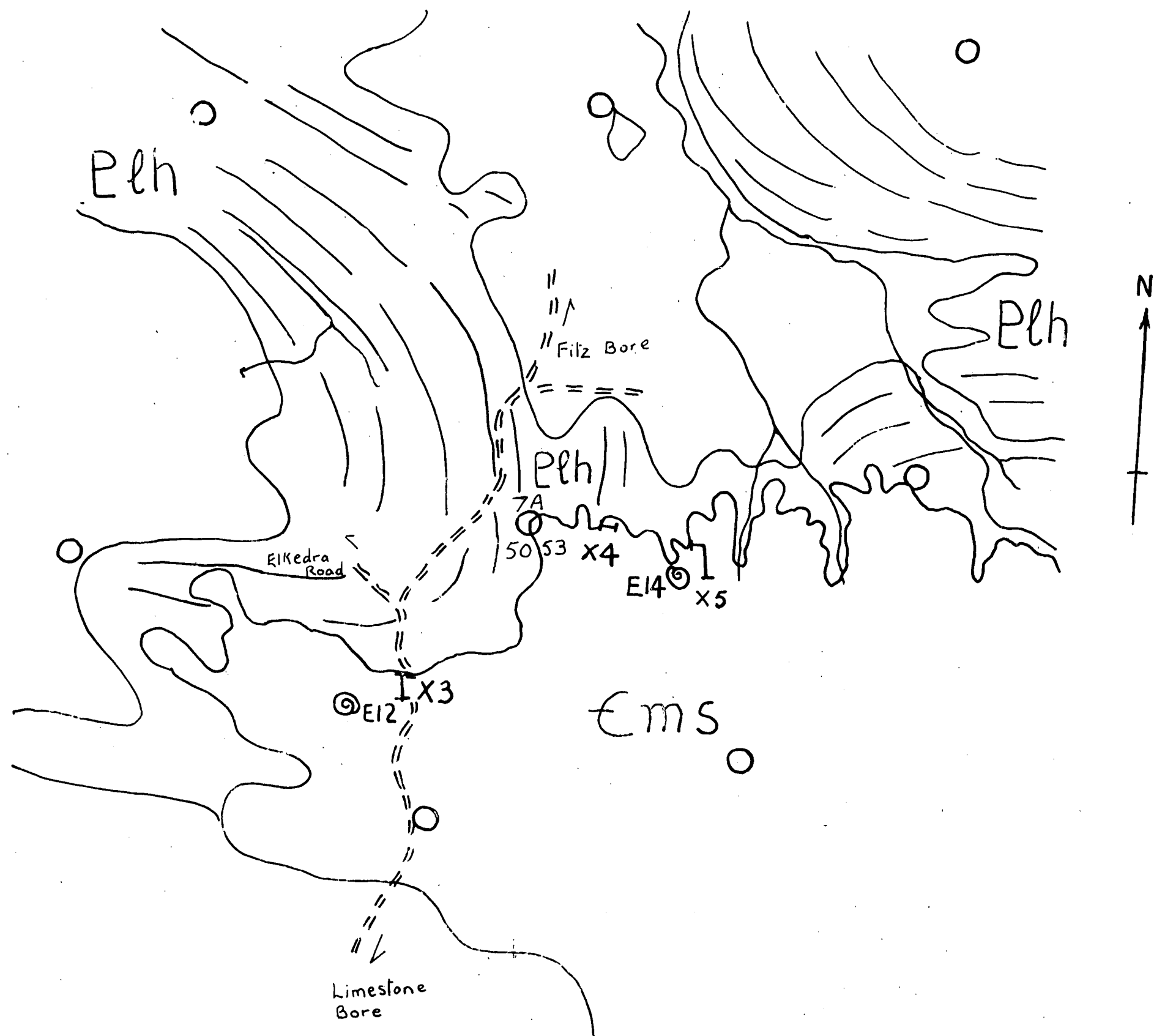
Vertical scale: 1 inch to 10 feet

Fig 6. REPRESENTATIVE SECTIONS THROUGH THE BASAL ARENITE-RUDITE UNIT - SANDOVER BEDS

Fig. 7. LOCATION OF MEASURED SECTION



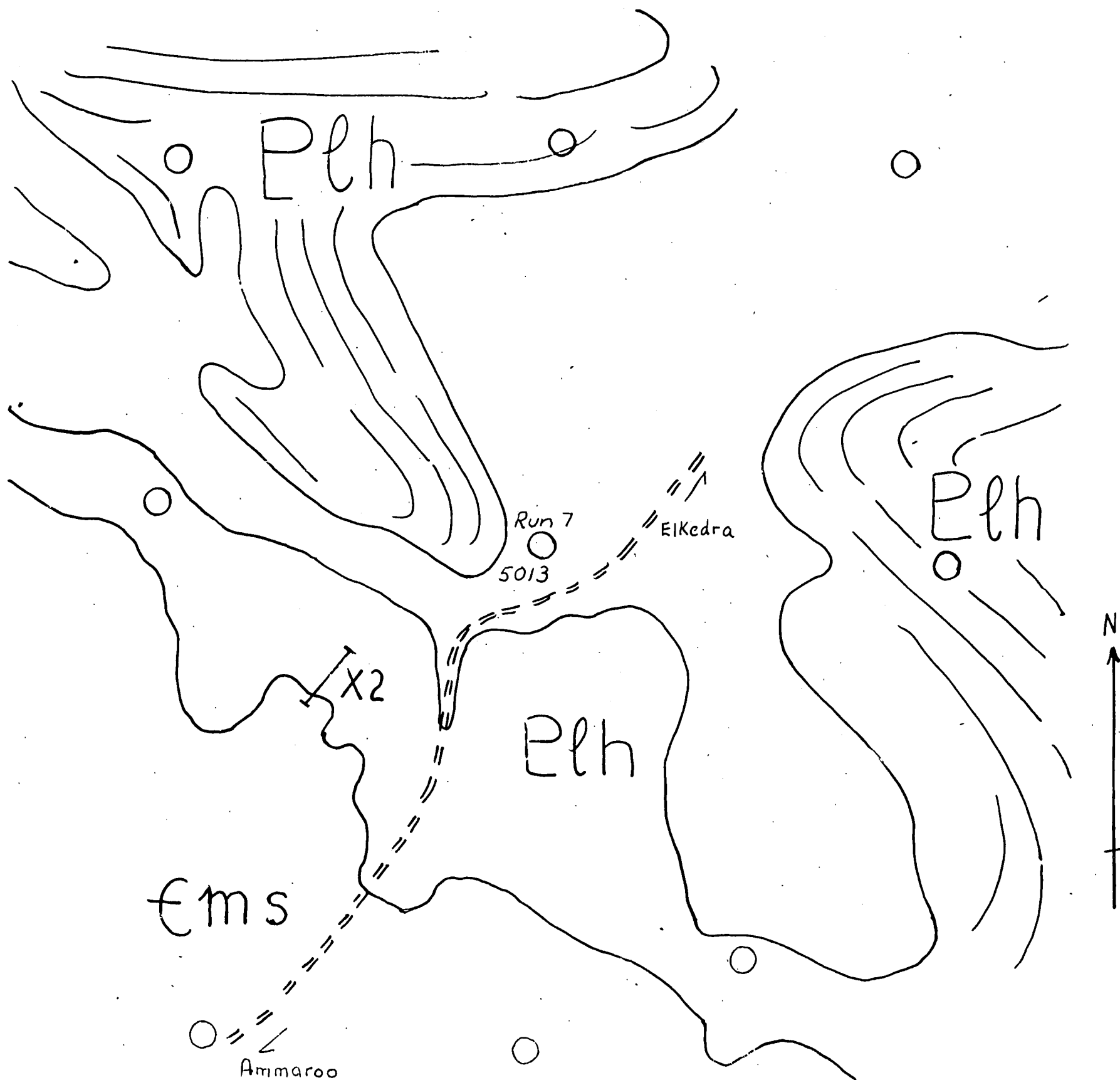
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ELKEDRA RUN 7A 5053

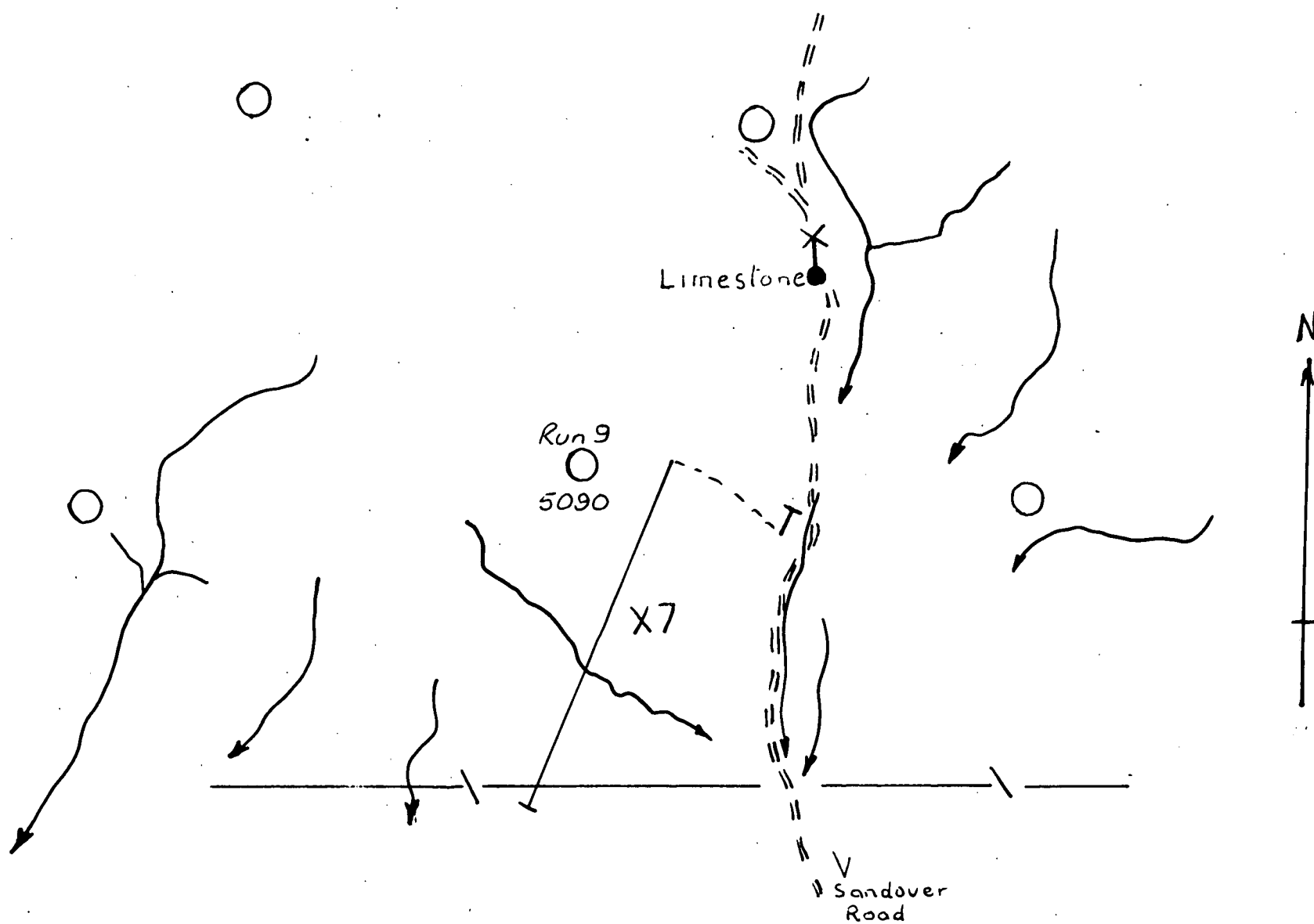
Scale 1:50,000

Fig. 8 LOCATION OF MEASURED SECTIONS



ELKEDRA RUN 7 5013 Scale 1:50,000

Fig. 9. LOCATION OF MEASURED SECTION



ELKEDRA RUN 9 5090

Fig.10. LOCATION OF MEASURED SECTION  
Scale 1:50,000



ELKEDRA RUN 14 5123

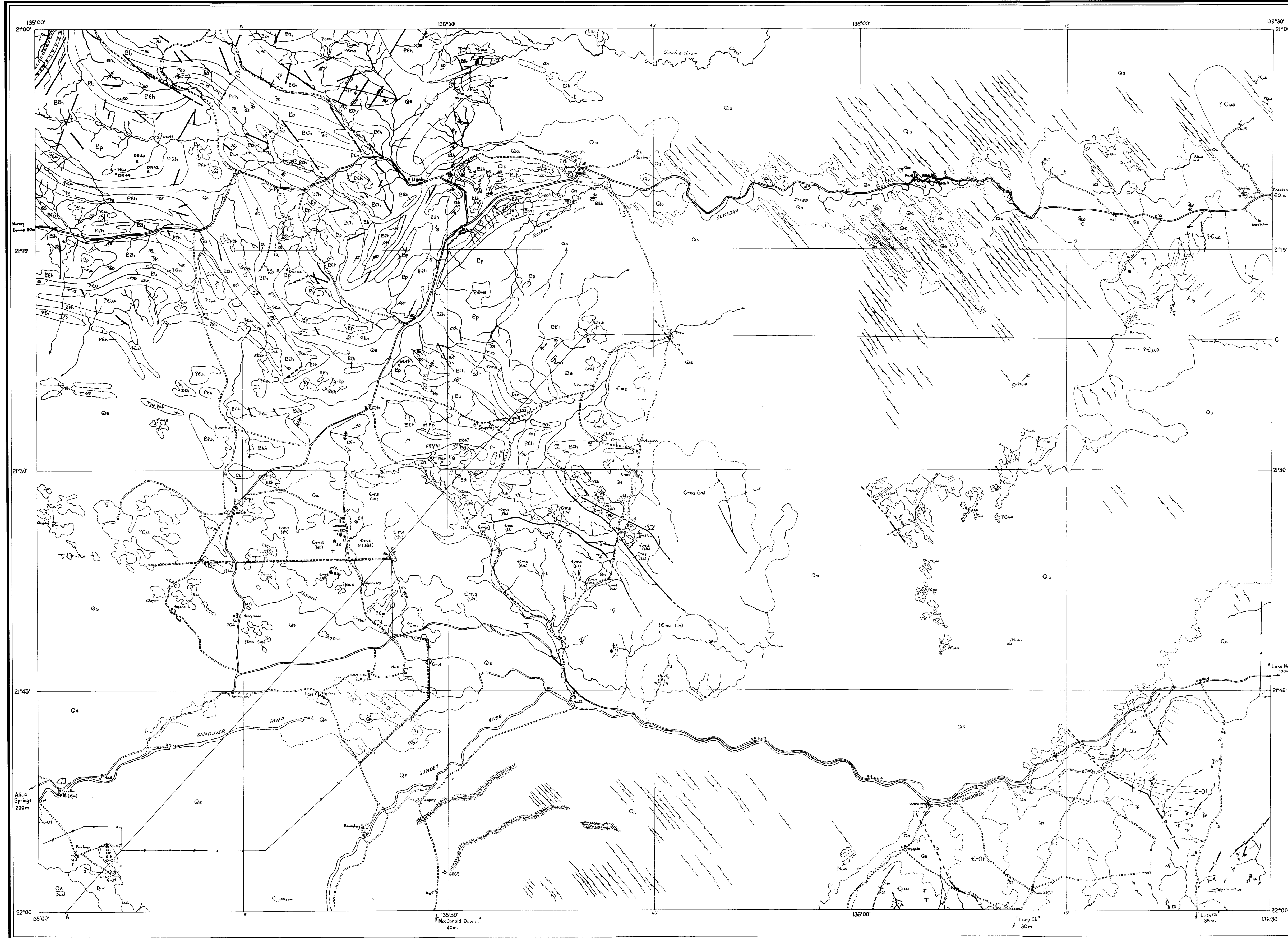
Scale 1:50,000

Fig. 11. LOCATION OF MEASURED SECTION

AUSTRALIA 1:250,000

ELKEDRA  
NORTHERN TERRITORY

1:250,000 GEOLOGICAL SERIES SHEET SF 53-7



Reference	
QUATERNARY	Qa Alluvium
	Qs Sand
	T Limestone, chert
TERTIARY	
UPPER DEVONIAN	Dud Dulcie Sandstone
	Quartz sandstone with some pebbly conglomerate
LOWER ORDOVICIAN TO UPPER CAMBRIAN	C-O1 Tomahawk Beds
	Quartz sandstone, calcareous sandstone, limestone, siltstone, dolomite
	Arrinthrungo Formation
UPPER CAMBRIAN	C-u1 Dolomite, limestone, sandstone
	Sandstone
MIDDLE CAMBRIAN	C-u2 Undifferentiated
	Ordovician limestone
	Unconformity
PRECAMBRIAN	C-ms Sandover Beds
	Limestone (u1)
	Siltstone (u2)
LOWER PROTEROZOIC	E-g Granite
	E-p Feldspar porphyry
	E-b Basalt
Hatches Creek Group	E-lh Sandstone, siltstone
	Acid and intermediate lavas
	Unconformity
Undifferentiated	P-c Gneiss, schist

- Geological boundary  
Anticline showing plunge  
Syncline showing plunge  
Monocline  
Fault  
Where location of boundaries, folds and faults is approximate, line is broken; where inferred, points, where concealed, boundaries and folds are dotted; faults are shown by short dashes.
- Strike and dip of strata  
Vertical strata  
Horizontal strata  
Dip < 15°  
Dip 15° - 45°  
Dip > 45°  
Trend of bedding  
Joints  
Strike and dip of joints  
Vertical joints  
Quartz vein  
Macrofossil locality  
Specimen locality  
BMR granite sample for age determination  
BMR stratigraphic hole: Georgina Basin  
Mine or prospect  
Tungsten
- Bore  
Well  
Tank or Earth Dam  
Wind pump  
Dam  
Abandoned bore  
Water hole  
Sand ridge  
Homestead  
Yard  
Landing ground  
Road  
Vehicle track  
Fence  
Astro station  
Height in feet; instrument levelled. Datum: mean sea level

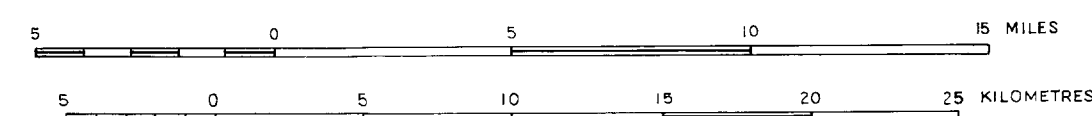
Compiled and issued by the Bureau of Mineral Resources, Geology and Geophysics,  
Department of National Development. Topographic base compiled by the Division  
of National Mapping, Department of National Development. Aerial photography by  
the Royal Australian Air Force, complete vertical coverage at 1:50,000 scale.  
Transverse Mercator projection.

INDEX TO ADJOINING SHEETS

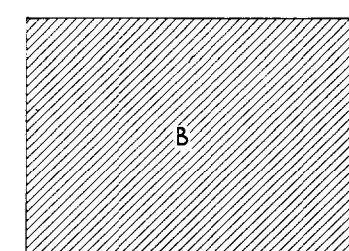
SONNEY WELL	FREW RIVER	AVON DOWNS
SANDOW CREEK	ELKEDRA RIVER	SANDOVER RIVER
ALCOOTA	HICKSITA	TOBERMORRY

ANNUAL CHANGE PST

Scale 1:250,000

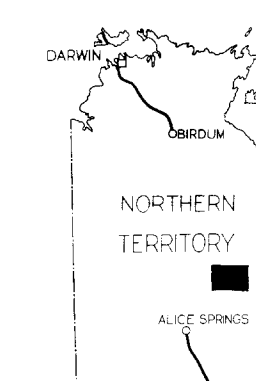


GEOLOGICAL RELIABILITY DIAGRAM



B Detailed reconnaissance, numerous traverses  
with air-photo interpretation

Geology by: K.G. Smith, J.R. Stewart, J.W. Smith, R.R. Vane, E.N. Milligan  
Compiled 1962 by: K.G. Smith and E.N. Milligan  
Drawn by: P.J. Brown



Section A-B-C  
(Folding diagrammatic)  
Scale 1/3

